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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-12288

Subject: MHI's Response to US-APWR DCD RAI No. 963-6828 (SRP 12.03-12.04)

Reference: 1) "Request for Additional Information No. 963-6828, SRP Section: 12.03-12.04 – Radiation Protection Design Features" dated October 3, 2012

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.963-6828".

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
Director- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosure:

1. Response to Request for Additional Information No.963-6828

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-12288
Docket No. 52-021

Response to Request for Additional Information No. 963-6828

October 2012

10/29/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI No.: No. 963-6828 Revision 0

SRP Section: 12.03-12.04 – Radiation Protection Design Features

APPLICATION SECTION: 12.3, 8, 10

DATE of RAI issue: 10/3/2012

QUESTION NO.: 12.03-48

10 CFR 20.1101(b), 10 CFR 20.1406(b) require licensees to describe design feature to maintain Occupational Radiation Exposure(ORE) ALARA, reduce contamination of the facility, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. SRP Section 12.3-4 Acceptance Criteria and Regulatory Guides 8.8 and 4.21, provide guidance for meeting the requirements of 10 CFR 20.1001 and 10 CFR 20.1406, including design features to reduce source intensity and to reduce the production, distribution, and retention of activated corrosion products.

US-APWR Tier 2 DCD Revision 2 Figure 9.3.4-1 "Chemical and Volume Control System Flow Diagram," (Sheet 3 of 7) and (Sheet 7 of 7) provided drawings of the resin demineralizers that showed the backwash retention elements and the associated wash water discharge lines. USAPWR Tier 2 DCD Revision 3 Figure 9.3.4-1 "Chemical and Volume Control System Flow Diagram," (Sheet 3 of 7) and (Sheet 7 of 7), which reduced the level of detail provided in these figures, removed these components from the drawings of the demineralizers. The staff was unable to find a discussion about the function of demineralizer backwash retention elements and the disposition of the resin wash water in DCD Tier 2, Revision 3 Subsection 9.3.4 or in Subsection 12.3.1.1.1.2 "Balance of Plant Equipment." Based on industry experience, high localized dose rates or unexpected system contamination may result from the unexpected accumulation of resin in lines or components.

Similarly, US-APWR Tier 2 DCD Revision 3 Figure 10.4.8-2 Steam Generator Blowdown System Piping and Instrumentation Diagram (2/2) removed this level of detail on the drawings of the resin demineralizers that showed the backwash retention elements and the associated wash water discharge lines, without including a discussion of the function of resin retention elements and destination of water used to backwash the steam generator blowdown demineralizers.

Please revise the US-APWR Tier 2 Sections 9, 10 and 12, to update the description of the design features provided for minimizing facility contamination and minimizing ORE from systems potentially containing radioactive resins, or provide the specific approaches used and the associated justification.

ANSWER:

Lines associated with the demineralizers that had previously been described in the detailed P&IDs in DCD Rev. 2 were eliminated as part of the DCD Rev. 3 P&ID simplification activity because they are not major lines. However, a description of the demineralizer backwash retention element and the disposition of resin wash water from the viewpoint of keeping Occupational Radiation Exposure (ORE) ALARA has been added to DCD Subsections 9.1.3, 9.3.4 10.4.8, 11.2, and 12.3 as shown in Attachment-1.

Impact on DCD

Refer to Attachment-1.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There are impacts on the S-COLA Subsection 9.3.4.2.6.17 and Table 12.3-201.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Reports

There is no impact on the Technical / Topical Reports.

9.1.3.2.1.1 Spent Fuel Pit

The SFP is described in Subsection 9.1.2.

9.1.3.2.1.2 Spent Fuel Pit Pumps

Two identical pumps are installed in parallel in the SFPCS. Each pump is sized to circulate the pit water through the SFP heat exchanger in conjunction with the demineralizer and the filter to perform purification and cooling of the SFP.

The SFP pumps are horizontal centrifugal type, and the wetted area in contact with the fuel pit water is of stainless steel material.

The spent fuel pit pumps trip on the SFP low-low level setpoint. This setpoint is above the SFP suction piping elevation, to assure that the SFP pumps are not damaged by potential air binding if the pool were to drain to the top of the suction piping elevation. DCD_09.01.03-7

9.1.3.2.1.3 Spent Fuel Pit Heat Exchangers

Two SFP heat exchangers are provided to remove decay heat from the SFP, as specified in Subsection 9.1.3.2.2.2. These heat exchangers are plate-type heat exchangers constructed of austenitic stainless steel. The SFP water circulates through one side of the heat exchanger while the CCW circulates through the other side. The design of SFP heat exchangers will incorporate specific features regarding industry operating experience as discussed in EPRI TR 1013470 to minimize leakage from Plate type heat exchangers and potential blockage of the heat exchanger flow passages (Ref. 9.1.7-27). DCD_09.02.02-81

9.1.3.2.1.4 Spent Fuel Pit Filters

Two vertical, cylindrical cartridge-type SFP filters are provided in the purification portion of the SFPCS. Each cartridge filter is designed for a flow rate of approximately 265 gpm. The filter is used to improve the pit water clarity by removing solid particles. The filters have a combined particle removal efficiency of approximately 98% for 1 μm particles, which, in combination with the spent fuel pit strainers, effectively removes debris from the system that could clog the SFP plate heat exchangers, which have flow passages of approximately 3 mm in diameter. The filter assembly is constructed of austenitic stainless steel with disposable filter cartridges. DCD_09.02.02-81

9.1.3.2.1.5 Spent Fuel Pit Demineralizers

Two vertical, cylindrical demineralizers are provided, and each demineralizer is designed for a flow rate of approximately 265 gpm. The demineralizer removes ionic impurities from the SFP water before being circulated back to the SFP. The vessels are constructed of austenitic stainless steel.

Spent fuel pit demineralizers are provided with a resin-retaining screen on the backwash line, and connected to a backwash discharge line to the waste holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing. DCD_12.03-48

9.3.4.2.6.11 Chemical Mixing Tank

The chemical mixing tank is utilized for adding chemical solutions to perform pH control and oxygen removal of the reactor coolant (pH control is discussed in Section 9.3.4.2.3.2). The tank is made of stainless steel.

9.3.4.2.6.12 RCP Purge Water Head Tank

The reactor coolant pump purge water head tank is provided to continuously supply the purge water to the reactor coolant pump No.2 and No.3 shaft seals for cooling by utilizing static head. Makeup for the purge water in the tank is provided intermittently and automatically with the primary makeup water.

The gas space of the tank is connected to the reactor coolant drain tank to prevent oxygen intrusion into the tank.

9.3.4.2.6.13 Resin Fill Tank

The resin fill tank is provided to fill each demineralizer with fresh resins. The tank is capable of being connected to each demineralizer resin fill line with flexible hoses connected to the conical-shaped bottom of the tank. The slurry of resin mixed with makeup water flows into the demineralizer through the flexible hose.

9.3.4.2.6.14 Mixed Bed Demineralizers

Two mixed bed demineralizers are provided in the purification loop to maintain reactor coolant purity. Each demineralizer is sized to accept the full purification flow during normal plant operation and to have a minimum design life of one core cycle.

A mixture of cation and anion resins is utilized in the demineralizers to remove fission and corrosion products. The anion resin is converted to borate form by addition of reactor coolant containing boric acid. During the operation, if ion exchange capability of the resin is diminished, the other demineralizer is utilized.

The demineralizer vessel is made of stainless steel and is equipped with connections for the exchange of resins and a screen for resin effluent prevention.

Mixed bed demineralizers are provided with a resin-retaining screen on the backwash line and connected to a backwash water discharge line to the holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing. DCD_12.03-48

9.3.4.2.6.15 Cation Bed Demineralizer

One cation resin bed demineralizer located downstream of the mixed bed demineralizers removes Li-7 produced in the reactor coolant and maintain the desired pH of the reactor coolant. The demineralizer is sized to provide adequate purification flow to control the Li-7 and/or the cesium concentration in the reactor coolant in the event of a fuel defect.

The demineralizer vessel is made of stainless steel and is equipped with connections for adjusting its resin contents and a screen for resin effluent prevention.

A cation bed demineralizer is provided with a resin-retaining screen on the backwash line and connected to a backwash water discharge line to the holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing. DCD_12.03-48

9.3.4.2.6.16 Deborating Demineralizer

Two deborating demineralizers are utilized to compensate for fuel burn-up near the end of the core life. Anion resins are provided to remove boric acid from the reactor coolant.

The demineralizer vessel is made of stainless steel and is equipped with connections for adjusting its resin contents and a screen for resin effluent prevention.

A deborating demineralizer is provided with a resin-retaining screen on the backwash line and connected to a backwash water discharge line to the holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing. DCD_12.03-48

9.3.4.2.6.17 Boric Acid Evaporator Feed Demineralizer

One boric acid evaporator feed demineralizer is utilized to remove Li and ionic impurities in the reactor coolant feed to the boric acid evaporator.

The demineralizer vessel is made of stainless steel and is equipped with connections for the exchange of resins and a screen for resin effluent prevention.

A boric acid evaporator feed demineralizer is provided with a resin-retaining screen on the backwash line and connected to a backwash water discharge line to the holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing. DCD_12.03-48

9.3.4.2.6.18 Reactor Coolant Filters

Two reactor coolant filters are provided to remove particulate and fine resins larger than 25 microns in diameter in the letdown flow. Each filter is designed to accept maximum purification flow.

The reactor coolant filter housing is made of stainless steel and has a removable cartridge type filter element.

9.3.4.2.6.19 Boric Acid Filter

One boric acid filter is provided to collect particulates from the boric acid solution makeup stream, such as boric acid tank sediment. The filter is designed to accept maximum makeup flow.

The demineralizers consist of two cation beds and two mixed beds. Each bed has 100 percent ion exchange capability. Any cation bed can be used with any mixed bed.

SG blowdown demineralizers are provided with a resin-retaining screen on the backwash line, and connected to a backwash discharge line to the waste holdup tank or the [[waste water system (WWS)]], depending on whether any radioactivity is detected. If the radioactivity from SG tube leakage is detected in the blowdown water, the discharge is diverted to the waste holdup tank in the Liquid Waste Management System for processing. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing. DCD_12.03-48

6. **SG blowdown isolation valves**

These valves isolate blowdown line upon receipt of an isolation signal. Two valves in series per SG located outside the containment in the reactor building are provided. See Table 10.4.8-1.

7. **SG blowdown sampling line isolation valves**

These valves isolate the sampling line upon receipt of an isolation signal. One valve per SG located outside the containment in the reactor building is provided. See Table 10.4.8-1.

8. **SG blowdown sample coolers**

These coolers are provided to cool the sample line water to approximately 113°F. Component cooling water (CCW) is used for cooling the sample line water. Four sample coolers, one for each SG blowdown line is provided. Each cooler is sized for 100 percent capacity.

10.4.8.3 Safety Evaluation

- Redundant power operated isolation valves provided in each blowdown line isolate safety and non safety-related portions of the steam generator blowdown system. This preserves the secondary side water inventory to remove sensible and decay heat from the reactor coolant system.

- The SGBDS's safety-related functions are accomplished by redundant means. A single, active component failure within the safety-related portion of the system does not compromise safety function of the system. Power is supplied by the Class 1E power system as described in Chapter 8.

- Radioactive contamination of the SGBDS can occur by a primary to secondary leakage in the steam generator. The SGBDS can become contaminated due to tritium diffusion through SG tubes even without primary-to-secondary leakage. A discussion of the radiological aspects of primary-to-secondary system leakage and conditions for operation is contained in Chapter 11. The isolation valve(s) in each blowdown line provides controls for reducing releases by isolating the provides an indication of the performance of the strainer. A listing of applicable codes is presented in Table 11.2-1.

Ion Exchange Columns are provided with a resin-retaining screen on the backwash line, and connected to a backwash water discharge line to the waste holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing. DCD_12.03-48

11.2.2.2.7 Chemical Drain Subsystem

The chemical drainage subsystem collects laboratory wastes and some of the decontamination solutions. To the greatest extent practicable, all decontamination solutions and process liquids are inherently free of hazardous materials and toxic substances. The use of these decontamination solutions and process liquids must not generate mixed waste. Additionally, laboratory wastes are collected for treatment and disposed of in appropriate portable containers. Only small amounts of laboratory wastes, basically those associated with the cleaning of glassware and similar activities, are expected to be in the chemical drainage subsystem. Any such wastes, which do not contain significant quantities of chemical constituents, may be transferred to the floor drainage processing subsystem.

Dilute acids and bases, along with heavy metals, are captured by the chemical drainage subsystem, pH adjusted, sampled, and characterized. The waste is neutralized prior to being pumped to waste holdup tanks for further processing or transferred to a container for disposal. Figure 11.2-1 provides flexibility to process chemical effluent either way.

The neutralization agent measuring tank is provided to measure and add a basic solution to the chemical drain tank and the waste holdup tanks. The tank is typically part of a neutralization package with a metering pump and associated piping. The neutralization package is designed to provide pH adjustments before water from the waste water hold up tank and chemical drain tank is processed. The component data on the neutralizing agent measuring tank is presented in Table 11.2-3.

11.2.2.2.8 Detergent Drain Subsystem

Detergent waste is collected in the detergent drain tank. This waste stream consists primarily of material from sinks, showers, emergency showers, etc. This waste stream does not typically contain any significant levels of radioactive contaminants. A detergent drain strainer is installed upstream of the detergent drain tank for the purpose of removing any materials that may be carried over from the waste streams. These stainless steel strainers are basket-type with 25 micron to 550 micron mesh openings. This waste stream is filtered and released through the discharge header.

The detergent drain tank is based on ANSI/ANS 55.6 (Ref. 11.2-6). The requirements for maximum daily input is 2,000 gallons. The tank is sized but excluding the collection of laundry waste as contaminated laundry is sent off site for cleaning and/or disposal. This tank is sufficient for anticipated operations. The equipment for this subsystem consists of the following:

- Detergent drain tank and associated detergent drain tank pump

Table 12.3-8 Regulatory Guide 4.21 Design Objectives and Applicable DCD Subsection Information for Minimizing Contamination and Generation of Radioactive Waste (Sheet 5 of 76)

Objective		System Features	DCD Reference
4	Reduce the need to decontaminate equipment and structures by decreasing the probability of any release, reducing any amounts released, and decreasing the spread of the contaminant from the source.	The spent fuel pit purification and cooling system (SFPCS) includes the following functions: - Purifies and clarifies the SFP water - Purifies the boric acid water for the refueling water storage pit (RWSP), the reactor cavity, and the refueling water storage auxiliary tank (RWSAT) in conjunction with the Refueling Water System (RWS) Spent fuel pit demineralizers are provided with a resin-retaining screen on the backwash line, and connected to a backwash discharge line to the waste holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing.	9.1.3 9.1.3.2.2.3 9.1.3.2.1.5

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Table 12.3-8 Regulatory Guide 4.21 Design Objectives and Applicable DCD Subsection Information for Minimizing Contamination and Generation of Radioactive Waste (Sheet 29 of 76)

Objective		System Features	DCD Reference
4	Reduce the need to decontaminate equipment and structures by decreasing the probability of any release, reducing any amounts released, and decreasing the spread of the contaminant from the source.	In addition to the features discussed in items above, the following design specifications and operational procedures are also implemented:	
		• Water chemistry is strictly monitored for primary and secondary systems. In particular, water is treated to control oxygen which is chemically scavenged to minimize potential for corrosion;	9.3.4.1.2.3
		• Stainless steel will be specified as the materials which are resistant to corrosion. Surface will be polished to facilitate easy decontamination; and	9.3.4.2.6
		• Suitable smooth-surface coatings facilitate the decontamination of potentially contaminated areas and equipment.	12.3.1.1.2.D
		• Floor drains with properly sloping floors are provided and radioactive and potentially radioactive drainage is separated from non-radioactive drainage.	12.3.1.1.2.D
		The summation of these design and operational features is designed to reduce the need to decontaminate equipment and structures by decreasing the probability of any release, reducing any amounts released, and decreasing the spread of the contaminant from the source.	
		Each of the demineralizers below are provided with a resin-retaining screen on the backwash line and connected to a backwash water discharge line to the holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing.	
		• Mixed bed demineralizers	9.3.4.2.6.14
		• Cation bed demineralizer	9.3.4.2.6.15
		• Deborating demineralizer	9.3.4.2.6.16
		• Boric acid evaporator feed demineralizer	9.3.4.2.6.17

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Table 12.3-8 Regulatory Guide 4.21 Design Objectives and Applicable DCD Subsection Information for Minimizing Contamination and Generation of Radioactive Waste (Sheet 43 of 76)

Objective		System Features	DCD Reference
4	Reduce the need to decontaminate equipment and structures by decreasing the probability of any release, reducing any amounts released, and decreasing the spread of the contaminant from the source.	In addition to the features discussed in items above, the following design specifications and operational procedures are also implemented:	
		• Stainless steel will be specified as the material which is resistant to corrosion. Surface finish will be polished to facilitate easy decontamination; and	11.2.2.2
		• Suitable smooth-surface coatings facilitate the decontamination of potentially contaminated areas and equipment.	12.3.1.1.2.D
		• Floor drains with properly sloping floors are provided and radioactive and potentially radioactive drainage is separated from non-radioactive drainage.	12.3.1.1.2.D
		• The LWMS and the Solid Waste Management System (SWMS), which employ flexible interconnecting piping for radioactive fluids, are designed with connectors that are incompatible with the connectors for non-radioactive fluids to prevent accidental cross-contamination.	
		The summation of these design and operational features is designed to reduce the need to decontaminate equipment and structures by decreasing the probability of any release, reducing any amounts released, and decreasing the spread of the contaminant from the source.	
		Ion Exchange Columns are provided with a resin-retaining screen on the backwash line, and connected to a backwash discharge line to the waste holdup tank. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing.	11.2.2.2.6

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Table 12.3-8 Regulatory Guide 4.21 Design Objectives and Applicable DCD Subsection Information for Minimizing Contamination and Generation of Radioactive Waste (Sheet 55 of 76)

Objective		System Features	DCD Reference
4	Reduce the need to decontaminate equipment and structures by decreasing the probability of any release, reducing any amounts released, and decreasing the spread of the contaminant from the source.	SG blowdown demineralizers are provided with a resin-retaining screen on the backwash line, and connected to a backwash discharge line to the waste holdup tank or the [[waste water system (WWS)]], depending on whether any radioactivity is detected. If the radioactivity from SG tube leakage is detected in the blowdown water, the discharge is diverted to the waste holdup tank in the Liquid Waste Management System for processing. The screen and discharge line are designed to maintain Occupational Radiation Exposure (ORE) ALARA during resin back washing.	10.4.8.2.3

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