2.2.4 Emergency Feedwater System

1.0 Description

The emergency feedwater system (EFWS) is a safety-related system. The EFWS has four divisions. The EFWS provides the following safety-related functions:

- Restoration and maintaining of the steam generator (SG) water inventory in the unaffected SGs.
- Manual EFW isolation.
- Automatic closure of the SG isolation valve and the SG level control valve.
- Containment isolation.

2.0 Arrangement

2.1 The functional arrangement of the EFWS is as shown in Figure 2.2.4-1—Emergency Feedwater System Functional Arrangement.

2.2 The location of the EFWS equipment is as listed in Table 2.2.4-1—EFWS Equipment Mechanical Design.

2.3 Physical separation exists between divisions of the EFWS.

3.0 Mechanical Design Features

3.1 Equipment listed in Table 2.2.4-1 as ASME Code Section III is designed, welded, and hydrostatically tested in accordance with ASME Code Section III.

3.2 Check valves listed in Table 2.2.4-1 will function as listed in Table 2.2.4-1.

3.3 Deleted.

3.4 Equipment identified as Seismic Category I in Table 2.2.4-1 can withstand seismic design basis loads without loss of safety function as listed in Table 2.2.4-1.

3.5 Deleted.

3.6 Deleted.

3.7 Deleted.

3.8 Deleted.

3.9 Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are designed in accordance with ASME Code Section III requirements.

3.10 Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are installed in accordance with an ASME Code Section III Design Report.

3.11 Pressure boundary welds in portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are in accordance with ASME Code Section III.

3.12 Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 retain their pressure boundary integrity at their design pressure.

3.13 Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are installed in accordance with ASME Code Section III requirements.

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

4.1 Displays listed in Table 2.2.4-2—EFWS Equipment I&C and Electrical Design are retrievable in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.2.4-2.

4.2 The EFWS equipment controls are provided in the MCR and the RSS as listed in Table 2.2.4-2.

4.3 Equipment listed as being controlled by a priority and actuator control system (PACS) module in Table 2.2.4-2 responds to the state requested by a test signal.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.2.4-2 are powered from the Class 1E division as listed in Table 2.2.4-2 in a normal or alternate feed condition.

5.2 Valves listed in Table 2.2.4-2 fail as-is on loss of power.

6.0 Environmental Qualifications

6.1 Equipment listed in Table 2.2.4-2 for harsh environment can perform the function in Table 2.2.4-1 following exposure to the design basis environments for the time required.

7.0 Equipment and System Performance

7.1 The pumps listed in Table 2.2.4-1 have sufficient net positive suction head available (NPSHA).

7.2 The EFWS delivers water to the SG at the required flow rate to restore and maintain SG water level and remove decay heat following the loss of normal feedwater supply due to design basis events.

7.3 The EFWS combined storage pool volume is sufficient to achieve a cold shutdown condition for design basis events.

7.4 The EFWS provides a maximum flow rate to a depressurized steam generator.

7.5 EFWS cross-connections allow alignment of EFWS pump suction on all EFWS storage pools and pump discharge alignment with any SG.

7.6 Deleted.

7.7 Class 1E valves listed in Table 2.2.4-2 perform the functions listed in Table 2.2.4-1 under system design conditions.

7.8 The EFWS provides for flow testing of the EFW pumps during plant operation.

8.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.2.4-3 lists the EFWS ITAAC.

Table 2.2.4-1—EFWS Equipment Mechanical Design (2 Sheets)

Equipment Description	Equipment Tag Number[(1)]	Equipment Location	ASME Code Section III	Function	Seismic Category
EFW Storage Pool Division 1 (Division 2, Division 3, Division 4)	30LAR10 BB001 (30LAR20 BB001) (30LAR30 BB001) (30LAR40 BB001)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	N/A	storage volume	I
EFW Pump Division 1 (Division 2, Division 3, Division 4)	30LAS11 AP001 (30LAS21 AP001) (30LAS31 AP001) (30LAS41 AP001)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	run	I
EFW Minimum Flow Check Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA002 (30LAR21 AA002) (30LAR31 AA002) (30LAR41 AA002)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	open	I
EFW Flow Control Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA103 (30LAR21 AA103) (30LAR31 AA103) (30LAR41 AA103)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	open	I
EFW Steam Generator Level Control Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA105 (30LAR21 AA105) (30LAR31 AA105) (30LAR41 AA105)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	open , close	I
EFW Steam Generator Isolation Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA006 (30LAR21 AA006) (30LAR31 AA006) (30LAR41 AA006)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	open , close (Containment Isolation)	I
EFW Containment Isolation Check Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA007 (30LAR21 AA007) (30LAR31 AA007) (30LAR41 AA007)	Reactor Building	Yes	open , close (Containment Isolation)	I

Table 2.2.4-1—EFWS Equipment Mechanical Design (2 Sheets)

Equipment Description	Equipment Tag Number(1)	Equipment Location	ASME Code Section III	Function	Seismic Category
EFW Supply Header Isolation Valve Division 1 (Division 2, Division 3, Division 4)	30LAR13 AA001 (30LAR23 AA001) (30LAR33 AA001) (30LAR43 AA001)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	open , close	I
EFW Discharge Header Isolation Valve Division 1 (Division 2, Division 3, Division 4)	30LAR14 AA001 (30LAR24 AA001) (30LAR34 AA001) (30LAR44 AA001)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	open , close	I
EFW Pump Flow Division 1 (Division 2, Division 3, Division 4)	30LAR11 CF801 (30LAR21 CF801) (30LAR31 CF801) (30LAR41 CF801)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	indication , control	I
EFW Flow to SG Division 1 (Division 2, Division 3, Division 4)	30LAR11 CF002 (30LAR21 CF002) (30LAR31 CF002) (30LAR41 CF002)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	Yes	indication	I
Demineralized Water Distribution System Isolation Valve	30LAR04 AA001	Safeguard Building 4	Yes	close	I

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

Table 2.2.4-2—EFWS Equipment I&C and Electrical Design (3 Sheets)

Equipment Description	Equipment Tag Number(1)	Equipment Location	IEEE Class 1E(2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
EFW Pump Division 1 (Division 2, Division 3, Division 4)	30LAS11 AP001 (30LAS21 AP001) (30LAS31 AP001) (30LAS41 AP001)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	1 2 3 4	Yes	Yes	On-Off / On-Off	Start-Stop / Start-Stop
EFW Flow Control Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA103 (30LAR21 AA103) (30LAR31 AA103) (30LAR41 AA103)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	1^N 2^A (2^N) (1^A) (3^N) (4^A) (4^N) (3^A)	Yes	Yes	Position / Position	Open-Close / Open-Close
EFW Steam Generator Level Control Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA105 (30LAR21 AA105) (30LAR31 AA105) (30LAR41 AA105)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	1^N 2^A (2^N) (1^A) (3^N) (4^A) (4^N) (3^A)	Yes	Yes	Position / Position	Open-Close/ Open-Close

Table 2.2.4-2—EFWS Equipment I&C and Electrical Design (3 Sheets)

Equipment Description	Equipment Tag Number[1]	Equipment Location	IEEE Class 1E[2]	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
EFW Steam Generator Isolation Valve Division 1 (Division 2, Division 3, Division 4)	30LAR11 AA006 (30LAR21 AA006) (30LAR31 AA006) (30LAR41 AA006)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	1^N 2^A (2^N) (1^A) (3^N) (4^A) (4^N) (3^A)	Yes	Yes	Position / Position	Open-Close / Open-Close
EFW Discharge Header Isolation Valve Division 1 (Division 2, Division 3, Division 4)	30LAR14 AA001 (30LAR24 AA001) (30LAR34 AA001) (30LAR44 AA001)	Safeguard Building (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	1^N 2^A (2^N) (1^A) (3^N) (4^A) (4^N) (3^A)	Yes	Yes	Position / Position	Open-Close/ Open-Close
EFW Pump Flow Division 1 (Division 2, Division 3, Division 4)	30LAR11 CF801 (30LAR21 CF801) (30LAR31 CF801) (30LAR41 CF801)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	1^N 2^A (2^N) (1^A) (3^N) (4^A) (4^N) (3^A)	Yes	N/A	Flow / Flow	NA / NA

Table 2.2.4-2—EFWS Equipment I&C and Electrical Design (3 Sheets)

Equipment Description	Equipment Tag Number(1)	Equipment Location	IEEE Class 1E(2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
EFW Flow to SG Division 1 (Division 2, Division 3, Division 4)	30LAR11 CF002 (30LAR21 CF002) (30LAR31 CF002) (30LAR41 CF002)	Safeguard Building 1 (Safeguard Building 2) (Safeguard Building 3) (Safeguard Building 4)	1^N 2^A (2^N) (1^A) (3^N) (4^A) (4^N) (3^A)	Yes	N/A	Flow / Flow	NA / NA
Demineralized Water Distribution System Isolation Valve	30LAR04 AA001	Safeguard Building 4	N/A	N/A	N/A	Position / N/A	Open-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 2.2.4-3—EFWS ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
2.1	The functional arrangement of the EFWS is as shown on Figure 2.2.4-1.	Inspections of the as-built system as shown on Figure 2.2.4-1 will be conducted.	The as-built EFWS conforms with the functional arrangement as shown in Figure 2.2.4-1.
2.2	The location of the EFWS equipment is as listed in Table 2.2.4-1.	An inspection will be performed of the location of the equipment listed in Table 2.2.4-1.	The equipment listed in Table 2.2.4-1 is located as listed in Table 2.2.4-1.
2.3	Physical separation exists between divisions of the EFWS.	An inspection will be performed to verify that the divisions of the EFWS are located in separate safeguard buildings.	The divisions of the EFWS are located in separate safeguard buildings.
3.1	Equipment listed in Table 2.2.4-1 as ASME Code Section III is designed, welded, and hydrostatically tested in accordance with ASME Code Section III.	a. Analysis of the equipment identified in Table 2.2.4-1 as ASME Code Section III will be performed per ASME Code Section III design requirements. b. Inspections will be conducted on the equipment identified in Table 2.2.4-1 as ASME Section III to verify welding has been performed per ASME Code Section III welding requirements. c. Hydrostatic testing of the equipment identified in Table 2.2.4-1 as ASME Code Section III will be performed per ASME Code Section III hydrostatic testing requirements.	a. ASME Code Section III Design Reports (NCA-3550) exist and conclude that the equipment identified in Table 2.2.4-1 as ASME Code Section III meets ASME Code Section III design requirements. b. Equipment identified in Table 2.2.4-1 as ASME Code Section III has been welded per ASME Code Section III welding requirements. c. Equipment identified in Table 2.2.4-1 as ASME Code Section III has been hydrostatically tested per ASME Code Section III hydrostatic testing requirements.
3.2	Check valves listed in Table 2.2.4-1 will function as listed in Table 2.2.4-1.	Tests will be performed for the operation of the check valves listed in Table 2.2.4-1.	The check valves listed in Table 2.2.4-1 perform the functions listed in Table 2.2.4-1.
3.3	Deleted.	Deleted.	Deleted.

Table 2.2.4-3—EFWS ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
3.4	Equipment identified as Seismic Category I in Table 2.2.4-1 can withstand seismic design basis loads without loss of safety function as listed in Table 2.2.4-1.	a. Type tests, analyses, or a combination of type tests and analyses will be performed on the equipment listed as Seismic Category I in Table 2.2.4-1 using analytical assumptions, or under conditions, which bound the Seismic Category I design requirements. b. Inspections will be performed of the as-installed Seismic Category I equipment listed in Table 2.2.4-1 to verify that the equipment including anchorage is installed as specified on the construction drawings.	a. Tests/analysis reports exists and conclude that the Seismic Category I equipment listed in Table 2.2.4-1 can withstand seismic design basis loads without loss of safety function. b. Inspection reports exist and conclude that the as-installed Seismic Category I equipment listed in Table 2.2.4-1 including anchorage is installed as specified on the construction drawings.
3.5	Deleted.	Deleted.	Deleted.
3.6	Deleted.	Deleted.	Deleted.
3.7	Deleted.	Deleted.	Deleted.
3.8	Deleted.	Deleted.	Deleted.
3.9	Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are designed in accordance with ASME Code Section III requirements.	Inspections will be performed for the existence of ASME Code Section III Design Reports.	ASME Code section III Design Reports (NCA-3550) exist for portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1.
3.10	Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are installed in accordance with an ASME Code Section III Design Report.	Inspections will be performed to verify the existence of an analysis which reconciles as-fabricated deviations to the ASME Code Design Report as required by ASME Code Section III.	For portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1, ASME Code Data Reports (N-5) exist and conclude that reconciliation (NCA-3554) of the as-installed system with the Design Report (NCA-3550) has occurred.

Table 2.2.4-3—EFWS ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
3.11	Pressure boundary welds in portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are in accordance with ASME Code Section III.	Inspections of pressure boundary welds verify that welding is performed in accordance with ASME Code Section III requirements.	ASME Code Section III Data Reports exist and conclude that pressure boundary welding for portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 has been performed in accordance with ASME Code Section III.
3.12	Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 retain their pressure boundary integrity at their design pressure.	Hydrostatic tests will be performed on the as-fabricated system.	For portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1, ASME Code Section III Data Reports exist and conclude that hydrostatic test results comply with ASME Code Section III requirements.
3.13	Portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1 are installed in accordance with ASME Code Section III requirements.	An inspection for the existence of ASME N–5 Data Reports will be performed.	For portions of the EFWS piping shown as ASME Code Section III in Figure 2.2.4-1, N–5 Data Reports exist and conclude that installation is in accordance with ASME Code Section III requirements.
4.1	Displays exist or can be retrieved in the MCR and the RSS as identified in Table 2.2.4-2.	Inspections will be performed for the existence or retrievability of the displays in the MCR or the RSS as listed in Table 2.2.4-2.	a. The displays listed in Table 2.2.4-2 as being retrieved in the MCR can be retrieved in the MCR. b. The displays listed in Table 2.2.4-2 as being retrieved in the RSS can be retrieved in the RSS.
4.2	Controls exist in the MCR and the RSS as identified in Table 2.2.4-2.	Tests will be performed for the existence of control signals from the MCR and the RSS to the equipment listed in Table 2.2.4-2.	a. The controls listed in Table 2.2.4-2 as being in the MCR exist in the MCR. b. The controls listed in Table 2.2.4-2 as being in the RSS exist in the RSS.
4.3	Equipment listed as being controlled by a PACS module in Table 2.2.4-2 responds to the state requested by a test signal.	A test will be performed using test signals .	Equipment listed as being controlled by a PACS module in Table 2.2.4-2 responds to the state requested by the test signal.

Table 2.2.4-3—EFWS ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
5.1	The components designated as Class 1E in Table 2.2.4-2 are powered from the Class 1E division as listed in Table 2.2.4-2 in a normal or alternate feed condition.	a. Testing will be performed for components designated as Class 1E in Table 2.2.4-2 by providing a test signal in each normally aligned division. b. Testing will be performed for components designated as Class 1E in Table 2.2.4-2 by providing a test signal in each division with the alternate feed aligned to the divisional pair.	a. The test signal provided in the normally aligned division is present at the respective Class 1E component identified in Table 2.2.4-2. b. 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 2.2.4-2.
5.2	Valves listed in Table 2.2.4-2 fail as-is on loss of power.	Testing will be performed for the valves listed in Table 2.2.4-2 to fail as-is on loss of power.	Following loss of power, the valves listed in Table 2.2.4-2 fail as-is.
6.1	Components listed as Class 1E in Table 2.2.4-2, that are designated as harsh environment, will perform the function listed in Table 2.2.4-1 in the environments that exist before and during the time required to perform their function.	a. 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 2.2.4-2 to perform the function listed in Table 2.2.4-1 for the environmental conditions that could occur before and during a design basis accident. b. For equipment listed for harsh environment in Table 2.2.4-2, an inspection will be performed of the as-installed Class 1E equipment and the associated wiring, cables and terminations.	a. The Class 1E equipment listed for harsh environment in Table 2.2.4-2 can perform the function listed in Table 2.2.4-1 before and during design basis accidents for the time required to perform the listed function. b. Inspection concludes the as-installed Class 1E equipment and associated wiring, cables, and terminations as listed in Table 2.2.4-2 for harsh environment conform with the design.
7.1	The pumps listed in Table 2.2.4-1 have sufficient NPSHA.	Testing and analyses will be performed to verify NPSHA for pumps listed in Table 2.2.4-1.	The pumps listed in Table 2.2.4-1 have NPSHA that is greater than net positive suction head required (NPSHR) at system run-out flow.

Table 2.2.4-3—EFWS ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
7.2	The EFWS delivers water to the steam generators at the required flowrate to restore and maintain SG water level and remove decay heat following the loss of normal feedwater supply due to design basis events.	Analysis will be performed to determine the EFWS delivery flowrate to the steam generators for design conditions.	The EFWS delivers the following design flowrate to the SGs for design conditions: Minimum flow of 198,416 lb_m/hr (or 399.4 gpm at 122°F) at pressures up to 1426.1 psia and linearly ramping to 61,906 lb_m/hr (or 124.6 gpm at 122°F) at 1568.2 psia.
7.3	The EFWS combined storage pool volume is sufficient to achieve a cold shutdown condition for design basis conditions.	Inspection and analysis will be performed to determine the EFWS storage pool volume required to achieve a cold shutdown condition for design basis conditions.	The following EFWS combined storage pool volume is sufficient to achieve a cold shutdown condition for design basis conditions: Minimum 365,000 gallons (total for 4 pools).
7.4	The EFWS provides for a maximum flow rate to a depressurized steam generator.	Analysis will be performed to verify the EFWS provides a maximum flow rate to a depressurized steam generator.	The EFWS provides the following maximum flow rate to a depressurized steam generator: Maximum 490 gpm.
7.5	EFWS cross-connections allow alignment of EFWS pump suction on all EFWS storage pools and pump discharge alignment with any SG.	Testing will be performed to demonstrate the EFWS cross-connections allow alignment of EFWS pump suction on all EFWS storage pools and pump discharge alignment with any SG.	The EFWS cross-connections allow the following system alignments: 1. EFWS pump suction to all EFWS storage pools. 2. EFWS pump discharge with any SG.
7.6	Deleted.	Deleted.	Deleted.
7.7	Class 1E valves listed in Table 2.2.4-2 perform the function listed in Table 2.2.4-1 under system design conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.2.4-2 to change position as listed in Table 2.2.4-1 under system design conditions.	The as-installed valve changes position as listed in Table 2.2.4-1 under system design conditions.
7.8	The EFWS has provisions to allow flow testing of the EFW pumps during plant operation.	Testing for flow of the EFW pumps back to the EFW Storage Pool will be performed.	The flow test line allows EFW pump flow back to the EFW storage pool.

Next File