

2.3.2 Chemical and Volume Control System**Design Description**

The chemical and volume control system (CVS) provides reactor coolant system (RCS) purification, RCS inventory control and makeup, chemical shim and chemical control, and oxygen control, and provides for auxiliary pressurizer spray. The CVS performs these functions during normal modes of operation including power generation and shutdown.

The CVS is as shown in Figure 2.3.2-1 and the component locations of the CVS are as shown in Table 2.3.2-5.

1. The functional arrangement of the CVS is as described in the Design Description of this Section 2.3.2.
2.
 - a) The components identified in Table 2.3.2-1 as ASME Code Section III are designed and constructed in accordance with ASME Code Section III requirements.
 - b) The piping identified in Table 2.3.2-2 as ASME Code Section III is designed and constructed in accordance with ASME Code Section III requirements.
3.
 - a) Pressure boundary welds in components identified in Table 2.3.2-1 as ASME Code Section III meet ASME Code Section III requirements.
 - b) Pressure boundary welds in piping identified in Table 2.3.2-2 as ASME Code Section III meet ASME Code Section III requirements.
4.
 - a) The components identified in Table 2.3.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.
 - b) The piping identified in Table 2.3.2-2 as ASME Code Section III retains its pressure boundary integrity at its design pressure.
5. The seismic Category I equipment identified in Table 2.3.2-1 can withstand seismic design basis loads without loss of safety function.
6.
 - a) The Class 1E equipment identified in Table 2.3.2-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.
 - b) The Class 1E components identified in Table 2.3.2-1 are powered from their respective Class 1E division.
 - c) Separation is provided between CVS Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

7. The CVS provides the following safety-related functions:
 - a) The CVS preserves containment integrity by isolation of the CVS lines penetrating the containment.
 - b) The CVS provides termination of an inadvertent RCS boron dilution by isolating demineralized water from the RCS.
 - c) The CVS provides isolation of makeup to the RCS.
8. The CVS provides the following nonsafety-related functions:
 - a) The CVS provides makeup water to the RCS.
 - b) The CVS provides the pressurizer auxiliary spray.
9. Safety-related displays in Table 2.3.2-1 can be retrieved in the main control room (MCR).
10.
 - a) Controls exist in the MCR to cause the remotely operated valves identified in Table 2.3.2-1 to perform active functions.
 - b) The valves identified in Table 2.3.2-1 as having protection and safety monitoring system (PMS) control perform an active safety function after receiving a signal from the PMS.
11.
 - a) The motor-operated and check valves identified in Table 2.3.2-1 perform an active safety-related function to change position as indicated in the table.
 - b) After a loss of motive power, the remotely operated valves identified in Table 2.3.2-1 assume the indicated loss of motive power position.
12.
 - a) Controls exist in the MCR to cause the pumps identified in Table 2.3.2-3 to perform the listed function.
 - b) The pumps identified in Table 2.3.2-3 start after receiving a signal from the PLS.
13. Displays of the parameters identified in Table 2.3.2-3 can be retrieved in the MCR.
14. The nonsafety-related piping located inside containment and designated as reactor coolant pressure boundary, as identified in Table 2.3.2-2 (pipe lines with "No" in the ASME Code column), has been designed to withstand a seismic design basis event and maintain structural integrity.

Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.3.2-4 specifies the inspections, tests, analyses, and associated acceptance criteria for the CVS.

Table 2.3.2-1									
Equipment Name	Tag No.	ASME Code Section III	Seismic Cat. I	Remotely Operated Valve	Class 1E/ Qual. for Harsh Envir.	Safety- Related Display	Control PMS	Active Function	Loss of Motive Power Position
RCS Purification Motor-operated Isolation Valve	CVS-PL-V001	Yes	Yes	Yes	Yes/Yes	Yes (Valve Position)	Yes	Transfer Closed	As Is
RCS Purification Motor-operated Isolation Valve	CVS-PL-V002	Yes	Yes	Yes	Yes/Yes	Yes (Valve Position)	Yes	Transfer Closed	As Is
RCS Purification Motor-operated Isolation Valve	CVS-PL-V003	Yes	Yes	Yes	Yes/Yes	Yes (Valve Position)	Yes	Transfer Closed	As Is
CVS Resin Flush Line Containment Isolation Valve	CVS-PL-V040	Yes	Yes	No	- / -	-	-	-	-
CVS Resin Flush Line Containment Isolation Valve	CVS-PL-V041	Yes	Yes	No	- / -	-	-	-	-
CVS Demineralizer Resin Flush Line Containment Isolation Thermal Relief Valve	CVS-PL-V042	Yes	Yes	No	- / -	-	-	Transfer Open/ Transfer Closed	-
CVS Letdown Containment Isolation Valve	CVS-PL-V045	Yes	Yes	Yes	Yes/Yes	Yes (Valve Position)	Yes	Transfer Closed	Closed
CVS Letdown Containment Isolation Valve	CVS-PL-V047	Yes	Yes	Yes	Yes/No	Yes (Valve Position)	Yes	Transfer Closed	Closed

Note: Dash (-) indicates not applicable.

Table 2.3.2-1 (cont.)									
Equipment Name	Tag No.	ASME Code Section III	Seismic Cat. I	Remotely Operated Valve	Class 1E/Qual. for Harsh Envir.	Safety-Related Display	Control PMS	Active Function	Loss of Motive Power Position
CVS Purification Return Line Pressure Boundary Check Valve	CVS-PL-V080	Yes	Yes	No	- / -	-	-	Transfer Closed	-
CVS Purification Return Line Pressure Boundary Isolation Check Valve	CVS-PL-V081	Yes	Yes	No	- / -	No	-	Transfer Closed	-
CVS Purification Return Line Pressure Boundary Check Valve	CVS-PL-V082	Yes	Yes	No	- / -	-	-	Transfer Closed	-
CVS Auxiliary Pressurizer Spray Line Pressure Boundary Valve	CVS-PL-V084	Yes	Yes	Yes	Yes/Yes	No	Yes	Transfer Closed	Closed
CVS Auxiliary Pressurizer Spray Line Pressure Boundary Check Valve	CVS-PL-V085	Yes	Yes	No	Yes/Yes	-	-	Transfer Closed	-
CVS Makeup Line Containment Isolation Motor-operated Valve	CVS-PL-V090	Yes	Yes	Yes	Yes/No	Yes (Valve Position)	Yes	Transfer Closed	As Is
CVS Makeup Line Containment Isolation Motor-operated Valve	CVS-PL-V091	Yes	Yes	Yes	Yes/Yes	Yes (Valve Position)	Yes	Transfer Closed	As Is
CVS Hydrogen Addition Line Containment Isolation Valve	CVS-PL-V092	Yes	Yes	Yes	Yes/Yes	Yes (Valve Position)	Yes	Transfer Closed	Closed

Note: Dash (-) indicates not applicable.

Table 2.3.2-1 (cont.)									
Equipment Name	Tag No.	ASME Code Section III	Seismic Cat. I	Remotely Operated Valve	Class 1E/ Qual. for Harsh Envir.	Safety-Related Display	Control PMS	Active Function	Loss of Motive Power Position
CVS Hydrogen Addition Line Containment Isolation Check Valve	CVS-PL-V094	Yes	Yes	No	- / -	-	-	Transfer Closed	-
CVS Makeup Line Containment Isolation Thermal Relief Valve	CVS-PL-V100	Yes	Yes	No	- / -	-	-	Transfer Open/ Transfer Closed	-
CVS Demineralized Water Isolation Valve	CVS-PL-V136A	Yes	Yes	Yes	Yes/No	No	Yes	Transfer Closed	Closed
CVS Demineralized Water Isolation Valve	CVS-PL-V136B	Yes	Yes	Yes	Yes/No	No	Yes	Transfer Closed	Closed

Note: Dash (-) indicates not applicable.

Table 2.3.2-2		
Line Name	Line Number	ASME Code Section III
CVS Purification Line	BTA L001	Yes
CVS Resin Flush Containment Penetration Line	BBB-L026	Yes
CVS Purification Line Return	BTA L038	Yes
CVS Letdown Containment Penetration Line	BBB-L047	Yes
CVS Makeup Containment Penetration Line	BBB L053	Yes
CVS Hydrogen Addition Containment Penetration Line	BBB-L061	Yes
CVS Supply Line to Regenerative Heat Exchanger	BBD L002	No
CVS Return Line from Regenerative Heat Exchanger	BBD L018 BBD L073	No No
CVS Line from Regenerative Heat Exchanger to Letdown Heat Exchanger	BBD L003 BBD L072	No No
CVS Lines from Letdown Heat Exchanger to Demin. Tanks	BBD L004 BBD L005	No No
CVS Lines from Demin Tanks to RC Filters	BBD L020 BBD L021 BBD L022 BBD L029 BBD L037	No No No No No
CVS Lines from RC Filters to Regenerative Heat Exchanger	BBD L030 BBD L031 BBD L034	No No No
CVS Resin Fill Lines to Demin. Tanks	BBD L008 BBD L013 BBD L025	No No No

Table 2.3.2-3			
Equipment	Tag No.	Display	Control Function
CVS Makeup Pump A	CVS-MP-01A	Yes (Run Status)	Start
CVS Makeup Pump B	CVS-MP-01B	Yes (Run Status)	Start
Letdown Flow Sensor	CVS-001	Yes	-
Letdown Flow Sensor	CVS-025	Yes	-
CVS Purification Return Line (Position Indicator)	CVS-PL-V081	Yes	-
Auxiliary Spray Line Isolation Valve (Position Indicator)	CVS-PL-V084	Yes	-
Boric Acid Tank Level Sensor	CVS-109	Yes	-
Boric Acid Flow Sensor	CVS-115	Yes	-
Makeup Blend Valve (Position Indicator)	CVS-PL-V115	Yes	-
CVS Demineralized Water Isolation Valve (Position Indicator)	CVS-PL-136A	Yes	-
CVS Demineralized Water Isolation Valve (Position Indicator)	CVS-PL-136B	Yes	-
Makeup Pump Discharge Flow Sensor	CVS-157	Yes	-
Makeup Flow Control Valve (Position Indicator)	CVS-PL-V157	Yes	-

Note: Dash (-) indicates not applicable.

Table 2.3.2-4 Inspections, Tests, Analyses, and Acceptance Criteria		
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the CVS is as described in the Design Description of this Section 2.3.2.	Inspection of the as-built system will be performed.	The as-built CVS conforms with the functional arrangement as described in the Design Description of this Section 2.3.2.
2.a) The components identified in Table 2.3.2-1 as ASME Code Section III are designed and constructed in accordance with ASME Code Section III requirements.	Inspection will be conducted of the as-built components as documented in the ASME design reports.	The ASME Code Section III design reports exist for the as-built components identified in Table 2.3.2-1 as ASME Code Section III.
2.b) The piping identified in Table 2.3.2-2 as ASME Code Section III is designed and constructed in accordance with ASME Code Section III requirements.	Inspection will be conducted of the as-built piping as documented in the ASME design reports.	The ASME Code Section III design reports exist for the as-built piping identified in Table 2.3.2-2 as ASME Code Section III.
3.a) Pressure boundary welds in components identified in Table 2.3.2-1 as ASME Code Section III meet ASME Code Section III requirements.	Inspection of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	A report exists and concludes that the ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds.
3.b) Pressure boundary welds in piping identified in Table 2.3.2-2 as ASME Code Section III meet ASME Code Section III requirements.	Inspection of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	A report exists and concludes that the ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds.
4.a) The components identified in Table 2.3.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.	A hydrostatic test will be performed on the components required by the ASME Code Section III to be hydrostatically tested.	A report exists and concludes that the results of the hydrostatic test of the components identified in Table 2.3.2-1 as ASME Code Section III conform with the requirements of the ASME Code Section III.

Table 2.3.2-4 (cont.) Inspections, Tests, Analyses, and Acceptance Criteria		
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.b) The piping identified in Table 2.3.2-2 as ASME Code Section III retains its pressure boundary integrity at its design pressure.	A hydrostatic test will be performed on the piping required by the ASME Code Section III to be hydrostatically tested.	A report exists and concludes that the results of the hydrostatic test of the piping identified in Table 2.3.2-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
5. The seismic Category I equipment identified in Table 2.3.2-1 can withstand seismic design basis loads without loss of safety function.	i) Inspection will be performed to verify that the seismic Category I equipment identified in Table 2.3.2-1 is located on the Nuclear Island. ii) Type tests, analyses, or a combination of type tests and analyses of seismic Category I equipment will be performed. iii) Inspection will be performed for the existence of a report verifying that the as-installed equipment including anchorage is seismically bounded by the tested or analyzed conditions.	i) The seismic Category I equipment identified in Table 2.3.2-1 is located on the Nuclear Island. ii) A report exists and concludes that the seismic Category I equipment can withstand seismic design basis dynamic loads without loss of safety function. iii) A report exists and concludes that the as-installed equipment including anchorage is seismically bounded by the tested or analyzed conditions.
6.a) The Class 1E equipment identified in Table 2.3.2-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.	Type tests, analyses, or a combination of type tests and analyses will be performed on Class 1E equipment located in a harsh environment.	A report exists and concludes that the Class 1E equipment identified in Table 2.3.2-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.
6.b) The Class 1E components identified in Table 2.3.2-1 are powered from their respective Class 1E division.	Testing will be performed on the CVS by providing a simulated test signal in each Class 1E division.	A simulated test signal exists at the Class 1E equipment identified in Table 2.3.2-1 when the assigned Class 1E division is provided the test signal.

Table 2.3.2-4 (cont.) Inspections, Tests, Analyses, and Acceptance Criteria		
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.c) Separation is provided between CVS Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	See Tier 1 Material, Section 3.3, Nuclear Island Buildings.	See Tier 1 Material, Section 3.3, Nuclear Island Buildings.
7.a) The CVS preserves containment integrity by isolation of the CVS lines penetrating the containment.	See Tier 1 Material, subsection 2.2.1, Containment System.	See Tier 1 Material, subsection 2.2.1, Containment System.
7.b) The CVS provides termination of an inadvertent RCS boron dilution by isolating demineralized water from the RCS.	See item 10b in this table.	See item 10b in this table.
7.c) The CVS provides isolation of makeup to the RCS.	See item 10b in this table.	See item 10b in this table.
8.a) The CVS provides makeup water to the RCS.	<p>i) Testing will be performed by aligning a flow path from each CVS makeup pump, actuating makeup flow to the RCS at pressure greater than or equal to 2000 psia, and measuring the flow rate in the makeup pump discharge line with each pump suction aligned to the boric acid tank.</p> <p>ii) Inspection of the boric acid tank volume will be performed.</p> <p>iii) Testing will be performed to measure the delivery rate from the DWS to the RCS. Both CVS makeup pumps will be operating and the RCS pressure will be below 6 psig.</p>	<p>i) Each CVS makeup pump provides a flow rate of greater than or equal to 100 gpm.</p> <p>ii) The volume in the boric acid tank is at least 70,000 gallons between the tank outlet connection and the tank overflow.</p> <p>iii) The total CVS makeup flow to the RCS is less than or equal to 200 gpm.</p>

Table 2.3.2-4 (cont.) Inspections, Tests, Analyses, and Acceptance Criteria		
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.b) The CVS provides the pressurizer auxiliary spray.	Testing will be performed by aligning a flow path from each CVS makeup pump to the pressurizer auxiliary spray and measuring the flow rate in the makeup pump discharge line with each pump suction aligned to the boric acid tank and with RCS pressure greater than or equal to 2000 psia.	Each CVS makeup pump provides spray flow to the pressurizer.
9. Safety-related displays identified in Table 2.3.2-1 can be retrieved in the MCR.	Inspection will be performed for retrievability of the safety-related displays in the MCR.	Safety-related displays identified in Table 2.3.2-1 can be retrieved in the MCR.
10.a) Controls exist in the MCR to cause the remotely operated valves identified in Table 2.3.2-1 to perform active functions.	Stroke testing will be performed on the remotely operated valves identified in Table 2.3.2-1 using the controls in the MCR.	Controls in the MCR operate to cause the remotely operated valves identified in Table 2.3.2-1 to perform active functions.
10.b) The valves identified in Table 2.3.2-1 as having PMS control perform an active safety function after receiving a signal from the PMS.	i) Testing will be performed using real or simulated signals into the PMS. ii) Testing will be performed to demonstrate that the remotely operated CVS isolation valves CVS-V090, V091, V136A/B close within the required response time.	i) The valves identified in Table 2.3.2-1 as having PMS control perform the active function identified in the table after receiving a signal from the PMS. ii) These valves close within the following times after receipt of an actuation signal: V090, V091 < 10 sec V136A/B < 20 sec
11.a) The motor-operated and check valves identified in Table 2.3.2-1 perform an active safety-related function to change position as indicated in the table.	i) Tests or type tests of motor-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions. ii) Inspection will be performed for the existence of a report verifying that the as-installed motor-operated valves are bounded by the tested conditions.	i) A test report exists and concludes that each motor-operated valve changes position as indicated in Table 2.3.2-1 under design conditions. ii) A report exists and concludes that the as-installed motor-operated valves are bounded by the tests or type tests.

Table 2.3.2-4 (cont.) Inspections, Tests, Analyses, and Acceptance Criteria		
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	iii) Tests of the as-installed motor-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions. iv) Exercise testing of the check valves with active safety functions identified in Table 2.3.2-1 will be performed under pre-operational test pressure, temperature and fluid flow conditions.	iii) Each motor-operated valve changes position as indicated in Table 2.3.2-1 under pre-operational test conditions. iv) Each check valve changes position as indicated in Table 2.3.2-1.
11.b) After loss of motive power, the remotely operated valves identified in Table 2.3.2-1 assume the indicated loss of motive power position.	Testing of the installed valves will be performed under the conditions of loss of motive power.	Upon loss of motive power, each remotely operated valve identified in Table 2.3.2-1 assumes the indicated loss of motive power position.
12.a) Controls exist in the MCR to cause the pumps identified in Table 2.3.2-3 to perform the listed function.	Testing will be performed to actuate the pumps identified in Table 2.3.2-3 using controls in the MCR.	Controls in the MCR cause pumps identified in Table 2.3.2-3 to perform the listed function.
12.b) The pumps identified in Table 2.3.2-3 start after receiving a signal from the PLS.	Testing will be performed to confirm starting of the pumps identified in Table 2.3.2-3.	The pumps identified in Table 2.3.2-2 start after a signal is generated by the PLS.
13. Displays of the parameters identified in Table 2.3.2-3 can be retrieved in the MCR.	Inspection will be performed for retrievability of the displays identified in Table 2.3.2-3 in the MCR.	Displays identified in Table 2.3.2-3 can be retrieved in the MCR.
14. The nonsafety-related piping located inside containment and designated as reactor coolant pressure boundary, as identified in Table 2.3.2-2, has been designed to withstand a seismic design basis event and maintain structural integrity.	Inspection will be conducted of the as-built components as documented in the CVS Seismic Analysis Report.	The CVS Seismic Analysis Reports exist for the non-safety related piping located inside containment and designated as reactor coolant pressure boundary as identified in Table 2.3.2-2.

Table 2.3.2-5		
Component Name	Tag No.	Component Location
CVS Makeup Pump A	CVS-MP-01A	Auxiliary Building
CVS Makeup Pump B	CVS-MP-01B	Auxiliary Building
Boric Acid Tank	CVS-MT-02	Yard
Regenerative Heat Exchanger	CVS-ME-01	Containment
Letdown Heat Exchanger	CVS-ME-02	Containment
Mixed Bed Demineralizer A	CVS-MV-01A	Containment
Mixed Bed Demineralizer B	CVS-MV-01B	Containment
Cation Bed Demineralizer	CVS-MV-02	Containment
Reactor Coolant Filter A	CVS-MV-03A	Containment
Reactor Coolant Filter B	CVS-MV-03B	Containment

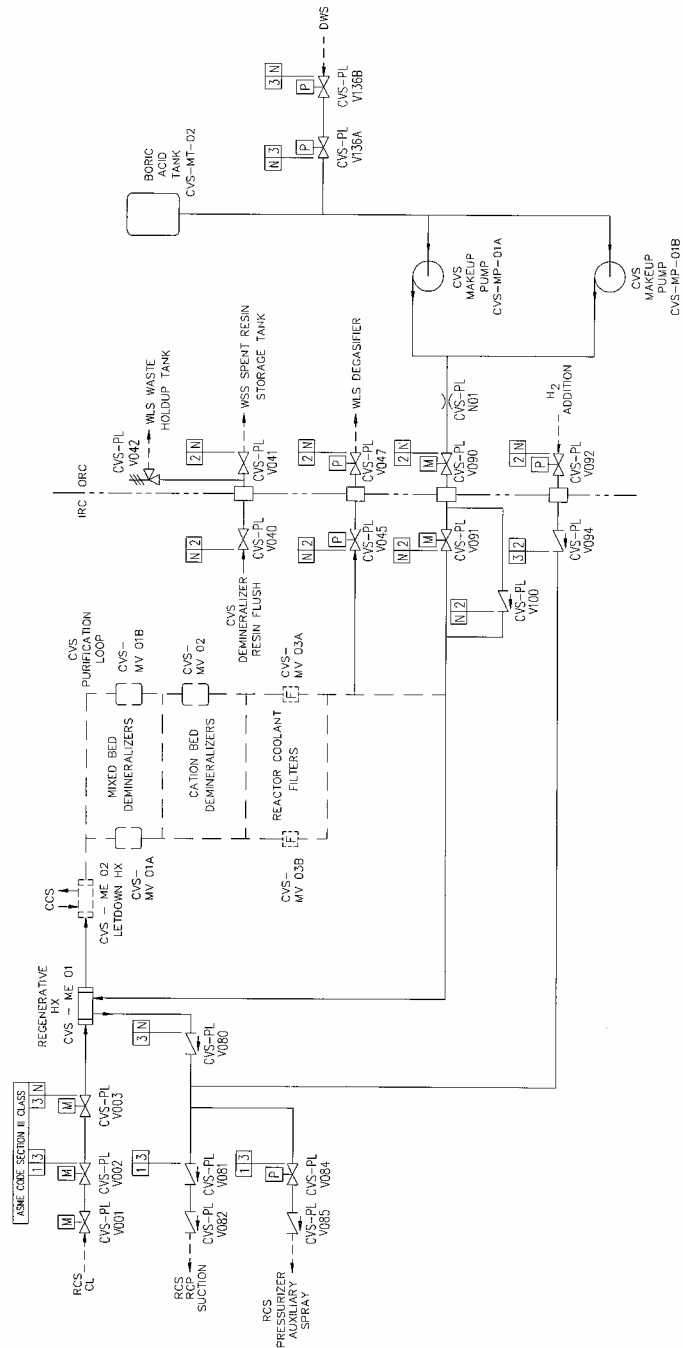


Figure 2.3.2-1
Chemical and Volume Control System