RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**381-8467**
SRP Section:	**10.04.08 – Steam Generator Blowdown System**
Application Section:	**10.04.08**
Date of RAI Issue:	**02/01/2016**

Question No. 10.04.08-1

FSAR Tier 1 subsection 2.7.1.8 and Tier 2 subsection 10.4.8.2.3.5, identify electrical signals that close containment isolation valves in the Steam Generator Blowdown System (SD-V005, -V006, -V007, and –V008) under “Abnormal Operation.” The signals identified are main steam isolation signal (MSIS), diverse protection system auxiliary feedwater actuation signal (DPSAFAS), containment isolation actuation signal (CIAS), and auxiliary feedwater actuation signal (AFAS). However, this information appears to be inconsistent with the description of the design of APR1400 instrumentation and controls systems in FSAR Tier 2 Chapter 7, which does not identify MSIS, DPS-AFAS, or AFAS as signals that actuate containment isolation valves. In addition, Tier 2 Subsection 10.4.8.2.3.5 identifies other conditions that actuate containment isolation valves, some of which are listed in Tier 2 Table 6.2.4-1 (“List of Containment Penetrations and System Isolation Positions”), and some of which are not. These signals are high radiation, blowdown flash tank high pressure, blowdown flash tank high temperature, and blowdown flash tank high-high level.

Please clarify how the containment isolation signals described for the Steam Generator Blowdown System are consistent with the design of Instrumentation & Controls (Tier 2 Chapter 7) and the design of containment isolation actuation signals (Tier 2 Chapter 6). This information is needed for the staff to determine if the design meets GDC 13 (“Instrumentation and Controls”) and to understand apparent inconsistencies in the FSAR.

Response

The actuation signals that close containment isolation valves (CIVs: SD-V005, - V006, -V007, and –V008) in the SGBS in DCD Tier 2 Table 6.2.4-1 are correctly identified, except that the AFAS and HRAS should be separated by a “/”. DCD Tier 1 Table 2.7.1.8-1 will be revised to include the HRAS and the BFTHHLAS signals and DCD Tier 2 Subsection 10.4.8.2.3.5.b will be revised to include the BFTHHLAS for consistency.

It is noted that the HRAS and the BFTHHLAS signals are used for closure of the two SBDS outermost CIVs (V007 and V008). The high temperature signal from the downstream side of the regenerative heat exchanger (RHX) is used to regulate the flow control valve (V305 in the condensate system), on the condensate flow return line from the RHX, for temperature control on the SGBS line; and provides an alarm on a high temperature in the main control room. The signal does not initiate closure actions on the SGBS CIVs. Similarly, the BD flash tank (BDFT) high pressure signal also regulates the BDFT pressure control valves (V087 and V088), but does not initiate closure actions on the SGBS CIVs. The BDFT high level signal also regulates the BD isolation valves (V081 thru V084), but does not initiate closure actions on the SGBS CIVs.

DCD Tier 2 Subsection 10.4.8.2.3.5, item (b) and item (e) discuss containment isolation signals and malfunction alarms in the SGBS components, respectively.

DCD Tier 2 Chapter 7 contains discussions of instrument and control at a higher level and does not cover detailed discussions of individual signals. For purpose of consistency, the individual signals for each component are not described in Tier 2 Chapter 7. Instead, these individual signals are addresses in the DCD sections and subsections where system design and control functions are discussed, such as DCD Subsection 10.4.8.2.3.5.

Impact on DCD

DCD Tier 1 Table 2.7.1.8-1, DCD Tier 2 Table 6.2.4-1, and 10.4.8.2.3.5.b will be revised as indicated 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 Environment Report.

Table 2.7.1.8-2 (1 of 2)

Steam Generator Blowdown System Component List

Component Name	Item No. (1)	ASME Section III Class	Seismic Category	Class 1E/Harsh Envir. Qual.	Display/ Control at MCR	Display/ Control at RSR	Control Signal	Active Safety Function	Loss of Motive Power Position	Radwaste Safety Class
Hot Leg Blowdown Valve (MOV)	SD-V001, V002	2	I	No/Yes	Yes/Yes	Yes/Yes	-	-	As is	-
Cold Leg Blowdown Valve (MOV)	SD-V003, V004	2	I	No/Yes	Yes/Yes	Yes/Yes	-	-	As is	-
Containment Isolation Valve (AOV)	SD-V005, V006	2	I	Yes/Yes	Yes/Yes	Yes/Yes	CIAS/ MSIS/ AFAS/ DPS-AFAS	Close	Close	-
Containment Isolation Valve (MOV)	SD-V007, V008	2	I	Yes/Yes	Yes/Yes	Yes/Yes	CIAS/ MSIS/ AFAS/ DPS-AFAS /HRAS/BFTHHLAS	Close	As is	-
Containment Isolation Valve (Gate)	SD-V1113	2	I	-/Yes	No/No	No/No	-	Close	-	-
	SD-V1114	2	I	-/Yes	No/No	No/No	-	Close	-	-
Containment Isolation Valve (Check)	SD-V1115	2	I	-/Yes	No/No	No/No	-	Close	-	-
	SD-V1116	2	I	-/Yes	No/No	No/No	-	Close	-	-
Steam Generator Blowdown Prefilter	SD-FT01, FT02	NSS	II	- /No	No/No	No/No	-	-	-	RW-IIc
Steam Generator Blowdown Postfilter	SD-FT03	NSS	II	- /No	No/No	No/No	-	-	-	RW-IIc

Table 6.2.4-1 (9 of 15)

Item No.	Service	Line Size (in)	Valve No.	Closure Time (sec)	Figure No.	Valve Type	Fluid	Length of Pipe(ft)[15]	Location Relative to Contain-ment	Flow Direction Relative to Contain-ment	Valve Arrange-ment (GDC)[2]	Valve Position[3]				Actuator Type[4]	Actuation Signal[5]	Type[6]	Type Test	Type-C Test	Justifi-cation for Not Testing	Essential/ Nonessential Line[7]
												Nor-mal	Fail Safe	Shut-down	Acci-dent							
60	Contain-ment low volume purge supply system	8 8	VQ-0033 VQ-0034	5 5	9.4.6-2	Butterfly[13] Butterfly[13]	Containment Atmosphere	- 3	Inside Outside	out	17 (56)	C C	C C	C C	C C	P P	CIAS/CPIAS CIAS/CPIAS	A,R,M A,R,M	C	Yes	-	Nonessential
61	SG #1 blowdown to blowdown flash tank	8 8	SD-0005 SD-0007	40 40	10.4.8-1	Gate Gate	Secondary Coolant	8 -	Outside Outside	Out	29 (57)	O O	C C	O O	C C	P E	MSIS/CIAS/ DPS-AFAS/ AFAS MSIS/CIAS/ DPS-AFAS /AFAS HRAS/ BFTHHLAS	A,R,M A,R,M "/"	A	No	[9]	Nonessential
62	SG #2 blowdown to blowdown flash Tank	8 8	SD-0006 SD-0008	40 40	10.4.8-1	Gate Gate	Secondary Coolant	8 -	Outside Outside	Out	29 (57)	O O	C C	O O	C C	P E	MSIS/CIAS/ DPS-AFAS /AFAS MSIS/CIAS/ DPS-AFAS /AFAS HRAS/ BFTHHLAS	A,R,M A,R,M "/"	A	No	[9]	Nonessential
63	SG wet layup recirculatio n return to SG #1	4 4	SD-1113 SD-1115	- -	10.4.8-1	Gate Check	Secondary Coolant	14 -	Outside Inside	In	9 (57)	LC C	- -	O/C O/C	LC C	HW -	- -	M -	C	Yes	[9]	Nonessential
64	SG wet layup recirculatio n return to SG #2	4 4	SD-1114 SD-1116	- -	10.4.8-1	Gate Check	Secondary Coolant	8 -	Outside Inside	In	9 (57)	L/C O	- -	O/C O/C	LC C	HW -	- -	M -	C	Yes	[9]	Nonessential
65	Fire Protection water supply to containment Line #2	6 6	FP-0030 FP–1440	30 -	9.5.1-1	Globe[12] Check	Fresh water	- -		In	28 (56)	O O	C -	C C	C C	P -	CIAS -	A,R,M -	C	Yes	[14]	Nonessential
67	PCW supply to containment ventilation units	12 12	WI-0013 WI-1043	50 -	9.2-7-2	Gate[12] Check	Chilled water	6 -	Outside Inside	In	28 (56)	O O	C -	O O	C C	P -	CIAS -	A,R,M -	C	Yes	[14]	Nonessential

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.

on high-high level signal from the blowdown flash tank and

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 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

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Question No. 10.04.08-3

Please describe how flow accelerated corrosion (FAC) is addressed for the Steam Generator Blowdown System (SGBS). The November 24, 2015, response (ML15328A218, Enclosure 3) to MCB Issue #10 (KHNP AI 10-12.10) proposes deleting a paragraph on FAC in the SGBS from FSAR Subsection 10.3.6.3. The response also describes factors in the selection of materials for the SGBS. However, the description does not address how FAC is addressed for susceptible portions of the SGBS. Since the proposed FSAR revision would delete the paragraph specifically addressing SGBS, and the SGBS is not part of the Steam and Feedwater System, the staff is unable to determine how FAC would be addressed for the SGBS.

Response

The Steam Generator Blowdown System (SGBS) piping is designed to address flow accelerated corrosion (FAC), and a Subsection (f) will be added to 10.4.8.2.2 to discuss details of the design and operation to address FAC in the SGBS.

Impact on DCD

A subsection (f) is added DCD Tier 2, Subsection 10.4.8.2.2 to address FAC considerations for the SGBS as indicated 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 Environment 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.

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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.

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

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f. SG blowdown piping

The SGBS piping is designed to address flow accelerated corrosion (FAC) as follows:

1) SGBS piping from the SGs to the blowdown flash tank is made of chrome-moly materials, which is resistant to flow accelerated corrosion (FAC).

2) The piping in the up and down stream lines of the SG blowdown filters and demineralizers is made of stainless steel. These segments of the piping are not applied for preventing FAC, but for corrosion.

3) The wet lay-up piping is made of stainless steel for consideration of chemical corrosion. The piping is not used during normal operation.

4) Other SGBS piping is made of carbon steel but not susceptible to FAC, since one of operating conditions in the piping is less than the ranges for FAC specified in ASME B31.1 (Reference 5).