Table 2.7.3.3-1 Component Cooling Water System Location of Equipment and Piping (Sheet 1 of 2)

System and Components	Location
Component cooling water heat exchangers	Reactor Building
Component cooling water pumps	Reactor Building
Component cooling water surge tank	Reactor Building
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A	Reactor Building
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B	Reactor Building
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661A and NCS-VLV-671A Component cooling water system piping and valves between and including the valve NCS-AOV-601 and NCS-VLV-653	Reactor Building
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661B and NCS-VLV-671B	Reactor Building
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	Containment Reactor Building
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	Containment Reactor Building
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	Containment Reactor Building

Table 2.7.3.3-1 Component Cooling Water System Location of Equipment and Piping (Sheet 2 of 2)

System and Components	Location
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	Containment Reactor Building
Component cooling water system piping and valves related to components installed in A/B from and excluding isolation valve NCS-AOV-602 up to and excluding stop valve NCS-VLV-651	Auxiliary Building Reactor Building
Component cooling water system piping and valves related to components installed in T/B from and excluding isolation valves NCS-AOV-662A,B up to and excluding stop valves NCS-VLV-669A,B	Turbine Building Reactor Building
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)	Containment
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)	Containment
Component cooling water system piping and valves between and including the valves NCS-AOV-601 and 602	Reactor Building
Component cooling water system piping and valves between and including the valves NCS-VLV-651 and 653	Reactor Building
Component cooling water system piping and valves between and including the valves NCS-AOV-661A,B and 662A,B	Reactor Building
Component cooling water system piping and valves between and including the valves NCS-VLV-669A,B and 671A,B	Reactor Building
Component cooling water surge tank surge line piping	Reactor Building

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 2 of 8)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir	PSMS Control	Active Safety Function	Loss of Motive Power Position
CCW return header tie line isolation valves	NCS-MOV-007 A, B, C, D	3	Yes	Yes	Yes/No	ECCS Actuation and undervoltage signal	Transfer Closed	As Is
						Containment Spray	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
						Remote Manual	Transfer Open/ Transfer Closed	
CS/RHR heat exchanger CCW outlet valves	NCS-MOV-145 A, B, C, D	3	Yes	Yes	Yes/No	ECCS Actuation and CCW pump start	Transfer Open	As Is
						Remote Manual	Transfer Open/ Transfer Closed	
RCP CCW supply line outside containment isolation valves	NCS-MOV-402 A, B	2	Yes	Yes	Yes/No	~~Containment Isolation Phase B~~	~~Transfer Closed~~	As Is
						Remote Manual	Transfer Open/ Transfer Closed	

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 3 of 8)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCP CCW supply line inside containment check valves	NCS-VLV-403 A, B	2	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
Reactor coolant pump thermal barrier heat exchanger component cooling water supply check valves	NCS-VLV-405 A, B, C, D	3	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
~~RCP CCW supply line outside containment isolation valve bypass valves~~	~~NCS-MOV-445 A, B~~	~~2~~	~~Yes~~	~~Yes~~	~~Yes/No~~	~~Remote Manual~~	~~Transfer Open/ Transfer Closed~~	~~As Is~~
RCP CCW return line inside containment isolation valves	NCS-MOV-436 A, B	2	Yes	Yes	Yes/Yes	~~Containment Isolation Phase B~~ Remote Manual	~~Transfer Closed~~ Transfer Open/ Transfer Closed	As Is
RCP CCW return line inside containment check valves	NCS-VLV-437 A, B	2	Yes	-	-/-	-	Transfer Closed	-
Reactor coolant pump component cooling water return line check valves	NCS-VLV-439 A, B	3	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
~~RCP CCW return line inside containment isolation valve bypass valves~~	~~NCS-MOV-447 A, B~~	~~2~~	~~Yes~~	~~Yes~~	~~Yes/Yes~~	~~Remote Manual~~	~~Transfer Open/ Transfer Closed~~	~~As Is~~

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 4 of 8)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCP CCW return line outside containment isolation valves	NCS-MOV-438 A, B	2	Yes	Yes	Yes/No	~~Containment Isolation Phase B~~ Remote Manual	~~Transfer Closed~~ Transfer Open/ Transfer Closed	As Is
~~RCP CCW return line outside containment isolation valve bypass valves~~	~~NCS-MOV-448 A, B~~	~~2~~	~~Yes~~	~~Yes~~	~~Yes/No~~	~~Remote Manual~~	~~Transfer Open/ Transfer Closed~~	~~As Is~~
RCP motor CCW supply line isolation valves	NCS-MOV-446 A, B,C,D	3	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is
RCP CCW supply line tie line isolation valves	NCS-MOV-232 A, B	3	Yes	Yes	Yes/No	Remote Manual	Transfer Open	As Is
RCP CCW return line tie line isolation valves	NCS-MOV-233 A, B	3	Yes	Yes	Yes/No	Remote Manual	Transfer Open	As Is
RCP CCW return line isolation valve	NCS-MOV-234 A, B	3	Yes	Yes	Yes/No	Remote Manual	Transfer Closed	As Is
RCP CCW supply line isolation valves	NCS-MOV-401 A, B	3	Yes	Yes	Yes/No	~~Containment Isolation Phase B~~ Remote Manual	~~Transfer Closed~~ Transfer Open/ Transfer Closed	As Is
Letdown heat exchanger CCW supply line outside containment isolation valve	NCS-MOV-531	2	Yes	Yes	Yes/No	Containment Isolation Phase A	Transfer Closed	As Is
Letdown heat exchanger CCW return line outside containment isolation valve	NCS-MOV-537	2	Yes	Yes	Yes/No	Containment Isolation Phase A	Transfer Closed	As Is

Table 2.7.3.3-3 Component Cooling Water System Piping Characteristics (Sheet 1 of 2)

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A	3	Yes
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B	3	Yes
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661A and NCS-VLV-671A Component cooling water system piping and valves between and including the valve NCS-AOV-601 and NCS-VLV-653	-	No
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661B and NCS-VLV-671B	-	No
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	Yes
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	Yes
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	Yes

Table 2.7.3.3-3 Component Cooling Water System Piping Characteristics (Sheet 2 of 2)

Pipe Line Name	ASME Code Section III Class	Seismic Category 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	Yes
Component cooling water system piping and valves related to components installed in A/B from and excluding isolation valve NCS-AOV-602 up to and excluding stop valve NCS-VLV-651	-	No
Component cooling water system piping and valves related to components installed in T/B from and excluding isolation valves NCS-AOV-662A,B up to and excluding stop valves NCS-VLV-669A,B	-	No
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	Yes
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	Yes
Component cooling water system piping and valves between and including the valves NCS-AOV-601 and 602	3	Yes
Component cooling water system piping and valves between and including the valves NCS-VLV-651 and 653	3	Yes
Component cooling water system piping and valves between and including the valves NCS-AOV-661A,B and 662A,B	3	Yes
Component cooling water system piping and valves between and including the valves NCS-VLV-669A,B and 671A,B	3	Yes
Component cooling water surge tank surge line piping	3	Yes

NOTE:
Dash (-) indicates not applicable

Table 2.7.3.3-4 Component Cooling Water System Equipment Alarms, Displays, and Control Functions (Sheet 1 of 2)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Component cooling water pumps (NCS-MPP-001 A,B,C,D)	No	Yes	Yes	Yes
CCW supply header tie line isolation valves (NCS-MOV-020A,B)	No	Yes	Yes	Yes
CCW return header tie line isolation valves (NCS-MOV-007A,B)	No	Yes	Yes	Yes
CS/RHR heat exchanger CCW outlet valves (NCS-MOV-145A,B,C,D)	No	Yes	Yes	Yes
RCP CCW supply line outside containment isolation valves (NCS-MOV-402A,B)	No	Yes	Yes	Yes
~~RCP CCW supply line outside containment isolation valve bypass valves (NCS-MOV-445A,B)~~	~~No~~	~~Yes~~	~~Yes~~	~~Yes~~
RCP CCW return line inside containment isolation valves (NCS-MOV-436A,B)	No	Yes	Yes	Yes
~~RCP CCW return line inside containment isolation valve bypass valves (NCS-MOV-447A,B)~~	~~No~~	~~Yes~~	~~Yes~~	~~Yes~~
RCP CCW return line outside containment isolation valves (NCS-MOV-438A,B)	No	Yes	Yes	Yes
~~RCP CCW return line outside containment isolation valve bypass valves (NCS-MOV-448A,B)~~	~~No~~	~~Yes~~	~~Yes~~	~~Yes~~
RCP motor CCW supply line isolation valves (NCS-MOV-446A,B,C,D)	No	Yes	Yes	Yes
RCP CCW supply line tie line isolation valves (NCS-MOV-232A,B)	No	Yes	Yes	Yes
RCP CCW return line tie line isolation valves (NCS-MOV-233A,B)	No	Yes	Yes	Yes
RCP CCW return line isolation valve (NCS-MOV-234A,B)	No	Yes	Yes	Yes
RCP CCW supply line isolation valves (NCS-MOV-401A,B)	No	Yes	Yes	Yes
Charging pump CCW return isolation valve (NCS-MOV-316A,B)	No	Yes	Yes	Yes
Charging pump fire fighting water supply isolation valve (NCS-MOV-321A, B)	No	Yes	Yes	Yes
Charging pump alternative cooling water supply isolation valve (NCS-MOV-322A,B)	No	Yes	Yes	Yes
Charging pump non-essential chilled water supply isolation valve (NCS-MOV-323A,B)	No	Yes	Yes	Yes
Charging pump alternative cooling water return isolation valve (NCS-MOV-324A,B)	No	Yes	Yes	Yes

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 9 of 10)

<table>
<tr><th>System Name</th><th>Tag No.</th><th>ASME Code Section III Class</th><th>Seismic Category I</th><th>Remotely Operated Valve</th><th>Class 1E/ Qual. For Harsh Envir.</th><th>Safety-Related Display</th><th>PSMS Control</th><th>Active Safety Function</th><th>Loss of Motive Power Position</th></tr>
<tr><td>CCWS</td><td>NCS-MOV-402 A, B</td><td colspan="8" rowspan="12">Refer to Tables 2.7.3.3-2 and 2.7.3.3-4</td></tr>
<tr><td>CCWS</td><td>NCS-VLV-403 A, B</td></tr>
<tr><td>~~CCWS~~</td><td>~~NCS-MOV-445 A, B~~</td></tr>
<tr><td>CCWS</td><td>NCS-MOV-436 A, B</td></tr>
<tr><td>CCWS</td><td>NCS-VLV-437 A, B</td></tr>
<tr><td>~~CCWS~~</td><td>~~NCS-MOV-447 A, B~~</td></tr>
<tr><td>CCWS</td><td>NCS-MOV-438 A, B</td></tr>
<tr><td>~~CCWS~~</td><td>~~NCS-MOV-448 A, B~~</td></tr>
<tr><td>CCWS</td><td>NCS-MOV-531</td></tr>
<tr><td>CCWS</td><td>NCS-MOV-537</td></tr>
<tr><td>CCWS</td><td>NCS-MOV-511</td></tr>
<tr><td>CCWS</td><td>NCS-MOV-517</td></tr>
</table>

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 10 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
15. Remotely operated CIVs located inside and outside the containment in series on the same penetration are powered from different Class 1E divisions.	15. Inspection of the remotely operated CIVs located inside and outside the containment in series on the same penetration will be performed.	15. The following CIVs located inside and outside the containment in series on the same penetration are powered from different Class 1E divisions.

Inside containment	Outside containment
RCS-AOV-147	RCS-AOV-148
CVS-AOV-005	CVS-AOV-006
CVS-MOV-203	CVS-MOV-204
NCS-MOV-436A ~~NCS-MOV-447A~~	NCS-MOV-438A ~~NCS-MOV-448A~~
NCS-MOV-436B ~~NCS-MOV-447B~~	NCS-MOV-438B ~~NCS-MOV-448B~~
LMS-AOV-052	LMS-AOV-053
LMS-AOV-055	LMS-AOV-056 LMS-AOV-060
LMS-LCV-010A	LMS-LCV-010B
LMS-AOV-104	LMS-AOV-105
PSS-AOV-003 PSS-MOV-006 PSS-MOV-013	PSS-MOV-031A
PSS-MOV-023	PSS-MOV-031B
PSS-AOV-062A PSS-AOV-062B PSS-AOV-062C PSS-AOV-062D	PSS-AOV-063
RWS-MOV-002	RWS-MOV-004
VCS-AOV-306	VCS-AOV-307
VCS-AOV-305	VCS-AOV-304
VCS-AOV-356	VCS-AOV-357
VCS-AOV-355	VCS-AOV-354
VWS-MOV-422	VWS-MOV-407
RMS-MOV-001	RMS-MOV-002
IGS-AOV-002	IGS-AOV-001

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-033B and 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-661B and NCS-VLV-671B (including 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	

Table 3.9-14 Valve Inservice Test Requirements (Sheet 66 of 112)

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-401A	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-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

Table 3.9-14 Valve Inservice Test Requirements (Sheet 67 of 112)

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-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
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~~

Table 3.9-14 Valve Inservice Test Requirements (Sheet 68 of 112)

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~~
~~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~~
~~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~~
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 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	

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

- Safety injection system.
- Containment spray system
- Residual heat removal system

<u>Component cooling water system</u>

- Emergency feedwater system
- Main steam system
- Seal water injection
- 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 h
systems. These systems are located in s
system is installed in each system. Leve
compartment sump. In addition, if leak is
suction/discharge pressure and pump flo
507A, B, C, D, NMS-MOV-701A, B, C, D a

<u>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.</u>

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. 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.

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 leakage rate testing will be subject to seals replacement based on a valve manufacturer recommendation.

Table 6.2.4-1 presents the design information regarding provisions for isolating the containment penetrations, while Table 6.2.4-2 and Figure 6.2.4-1 presents associated containment isolation configurations. Table 6.2.4-3 presents the list of containment 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.

- 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.

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. In addition, penetrations exist that do not contain isolation valves, these lines are typically blank flanged. Table 6.2.4-2 lists GDC 56 systems with single valve isolation or blank flanges and justification, in accordance with the guidance in NUREG-0800, SRP 6.2.4 (Ref. 6.2-27).

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	Power Source	Remark
P220	56	CSS	Silicone Oil	3/4	Yes	Sht. 17	-	-	A	N	-	-	-	-	-	-	-	-	-	-	-	-	Note 8
P222	56	CSS	Silicone Oil	3/4	Yes	Sht. 17	-	-	A	N	-	-	-	-	-	-	-	-	-	-	-	-	Note 8
P416	56	CSS	Silicone Oil	3/4	Yes	Sht. 17	-	-	A	N	-	-	-	-	-	-	-	-	-	-	-	-	Note 8
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	
				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	
				4			~~NCS-MOV-445B~~	~~Out~~				~~Globe~~	~~Motor~~	~~Manual~~	~~None~~	~~C~~	~~C~~	~~O~~	~~FAI~~	~~NA~~	~~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	
				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	
				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	O	O	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	

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.

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.

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 Re

During refueling, the r by the heat load. Normally, three t taken out of service for maintenan CW to all loops in service in the ter temperature not excee

9.2.2.2.2.4 Los

All CCWP are automatically actuated by ECCS actuation signal. The start signal to the pumps is delayed. (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 **<u>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)</u>** ~~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).~~ The header tie line isolation

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.

operator may close the header tie line isolation valves from the MCR. Because

9.2.2.3.2 Leakage from the CCWS

A decrease to the setpoint in the CCW surge tank [illegible]tomatic 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~~ the subsystem consists of two ~~individual~~ trains, the train with the leak can be isolated and the other train ~~can be operated~~. **remains operational.**

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 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.

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.

9.2.2.3.3 Sharing o[illegible]

The CCWS is not shared [illegible]

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.

9.2.2.3.4

Water c... coverin... 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.~~

~~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.~~

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 indibidual heat loads.

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.

(Opening the RCP Cross Tie Isolation Valves provides a flow path for RCP cooling if there should be a failure of the operating train in the same subsystem that has another train in a maintenance outage.)

Tabl[...]ilure Modes and Effects Analysis (Sheet 1 of 4)

Item	C[...]	[...]	[...]de	Effect on System Safety Function	Failure Detection Method
1	CCW [...]	[...] related components	[...]n the demand signal Trip for any reason	None Remaining three 50% capacity pumps are available. Minimum two pumps are required.	Pump status lights indication in MCR Low pressure alarm of header pressure
2	header tie line isolation valve (MOV-007A,B, MOV-020A,B)	Separates to independent two trains	Fails to close upon the ~~demand signal~~ remote manual signal	None Each train have own isolation valve. Either train could be isolated from the other train. Note 1	Valve [...] MCR
		~~Opens to provide flow path to A1 loop after close of header tie line isolation valve~~	~~Fails to open upon the remote manual signal~~	~~None~~ ~~Each train have own isolation valve. Either train's valve could be opened.~~	~~Valve position indication in MCR~~
3	header tie line isolation valve (MOV-007C,D, MOV-020C,D)	Separates to independent two trains	Fails to close upon the ~~demand signal~~ remote manual signal	None Each train have own isolation valve. Either train could be isolated from the other train.	Valve position indication in MCR
		~~Opens to provide flow path to C1 loop after close of header tie line isolation valve~~	~~Fails to open upon the remote manual signal~~	~~None~~ ~~Each train have own isolation valve. Either train's valve could be opened.~~	~~Valve position indication in MCR~~
4	CS/RHR HX cooling water outlet valve (MOV-145A,B,C,D)	Opens to provide flow path to CS/RHR heat exchanger	Fails to open upon the demand signal	None Remaining three 50% capacity CS/RHR Heat Exchanger are available. Minimum two Heat [...]	Valve position indication in MCR

Note 1: As discussed in Subsection 9.2.2.2.2.4, header tie line isolation valve closure is assumed within 24 hours, by manual operation from the MCR, after an ECCS signal to establish separation of the two trains within a subsystem. Prior to closure of the header tie line isolation valves, there is the potential for additional loading on one train of a subsystem if a single failure is postulated in the other train (e.g., Given a ECCS automatic initiation signal and a single failure of one CCWS pump to auto start, one CCWS may supply ECCS loads to two trains). The additional heat load on the available heat exchanger is small in comparison to the heat exchanger margins discussed in Subsection **9.2.2.2.1.1.**

Table 9.2.2-3 Component Cooling Water System Failure Modes and Effects Analysis (Sheet 3 of 4)

Item	Component	Safety Function	Failure Mode	Effect on System Safety Function	Failure Detection Method
9	Containment isolation valve for supply to excess letdown heat exchanger (MOV-511)	Closes to provide containment pressure boundary	Fail to close on the demand signal	None System inside containment is used as one of the isolation barriers. And system is designed to satisfy the requirements for closed system.	Valve position indication in MCR
10	Containment isolation valve for return line from excess letdown heat exchanger (MOV-517)	Closes to provide containment pressure boundary	Fail to close on the demand signal	None System inside containment is used as one of the isolation barriers. And system is designed to satisfy the requirements for closed system.	Valve position indication in MCR
11	Containment isolation valve for supply to RCP (MOV-402A,B)	Closes to provide containment pressure boundary	Fail to close on the ~~demand signal~~ remote manual signal	None A check valve (VLV-403A,B) is provided in series to provide containment pressure boundary.	Valve (motor operated valve) position indication in MCR
		~~Opens to provide flow path to RCP~~	~~Fail to open up on the remote manual signal~~	~~None~~ ~~A motor operated valve (MOV-445A,B) is provided in parallel to provide flow path to RCP.~~	~~Valve (motor operated valve) position indication in MCR~~

Table 9.2.2-3 Component Cooling Water System Failure Modes and Effects Analysis (Sheet 4 of 4)

Item	Component	Safety Function	Failure Mode	Effect on System Safety Function	Failure Detection Method
12	Containment isolation valve (inside CV) for return line from RCP (MOV-436A,B)	Closes to provide containment pressure boundary	Fail to close on the ~~demand signal~~ remote manual signal	None A motor operated valve (MOV-438A,B) is provided in series to provide containment pressure boundary.	Valve position indication in MCR
		~~Opens to provide flow path to RCP~~	~~Fail to open up on the remote manual signal~~	~~None~~ ~~A motor operated valve (MOV-447A,B) is provided in parallel to provide flow path to RCP.~~	~~Valve position indication in MCR~~
13	Containment isolation valve (outside CV) for return line from RCP (MOV-438A,B)	Closes to provide containment pressure boundary	Fail to close on the ~~demand signal~~ remote manual signal	None A motor operated valve (MOV-436A,B) is provided in series to provide containment pressure boundary.	Valve position indication in MCR
		~~Opens to provide flow path to RCP~~	~~Fail to open up on the remote manual signal~~	~~None~~ ~~A motor operated valve (MOV-448A,B) is provided in parallel to provide flow path to RCP.~~	~~Valve position indication in MCR~~

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/29/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 571-4365 REVISION 0**
SRP SECTION:	**09.02.02 – REACTOR AUXILIARY COOLING WATER SYSTEM**
APPLICATION SECTION:	**9.2.2**
DATE OF RAI ISSUE:	**4/13/2010**

QUESTION NO.: 09.02.02-59
Follow-up to RAI 362-2278, question 09.02.02-35

Based on the staff's review of the applicant's response to RAI 09.02.02-35, the following item should be addressed.

The applicant referenced DCD Tier 2, Section 9.2.2.1 stating that the CCWS supply to the RCPs is required by GDC 44. The DCD is unclear as to whether the CCWS supply lines to the RCPs meet the guidance in the SRP and that the component cooling water supply to each pump is designed to withstand a single, active failure or a moderate-energy line crack as defined in Branch Technical Position 3-3 and to seismic Category I, Quality Group C, and American Society of Mechanical Engineers (ASME) Section III Class 3 requirements. The CCWS supply system to the RCPs should be adequately described in the DCD related to the SRP.

Reference: MHI's Responses to US-APWR DCD RAI No. 362-2278; MHI Ref: UAP-HF-09333; dated June 19, 2009; ML091760624.

ANSWER:

Tier 2 Subsection 9.2.2.2.1.4 will be revised to address CCWS piping to the RCPs.

The response provided to this question via UAP-HF-10160 committed to adding the discussion presented below to the DCD. DCD Revision 3 inadvertently omitted the change. The change will be added to the next DCD revision.

Impact on DCD
DCD Tier 2 Subsection 9.2.2.2.1.4 will be revised as follows:

Carbon steel is used for the **CCWS** piping~~ of the CCWS~~. Piping joints and connections are welded, except where flanged connections are required.

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.

Impact on R-COLA
There is no impact on the R-COLA.

Impact on S-COLA
There is no impact on the S-COLA.

Impact on PRA
There is no impact on the PRA.

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
- Refueling water storage system (RWS) which supplies the refueling 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.

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.

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 s

<u>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.</u>

T eak from RCP thermal barrier Hx in consideration of isolation time. 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.

9.2.2.2.1.4 Piping

Carbon steel is used for the ~~piping of the CCWS~~ **<u>CCWS piping</u>**. Piping joints and connections are welded, except where flanged connections are required.

9.2.2.2.1.5 Valves

- **Header tie line isolation valve**

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 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:

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/29/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 571-4365 REVISION 0**
SRP SECTION:	**09.02.02 – REACTOR AUXILIARY COOLING WATER SYSTEM**
APPLICATION SECTION:	**9.2.2**
DATE OF RAI ISSUE:	**4/13/2010**

QUESTION NO.: 09.02.02-60
Follow-up to RAI 362-2278, question 09.02.02-36

Based on the staff's review of the applicant's response to RAI 09.02.02-36, the staff determined that for except for the ninth (9th) bullet (CCWS radiation monitors), the RAI responses were not adequately described or resolved. Specifically, the interlocks, setpoints, power supplies and logic were not described. Therefore, additional information and details should be provided.

Reference: MHI's Responses to US-APWR DCD RAI No. 362-2278; MHI Ref: UAP-HF-09333; dated June 19, 2009; ML091760624.

ANSWER:

- Bullet 1

  [Question] For the component cooling water pumps, low system pressure starts the standby pump. Describe in the DCD which pumps are interlocked together for this function and describe the flow rate setpoints, power supplies and logic.

  [Answer] Using a pressure sensor installed on each header tie line, the CCWS monitors discharge pressure during CCW pump operation. When this pressure drops below the setpoint, the operating pumps are expected to trip. Therefore, a low pressure signal results in an alarm and automatic actuation of the standby pump; the low pressure signal is actuated by the pressure sensor installed in the same train. A header pressure and the start/stop positions of the CCW pump are displayed in the MCR. The CCWS pumps are powered from their respective Class 1E division, as described in DCD Subsection 9.2.2.2.2.5.

- Bullet 2

  [Question] In regards to CCWS header-tie line (suction and discharge) isolation, describe in the DCD which valves are interlocked together for this function and describe the setpoints, power supplies and logic.

  [Answer] The CCWS header tie line isolates safety system headers A, B, C and D in the event of an anomaly or accident in the CCWS. The purpose is to ensure that a failure in one safety system header would not affect the other safety system headers. The header tie line isolation valves (NCS-MOV-007A/B and C/D as well as NCS-MOV 020A/B and C/D) are closed by the operator as determined by procedure to achieve train separation. The open/close positions of the valves are displayed in the MCR. Because there are two tie-line isolation valves, separation of the safety system train can be ensured even in the event of a single active failure. Please refer to the response to Question 9.2.2-51 for information regarding power supplies.

- Bullet 3

[Question] In regards to the CCWS containment spray heat exchanger, describe in the DCD which valves are interlocked together for this function and describe the setpoints, power supplies and logic.

[Answer] There are normally closed motor-operated gate valves (NCS-MOV-145A/B/C/D) at the outlet of the CS/RHR Hx to which each safety system CCW header supplies water. The valves are closed during normal operation when the CS/RHR Hx is not operating and are opened remotely by an MCR operator during plant cooldown operations. The valves are opened automatically if both an ECCS actuation signal and the signal to actuate CCW pumps in the same train to supply cooling water to the CS/RHR Hx are received. In addition, please refer to the response to Question 9.2.2-51 for information regarding power supplies.

- Bullet 4

[Question] In regards to the reactor coolant pumps/motors, CCWS isolation valves, and containment isolation valves, describe in the DCD which valves are interlocked together for this function and describe the power supplies, setpoints and logic.

[Answer] Containment isolation valves (NCS-MOV-402A/B, 436A/B and 438A/B) are installed on the RCP coolant lines that penetrate the containment. The valves, which are open during normal operation, do not close automatically even if containment isolation signals affect other containment isolation valves so that flow is not interrupted to the RCP thermal barriers. The open/close positions of the valves, and related valves (NCS-MOV-401A/B) are displayed in the MCR and may be operated from the MCR if closure is required. Please refer to the response to Question 9.2.2-51 for information regarding power supplies.

- Bullet 5

[Question] In regards to the letdown and excess letdown, CCWS isolation valves, and containment isolation valves, describe in the DCD which valves are interlocked together for this function and describe the power supplies, setpoints and logic.

[Answer] Motor-operated containment isolation valves (NCS-MOV-511, 517, 531 and 537) are installed on the containment-penetrating coolant lines that connect to the non-regenerative 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 non-regenerative and the excess letdown heat exchangers after T signal isolation. DCD Tier 2 Subsection 9.2.2.2.1.5 will be revised to reflect that restoration of flow to the letdown and excess letdown heat exchangers is not required after isolation of the cooling water supply and return lines. Please refer to the response to Question 9.2.2-51 for information regarding power supplies.

- Bullet 6

[Question] For the CCWS isolation valves in the auxiliary building and turbine building, describe in the DCD which valves are interlocked together for this function and describe the power supplies, setpoints and logic.

[Answer] Air-operated valves (NCS-AOV-057 A/B and 058 A/B) for establishing a seismic boundary or achieving isolation in the event of a system or component failure are installed on the coolant supply lines that lead to the boric acid evaporators, waste treatment systems and other equipment installed in the low-seismic-class auxiliary building as well as those that lead to the instrument air compressors in the turbine building. Two valves are installed in series to assure closure in the event of a single failure. These valves close automatically upon CCW surge tank low-low, ECCS actuation and containment spray signals. The open/close positions of the valves are displayed in the MCR. The valves fail to the closed position on loss of air. The DCD will also be modified to add a statement that valve position is indicated in the MCR. Please refer to the response to Question 9.2.2-51 for information regarding power supplies.

- Bullet 7

[Question] In regards to the reactor coolant pumps thermal barrier CCWS isolation valves, describe in the DCD which valves are interlocked together for this function and describe the power supplies, setpoints and logic.

[Answer] Two motor-operated valves (NCS-FCV-129A/B, 130A/B, 131A/B, and 132A/B) are installed in series at each RCP thermal barrier coolant outlet to assure isolation in the event of a single failure. When a leak occurs in the RCS, the valves close automatically upon receipt of a coolant high flow signal from each flow rate sensor to prevent high temperature and pressure in the CCWS. Two motor-operated valves (NCS-FCV-129A/B, 130A/B, 131A/B, and 132A/B) receive a separate signal from each flow device. Upon receipt of a high flow signal, the valves are closed. The high flow signal must occur for a duration specified at the detailed design stage to assure that a spurious signal does not unnecessarily close the valves. A typical signal duration used in Japanese plants is on the order of 10 to 15 seconds.

The piping between the check valves (NCS-VLV-405A, B, C and D) and motor-operated valves (NCS-FCV-129A/B, 130A/B, 131A/B, and 132A/B) is designed for RCS rated conditions. The piping has a relief valve to protect the piping if a leak from the RCS would occur. The open/close positions of the valves are displayed in the MCR. DCD Tier 2 Subsection 9.2.2.2.1.5 will be revised to clarify the function and actuation of the two motor-operated valves that are installed in series at each RCP thermal barrier coolant outlet. DCD Tier 2 Subsection 9.2.2.2.1.4 will be revised to specify the piping design between the check valves and motor-operated valves as well as the valve closure signal. Please refer to the response to Question 9.2.2-51 for information regarding power supplies.

- Bullet 8

[Question] In regards to the CCWS surge tanks, level, and pressure, describe in the DCD which valves are interlocked together for this function and describe the power supplies, setpoints and logic.

[Answer] Several valves are actuated in response to the surge tank water level. The water level drops in the event of leakage from the CCW system and from long-term water level changes during normal operation. As the water level drops to the surge tank low level, a surge tank low signal is generated, and valves (NCS-LCV-010 and 020) which provide make-up to the CCW system open. The normal make-up water in this case is degassed water or demineralized water. If the water level drops further, it is assumed that there is a leak exceeding the make-up flow rate of 75 gpm, and the valves (NCS-AOV-057 A/B and 058 A/B) at the boundary with the non-Seismic I piping close. Please refer to the response to Question 9.2.2-51 for information on power supplies.

- Bullet 10

[Question] Describe in the DCD any time delays related to a CCWS pump automatic start signal (such as safety injection signals), containment spray heat exchanger discharge valve opening times, and sub-train header valve isolation timing.

[Answer] The CCW pumps are actuated by an engineered safety features actuation signal (ECCS signal) or loss of off-site power signal (BO signal). The ECCS signal actuates all CCW pumps at a 10-sec time delay.

In the case of the "BO" signal, the operating CCW pumps are stopped upon a "UV" signal for gas turbine protection. The logic allows the CCW pumps to start 10 seconds after emergency power is established from the gas turbine. See DCD Tier 2 Section 8.3 for details. The isolation valves in the CS/RHR Hx outlet open upon an ECCS signal or a signal to actuate the CCW pumps in the same train. These valves are fully open approximately 120 seconds after signal reception.

DCD Tier 2 Subsection 9.2.2.2.2.4 will be revised to clarify the 10-sec time delay.

Impact on DCD

<u>DCD Tier 2 Subsection 9.2.2.2.1.4 will be revised as follows:</u>

- Add statement that piping related to RCP thermal barrier between check valves and motor-operated valves is designed for RCS rated conditions.

DCD Tier 2 Subsection 9.2.2.2.1.5 will be revised as follows:

- Containment Spray/Residual Heat Removal Heat Exchanger (CS/RHRS HX) CCW Outlet Valve
    - Clarify that both ECCS and pump start signal are required for CS/RHR valve outlet valve auto open.
    - Add valve opening times.
    - Add statement regarding MCR valve position indication.
- RCP Thermal Barrier HX CCW Return Line Isolation valve
    - Add description of redundant valves which isolate on separate flow device signals.
    - Add statement regarding MCR valve position indication.
    - Add statement regarding sufficient duration of high flow signal.
- Containment Isolation Valve
    - Add statement that RCPs are not automatically isolated on containment isolation signals.
    - Clarification that restoration of flow to the letdown and excess letdown heat exchangers is not required after isolation of the cooling water.
    - Add statement regarding MCR valve position indication.
- Isolation valve between seismic category I portion and non-seismic category I portion
    - Add statement regarding MCR valve position indication.
    - Reflect modified isolation valve configuration.

DCD Tier 2 Subsection 9.2.2.2.2.4 will be revised as follows:

- Clarify the 10-second CCW pump start time delay.

DCD Tier 2 Subsection 9.2.2.5.1 will be revised as follows:

- Add basis for starting standby CCWS pump on low-pressure indication.

Impact on R-COLA
There is no impact on the R-COLA.

Impact on S-COLA
There is no impact on the S-COLA.

Impact on PRA
There is no impact on the PRA.

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
- Refueling water storage system (RWS) which supplies the refueling 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.

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.

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.

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. 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.

9.2.2.2.1.4 Piping

Carbon steel is used for the piping of the CCWS. 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.

9.2.2.2.1.5 Valves

- **Header tie line isolation valve**

The function of this motor operated valve is to separate each independent trains during abnormal and accident conditions. train is isolated from any 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:

- 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 barr pit heat exchanger, the isolation signal can be bypas In addition, the header isolation valves are opened B, A1 and A2 trains (or C, D, C1 and C2 trains) by one CCW pump during normal operation.

These valves are fully open approximately 120 seconds after signal reception. The open/close positions of the valves are displayed in the MCR.

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

The CCW which is supplied to the CS/RHR heat exchanger is shutoff by the CCW outlet isolation valve during standby. However, this normal closed motor operated valve automatically opens at once upon ~~ECCS actuation signal plus~~ the respective train CCW pump start signal to establish cooling water flow to the CS/RHR heat exchanger.

receipt of both an ECCS actuation signal and

- **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.

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

The surge tank vent valve opens upon CCW closes when the radiation monitor level excee provides surge tank overpressure protection.

- **Other Relief Valve**

Other relief valves are provided to re thermal expansion when equipment

- **Containment Isolation Valve**

Containment isolation valves are ins 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.

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 seism portion**

The CCW system supplies cooling w Category I buildings (turbine building and auxiliary building). Each CCW supply line (A2

(NCS-AOV-057A/B, NCS-AOV-058A/B)

(See Figure 9.2.2-1, Sheets 1, 2 of 9). The open/close positions of the valves is displayed in the MCR.

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~~ **S** signal, P signal or surge tank low-low level signal.

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, ~~Sheet 9~~ **Sheets 1, 2** of 9).

~~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~~

- **RCP CCW tie line isolation valve**

This normally closed motor operated valve opens 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.

- **RCP motor CCW supply line isolation valve**

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.

- **RCP CCW supply line isolation valve**

This normally open motor operated valve closes automatically upon P signal to shutoff the component cooling water flow to the containment vessel.

- **RCP CCW return line isolation valve**

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).

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.

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.

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 ~~CCWP~~ CCW 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). The header tie line isolation

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~~.

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.

based on a low pressure indication. The standby pump is automatically started based on this indication.

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.

A low-low water level signal 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.

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 pressures are maintained within a pre-set range. High and low surge tank pressures are alarmed in the MCR.

9.2.2.5.7 CCWP discharge and suction pressure

The CCW pump discharge and suction pressures are locally indicated and are used for CCW pump performance testing.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/29/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 571-4365 REVISION 0**
SRP SECTION:	**09.02.02 – REACTOR AUXILIARY COOLING WATER SYSTEM**
APPLICATION SECTION:	**9.2.2**
DATE OF RAI ISSUE:	**4/13/2010**

QUESTION NO.: 09.02.02-67
Follow-up to RAI 362-2278, question 09.02.02-44

Based on the staff's review of the applicant's response to RAI 09.02.02-44, the following previously identified items need to be further addressed.

Item 1: The staff was unable to accept the response since the RAI response did not provide a DCD markup of the changes that will be incorporated into Tier 2, Section 9.2.2. Therefore, the DCD markup for the changes should to be provided.

Item 3: The staff was unable to accept the response since the proposed DCD markup was not correctly incorporated in Revision 2 of the DCD. Therefore, the DCD markup for the changes should to be provided. Or, verify that the response incorrectly referenced section 9.2.2.4.1, instead of 9.2.2.4.2, for which there was a markup which was correctly incorporated in Revision 2 of the DCD.

Item 7: In order to perform a complete evaluation of the system, Tier 1, should state how the system maintains temperature and how flow is controlled.

Items 8 and Item 10: The staff was unable to accept the response since it was unclear as to whether the surge tank is sized for system leakage for 7 days without makeup or if credit is taken for a seismic source for 7 days. The tank size and seismic makeup should be address in Tier 1.

Item 11: The staff was unable to accept the response since instrumentation was not described on the Tier 1 figures. The applicant should describe if any of the following apply for the CCWS (see SRP 14.3 Appendix C I B, "Figures");

- As a minimum, the instruments (pressure, temperature, etc.) required to perform Generic Technical Guidelines (e.g., ERGs, EPGs)(as described in the DCD Tier 2 Chapter 18) should be shown on the figures, or described in the design description (DD).
- The minimum inventory of alarms, indications, and controls, if established in the main control room or remote shutdown panel ITAAC, do not have to be discussed in individual DD's or shown on figures. Other "essential" alarms (e.g., associated with shutdown cooling system (SCS) high pressure, SCS performance monitoring indications) not part of the minimum inventory should be shown on the figures.
- Identification of all alarms, displays and controls on the remote shutdown panel should be

included in the system diagram or alternatively in the remote shutdown panel ITAAC.

Item 14: The staff was unable to accept the response since the proposed DCD markup and the information that was incorporated into Revision 2 of the DCD was different (flow mark numbers).

Item 15: The staff was unable to accept the response since the Tier 1 figures and Tier 2 figures disagree. Specifically, the placement of the thermal barrier cross-tie header is upstream of the charging pump as shown on the Tier 2 figures and the placement of MOV-234A/B are incorrect on the Tier 1 figures. Check valves VLV-231A and VLV-231B are important design features as part of the thermal barrier cross-tie and should be shown in the Tier 1 figures.

Reference: MHI's Responses to US-APWR DCD RAI No. 362-2278; MHI Ref: UAP-HF-09388; dated July 16, 2009; ML092080393.

ANSWER:

Item 1: Tier 2 DCD Section 9.2.2 Rev 2 (and DCD Revision 3 provided to the NRC by MHI letter UAP-HF-11078 on 31 March 2011) incorporates the previous markups. That, along with the new markups provided in the response to this and other Section 9.2.2 questions, provides the required level of detail for Tier 2 material consistent with previously approved certifications. Attached is the Tier 2 markup of Section 9.2.2 for changes associated with this response.

Item 3: The previous response incorrectly referenced section 9.2.2.4.1, instead of 9.2.2.4.2, for which there was a markup that was correctly incorporated in Revision 2 of the DCD. Attached is Tier 2 Section 9.2.2.4.2, DCD Revision 3, which includes the change identified in the previous response. In addition, DCD Tier 2 Section 9.2.2.4.2 will be changed to "individual" from "indibidual".

Item 7: 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 more than enough supply water to the auxiliary equipment. The heat exchangers that remove heat load under normal operation have an adequate capacity to supply CCW of 100°F to each piece of auxiliary equipment even for an ESW temperature of 95°F. Thus, the supply temperature of 100°F or less necessary for normal operation is maintained without any special control, so that flow rate is regulated depending on the CCW temperature, without any temperature control. DCD Tier 2 Subsection 9.2.2.2.1.2 will be revised to discuss the effect of throttling. The operator must manually open the CV atmosphere gas sample cooler outlet valve (NCS-VLV-224) during accident conditions. The Containment Spray/ RHR Hx outlet (NCS-MOV-145A, B, C and D) valves are automatically or remotely opened. However, these valves do not control the supply flow of each component. On the other hand, the Letdown Hx outlet valve (NCS-TCV-013) controls the temperature of letdown water, which may result in flow changes during normal operation. DCD Tier 2 Subsection 9.2.2.2.2.4 will be revised to reflect operation of the CV atmosphere gas sample cooler, Containment Spray/RHR Hx and Letdown Hx outlet valves. The manual flow control valves are shown in Tier 2 DCD Figure 9.2.2-1 as detailed design information. Therefore, MHI believes it is unnecessary to include manual flow control valves, which reflect detail design information, in Tier 1.

Item 8 and 10: Surge tank piping systems description and clarifications to delete unnecessary piping were included in DCD Revision 2 Tier 1 Tables 2.7.3.3-1 through 2.7.3.3-3 (and DCD Revision 3). The surge tank has adequate capacity that makeup is not required for at least 7 days if the tank is isolated. DCD Revision 3 Tier 1 Table 2.7.3.3-5 includes Acceptance Criterion 7.iii for the associated surge tank volume which takes the required makeup capacity into account. As part of the response to Question 9.2.2-49, Tier 2 Section 9.2.2.2.1.3 will be modified to address the CCWS surge tank capacity. In response to Question 9.2.2-49, DCD Tier 2 Section 9.2.2.3.2 will also be changed to address the total leakage over a 7-day period. (Comparison of these values indicates that there is adequate tank volume to accommodate potential leakage after a seismic event without makeup for seven days.) Thus, an additional Tier 1 ITAAC is judged to be unnecessary.

Item 11: Discussion of CCW radiation monitor is intentionally omitted from Tier 1 Section 2.7.3.3 as these parameters are not safety related and represent a level of detail that is inconsistent with SRP 14.3 guidance. Radiation monitoring is described not in the figures but in the tables in Tier 1 Section 2.7.6.6. Therefore, it is not necessary to be included in the Tier 1 figures. MHI considers that it conforms to the following position of the SRP "As Section 1.B.i in Appendix C to SRP 14.3 states, the format for the figures and/or diagrams should be simplified piping diagrams for mechanical systems." Safety-related instruments have been listed in Tables 2.7.3.3-2 and 2.7.3.3-4.

Item 14: The tag numbers provided in the previous response were incorrect. DCD Revision 2 contains the correct tag numbers.

Item 15: Tier 1 DCD Revision 3 Figure 2.7.3.3-1 (which was submitted to the NRC on 31 March 2011) was revised to show check valves VLV-231A and VLV-231B. The placement of the thermal barrier cross-tie header on the Tier 1 figure has not been changed. As a functional flow diagram, the Tier 1 figure is not intended to show the relative position of branches in a continuous pipe line since there is no functional difference. Similarly, a future change in the relative position with no functional change should not require a Tier 1 revision.

Impact on DCD

DCD Tier 2 Subsection 9.2.2.2.1.2 will be revised as follows:

- Add description of CCWS flow rate control.

DCD Tier 2 Subsection 9.2.2.2.1.5 will be revised as follows:

- Add description of CCWS flow rate control to "Containment Spray/Residual Heat Removal Heat Exchanger (CS/RHRS HX) CCW Outlet Valve"
- Add additional bullet and control function description for "Letdown Heat Exchanger Outlet Valve"

DCD Tier 2 Subsection 9.2.2.2.2.4 will be revised as follows:

- Add statement that operator must manually open the CV atmosphere gas sample cooler outlet valve during accident conditions.

DCD Tier 2 Subsection 9.2.2.4.2 will be revised as follows:

- Correct spelling of "individual"

Impact on R-COLA
There is no impact on the R-COLA.

Impact on S-COLA
There is no impact on the S-COLA.

Impact on PRA
There is no impact on the PRA.

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 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 their safety related function since the direct impact of a pipe break in the non-safety portion of the system can be accommodated. The CCW system's safety function will be maintained as a result of the nonsafety-related piping failure, and the indirect impact of the pipe break will not impact any SSC safety function.

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 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 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.

Xs are plate type. Guide 1.26 (Ref. equirements of

onents cooled by

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 surge tanks are located at a higher elevation than the pumps to ensure sufficient NPSH margin is available.

9.2.2.2.1.3 CCW Surge Tank

The CCW surge tanks are connected to the suction side of the CCWP. 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.

- 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 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.

- **Containment S** valves (NCS-MOV-145A, B, C and D) **anger (CS/RHRS HX) CCW Outlet Valve**

The CCW which is supplied to the CS/RHR heat exchanger is shutoff by the CCW outlet isolation ~~valve~~ during standby. However, this normal closed motor operated valve automatically opens at once upon ECCS actuation signal plus the respective train CCW pump start signal to establish cooling water flow to the CS/RHR heat exchanger.

- **RCP Thermal Barrier HX CCW Return Line Isolation valve**

Two motor operated valves are located at the CCW outlet of the RCP thermal barrier Hx and close automatically upon a high flow rate **(These valves do not control the supply flow of each component.)** ent of in-leakage from the RCS through the therma ge from further contaminating the CCWS.

- **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.

- **Isolation valve between seismic category I portion and non-seismic category I portion**

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.

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, Sheet 9 of 9).

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

- **RCP CCW tie line isolation valve**

This normally closed motor operated valve opens 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.

- **RCP motor CCW supply line isolation valve**

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.

- **RCP CCW supply line isolation valve**

This normally open motor operated valve closes automatically upon P signal to shutoff the component cooling water flow to the containment vessel.

- **RCP CCW return line isolation valve**

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
232A and B and NCS-MOV-233A ar

- **Letdown Heat Exchanger Outlet Valve (NCS-TCV-013)**

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

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.

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

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.

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 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;

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.

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.

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 ~~indibidual~~ **individual** heat loads.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/29/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 571-4365 REVISION 0**
SRP SECTION:	**09.02.02 – REACTOR AUXILIARY COOLING WATER SYSTEM**
APPLICATION SECTION:	**9.2.2**
DATE OF RAI ISSUE:	**4/13/2010**

QUESTION NO.: 09.02.02-68
Follow-up to RAI 362-2278, question 09.02.02-45

Based on the staff's review of the applicant's response to RAI 09.02.02-45, the following previously identified items need to be further addressed.

Item (1)1: The power supplies for the CCWS valves are not specifically included in Tier 1 DCD Table 2.7.3.3-2. This table only references the components as being Class 1E powered. In addition, the specific Class IE power was not listed for valves that are non-divisionalized, such as NCS-MOV-511, -517, and NCS-AOV 601, -602, -661A, -661B, -662A, and -662B etc. Table 2.7.3.3-2 should clearly state the divisional power supplies for each component.

Item (1)2: The specific heat removal rate was not identified in the ITAAC and should be included in Tier 1 ITAAC.

Item (1)3: It was stated that the applicant will revise the description, but the markup of the description was not provided. In addition, the PSMS column for Tier 1 Table 2.7.3.3-2, listed MOVs that close on containment isolation signals "phase a" or "phase b" which are not described in Tier 2 Table 6.2.4-3, "List of Containment Penetrations and System Isolation Position," This Tier 2 table lists containment isolation signals as "T" and "P". The Tier 1 and Tier 2 information related to isolation signals should be consistent.

Item (1)4: The response did not include the detail requested by the staff. That is, the CCWS pump testing should demonstrate that adequate net positive suction head, at the maximum CCWS flow rate conditions, with the inventory in the surge tank at the lowest allowable level (as corrected to account for actual temperature). The maximum CCWS flow rate and minimum allowable surge tank water level, along with the corresponding design basis water temperature that apply need to be listed to assure that test conditions are properly established.

Item (2): Flow rates for the important user should be provided in Tier 1.

Item (3)1: In response to RAI 09.02.02-45 the applicant listed an elevated surge tank and slow acting system valves as design features to minimize water hammer. In addition, it was noted in the response to RAI 09.02.02-31, Item 3, and added text to Tier 2, Section 9.2.2.2.1.5, "Valves." It indicates that the header tie line isolation valves will automatically close in about 10 seconds (which is not considered slow acting valves) and a potential for a system water hammer event.

The applicant should consider an ITAAC of the fast closing valves in Tier 1 to verify that a water hammer event does not occur.

Item (3)4: The surge tank volume verification should be added to the Tier 1 ITAAC as stated in the SRP 14.3 Appendix C I.A.iii.(5) and the safety-related or seismic qualified makeup water supply should be added in Tier 1 ITAAC for the 7 days leakage requirements. Specifically, the capacity of the surge tank should be verified if the tank is needed to perform the direct safety function. For example, in the case of the RCW surge tank a certain volume is required to meet the specific system leakage assumptions.

Item (3)5: The Tier 1 markup for valves NCS-VLV-016A, B, C, D was incorporated differently in Revision 2 of the DCD. In addition, check valves NCS-VLV-231A/B (thermal barrier cross-tie) are missing from the Tier 1 Tables.

Item (3)6: The Tier 1 markup was not provided as part of the applicant's response and these should be provided.

Item (4): Numeric values; for example heat transfer, flow rates and valve timing, were not provided in the RAI response and the RAI was not adequately addressed.

Reference: MHI's Responses to US-APWR DCD RAI No. 362-2278; MHI Ref: UAP-HF-09333; dated June 19, 2009; ML091760624.

ANSWER:

Item (1)1: Please see the response to Question 09.02.02-51 Item 4.

Item (1)2: DCD Tier 1, Revision 3 has been submitted for NRC review [Ref. MHI letter UAP-HF-11078 dated 3/31/11]. Tier Table 2.7.3.3-5, Item 7i, was added to include the required UA value to verify the heat exchanger capability.

Item (1)3: "T" and "P" are the abbreviations for "Containment Isolation Signal" and "Containment Spray Signal", respectively, as shown in the legend for Tier Figure. 1.7-3. Containment Isolation Phases A and B are described in Tier 2 Subsection 7.3.1.5.4 and 7.3.1.5.5, respectively. DCD Revision 3 Tier 2 Table 6.2.4-3 ("List of Containment Penetrations and System Isolation Positions") was revised to add "Containment Isolation Phase A" as the explanation of "T" and "Containment Isolation Phase B" as the explanation of "P".

Item (1)4: DCD Tier 1 Revision 3, Table 2.7.3.3-5 (Item 13) has been revised to consider piping losses and minimum conditions for NPSH determination.

Item (2): DCD Tier 1, Revision 3 has been submitted for NRC review [Ref. MHI letter UAP-HF-11078 dated 3/31/11]; Revision 3 includes an ITAAC that addresses total CCWS flow rate. Additionally, Tier 1 Table 2.7.3.3-5 will be modified to reflect flow rate to important users.

Note that a CCWS pump auto start in the event of an ESWS pump trip has been considered for ITAAC, but is unnecessary because this feature is not a direct safety function. During normal operation, if an ESWS pump trips, there would not be a rapid temperature increase on the CCWS side that would require an automatic start of another CCWS pump. The auto start of the CCWS pump based on a ESWS pump trip is described in 9.2.1.2.3.1. Operators could start a standby pump, as needed, based on a CCW temperature high temperature alarm (TIA-025, 026, 032, 033). During an accident condition, all CCWS have already been started. Thus, there is no ITAAC for such an interlock. The CCWS pump auto start feature will be tested in Chapter 14.2.12.1.87 as part of the CCWS pump controls and interlocks.

Item (3)1: Please see response to Question 9.2.2-55 for changes to Subsection 14.2.12.1.87

related to CCWS preoperational method related to monitoring of water hammer when header tie line isolation valves are closed. The response to Question 9.2.2-55 also addresses the DCD Revision 2 Subsection 9.2.2.2.1.5 inaccuracy regarding the 10-second valve closure time.

Item (3)4: DCD Tier 1 Revision 3, Tier 1 Table 2.7.3.3-5 (Item 7.iii) has been revised to include verification of surge tank volume. Based on a recent design change, Table 2.7.3.3-5 (Item 7.iii) will be revised to reflect a larger surge tank volume. In addition, Tier 1 Subsection 2.7.3.3-1 will be revised to reflect the effect of the partition plate modification on train separation. Please also see responses to Questions 09.02.02-49, 09.02.02-51, 09.02.02-57 and 09.02.02-69, which address requirements for 7-day makeup.

Item (3)5: DCD Tier 1 Revision 3, Tier 1 Table 2.7.3.3-2 has been revised to include check valves NCS-VLV-231A and B. The RAI 362-2278 markup for valves NCS-VLV-016A/B/C/D, which listed the "Active Safety Function" as Transfer Open/Transfer Closed", is correct. The DCD will be corrected accordingly.

Item (3)6: The intended markups have been included in DCD Tier 1 Revision 3. Specifically, Table 2.7.3.3-5 Items 5.a, 7.ii, 13 were modified; Item 7.iii was added.

Item (4): DCD Tier 1 Revision 3, recently submitted for NRC review, includes quantitative information on surge tank size, heat exchanger UA, pump flow rate and valve timing. In addition, the DCD will be revised to include the supplemental quantitative information provided in the responses to Questions 9.2.2-49, 9.2.2-51, 9.2.2-52, 9.2.2-53, 9.2.2-54, 9.2.2-55 and 9.2.2-60.

Impact on DCD

<u>DCD Tier 1 Subsection 2.7.3.3-1 will be revised as follows:</u>

- Revise "Design Description" for consistency with surge tank design change.

<u>DCD Tier 1 Table 2.7.3.3-2 will be revised as follows:</u>

- Correct "Active Safety Function" for valves NCS-VLV-016A/B/C/D.

<u>DCD Tier 1 Table 2.7.3.3-5 will be revised as follows</u>

- Revise surge tank volume consistent with design change.
- Add ITAAC for flow rate to CCWS important users.

<u>DCD Tier 2 Subsection 9.2.2.2.1.2 will be revised as follows:</u>

- Reference interlock with ESWS discussed in Subsection 9.2.1.2.3.1.

<u>DCD Tier 2 Subsection 14.2.12.1.34 will be revised as follows:</u>

- Clarify that test method includes interlocks

Impact on R-COLA
There is no impact on the R-COLA.

Impact on S-COLA
There is no impact on the S-COLA.

Impact on PRA
There is no impact on the PRA.

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 1 of 8)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Component cooling water (CCW) heat exchangers	NCS-MHX-001 A, B, C, D	3	Yes	-	-/-	-	-	-
Component cooling water pumps	NCS-MPP-001 A, B, C, D	3	Yes	-	Yes/No	ECCS Actuation	Start	Transfer Open/ Transfer Closed
						LOOP sequence	Start	
						Low CCW header pressure	Start	
Component cooling water surge tanks	NCS-MTK-001 A, B	3	Yes	-	-/-	-	-	-
Component cooling water pump discharge check valves	NCS-VLV-016 A, B, C, D	3	Yes	-	-/-	-	~~Transfer Open~~	-
CCW supply header tie line isolation valves	NCS-MOV-020 A, B, C, D	3	Yes	Yes	Yes/No	ECCS Actuation and undervoltage signal	Transfer Closed	As Is
						Containment Spray	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
						Remote Manual	Transfer Open/ Transfer Closed	

2.7.3.3 Component Cooling Water System (CCWS)

2.7.3.3.1 Design Description

The component cooling water system (CCWS) is a safety-related system that provides cooling water to various components including non safety-related components. The CCWS is the intermediate cooling system that transfers heat from the cooled components to the essential service water system.

The CCWS provides for containment isolation, as described in Section 2.11.2, of the CCWS lines penetrating the containment.

The CCWS consists of four divisions (Division A, B, C & D). Each division has one component cooling water (CCW) pump and one component cooling water heat exchanger and provides 50% of the cooling capacity required for its safety function. Each division provides cooling water for a safety injection pump, a core spray/residual heat removal (CS/RHR) pump and other safety-related components shown in Figure 2.7.3.3-1. Header tie lines between Division A and B, and between Division C and D are provided. A common line for supply header A1 and supply header A2 branches out from the tie line between Division A and B. Similarly, a common line for the supply header C1 and the supply header C2 branches out from the tie line between Division C and D. The supply headers A1 and C1 provide cooling water for charging pumps, SFP heat exchangers and other safety-related components shown in Figure 2.7.3.3-1. The supply headers A2 and C2 provide cooling water for the instrument air system and other non safety-related components shown in Figure 2.7.3.3-1. The CCWS line is connected to the non-essential chilled water system to provide alternate cooling water to the containment fan cooler units through the non-essential chilled water system.

1.a The functional arrangement of the CCWS is as described in the Design Description of Subsection 2.7.3.3 and in Table 2.7.3.3-1 and as shown in Figure 2.7.3.3-1.

1.b Each mechanical division of the CCWS ~~(Divisions A, B, C & D) with the exception of that portion of the system consisting of the supply headers A2 & C2,~~ is physically separated from the other divisions so as not to preclude accomplishment of the safety function.

2.a.i The ASME Code Section III components of the CCWS, iden **as shown in Figure 2.7.3.3-1** are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

2.a.ii The ASME Code Section III components of the CCWS identified in Table 2.7.3.3-2 are reconciled with the design requirements.

2.b.i The ASME Code Section III piping of the CCWS, including supports, identified in Table 2.7.3.3-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

2.b.ii The ASME Code Section III piping of the CCWS, including supports, identified in Table 2.7.3.3-3, is reconciled with the design requirements.

Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	6.a.ii Inspection will be performed of the as-built Class 1E equipment identified in Table 2.7.3.3-2 as being qualified for a harsh environment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.3.3-2 as being qualified for a harsh environment are bounded by type tests or a combination of type tests and analyses.
6.b Class 1E equipment, identified in Table 2.7.3.3-2, is powered from its respective Class 1E division.	6.b A test will be performed on each division of the as-built Class 1E equipment identified in Table 2.7.3.3-2 by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.3.3-2 under test.
6.c Separation is provided between redundant divisions of CCWS Class 1E cables, and between Class 1E cables and non-Class 1E cables.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided in accordance with RG 1.75, between the as-built cables of redundant Class 1E divisions and between Class 1E cables and non-Class 1E cables.
7. The CCWS removes heat from various components during all plant operating conditions, including normal plant operating, abnormal and accident conditions.	7.i An analysis will be performed that determines the heat removal capability of the CCW heat exchangers.	7.i A report exists and concludes that the product of the overall heat transfer coefficient and the effective heat exchange area, UA, of each CCW heat exchanger identified in Table 2.7.3.3-2 is greater than or equal to 10.0 x 10^6 Btu/hr-°F.
	7.ii Tests will be performed to confirm that the as-built CCW pumps can provide flow to the CCW heat exchangers.	7.ii Each as-built CCW pump identified in Table 2.7.3.3-2 is capable of achieving its design flow rate of 11,000 gpm to each CCW heat exchanger in the same division.
	7.iii Inspections will be performed to confirm the as-built CCW surge tank volume.	7.iii The as-built CCW surge tank volume is greater than or equal to the design volume of ~~283~~ ft^3.

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Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The CCWS removes heat from various components during all plant operating conditions, including normal plant operating, abnormal and accident conditions.	7.i An analysis will be performed that determines the heat removal capability of the CCW heat exchangers.	7.i A report exists and concludes that the product of the overall heat transfer coefficient and the effective heat exchange area, UA, of each CCW heat exchanger identified in Table 2.7.3.3-2 is greater than or equal to 10.0 x 10^6 Btu/hr-°F.
	7.ii Tests will be performed to confirm that the as-built CCW pumps can provide flow to the CCW heat exchangers.	7.ii Each as-built CCW pump identified in Table 2.7.3.3-2 is capable of achieving its design flow rate of 11,000 gpm to each CCW heat exchanger in the same division.
	7.iii Inspections will be performed to confirm the as-built CCW surge tank volume.	7.iii The as-built CCW surge tank volume is greater than or equal to the design volume of 283 ft^3.
	7.iv Tests will be performed to verify that the as-built CCWS can provide flow to each CS/RHR heat exchanger.	7.iv Each CCW pump deliver at least 4400 gpm of component cooling water to each CS/RHR heat exchanger.
	7.v Tests will be performed to verify that the as-built CCWS can provide flow to each RCP thermal barrier with any two CCW pumps operating.	7.v Any two CCW pumps deliver at least 40.0 gpm of component cooling water to each RCP thermal barrier.
	7.vi Tests will be performed to verify that the as-built CCWS can provide flow to each SFP heat exchanger with any two CCW pumps operating.	7.vi Any two CCW pumps deliver at least 3,600 gpm of component cooling water to each spent fuel pit heat exchanger.
8.a Controls are provided in the MCR to open and close the remotely operated valves identified in Table 2.7.3.3-2.	8.a Tests will be performed on the as-built remotely operated valves identified in Table 2.7.3.3-2 using controls in the as-built MCR.	8.a Controls in the as-built MCR open and close the as-built remotely operated valves identified in Table 2.7.3.3-2.

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 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 their safety related function since the direct impact of a pipe break in the non-safety portion of the system can be accommodated. The CCW system's safety function will be maintained as a result of the nonsafety-related piping failure, and the indirect impact of the pipe break will not impact any SSC safety function.

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.

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 surge tanks are located at a higher elevation than the pumps to ensure sufficient NPSH margin is available.

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

9.2.2.2.1.3 CCW Surge Tank

The CCW surge tanks are connected to the suction side of the CCWP. 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.

14.2.12.1.34 Essential Service Water System (ESWS) Preoperational Test

A. Objective

1. To demonstrate the operation of the ESWS.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

, including interlocks

C. Test Method

1. Verify manual and automatic system controls.
2. Verify system flowrates and performance of ESWS pumps.
3. Verify alarms and status indications are functional.
4. Verify the absence of indications of water hammer by re-activating the ESW pump after a simulated LOOP as specified in Subsection 14.2.12.1.45, Class 1E Bus Load Sequence Preoperational Test.

D. Acceptance Criterion

1. The ESWS operates within design limits, as described in Subsection 9.2.1.

14.2.12.1.35 Main and Unit Auxiliary Transformers Preoperational Test

A. Objectives

1. To demonstrate operation of protective relaying, alarms, and control devices of the main and unit auxiliary transformers.
2. To demonstrate the energization of the unit auxiliary transformers.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.