MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #1 (AI 10-12.1)

APR1400 Final Safety Analysis Report (FSAR) Subsection 10.4.8.1.2 states that the components, piping, and supports downstream of the outermost containment isolation valves of the SGBS "meet the following intents of the quality standards of Position C.1.1, C.4, and C.7 of NRC RG 1.143."

In this context, it is unclear to the staff precisely what the applicant means by meeting the intent of the RG 1.143 positions. If there are exceptions to the RG positions, revise the FSAR to describe the exceptions. If there are no exceptions, change the wording to state that they meet the RG positions. According to FSAR Table 1.9-1, the APR1400 design conforms to RG 1.143 with no exceptions identified.

Response

There are no exceptions to the RG positions of NRC RG 1.143 because the RG positions relevant to the SGBS are C.1.1, C.4, and C.7 and the other RG positions do not apply to the SGBS.

The FSAR will be revised to clarify the RG positions of NRC RG 1.143 that apply.

Impact on DCD

The DCD Section 10.4.8.1.2 will be revised as shown in the attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

10.4.8.1.2 Non-Safety Power Generation Design Bases

The non-safety-related functions and design basis requirements of the SGBS are as follows:

a. Remove non-volatile materials generated from condenser tube leaks, primary-to-secondary tube leaks, and corrosion that would otherwise become more concentrated in the shell side of the SGs, in order to help maintain SG shell-side water chemistry as specified in Table 10.3.5-1 (GDC 13)

b. Enable blowdown concurrent with SG tube leak to remove radioactive materials from the secondary side without release of radioactivity to the environment

c. Sample blowdown water for chemistry analysis and monitor the SG primary-to-secondary tube leakage with SG blowdown water radiation monitor (GDC 14)

d. Establish and maintain wet and dry lay-up of the steam during plant shutdown

e. Drain the secondary water of the SG for maintenance

f. Control the blowdown water temperature to protect the demineralizer resin from high temperatures

g. Monitor the radiation level downstream of the post-filter

. The SGBS meets

All components, piping, and their associated supports downstream of the outermost containment isolation valves of the SGBS are non-safety ~~and meet the following intents of~~ the quality standards of Position C.1.1, C.4, and C.7 of NRC RG 1.143 (Reference 27).

a. Table 10.4.8-3 details the equipment codes for design and construction as required in Table 1 of NRC RG 1.143. The structures, systems, and components (SSCs) of the SGBS are designed in conformance with applicable codes and standards, and guidelines provided in NRC RG 1.143.

The SGBS components are determined for the radioactive safety classification in accordance with the guidance provided in RG 1.143. The component safety

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #2 (AI 10-12.2)

FSAR Table 3.2-1, “Classification of Structures, Systems, and Components,” provides quality, seismic, and safety classification information for the Steam Generator Blowdown System under Item #86 (“SD – SG Blowdown”), beginning on page 60 of the table (FSAR page 3.2-75). In some cases, the level of detail is insufficient for the staff to evaluate the classifications.

Revise Item 86 (“SD – SG Blowdown”) in FSAR Table 3.2-1 to clarify the following information related to the SGBS.

- In item “a,” identify the components to which this applies (piping? valves? etc.)
- In item “m” identify the components to which this applies for the Wet Layup System

Response

The FSAR will be revised to clarify the information.

Impact on DCD
The DCD Tier 2 Table 3.2-1 will be revised as shown in the attachment.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical, or Environmental Report.

Table 3.2-1 (60 of 86)

Item No. / Principal SSCs	Location(2)	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B(3)	Seismic Category	Remarks
3) Piping and valves on the IRWST cooling line from downstream of SI-688, 693 to SI-300, 301 (up to and including SI-391)	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
4) External reactor vessel cooling fill line downstream of and excluding SI-391	AB	NNS	D	ASME B31.1-2007 with 2008, 2009 addenda	A	II	(3)(d)
5) Piping and valves on the SCS filling line from and including SI-708, 709 to upstream of SI-106	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
6) Radioactive drain system connection piping	RCB, AB	NNS	D	ASME B31.1-2007 with 2008, 2009 addenda	A	II	(3)(d)
7) All relief valves discharge piping	RCB, AB	NNS	D	ASME B31.1-2007 with 2008, 2009 addenda	A	II	(3)(d)
86. SD – SG Blowdown							
a. Valves and piping from ~~From~~ SG up to the anchor wall of the blowdown flash tank room, including containment isolation valves	RCB, AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
b. Blowdown flash tank	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)
c. Regenerative heat exchanger	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)
d. Mixed bed demineralizer	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)

Table 3.2-1 (62 of 86)

Item No. / Principal SSCs	Location(2)	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B(3)	Seismic Category	Remarks
l. Wet lay-up recirculation pump	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)
m. ~~Portion of~~ Valves and piping from wet lay-up subsystem within containment or auxiliary building except the containment penetration area and pressure boundaries.	RCB, AB	NNS	D	ASME B31.1-2010	N/A	II	(3)(d), (4)
87. SI – Safety Injection							
a. Safety injection pumps	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
b. Safety injection tanks	RCB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
c. Safety injection filling tank	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	N/A	III	
d. Piping and valves							
1) SIP miniflow line (from SIP orifice or SI-218, 219, 254, 255 to IRWST)	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
2) SI piping and valves from IRWST to upstream of and excluding the check valves SI-543, 541, 542, 540 and hot leg isolation valve SI-604, 609	RCB, AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #3 (AI 10-12.3)

Based on the review of FSAR Subsection 10.4.8, the staff is unclear regarding the applicant's classification of the SGBS piping as it applies to its design, fabrication, testing, and inspection. FSAR Subsection 10.4.8.1.1 suggests this piping is not part of the safety Class 2 portion, but the design of the blowdown pipe is not discussed. The staff needs this information to determine if the system meets the requirements of GDC 1 and GDC 2.

Revise Subsection 10.4.8 of the FSAR to describe the classification of the blowdown pipe, and the codes and standards that apply to its design, fabrication, testing, and inspection.

Response

The Classification of SGBS equipment and components is described in Tier 2 FSAR, Subsection 10.4.8.2.1. The classification of the blowdown pipe and the codes and standards are described in Tier 2 FSAR, Table 3.2-1 as shown in the attachment.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

Table 3.2-1 (60 of 86)

Item No. / Principal SSCs	Location(2)	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B(3)	Seismic Category	Remarks
3) Piping and valves on the IRWST cooling line from downstream of SI-688, 693 to SI-300, 301 (up to and including SI-391)	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
4) External reactor vessel cooling fill line downstream of and excluding SI-391	AB	NNS	D	ASME B31.1-2007 with 2008, 2009 addenda	A	II	(3)(d)
5) Piping and valves on the SCS filling line from and including SI-708, 709 to upstream of SI-106	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
6) Radioactive drain system connection piping	RCB, AB	NNS	D	ASME B31.1-2007 with 2008, 2009 addenda	A	II	(3)(d)
7) All relief valves discharge piping	RCB, AB	NNS	D	ASME B31.1-2007 with 2008, 2009 addenda	A	II	(3)(d)
86. SD – SG Blowdown							
a. From SG up to the anchor wall of the blowdown flash tank room, including containment isolation valves	RCB, AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
b. Blowdown flash tank	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)
c. Regenerative heat exchanger	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)
d. Mixed bed demineralizer	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)

Table 3.2-1 (61 of 86)

Item No. / Principal SSCs	Location(2)	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B(3)	Seismic Category	Remarks
e. Valves and piping from the anchor wall of the blowdown flash tank room to the points (V1045, 050) where discharged into the condensate, and the wastewater treatment system	AB	NNS	D	ASME B31.1-2010	A	II	(3)(d), (4)
f. Valves and piping-from the points (V1045, 050) where discharged into the condensate, and the wastewater treatment system to the auxiliary building wall.	AB	NNS	D	ASME B31.1-2010	A	II	(3)(d)
g. Valves and piping from the anchor wall of the blowdown flash tank room to wall of MSIV room	AB	NNS	D	ASME B31.1-2010	A	II	(3)(d), (4)
h. Valves and piping at the downstream of wall of MSIV room	AB, TGB	NNS	D	ASME B31.1-2010	N/A	III	
i. Valves and piping except (e), (f), (g), and (h) within auxiliary building	AB	NNS	D	ASME B31.1-2010	A	II	(3)(d), (4)
j. Equipment and piping of the liquid radwaste system interfaced to the SGBS within the compound building	CPB	NNS	D	ASME B31.1-2010	N/A	III	(4)
k. Equipment and piping within the compound building and turbine building	CPB, TGB	NNS	D	ASME B31.1-2010	N/A	III	

Table 3.2-1 (62 of 86)

Item No. / Principal SSCs	Location(2)	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B(3)	Seismic Category	Remarks
l. Wet lay-up recirculation pump	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	A	II	(3)(d), (4)
m. Portion of wet lay-up subsystem within containment or auxiliary building except the containment penetration area and pressure boundaries.	RCB, AB	NNS	D	ASME B31.1-2010	N/A	II	(3)(d), (4)
87. SI – Safety Injection							
a. Safety injection pumps	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
b. Safety injection tanks	RCB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
c. Safety injection filling tank	AB	NNS	D	ASME Sec. VIII-2007 with 2008 addenda	N/A	III	
d. Piping and valves							
1) SIP miniflow line (from SIP orifice or SI-218, 219, 254, 255 to IRWST)	AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	
2) SI piping and valves from IRWST to upstream of and excluding the check valves SI-543, 541, 542, 540 and hot leg isolation valve SI-604, 609	RCB, AB	SC-2	B	ASME Sec. III NC-2007 with 2008 addenda	Yes	I	

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #4 (AI 10-12.4)

What is the operating experience with the “Concept of Central Blowdown,” illustrated in FSAR Figure 10.4.8-2? In your response, address whether this type of blowdown pipe has experienced degradation leading to loose parts, whether those loose parts have been detected and retrieved during scheduled inspections, and whether they have caused any damage to SG tubes.

Response

Figure 10.4.8-3 is typographical error in Tier 2 FSAR Subsection 10.4.8.2.3.2. Figure 10.4.8-3 will be revised to Figure 10.4.8-2.

Operating experience has shown that there has not been any degradation leading to loose parts, and damage to SG tubes for the type of blowdown pipe illustrated in FSAR Figure 10.4.8-2.

Impact on DCD

The DCD Section 10.4.8.2.3.2 will be revised as shown in the attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

10.4.8-2

The APR1400 SGs use a "central" blowdown system arrangement. In this arrangement, blowdown holes are drilled from the lower part of blowdown pipe where it is installed at the top of tube sheet. This arrangement is shown as Figure ~~10.4.8-3~~ and facilitates effective sludge removal from the tube sheet. The blowdown from each SG is depressurized by the pressure control valves located in the vent line of the blowdown flash tank where water and flashing vapor are separated. The vented steam is discharged to the high-pressure feedwater heater. When the high-pressure feedwater heater is unavailable, the vent pass is diverted to condenser.

10.4.8.2.3.3 Plant Shutdown

During long-term shutdown periods, the WLS is used to control the water chemistry in the SG. Following draining or dry lay-up, the WLS refills the SGs.

10.4.8.2.3.4 Steam Generator Drain

The SGBS is used to drain the SGs for maintenance or for a refueling shutdown. In this mode, the blowdown drain water is directed to the liquid radwaste system only when radioactivity is detected, otherwise drained to [[the wastewater treatment system (WWTS)]]. The COL applicant is to describe the nitrogen or equivalent system design for the SG drain (COL 10.4(7)).

10.4.8.2.3.5 Abnormal Operation

a. Condenser tube leakage

   In the event of a main condenser tube leakage and concurrent high sodium concentration downstream of the demineralizers and filters treating impurities, the blowdown water is discharged to [[the WWTS]].

b. Containment isolation signals

   The containment isolation valves are automatically isolated at the following signals:

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #5 (AI 10-12.5)

Based on the review of FSAR Subsection 10.4.8, the staff is unclear regarding the applicant's proposed modes of operation of the SGBS (continuous blowdown, abnormal blowdown, emergency blowdown, and high-capacity blowdown). An understanding of these operating modes is necessary for the staff to evaluate the capability of the system to meet GDC 14 as it relates to maintaining secondary water chemistry.

Revise FSAR Section 10.4.8 to clarify the definitions of continuous blowdown, abnormal blowdown, emergency blowdown, and high-capacity blowdown, and the blowdown rates associated with these various modes. In these definitions, identify whether the blowdown rates are for each steam generator (SG) or the combined rate for both SGs. In addition, clarify the description of the flash tank capacity in FSAR Table 10.4.8-1. Further, clarify the meaning of the flash tank capacity listed in Table 10.4.8-1, "one SG EBD and the other ABD with 200 seconds."

Response

1) Clarify the definitions

Tier 2 FSAR, Section 10.4.8 will be revised.

2) Blowdown rates associated with these various modes and identify whether the blowdown rates are for each steam generator (SG) or the combined rate for both SGs.

Tier 2 FSAR, Sections 10.4.8.2.3.1, 10.4.8.2.3.2 and 10.4.8.2.3.6 will be revised to clarify the blowdown rates.

3) Clarify the meaning of the flash tank capacity listed in Table 10.4.8-1

The meaning of the flash tank capacity is the flash tank size to accommodate the EDB of one steam generator and the ADB of the other steam generator for the 200 seconds that is required from the main steam system.

Impact on DCD
The DCD Sections 10.4.8, 10.4.8.2.3.1, 10.4.8.2.3.2 and 10.4.8.2.3.6 will be revised as shown in the attachment.

Impact on PRA
There is no impact on the PRA.

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical, or Environmental Report.

a. Prevention of rapid valve motion

b. Introduction of voids into water-filled lines and components

c. Proper filling and venting of water-filled lines and components

d. Introduction of steam or heated water that can flash into water-filled lines and components

e. Introduction of water into steam-filled lines or components

f. Proper warmup of steam-filled lines

g. Proper drainage of steam-filled lines

h. Effects of valve align

10.4.7.7 Flow-Accelerated

The condensate and feedwate damage. The methods descr erosion/corrosion degradation

During normal power operation, the CBD from each SG is used to control chemistry in the steam generator secondary side water. The CBD is defined for two conditions, Normal Blowdown (NBD) and Abnormal Blowdown (ABD). When the chemistry is within the normal limits, the NBD is maintained. If the water chemistry is above the normal limits, the ABD is used. Periodically, HCBD is provided to remove any accumulated sludge near the tube sheet area. EBD using HCBD valves and piping can be operated to reduce the steam generator water level during Multiple Steam Generator Tube Rupture (MSGTR) event.

10.4.8 Steam Generator Blowdown System

The steam generator blowdown system (SGBS) consists of two subsystems, the blowdown subsystem (BDS) and wet lay-up subsystem (WLS). The SGBS assists in maintaining the chemical characteristics of the secondary side water, within permissible limits, during normal plant operation and anticipated operational occurrences (AOOs), due to main condenser tube leak or SG primary-to-secondary tube leakage. The SGBS is designed to remove impurities concentrated in SGs by continuous blowdown (CBD), periodical high-capacity blowdown (HCBD), and emergency blowdown (EBD).

e. Wet lay-up recirculation pump

The centrifugal wet lay-up recirculation pump recirculates the SG secondary side water through filters and demineralizers during wet lay-up of the SG. The pumps are also used to drain and fill the SG secondary side.

10.4.8.2.3 System Operation

10.4.8.2.3.1 Plant Startup

The SGs are maintained in wet lay-up by the WLS when the plant is expected to be shut down for a long period. After the WLS operation is ceased, the water in the SG is transferred to either the [[wastewater treatment facility]] or the liquid radwaste system. If the SG water is nonradioactive, it is drained to the [[wastewater treatment facility]] by gravity or by using the wet lay-up recirculation pump until the required water quality is met and the desired water level is achieved. If the SG water is radioactive, it is drained to the liquid radwaste system by gravity or by using the wet lay-up recirculation pump until the required water quality is met and the desired water level is achieved.

The abnormal blowdown (ABD) is started following feedwater pump startup operation.

The ABD of 1 percent of SG's maximum steaming rate (SGMSR) is maintained until the water quality is within the normal limits.

SGMSR is 4,071 ton/hr (8,975,000 lbm/hr) for each steam generator.

10.4.8.2.3.2 Normal Operation

During normal power operation, the CBD that flows from each SG is maintained to keep the SG secondary side water chemistry within the specified limits. The CBD flow rate is 0.2 percent in normal blowdown or 1 percent in ABD.

from each SGMRS

The blowdown system cools the blowdown water with regenerative heat exchanger to a temperature that is acceptable for processing filters and demineralizers.

The APR1400 SGs use a “central” blowdown system arrangement. In this arrangement, blowdown holes are drilled from the lower part of blowdown pipe where it is installed at the top of tube sheet. This arrangement is shown as Figure 10.4.8-3 and facilitates effective sludge removal from the tube sheet. The blowdown from each SG is depressurized by the pressure control valves located in the vent line of the blowdown flash tank where water and flashing vapor are separated. The vented steam is discharged to the high-pressure feedwater heater. When the high-pressure feedwater heater is unavailable, the vent pass is diverted to condenser.

The BDS is designed to handle intermittent HCBD of up to 5 percent of SGMSR from one steam generator and 1 percent of SGMSR from the other for two minutes.

10.4.8.2.3.3 Plant Shutdown

During long-term shutdown periods, the WLS is used to control the water chemistry in the SG. Following draining or dry lay-up, the WLS refills the SGs.

10.4.8.2.3.4 Steam Generator Drain

The SGBS is used to drain the SGs for maintenance or for a refueling shutdown. In this mode, the blowdown drain water is directed to the liquid radwaste system only when radioactivity is detected, otherwise drained to [[the wastewater treatment system (WWTS)]]. The COL applicant is to describe the nitrogen or equivalent system design for the SG drain (COL 10.4(7)).

10.4.8.2.3.5 Abnormal Operation

a. Condenser tube leakage

   In the event of a main condenser tube leakage and concurrent high sodium concentration downstream of the demineralizers and filters treating impurities, the blowdown water is discharged to [[the WWTS]].

b. Containment isolation signals

   The containment isolation valves are automatically isolated at the following signals:

3) High-level alarms for the blowdown flash tank

The malfunctions of the above SGBS components isolate the SGBS lines and after those conditions are restored, the SGBS is in service.

the EBD flow rate are approximately 14 percent of SGMSR from one steam generator to reduce a steam generator water level during MSGTR.

10.4.8.2.3.6 Multiple Steam Generator Tube Rupture

In the event of a main steam generator tube rupture (MSGTR) that is beyond the design basis accident, the EBD is operated to reduce the SG water water level using the HCBD valve and piping.

10.4.8.2.4 Design Features for Minimization of Contamination

The SGBS is designed with specific features to meet the requirements of 10 CFR 20.1406 (Reference 7) and Regulatory Guide 4.21 (Reference 8). The basic principles of NRC RG 4.21 and the methods of control are delineated in four design objectives and two operational objectives, as described in Subsection 12.4.2. The following evaluation summarizes the primary features to address the design and operational objectives for the SGBS.

The SGBS has been evaluated for leak identification from the SSCs that contain radioactive or potentially radioactive materials, the areas and pathways where leakage may occur, and the methods of leakage control incorporated in the design of the system. The leak identification evaluation indicated that the SGBS is designed to facilitate early leak detection and the prompt assessment and response to manage collected fluids. Unintended contamination to the facility and the environment is minimized and/or prevented by the SSC design, supplemented by operational procedures and programs and inspection and maintenance activities.

Prevention/Minimization of Unintended Contamination

a. The SGBS components are located in elevated cubicles inside the auxiliary building. The cubicle floors are sloped, coated with epoxy, and provided with drains that are routed to the local drain hubs. This design approach prevents the spread of contamination through the facility and to the environment.

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Issue #6 (AI 10-12.6)

FSAR Subsection 10.4.8.2.3.2 states that the continuous blowdown (CBD) flow rate is, "0.2 percent in normal blowdown or 1 percent in ABD."

Revise this sentence of the FSAR to clarify whether this is the total rate from both SGs or the rate from each SG. In addition, provide the bases for concluding these rates are adequate for maintaining or correcting the secondary water chemistry.

Response

The maximum continuous blowdown flow rate at 1% of maximum steaming rate is based on operating experience and EPRI-URD. Refer to the "Steam Generator Reference Book," EPRI TR-103824. The EPRI guidelines for PWR secondary water chemistry cover all aspects of secondary water chemistry.

The FSAR will be revised to clarify whether this is the total rate from both SGs or the rate from each SG.

Impact on DCD

The DCD Section 10.4.8.2.3.2 will be revised as shown in the attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

e. Wet lay-up recirculation pump

The centrifugal wet lay-up recirculation pump recirculates the SG secondary side water through filters and demineralizers during wet lay-up of the SG. The pumps are also used to drain and fill the SG secondary side.

10.4.8.2.3 System Operation

10.4.8.2.3.1 Plant Startup

The SGs are maintained in wet lay-up by the WLS when the plant is expected to be shut down for a long period. After the WLS operation is ceased, the water in the SG is transferred to either the [[wastewater treatment facility]] or the liquid radwaste system. If the SG water is nonradioactive, it is drained to the [[wastewater treatment facility]] by gravity or by using the wet lay-up recirculation pump until the required water quality is met and the desired water level is achieved. If the SG water is radioactive, it is drained to the liquid radwaste system by gravity or by using the wet lay-up recirculation pump until the required water quality is met and the desired water level is achieved.

The abnormal blowdown (ABD) is started following feedwater pump startup operation.

The ABD of 1 percent of SG's maximum steaming rate (SGMSR) is maintained until the water quality is within the normal limits.

10.4.8.2.3.2 Normal Operation

During normal power operation, the CBD that flows from each SG is maintained to keep the SG secondary side water chemistry within the specified limits. The CBD flow rate is 0.2 percent in normal blowdown or 1 percent in ABD

from each SGMRS

The blowdown system cools the blowdown water with regenerative heat exchanger to a temperature that is acceptable for processing filters and demineralizers.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #7 (AI 10-12.7)

In FSAR Subsection 10.4.8.2.3.2, the applicant's design basis for the regenerative heat exchanger exit temperature (57.2ºC, 135ºF) is unclear to the staff.

Revise FSAR Subsection 10.4.8.2.3.2 to describe the basis for the 57.2ºC (135ºF) temperature limit at the regenerative heat exchanger exit. If the basis for this limit is the temperature limit of the ion exchange resins, is the same temperature limit applied when the blowdown water is directed to the wastewater treatment system or liquid radwaste system? If a different temperature limit applies, revise FSAR Subsection 10.4.8.2.3.2 to provide this clarification.

Response

The temperature limit at the regenerative heat exchanger exit is to avoid demineralizer resin damage. This limit is the same temperature limit applied when the blowdown water is directed to the wastewater treatment system or the liquid radwaste system. The FSAR will be revised to describe the basis for the temperature limit.

Impact on DCD

The DCD Section 10.4.8.2.3.2 will be revised as shown in the attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

The blowdown water returns to the secondary system and after being filtered and demineralized, meets the applicable chemistry requirements to return the water to the main condenser.

The blowdown system removes suspended and dissolved impurities that are concentrated in the secondary-side liquid of the SG using the CBD.

Each SG has two branch lines connected respectively to the hot leg and the economizer regions of the SG shell side. The blowdown is directed independently into the blowdown flash tank, where the flashed steam is returned to the cycle through the high-pressure feedwater heaters. The liquid portion flows to the regenerative heat exchanger, where it is cooled by the condensate system and then directed through one of two parallel blowdown pre-filters, where the major portion of the suspended solids is removed. After filtration, the blowdown fluid is processed by the blowdown demineralizers and returned to the condenser using a common discharge line.

to avoid the demineralizer resin damage

The blowdown water temperature at the exit of the regenerative heat exchanger is maintained at 57.2 °C (135 °F) by controlling the condensate flow rate to the regenerative heat exchanger. The temperature controller at the exit of the regenerative heat exchanger automatically controls the condensate control valve. When the blowdown water is unacceptable for use or contaminated with radioactive materials, the water is directed to the wastewater treatment system or liquid radwaste system.

When the CBD is operated, the blowdown flash tank level controller is set to automatic mode, and the level control valve downstream of the post-filter maintains the water level in the blowdown flash tank. Before the HCBD or EBD is opened, the blowdown flash tank level controller is set to manual mode, and the level control valve is manually set to the normal blowdown (NBD) or ABD opening. When the HCBD or EBD is operated, the water level in the blowdown flash tank increases. After the HCBD or EBD operation is stopped, the water level on the blowdown flash tank is returned to the normal level manually by setting the level control valve to the ABD opening. Each CBD (normal blowdown or ABD) flow is controlled by remotely opening and closing a corresponding CBD isolation valves in series with a flow regulation valve.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #8 (AI 10-12.8)

FSAR Subsection 10.4.8.2.3.5, Item c, “Abnormal water chemistry condition,” appears to define abnormal water chemistry as excessive radioactivity or sodium concentration. The APR1400 secondary water chemistry guidelines (Table 10.3.5-1, “Operating Chemistry Conditions for Secondary Steam Generator Water”) and corresponding EPRI guidelines have three action levels for sodium, and there are action levels for parameters other than sodium. Therefore, revise the FSAR to clarify the criteria that define the abnormal water chemistry condition.

Response

The FSAR will be revised to clarify the criterion that defines abnormal water chemistry condition.

Impact on DCD

The DCD Section 10.4.8.2.3.5 will be revised as shown in the attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

1) Main steam isolation signal

2) Diverse protection system auxiliary feedwater actuation signal

3) Containment isolation actuation signal

4) Auxiliary feedwater actuation signal

The outermost containment isolation valves in the blowdown lines are interlocked to close automatically on a high radiation signal from the radiation monitor installed at the outlet of the post-filter.

c. Abnormal water chemistry condition

When the radioactivity level at the outlet of the SG blowdown demineralizers exceeds the predetermined limit, blowdown water is discharged to the liquid radwaste treatment system. When the ~~sodium concentration~~ water chemistry condition as specified in Table 10.3.5-1 exceeds the specified limit, blowdown water is discharged to the WWTS.

d. SG Tube Leakage

In the case of SG primary to secondary tube leakage within tube leak rate as specified in the plant Technical Specifications, blowdown water continues to be purified with SG blowdown demineralizers to remove the radioactivity entering from leaking SG tube (s).

e. Malfunction in SGBS component

The following conditions indicate respectively the potential malfunctions of the blowdown flash tank vent line, the regenerative heat exchanger, and blowdown flash tank:

1) High-pressure alarm for the blowdown flash tank

2) High-temperature alarm at the exit of the regenerative heat exchanger

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #9 (AI 10-12.9)

FSAR Subsection 10.4.8.2.3.5, Item c, refers to high radioactivity measured at the SG blowdown demineralizer outlet. The staff was not able to identify a radiation monitor at this location in the figures (FSAR Figure 10.4.8-1).

Revise FSAR Subsection 10.4.8 to provide more information about these measurements, including the designation and location of the radiation monitors.

Response

The designation for the radiation monitor is located in the Figure 10.4.8-1 as shown in the attachment 1. The location of the radiation monitors is described in Subsection 10.4.8.5 as shown in attachment 2.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

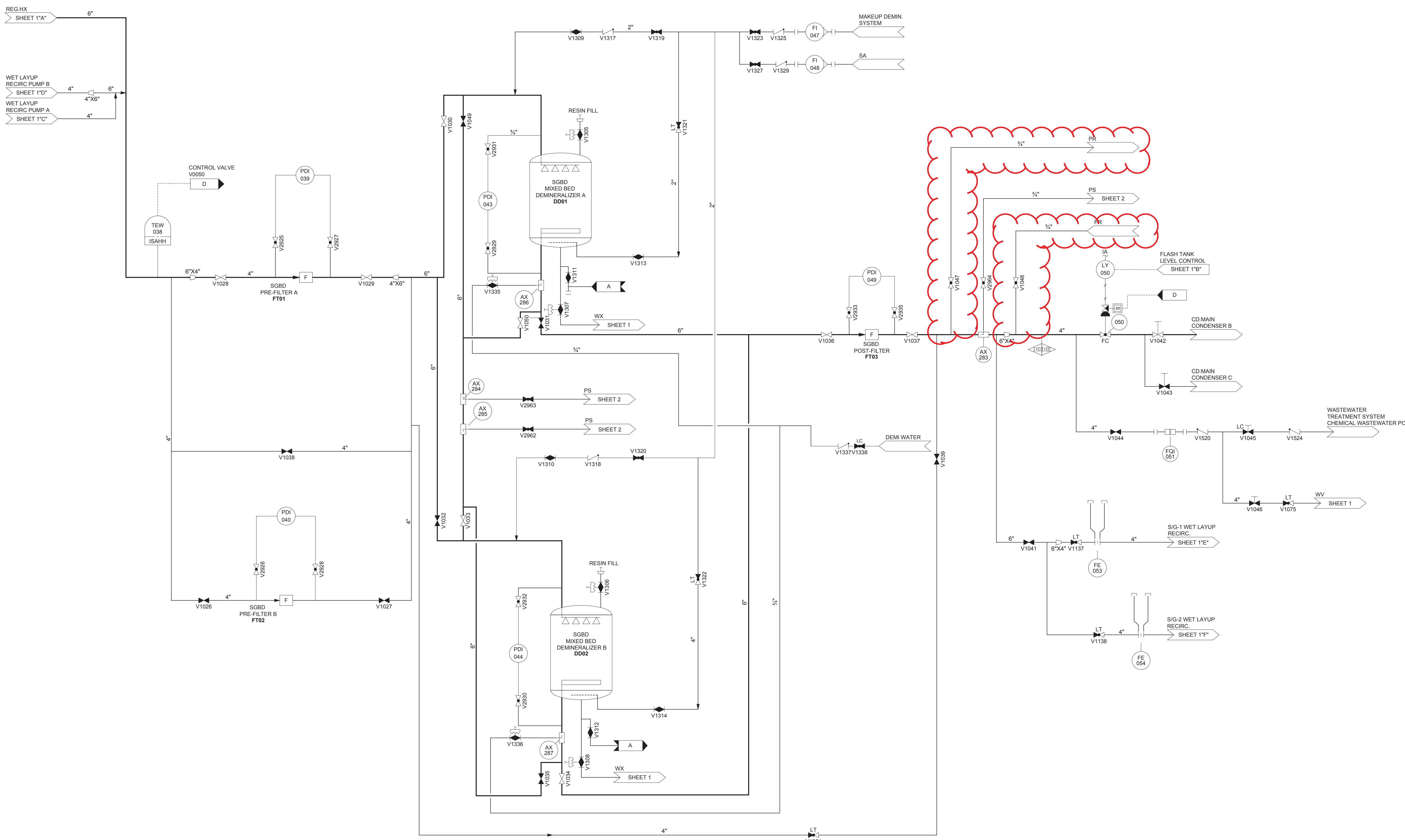

Figure 10.4.8-1 Steam Generator Blowdown System Flow Diagram (2 of 2)

The blowdown flash tank is provided with a level and pressure instrument.

Flow elements downstream of the isolation valves measure and indicate blowdown flow from each SG.

The blowdown water temperature instrumentation monitor at the exit of the regenerative heat exchanger controls the condensate flow rate to the regenerative heat exchanger to maintain the temperature below approximately 57.2 °C (135 °F).

The differential pressure indicators display locally the differential pressure across the pre-filters, demineralizers, and post-filters.

The SG blowdown water radiation monitor, located in the downstream of the post-filter detects the radioactivity in the SG blowdown water.

10.4.9 Auxiliary Feedwater System

10.4.9.1 Design Bases

10.4.9.1.1 Functional Requirements

a. The auxiliary feedwater system (AFWS) provides an independent safety-related means of supplying auxiliary feedwater (AFW) to the SG(s) for the following events whenever the reactor coolant temperature is above the cut-in temperature for shutdown cooling system initiation and the main feedwater system is inoperable. The AFWS and supporting systems are designed to provide the required flow to the SG(s) with a loss of offsite power (LOOP) event, assuming a single active failure.

    1) Loss of normal feedwater

    2) Main steam line break (MSLB) or feedwater line breaks (FLB)

    3) Steam generator tube rupture (SGTR)

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #10 (AI 10-12.10)

This issue is related to the way steam and feedwater system material selection is applied to the SGBS to address flow-accelerated corrosion (FAC). The staff notes that this issue is also identified in the review of FSAR Subsection 10.3.6.

In FSAR Section 10.3.6.3, page 10.3-27, the applicant states:

> Most of the piping on steam and feedwater systems is made of carbon steel. Materials for the piping portions that are extremely susceptible to FAC are installed using an FAC- resistant alloy such as Cr-Mo steel.

And

> c. SG blowdown piping from SG to the blowdown flash tank is made of chrome-moly materials. FAC-susceptible portions are made of stainless steel; …. Other SG blowdown piping is made of carbon steel with 1.524 mm (0.06 in) additional margin in design.

Provide an explanation of how material selection for the SGBS correlates to the FAC susceptibility. For example, it is not clear to the staff why “extremely susceptible” portions of steam and feedwater piping use Cr-Mo steel, and FAC-susceptible SGBS piping is made of stainless steel. These materials selections appear to correlate lower FAC resistance (Cr-Mo steel) with higher FAC susceptibility (“extremely susceptible”). Paragraph c, quoted above, also suggests that blowdown piping from the SG to the flash tank is not considered susceptible to FAC but it is made of Cr-Mo steel. In addition, provide the basis for using 1.524 mm (0.06 inch) as an adequate additional margin for carbon steel SGBS piping.

Response

“SG blowdown piping from SG to the blowdown flash tank, which is susceptible to FAC, is made of chrome-moly materials…..FAC-susceptible portions are made of carbon steel with 1.524 mm (0.06 in) additional margin in design” was not the intended wording. The stainless steel in wet lay-up piping, which are not used during normal operation, was not applied for FAC prevention but for preventing corrosion. The stainless steel in the up and down stream lines of filters and demineralizers was also not applied for FAC prevention, but for preventing corrosion and protecting performance. The additional margin (corrosion allowance) was not applied to the piping downstream of SGBD flash tank. The piping is not susceptible to FAC, because the operating flow velocity is below 10 ft/sec and the operating temperature is below 150 ℉. So, the written content will be deleted in DCD Tier 2, Subsection 10.3.6.3.

Impact on DCD

The DCD Section 10.3.6.3 will be revised as shown in the attachment.

Impact on PRA

There is no impact on the PRA.

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Impact on Technical Specifications
There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports
There is no impact on any Technical, Topical, or Environmental Report.

steel steam and water piping in consideration of the 40 years of design life. The piping layout is also considered to minimize the incidence of FAC or erosion/corrosion in piping.

Most of the piping on steam and feedwater systems is made of carbon steel. Materials for the piping portions that are extremely susceptible to FAC are installed using an FAC-resistant alloy such as Cr-Mo steel.

The following piping portions with potential for FAC are generally based on NSAC-202L-R3 (Reference 17) and NUREG-1344 (Reference 18) attached to GL 89-08 (References 19).

a. For other safety/non-safety carbon steel piping with relatively mild FAC degradation identified in NUREG-1344 attached to GL 89-08, NSAC-202L-R3, and through experience, the average thinning rates of 2.54×10^{-6} mm/hr (0.1×10^{-6} in/hr) in steam system and 4.35×10^{-6} mm/hr (0.17×10^{-6} in/hr) in the water system are given based on the actual measurement records from Korea standard nuclear plants. The additional thickness of 0.889 mm (0.035 in) for the portion of steam system piping, and 1.524 mm (0.06 in) for the portion of water system piping in design are applied in consideration of the 40 years of design life.

b. As shown in Table 10.3.2-4, the main feedwater piping from the main feedwater isolation valve (MFIV) in the MSVH to SGs and the piping downstream of downcomer feedwater control valves are made of high-content chrome-moly materials. This portion of the feedwater system is potentially susceptible to FAC, and the design specifications require FAC-resistant piping materials as described above. Other feedwater system piping is generally made of carbon steel with 1.524 mm (0.06 in) additional margin in design.

~~c. SG blowdown piping from SG to the blowdown flash tank is made of chrome-moly materials. FAC-susceptible portions are made of stainless steel; FAC-susceptible portions include wet layup recirculation lines, filters on upstream and downstream lines, and mixed-bed demineralizer upstream and downstream lines. Other SG blowdown piping is made of carbon steel with 1.524 mm (0.06 in) additional margin in design.~~

~~d.~~ c Condensate piping from the deaerator inlet control valves to the deaerator is made of chrome-moly materials. Other condensate piping is made of carbon steel with a 1.524 mm (0.06 in) additional margin in the design.

~~e.~~ d As shown in Table 10.3.2-2 and Table 10.3.2-3, the entire portion of MSS piping is made of carbon steel with a 0.889 mm (0.035 in) additional margin in design.

~~f.~~ e The entire portion of extraction steam piping is made of chrome-moly materials

~~g.~~ f Most feedwater heater drain piping is made of carbon steel with 1.524 mm (0.06 in) additional margin in design. FAC-susceptible portions such as downstream components of control valves are made of high-content chrome-moly materials.

For safety/non-safety carbon steel piping with relatively mild potential for FAC degradation, the required design wall thickness is based on piping design pressure, design temperature, and allowable stress in accordance with ASME Section III NC/ND-3640 or ASME B31.1 Paragraph 104. The specified wall thickness (prior to fabrication) is a standardized wall thickness stipulated in ASME B36.10M (Reference 20). It is determined to exceed the required design wall thickness with consideration of minus tolerances of the thicknesses by the appropriate amount to account for the expected wall thickness loss during fabrication. The piping layout includes a consideration of several features for the various piping systems to minimize the incidence of FAC and erosion/corrosion in piping as follows:

a. Elimination of high-turbulence points wherever possible (e.g., increasing the pipe length downstream of flow orifice, control valve)

b. Application of a suitable flow orifice to minimize cavitation possibilities (e.g., using the multi-plate orifice and multi-hole orifice)

c. Application of long-radius elbows

d. Application of smooth transition at shop or field welds

e. Selection of pipe diameter to have velocities within industry-recommended values

MCB Issue List Regarding APR-1400, DCD Tier 2, SECTION 10.4.8

Issue #11 (AI 10-12.11)

FSAR Subsection 10.4.8.1.2, the second paragraph "b" states:

The quality assurance (QA) program for the design, installation, procurement, and fabrication of SGBS components conforms with Regulatory Position C.7 of NRC RG 1.143.

Revise this paragraph of the FSAR to describe the applicable QA program or identify where in the FSAR the program is described.

Response

The FSAR will be revised to identify where in the FSAR the QA program is described.

Impact on DCD

The DCD Section 10.4.8.1.2 will be revised as shown in the attachement.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

classification is summarized in Table 10.4.8-1. Accordingly, the SGBS is classified as RW-IIc, based on the highest safety classification for the components within the system boundary. The SGBS components are housed within the auxiliary building designed as seismic Category I, which exceeds seismic design requirements for radwaste safety classification RW-IIc.

The safety classification for the SGBS component applies to the components, up to and including the nearest valves, fittings, and/or welded/flanged nozzle connections.

b. The quality assurance (QA) program for the design, installation, procurement, and fabrication of SGBS components conforms with Regulatory Position C.7 of NRC RG 1.143. The QA program is described in Table 3.2-1.

c. The SGBS is designed and tested to the codes and standards listed in Table 10.4.8-3 in accordance with Regulatory Positions C.1.1.1 and C.4 of NRC RG 1.143.

The SGBS follows the ALARA design and operational approach described in Sections 12.1 and 12.3 in accordance with NRC RG 8.8 (Reference 19). The SGBS' demineralizers are located in a shielded area to reduce the occupational radiation exposure (ORE).

10.4.8.2 System Description

10.4.8.2.1 General Description

SGBS schematic diagrams are shown in Figure 10.4.8-1. Classification of SGBS equipment and components is shown in Section 3.2.

The blowdown subsystem (BDS) consists of blowdown piping connected to each SG, a blowdown flash tank, a regenerative heat exchanger, two pre-filters, two demineralizers, a post-filter, and control valves. The wet lay-up subsystem (WLS) consists of two recirculation trains (one for each SG) and shares filters and demineralizers with the BDS.