Enclosure 1

UAP-HF-11242
Docket No. 52-021

Markup DCD for Section 9.2

July 2011

Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 21 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards(3)	Seismic Category(4)	Notes
9. Containment Spray System (CSS)							
Spray nozzles	2	PCCV	B	YES	2	I	
Containment spray system piping and valves	2	PCCV R/B	B	YES	2	I	
10. Post Accident pH Control System(PHS)							
NaTB baskets	2	PCCV	B	YES	5	I	
NaTB basket containers	2	PCCV	B	YES	2	I	
NaTB solution transfer piping	2	PCCV	B	YES	2	I	
11. Component Cooling Water System (CCWS)							
Component cooling water pumps	3	R/B	C	YES	3	I	
Component cooling water surge tanks	3	R/B	C	YES	3	I	
Component cooling water heat exchangers	3	R/B	C	YES	3	I	
Component cooling water supply/ return headers A, B ,A1 and A2 piping and valves excluding the following; Component cooling water system containment isolation valves and piping between these valves(1) Component cooling water supply/ return header A2 piping, in between but excluding the valves NCS-~~VLV-033~~AOV-058A and NCS-VLV-034A(2)	3	R/B	C	YES	3	I	1. Component cooling water system containment isolation valves and piping between these valves are Equipment Class 2, Quality Group B, Seismic Category I. 2. Valves NCS-~~VLV-033~~AOV-058A and NCS-VLV-034A are Equipment Class 3, Quality Group C.

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Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 22 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards(3)	Seismic Category(4)	Notes
Component cooling water supply/ return headers C, D, C1 and C2 piping and valves excluding the following; Component cooling water system containment isolation valves and piping between these valves(3) Component cooling water supply/ return header C2 piping, in between but excluding the valves NCS-~~VLV-033~~AOV-058B and NCS-VLV-034B(4)	3	R/B	C	YES	3	I	3. Component cooling water system containment isolation valves and piping between these valves are Equipment Class 2, Quality Group B, Seismic Category I. 4. Valves NCS-~~VLV-033~~AOV-058B and NCS-VLV-034B are Equipment Class 3, Quality Group C.
Component cooling water supply/ return header A2 piping and valves between and excluding the valves NCS-~~VLV-033~~AOV-058A and NCS-VLV-034A (excluding the valves), excluding the following; Component cooling water system containment isolation valves and piping between these valves(5) Component cooling water system piping and valves between these valves NCS-~~AOV~~VLV-661A and NCS-VLV-~~671~~669A (~~including~~excluding the valves)~~(6)~~ Component cooling water system piping and valves between these valves NCS-~~AOV~~VLV-601 and NCS-VLV-~~653~~651 (~~including~~excluding the valves)~~(7)~~	4	R/B	D	N/A	4	II	5. Component cooling water system containment isolation valves and piping between these valves are Equipment Class 2, Quality Group B, Seismic Category I. 6. ~~Valves NCS-AOV-661A and NCS-VLV-671A are Equipment Class 3, Seismic Category I.~~ 7. ~~Valves NCS-AOV-601A and NCS-VLV-653 are Equipment Class 3, Quality Group 3, Seismic Category I.~~

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Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 23 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards[3]	Seismic Category[4]	Notes
Component cooling water supply/ return header C2 piping and valves between and excluding the valves NCS-~~VLV-033~~AOV-058B and NCS-VLV-034B (excluding the valves), excluding the following; Component cooling water system containment isolation valves and piping between these valves[8] Component cooling water system piping and valves between these valves NCS-~~AOV~~VLV-661B and NCS-VLV-~~671~~669B (~~including~~excluding the valves)~~[9]~~	4	R/B	D	N/A	4	II	8. Component cooling water system containment isolation valves and piping between these valves are Equipment Class 2, Quality Group B, Seismic Category I. 9. ~~Valves NCS-AOV-661B and NCS-VLV-671B are Equipment Class 3, Seismic Category I.~~
Component cooling water system piping and valves related to the excess letdown heat exchanger inside containment between and including the valves NCS-MOV-511,517, SRV-513	2	PCCV, R/B	B	YES	2	I	
Component cooling water system piping and valves related to the letdown heat exchanger inside containment between and including the valves NCS-MOV-531,537, SRV-533	2	PCCV R/B	B	YES	2	I	
Component cooling water system piping and valves between and including the containment isolation valves NCS-MOV-402A,436A,438A~~,445A,447A,448A~~ and NCS-VLV-403A,437A	2	PCCV R/B	B	YES	2	I	
Component cooling water piping and valves between and including the containment isolation valves NCS-MOV-402B,436B,438B~~,445B,447B,448B~~ and NCS-VLV-403B,437B	2	PCCV R/B	B	YES	2	I	

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Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 24 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards(3)	Seismic Category(4)	Notes
Component cooling water system piping and valves related to components installed in auxiliary building from and excluding ~~isolation~~stop valve NCS-~~AOV-602~~-VLV-601 up to and excluding stop valve NCS-VLV-651	4	A/B R/B	D	N/A	4	NS	
Component cooling water system piping and valves related to components installed in turbine building from and excluding ~~isolation~~stop valves NCS-~~AOV-662~~VLV-661A,B up to and excluding stop valves NCS-VLV-669A,B	4	T/B R/B	D	N/A	4	NS	
Component cooling water system piping and valves related to reactor coolant pumps between the containment isolation valves NCS-MOV-436A,447A (excluding) and NCS-VLV-403A,437A (excluding) and the valves NCS-SRV-406A,B,435A (including)	3	PCCV	C	YES	3	I	
Component cooling water system piping and valves related to reactor coolant pumps between the containment isolation valves NCS-MOV-436B,447B (excluding) and NCS-VLV-403B,437B (excluding) and the valves NCS-SRV-406C,D,435B (including)	3	PCCV	C	YES	3	I	
~~Component cooling water system piping and valves between and including the valves NCS-AOV-601 and 602~~	~~3~~	~~R/B~~	~~C~~	~~YES~~	~~3~~	~~I~~	

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Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 25 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards(3)	Seismic Category(4)	Notes
~~Component cooling water system piping and valves between and including the valves NCS-VLV-651 and 653~~	~~3~~	~~R/B~~	~~C~~	~~YES~~	~~3~~	~~I~~	
~~Component cooling water system piping and valves between and including the valves NCS-AOV-661A,B and 662A,B~~	~~3~~	~~R/B~~	~~C~~	~~YES~~	~~3~~	~~I~~	
~~Component cooling water system piping and valves between and including the valves NCS-VLV-660A,B and 671A,B~~	~~3~~	~~R/B~~	~~C~~	~~YES~~	~~3~~	~~I~~	
Component cooling water system Piping from component cooling water surge tank to and including the valve(NCS-SRV-003A,NCS-RCV-056A,NCS-PCV-012,NCS-VLV-045A,NCS-VLV-047A)	3	R/B	C	YES	3	I	
Component cooling water system Piping from component cooling water surge tank to and including the valve(NCS-SRV-003B,NCS-RCV-056B,NCS-PCV-022,NCS-VLV-045B,NCS-VLV-047B)	3	R/B	C	YES	3	I	
Component cooling water surge tank surge line piping	3	R/B	C	YES	3	I	
Makeup line piping and valves from and including the valves NCS-VLV-051A,B and 054A,B up to and excluding the valves NCS-LCV-010,020	4	R/B	D	N/A	4	II	
Makeup line piping and valves from and including the valves NCS-VLV-061A,B up to and excluding the valves NCS-VLV-062A,B	4	R/B	D	N/A	4	II	

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Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 26 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards(3)	Seismic Category(4)	Notes
Makeup line piping and valves from and including the valves NCS-VLV-065A,B up to and including the valves NCS-LCV-010,020 and NCS-VLV-062A,B	3	R/B	C	YES	3	I	
Nitrogen gas supply line piping and valves from and including the valves NCS-VLV-041A,B up to and excluding the valves NCS-PCV-012,022 and NCS-VLV-045A,B	10	R/B	N/A	N/A	5	NS	
Chemical addition line piping and valves up to and excluding the valves NCS-VLV-047A,B	10	R/B	N/A	N/A	5	NS	
Component cooling water system piping from alternative component cooling water supply/ return headers A1 to and including the valve(NCS-MOV-321A, 323A, 325A, 326A)	3	R/B	C	YES	3	I	
Component cooling water system piping from alternative component cooling water supply/ return headers C1 to and including the valve (NCS-MOV-241, 242, 321B, 323B, 325B, 326B)	3	R/B	C	YES	3	I	
12. Spent Fuel Pit Cooling and Purification System (SFPCS)							
Spent fuel pit pumps	3	R/B	C	YES	3	I	
Spent fuel pit heat exchangers	3	R/B	C	YES	3	I	
Spent fuel pit filters	8	A/B	D	N/A	4	NS	
Spent fuel pit strainers	8	A/B	D	N/A	4	NS	
Spent fuel pit demineralizers	8	A/B	D	N/A	4	NS	

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Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 53 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards(3)	Seismic Category(4)	Notes
Essential chilled water chemical feed tank supply and return line piping and between and excluding the valves VWS-VLV0271A,B,C,D and VWS-VLV-274A,B,C,D	5	PS/B	N/A	N/A	4	II	
Piping from essential chilled water compression tank to and including the valves VWS-SRV-253A,B,C,D and VWS-VLV-254A,B,C,D	3	PS/B	C	YES	3	I	
46. <u>Non-Essential Chilled Water System</u>							
Non-essential chiller units Evaporator side Condenser side	 9 9	 A/B A/B	 N/A N/A	 N/A N/A	 5 5	 NS NS	
Non-essential chilled water pumps	9	A/B	N/A	N/A	5	NS	
Non-essential chilled water compression tanks	9	A/B	N/A	N/A	5	NS	
Non-essential chilled water system cooling towers	9	A/B	N/A	N/A	5	NS	
Non-essential chilled water system condenser water pumps	9	A/B	N/A	N/A	5	NS	
Non-essential chilled water chemical feed tank	10	A/B	N/A	N/A	5	NS	
Piping and valves (except portion of the containment penetration)	9	PCCV R/B A/B PS/B T/B	N/A	N/A	5	NS	~~Piping and valves within areas containing safety-related equipment are designed as seismic category II.~~

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Table 3.2-2 Classification of Mechanical and Fluid Systems, Components, and Equipment (Sheet 54 of 56)

System and Components	Equipment Class	Location	Quality Group	10 CFR 50 Appendix B (Reference 3.2-8)	Codes and Standards(3)	Seismic Category(4)	Notes
Piping and valves within areas containing safety-related equipment (except portion of the containment penetration)	5	PCCV R/B A/B PS/B T/B	N/A	N/A	5	II	
(Deleted)							
Piping and valves between and including the containment isolation valves VWS-MOV-403 and 421, VWS-MOV-422, VLV-423 and 407	2	PCCV R/B	B	YES	2	I	
~~Valves VWS-MOV-424,425~~	~~3~~	~~R/B~~	~~C~~	~~YES~~	~~5~~	~~I~~	
Non-essential chilled water chemical feed tank supply and return line piping and valves between VWS-VLV-571 and VWS-VLV-574	10	A/B	N/A	N/A	5	NS	
47. Containment Hydrogen Control System							
Igniters	4	PCCV	D	N/A	5	II	
48. Radiation monitoring system							
Piping and valves between and including the containment isolation valves	2	PCCV R/B	B	YES	2	I	
49. Condensate Storage and Transfer System							
Condensate storage tank	8	O/B	D	N/A	4	NS	
The components downstream condensate storage tank	8	O/B T/B	D	N/A	4	NS	
50. Turbine Component Cooling Water System							

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 58 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
CSS-VLV-005C	Containment spray header containment isolation	Check	Maintain Close Transfer Open Transfer Close	Active Containment Isolation	AC	Check Exercise /Refueling Outage	
CSS-VLV-005D	Containment spray header containment isolation	Check	Maintain Close Transfer Open Transfer Close	Active Containment Isolation	AC	Check Exercise /Refueling Outage	
NCS-MOV-007A	Train return header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	7
NCS-MOV-007B	Train return header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	7

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 59 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-MOV-007C	Train return header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	7
NCS-MOV-007D	Train return header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	7
NCS-MOV-020A	Train supply header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	7

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 60 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes	
NCS-MOV-020B	Train supply header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold-Shutdown~~Refueling Outage Operability Test	7	DCD_09.02.02-49 DCD_09.02.02-49
NCS-MOV-020C	Train supply header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold-Shutdown~~Refueling Outage Operability Test	7	DCD_09.02.02-49 DCD_09.02.02-49
NCS-MOV-020D	Train supply header separation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Train separation portion Isolation Leak Test Exercise Full Stroke/ ~~Cold-Shutdown~~Refueling Outage Operability Test	7	DCD_09.02.02-49 DCD_09.02.02-49

Table 3.9-14 Valve Inservice Test Requirements (Sheet 63 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-MOV-531	Letdown heat exchanger component cooling water supply containment isolation	Remote MO Gate	Maintain Close Transfer Close	Active Containment Isolation Safety Seat Leakage Remote Position	A	Remote Position Indication, Exercise/2 Years Containment Isolation Leak Test Exercise Full Stroke/ Cold Shutdown Operability Test	4 5
NCS-MOV-537	Letdown heat exchanger component cooling water return containment isolation	Remote MO Gate	Maintain Close Transfer Close	Active Containment Isolation Safety Seat Leakage Remote Position	A	Remote Position Indication, Exercise/2 Years Containment Isolation Leak Test Exercise Full Stroke/ Cold Shutdown Operability Test	4 5
NCS-VLV-231A	A, B-reactor coolant pump supply line check	Check	Maintain Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
NCS-VLV-231B	A, B-reactor coolant pump supply line check	Check	Maintain Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 68 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-MOV-401B	Reactor coolant pump component cooling water supply line isolation	Remote MO Gate	Maintain Close Transfer Close Transfer Open Maintain Open	Active Remote Position	B	Remote Position Indication, Exercise/2 Years Exercise Full Stroke/ Cold Shutdown Operability Test	7
~~NCS-MOV-445A~~	~~Reactor coolant pump component cooling water supply containment isolation valve bypass~~	~~Remote MO Globe~~	~~Maintain Close~~ ~~Transfer Close~~ ~~Transfer Open~~	~~Active~~ ~~Containment Isolation~~ ~~Safety Seat Leakage~~ ~~Remote Position~~	~~A~~	~~Remote Position Indication, Exercise/2 Years~~ ~~Containment Isolation Leak Test~~ ~~Exercise Full Stroke/ Cold Shutdown Operability Test~~	~~5~~ ~~7~~
~~NCS-MOV-445B~~	~~Reactor coolant pump component cooling water supply containment isolation valve bypass~~	~~Remote MO Globe~~	~~Maintain Close~~ ~~Transfer Close~~ ~~Transfer Open~~	~~Active~~ ~~Containment Isolation~~ ~~Safety Seat Leakage~~ ~~Remote Position~~	~~A~~	~~Remote Position Indication, Exercise/2 Years~~ ~~Containment Isolation Leak Test~~ ~~Exercise Full Stroke/ Cold Shutdown Operability Test~~	~~5~~ ~~7~~
NCS-MOV-446A	Reactor coolant pump motor component cooling water inlet side isolation	Remote MO Gate	Maintain Open Transfer Close	Active Remote Position	B	Remote Position Indication, Exercise/2 Years Exercise Full Stroke/ Cold Shutdown Operability Test	7

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 69 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-MOV-446B	Reactor coolant pump motor component cooling water inlet side isolation	Remote MO Gate	Maintain Open Transfer Close	Active Remote Position	B	Remote Position Indication, Exercise/2 Years Exercise Full Stroke/ Cold Shutdown Operability Test	7
NCS-MOV-446C	Reactor coolant pump motor component cooling water inlet side isolation	Remote MO Gate	Maintain Open Transfer Close	Active Remote Position	B	Remote Position Indication, Exercise/2 Years Exercise Full Stroke/ Cold Shutdown Operability Test	7
NCS-MOV-446D	Reactor coolant pump motor component cooling water inlet side isolation	Remote MO Gate	Maintain Open Transfer Close	Active Remote Position	B	Remote Position Indication, Exercise/2 Years Exercise Full Stroke/ Cold Shutdown Operability Test	7
~~NCS-MOV-447A~~	~~Reactor coolant pump component cooling water return containment isolation valve(In-CV) bypass~~	~~Remote MO Globe~~	~~Maintain Close~~ ~~Transfer Close~~ ~~Transfer Open~~	~~Active~~ ~~Containment Isolation~~ ~~Safety Seat Leakage~~ ~~Remote Position~~	~~A~~	~~Remote Position Indication, Exercise/2 Years~~ ~~Containment Isolation Leak Test~~ ~~Exercise Full Stroke/ Cold Shutdown~~ ~~Operability Test~~	~~5~~ ~~7~~

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 70 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes	
~~NCS-MOV-447B~~	~~Reactor coolant pump component cooling water return containment isolation valve(In-CV) bypass~~	~~Remote MO Globe~~	~~Maintain Close~~ ~~Transfer Close~~ ~~Transfer Open~~	~~Active~~ ~~Containment Isolation~~ ~~Safety Seat Leakage~~ ~~Remote Position~~	~~A~~	~~Remote Position Indication, Exercise/2 Years~~ ~~Containment Isolation Leak Test~~ ~~Exercise Full Stroke/ Cold Shutdown~~ ~~Operability Test~~	~~5~~ ~~7~~	DCD_09.02.02-58
~~NCS-MOV-448A~~	~~Reactor coolant pump component cooling water return containment isolation valve(In-CV) bypass~~	~~Remote MO Gate~~	~~Maintain Close~~ ~~Transfer Close~~ ~~Transfer Open~~	~~Active~~ ~~Containment Isolation~~ ~~Safety Seat Leakage~~ ~~Remote Position~~	~~A~~	~~Remote Position Indication, Exercise/2 Years~~ ~~Containment Isolation Leak Test~~ ~~Exercise Full Stroke/ Cold Shutdown~~ ~~Operability Test~~	~~5~~ ~~7~~	DCD_09.02.02-58
~~NCS-MOV-448B~~	~~Reactor coolant pump component cooling water Return Containment Isolation Valve(In-RB) Bypass Valve~~	~~Remote MO Gate~~	~~Maintain Close~~ ~~Transfer Close~~ ~~Transfer Open~~	~~Active~~ ~~Containment Isolation~~ ~~Safety Seat Leakage~~ ~~Remote Position~~	~~A~~	~~Remote Position Indication, Exercise/2 Years~~ ~~Containment Isolation Leak Test~~ ~~Exercise Full Stroke/ Cold Shutdown~~ ~~Operability Test~~	~~5~~ ~~7~~	DCD_09.02.02-58
NCS-SRV-003A	Component cooling water surge tank relief	Relief	Maintain Close Transfer Open Transfer Close	Active	BC	Class 2/3 Relief Valve Tests/10 Years and 20% in 4 Years		
NCS-SRV-003B	Component cooling water surge tank relief	Relief	Maintain Close Transfer Open Transfer Close	Active	BC	Class 2/3 Relief Valve Tests/10 Years and 20% in 4 Years		

Table 3.9-14 Valve Inservice Test Requirements (Sheet 71 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-VLV-016A	Component cooling water pump discharge check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
NCS-VLV-016B	Component cooling water pump discharge check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
NCS-VLV-016C	Component cooling water pump discharge check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
NCS-VLV-016D	Component cooling water Pump discharge check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
~~NCS-AOV-601~~	~~Auxiliary building component cooling water supply header isolation~~	~~Remote AO Butterfly~~	~~Maintain Close Transfer Close~~	~~Active to Failed Remote Position~~	~~B~~	~~Remote Position Indication, Exercise/2 Years Exercise Full Stroke/ Cold Shutdown Operability Test~~	~~6~~
~~NCS-AOV-602~~	~~Auxiliary building component cooling water supply header isolation~~	~~Remote AO Butterfly~~	~~Maintain Close Transfer Close~~	~~Active to Failed Remote Position~~	~~B~~	~~Remote Position Indication, Exercise/2 Years Exercise Full Stroke/ Cold Shutdown Operability Test~~	~~6~~

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 72 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes	
~~NCS-VLV-652~~	~~Auxiliary building component cooling water return header check~~	~~Check~~	~~Maintain Close Transfer Close~~	~~Active~~	~~BC~~	~~Check Exercise/ Refueling Outage~~	~~3~~	DCD_09.02.02-49
~~NCS-VLV-653~~	~~Auxiliary building component cooling water return header check~~	~~Check~~	~~Maintain Close Transfer Close~~	~~Active~~	~~BC~~	~~Check Exercise/ Refueling Outage~~	~~3~~	
NCS-AOV-~~661~~057A	~~Turbine building~~ ~~c~~Component cooling water A2 supply header isolation	Remote AO ~~Globe~~Butterfly	Maintain Close Transfer Close	Active to Failed Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	6	DCD_09.02.02-49 DCD_09.02.02-49
NCS-AOV-~~662~~058A	~~Turbine building~~ ~~c~~Component cooling water A2 supply header isolation	Remote AO ~~Globe~~Butterfly	Maintain Close Transfer Close	Active to Failed Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	6	DCD_09.02.02-49 DCD_09.02.02-49

Table 3.9-14 Valve Inservice Test Requirements (Sheet 73 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-VLV-~~670~~036A	~~Turbine building~~ ~~c~~Component cooling water A2 return~~supply~~ header check	Check	Maintain Close Transfer Close	Active Safety Seat Leakage	~~B~~AC	Non-safety portion Isolation Leak Test Check Exercise/ Refueling Outage	3
NCS-VLV-~~671~~037A	~~Turbine building~~ ~~c~~Component cooling water A2 return~~supply~~ header check	Check	Maintain Close Transfer Close	Active Safety Seat Leakage	~~B~~AC	Non-safety portion Isolation Leak Test Check Exercise/ Refueling Outage	3
NCS-AOV-~~661~~057B	~~Turbine building~~ ~~c~~Component cooling water C2 supply header isolation	Remote AO ~~Globe~~Butterfly	Maintain Close Transfer Close	Active to Failed Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	6
NCS-AOV-~~662~~058B	~~Turbine building~~ ~~c~~Component cooling water C2 supply header isolation	Remote AO ~~Globe~~Butterfly	Maintain Close Transfer Close	Active to Failed Remote Position Safety Seat Leakage	~~B~~A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ ~~Cold Shutdown~~Refueling Outage Operability Test	6

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 74 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-VLV-~~670~~036B	~~Turbine building~~ ~~c~~Component cooling water C2 return~~supply~~ header check	Check	Maintain Close Transfer Close	Active Safety Seat Leakage	~~B~~AC	Non-safety portion Isolation Leak Test Check Exercise/ Refueling Outage	3
NCS-VLV-~~671~~037B	~~Turbine building~~ ~~c~~Component cooling water C2 return~~supply~~ header check	Check	Maintain Close Transfer Close	Active Safety Seat Leakage	~~B~~AC	Non-safety portion Isolation Leak Test Check Exercise/ Refueling Outage	3
NCS-VLV-405A	Reactor coolant pump thermal barrier heat exchanger component cooling water supply check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
NCS-VLV-405B	Reactor coolant pump thermal barrier heat exchanger component cooling water supply check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
NCS-VLV-405C	Reactor coolant pump thermal barrier heat exchanger component cooling water supply check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 78 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-VLV-437B	Reactor coolant pump component cooling water return containment isolation check	Check	Maintain Close Transfer Close	Active Containment Isolation Safety Seat Leakage	AC	Containment Isolation Leak Test	5
NCS-MOV-321A	Charging pump fire water supply line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-321B	Charging pump fire water supply line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-322A	Charging pump alternative water supply line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 79 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-MOV-322B	Charging pump alternative water supply line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-323A	Charging pump non-essential chilled water supply line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-323B	Charging pump non-essential chilled water supply line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-324A	Charging pump alternative water return line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 80 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-MOV-324B	Charging pump alternative water return line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-325A	Charging pump fire water return line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-325B	Charging pump fire water return line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-326A	Charging pump non-essential chilled water return line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	

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Table 3.9-14 Valve Inservice Test Requirements (Sheet 81 of 118)

Valve Tag Number	Description	Valve/ Actuator Type	Safety-Related Missions	Safety Functions(2)	ASME IST Category	Inservice Testing Type and Frequency	IST Notes
NCS-MOV-326B	Charging pump non-essential chilled water return line isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-241	Containment fan cooler alternative cooling water supply isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
NCS-MOV-242	Containment fan cooler alternative cooling water supply isolation	Remote MO Gate	Maintain Close	Safety Seat Leakage	A	Remote Position Indication, Exercise/2 Years Non-safety portion Isolation Leak Test Exercise Full Stroke/ Refueling Outage Operability Test	
SFS-VLV-006A	Spent fuel pit pump discharge check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3
SFS-VLV-006B	Spent fuel pit pump discharge check	Check	Maintain Open Transfer Open Transfer Close	Active	BC	Check Exercise/ Refueling Outage	3

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Table 3D-2 US-APWR Environmental Qualification Equipment List (Sheet 40 of 61)

Item Num	EquipmentTag	Description	Location		Purpose	Operational Durantion	Environmental Conditions	Radiation Condition	Influence of Submergence for Total Integrated Dose	Qualification Process	Seismic Category	Comments
			Building	Zone	RT, ESF, PAM, Pressure Boundary (PB), Other(1)		Harsh or Mild	Harsh or Mild	Yes/No	E=Electrical M=Mechanical	I, II, Non	
60	NCS-MOV-402B	Motor Operated Valve	R/B	6	ESF	1yr	Mild	Harsh	No (1)	M	I	
61	NCS-MOV-446A	Motor Operated Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
62	NCS-MOV-446B	Motor Operated Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
63	NCS-MOV-446C	Motor Operated Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
64	NCS-MOV-446D	Motor Operated Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
~~65~~	~~NCS-MOV-445A~~	~~Motor Operated Valve~~	~~R/B~~	~~6~~	~~ESF~~	~~1yr~~	~~Mild~~	~~Harsh~~	~~No (1)~~	~~M~~	~~I~~	
~~66~~	~~NCS-MOV-445B~~	~~Motor Operated Valve~~	~~R/B~~	~~6~~	~~ESF~~	~~1yr~~	~~Mild~~	~~Harsh~~	~~No (1)~~	~~M~~	~~I~~	
~~67~~	~~NCS-MOV-447A~~	~~Motor Operated Valve~~	~~PCCV~~	~~1-5~~	~~ESF~~	~~1yr~~	~~Harsh~~	~~Harsh~~	~~No (1)~~	~~M~~	~~I~~	
~~68~~	~~NCS-MOV-447B~~	~~Motor Operated Valve~~	~~PCCV~~	~~1-5~~	~~ESF~~	~~1yr~~	~~Harsh~~	~~Harsh~~	~~No (1)~~	~~M~~	~~I~~	
~~69~~	~~NCS-MOV-448A~~	~~Motor Operated Valve~~	~~R/B~~	~~6~~	~~ESF~~	~~1yr~~	~~Mild~~	~~Harsh~~	~~No (1)~~	~~M~~	~~I~~	
~~70~~	~~NCS-MOV-448B~~	~~Motor Operated Valve~~	~~R/B~~	~~6~~	~~ESF~~	~~1yr~~	~~Mild~~	~~Harsh~~	~~No (1)~~	~~M~~	~~I~~	
71	NCS-FCV-130A	Flow Control Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
72	NCS-FCV-130B	Flow Control Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
73	NCS-MOV-438B	Motor Operated Valve	R/B	6	ESF	5min	Mild	Harsh	No (1)	M	I	
74	NCS-FCV-132A	Flow Control Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
75	NCS-FCV-132B	Flow Control Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
76	NCS-SRV-513	Safety Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
77	NCS-SRV-533	Safety Valve	PCCV	1-5	ESF	1yr	Harsh	Harsh	No (1)	M	I	
78	NCS-AOV-601	Air Operated Valve	R/B	13-3	ESF	1yr	Mild	Mild	No (1)	M	I	
79	NCS-AOV-602	Air Operated Valve	R/B	13-3	ESF	1yr	Mild	Mild	No (1)	M	I	
80	NCS-AOV-661A	Air Operated Valve	R/B	14	ESF	1yr	Mild	Mild	No (1)	M	I	
81	NCS-AOV-662A	Air Operated Valve	R/B	14	ESF	1yr	Mild	Mild	No (1)	M	I	
82	NCS-AOV-661B	Air Operated Valve	R/B	14	ESF	1yr	Mild	Mild	No (1)	M	I	
83	NCS-AOV-662B	Air Operated Valve	R/B	14	ESF	1yr	Mild	Mild	No (1)	M	I	
84	NCS-PCV-012	Pressure Control Valve	R/B	8	PB	1yr	Mild	Harsh	No (1)	M	I	

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Table 3D-2 US-APWR Environmental Qualification Equipment List (Sheet 41 of 61)

Item Num	EquipmentTag	Description	Location		Purpose	Operational Durantion	Environmental Conditions	Radiation Condition	Influence of Submergence for Total Integrated Dose	Qualification Process	Seismic Category	Comments
			Building	Zone	RT, ESF, PAM, Pressure Boundary (PB), Other(1)		Harsh or Mild	Harsh or Mild	Yes/No	E=Electrical M=Mechanical	I, II, Non	
85	NCS-PCV-022	Pressure Control Valve	R/B	8	PB	1yr	Mild	Harsh	No (1)	M	I	
86	NCS-MOV-321A	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
87	NCS-MOV-321B	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
88	NCS-MOV-322A	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
89	NCS-MOV-322B	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
90	NCS-MOV-323A	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
91	NCS-MOV-323B	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
92	NCS-MOV-324A	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
93	NCS-MOV-324B	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
94	NCS-MOV-325A	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
95	NCS-MOV-325B	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
96	NCS-MOV-326A	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
97	NCS-MOV-326B	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
98	NCS-MOV-241	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
99	NCS-MOV-242	Motor Operated Valve	R/B	13-3	PB	1yr	Mild	Harsh	No (1)	M	I	
Equipment (Spent Fuel Pit Cooling and Purification System)												
1	SFP-MPP-001A	A-Spent Fuel Pit Pump	R/B	6	ESF	1yr	Mild	Harsh	No (1)	M	I	
2	SFP-MPP-001B	B-Spent Fuel Pit Pump	R/B	6	ESF	1yr	Mild	Harsh	No (1)	M	I	
3	SFP-MHX-001A	A-Spent Fuel Pit Heat Exchanger	R/B	6	ESF	1yr	Mild	Harsh	No (1)	M	I	
4	SFP-MHX-001B	B-Spent Fuel Pit Heat Exchanger	R/B	6	ESF	1yr	Mild	Harsh	No (1)	M	I	
Equipment (Essential Service Water System)												
1	EWS-MPP-001A	A-Essential Service Water Pump	UHSRS	-	ESF	1yr	Mild	-	-	M	I	
2	EWS-MPP-001B	B-Essential Service Water Pump	UHSRS	-	ESF	1yr	Mild	-	-	M	I	
3	EWS-MPP-001C	C-Essential Service Water Pump	UHSRS	-	ESF	1yr	Mild	-	-	M	I	
4	EWS-MPP-001D	D-Essential Service Water Pump	UHSRS	-	ESF	1yr	Mild	-	-	M	I	

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Systems that are including remote manual valve for containment isolation are followings:

- Safety injection system.
- Containment spray system
- Residual heat removal system
- Emergency feedwater system
- Main steam system
- Seal water injection
- Component cooling water system DCD_09.02.02-58
- Post-accident sampling return line
- Fire protection water supply system

The condition in which containment isolation is needed in safety injection system, containment spray system and residual heat removal system is when leak occurs in these systems. These systems are located in safeguard component area. Leak detection system is installed in each system. Level instruments are installed in each pump compartment sump. In addition, if leak is occurred, operators can notice by pump suction/discharge pressure and pump flow rate. As for main steam system, NMS-MOV-507A, B, C, D, NMS-MOV-701A, B, C, D and EFS-MOV-101A, B, C, D are remote manual isolation valves. The condition in which containment isolation is needed is to prevent fission product from releasing such as in SGTR. In each main steam line, radiation monitors is installed. So operators can notice that these valves should be closed. As for seal water injection line, CVS-MOV-178 A, B, C, D are remote manual isolation valves. The condition in which containment isolation is needed is the case that seal injection flow is lost. In each injection line, flow rate instrument is installed. So operators can notice that these valves should be closed. The CCW supply and return line to the RCPs, NCS-MOV-402A/B, 436A/B, 438A/B, are remote manual isolation valves. Containment isolation would be considered if there were significant leakage from the CCWS, which could jeopardize the surge tank volume. Leakage can be recognized by operators as discussed in Subsection 9.2.2.3.2. As for post-accident sampling return line and fire protection water supply system, PSS-MOV-071 and FSS-MOV-004 are remote manual isolation valves. The reason why these valves does not receive containment isolation signal is that these are closed under administrative control, such as locked closed. Therefore, these valves are not needed to be closed if leak occur. DCD_09.02.02-58

Containment purge isolation valves (Containment Purge System) may be supplied with resilient seals and the subject containment penetrations and containment isolation valves will receive preoperational and periodic Type C leak rate testing in accordance with 10 CFR 50, Appendix J. The soft seated containment isolation butterfly valves in the containment purge system which may require resilient seal replacement following the automatic isolation valve inside and one automatic isolation valve outside the containment.

Containment isolation provisions for lines in ESF or ESF-related systems normally consist of two isolation valves in series. A single isolation valve is acceptable if the system reliability can be shown to be greater, the system is closed outside the containment, and a single active failure can be accommodated with only one isolation valve in the line. Table 6.2.4-2 lists GDC 55 systems with single valve isolation and justification, in accordance with the guidance in NUREG-0800, SRP 6.2.4 (Ref. 6.2-27).

6.2.4.3.2 Evaluation of Conformance to General Design Criterion 56 of 10 CFR 50, Appendix A

Each line that connects directly to the containment atmosphere and penetrates the primary reactor containment is provided with containment isolation valves as follows, unless it can be demonstrated that the containment isolation provisions for a specific class of lines, such as instrument lines, are acceptable on some other defined basis. Isolation valves outside containment are located as close to containment as practical for those systems designed in conformance with GDC 56 or some other defined basis set forth in RG 1.141. The following systems penetrating the containment meet GDC 56 criteria:

- Fire protection water supply system (FSS) injection line to reactor cavity and station service air system (SSAS) service air line, using one automatic isolation valve inside containment and one locked closed isolation valve outside containment.

- CSS containment spray line, HVAC containment supply and exhaust line, plant radiation monitoring system (RMS) containment air sampling line, WMS containment sump pump discharge line, refueling water recirculation pump suction and discharge line, instrument air system (IAS) instrument air line, non-essential chilled water system containment fan cooler lines, and FSS water supply line to containment air purification unit, using one automatic isolation valve inside and one automatic isolation valve outside the containment.

- Leakage rate testing narrow range pressure detection line, using one locked closed isolation valve inside with a pipe cap and one locked closed isolation valve outside the containment.

- Component cooling water system (CCWS) supply line to the RCPs, using two ~~automatic~~ containment isolation valves of which the outboard valve is capable of remote manual operation. DCD_09.02.02-58

- CCWS return line from RCPs, using two ~~automatic~~ containment isolation valves, one inside and one outside of the containment, each capable of remote manual operation. DCD_09.02.02-58

Containment isolation provisions for lines in ESF or ESF-related systems normally consist of two isolation valves in series. A single isolation valve is acceptable if the system

Table 6.2.4-3 List of Containment Penetrations and System Isolation Positions (Sheet 6 of 15)

Pen NO.	GDC	System Name	Fluid	Line Size (in.)	ESF or Support System	Valve Arragmt Figure 6.2.4-1	Valve Number	Location of Valve	Type Tests	Type C Test	Length of Pipe (Note 1)	Valve: Type	Valve: Operator	Actuation Mode: Primary	Actuation Mode: Secondary	Valve Position: Normal	Valve Position: Shutdown	Valve Position: Post-Accident	Power Failure	Actuation Signal	Valve Closure Time	Power Source (Note 2)	Remark	
P417	56	CSS	Silicone Oil	3/4	Yes	Sht. 17	-	-	A	N	-	-	-	-	-	-	-	-	-	-	-	-	Note 8	
P405L	56	CSS	Silicone Oil	3/4	No	Sht. 17	-	-	A	N	-	-	-	-	-	-	-	-	-	-	-	-	Note 8	
P234	56	CCWS	Water with corrosion inhibitor	8	Yes	Sht. 19	NCS-VLV-403A	In	C	Y	-	Check	Self	Auto	None	-	-	-	NA	NA	NA	NA		
				8			NCS-MOV-402A	Out			10.0 ft	Gate	Motor	~~Auto~~RM	~~RM~~Manual	O	O	~~C~~O	FAI	~~P~~NA	40	1E		DCD_09.02.02-58
				~~4~~			~~NCS-MOV-445A~~	~~Out~~				~~Globe~~	~~Motor~~	~~Manual~~	~~None~~	~~C~~	~~C~~	~~O~~	~~FAI~~	~~NA~~	~~20~~	~~1E~~		
				3/4			NCS-VLV-452A	In			-	Globe	Manual	Manual	None	C	C	C	NA	NA	NA	NA		
P249	56	CCWS	Water with corrosion inhibitor	8	Yes	Sht. 19	NCS-VLV-403B	In	C	Y	-	Check	Self	Auto	None	-	-	-	NA	NA	NA	NA		
				8			NCS-MOV-402B	Out			10.0 ft	Gate	Motor	~~Auto~~RM	~~RM~~Manual	O	O	~~C~~O	FAI	~~P~~NA	40	1E		DCD_09.02.02-58
				~~4~~			~~NCS-MOV-445B~~	~~Out~~				~~Globe~~	~~Motor~~	~~Manual~~	~~None~~	~~C~~	~~C~~	~~O~~	~~FAI~~	~~NAI~~	~~20~~	~~1E~~		
				3/4			NCS-VLV-452B	In			-	Globe	Manual	Manual	None	C	C	C	NA	NA	NA	NA		
P232	56	CCWS	Water with corrosion inhibitor	8	Yes	Sht. 20	NCS-MOV-436A	In	C	Y	-	Gate	Motor	~~Auto~~RM	~~RM~~None	O	O	~~C~~O	FAI	~~P~~NA	40	1E		DCD_09.02.02-58
				8			NCS-MOV-438A	Out			10.0 ft	Gate	Motor	~~Auto~~RM	~~RM~~Manual	O	O	~~C~~O	FAI	~~P~~NA	40	1E		
				~~4~~			~~NCS-MOV-447A~~	~~In~~				~~Globe~~	~~Motor~~	~~Manual~~	~~None~~	~~C~~	~~C~~	~~O~~	~~FAI~~	~~NA~~	~~20~~	~~1E~~		
				~~4~~			~~NCS-MOV-448A~~	~~Out~~				~~Globe~~	~~Motor~~	~~Manual~~	~~None~~	~~C~~	~~C~~	~~O~~	~~FAI~~	~~NA~~	~~20~~	~~1E~~		
				3/4			NCS-VLV-437A	In			-	Check	Self	Auto	None	-	-	-	NA	NA	NA	NA		
P251	56	CCWS	Water with corrosion inhibitor	8	Yes	Sht. 20	NCS-MOV-436B	In	C	Y	-	Gate	Motor	~~Auto~~RM	~~RM~~None	O	O	~~C~~O	FAI	~~P~~NA	40	1E		DCD_09.02.02-58
				8			NCS-MOV-438B	Out			10.0 ft	Gate	Motor	~~Auto~~RM	~~RM~~Manual	O	O	~~C~~O	FAI	~~P~~NA	40	1E		
				~~4~~			~~NCS-MOV-447B~~	~~In~~			~~-~~	~~Globe~~	~~Motor~~	~~Manual~~	~~None~~	~~C~~	~~C~~	~~O~~	~~FAI~~	~~NA~~	~~20~~	~~1E~~		
				~~4~~			~~NCS-MOV-448B~~	~~Out~~			~~-~~	~~Globe~~	~~Motor~~	~~Manual~~	~~None~~	~~C~~	~~C~~	~~O~~	~~FAI~~	~~NA~~	~~20~~	~~1E~~		
				3/4			NCS-VLV-437B	In			-	Check	Self	Auto	None	-	-	-	NA	NA	NA	NA		
P233	57	CCWS	Water with corrosion inhibitor	4	No	Sht. 21	NCS-MOV-511	Out	A	N	9.0 ft	Gate	Motor	Auto	RM	O	O	C	FAI	T	20	1E	Note 5	
P235	57	CCWS		4	No	Sht. 21	NCS-MOV-517	Out	A	N	9.0 ft	Gate	Motor	Auto	RM	C	C	C	FAI	T	20	1E	Note 5	
P252	57	CCWS		8	No	Sht. 22	NCS-MOV-531	Out	A	N	9.0 ft	Gate	Motor	Auto	RM	O	O	C	FAI	T	40	1E	Note 5	
P250	57	CCWS		8	No	Sht. 22	NCS-MOV-537	Out	A	N	9.0 ft	Gate	Motor	Auto	RM	O	O	C	FAI	T	40	1E	Note 5	
P276R	56	WMS	Gas	3/4	No	Sht. 23	LMS-AOV-052	In	C	Y	-	Dia	Air	Auto	RM	O	O	C	FC	T	15	1E		
				3/4			LMS-AOV-053	Out			11.0 ft	Dia	Air	Auto	RM	C	C	C	FC	T	15	1E		
P284	56	WMS	Gas	2	No	Sht. 24	LMS-AOV-055	In	C	Y	-	Dia	Air	Auto	RM	O	O	C	FC	T	15	1E		
				2			LMS-AOV-056	Out			16.0 ft	Dia	Air	Auto	RM	O	O	C	FC	T	15	1E		
				2			LMS-AOV-060	Out			-	Dia	Air	Auto	RM	O	O	C	FC	T	15	1E		
P205	56	WMS	Borated Water	3	No	Sht. 25	LMS-LCV-010A	In	C	Y	-	Dia	Air	Auto	RM	C	C	C	FC	T	15	1E		
				3			LMS-LCV-010B	Out			9.0 ft	Dia	Air	Auto	RM	O	O	C	FC	T	15	1E		

The signal path for this interlock is from local flow transmitters to the RPS, and then to the SLS, which controls each isolation valve.

7.6.1.4 Accumulator Discharge Valve Open Interlock

Each of the four RCS loops is provided with a separate accumulator. Each ECCS accumulator discharge line connecting to the RCS cold leg is provided with a motor operated isolation valve. Normally the isolation valve is open; therefore, the accumulator system is normally available for its designed function.

The accumulator discharge valve can be closed manually. However, an interlock is provided to open this valve when the reactor coolant pressure is above the P-11 setpoint. The interlocks for these valves are shown in Figure 7.6-5. The safety-related interlocks preclude multiple valve misalignment due to spurious commands from operational VDUs. DCD_07.01-30

The ECCS actuation signal will automatically open the valve and make the accumulator system available, except when the valve is manually closed and manually put in the Lock condition. The Lock condition for the accumulator discharge valve is applied only when the associated accumulator is re-charged with gas or water. Recharging is a maintenance activity, which occurs only when the accumulator pressure or water level is lower than required. Under this condition, the accumulator itself is inoperable; therefore, automatically opening the accumulator discharge valve does not provide the accumulator design function. The accumulator discharge valve interlock is indicated on the BISI, and the accumulator bypass or inoperable condition is managed by the technical specifications in Subsection 3.5.1 of DCD Chapter 16. DCD_07.06-16

This interlock may be manually bypassed for test and maintenance to close the accumulator discharge valve by two deliberate operator actions. If this valve is closed and not selected to “Lock”, then the ECCS actuation signal will automatically open the valve and make the accumulator system available. The “Lock” function is described in the HSI/HFE Topical Report ~~MUAP-07007~~ (Reference 7.6-1) Subsection 4.5.3.a. DCD_07.01-30

The accumulator system can be bypassed for test and maintenance by manually closing its discharge valve and selecting it to “Lock”. In the “Lock” mode, the accumulator discharge valves will not automatically open, therefore the affected accumulator will be un-available for its designed ESF function. During this condition, the inoperable status of the accumulator is alarmed in the MCR and indicated continuously on the BISI system displays.

The signal path for this interlock is from the pressurizer pressure transmitters to the RPS, and then to the SLS, which controls these MOVs via motor control centers.

7.6.1.5 ~~CCW Supply and Return Header Tie Line Isolation Interlock~~Not Used DCD_09.02.02-48

~~The CCW system consists of two independent subsystems. Each subsystem consists of two 50% trains. One subsystem consists of trains A & B, and the other subsystem consists of trains C & D, for a total of four 50% trains. There are cross-connections between trains A and B, and between trains C and D. Each subsystem supplies a non-essential safety class loop and a non-safety loop. There are two series motor operated isolation valves for each supply and return tie line between separate trains. These~~

~~isolation valves ensure each mechanical safety train is isolated from any potential passive failure in the non-safety portion or another mechanical safety train of the CCWS.~~ DCD_07.01-30 DCD_09.02.02-48

~~The two series isolation valves in each CCW header are automatically closed during the following conditions:~~

- ~~ECCS actuation combined with LOOP~~
- ~~CS actuation~~
- ~~Low CCW surge tank water level~~

~~For NCS-MOV-007A, B and NCS-MOV-020A, B the piping diagrams for these valves are shown in Figure 9.2.2-1 (Sheet 1 of 9) in Chapter 9, and for NCS-MOV-007C, D and NCS-MOV-020C, D in Figure 9.2.2-1 (Sheet 2 of 9) of Chapter 9.~~

~~The interlocks for these valves are shown in Figure 7.6-6. These interlocks ensure the independence of each safety mechanical train of the CCWS thereby providing CCW coolant to ESF systems required for mitigating conditions of the event. The safety related interlocks preclude multiple valve misalignment due to spurious commands from operational VDUs.~~ DCD_07.01-30

~~These interlocks may be manually bypassed for reopening the valves to restore RCP seal and spent fuel pit heat exchanger cooling, if required. The bypass can be selected from the safety VDU. To select the bypass from the operational VDU, the Bypass Permissive for the respective train must be enabled.~~ DCD_07.01-30

~~Two series valves assigned to different trains ensures isolation even in the presence of a single failure.~~

~~The signal path for the ECCS and CS interlocks is from the ESFAS to the SLS that controls the isolation valves through motor control centers. The signal path for the surge tank interlock is from local level transmitters to the RPS to the SLS for control of these same valves.~~

7.6.1.6 RCP Thermal Barrier HX CCW Return Line Isolation Interlock

Each CCW subsystem supplies cooling water to the RCP thermal barrier heat exchanger. Two motor-operated valves and flow meters are located at the CCW outlet line of the RCP thermal barrier heat exchanger.

These valves close automatically upon a high flow rate signal at the outlet of this line in the event of in-leakage from the RCS through the thermal barrier heat exchanger, and prevent this in-leakage from further contaminating the CCWS.

The interlocks for these valves are shown in Figure 7.6-7. The safety related interlocks preclude multiple valve misalignment due to spurious commands from ~~O~~operational VDUs. DCD_07.01-30

These interlocks ensure isolation of in-leakage from the RCS through the thermal barrier heat exchanger.

DCD_09.02.02-48

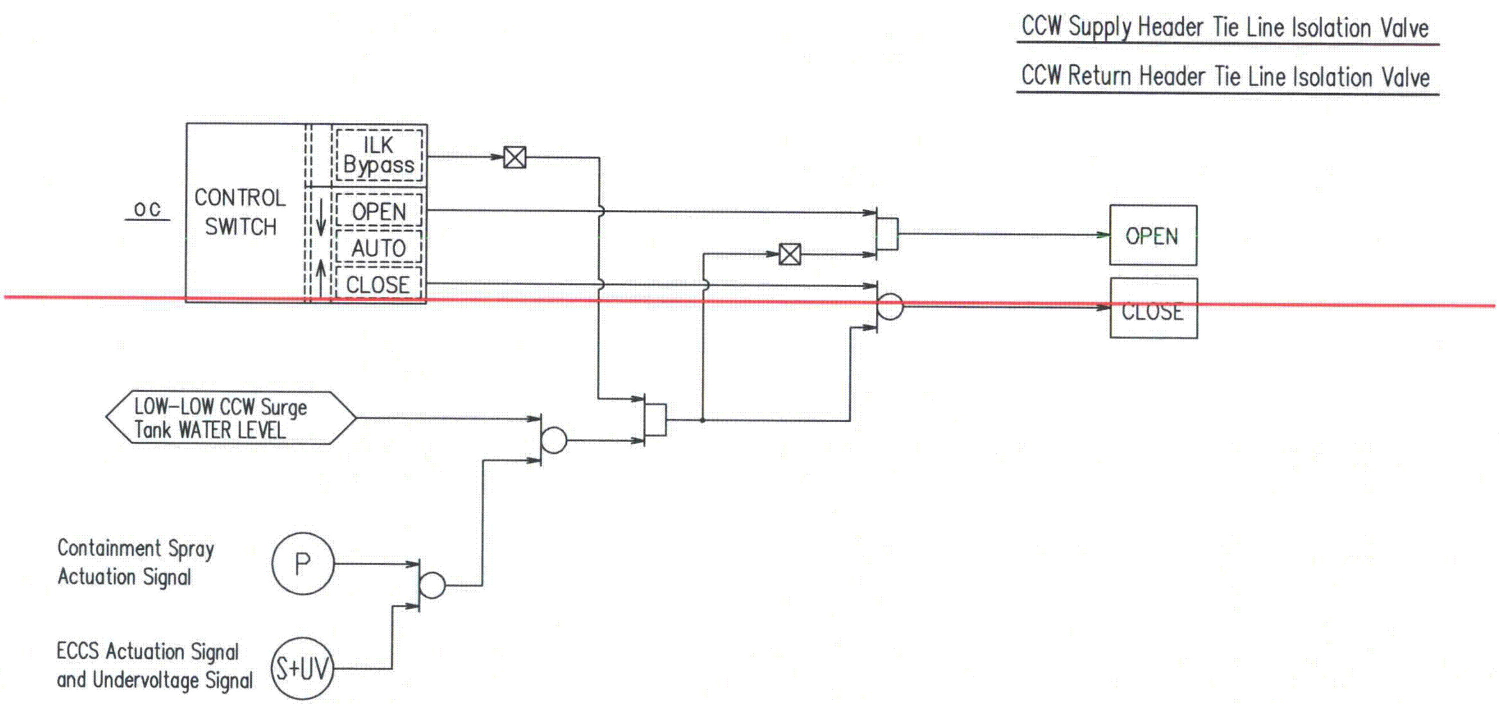

Figure 7.6-6 ~~Interlocks for CCW Header Tie Line Isolation Valves~~Not Used

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

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

9.1.3.2.1.3 Spent Fuel Pit Heat Exchangers

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

9.1.3.2.1.4 Spent Fuel Pit Filters

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

9.1.3.2.1.5 Spent Fuel Pit Demineralizers

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

9.1.3.2.1.6 Spent Fuel Pit Strainers

Spent fuel pit strainers are provided at the intake of the SFP to remove relatively large size solid materials for SFP and CS/RHR pump protection. The strainer is made of stainless steel.

9.1.3.2.1.7 Valves

Manual valves are Equipment Class 3 and Seismic Category I. Therefore they are capable of isolating the cooling and purification portions of the system under accident conditions. ~~Manual valves are used to isolate the cooling portion of the SFPCS from the purification portion.~~In the event that the manual valves leaked or were not closed following a piping failure in the purification portion (e.g., due to a seismic event or internally-generated missile), potential drain down of the SFP is prevented by the SFP DCD_09.01.03-7

9.2 Water systems

9.2.1 Essential Service Water System

The essential service water system (ESWS) provides cooling water to remove the heat from the component cooling water (CCW) heat exchangers (HXs) and the essential chiller units. The ESWS transfers the heat from these components to the ultimate heat sink (UHS). The UHS is described in Subsection 9.2.5.

DCD Subsection 1.8 identifies the significant interfaces between the US-APWR standard plant design and CDI for the SSCs outside the scope of the certified design. In Table 1.8-1, the ESWS is categorized as CDI interface type. DCD Section 9.2.1, on the other hand, mainly describes the ESWS functional requirements regardless of location although some structures (e.g. ESWPT and UHSRS) where some of the ESWS components are located are site specific. The requirements for the following SSCs installed in the UHSRS and those that are described in Table 3.2-4, DCD Chapter 7 main text, DCD Section 9.2.1 and Figure 9.2.1-1 are identified as functional requirements of standard plant design information. DCD_09.02.01-32

- ESW pump
- ESW pump discharge strainer
- ESW pump discharge motor operated valve
- ESW pump discharge check valve
- Vacuum breaker installed upstream of the check valve
- Instrumentations such as the pump discharge pressure sensor for confirmation of pump performance, the ESW header line pressure sensor and the pump discharge strainer differential pressure sensor
- Associated isolation valves and piping

9.2.1.1 Design Bases

The ESWS operates during all modes of plant operation and performs safety-related as well as non-safety related functions. The ESWS is designed to meet the relevant requirements of GDC 2, GDC 4, GDC 5, GDC 44, GDC 45, and GDC 46 (Ref. 9.2.11-1).

9.2.1.1.1 Safety Design Bases

The ESWS is designed to the requirements of the overall US-APWR plant design criteria. Specific safety design bases for the ESWS are as follows:

- The system is capable of transferring heat loads from safety-related SSCs (specifically, the CCWS heat exchangers and essential chiller units) to the UHS during normal operating and accident conditions, including LOCA, pursuant to the requirements of GDC 44. DCD_09.02.01-32

- The essential service water pumps (ESWPs) are designed to have sufficient available net positive suction head (NPSH) to assure that they can perform their safety function at the lowest probable water level of the UHS.

- The ESWS is composed of four redundant trains completely separated from each other, and whose components and piping are not shared with the other trains and other plant units. There are no interconnections among the trains so that the failure of one train will not affect another per GDC 5.

9.2.1.1.2 Power Generation Design Bases

The ESWS removes the heat loads from the CCWS through heat exchange with the CCWS heat exchangers and essential chiller units during normal plant operation, refueling, and normal shutdown.

9.2.1.1.3 Nonsafety-Related Design Bases

In the US-APWR standard plant design, the ESW pump~~The ESWS~~ does not provide cooling water to ~~any~~ non_safety-related components. As discussed in Section 9.2.2, non safety-related heat loads are supported by the safety-related CCW heat exchangers during ~~normal~~power operation, but such loads are shed during accident conditions. The essential chiller unit supplies cooling water for only safety-related loads and components. [[As conceptual design, the ESWS is ~~plant operations or design basis LOCA conditions. The ESWS may be~~ used as a backup source of water to the fire protection water supply system (FSS) in the event the normal supply is unavailable due to earthquake. The ESWS is normally isolated from the FSS. The ESWS is not required to supply water to the FSS during any design basis event other than the safe shutdown earthquake.]] DCD_09.02.01-32 DCD_09.02.01-43 DCD_09.02.01-32 DCD_09.02.01-32

Backwashing of the CCW heat exchangers on the essential service water side can be performed if the heat exchanger differential pressure of the essential water side is identified to be higher than the setpoint. Operator-initiated backwashing to prevent heat exchanger clogging is a safety-related function which is based on low ESW flow rate indication; the flow rate instrumentation is safety-related. Automatic actuation of backwashing by high strainer differential pressure is nonsafety function. DCD_09.02.01-33

9.2.1.2 System Description

9.2.1.2.1 General Description

Figure 9.2.1-1 shows the piping and instrumentation diagram of the ESWS. The ESWS draws water from the UHS [[basin]] and returns the effluent water to the UHS after passing through the CCW HXs and the essential chiller units. It follows that the ESWS cooling water does not contain radioactive materials nor release radioactive contaminants to the environment. The essential chiller units also do not include any radioactive fluid. The CCWS is the intermediate loop between the reactor auxiliaries and the ESWS. This arrangement minimizes direct leakage of radioactive fluid from the ESWS to the environment. Nevertheless, the CCW plate heat exchangers are constructed to prevent intermixing of the fluids from both sides so that any leakage will go to the outside of the heat exchanger except when a hole is developed in the plates—a rare event with titanium plates. Gasket failure directs leakage towards the outside of the CCW heat exchanger,

- The type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant based on the site conditions

[[As part of the water chemistry management program for the cooling towers and basins, an ESWS blowdown line is installed at the ESWP discharge piping. Part of the pumped ESW is blown down to remove a portion of the accumulated chemical salts and dissolved solids per site environmental chemistry requirements while the UHS makeup system is in operation. Details are given for blowdown and UHS basin water makeup in Section 9.2.5.]]

The COL Applicant is to verify system layout of the ESWS and UHS and is to develop operating procedures to assure that the ESWS and UHS are above saturation conditions for all operating modes.

The COL Applicant is to develop maintenance and test procedures to monitor debris buildup and flush out debris.

9.2.1.2.2 Component Description

Table 9.2.1-1 shows the design parameters of the major components in the system.

9.2.1.2.2.1 ESWPs

Four 50% capacity ESWPs, one per train, supply cooling water to remove heat from the recipient components, and then discharge the heated water to the UHS. Approximately 12,043 gpm ESWP flow is required for all modes of plant operation as indicated in the DCD Table 9.2.1-4. This provides approximately 7.7 percent margin to the design ESWP flow rate of 13,000 gpm. The margin allows for pump and heat transfer degradation by fouling, leakages, excessive pressure drop across system components or, fluctuations due to supplied electrical frequency.

The pumps are powered from the Class 1E ac power system. On loss of offsite power, the pumps are automatically powered from their respective emergency power source.

Each pump is designed to provide 13,000 gpm flow at the required total dynamic head. The required pressure drop across the ESWS components and piping (within standard plant design scope) is approximately 100 feet. The COL Applicant is to determine the required ESWP total dynamic head (TDH) by adding pressure drop across the site specific components and piping and maximum static lift to this pressure drop. The COL Applicant is to provide the site specific data for the ESWPs and assure that the selected ESWP will require less NPSH than the minimum available NPSH under all operating conditions. The COL Applicant is to assure that the sum of the shut-off head of the selected ESW pumps and the static head will not result in exceeding the ESWS design pressure. The UHS level is based on the 30-day emergency cooling at design basis accident heat loads, pump(s) operating at design flow rates with maximum cooling water temperature of 95° F. The potential for vortex formation is evaluated and the available NPSH computed using these parameters. The COL Applicant is responsible for the testing of ~~to evaluate~~ the potential for vortex formation based on the most limiting assumptions that apply (e.g., temperature, flow rate, operation of other pumps for vortex evaluation). DCD_09.02.01-38

The mode of cooling of the ESWP motors is air cooled. DCD Subsection 9.4.5 describes the design detail of the ESW pump area ventilation system requiring the heating, ventilating~~site specific~~ and air conditioning~~will be determined by the COL Applicant~~. DCD_09.02.01-32

9.2.1.2.2.2 Strainers

Two 100% capacity parallel strainers powered from Class 1E power source are located in each ESWP discharge line to prevent the CCW heat exchanger from clogging. Periodic inspection, monitoring, maintenance, performance and functional testing (including the heat transfer capability of the CCW heat exchangers consistent with GL 89-13) are performed to minimize the effect of potential CCW heat exchanger fouling. These activities will ensure that the actual fouling factor will not exceed the design fouling factor for at least the duration required for UHS capacity of 30 days or minimum of 36 days for a cooling pond. The strainers are the automatic self-cleaning type; each has a backwash line with an isolation valve of MOV-573 or MOV-574 as shown in Figure 9.2.1-1 with their valve ID marking. The COL Applicant is to determine the backwash line discharge location in accordance with the type of the UHS used. The backwash line valves are powered by a Class 1E DC source so that they will be operable during Loss of Offsite Power. The strainers have exhaust valves which are part of the strainers, the valve symbol is shown but a unique valve ID is not identified in Figure 9.2.1-1. Also, the strainers have manual isolation valves, VLV-506 and 507, on ESW inlet piping and have manual isolation valves, VLV-508 and 509, on ESW outlet piping respectively as shown in Figure 9.2.1-1 with their valve ID marking. An automatic vent valve is also installed to sweep out air introduced into the piping system by the vacuum breakers that are installed to prevent water hammer. Inside the strainer there is a cylilndrical screen with a rotating brush; the brush sweeps the inner surface of the cylindrical screen when the strainer receives start signal. The strainers including their associated components such as exhaust valve or rotating brush motor are powered from class 1E source. DCD_09.02.01-52

Strainers operating modes are Non-Backwash Operating, Backwash Operating or Out-of-Service. The strainer is available when in either Non-backwash Operating or Backwash Operating modes. The details of each operating mode is as follows:

Non-Backwash Operating:

- The associated inlet manual isolation valve of VLV-506 or VLV-507 is opened.
- The associated outlet manual isolation valve of VLV-508 or VLV-509 is opened.
- The full flow from ESW pump flows to CCW heat exchanger and essential chiller unit through the strainer.
- The exhaust valve is closed.
- The inner brush is not rotated by the drive unit.
- The associated backwash isolation valve of MOV-573 or MOV-574 is closed.

Backwash Operating:

- The associated inlet manual isolation valve of VLV-506 or VLV-507 is opened. DCD_09.02.01-52
- The associated outlet manual isolation valve of VLV-508 or VLV-509 is opened.
- The partial flow below 500 gpm is discharged through backwashing line.
- The main flow over 11,543 gpm flows to CCW heat exchanger and essential chiller unit.
- The exhaust valve is opened.
- The inner brush is rotated by the drive unit. Debris trapped on the screen is dislodged by the brush and flushed through the exhaust valve by the differential pressure between the strainer internal pressure (provided by the ESW pump head) and discharge pressure.
- The associated backwash isolation valve of MOV-573 or MOV-574 is opened.

Out-of-Service:

- The associated inlet manual isolation valve of VLV-506 or VLV-507 is closed.
- The associated outlet manual isolation valve of VLV-508 or VLV-509 is closed.
- The exhaust valve is closed.
- The inner brush is not rotated by drive unit.
- The associated backwash isolation valve of MOV-573 or MOV-574 is closed.

The initiation and termination of the Backwash Operating is performed as follows:

Nonsafety-related Backwash Operating initiation and termination during starup, power operation, refueling and cooldown by CS/RHRS

- The differential pressure of the strainer is monitored; the strainer differential pressure is not safety-related.
- The predetermined high differential pressure signal provides a start signal for Backwash Operating to Non-backwash Operating strainer when ECCS actuation or LOOP signal is not provided and an alarm is sent locally and to the MCR. The high differential pressure setpoint is less than the maximum allowable differential pressure associated with strainer clogging. Thus, the automatic strainers are not expected to fail due to clogging since backwashing is performed at the lower setpoint.
- Upon the receipt of a start signal, the inner brush startes to rotate by the drive unit.
- Also, upon the receipt of a start signal, the exhaust valve and associated strainer backwash isolation valve, MOV-573 or MOV-574 will be opened simultaneously when ECCS actuation or LOOP signal is not provided.

- When the differential pressure of the strainer is below the setpoint, the inner brush stops rotating and the exhaust valve and associated strainer backwash isolation valve will be closed simultaneously. Also, the alarms are stopped. DCD_09.02.01-52

Safety-related Backwash Operating initiation and termination during accident or abnormal condition with ECCS actuation signal or LOOP signal.

- Upon the receipt of an ECCS actuation or LOOP signal from the PSMS, Backwash Operating strainers will be terminated and their associated backwash isolation valves, MOV-573 or MOV-574 will maintain open position to establish discharge path for debris removal. For the Non-backwash Operating strainer, the associated strainer backwash isolation valve will open automatically as an active safety function to establish discharge path for debris removal upon the receipt of the ECCS actuation or LOOP signal.
- During abnormal conditions, such as during an accident or LOOP, the nonsafety-related differential pressure indications and alarms are not credited. Therefore, the operator performs the active safety function by remotely controlling strainer backwashing, if necessary, based on flow rate indication.
- The ESW flow rate to the CCW heat exchanger indication is safety-related and available in the MCR. This indication, EWS-FIA-034-S, 035-S, 036-S, 037-S which is shown in Figure 9.2.1-1, aids the operator in identifying the need for strainer backwashing. There is also a low flow rate alarm to indicate the reduction of the CCW heat exchanger performance due to the low flow rate compared to the design value of 11,000 gpm.
- The operator provides a start signal for the Non-backwash Operating strainer through the PSMS from the MCR by safety VDU switch if the low ESW flow rate to the CCW heat exchanger annunciates. Alarms and displays for EWS-FIA-034-S, 035-S, 036-S and 037-S and controls for the strainers and the backwash isolation valves are provided in the safety VDU and the RSC.
- When the ESW flow rate is restored to over 11,000 gpm, the operator can stop the strainer through the PSMS from the MCR by safety VDU switch. Also, the alarms are stopped.
- Start and stop signal for the strainer from the MCR by operator and the ECCS actuation or Loop signal override non safety-related Backwash Operating initiation and termination signal.

Safety-related Backwash Operating termination due to the ESW pump stoppage.

- As an active safety function, when the strainer is under Backwash Operating, the associated backwash isolation valve, MOV-573 or MOV-574 and the strainer integral exhaust valve are interlocked to close at a pump stop signal from PSMS to prevent water drainage that could potentially lead to water hammer. The closure signal overrides all safety and non-safety Backwash Operating initiation signals.

- The isolation valve is also provided with remote manual control through the PSMS from the MCR by safety VDU to enable remote manual isolation as an active safety function during abnormal condition. DCD_09.02.01-52
- Also, the exhaust valve will be closed manually when the strainer is stopped simultaneously through the PSMS from the MCR by safety VDU.

During power operations, the operator may also periodically swap the Backwash Operating or Non-backwash Operating strainer in the same train to Out-of-Service as follows:

- For the example case in which the strainer SST-001A-S is Non-backwash Operating and the strainer SST-002A-S is Out-of-Service.
- Open isolation valves of VLV-507A-S and VLV-509A-S for SST-002A-S locally then set the VDU switch for SST-002A-S to the auto position in MCR; this changes, the operating mode of SST-002A-S is from Out-of-Service to Non-backwash Operating.
- Turn the VDU switch for SST-001A-S in MCR to the pull lock position. Close isolation valves of VLV-506A-S and VLV-508A-S for SST-001A-S locally. If the strainer is backwash operating, stop the strainer from the MCR to make the strainer non-backwashing operating, and then turn the switch to the pull lock position. Therefore, the condition SST-001A-S is changed from Backwash Operating or Non-Backwash Operating to Out-of-Service.
- The strainer swapping operation is completed.
- The inlet and outlet isolation valves for the strainers shown on Figure 9.2.1-1 do not have remote valve operator symbol; the valves can be identified as local manual valves.

No common cause failures are expected due to operator errors at manual swapping of the strainers since the isolation valves are administratively locked on each side of the strainers.

~~Two 100% capacity parallel strainers are located in each ESWP discharge line. The strainers are automatic self-cleaning type. The differential pressure across the operating strainer is monitored. When the predetermined high differential set pressure across the strainer is reached an alarm is sent locally and to the MCR. A high differential pressure alarm initiates backwashing for discharge of the accumulated debris inside the strainer. Backwash operation is started before the maximum allowable differential pressure is reached to prevent strainer clogging. The automatic strainers are not expected to fail due to clogging since backwashing is performed at an alarm setpoint that is much lower than the maximum allowable differential pressure. The operator also may remotely start backwash operation when automatic actuation fails. At abnormal conditions such as during an accident or LOOP, however, the nonsafety-related differential pressure indications and alarms are not credited so that the operator may have to remotely start strainer backwashing. The safety-related flow indication and alarm categorized as PAM variables will aid the operator to identify the need for strainer backwashing. In principle, the backup strainer is installed only for cases when the operating strainer is clogged at an~~

~~unanticipated degree, although this is rather unlikely. Failure of any active component in the backwash line or the strainer itself, which could lead to failure of the associated train, can be dealt with in one of two ways: i.e. either to shut down that train or operate the standby strainer. Failure of one train does not challenge the performance of the entire ESWS as mentioned previously. See the failure modes effects and analysis in Table 9.2.1-2.~~ DCD_09.02.01-52

~~During normal operations, the operator may also periodically swap the strainers to operate the standby or parallel strainer in lieu of the normally operating strainer in the same operating train. No common cause failures are expected due to operator errors at manual swapping of the strainers since the isolation valves are administratively locked on each side of the strainers.~~

~~The strainer backwash line is installed with a normally open isolation valve. The COL Applicant is to determine the backwash line discharge location in accordance with the type of the UHS used. This normally open isolation valve in the backwash line and the strainer integral backwash control valve are interlocked to close at a pump stop signal to prevent water drainage that could potentially lead to water hammer. The isolation valve is also provided with remote manual control from the MCR to enable remote manual isolation during accidents. The backwash line valves are powered by a Class 1E DC source so that they close upon loss of offsite power. An automatic vent valve is also installed to sweep out air introduced into the piping system by the vacuum breakers installed for prevention of water hammer.~~

The automatic strainers have a 3 mm mesh which is considered to effectively remove debris from the system that could clog the CCW plate heat exchangers with flow passages approximately 3~6 mm in diameter. Since the essential chiller units, being shell and tube type heat exchangers, have a much larger flow path than the CCW heat exchangers, no strainer for additional filtering is deemed necessary. [[The 3mm mesh of the strainer element also assures that potential clogging of the cooling tower nozzles is avoided.]]

The ESWP discharge strainers are designed per ASME Boiler and Pressure Vessel Code Section III, Division I, Subsection ND - Class 3 Components and ASME NQA-1 – Quality Assurance Requirements for Nuclear Facility Applications.

The COL Applicant is to provide the design details of the strainer backwash line, vent line, and their discharge locations.

9.2.1.2.2.3 CCW HX

Four 50% capacity plate type HXs, one per train, are provided. A detailed description of the HXs is given in Subsection 9.2.2.

CCW heat exchanger clogging will be prevented by the ESWP discharge strainer. Further, a~~A~~ backflushing line is provided for each CCW HX to enable backflushing of the heat exchanger following a high differential pressure alarm that ~~may likely be~~is caused by accumulation of debris materials inside the heat exchanger plate flow channels. DCD_09.02.01-33

To prevent potential CCW heat exchanger fouling, periodic inspection, monitoring, maintenance, performance and functional testing (including the heat transfer capability of the CCW heat exchangers consistent with GL 89-13) will be provided as discussed in Subsections 9.2.1.3 and 9.2.1.4. Further, adequate fouling factor margins in accordance with the manufacturer's standards and the system water chemistry will be required in the design specifications. Periodic inspection, monitoring and maintenance will ensure that the actual fouling is within design fouling factor margins to accomodate heat transfer for a minimum of the UHS design of 30 days or 36 days for a cooling pond. DCD_09.02.01-52

The design of CCW heat exchangers will incorporate specific features regarding industry operating experience as discussed in EPRI TR 1013470 to minimize leakage from plate-type heat exchangers and potential blockage of the heat exchanger flow passages (Ref. 9.1.7-27). DCD_09.02.02-81

9.2.1.2.2.4 Essential Chiller Units

Four 50% capacity chiller units, one per train, are provided. A detailed description of the essential chiller units is given in Subsection 9.2.7.

9.2.1.2.2.5 Piping

Carbon steel piping designed, fabricated, installed and tested in accordance with ASME Section III, Class 3 requirements, is used for the safety-related portion of the ESWS. Piping is arranged to permit access for inspection. The essential service water pipe tunnel (ESWPT), including the ESW piping from this tunnel to the ESW pump intake and discharge structures and the UHS, is site specific but the existence and function of which are required in the standard design. The COL Applicant is to locate the pipes entering and exiting the pipe tunnel based on the location of the UHSRS, as required. [[The piping located in trenches will be externally lined carbon steel and the lining material specification will vary according to the site soil chemistry. The rest of the ESWS piping will be carbon steel or internally lined carbon steel depending on ESWS water chemistry requirements. Cathodic protection will be provided for buried piping. Access manholes will be provided as required for periodic inspection.]] The piping will be inspected per ASME Section XI, article IWA 5244 requirements.

9.2.1.2.2.6 Valves

The water in the ESWS does not normally contain radioactivity and, therefore, special provisions against leakage to the atmosphere are not necessary. Isolation valves are provided upstream and downstream of each component to facilitate its removal from service.

A motor operated valve is provided at the discharge of each pump. The starting logic of the ESWP interlocks the motor operated valve with the pump operation. The closed discharge valve opens after starting the ESWP. This feature minimizes transient effects that may occur as the water sweeps out air that may be present in the system. If the motive power of the valve is lost, the valve maintains its current position.

Each CCW HX is provided with two separate locked closed isolation valves and piping around the heat exchanger for back flushing. One valve is located in the piping running from the inlet of the heat exchanger inlet isolation valve to the inlet of the heat exchanger discharge isolation valve, and the second valve is located in the piping running from the outlet of the heat exchanger inlet isolation valve to the outlet of the heat exchanger discharge isolation valve. To initiate back flush operation, both bypass valves are opened and the heat exchanger isolation valves are closed. Cooling water flows from the discharge side into the heat exchanger and is discharged from the heat exchanger inlet side to the ESW discharge line.

To avoid concerns with potential downstream pipe wall thinning, butterfly valves provided in the ESWS piping are not used for excessive throttling of the water flow. The valves are sized such that they are near the full open position during the various modes of plant operation. Valve opening margins are included to ensure that the design flow is met during all plant operating modes. Restriction orifices are provided downstream of the heat exchangers as required for flow balancing. Orifices having adequate differential pressures are installed downstream of the heat exchangers to prevent excess throttling of the butterfly flow control valves.

9.2.1.2.2.7 Deleted

9.2.1.2.3 System Operation

9.2.1.2.3.1 ~~Normal~~Power Operation DCD_09.02.01-43

The ESWS consists of four independent trains. During normal plant operation, two trains are operating and at least one other train is on standby. The term "standby" is used to indicate that a component is operable upon receipt of either an automatic or manual actuation signal, but is not required to operate. Each train is designed to provide 50% of cooling capacity required for design basis accident and for safe shutdown with LOOP. The ESWS is designed to perform its safety function of removing heat from the CCW heat exchangers and essential chiller units for accident mitigation and during safe shutdown with one train assumed out of service due to maintenance coincident with a LOOP and a single failure in another train. A maximum ESW operating temperature of 95° F, based on the bounding meteorological and water source conditions from representative locations in the United States, has been evaluated to adequately remove CCW HX heat load at all operating conditions. This temperature is deemed conservative and supports safely bringing the reactor coolant temperature from 350° F to 200° F 36 hours after reactor shutdown via four operating ESWS and CCWS trains. Failure of one train will not prevent the ESWS from achieving cold shutdown conditions. DCD_09.02.01-40

During refueling condition, the number of required operating train of CCWS and ESWS are three. At power operating condition, the number of required operating train of ESWS will be decreased to two trains when the heat load of SFP is decreased after refueling operation as shown in Table 9.2.1-3 because equal or more than half of the latest taken fuel assemblies to the SFP are returned back to the reactor vessel before starting power operation. During power operation, at least two trains are required to be in operation, however, three ESWS trains shall be operable for the Modes 1, 2, 3 and 4 as described in T-spec 3.7.8. Therefore, one ESWS train with the consideration of another train is under DCD_09.02.01-40 on-line maintenance or two trains without consideration of on-line maintenance will become in standby. When the train becomes in standby, the pump discharge MOV which has slow closure time of approx. 30 seconds will be closed gradually, and then, the pump will be stopped. The operation above can be done from MCR, however, it will be better to monitor the equipment stoppage by attending local operator. DCD_09.02.01-40

Table 9.2.1-3 and Table 9.2.1-4, respectively, provide heat loads and water flow balance for various operating modes. The ESWS design heat loads are based on the maximum safe shutdown heat loads with only two ESWS trains operable while one train is assumed to have failed due to a single active component failure and another train is undergoing online maintenance. The ESW flow rate of 13,000 gpm and maximum supply temperature of 95° F are maintained even under these conditions.

The ESWP operation, ESW header pressure signals, and component cooling water pump (CCWP) operation are interlocked to enable automatic start and stop functions of the ESWPs and CCWPs. A low ESW header pressure signal due to failure or tripping of an operating ESWP is alarmed in the MCR. When the low ESW header pressure alarm is annunciated, the standby ESWP and the standby CCWP of the same train designation start automatically as follows, ensuring continuous heat removal~~.~~: DCD_09.02.01-40

Case (1). A and C trains of ESWS and CCWS are in operation:

With low A-ESWP discharge header pressure, B-ESWP and B-CCWP automatically start; however, if B train is out for on-line maintenance, train D must be manually started from the MCR.

With low C-ESWP discharge header pressure, D-ESWP and D-CCWP automatically start; however, if D train is out for on-line maintenance, train B must be manually started from theMCR.

Case (2). A and D trains of ESWS and CCWS are in operation:

With low A-ESWP discharge header pressure, B-ESWP and B-CCWP automatically start; however, if B train is out for on-line maintenance, train C must be manually started from the MCR.

With low D-ESWP discharge header pressure, C-ESWP and C-CCWP automatically start; however, if C train is out for ON-LINE MAINTENANCE, train B must be manually started from the MCR.

Case (3). B and C trains of ESWS and CCWS are in operation:

With low B-ESWP discharge header pressure, A-ESWP and A-CCWP automatically start; however, if A train is out for ON-LINE MAINTENANCE, train D must be manually started from the MCR.

With low C-ESWP discharge header pressure, D-ESWP and D-CCWP automatically start; however, if D train is out for ON-LINE MAINTENANCE, train A must be manually started from the MCR.

Case (4). B and D trains of ESWS and CCWS are in operation:

With low B-ESWP discharge header pressure, A-ESWP and A-CCWP automatically start; however, if A train is out for ON-LINE MAINTENANCE, train C must be manually started from the MCR. DCD_09.02.01-40

With low D-ESWP discharge header pressure, C-ESWP and C-CCWP automatically start; however, if C train is out for ON-LINE MAINTENANCE, train A must be manually started from the MCR.

~~-~~In the same manner, a low CCW supply header pressure signal accompanied by a start signal from the CCWP in the same train will automatically start the corresponding ESWP. When the ESWP is started, the respective pump discharge MOV will also open at the receipt of the pump start signal. This indicates that an operating CCWP has failed and requires the alternate (or standby) ESWP and CCWP in another train to start for backup. Subsection 9.2.2.5.1 also describes the backup actuation for CCWP. The EWSP, however, does not start if the pump discharge MOV is not in a fully closed position as a means to prevent water hammer previously discussed in Subsection 9.2.1.2.1. Only emergency core cooling system (ECCS) actuation and LOOP sequence (also termed as blackout sequence) signals can override the permissive discharge MOV interlock in order to prioritize the ESWS cooling function during an accident or a LOOP. DCD_09.02.01-40 DCD_09.02.01-40

All valves except the pump discharge valves, the strainer discharge backwash isolation valves and the normally closed boundary valves in the exchanger drain piping in the flow path are locked open. The discharge MOV position is monitored in the control room. At pump swapping operation, i.e. alternately operating the standby pump in lieu of the operating pump during normal power operation, failure of the valve to open on standby pump start is alarmed in the control room. The operator will stop the pump and restart the ~~standby~~previously started pump. The pump discharge pressure is monitored and low pressure is alarmed. The system design and layout provide adequate resistance to prevent pump runout. DCD_09.02.01-40 DCD_09.02.01-40 DCD_09.02.01-40

Voiding upstream of the pump discharge check valve in any train may occur during loss of offsite power and subsequent pump trip, particularly at a low UHS water level. To maintain the pressure at this portion above the saturation pressure to preclude steam void formation which leads to water hammer, vacuum breakers shall be installed between the pump discharge and its check valve. Air entering the piping cushions any abrupt water flow filling the voids and water hammer will not take place at pump actuation. The entering air then discharges through the automatic vent valve installed in the strainer. The motor-operated pump discharge valve, being powered by a safety DC power source, is unaffected by the loss of offsite power and will close when the pump stops. [[Water in the cooling tower spray header will drain to the UHS.]] The check valve located in the pump discharge pipe will prevent water flowing back through the pump into the intake structure. In order to preclude water hammer on pump restart, the motor operated valve at the discharge of each pump is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed. When the emergency electrical power becomes available from the gas turbine generators (GTGs), the ESW pump is restarted in accordance with the LOOP sequence (or blackout sequence) signal and the discharge MOV opens. Since most of the ESWS remains filled with water, the ESW pump restart will sweep out the trapped air via high point vents attached at the ESWP discharge strainers. Therefore, any potential water hammer forces, DCD_09.02.01-40 if present, will have minimum impact on the ESWS operation. The COL Applicant is to provide a void detection system with alarms to detect system voiding. [[The void detection system is provided by the level transmitter located around the highest piping in the ESWS/UHS. When the water level in the ESWS/UHS decrease below the location of the level switch, the operator is annunciated and required to recover the water level by operating the standby ESWP to make the water hammer effect minimum at the standby train which the water volume may be decreased by natural evaporation.]] DCD_09.02.01-49

Draining of ESW in an inactive or non-operating~~tripped~~ ESWS train is prevented by double isolation valves downstream of the ESWP, i.e. check valve and MOV. The differential pressure measured during leakage testing of these valves is established in accordance with the MSS SP-61-1999, Pressure Testing of Steel Valves, is equal to the design pressure. Actual differential pressure of the MOV is equal to the static pressure which is lower than the pressure at testing with the pump in standby or ~~tripped~~non-operation. Actual differential pressure across the check valve installed upstream of the MOV is low because the system pressure tends to work against the MOV, therefore, almost no leakage can be anticipated. The MOV and the check valve are identified in DCD Table 3.9-14 with their safety function in "maintain closed" position. The IST program with detailed criteria including valve leak rates will be prepared by the COL Applicant in accordance with COL 3.9(8). Inservice testing of the ESWS, as described in Tier 2 DCD Subsection 3.9.6.1, includes discharging of any voids into the UHS [[basin]] and filling of the system to ensure that voids which are the primary cause of water hammer are minimized. DCD_09.02.01-40 DCD_09.02.01-40

The effect of long-term corrosion of the piping is mitigated by adding a corrosion inhibitor. The ESW is periodically sampled and chemicals are added, as required, during ~~normal~~power operation. DCD_09.02.01-43

Radioactivity leakages from the CCWS to the ESWS can be detected by the radiation monitors located downstream of the CCW heat exchangers. Predetermined high radiation level is alarmed in the MCR. The operator manually isolates the contaminated ESWS train and corresponding CCW train by stopping the ESWS and CCW pumps, and thus taking the contaminated CCW heat exchanger out of service. Standby CCWS and ESWS trains are placed in service. The manual isolation valves placed on each side of the CCW heat exchanger will also be closed to ensure that the radioactive leakage is not circulated in the ESW and eventually in the UHS. A second valve, which acts as a control valve, downstream of the CCW downstream isolation valve can also be closed to further isolate the train.

Nevertheless, the CCWS, which is intermediate between the ESWS and reactor auxiliaries, has been designed so that no radioactive contamination to the environment occurs through direct leakage into the ESWS. If, however, radioactive leakage does occur in the CCWS, radiation monitors will alarm in the MCR to enable immediate stoppage of the CCW pump and isolation of the leaking train. The leaking train is ultimately placed out of service to treat this problem. Therefore, prior to occurrence of radioactive leakage into the ESWS, isolation of the affected CCWS train should have taken place first.

Clogging of the CCW heat exchanger is prevented by the ESWP discharge strainer. If the heat exchanger differential pressure on the essential water side is higher than setpoint, the alarm will be annunciated to the MCR. The operator can perform backwashing of the DCD_09.02.01-32

CCW heat exchanger locally. Because of the reverse flow through the CCW heat exchanger, there is a possibility that the CCW heat exchanger will not perform the design heat transfer from the CCWS to ESWS and the train is therefore considered inoperable. If the backwash operation will reduce the number of operable trains to fewer than three, the backwashing of the heat exchanger shall be finished and the train shall be restored within completion time of 72 hours in accordance with Technical Specification 3.7.8 DCD_09.02.01-32

9.2.1.2.3.2 Emergency Operation

Loss of Coolant Accident (LOCA)

All ESWPs are automatically started by the ECCS actuation signal, and supply cooling water to their respective CCW HXs and essential chiller units. When offsite power is not available, ESWPs are automatically powered by onsite Class 1E power supplies.

During LOCA conditions, a minimum of two trains of the ESWS are required.

Loss of Offsite Power

On loss of offsite power, onsite Class 1E gas turbine generators (GTGs) are automatically started to restore power to the Class 1E 6.9 KV power buses that service safety-related active components such as ESWS pumps and discharge MOVs. GTG operation, including automatic starting and sequencing logic, is further described in Subsection 8.3.1. During this condition, a minimum of two trains of ESWS are required.

9.2.1.3 Safety Evaluation

The safety-related portion of the ESWS is designed and constructed to seismic category I requirements. The safety-related portions of the ESWS are protected against natural phenomena and missiles. The following sections address natural phenomena and missiles protection.

- Section 3.3, Wind and tornado loadings
- Section 3.4, Water Level (Flood) Protection
- Section 3.5, Missile Protection
- Section 3.7, Seismic Design;

Pipe rupture protection is addressed in Section 3.6, Protection against Dynamic Effects Associated with Postulated Rupture of Piping.

The ESWS continues to perform its safety function in the event of a fire. Subsection 9.5.1 addresses fire protection.

Leakage in the ESWS due to piping or component failure that could cause flooding of surrounding SSCs has been evaluated for the CCW pump and CCW HX room. Flooding mitigation in the ESWS is achieved by installation of a nonsafety grade electrode type level switch or detector in the leak-detecting floor drain box in the CCWP and CCW HX room of each train. Pre-determined water level due to leakage in any CCWP and CCW HX room is alarmed in the MCR. A nonsafety grade electrode type level switch is also provided in the leak-detection floor drain box in each essential chiller unit room located in the power source building (PS/B). Pre-determined water level due to leakage in any essential chiller room is alarmed in the MCR. The leaking train can also be identified by low outlet flow from each CCW HX or decrease in the ESWS header pressure. The leaking ESWS and CCWS trains are then isolated by shutting down the corresponding ESWS pump and CCWS pump, and activating the standby and intact ESWS and CCWS trains. If, however, the leak detector fails to alarm, or the operator fails to recognize the flooding signals, the physical separations, which include water tight doors, between the east side of the ESWS enclosing ESWS trains A and B and the west side of the ESWS enclosing ESWS trains C and D will serve to isolate flooding and prevent it from propagating to other trains as follows:~~.~~ DCD_09.02.01-44

The Reactor Building Non-radiological Controlled Area (NRCA) is separated into the east and west areas by concrete walls and/or water-tight doors. The concrete walls are designed to prevent flood water migration from one safety train to another. This is accomplished by installing piping, electrical conduit, HVAC duct, cable trays and other potential connections with penetrations that are above the maximum flood level and/or by sealing the penetrations. The east side includes two trains (A and B) of the CCW heat exchanger and pump rooms. The west side includes two trains (C and D) of the CCW heat exchanger and pump room. Equipment rooms are isolated by concrete walls and the fireproof doors which are not water-tight. Therefore, flood water is assumed to run across the area.

Flood events are evaluated with the following assumptions:

- Earthquake
  For flooding events caused by an earthquake, non-seismic category I piping and components are assumed to fail and release all of their contents.

- High-energy line break/Moderate-energy line break
  HELB event is not a concern, because there are no piping breaks, which are assumed to occur in the subject area.

- Fire fighting operations
  The flooding contribution from fire fighting operations is based on the full operation of two hose stations for 2 hours.

The worst case results are from a combination of earthquake and fire fighting operations, with a maximum water level of:

- East side: 0.45 ft above elevation -26 ft, 4 in.

- West side: 0.60 ft above elevation -26 ft, 4 in.

The pump foundations (top of concrete) height is 1.0 foot above floor elevation -26 ft, 4 in. As such, the pumps are not flooded. The instrumentation of each pump is located above the level of flood water.

Further discussion regarding flood protection is addressed in DCD Subsection 3.4.1.5.2.2. DCD_09.02.01-44

The ESWS equipment and piping are located in the R/B, the UHSRS, the ESWPT, and the PS/Bs. These buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other appropriate natural phenomena. Sections 3.3, 3.4, 3.5, 3.7, 3.8 and 9.5 describe the bases of the structural design and protection from natural events.

Radioactive contamination of the ESWS is unlikely but can occur if the CCWS system is contaminated and then leaks into ESWS via the CCW HX. Subsection 9.2.1.2.1 describes prevention of this leakage to the environment.

Four independent, redundant trains, each powered from an independent Class 1E power supplies, are provided. The system is designed to provide the required cooling to mitigate the consequences of an accident with a single failure and one train unavailable due to maintenance coincident with a loss of offsite power.

The ESWS and its components are initially tested in accordance with the program given in Section 14.2. Periodic in-service functional testing is performed as described in Subsection 9.2.1.4. Section 6.6 lists appropriate ASME Section XI requirements for the safety-related portion of the system.

Failure mode and effects analysis (FMEA) Table 9.2.1-2 concludes that no single failure, coincident with one train being unavailable due to maintenance and a loss of offsite power compromises the safety functions of ESWS.

The ESWS is not shared with multi-units.

The COL Applicant is to provide the evaluation of the ESWP at the lowest probable water level of the UHS. The COL Applicant is to develop recovery procedure in the event of approaching low water level of UHS.

The ESWS is designed for operation at low water temperature of 32° F during all modes of plant operation. The COL Applicant is to provide protection of the site specific safety related portions of the ESWS including [[~~such as~~ the ESWS blowdown line, FSS supply line, ESWPT piping running between the nuclear island and UHSRS, and any ESWS piping in the UHSRS]] against adverse environmental, operating, and accident conditions that can occur such as countermeasures to freezing by safety-related heat tracing, low temperature operation, and thermal overpressurization. Temperature in the reactor building is maintained through ventilation and therefore heat tracing is not required. The SSCs outside the scope of the certified design building such as the branch piping to the pump discharge pressure sensor, [[to the conductivity cell]], to the pump ESWS header pressure sensor, to the pump discharge strainer differential pressure sensor, [[the UHS basin blowdown bypass lines]] and the standby strainer lines would become stagnant, therefore, the possibility for freezing depends on the location which is determined by the COL Applicant. DCD_09.02.01-35 DCD_09.02.01-35

The COL Applicant is to provide the safety evaluation of the capability of the ESWS to: (1) isolate its site-specific, nonsafety-related portions [[such as the ESWS blowdown line and

FSS supply line with clarification for their connecting locations and their boundaries when applicable]]; and (2) provide measures to prevent long-term corrosion and organic fouling that may degrade its performance, per Generic Letter (GL) 89-13. DCD_09.02.01-33

Some portions of the system are nonsafety-related, e. g., sections of pipe in heat exchanger drain piping after the isolation valves. These boundary isolation valves which provide separation between the safety-related and nonsafety-related portions are normally closed. During a design basis event, postulated simultaneous failure of all nonsafety-related piping would not impact operation of any ESWS train, thus will not affect the ESWS capability to perform its safety related functions.

The COL Applicant is to specify appropriate sizes of piping and pipe fittings such as restriction orifices to prevent potential plugging due to debris buildup, and develop maintenance and test procedures to monitor debris build up and flush out debris.

9.2.1.4 Inspection and Testing Requirements

The ESWS is hydrostatically tested prior to initial startup. Preoperational testing is described in Section 14.2. System performance during ~~normal~~power operation is verified by monitoring system pressures, temperatures and flows. DCD_09.02.01-43

Inservice inspection and testing of piping is performed in accordance with the requirements of ASME Section XI, as discussed in section 6.6.

Inservice testing of active pumps and valves is performed to assure operational readiness, as described in subsection 3.9.6. Acceptance criteria for the monitored parameters are established to allow for pump degradation and to maintain acceptable pump performance for all modes of plant operation.

Periodic performance verification of the ESWS components, including the heat exchanger(s) cooled by the ESW, is performed to detect performance degradation due to fouling. The heat exchangers are monitored per test program developed in accordance with the requirements of GL 89-13. Acceptance criteria for performance verification are established to allow for degradation and maintain acceptable heat exchanger performance for all modes of plant operation.

The COL Applicant shall conduct periodic inspection, monitoring, maintenance, performance and functional testing and verification of the ESWS and UHS piping and components, including the heat transfer capability of the CCW heat exchangers and essential chiller units, consistent with GL 89-13 and GL 89-13 supplement 1. The COL Applicant is to develop operating procedures to periodically alternate the operation of the trains thus performance of all trains will be regularly monitored.

9.2.1.5 Instrumentation Requirements

The operator has functional control and monitoring capability of the ESWS in the MCR and also at the remote shutdown room (RSR). All functions described below that are available in the MCR are also available at the RSR and have local read out. DCD_09.02.01-41

9.2.1.5.1 ESWS discharge pressure

The ESWP discharge pressure is locally indicated, and pressure readings are used for ESWP performance testing.

9.2.1.5.2 ESW header line pressure

ESW header pressure is indicated both locally and in the MCR. When the pressure decreases due to failure or inadvertent shutdown of the operating pump or valve misalignment, a low pressure alarm is transmitted both locally and to the MCR. The ESW header line pressure is categorized as a PAM variable to assist the MCR personnel in evaluating the safety status of the plant.

The ESW header line pressure signal is also used for backup activation of the alternate ESWS train as ~~discusses~~discussed in Subsection 9.2.1.2.3.1. DCD_09.02.01-43

9.2.1.5.3 CCW HX essential service water flow

The ~~FSW~~ESW flow rate to the CCW ~~HX~~ heat exchanger is indicated locally and in the MCR. A low flow alarm is transmitted both locally and to the MCR. The CCW ~~HX~~heat exchanger ESW flow indication for safe shutdown is safety-related ~~also categorized~~ as ~~a PAM variable~~shown in Table 7.4-2. The CCW heat exchanger ESW flow is to be used for indicating the possibility of the clogging of the pump discharge strainer and used for initiating manual backwash remotely during accident condition. DCD_09.02.01-52

9.2.1.5.4 Essential chiller unit service water flow

The ESW flow rate to the essential chiller units is indicated locally.

9.2.1.5.5 Differential pressure of strainer

Differential pressure of strainers located in each ESWP discharge line is indicated locally and in the MCR. High differential pressure alarm is transmitted locally and to the MCR. The differential pressure signals activate the start and stop functions of the ESWP discharge strainers.

9.2.1.5.6 Radiation monitor

Radiation monitors are located downstream of the CCW HX and the signal is indicated locally and in the MCR. When the radiation level exceeds the setpoint, an alarm is transmitted both locally and to the MCR.

9.2.1.5.7 Other instrumentation

As shown in the piping and instrumentation diagram of the ESWS, other instrumentation and thermowells for temperature detection are provided where required to support testing and maintenance.

In addition, remotely operated pump discharge valves are provided with position indication instrumentation. The valve positions are monitored in the MCR. Valve operation is interlocked with the pumps as noted in Subsection 9.2.1.2.3.1. The ESW pump control and status indication are provided in the MCR. The ESWS is interlocked with the CCWS such that at either a low ESW supply header pressure or at low CCW header pressure, alternate standby pumps are being automatically activated as described in 9.2.1.2.3.1. The CCWS is used for supplying the cooling water to the components which are essential for normal power operation. The interlock between the ESWS and CCWS for inadvertent stoppage of one train of ESWS or CCWS is necessary for maintaining the water supplement to the components that require rapid water re-supplement such as charging pump, letdown heat exchanger, instrument air compressor, seal water heat exchanger or RCP thermal barrier. There are no interlocks between the ESWS and the essential chilled water system because the ECWS is not required to restart rapidly at inadvertent stoppage of the components. DCD_09.02.01-40 DCD_09.02.01-40

9.2.2 Component Cooling Water System

9.2.2.1 Design Bases

The component cooling water system (CCWS) provides cooling water required for various components during all plant operating conditions, including normal plant operating, abnormal and accident conditions. It is an intermediate, closed loop cooling system that transfers heat from the various components to the ESWS. The CCWS is designed to meet the relevant requirements of GDC 2, GDC 4, GDC 44, GDC 45, and GDC 46 (Ref. 9.2.11-1). Its design bases are further described below.

9.2.2.1.1 Safety Design Basis

The CCWS design bases to meet the safety-related functional requirements are :

- The CCWS consists of two independent subsystems, with each subsystem providing 100% of the cooling capacity required for safe function. Each of the subsystems contains two fifty percent (2 x 50%) trains, for a total of four 50% trains.
- The CCWS is designed to have the capability to provide cooling water using either offsite power supply or onsite Class 1E power supply. Each train is powered by Class 1E power supplies respectively.
- The CCWS is designed to perform its safety function of accident mitigation assuming that one 50% train is out of service for maintenance coincident with the loss of offsite power and a single failure in another train.
- The CCWS is designed to seismic category I requirements so as to remain functional during and following a SSE.
- The CCWS is designed to have the capability to isolate the non-safety portions of the system during accident mitigation.
- The CCWS is designed against natural phenomena and internal missiles.
- The CCWS safety components are designed to withstand design loadings.

- The CCWS is protected against adverse environmental, operating, and accident conditions that can occur, such as flooding, high energy line break (HELB), thermal overpressurization, and water hammer.

- The CCWS is designed for periodic inservice testing and inspection of components in accordance with ASME Code Section XI.

- The CCWS is designed to withstand leakage in one train without loss of the system's safety function.

- Applicable codes and standards for the CCWS are listed in Section 3.2. The containment isolation valves and the piping between the isolation valves are designed and constructed to the requirements of ASME section III, Class 2. The remainder of the system is designed and constructed to the requirements of ASME Section III, Class 3, except for the portion that is not required to perform safety functions.

- The CCWS, in conjunction with the Essential Service Water System (ESWS) and the Ultimate Heat Sink (UHS), is capable of removing sufficient heat from the essential heat exchangers to ensure a safe reactor shutdown and cooling following a postulated accident coincident with a loss of offsite power and assuming one train is unavailable due to maintenance and a single active failure in a second train.

- The CCWS, in conjunction with the ESWS, is capable of maintaining the outlet temperature of the CCW heat exchanger below the limits of ~~110~~125 °F during a design basis accident with loss of offsite power. DCD_09.02.02-51

9.2.2.1.2 Power Generation Design Bases

The CCWS is designed to:

- Serve as an intermediate system between components containing radioactive fluids, which are cooled by the system, and the ESWS so as to prevent direct leakage of radioactive fluid into the environment through the ESWS.

- Provide sufficient cooling capacity for the components required during normal operating conditions such as normal power operation, normal shutdown and refueling as described below.

- Detect leakage of radioactive material into the system and control leakage of radioactive material out of the system. The Component Cooling Water system is subjected to the design objectives of RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning" as it contains radioactive liquid. A discussion of the design objectives and operational programs to address these radiological aspects of the system is contained in DCD Section 12.3.1. System and component design features addressing RG 4.21 (Ref. 9.2.11-9) are summarized in Table 12.3-8.

- Prevent long term corrosion that may degrade system performance.

9.2.2.1.2.1 ~~Normal~~Power Operation DCD_09.02.02-52

The CCWS is designed to transfer heat from the plant components required to support normal power operation with one train (pump and heat exchanger) unavailable due to online maintenance and a single active component failure. The CCWS is sized such that the component cooling water supply temperature to plant components is not more than 100°F. As indicated in Table 9.2.2-6. ~~N~~normal operating heat loads are reactor coolant pump, charging pump, letdown heat exchanger, instrument air, spent fuel pool cooling heat exchanger, sample heat exchanger, seal water heat exchanger, blowdown sample cooler, B.A. evaporator, waste gas compressor, and so on. The CCWS provides sufficient surge tank capacity below the low level alarm to allow for operators to take action. DCD_09.02.02-52

9.2.2.1.2.2 ~~Normal Plant~~ Cooldown by CS/RHRS DCD_09.02.02-52

The CCWS is designed to remove both decay and sensible heat from the core and the reactor coolant system in addition to some normal operating heat loads during the latter stages of plant cooldown, as indicated in Table 9.2.2-6. The component cooling water system is sized to reduce the temperature of the reactor coolant system from 350°F at approximately 4 hours after reactor shutdown to 140°F using 4 trains while maintaining the component cooling water supply below 110°F. Failure of one train of CCW with another train unavailable due to maintenance will not prevent achieving cold shutdown conditions. The CCWS continues to provide cooling water to the residual heat removal system throughout the shutdown after cooldown is complete. DCD_09.02.02-52

9.2.2.1.2.3 Refueling

During refueling, cooling water flow is provided to spent fuel pool heat exchangers to cool the spent fuel pool, as indicated in Table 9.2.2-6. For a full core off-load cooling water is also supplied to a normal residual heat removal heat exchanger as part of spent fuel pool cooling. The CCWS maintains the spent fuel pit water temperature below 120°F. System operation is with both CCWS ~~divisions~~subsystems available. The component cooling water supply temperature to plant components in the refueling mode is not more than 100°F. DCD_09.02.02-52 DCD_09.02.02-52

9.2.2.1.2.4 Startup

The CCWS is designed to transfer heat from the plant components required to support plant startup with two trains in each subsystem in operation at the time of maximum heat load. The number of active CCWS trains is determined by the operating states of the components to be cooled and the temperature of the ESW supplied to the CCW heat exchangers. Potential CCWS users in this configuration are identified in Table 9.2.2-6. Heat loads for CCWS in the startup configuration reflect higher Excess Letdown and CS/RHR heat exchanger requirements; in addition, Letdown load is higher than power operation. The CCWS is sized such that the component cooling water supply temperature to plant components is not more than 100°F.

9.2.2.1.2.5 Accident

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The CCWS is designed to transfer heat from the plant components required to support safety-related loads during accident conditions with one train in each subsystem in operation. The CCWS can operate two trains to remove the heat load during an accident condition even if a single failure occurs with one of four trains inoperable due to maintenance. As indicated in Table 9.2.2-6, changes to potential CCWS users in this configuration compared to power operation include the CS/RHR heat exchangers and shedding of some normal operation loads. The CCWS is sized such that the component cooling water supply temperature to plant components is not more than 125°F.

9.2.2.1.2.6 Safe Shutdown

The CCWS is designed to transfer heat from the plant components required to support safe shutdown with one train in each subsystem in operation. The CCWS can operate two trains to put the plant into safe shutdown even if a single failure occurs with one of four trains inoperable due to maintenance. As indicated in Table 9.2.2-6, potential users of CCWS in this configuration are the same as the accident configuration except that C/V atmosphere gas sample cooler is not required. The CCWS is sized such that the component cooling water supply temperature to plant components is not more than 125°F.

9.2.2.2 System Description

The system flow diagram is shown in Figure 9.2.2-1.

The CCWS is the closed loop system that functions as an intermediate system between the various components cooled by CCWS and the ESWS, (Subsection 9.2.1). The CCWS transfers heat and prevents direct leakage of the radioactive fluid from the components to the ESWS.

The CCWS consists of two independent subsystems. One subsystem consists of trains A & B, and the other subsystem consists of trains C & D, for a total of four trains. Each train has one CCWP and one CCW HX and provides 50% of the cooling capacity required for safety function.

Electrical power to the CCWS is supplied from Class 1E buses that are backed up by Class 1E power supply so that the system is capable to operate during a loss of off site power.

There is the header tie line between trains A and B, and between trains C and D. The header tie line in each subsystem branches into two loops "A1" and "A2" from the header tie line between A and B, and "C1" and "C2" from the Header Tie Line between C and D. See Table 9.2.2-1 for the components supplied by each loop. DCD_09.02.02-48

Each subsystem is served by one CCW surge tank. The CCW surge tank is installed at the highest point of the system to facilitate system air venting to ensure a water solid closed loop and to provide the net positive suction head at the CCWP suction. In addition, the surge tank accommodates the thermal expansion and contraction of the cooling water and potential leakage into or out of the CCWS.

Demineralized quality water with corrosion inhibitors is circulated in the CCWS. No outside impurities are expected to be infiltrated in the system, therefore, ~~the~~a CCW filter is not necessary. The impacts of non-safety related SSC failures in the CCW system will not adversely affect safety-related SSCs ~~to perform~~performing their safety~~-related~~ function since the direct impact of a pipe break in the non-safety portion of the system can be accommodated. ~~The~~Each non-safety CCW header is isolated by redundant valves between the seismic category I and non-safety piping. Air operated valves (NCS-AOV-057A/B and NCS-AOV-058A/B) isolate the supply lines and check valves (NCS-VLV-036A/B and NCS-VLV-037A/B) isolate the return lines. The valves are located on the Reactor Building side of the boundary between seismic category I and non-safety piping. All non-safety related components are supplied from the two non-safety CCW headers A2 and C2 (refer to Table 9.2.2-1). Therefore, the CCW system's safety function will be maintained ~~as a result of the~~in the event of a nonsafety-related piping failure, and the indirect impact of the pipe break will not impact any SSC safety function. DCD_09.02.02-48 DCD_09.02.02-48 DCD_09.02.02-48

During a severe accident, alternative methods of charging pump cooling using CCWS connections are available from water supplied by the non-essential chilled water system (non-ECWS) or the fire water supply system (FSS). The non-ECWS and the FSS are non-seismic class. Therefore, at the boundary of the FSS (or the non-ECWS) and the CCWS, there are redundant normally-closed motor operated valves (MOV-321A/B, 322A/B, 323A/B, 324A/B, 325A/B and 326A/B). These valves at the safety related and non-safety-related boundaries are installed in series, and even if one valve opens during normal operation of the CCWS, it would not affect the CCWS since the other valve is closed. If there were a total loss of CCW, non-essential chilled water could be supplied to the CCWS to be used for CVS charging pump cooling water; this would be accomplished by opening MOV-322A/B, 323A/B, 324A/B, and 326A/B after closing MOV-316A/B. Fire water could be supplied to the CCWS to provide CVS charging pump cooling water by opening MOV-321A/B, 322A/B, 324A/B, and 325A/B after closing MOV-316A/B. These valves can be operated from the MCR. The water supply path from the non-ECWS or the FSS to the charging pumps is discussed in Section 19.2. DCD_09.02.02-80

The CCWS can be used as an alternative supply of cooling water to the containment fan coolers of the non-ECWS. The non-ECWS is non-seismic class. Therefore, at the boundary with the CCWS, two locked-closed valves (NCS-MOV-241, 242) with their breakers open are provided. These valves on the boundaries with the CCWS are locked-closed, hence they would not open during normal operation of the CCWS by misoperation. During a severe accident, if containment spray could not be performed, CCW could be supplied to the containment fan coolers by opening NCS-MOV-241 and 242 and closing valves VWS-MOV-401 and 409. These valves can be operated from the MCR. To initialize the alternative containment cooling method, the operator must first pressurize the CCW surge tank to 100 psig which exceeds the design pressure of 50 psig. A pressure of 100 psig, which exceeds the containment design pressure of 68 psig, will match the saturation pressure so that flashing in the containment fan cooler is prevented. Because a severe accident is beyond design basis accident requirements, pressurizing the CCW surge tank to 100 psig can be realistically credited as the tank design specification margin will be adequate to demonstrate that the tank will maintain its integrity at 100 psig. The CCW surge tank detailed design will consider a provision for corrosion allowance, as required by ASME Section III. Because the tank is covered with nitrogen and the temperature is less than 100°F during the power operation, corrosion is unlikely to occur. Therefore, there is reasonable assurance that tank integrity at 100 psig can be maintained for plant life. (Note that the pressure rating on the piping between the surge tank and valves NCS-VLV-005A/B/C/D is 50 psig as shown on Figure 9.2.2-1. However, the piping material is the same as that used for piping up the pump suction, which is 200 psig. By convention, the pressure boundary mark is placed at the valve. So, the piping can withstand pressurization to 100 psig as required for the severe accident response.) DCD_09.02.02-80

Before pressurizing the surge tank up to 100 psig, the operator will take action to prevent the safety valve actuation; then nitrogen gas will be used to pressurize the tank. The COL Applicant is to develop a milestone schedule for implementation of the emergency operating procedures to ensure that the necessary header tie line isolation valves are closed within 24 hours after an event to achieve train separation. See COL Item 13.5(6)

The containment isolation valves on the supply line to the containment fan coolers from the CCWS open fully in approximately 50 seconds. Therefore, the gradual CCWS flow into the non-ECWS will not create a concern for water hammer. The alternative cooling water supply to the containment fan coolers is discussed in Section 19.2.

9.2.2.2.1 Component Descriptions

The CCWS components are described below. Design parameters for major components of CCWS are provided in Table 9.2.2-2.

9.2.2.2.1.1 CCW HX

The CCW HXs transfer heat from the CCWS to the ESWS. The CCW HXs are plate type. The CCW HXs are designated quality group C as defined in Regulatory Guide 1.26 (Ref. 9.2.11-3), seismic category I, and are designed in accordance with the requirements of the ASME Section III, class 3.

Heat exchangers are designed to remove heat loads associated with all modes of operation. The "design" condition is associated with CCW and ESW flow rates of 11000 gpm, a maximum CCWS design outlet temperature is 100°F and maximum cooling water inlet temperature from ESWS is 95°F. At the design condition, the heat removal capacity of each CCWS heat exchanger is 50 x 10^6 Btu/hr. DCD_09.02.02-52

The heat exchangers are sized to provide cooling water no greater than 100°F during normal operation, no greater than 110°F during shutdown operation and no greater than 125°F during accident and safe shutdown conditions. The assumed ESWS temperature is 95°F for all operating condtions. Heat exchanger fouling factors are in accordance with manufacturer's standards and the system water chemistry.

The CCWS plate-type heat exchanger “design” heat removal capacity of 50 x 10^6 BTU/hr allows removal of the normal operating heat load using two heat exchangers. The design heat load is determined by summing individual user requirements, which are listed in Table 9.2.2-6. The heat load from the SFP is based on the decay heat for the design SFP loading as described in Section 9.1.3.1, calculated by ANSI/ANS 5.1; the decay heat predicted by ANSI/ANS 5.1 is larger than ORIGEN 2.2 output. Thus, the SFP heat exchanger heat load shown in Table 9.2.2-6 used for CCWS design is conservative by about $6x10^6$ Btu/hr in comparison to ORIGEN 2.2 predictions. As a result, there is a net 10% margin in the CCWS design heat removal capacity due to the conservatism in the SFP heat exchanger load. In addition, vendor design margin for the heat exchanger area is a minimum of 20% over the area associated with the design heat removal capacity. DCD_09.02.02-52

Actual heat exchanger performance based on these design considerations will reflect the temperature differential across the heat exchange surface (ΔT) and the product of the overall heat exchange coefficient and heat exchange area (UA). The heat exchange area, A, is not dependent on the CCWS operating mode; however, U and ΔT will change due to changes in flow rate or temperature conditions in each heat exchange configuration. Tables 9.2.2-4 and 9.2.2-5 provide heat loads and flow rates, respectively, for various CCWS operating modes.

9.2.2.2.1.2 CCWP

The CCWP circulates cooling water through the CCW HX and the components cooled by CCWS.

The pumps are horizontal centrifugal pumps and driven by an ac powered induction motor.

The pumps are designated quality group C as defined in Regulatory Guide 1.26, seismic category I, and are designed in accordance with the requirements of the ASME Section III, class 3.

The pumps are designed in consideration of head losses in the cooling water inlet piping based on full power flow conditions, increased pipe roughness, maximum pressure drop through the system heat exchangers, and the actual amount of excess margin etc. The design head and flow rate of the CCWS pumps are provided in Table 9.2.2-2. The design head is calculated based on supplying cooling water to the RCP thermal barriers, which is the line having the most severe pressure loss. The pumps have a design head of 180 ft which ensures a minimum of 5% margin over the head required to account for the pressure loss of this line at the design flow rate. The design flow rate of 12,000 gpm is at least 20% larger than that required for any CCWS operational mode, as indicated in Table 9.2.2-5. DCD_09.02.02-53

~~The surge tanks are located at a higher elevation than the pumps to ensure sufficient NPSH margin is available.~~ The CCWS surge tank is located at a higher elevation (upper level of the Reactor Building) than the CCWS pumps (lower level of the Reactor Building). Calculations of available NPSH is based on conservative assumptions such as highest CCWS flow rate, highest surge tank temperature and lowest surge tank level. Using these conservative assumptions, the calculated NPSH is further reduced to define the design specification for the required NPSH of the CCWS pumps. This approach ensures that the CCWS pumps have flooded suction during all operating conditions and vortexing can be avoided. DCD_09.02.02-57

The flow rate of CCWS is regulated using a manual flow control valve installed downstream of each piece of auxiliary equipment which is set to maintain adequate supply water to the auxiliary equipment. The heat exchangers that remove the heat load DCD_09.02.02-67 under normal operation have an adequate capacity to supply CCW of 100°F to each piece of auxiliary equipment even with an ESW temperature of 95°F. Thus, the supply temperature of 100°F or less necessary for normal operation is maintained without automatic control, so that flow rate is regulated depending on the CCW temperature, without direct temperature control. DCD_09.02.02-67

CCWS pump operation is interlocked with ESWS pump operation to support uninterrupted heat removal, as described in Subsection 9.2.1.2.3.1. DCD_09.02.02-68

9.2.2.2.1.3 CCW Surge Tank

The CCW surge tanks are constructed of carbon steel and located in the upper level of the Reactor Building. They connected to the suction side of the ~~CCWP~~CCWS pumps. There are a total of two surge tanks, one for each of the two CCWS subsystems. Each surge tank is divided into two equal compartments by an internal partition plate; the partition plate extends above the high water level setpoint.. The surge tank accommodates the thermal expansion and contraction of the cooling water and potential leakage into or from the CCWS. Makeup water is supplied to the respective surge line. In the event that makeup water is not available, each CCWS surge tank compartment has a volume between the low-low level setpoint and the "0" instrument level of more than 800 gallons. This is more than adequate to accommodate potential system leakage from pump seals and valves over a seven-day period, as discussed in Subsection 9.2.2.3.2. DCD_09.02.02-57 DCD_09.02.02-49 DCD_09.02.02-49

The CCW surge tank is designated quality group C as defined in Regulatory Guide 1.26, seismic category I, and is designed to the requirements of the ASME Section III, class 3.

In case of a small leak out of the system, makeup water is supplied as necessary until the leak is isolated.

The makeup water can be supplied from the following systems:

- Demineralized water system (DWS) which supplies the demineralized water
- Primary makeup water system (PMWS) which supplies the deaerated water ~~and primary makeup water~~ DCD_09.02.02-69
- ~~Refueling water storage system (RWS) which supplies the refueling water~~Fire protection water supply system (FSS) which supplies fire protection water

Deaerated water is used for initial filling of this system and demineralized water is used for automatic makeup when the tank water level reaches a low level setpoint.

~~If necessary, primary makeup water and refueling water may be used during an emergency. Refueling water storage pit is water source of seismic category I.~~The CCWS is designed such that makeup to the surge tanks is not required for a minimum of seven days if the system is isolated. To provide additional capability for long-term functionality after a safe shutdown earthquake, makeup to each CCWS surge tank can be provided by the FSS using piping to the makeup connection that is designed to remain functional after a SSE. The supply to the FSS makeup connection is through seismically qualified piping from a seismically qualified water source, as discussed in Subsection 9.5.1.2.2 DCD_09.02.02-69

Water chemistry control of CCWS is performed by adding chemicals to the CCW surge tank to prevent long term corrosion that may degrade system performance. The CCW in the surge tank is covered with nitrogen gas to maintain water chemistry. The elevation of the surge tank and piping arrangement minimize the potential for nitrogen accumulation in places other than the surge tank. Strainers are provided in piping connecting makeup water sources to the surge tank; based on heat exchanger flow passage dimensions, the strainer mesh size is 3mm. DCD_09.02.02-57 DCD_09.02.02-81

In order to provide redundancy for a passive failure (a loss of system integrity resulting in abnormal leakage), an internal partition plate is provided in the tank so that two separate surge tank volumes are maintained. Accessibility is provided for inspection of the partition plate. DCD_09.02.02-57

The CCW surge tank ~~capacity of 50% is able to receive the amount of inleak from RCP thermal barrier Hx in consideration of isolation time.~~normal free volume of 20% can accomodate 300 gpm potential inleakage from an RCP thermal barrier heat exchanger for thirty seconds. The most significant volume change due to system temperature change is associated with start/stop of the Boric Acid Evaporator; the effect of such a change is about 10% of surge tank compartment volume, based on a potential temperature variation of ±7°F. Relief valves provide overpressure protection and discharge to the Reactor Building sump. ~~Regarding the makeup water source of the RWSP to be seismic category I, this makeup water source provides capacity to accommodate system leakage for seven days.~~ Makeup water supply is performed by an operator by locally operating the manual valves. A vacuum breaker is installed on the surge tank to prevent damaging the tank in the event of a sudden decrease in water level. DCD_09.02.02-69

9.2.2.2.1.4 Piping

Carbon steel is used for the ~~piping of the CCWS~~CCWS piping. Piping joints and connections are welded, except where flanged connections are required. With regard to isolation of the RCP thermal barrier, piping between the check valves (NCS-VLV-405A, B, C and D) and motor-operated valves (NCS-FCV-129B, 130B, 131B, and 132B) is designed for RCS rated conditions. DCD_09.02.02-59 DCD_09.02.02-60

CCWS supply lines which supply cooling water to the safety related SSCs and to the RCPs are designed to withstand the high energy line break (HELB) as defined in BTP ASB 3-3, and to the requirements of seismic Category I, Quality Group C, and ASME Section III Class 3. DCD_09.02.02-59

9.2.2.2.1.5 Valves

The following summarizes the major CCWS valves and their functions. Table 9.2.2-7 provides a listing of valves and the Class 1E power source. DCD_09.02.02-51

- **Header tie line isolation valve (Supply valves NCS-MOV-020A/B/C/D and Return valves NCS-MOV-007A/B/C/D)** DCD_09.02.02-48

Each safety train has both supply and return header tie line isolation valves so that a single failure of one of the safety trains will not impact the other safety trains. The function of this motor operated valve is to separate each subsystem into two independent trains during abnormal and accident conditions. This ensures each safety train is isolated from ~~any~~a potential passive failure in the non-safety portion or another safety train of the CCWS. ~~This valve automatically closes at once upon the following signals:~~This valve is operated from the MCR when an operator determines that train separation is required. DCD_09.02.02-48

- ~~Low- low water level signal of a CCW surge tank~~
- ~~ECCS actuation signal and under voltage signal~~
- ~~Containment Spray signal~~

Header isolation meets the single failure criteria by incorporating two header tie line isolation valves. The ~~header isolation valves are designed to close within 30 seconds upon a S+UV signal, P signal, or surge tank water low-low level. Then, in order to resume supply of the cooling water to the RCP thermal barrier heat exchanger and the spent fuel pit heat exchanger, the isolation signal can be bypassed and the isolation valves respond. In addition, the~~ header isolation valves are ~~opened in order~~open to supply cooling water to A, B, A1 and A2 trains (or C, D, C1 and C2 trains) by one CCW pump during normal operation. In the event of an accident, the header tie line valves are closed by operator action from the MCR to achieve independence between trains. MOV-007A and MOV-020A (or MOV-007B and MOV-020B) will be closed for Subsystem A. Conversely, MOV-007C and MOV-020C (or MOV-007D and MOV-020D) will be closed for Subsystem B. The header isolation valves are designed to close within 30 seconds, but shall not close so rapidly that water hammer would occur. DCD_09.02.02-48 DCD_09.02.02-48

- **Containment Spray/Residual Heat Removal Heat Exchanger (CS/RHRS HX) CCW Outlet Valve (NCS-MOV-145A/B/C/D)** DCD_09.02.02-60

The CCW which is supplied to the CS/RHR heat exchanger is shutoff by the CCW outlet isolation valves (NCS-MOV-145A, B, C and D) during standby. However, this normal closed motor operated valve automatically opens at once upon ~~ECCS actuation signal plus~~receipt of both an ECCS actuation signal and the respective train CCW pump start signal to establish cooling water flow to the CS/RHR heat exchanger. (These valves do not control the supply flow of each component.) These valves are fully open approximately 120 seconds after signal reception. The open/close positions of the valves are displayed in the MCR. DCD_09.02.02-67 DCD_09.02.02-60 DCD_09.02.02-67 DCD_09.02.02-60

- **RCP Thermal Barrier HX CCW Return Line Isolation valve (NCS-FCV-129A/B, 130A/B, 131A/B and 132A/B)**

Two motor operated valves are located at the CCW outlet of the RCP thermal barrier Hx and close automatically upon a high flow rate signal at the outlet of this line in the event of in-leakage from the RCS through the thermal barrier Hx, and prevents this in-leakage from further contaminating the CCWS. The motor-operated valves receive a separate signal from each flow device. When the valves receive a high flow signal, the valves are closed. The high flow signal must occur for a duration that is sufficient to assure that a spurious signal does not unnecessarily close the valves. The open/close positions of the valves are displayed in the MCR. The valves are redundant to assure isolation in the event of a single failure. DCD_09.02.02-60

- **CCW Surge Tank Vent Valve and Relief Valve**

The surge tank vent valve opens upon CCW surge tank high pressure and this valve closes when the radiation monitor level exceeds its set point. The surge tank relief valve provides surge tank overpressure protection.

- **Other Relief Valve**

Other relief valves are provided to relieve the pressure buildup caused by potential thermal expansion when equipment is isolated.

- **Containment Isolation Valve**

Containment isolation valves are installed on CCW lines penetrating containment as described in Subsection 6.2.4. Containment isolation valves installed on the RCP coolant line that penetrates the containment are not automatically closed on a containment isolation signal in order to preserve flow to the RCP motor and seals. The open/close positions of the valves are displayed in the MCR where operators may control valve position as necessary. DCD_09.02.02-60

Motor-operated containment isolation valves are installed on the containment-penetrating coolant lines that lead to the letdown and the excess letdown heat exchanger. The isolation valves close automatically upon a containment isolation signal ("T" signal). The open/close positions of the valves are displayed in the MCR. It is not required to restore CCW flow to the letdown and the excess letdown heat exchangers after T signal isolation.

- **Isolation valve between seismic category I portion and non-seismic category I portion (NCS-AOV-057A/B, NCS-AOV-058A/B)** DCD_09.02.02-60

The CCW system supplies cooling water to components located in the non-seismic Category I buildings (turbine building and auxiliary building). Each CCW supply line (A2 and C2) has two in-series air operated isolation valves. These valves close automatically to isolate the non-seismic Category I portion of the CCW system upon receipt of a S~~+UV~~ signal, P signal or surge tank low-low level signal (See Figure 9.2.2-1, Sheets 1, 2 of 9). The open/close positions of the valves is displayed in the MCR. DCD_09.02.02-60

In-series check valves are provided on the CCW return lines from the non-seismic Category I portion of the CCW system (See Figure 9.2.2-1, Sheets ~~9~~1, 2 of 9). DCD_09.02.02-60

~~The CCW supply header (A2 and C2) isolation valves close automatically when one of the following occurs (See Figure 9.2.2-1, Sheet 9 of 9).~~

a) ~~The isolation valves on auxiliary building supply line~~

- ~~Low-low water level signal of the component cooling water surge tank~~
- ~~ECCS actuation signal~~
- ~~Containment spray signal~~

b) ~~The isolation valves on turbine building supply line~~

- ~~Low- low water level signal of the component cooling water surge tank~~
- ~~ECCS actuation signal and under voltage signal~~
- ~~Containment spray signal~~

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- **RCP CCW tie line isolation valve (NCS-MOV-232A/B, NCS-MOV-233A/B)** DCD_09.02.02-56

This normally closed motor operated valve ~~opens when it becomes impossible to supply cooling water to the RCP of A1 (or C1) header~~is manually opened from the MCR in the event that CCW flow is interrupted to the RCP motors and thermal barriers due to ~~the single failure of the CCW pump and on-line maintenance, and ensures the thermal barrier cooling water.~~ a single failure of one train while the second train in the same subsystem is undergoing on-line maintenance. Valve opening allows CCW flow to the affected RCP thermal barriers and motor bearing oil coolers from the alternative subsystem. The supply valves connecting to the alternative CCW subsystem are NCS-MOV-232A/B; the return valves are NCS-MOV-233A/B. The valves are operated in conjunction with an RCP CCW return line isolation valve (NCS-MOV-234A/B) to establish the alternative flow path.

- **RCP motor CCW supply line isolation valve (NCS-MOV-446A/B/C/D)**

This normally open motor operated valve ~~closes when it becomes impossible to supply cooling water to the RCP of A1 (or C1) header due to the single failure of the CCW pump and on-line maintenance, and ensures the thermal barrier cooling water.~~is manually closed from the MCR in the event that CCW is interrupted to the RCP motors and thermal barriers. Closure of the valve allows one CCWS pump to provide adequate flow to four thermal barrier heat exchangers.

- **RCP CCW supply line isolation valve (NCS-MOV-401A/B)**

This normally open motor operated valve ~~closes automatically upon P signal~~can be closed manually from the MCR to shutoff the component cooling water flow to the containment vessel.

- **RCP CCW return line isolation valve (NCS-MOV-234A/B)** DCD_09.02.02-56

~~This normally open motor operated valve closes to establish the return line of the thermal barrier cooling water in the case it becomes impossible to supply cooling water to the RCP of A1 (or C1) header due to the single failure of the CCW pump and on-line maintenance. The cooling water for the thermal barrier is ensured by opening NCS-MOV-232A and B and NCS-MOV-233A and B and closing NCS-MOV-234A (or 234B).~~This valve is normally open, but must be closed to configure the flow path to the RCPs in one subsytem (A1 or C1 header) from the other subsystem using the RCP CCW tie line isolation valves (NCS-MOV-232A/B, NCS-MOV-233A/B).

- **Letdown Heat Exchanger Outlet Valve (NCS-TCV-013)** DCD_09.02.02-67

The Letdown Heat Exchanger outlet valve is used to control the temperature of letdown water.

9.2.2.2.2 System Operations

Table 9.2.2-4 and 9.2.2-5, respectively, provide heat loads and water flow balance for various operating modes; the tables provide CCWS headers values as well as the number of operating trains. Table 9.2.2-6 provides heat loads for specific CCWS users for the various operating modes. Figure 9.2.2-2 provides system operating parameters for various locations and operating modes. DCD_09.02.02-54 DCD_09.02.02-51

9.2.2.2.2.1 Normal Power Operation

During normal operation, at least one train from each subsystem is placed in service. A total of two CCWP and two CCW HXs are in operation. A combination of trains in service is trains A or B and trains C or D.

During this operating condition, an operating CCWP in each subsystem supplies CCW to all loops in the particular subsystem with cooling water temperature not exceeding 100 °F maximum.

CCWPs which are not in service are placed in standby and automatically start upon a low pressure signal of CCW header pressure. During normal power operation, one of the two standby trains of CCW may be isolated for maintenance. If the operating train in the same subsystem with the train out for maintenance were to become unavailable, then CCW would be unavailable for two RCP motor coolers and thermal barrier heat exchangers. The RCP cross-tie isolation valves NCS-MOV-232A/B and 233A/B can be manually opened from the MCR (in conjunction with closing the appropriate NCS-MOV-234A or B valve from the MCR) to compensate for the CCW loss. The operator should align this alternative flow path to the RCP motor within 10 minutes to preclude motor overheating. This alternative flow path also provides CCW flow to the RCP thermal barriers, which ensures RCP seal cooling in the event that CVCS were unavailable for RCP seal injection. Because these valves can be slowly opened and closed, potential water hammer can be avoided. The open/close positions of the valves are displayed in the MCR. Subsection 5.4.1.3.4 discusses the effect of loss of component cooling water on reactor coolant pump operation. DCD_09.02.02-56

A milestone schedule for implementation of the operating and maintenance procedures is defined in Subsection 13.5.2. Such procedures must include isolating one train of CCW for maintenance, and the use of the RCP cross-tie valves to provide RCP thermal barrier cooling in the case of a CCW failure in the subsystem that already has one train isolated.

9.2.2.2.2.2 Normal Plant Shutdown

After approximately four hours of normal plant cool down, when the reactor coolant temperature and pressure are reduced to approximately 350 °F and 400 psig, the standby CCW HXs and pumps are placed in service resulting in four trains (i.e. four CCWPs and four CCW HXs) in operation. The CCWS isolation valve for each of the CS/RHR HXs is opened to supply cooling water to these HXs.

The failure of one cooling train (i.e. failure in one pump or one HX) increases the time for plant cool down, however, it does not affect the safe operation of the plant. The plant can be safely brought to the cold shutdown condition with a minimum of two trains.

During plant cool down by the residual heat removal system, the CCW supply temperature to the various components is permitted to increase to 110 °F.

9.2.2.2.2.3 Refueling

During refueling, the required number of CCW HXs and pumps is determined by the heat load. Normally, three trains operate in this mode. The remaining train may be taken out of service for maintenance. An operating CCWP in each subsystem supplies CCW to all loops in service in the particular subsystem with a maximum CCW supply water temperature not exceeding 100 °F.

9.2.2.2.2.4 Loss of Coolant Accident

All CCW~~P~~ pumps are automatically actuated by an ECCS actuation signal. The pump start signal ~~to the pumps is delayed~~has a 10-sec time delay for load sequencing. (Refer to Figure 8.3.1-2 Logic diagrams (Sheet 18 of 24)) The isolation valves for the CS/RHR HXs are automatically opened by the ECCS actuation signal and the same train CCWP start signal. The header tie line isolation valves ~~are closed by an ECCS actuation signal in coincidence with an undervoltage signal, and the CCWS is separated into four individual trains (A, B, C and D)~~are not automatically closed on an ECCS signal so that flow is not interrupted to the RCP thermal barriers coolers. The header tie line isolation valves must be closed by operator action to separate the CCWS into four trains (A, B, C and D). The COL Applicant is to develop a milestone schedule for implementation of the emergency operating procedures to assure that the necessary header tie line isolation valves are closed within 24 hours after an event to achieve train separation. See COL Item 13.5(6). The header tie line isolation valves can be manually reopened from the MCR to restore RCP seal and SFP HX cooling, if required. The operator must manually open the CV atmosphere gas sample cooler outlet valve (NCS-VLV-224) during accident conditions for gas sampling.

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As a minimum, two trains are required to operate during a LOCA.

9.2.2.2.2.5 Loss of Offsite Power (LOOP)

In the case of a LOOP, all CCWPs are automatically loaded onto their respective Class 1E power sources. The CCWS continues to provide cooling of the required components. The operator must manually open the CV atmosphere gas sample cooler outlet valve (NCS-VLV-224) during accident conditions for gas sampling. DCD_09.02.02-67

As a minimum, two trains are required to operate during a LOOP.

9.2.2.2.2.6 Water Hammer Prevention

The CCWS is designed in consideration of water hammer prevention and mitigation in accordance with the following as discussed in NUREG-0927.

- An elevated surge tank to keep the system filled.
- Vents for venting components and piping at all high points in the system.
- After any system drainage, venting is assured by personnel training and procedures.
- System valves are slow acting.

The CCWS is under pressure due to the static water head of the surge tank. In case of an earthquake, piping in non-earthquake resistant buildings may break. However, voiding, and associated water hammer potential, will not develop even if pressure is reduced in the broken section to atmospheric because the CCW water temperature is less than the saturation temperature at atmospheric pressure. Moreover, as isolation valves to the non-earthquake resistant buildings close because of low-low surge tank water level, the surge tank maintains a static water head. Thus, voiding is unlikely to occur in the event of pipe breaks. DCD_09.02.02-50

The COL Applicant is to develop a milestone schedule for implementation of the operating and maintenance procedures for water hammer prevention. The procedures should address the operating and maintenance procedures for adequate measures to avoid water hammer due to a voided line condition.

9.2.2.3 Safety Evaluation

The CCWS is designed to perform its safety function with only two out of four trains operating. As shown in Table 9.2.2-3, the CCWS is completely redundant and a single failure does not compromise the system's safety function even if one train is out of service for maintenance.

The safety-related portions of the CCWS is protected against natural phenomena and internal missiles. The following sections addresses natural phenomena and missiles protection.

- Section 3.3, Wind and tornado loadings;
- Section 3.4, Water Level (Flood) Protection;
- Section 3.5, Missile Protection;
- Section 3.7, Seismic Design;

Pipe rupture protection is addressed in Section 3.6, Protection against Dynamic Effects Associated with Postulated Rupture of Piping.

The CCWS continues to perform its safety function in the event of a fire. Subsection 9.5.1 addresses fire protection.

The R/B which contains safety-related portions of the CCWS is designed and constructed as a safety-related and seismic category I structure. The safety-related portions of the CCWS are designed and constructed as seismic category I.

Relief valves are provided on the components as necessary to prevent potential thermal overpressurization against over pressure of equipment and piping.

The CCWS is a closed system that is maintained in a water solid condition with a surge tank located at the highest point in the system thus preventing the potential for water hammer.

9.2.2.3.1 Leakage from Higher Pressure Components into CCWS

If leakage from a higher pressure component to the CCWS should occur, the water level of CCW surge tank increases and an alarm is transmitted to the MCR. If the in-leakage is radioactive, the radiation monitors of the CCWS also indicate in the MCR the increased radiation level and transmit an alarm when the radiation level reaches its set point. After the leak source is identified, the leak is isolated from the CCWS.

In the event that the in-leakage is through the RCP thermal barrier HX, the isolation valves on the RCP thermal barrier HX CCW return line are automatically closed by the high flow rate signal, thereby preventing further CCWS contamination.

9.2.2.3.2 Leakage from the CCWS

A decrease to the setpoint in the CCW surge tank water level initiates automatic makeup water to the surge tank and an alarm is transmitted to the main control room indicating a system leak. After the leak source is identified by visual inspection or by a change in individual CCW flow rate, the leak is isolated.

If the water level of the surge tank further decreases, the surge tank low-low water level signal is transmitted to the MCR and the ~~header tie line isolation valves automatically close. Since~~operator may close the header tie line isolation valves from the MCR. Because the subsystem consists of two ~~individual~~ trains, the train with the leak can be isolated and the other train ~~can be operated~~remains operational. DCD_09.02.02-58

In the event of a loss of system integrity in the non-seismic portion of the system, the CCWS is designed to maintain functionality by closing ~~both header tie line isolation valves and~~ the isolation valves in the supply and return lines to the non-seismic category I buildings. Automatic closure is activated upon the surge tank low-low water level signal. ~~Seismic Category I make up to the component cooling surge tank is available from the refueling water storage pit.~~The flow rate of make-up water to the surge tank is designed to be 75 gpm. This makeup capability is more than adequate to compensate for the worst case leakage through pump seals and valves if isolation of non-safety piping were required. In such a scenario, the total CCWS subsystem leak (two trains) rate is small; the potential total lost volume over a 7-day period is calculated to be less than 50 gallons per subsystem (including 25 gallons per 7 days associated with boundary isolation valving). This potential loss is also small in comparison to the available compartment water volume. Thus, the surge tank available water volume can compensate for potential leakage losses without makeup for at least 7 days. The makeup capability is also DCD_09.02.02-58 DCD_09.02.02-49 DCD_09.02.02-49 sufficient to compensate for failure of a CCWS pump seal. Such a leak could be terminated by isolation of the affected pump. DCD_09.02.02-49

As indicated above, the potential tank water loss due to leakage over 7 days is small in comparison to the available surge tank water volume. The volume of water in each surge tank compartment between the low-low level setpoint and the instrument "0" level exceeds 800 gallons. This volume allows each tank compartment to accommodate leakage of more than 3 gallons per hour continuously for 7 days without affecting CCWS function, in the event that makeup were not available.

To provide additional capability for makeup after 7 days, if needed, each CCWS subsystem has a connection for water supply from the Fire Protection Water Supply System (FSS). Because the CCWS is designed to be isolated from non-safety piping with only a small system leakage rate, makeup through the FSS would not be required for at least 7 days, even in the event of a SSE.

Component cooling water inleakage to the RCS could occur only when the RCS pressure falls below the CCWS pressure. The RCS pressure falls below the CCWS pressure only during plant shutdown, and a load which is so large as to cause damage to the thermal barrier is unlikely because the RCS side is at low temperature and low pressure. For these reasons, it is considered that there is a very low potential for inleakage of component cooling water into the RCS. DCD_09.02.02-58

9.2.2.3.3 Sharing of CCWS

The CCWS is not shared with multi-units.

9.2.2.3.4 Prevention of Corrosion

Water chemistry of CCWS is controlled and maintained by adding chemicals and covering the surge tank with nitrogen gas to prevent long term corrosion that may degrade system performance.

9.2.2.3.5 RCP seal protection

~~Even in the event that the CCW to RCP is isolated by a containment spray actuation signal and the seal water injection from the CVCS is also lost, the containment isolation valves on the CCW supply and return lines can be manually reopened from the MCR to restore RCP seal cooling. As shown in Table 9.2.2-3, the CCWS is designed to restore CCW supply to the RCP thermal barrier HX, assuming any single failure.~~ DCD_09.02.02-58

~~To re-supply water to the thermal barrier after the isolation of the containment vessel during an accident, the cooling water for the thermal barrier is ensured by opening NCS-MOV-445A/B, NCS-MOV-447A/B, and NCS-MOV-448A/B.~~The CCW provides cooling to the thermal barrier of the reactor coolant pump seals. Thermal barrier cooling provides a redundant method to CVCS seal injection for RCP seal protection. Thermal barrier cooling does not isolate on an accident signal. In the event that both CCWS flow to the RCP thermal barriers and CVCS seal injection were unavailable, the RCP seals would be expected to maintain their integrity for a short time, as indicated in Subsection 8.4.2.1.2.

9.2.2.3.6 RCP seal protection during SBO conditions

RCP seal integrity during SBO conditions is discussed in Section 8.4.

9.2.2.4 Inspection and Testing Requirements

9.2.2.4.1 Preoperational Testing and Inspection

Preoperational testing of the CCWS is performed as described in Section 14.2 to verify that system is installed in accordance with plans and specifications. The system is hydrostatically tested and is functionally tested to verify that the proper sequence of valve positions and pump starting occur on the appropriate signals. The pumps are tested to verify performance. Proper orifice installation and/or valve position settings are verified and adjusted, as required, to maintain proper flow balance in the system.

9.2.2.4.2 In-Service Testing and Inspection

During normal operation, the standby pump and CCW HX are periodically tested for operability or, alternatively, placed in service in place of the train which has been operating. Additionally periodic flow testing is performed to verify correct flow balancing among indi~~b~~vidual heat loads. DCD_09.02.02-67

Descriptions of the testing and inspection programs for pumps and valves are provided in the following subsections and sections:

- Subsection 3.9.6, Functional design, qualification & in-service testing programs for pumps, valves & dynamic restraints;
- Subsection 6.2.4, Containment Isolation System (applicable to CCWS containment isolation valves);
- Section 6.6, In-service inspection & testing of class 2 & 3 components.

9.2.2.5 Instrumentation Requirements

9.2.2.5.1 CCW supply header pressure

CCW header pressure is indicated in the MCR. When the pressure decreases due to the failure or inadvertent shutdown of the operating pump or valve misalignment, an alarm is transmitted to the MCR ~~and the standby pump is started~~based on a low pressure indication. The standby pump is automatically started based on this indication. DCD_09.02.02-60

9.2.2.5.2 CCW radiation monitor

Radiation monitors are located downstream of the supply headers and the signal is indicated in the MCR. When the signal exceeds the setpoint, an alarm is transmitted and the CCW surge tank vent valve is closed.

9.2.2.5.3 CCW supply header flow rate

The CCW supply header flow rates are indicated in the MCR.

9.2.2.5.4 CCW surge tank water level

~~The CCW surge tank water level is indicated in the MCR. If CCWS in-leakage or out-leakage occurs, a high or low water level alarm is transmitted to the MCR.~~The CCWS is designed with redundant MCR level indication for each surge tank compartment. The normal demineralized water makeup line for each CCWS surge tank compartment contains a flow indication device that can also be read in the MCR. The combination of continuously monitored compartment level and demineralized water makeup flow provides the ability to trend compartment level data and normal makeup flow. The capability to trend this data allows operators to ensure that the compartment water volume does not decrease below that necessary to ensure CCWS function for 7 days without makeup for post-seismic operation, if necessary. DCD_09.02.02-57

Surge tank water level considerations include:

- Potential inleakage from an RCP thermal barrier heat exchanger, as discussed in Subsection 9.2.2.2.1.3.
- Volume variations due to CCW temperature change, as discussed in Subsection 9.2.2.2.1.3.
- Adequate volume in each compartment to accommodate potential leakage for 7 days without makeup, as discussed in Subsection 9.2.2.3.2.

~~A low-low water level signal~~The normal water makeup valves (LCV-010A/B/C/D) are automatically closed when the surge tank reaches the normal level. A high water level signal provides an alarm in the MCR. A low water level signal provides an alarm in the MCR and opens the normal water makeup valves. Only one of the two instruments for each compartment is used to provide automatic control of the associated surge tank makeup valve. A low-low water level signal also provides a MCR alarm and isolates the components located in the non-seismic category I buildings. ~~In addition, the isolation valves on the header tie line are closed by a low-low water level signal and the subsystem, where the low-low water level signal is actuated, is divided into two independent trains for each train to supply the respective loop.~~Level indication that is on-scale (i.e., at or above the 0% instrument level) is indicative of adequate CCWS pump net positive suction head. DCD_09.02.02-48 DCD_09.02.02-57

9.2.2.5.5 RCP thermal barrier HX and RCP motor cooling water flow rate

Reactor coolant pump thermal barrier HX and motor cooling water flow rate is indicated in the MCR. If the flow rate drops to its low flow setpoint, a low flow alarm is transmitted to the MCR. A high flow alarm, resulting from the in-leakage of reactor coolant to CCWS due to the reactor coolant pump thermal barrier HX tube leak, is transmitted to the MCR when the flow rate becomes about 1.5 times as large as the normal flow rate, and the isolation valves located at cooling water return line are closed.

9.2.2.5.6 CCW surge tank pressure

The CCW surge tank pressure is locally indicated. The surge tank nitrogen cover gas supply valve and tank vent valve are controlled with open-closed control so that the tank