2.8.6 Main Feedwater System

1.0 Description

The main feedwater system (MFWS) is a non-safety-related system with portions that are safety related. It transports and controls feedwater from the deaerator/feedwater storage tank to the steam generators (SGs). It includes the startup/shutdown feedwater supply. The MFWS is safety related from the connections to the SGs to the fixed seismic restraint in each main feedwater line and to the fixed seismic restraint in each startup/shutdown feedwater line.

The MFWS provides the following safety-related function:

- Shut off main feedwater supply and startup/shutdown feedwater supply.

The MFWS provides the following non-safety-related functions:

- The MFWS supplies feedwater to the SGs for power operation.
- A startup/shutdown system supplies feedwater to the SGs for low-power operation.

2.0 Arrangement

2.1 The functional arrangement of the MFWS is as shown in Figure 2.8.6-1—MFWS Functional Arrangement.

2.2 The location of the MFWS equipment is as listed in Table 2.8.6-1—MFWS Equipment Mechanical Design.

2.3 Physical separation exists between the safety-related portions of the main feedwater divisions. The safety-related valves in Divisions 1 and 2 are located in separate valve rooms in Safeguard Building (SB) 1. The safety-related valves in Divisions 3 and 4 are located in separate valve rooms in SB 4.

3.0 Mechanical Design Features

3.1 Equipment listed in Table 2.8.6-1 as ASME Code Section III is designed and tested in accordance with ASME Code Section III.

3.2 Check valves listed in Table 2.8.6-1 will function as listed in Table 2.8.6-1.

3.3 Piping indicated in Figure 2.8.6-1 as ASME Code Section III is designed and tested in accordance with ASME Code Section III.

3.4 Equipment identified as Seismic Category I in Table 2.8.6-1 can withstand a design basis seismic load without loss of safety function as listed in Table 2.8.6-1.

3.5 Supports for piping shown as ASME Section III on Figure 2.2.4-1 will be designed per ASME Section III.

3.6 Specifications exist for components listed as ASME Section III in Table 2.2.4-1.

3.7 Specifications exist for piping shown as ASME Section III on Figure 2.2.4-1.

3.8 Specifications exist for supports for piping shown as ASME Section III on Figure 2.2.4-1.

4.0 Instrumentation and Control (I&C) Design Features, Displays, and Controls

4.1 Displays listed in Table 2.8.6-2—MFWS Equipment I&C and Electrical Design are retrievable in the main control room (MCR) as listed in Table 2.8.6-2.

4.2 The MFWS equipment controls are provided in the MCR as listed in Table 2.8.6-2.

4.3 Actuators listed as being controlled by a priority actuation and control system (PACS) module in Table 2.8.6-2 are controlled by a PACS module.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.8.6-2 are powered from the Class 1E division as listed in Table 2.8.6-2 in a normal or alternate feed condition.

5.2 The main feedwater full load isolation valves (MFWFLIV) are energized to close via two separate closing lines. The MFWFLIVs close on loss of hydraulic pressure. The main feedwater check valves inside the Reactor Building (RB) close on flow reversal. Other valves listed in Table 2.8.6-2 fail as-is on loss of power.

6.0 Environmental Qualifications

6.1 Electrical drivers for equipment listed in Table 2.8.6-2 for harsh environment can perform the safety function in Table 2.8.6-1 following exposure to the design basis environments for the time required.

7.0 Equipment and System Performance

7.1 Class 1E valves listed in Table 2.8.6-2 can perform the function listed in Table 2.8.6-1 under system design conditions.

8.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.8.6-3—MFWS Inspections, Tests, Analyses, and Acceptance Criteria specifies the inspections, tests, analyses, and acceptance criteria for the MFWS.

Table 2.8.6-1—MFWS Equipment Mechanical Design (2 Sheets)

Equipment Description	Equipment Tag Number(1)	Equipment Location	ASME Code Section III	Function	Seismic Category
Main Feedwater Full Load Isolation Valves (MFWFLIV)	30LAB60AA001 30LAB70AA001 30LAB80AA001 30LAB90AA001	SB 1 SB 1 SB 4 SB 4	Yes	Close	I
Main Feedwater Full Load Control Valves (MFWFLCV)	30LAB60AA101 30LAB70AA101 30LAB80AA101 30LAB90AA101	SB 1 SB 1 SB 4 SB 4	Yes	Close	I
Main Feedwater Isolation Valves (MFWIV)	30LAB60AA002 30LAB70AA002 30LAB80AA002 30LAB90AA002	SB 1 SB 1 SB 4 SB 4	Yes	Close	I
Main Feedwater Check Valves (MFWCkV)	30LAB60AA003 30LAB70AA003 30LAB80AA003 30LAB90AA003	RB RB RB RB	Yes	Close	I
Main Feedwater Low Load Isolation Valves (MFWLLIV)	30LAB64AA001 30LAB74AA001 30LAB84AA001 30LAB94AA001	SB 1 SB 1 SB 4 SB 4	Yes	Close	I
Main Feedwater Low Load Control Valves (MFWLLCV)	30LAB64AA101 30LAB74AA101 30LAB84AA101 30LAB94AA101	SB 1 SB 1 SB 4 SB 4	Yes	Close	I
Main Feedwater Very Low Load Control Valves	30LAB64AA102 30LAB74AA102	SB 1	Yes	Close	I

Table 2.8.6-1—MFWS Equipment Mechanical Design (2 Sheets)

Equipment Description	Equipment Tag Number(1)	Equipment Location	ASME Code Section III	Function	Seismic Category
(MFWVLLCV)	30LAB84AA102 30LAB94AA102	SB 1 SB 4 SB 4			
Deaerator/Feedwater Storage Tank	30LAA10BB001	Turbine Building	N/A	N/A	N/A
High-Pressure Feedwater Heaters	N/A	Turbine Building	N/A	N/A	N/A
Main Feedwater Pump	30LAC11AP001	Turbine Building	N/A	N/A	N/A
Main Feedwater Pump	30LAC12AP001	Turbine Building	N/A	N/A	N/A
Main Feedwater Pump	30LAC13AP001	Turbine Building	N/A	N/A	N/A
Startup/Shutdown Feedwater Pump	30LAJ10AP001	Turbine Building	N/A	N/A	N/A

1) Equipment tag numbers are provided for information only and are not part of the certified design.

Table 2.8.6-2—MFWS Equipment I&C and Electrical Design (2 Sheets)

Equipment Description	Equipment Tag Number[1]	Equipment Location	IEEE Class 1E [2]	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Main Feedwater Full Load Isolation Valves (MFWFLIV)	30LAB60AA001	SB 1	3^N, 1^N 4^A, 2^A	yes	yes	Pos./ N/A	Close/ N/A
	30LAB70AA001	SB 1	4^N, 2^N				
	30LAB80AA001		3^A, 1^A				
	30LAB90AA001	SB 4	1^N, 3^N 2^A, 4^A				
		SB 4	2^N, 4^N 1^A, 3^A				
Main Feedwater Full Load Control Valves (MFWFLCV)	30LAB60AA101 30LAB70AA101 30LAB80AA101 30LAB90AA101	SB 1	1^N, 2^A	yes	yes	Pos./ N/A	Close/ N/A
		SB 1	2^N, 1^A				
		SB 4	3^N, 4^A				
		SB 4	4^N, 3^A				
Main Feedwater Isolation Valves (MFWIV)	30LAB60AA002 30LAB70AA002 30LAB80AA002 30LAB90AA002	SB 1	1^N, 2^A	yes	yes	Pos./ N/A	Close/ N/A
		SB 1	2^N, 1^A				
		SB 4	3^N, 4^A				
		SB 4	4^N, 3^A				

Table 2.8.6-2—MFWS Equipment I&C and Electrical Design (2 Sheets)

Equipment Description	Equipment Tag Number(1)	Equipment Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Main Feedwater Low Load Isolation Valves (MFWLLIV)	30LAB64AA001 30LAB74AA001 30LAB84AA001 30LAB94AA001	SB 1 SB 1 SB 4 SB 4	$3^N, 4^A$ $4^N, 3^A$ $1^N, 2^A$ $2^N, 1^A$	yes	yes	Pos./ N/A	Close/ N/A
Main Feedwater Low Load Control Valves (MFWLLCV)	30LAB64AA101 30LAB74AA101 30LAB84AA101 30LAB94AA101	SB 1 SB 1 SB 4 SB 4	$1^N, 2^A$ $2^N, 1^A$ $3^N, 4^A$ $4^N, 3^A$	yes	yes	Pos./ N/A	Close/ N/A
Main Feedwater Very Low Load Control Valves (MFWVLLCV)	30LAB64AA102 30LAB74AA102 30LAB84AA102 30LAB94AA102	SB 1 SB 1 SB 4 SB 4	$1^N, 2^A$ $2^N, 1^A$ $3^N, 4^A$ $4^N, 3^A$	yes	yes	Pos./ N/A	Close/ N/A

1) Equipment tag numbers are provided for information only and are not part of the certified design.
2) ^{N} denotes the division the component is normally powered from. ^{A} denotes the division the component is powered from when alternate feed is implemented.

Table 2.8.6-3—MFWS Inspections, Tests, Analyses, and Acceptance Criteria (4 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
2.1	The functional arrangement of the MFWS is as shown on Figure 2.8.6-1.	Inspections of the as-built system as shown on Figure 2.8.6-1 will be conducted.	The as-built MFWS conforms with the functional arrangement as shown in Figure 2.8.6-1.
2.2	The location of the MFWS equipment is as listed in Table 2.8.6-1.	An inspection will be performed of the location of the equipment listed in Table 2.8.6-1.	The equipment listed in Table 2.8.6-1 is located as listed in Table 2.8.6-1.
2.3	Physical separation exists between divisions of the safety-related parts of MFWS.	An inspection will be performed to verify that the divisions of the MFWS are located in separate SBs.	The divisions of the MFWS are located in separate SBs.
3.1	The components designated as ASME Code Section III in Table 2.8.6-1 are designed to ASME Code Section III requirements.	Inspections will be conducted of ASME design, NDE, and hydrostatic test reports for the components listed as ASME Code Section III in Table 2.8.6-1.	A report exists and concludes that the components listed as ASME Code Section III in Table 2.8.6-1 have been designed and hydrostatically tested in accordance ASME Code Section III requirements.
3.2	Check valves listed in Table 2.8.6-1 will function as listed in Table 2.8.6-1.	Tests will be performed for the operation of the check valves listed in Table 2.8.6-1.	The check valves listed in Table 2.8.6-1 perform the functions listed in Table 2.8.6-1.
3.3 a	The piping identified as being within the ASME Code Section III boundary as indicated in Figure 2.8.6-1 has been designed in accordance with ASME Code Section III requirements including seismic loads.	Analysis of the as-designed piping will be performed in accordance with ASME Code Section III requirements for the piping indicated in Figure 2.8.6-1.	ASME Code Section III stress reports exist and conclude that the as-designed piping identified as ASME Code Section III in Figure 2.8.6-1 meets ASME Code Section III design requirements.

Table 2.8.6-3—MFWS Inspections, Tests, Analyses, and Acceptance Criteria (4 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
3.3 b	The piping identified as being within the ASME Code Section III boundary as indicated in Figure 2.8.6-1 has been inspected and hydrostatically tested in accordance with ASME Code Section III.	Inspections will be conducted of the as-built piping as indicated in Figure 2.8.6-1 for the following: Welding has been performed per ASME Code Section III. Hydrostatic testing per ASME Code Section III was performed.	A report exists and concludes that the piping as indicated in Figure 2.8.6-1 as ASME Code Section III has been welded in accordance with ASME Code Section III welding requirements. A report exists and concludes that the piping as indicated in Figure 2.8.6-1 as ASME Code Section III has been hydrostatically tested in accordance with ASME Code Section III requirements.
3.4	Equipment identified as Seismic Category I in Table 2.8.6-1 can withstand a design basis seismic load without loss of safety function as listed in Table 2.8.6-1.	Type tests, tests, analyses, or a combination of tests and analyses will be performed on the equipment designated as Seismic Category I in Table 2.8.6-1.	The equipment designated as Seismic Category I in Table 2.8.6-1 can withstand a design basis seismic load without loss of safety function.
3.5	Supports for piping shown as ASME Section III on Figure 2.8.6-1 will be designed per ASME Section III.	An analysis will be performed.	a. Supports for piping shown as ASME Section III on Figure 2.8.6-1 are designed to ASME Section III. b. Snubbers have been identified, including those analyzed for fatigue for piping shown as ASME Section III on Figure 2.8.6-1. c. Support mass is less than ten percent of the adjacent pipe span for piping shown as ASME Section III on Figure 2.8.6-1.

Table 2.8.6-3—MFWS Inspections, Tests, Analyses, and Acceptance Criteria (4 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
3.6	Specifications exist for components listed as ASME Section III in Table 2.8.6-1.	An inspection will be performed.	Specifications exist for components listed as ASME Section III in Table 2.8.6-1.
3.7	Specifications exist for piping shown as ASME Section III on Figure 2.8.6-1.	An inspection will be performed.	Specifications exist for piping identified as ASME Section III on Figure 2.8.6-1.
3.8	Specifications exist for supports for piping shown as ASME Section III on Figure 2.8.6-1.	An inspection will be performed.	Specifications exist for supports for piping shown as ASME Section III on Figure 2.8.6-1.
4.1	Displays exist or can be retrieved in the MCR as identified in Table 2.8.6-2.	Inspections will be performed for the existence or retrievability of the displays in the MCR as listed in Table 2.8.6-2.	The displays listed in Table 2.8.6-2 as being retrieved in the MCR can be retrieved in the MCR.
4.2	Controls exist in the MCR as identified in Table 2.8.6-2.	Tests will be performed for the existence of control signals from the MCR to the equipment listed in Table 2.8.6-2.	The controls listed in Table 2.8.6-2 as being in the MCR exist in the MCR.
4.3	Actuators listed as being controlled by a PACS module in Table 2.8.6-2 are controlled by a PACS module.	An operational test will be performed using test signals for the actuators being controlled by a PACS module as listed in Table 2.8.6-2. An inspection will be performed on the actuation of the actuator.	The actuators listed as being controlled by a PACS module in Table 2.8.6-2 actuate to the state requested by the signal.
5.1	The components designated as Class 1E in Table 2.8.6-2 are powered from the Class 1E division as listed in Table 2.8.6-2 in a normal or alternate feed condition.	Testing will be performed for components designated as Class 1E in Table 2.8.6-2 by providing a test signal in each normally aligned division. Testing will be performed for components designated as Class 1E in Table 2.8.6-2 by providing a test signal in each division with the alternate feed aligned to the divisional pair.	The test signal provided in the normally aligned division is present at the respective Class 1E component identified in Table 2.8.6-2. The test signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E component identified in Table 2.8.6-2.

Table 2.8.6-3—MFWS Inspections, Tests, Analyses, and Acceptance Criteria (4 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
5.2	MFWFLIVs are energized to close via two closure lines. MFWFLIVs fail closed on loss of hydraulic pressure. Other valves listed in Table 2.8.6-2 fail as-is on loss of power.	Testing will be performed for the MFWFLIVs to close. Testing will be performed for the other valves listed in Table 2.8.6-2 to fail as-is on loss of power.	MFWFLIVs are energized to close via two closure lines. MFWFLIVs fail closed on loss of hydraulic pressure. Following loss of power, the other valves listed in Table 2.8.6-2 fail as-is.
6.1	Components listed as Class 1E in Table 2.8.6-2 that are designated as harsh environment will perform the function listed in Table 2.8.6-1 in the environments that exist before and during the time required to perform their safety function.	6.1a. Type tests, tests, analyses, or a combination of tests and analyses will be performed to demonstrate the ability of the equipment listed for harsh environment in Table 2.8.6-2 to perform the function listed in Table 2.8.6-1 for the environmental conditions that could occur before and during a design basis accident. 6.1b. For equipment listed for harsh environment in Table 2.8.6-2, an inspection will be performed of the as-installed Class 1E equipment and the associated wiring, cables and terminations.	6.1a. The Class 1E equipment listed for harsh environment in Table 2.8.6-2 can perform the function listed in Table 2.8.6-1 before and during design basis accidents for the time required to perform the listed function. 6.1b. Inspection concludes the as-installed Class 1E equipment and associated wiring, cables, and terminations as listed in Table 2.8.6-2 for harsh environment conform with the design.
7.4	Class 1E valves listed in Table 2.8.6-2 perform the function listed in Table 2.8.6-1 under system conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.8.6-2 to change position as listed in Table 2.8.6-1 under system design conditions.	The as-installed valve changes position as listed Table 2.8.6-1 under system design conditions.