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December 6, 2013

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Perry Buckberg

Docket No. 52-021
MHI Ref: UAP-HF-13291

Subject: MHI's Response to US-APWR DCD RAI No. 1026-7095 (SRP 12.03-12.04)

Reference: 1) "Request for Additional Information No. 1026-7095, SRP Section: 12.03-12.04 – Radiation Protection Design Features, Application Section: 12.3, 9.1.3, 9.1.4, 9.2.2, 9.2.6, 11," dated April 30, 2013.

With this letter, Mitsubishi Heavy Industries, Ltd. (MHI) transmits to the U.S. Nuclear Regulatory Commission (NRC) a document entitled "MHI's Response to US-APWR DCD RAI No. 1026-7095 (SRP 12.03-12.04)."

Enclosed is the response to the questions contained within Reference 1.

Please contact to 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,
Executive Vice President
Mitsubishi Nuclear Energy Systems, Inc.
On behalf of Mitsubishi Heavy Industries, Ltd.

Enclosure:

1. Response to US-APWR DCD RAI No. 1026-7095 (SRP 12.03-12.04)

D081
NRO

CC: P. Buckberg
J. Tapia

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Enclosure 1

UAP-HF-13291
Docket No. 52-021

Response to US-APWR DCD RAI No. 1026-7095 (SRP 12.03-12.04)

December 2013

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/6/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.1026-7095**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3, 9.1.3, 9.1.4, 9.2.2, 9.2.6, 11**
DATE OF RAI ISSUE:	**04/30/2013**

QUESTION NO. : 12.03-50

In RAI 578-4483 Question 12.03-12.04-37, the staff asked the applicant to provide information about the design features provided to minimize contamination of the facility and the environment, consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The applicant's response to RAI 578-4483 Question 12.03-12.04-37 Revision 2 dated August 30, 2012, stated in the RAI answer that when fluid is detected in a trench, the detection instrument initiates an alarm for operator actions. The applicant committed to changing the DCD to include the description of liquid alarms for leakage detection. Examples include proposed changes to DCD Subsection 10.4.11.2.1 "General Description", 9.1.3.2 "System Description," DCD Subsection 9.2.6.2.4 "Condensate Storage Tank." However, the applicant's proposed changes to the DCD do not indicate where the alarms provided for leakage detection instruments in trenches and other areas containing piping, annunciate so that plant operators may receive timely notification of the adverse condition.

Please revise and update the US-APWR DCD, to include information about where leakage detection instrumentation provided for minimizing contamination of the facility and environment consistent with 10 CFR 20.1406, alarms annunciate, or provide the specific alternative approaches used and the associated justification.

ANSWER:

Leak detection instrumentation is provided for trenches containing buried piping as well as for other system piping. As described in the response to RAI 578-4483 Question 12.03-12.04-37, the leak detection instrumentation alarms in the Main Control Room in the event that the level of collected leakage reaches a predetermined setpoint in order for the operator to promptly take the necessary actions to correct the adverse operational condition. The DCD has been changed to specify the location in which the leak detection alarms will annunciate.

Impact on DCD

The following portions of the DCD will be revised as indicated in Attachment 1.

- Subsection 9.1.3.2
- Subsection 9.2.6.2.4
- Subsection 9.3.3.2.2

- Subsection 10.4.11.2.1
- Table 12.3-8

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Report

There is no impact on any Technical / Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/6/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.1026-7095**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3, 9.1.3, 9.1.4, 9.2.2, 9.2.6, 11**
DATE OF RAI ISSUE:	**04/30/2013**

QUESTION NO. : 12.03-51

In RAI 578-4483 Question 12.03-12.04-37, the staff asked the applicant to provide information about the design features provided to minimize contamination of the facility and the environment, consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The applicant's response to RAI 578-4483 Question 12.03-12.04-37 Revision 2 dated August 30, 2012, stated in the RAI answer that if an alarm is acknowledged, and a new (subsequent) alarm from a different component is generated, the indications on the MCR panel will still flash for operator action. The applicant committed to changing DCD to Table 11.2-8 "Summary of Tank Indication, Level Annunciations, and Overflows," to indicate that the leak detection instruments for the floor drains sump and the equipment drains sump in the Auxiliary Building (A/B) alarm locally and also in the Main Control Room (MCR) through a representative alarm. However, the applicant's proposed change to the DCD does not state that alarms provided for leakage detection instruments will still flash when a new (subsequent) alarm from a different component is generated.

Please revise and update the US-APWR DCD, to include information about the receipt and acknowledgement of alarms for leakage detection instruments, or provide the specific alternative approaches used and the associated justification.

ANSWER:

As stated in the response to RAI 578-4483 Question 12.03-12.04-37 Revision 2, leak detection instruments for the floor drains sump and equipment drains sump in the Auxiliary Building (A/B) will alarm both locally in the Auxiliary Control Room (ACR) and in the Main Control Room (MCR). This design provision allows for prompt leak detection capability and appropriate operator response in order to identify the source of leakage and minimize the spread of contaminated liquid in accordance with the RG 4.21 objectives. In the event that an alarm is annunciated in the MCR and/or in the ACR, and a subsequent leak detection alarm or component failure is annunciated while the first alarm is being responded to, both indications will remain active on the alarm panel. This ensures that both components receive operator action to analyze and respond to the operational situation prompting the alarm. A note has been added to DCD Table 11.2-8 to clarify that should a leak be detected simultaneously or subsequently, all alarms will continue to annunciate for prompt operator action.

Impact on DCD

Table 11.2-8 will be revised as indicated in Attachment 1.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Report

There is no impact on any Technical / Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/6/13

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Docket No. 52-021

RAI NO.:	**NO.1026-7095**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3, 9.1.3, 9.1.4, 9.2.2, 9.2.6, 11**
DATE OF RAI ISSUE:	**04/30/2013**

QUESTION NO. : 12.03-52

In RAI 578-4483 Question 12.03-12.04-38, the staff asked the applicant to provide information about the design features provided to minimize contamination of the facility and the environment, consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The applicant's response to RAI 578-4483 Question 12.03-12.04-38 Revision 2 dated August 30, 2012, stated in the RAI answer that using single-walled carbon steel pipe in the trench facilitates additional radial cooling of the fluid and enables the use of high density polyethylene (HDPE) piping for underground burial, and that from the transition manhole the discharge piping is connected to a buried double-walled HDPE piping to an existing WWS discharge. From these statements in the applicant's answer, the staff could ascertain that the applicant intends to use HDPE in portions of the certified design. However, the applicant's proposed changes to the DCD do not describe the use of HDPE piping, nor do the applicant's proposed changes to the DCD describe the installation, testing and maintenance requirements for the use of HDPE piping in the portions of the US-APWR design with piping potentially containing radioactive material.

Please revise and update the US-APWR DCD, to include information, for systems potentially containing radioactive material, where HPDE piping is to be used, and the installation, testing and maintenance requirements and specifications, or provide the specific alternative approaches used and the associated justification.

ANSWER:

The High Density Polyethylene (HDPE) piping used as a portion of the buried yard piping, including the transition manhole is a site-specific application that may be selected by the Combined License (COL) Applicant due to a salty soil environment. For the US-APWR Design Control Document (DCD), the standard plant design for the treated liquid waste processing systems ends at the isolation valve of the discharge lines. Also, the site-specific startup SGBDS is sent to an existing Waste Water System (WWS) for discharge. The startup SGBDS terminates at the same manhole transitioning from stainless steel piping into HDPE piping for transporting treated wastewater. Hence, the HDPE portion of the piping is not a part of the standard plant design. COL Item 12.3(10) is included to provide flexibility to the COL Applicant to implement the site-specific design features that would include installation, testing, and maintenance requirements and specifications for the HDPE pipes. If HDPE pipes are selected, installation, testing, and maintenance requirements and specifications for the HDPE pipes will be addressed by the COL Applicant in their Final Safety Analysis Report (FSAR).

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Report

There is no impact on any Technical / Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/6/13

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RAI NO.:	**NO.1026-7095**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3, 9.1.3, 9.1.4, 9.2.2, 9.2.6, 11**
DATE OF RAI ISSUE:	**04/30/2013**

QUESTION NO. : 12.03-53

In RAI 578-4483 Question 12.03-12.04-38, the staff asked the applicant to provide information about the design features provided to minimize contamination of the facility and the environment, consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The applicant's response to RAI 578-4483 Question 12.03-12.04-38 Revision 2 dated August 30, 2012, stated in the RAI answer that the design is supplemented by periodic hydrostatic or pressure testing of piping segments. However, based on the information contained within the applicant's response to RAI 578-4483 Question 12.03-12.04-38 and the US-APWR DCD Tier 2 Revision 3, it is not clear to the staff which segments of piping, and in particular those segments of piping that may be located below grade, are capable of being tested for leakage, because of the absence of isolation points and test connection indications on DCD figures. Examples include: proposed DCD Figure 9.1.4-4 "Outline of Refueling Water Storage System," shows an unrestricted discharge path between the containment isolation valves for the Containment Vessel Drain Tank (CVDT) pump discharge and the Refueling Water Storage Auxiliary Tank (RWSAT); proposed DCD Figure 9.1.4-4 "Outline of Refueling Water Storage System," shows an unrestricted flow path between the RWSAT and the Auxiliary Building Sump Tank; and lines to and from the condensate storage tank, including the Auxiliary Boiler Package, as shown on US-APWR DCD Tier 2 Revision 3 Figure 9.2.6-1 "Condensate Storage Facilities System Flow Diagram."

Please revise and update the US-APWR DCD, to include information regarding the design features provided to support hydrostatic or pressure testing of piping segments, as described in the RAI response, or provide the specific alternative approaches used and the associated justification.

ANSWER:

<u>CVDT pump to RWSAT</u>

DCD Figure 9.1.4-4 "Outline of Refueling Water Storage System," is a schematic drawing that does not contain design details showing isolation valves or test connections. The Containment Vessel Reactor Coolant Drain Tank (CVDT) pump discharge line has several isolation valves for various flow paths as shown on DCD Figure 11.2-1 "Liquid Waste Processing System Process Flow Diagram" (Sheet 3 of 3). Additionally, a valve is installed at the inlet to the RWSAT for maintenance and pipe testing purposes. Thus, periodic hydraulic testing of the pipe routed from the CVDT to the RWSAT and outside the buildings for leak detection can be conducted using the CVDT pumps and the pump discharge pressure indicator. This design feature is provided to minimize contamination of the facility and the environment consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406.

RWSAT to Auxiliary Building Sump

The RWSAT drain line is connected to the equipment drain line inside the Tank House with an isolation valve upstream of the connection. The equipment drain line then penetrates the Tank House wall and the Auxiliary Building (A/B) wall. This segment of the equipment drain pipe, which is part of the equipment drainage system, is embedded in the basemat and is constructed with double-walled stainless steel piping. This double-walled drain pipe is slightly sloped with no isolation valve and gravity drains. Any leakage from the inner pipe is collected in the outer pipe and drained to the A/B sump. The double-walled drain pipe is equipped with leak detection instrumentation that initiates an alarm in the Main Control Room (MCR) for operator action. The use of the double-walled piping design eliminates the need for leak testing the inner pipe. This design feature allows for leak detection and prevention of contamination to the facility or the environment, and is consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406.

Condensate Storage Tank to Auxiliary Boiler

The auxiliary boiler receives condensate makeup from the auxiliary steam drain tank or the condensate storage tank (CST). Pumps, pump discharge pressure indicators, and lines from the auxiliary steam drain tank and the CST to the auxiliary boiler are shown on DCD Figure 10.4.11-1 and Figure 9.2.6-1. Additionally, the line from the CST to the auxiliary boiler has isolation valves for maintenance and pipe testing purposes. Thus, periodic hydraulic testing for leak detection of piping associated with the auxiliary boiler package and outside the buildings can be conducted. This design feature meets the guidance of RG 4.21 and the requirements of 10 CFR 20.1406 for prevention of contamination of the facility and the environment.

Impact on DCD

The following portions of the DCD will be revised as indicated in Attachment 1:

- Subsection 9.1.4.2.2.2
- Subsection 9.3.3.2.2
- Subsection 10.4.11.2.1

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Report

There is no impact on any Technical / Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/6/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.1026-7095**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3, 9.1.3, 9.1.4, 9.2.2, 9.2.6, 11**
DATE OF RAI ISSUE:	**04/30/2013**

QUESTION NO. : 12.03-54

On April 13, 2011, the applicant submitted proposed DCD changes in response to RAI 135-4206 Question 12.03-12.04-11, which committed to changing subsections of the US-APWR DCD Tier 2, such as Subsections 9.2.6.2.4 "Condensate Storage Tank," 10.4.8 "Steam Generator Blowdown System," and Table 12.3-8 "Regulatory Guide 4.21 Design Objectives and Applicable DCD Subsection Information for Minimizing Contamination and Generation of Radioactive Waste," to include additional information about design features provided to minimize contamination of the facility and the environment. In RAI 578-4483 Question 12.03-12.04-38, the staff asked the applicant to provide information about the design features provided to minimize contamination of the facility and the environment, consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The applicant's response to RAI 578-4483 Question 12.03-12.04-38 Revision 2 dated August 30, 2012, also committed to changing DCD Tier 2 Subsections 9.2.6.2.4, 10.4.8 and Table 12.3-8. However, the proposed changes to the DCD in the applicant's response to RAI 578-4483 Question 12.03-12.04-38 Revision 2 dated August 30, 2012 did not contain the changes committed in the response to response to RAI 135-4206 Question 12.03-12.04-11 dated April 13, 2011. While the staff has provided examples of discrepancies between the RAI responses dated April 13, 2011 and August 30, 2012, this does not represent and exhaustive comparison of the contents of RAI responses.

Please revise and update the US-APWR DCD, to include information committed to in the response to RAI 135-4206 Question 12.03-12.04-11 dated April 13, 2011, or provide the specific alternative approaches used and the associated justification.

ANSWER:

MHI DCD RAI responses only include those specific pages of the DCD that are actually changed by the associated RAI response. The series of four responses to R-COLA RAI 135-4206 Question 12.03-12.04-11 made revisions to DCD Tier 2 Rev. 3 Subsection 9.2.6.2.4, Figure 9.2.6-1 , Subsection 10.4.8.2.1, Subsection 10.4.11.2.1, and Table 12.3-8. These R-COLA created DCD changes were separately submitted to the US-APWR docket via MHI letters UAP-HF-11091 dated 04/06/2011 and subsequently updated via UAP-HF-12208 dated 07/07/2011, UAP-HF-11218 dated 07/15/2011, and UAP-HF-11253 dated 08/3/2011. Per the normal MHI RAI response procedure, the August 2012 response to DCD RAI 578-4483 Question 12.03-12.04-38 only included those DCD pages that were specifically revised by the RAI response. As a result, mark-ups of DCD Subsection 10.4.11.2.1 and Table 12.3-8 were the only mark-up pages associated with DCD RAI 578-4483 that also included corresponding RCOLA RAI 135-4206 mark-ups on the same DCD page. The other mark-up pages associated with the R-COLA RAI response were not included because they were not subsequently changed by the response to RAI 578-4483.

All of the R-COLA RAI changes described above were officially included in the DCD via the associated DCD Rev. 3 Tracking Reports described below.

MUAP-11021, DCD Rev 3 RAI Tracking Report, Revision 0 (ML11229A194)

- Updated Section 9.2.6.2.4 to add description about CST overflow in the last of the first paragraph of Subsection 9.2.6.2.4 per MHI Letter No. UAP-HF-11091 dated 04/6/2011
- Added CST overflow line in Figure 9.2.6-1 per MHI Letter No. UAP-HF-11091 dated 04/6/2011
- Added description about SGBD piping and Auxiliary Boiler blow down to Sections 10.4.8.2.1 and 10.4.11.2.1 per MHI Letter No. UAP-HF-11091 dated 04/6/2011
- Added description about CST overflow and Auxiliary blow down to Table 12.3-8 per MHI Letter No. UAP-HF-11218 dated 07/15/2011

MUAP-11021, DCD Rev 3 RAI Tracking Report, Revision 1 (ML12030A217)

- Revised description about CST overflow in the last of the first paragraph of Subsection 9.2.6.2.4 to a new paragraph per MHI Letter No. UAP-HF-11253 dated 8/3/2011
- Revised description about CST overflow in Table 12.3-8 per MHI Letter No. UAP-HF-11253 dated 08/3/2011

If the staff pulled together all of the above references and compared all of the mark-ups in the appropriate time sequence, they would see that all of the changes associated with R-COLA RAI 135-4206 Question 12.03-12.04-11 and the August 2012 version of the response to DCD RAI 578-4483 12.03-12.04-38 have already been incorporated into the DCD. Any subsequent revisions of DCD RAI 578-4483 are incorporated in a similar manner. Since all DCD Rev. 3 Tracking Report changes are automatically rolled-up into DCD Rev. 4, which is scheduled for submittal at the end of August 2013, no additional DCD changes are necessary as a result of this question.

Impact on DCD

All previous DCD changes associated with the responses to R-COLA RAI 135-4206 Question 12.03-12.04-11 and DCD RAI 578-4483 12.03-12.04-38 have already been incorporated into the DCD via the Rev. 3 Tracking Reports, which automatically roll into DCD Rev. 4. Therefore, there is no additional impact on the DCD as a result of this question.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Report

There is no impact on any Technical / Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/6/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.1026-7095**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3, 9.1.3, 9.1.4, 9.2.2, 9.2.6, 11**
DATE OF RAI ISSUE:	**04/30/2013**

QUESTION NO. : 12.03-55

On August 2, 2011, the applicant submitted proposed DCD changes in response to RAI 135-4206 Question 12.03-12.04-11, which committed to changing US-APWR DCD Tier 2 Subsection 9.2.6.2.4 "Condensate Storage Tank," and Table 12.3-8 "Regulatory Guide 4.21 Design Objectives and Applicable DCD Subsection Information for Minimizing Contamination and Generation of Radioactive Waste (Sheet 16 of 62)," to include additional information about design features of the Condensate Storage Tank (CST) provided to minimize contamination of the facility and the environment. In RAI 578-4483 Question 12.03-12.04-38, the staff asked the applicant to provide information about the design features provided to minimize contamination of the facility and the environment, consistent with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The applicant's response to RAI 578-4483 Question 12.03-12.04-38 Revision 2 dated August 30, 2012, committed to changing DCD Tier 2 Subsection 9.2.6.2.4 "Condensate Storage Tank," to provide additional information about coatings in the trench to the CST. However, the proposed changes to the DCD in the applicant's response to RAI 578-4483 Question 12.03-12.04-38 Revision 2 dated August 30, 2012 did not contain the changes committed in the response to response to RAI 135-4206 Question 12.03-12.04-11 dated August 2, 2011.

Please revise and update the US-APWR DCD, to include information committed to in the response to RAI 135-4206 Question 12.03-12.04-11 dated August 2, 2011, or provide the specific alternative approaches used and the associated justification.

ANSWER:

The staff has notified MHI that the question has been withdrawn. Therefore, no response is provided.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Report

There is no impact on any Technical / Topical Report.

The SFPCS consists of one 100% capacity RWSAT (29,410 cu. ft), pumps, associated valves, piping, and instrumentation. The piping to and from the RWSAT is single-walled stainless steel that runs above ground and penetrates the building wall directly into the tank. For piping between buildings, penetration sleeves are provided to collect and direct any leakage back into the building drain for further processing. The RWSAT employs leak-tight valves to minimize leakage to the environment. This design is supplemented by operational programs, which include periodic visual inspections for piping integrity. Testing the piping segments will be included as a part of the plant routine inspections and maintenance program.

Cooling is performed for the SFP water by circulating the SFP water with the SFP pump and removing decay heat through the SFP heat exchanger. The heat removal is accomplished by taking high temperature water from the SFP, pumping it through a heat exchanger, transferring heat from the SFP water to the CCWS (discussed in Subsection 9.2.2), and returning the cooled water to the SFP.

Purification is performed for the SFP water by bypassing approximately 265 gpm from the cooling portion into the purification portion's demineralizer and filter, and removing solid materials and dissolved impurities. Two motor operated isolation valves are provided to permit isolation from the cooling portion and allow purification of the SFP water in the refueling cavity, the RWSAT, or the RWSP in parallel to the SFP cooling operation.

When the heat load of the SFP is high (for full core offload), two RHRS trains (A and D), each comprising of one CS/RHRS pump and one CS/RHRS heat exchanger, perform SFP cooling in conjunction with the two SFP cooling trains.

The SFP is initially filled with water that has a boron concentration of approximately 4000 ppm; refer to Table 9.1.3-2 for the SFP design parameters. The boric acid water is supplied from the RWSP to the SFP through the refueling water recirculation pump, or directly supplied by connecting a temporary pipe to the boric acid water supply end connection located at the outlet of the boric acid blender in the chemical and volume control system.

The SFP condition resulting from the unlikely failure of the spent fuel cooling portion would be a rise in the SFP water temperature followed by an increase in evaporative losses. Minor leakage from SFPCS piping, components, or SFP liner will also decrease the SFP water level. A liner leakage collection system directs any possible leakage from SFP liner plate welds and floor to the R/B sump. A leakage level alarm for early detection is installed upstream of the R/B sump. Makeup to the SFP is manually started upon receipt of a low-level alarm signal from the SFP to the MCR. These losses could be made up from the following water sources.

The safety-related boric acid water makeup line is provided from the RWSP to the SFP. This tank contains 4000 ppm boric acid, thereby maintaining the initial boric acid water concentration in the SFP. The same concentration will be maintained during normal operations. The RWSP, as a primary water source of water to the SFP, is seismic category I. The makeup line from the RWSP to the SFP is seismic category I, ASME Code section III Class 3. The RWSP has a leak detection system ~~which~~that alarms in the MCR and consists of leak detection channels that interface with the RWSP liner and are routed through the RWSP floor into standpipes between the RWSP and the PCCV. DCD_12.03-50

After the reactor head bolting is de-tensioned, but prior to lifting the head and overflowing from the reactor vessel, the lower levels of the refueling cavity are flooded using the refueling water recirculation pump from the RWSP. This is done at flow rate which will minimize scattering of activated dust.

When the lower levels of the refueling cavity are flooded, the reactor vessel head assembly is unseated and raised 2.5 ft above the flange. At this point, disconnection of the control drive shafts is verified. Upon verification of disconnection, the reactor vessel head assembly is raised while maintaining a maximum of one foot clearance above the refueling cavity water to provide shielding. The water level of the refueling cavity is gradually increased by overflowing the reactor vessel by CS/RHR pump from the RWSP.

When the water level reaches the normal refueling water level, the reactor vessel head assembly is transported to the lay down area. Concurrently, refueling cavity lighting and the refueling cavity water filtration system is placed in service. The refueling water in the refueling cavity is transferred to the spent fuel pit (SFP) demineralizer and the spent fuel pit (SFP) filter for purification. After that, the water is returned to the refueling cavity.

The upper reactor internals with the in-core instrumentation system (ICIS) thimble assemblies is lifted using the lift rig with a load cell in the lift rigging. The load cell monitors the force applied when lifting the internals and provides indication of interference with other core structures and fuel assemblies. When the upper reactor internals is clear of the reactor vessel, it is transferred to its storage location in the lower refueling cavity. The core is then ready for refueling.

In parallel, the operators perform water filling operation for refueling canal through the SFP. The water for refueling canal is transferred by the refueling water circulation pump from the refueling water storage auxiliary tank (RWSAT).

The RWSAT stores the water for the refueling canal, the inspection pit, and the cask pit. The boron concentration in the RWSAT can be maintained at a 4000 ppm concentration by using the CVCS makeup system. The RWSAT provides water source for the refueling water recirculation pump. The RWSAT and related piping is located in an enclosed tank house with unit heater to preclude freezing. The RWSAT has connections with the SFP demineralizer and the refueling water recirculation pumps. In addition, the RWSAT has a connection from the C/V reactor coolant drain pump to receive the accumulator water. If the accumulator is required to drain all the water, the water is transferred by using C/V reactor coolant drain pump directly. High radiation water from the reactor coolant loop drain is not transferred to the RWSAT. High radiation water is transferred to the CVCS holdup tank via the C/V reactor coolant drain pumps. Manual valves between the discharge of the refueling water recirculation pump and the discharge of the SFP Demineralizer are used for switching the in-service lines in the discharge line of the refueling water recirculation pump. The RWSAT inlet, outlet and drain line~~s~~ isolation valves are used for leak testing. A valve is installed at the inlet to the RWSAT that allows for periodic hydraulic testing of the pipe routed from the C/V reactor coolant drain tank to the RWSAT using the C/V reactor coolant drain pumps with pump discharge pressure indication. The RWSA~~S~~T has ~~an~~ overflow ~~piping~~ and drain piping ~~to~~that are connected to the Auxiliary Building (A/B) equipment drain line to prevent direct release of the tank water to the environment~~the water from exposure to the environment directly~~. The RWSAT overflow piping is routed from the RWSAT tank house into the A/B Boric Acid

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Tank (BAT) valve area at Elevation -8 ft-7-in. Any overflow from the RWSAT will discharge into a receiving drain line that is equipped with a funnel inside the BAT valve area. The overflow is then routed to the A/B Equipment Drain Sump Tank for collection and then pumped to the LWMS waste holdup tanks for processing. The RWSAT overflow piping and receiving drain line are sized such that they can discharge the maximum flow from the RWSAT. High water level instrumentation is provided on the RWSAT to provide early warning of an overflow condition that alarms in the Main Control Room (MCR) for prompt operator action. The BAT valve area is epoxy coated and is equipped with a drain sump with liquid level detection instrumentation to initiate an alarm signal in the MCR for operator action should water spill out of the funnel. The overflow piping also serves as the tank vent. An exhaust air intake is located in close proximity to the overflow outlet and the receiving drain line funnel.~~The overflow alarm is installed in the overflow line to announce the operator.~~ The RWSAT drain piping is connected to the equipment drain line inside the tank house with an isolation valve upstream of the connection. The equipment drain line then penetrates the tank house wall and A/B wall. This segment of the equipment drain pipe, which is part of the equipment drainage system, is embedded into the basemat and is constructed with double-walled stainless steel piping. This double-walled drain pipe is slightly sloped with no isolation valve and gravity drains. Any leakage from the inner pipe is collected in the outer pipe and drained to the A/B sump. The double-walled drain pipe is equipped with leak detection instrumentation that initiates an alarm in the MCR for operator action. The use of the double-walled piping design eliminates the need for leak testing the inner pipe. These design features facilitate the prevention of contamination of the facility and the environment and is consistent with the guidance of RG 4.21 and the requirements of 10 CFR 20.1406.

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- Phase III – Fuel Handling

  All irradiated fuel assemblies are removed from the core and relocated to the SFP. The partially used fuel and new fuel assemblies are then transferred and installed into their designated positions in the reactor core.

  In general, the fuel handling procedure is as follows:

  - The refueling machine is indexed over a fuel assembly in the core.
  - The refueling machine mast latches onto a fuel assembly. The fuel assembly is raised to the designated height clearing the vessel flange while maintaining the established satisfactory radiation shielding depth below the water surface.
  - The fuel transfer car is moved into the containment from the fuel storage area where the fuel container is pivoted into the vertical position.
  - The refueling machine loaded with an irradiated fuel assembly traverses the refueling cavity until it is indexed over the vertical fuel transfer system fuel container. The irradiated fuel assembly is lowered into the container and unlatched.

tank to slightly beyond the outer diameter of the dike in order to minimize the collection of rain and snow inside the dike. Liquid inside the dike is sampled for contamination and removed for disposal or treatment. These design features satisfy the requirements of GDC 60.

The CST, the dike and the pump house are located away from the safety-related SSCs. The system has no safety-related functions, and provisions have been made to collect and control contents (i.e., tank located away from the safety-related SSCs, site grading and yard drainage) of the CST in the event of a system leak, tank overflow or tank rupture, so that structural failure of the system will not affect the ability of safety-related SSCs to perform their intended function. Hence, the design of the CST is in conformance with the guidelines of Regulatory Position C.2 of RG 1.29, and with the relevant requirements of GDC 2.

The underground segment of transfer piping running between the CST and the hotwell is single-walled welded stainless steel piping in a coated trench with removable but sealed covers. The coating in the trench is Service Level II as defined in RG 1.54 Revision 1 and is subject to the graded 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 using the inspection plan guidance of ASTM D 5163. The trench also has inspection manholes with drain collection basins and liquid level switches that alarm in the MCR for prompt operator action. This design is supplemented by periodic hydrostatic or pressure testing of pipe segments, instrument calibration, and when required, visual inspection and maintenance of piping, trench and instrument integrity, in compliance with the guidance of RG 4.21 and industry operating experience. Design and system features addressing RG 4.21 are captured in Subsection 12.3.1.3 of the DCD. DCD_12.03-50

Design parameters of the CST are shown in Table 9.2.6-1.

The water chemistry in the CST is maintained in accordance with Table 9.2.6-2.

9.2.6.2.5 Condensate Transfer Pumps

Two 100% capacity condensate transfer pumps are provided. The condensate transfer pumps take suction from the CST and supply condensate to the condenser hotwell and various other users throughout the plant as shown in Figure 9.2.6-1. Design parameters of the condensate transfer pumps are shown in Table 9.2.6-1.

9.2.6.2.6 Primary Makeup Water Tanks

Two 140,000 gallon capacity PMWTs are provided. Each tank is provided with a diaphragm that is in continuous contact with the tank water to prevent absorption of oxygen from air. The top of the diaphragm is blanketed with deaerated, demineralized water. The tanks receive deaerated, demineralized water from the DWST. They also receive distilled water discharged from the boric acid evaporator (subsection 9.3.4). Normally, one tank supplies water to the users, while the other tank is standby. Each tank has sufficient capacity to serve all users. Each tank is provided with level and other anticipated drainage periods. Generally these sumps and sump tanks are provided with sufficient storage capacity consistent with sump pump operation.

- The equipment and floor drain systems and components are designed as equipment class 4, 5, 8 and 10 as listed in Table 3.2-2, except for ESF rooms floor drain systems and components that are designed as seismic category I, equipment Class 3.
- If the failure of any nonsafety-related component (such as drain piping, sump tanks and sump pumps) has the potential to result in damage to safety-related components by an earthquake, that non-safety related component is designed as seismic category II.

9.3.3.1.3 Codes and Standards

The equipment and floor drainage systems are designed in accordance with the applicable codes and standards as listed in Chapter 3,Table 3.2-2.

9.3.3.2 System Description

The equipment and floor drains include the drains of A/B, R/B, T/B, C/V, PS/B and access building. Liquid waste drains by gravity and collects to tanks or sumps in each building. The waste is then transferred to the waste holdup tank for processing. The radioactive waste is processed in the LWMS before being discharged to the environment.

The detergent drains, including personnel decontamination waste, and the chemical drains are collected separately, and treated as required.

All the radioactive wastes are monitored prior to discharge, as discussed in Chapter 11, Section 11.2.

9.3.3.2.1 General Description

The equipment and floor drainage systems consist of collection piping, valves, equipment drains, floor drains, collection sumps and sump pumps.

9.3.3.2.2 Component Description

1. Collection piping: In all potentially radioactive areas, the collection system piping for the liquid waste is stainless steel. Potentially radioactive laboratory and decontamination waste, regeneration waste, and detergent waste collection system piping is stainless steel. Non radioactive collection piping is generally made of carbon steel although some parts are stainless steel. The collection piping is double-walled piping with leak detection instruments that alarm in the MCR for prompt operator action to prevent contamination discharge to the environment at the lowest elevation floor of the A/B and the R/B. This design feature meets the guidance of RG 4.21 and the requirements of 10 CFR 20.1406 for prevention of contamination of the facility and the environment. DCD_12.03-50 DCD_12.03-53
2. Collection sumps: The strategically located sumps are used to collect radioactive and non radioactive liquid waste. The non-radioactive collection sumps are constructed of

Condensed water from these components is collected in the auxiliary steam drain tank and then, by using the auxiliary steam drain pump, is transferred to the condenser during plant normal operation, or to the auxiliary boiler during the period in which the main steam is not available.

- Boric acid (B/A) evaporator
- B/A batching tank
- Non safety-related HVAC equipment

The ASSS supplies steam for plant system heating when main steam is not available. The auxiliary boiler takes condensate makeup from the auxiliary steam drain tank inside the A/B, or from the condensate storage tank (CST) in the yard. The auxiliary boiler is located in the yard near the plant area. The auxiliary boiler facility and the associated piping are designed in accordance with RG 4.21. The condensate piping from the ASSS drain tank is a single-walled carbon steel pipe run above ground in pipe chases from A/B to the T/B, and is then connected to double-walled welded carbon steel piping through the T/B wall penetration to the auxiliary boiler. Since this is not a high traffic area, this segment of pipe is run above ground and is slightly sloped so that any leakage is collected in the outer pipe and drained to the auxiliary boiler building. At the auxiliary boiler building end, a leak detection instrument is provided to monitor leak. A drain pipe is provided to direct any drains to the building sump. The line from the CST to the auxiliary boiler has isolation valves for maintenance and pipe testing. The facility floor has an epoxy coating and the sump has a liquid level detection instrument alarm for operator action. The sump drain line pumps the liquid contents to the T/B sump for collection and analysis. The sump drain line inside the auxiliary boiler building is constructed of single-walled carbon steel pipe. From the auxiliary boiler building wall penetration to the T/B outside wall, the drain line is constructed of double-walled piping run above ground. Inside the T/B, the pipe is single-walled as it is routed to the T/B sump. The double-walled segment of the sump drain line is sloped towards the turbine building and is equipped with leak detection instrumentation that alarms in the MCR for prompt operator action. The steam piping is jacketed with insulation and heat protection. The Auxiliary Boiler is designed with a blowdown connection from the boiler drum to the building sump. The boiler blowdown is drained directly into the sump for transfer into the Turbine Building sump. The T/B sump contents are then pumped to the Waste Holdup Tanks in the LWMS for processing. This design is supplemented by operational programs which includes periodic hydrostatic or pressure testing of pipe segments, instrument calibration, and when required, visual inspection and maintenance of piping, trench and instrument integrity. These design features meet the guidance of RG 4.21 and the requirements of 10 CFR 20.1406 for prevention of contamination of the facility and the environment.

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A discussion of the radiological aspects of the system leakage is contained in DCD Section 11.1. Design and system features addressing RG 4.21 are captured in Subsection 12.3.1.3 of the DCD.

Monitoring the leakage from the primary side of the evaporator, the radiation monitor is attached to the downstream of the auxiliary steam drain pump. The high alarm of the

Table 11.2-8 Summary of Tank Indication, Level Annunciations, and Overflows

Tank	Level Indication Location	Alarm	Location of Alarm (Notes 2 and 3)	Overflows Into
WHTs	radwaste control room	High Level	Radwaste control room	A/B Sump
		Low Level	Radwaste control room	
Chemical Drain Tank	Radwaste control room	High Level	Radwaste control room	A/B Sump
		Low Level	Radwaste control room	
Waste Monitor Tanks	Radwaste control room	High Level	Radwaste control room	A/B Sump
		Low Level	Radwaste control room	
Detergent Drain Tank	Radwaste control room	High Level	Radwaste control room	A/B Sump
		Low Level	Radwaste control room	
C/V Sump	MCR + Radwaste control room	High Level	MCR + Radwaste control room	C/V Sump
		Low Level	MCR + Radwaste control room	
Sump Tanks (Note 1)	Radwaste control room	High Level	Radwaste control room	Cell
		Low Level	Radwaste control room	
C/V Reactor Coolant Drain Tank	MCR + Radwaste control room	High Level	MCR + Radwaste control room	C/V Sump
		Low Level	MCR + Radwaste control room	
	MCR + Radwaste control room	High Pressure	Radwaste control room	
	MCR + radwaste control room	High Temp	Radwaste control room	
Detergent Drain Monitor Tank	Radwaste control room	High Level	Radwaste control room	A/B Sump
		Low Level	Radwaste control room	
Stand Pipe	Local + MCR	High Level	MCR	C/V Sump
	Local + MCR	Low Level	MCR	

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Notes:

1. ~~All the listed sumps include instrumentation that alarm in the MCR and radwaste control room. .~~The leak detection instruments for the floor drains sump and the equipment drains sump in the A/B alarm locally and also in the MCR through a representative alarm. DCD_12.03-51
2. High level alarms in the radwaste control room are annunciated in the MCR as a common alarm.
3. Leak detection and component failure instrumentation alarms will continue to annunciate when subsequent or simultaneous alarms from different components are generated. DCD_12.03-51

Table 12.3-8 Regulatory Guide 4.21 Design Objectives and Applicable DCD Subsection Information for Minimizing Contamination and Generation of Radioactive Waste (Sheet 18 of 77)

Objective		System Features	DCD Reference
		The underground segment of transfer piping running between the CST and the hotwell is single-walled welded stainless steel piping in a coated trench with removable but sealed covers. The coating in the trench is Service Level II as defined in RG 1.54 Revision 1 and is subject to the graded 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 D4537 using the inspection plan guidance of ASTM D 5163. The trench also has inspection manholes with drain collection basins and liquid level switches that alarms in the MCR for prompt operator action. This design is supplemented by periodic hydrostatic or pressure testing of pipe segments, instrument calibration, and when required, visual inspection and maintenance of piping, trench and instrument integrity, in compliance with the guidance of RG 4.21 and industry operating experience.	9.2.6.2.4
2	Provide for adequate leak detection capability to provide prompt detection of leakage for any structure, system, or component which has the potential for leakage.	Piping in a coated trench with removable but sealed covers, this design is supplemented by periodic hydrostatic or pressure testing of pipe segments, instrument calibration, and when required, visual inspection and maintenance of piping, trench and instrument integrity.	9.2.6.2.4

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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 68 of 77)

Auxiliary Steam Supply System **(Note: The "System Features" column consists of excerpts/summary from the DCD)**

Objective		System Features	DCD Reference
1	Minimize leaks and spills and provide containment in areas where such events may occur.	The condensate piping from the ASSS drain tank is a single-walled carbon steel pipe run above ground in pipe chases from the A/B to the T/B, and is then connected to double-walled welded carbon steel piping through the T/B wall penetration to the auxiliary boiler. Since this is not a high traffic area, this segment of pipe is run above ground and is slightly sloped so that any leakage is collected in the outer pipe and drained to the auxiliary boiler building. At the auxiliary boiler building end, a leak detection instrument is provided to monitor leak. A drain pipe is provided to direct any drains to the building sump. The line from the CST to the auxiliary boiler has isolation valves for maintenance and pipe testing. The facility floor has an epoxy coating and the sump has a liquid level detection instrument alarm for operator action. The sump drain line pumps the liquid contents to the T/B sump for collection and analysis. The sump drain line inside the auxiliary boiler building is constructed of single-walled carbon steel pipe. From the auxiliary boiler building wall penetration to the T/B outside wall, the drain line is constructed of double-walled piping run above ground. Inside the T/B, the pipe is single-walled as it is routed to the T/B sump. The double-walled segment of the sump drain line is sloped towards the turbine building and is equipped with leak detection instrumentation that alarms in the MCR for prompt operator action. The steam piping is jacketed with insulation and heat protection. The Auxiliary Boiler is designed with a blowdown connection from the boiler drum to the building sump. The boiler blowdown is drained directly into the sump for transfer into the Turbine Building sump. The T/B sump contents are then pumped to the Waste Holdup Tanks in the LWMS for processing. This design is supplemented by operational programs which includes periodic hydrostatic or pressure testing of pipe segments, instrument calibration, and when required, visual inspection and maintenance of piping, trench and instrument integrity.	10.4.11.2.1

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