2.2.7 Extra Borating System

1.0 Description

The extra borating system (EBS) is a safety-related system. The EBS has two divisions. The EBS provides the following safety related functions:

- Core reactivity control.
- Reactor coolant pressure boundary integrity.
- Containment isolation.

The EBS provides the following non-safety related functions:

- Borated water to the RCS for beyond design basis events.

2.0 Arrangement

2.1 The functional arrangement of the EBS is as shown in Figure 2.2.7-1—Extra Borating System Functional Arrangement.

2.2 The location of the EBS equipment is as listed in Table 2.2.7-1—EBS Equipment Mechanical Design.

2.3 Physical separation exists between divisions of the EBS.

3.0 Mechanical Design Features

3.1 Equipment listed in Table 2.2.7-1 as ASME Code Section III is designed and tested in accordance with ASME Code Section III.

3.2 Check valves listed in Table 2.2.7-1 will function as listed in Table 2.2.7-1.

3.3 Piping indicated in Figure 2.2.7-1 as ASME Code Section III is designed, welded, and tested in accordance with ASME Code Section III.

3.4 Equipment identified as Seismic Category I in Table 2.2.7-1 can withstand a design basis seismic load without loss of function as listed in Table 2.2.7-1.

3.5 Supports for piping shown as ASME Section III on Figure 2.2.7-1 will be designed per ASME Section III.

3.6 Components listed as ASME Code Class 1 in Table 2.2.7-1 will be analyzed for fatigue in accordance with ASME Section III Class 1.

3.7 Specifications exist for components listed as ASME Section III in Table 2.2.7-1.

3.8 Specifications exist for piping shown as ASME Section III on Figure 2.2.7-1.

3.9 Specifications exist for supports for piping shown as ASME Section III on Figure 2.2.7-1.

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

4.1 Displays listed in Table 2.2.7-2—EBS Equipment I&C and Electrical Design are retrievable in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.2.7-2.

4.2 The EBS equipment controls are provided in the MCR and the RSS as listed in Table 2.2.7-2.

4.3 Actuators listed as being controlled by a priority actuation and control system (PACS) module in Table 2.2.7-2 are controlled by a PACS module.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.2.7-2 are powered from the Class 1E division as listed in Table 2.2.7-2 in a normal or alternate feed condition.

5.2 Valves listed in Table 2.2.7-2 fail as-is on loss of power.

6.0 Environmental Qualifications

6.1 Equipment listed in Table 2.2.7-2 for harsh environment can perform the function in Table 2.2.7-1 following exposure to the design basis environments for the time required.

7.0 Equipment and System Performance

7.1 The pumps listed in Table 2.2.7-1 have sufficient net positive suction head available (NPSHA).

7.2 Class 1E valves listed in Table 2.2.7-2 can perform the function listed in Table 2.2.7-1 under system design conditions.

7.3 The EBS provides for flow testing of the EBS pumps during plant operation.

7.4 Containment isolation valves listed in Table 2.2.7-1 close within the containment isolation response time following initiation of a containment isolation signal.

8.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.2.7-3—EBS Inspections, Tests, Analyses, and Acceptance Criteria specifies the inspections, tests, analyses, and acceptance criteria for the EBS.

Table 2.2.7-1 - EBS Equipment Mechanical Design

Equipment Description	Equipment Tag Number(1)	Equipment Location	ASME Code Section III	Function	Seismic Category
EBS Tank Division 1 (Division 4)	30JDH10 BB001 (30JDH40 BB001)	Fuel Building	yes	storage volume	I
EBS Pump Division 1 (Division 4)	30JDH10 AP001 (30JDH40 AP001)	Fuel Building	yes	run	I
Containment Isolation Valve Division 1 (Division 4)	30JDH10 AA006 (30JDH40 AA006)	Fuel Building	yes	open, close (Containment Isolation)	I
Containment Isolation Check Valve Division 1 (Division 4)	30JDH10 AA007 (30JDH40 AA007)	Reactor Building	yes	open, close (Containment Isolation)	I
EBS RCPB Isolation Valve to RCS Cold Leg 1 Division 1	30JDH10 AA015	Reactor Building	yes (Class 1)	open, close	I
EBS RCPB Isolation Valve to RCS Cold Leg 2 Division 1	30JDH20 AA015	Reactor Building	yes (Class 1)	open, close	I
EBS RCPB Isolation Valve to RCS Cold Leg 3 Division 4	30JDH30 AA015	Reactor Building	yes (Class 1)	open,close	I
EBS RCPB Isolation Valve to RCS Cold Leg 4 Division 4	30JDH40 AA015	Reactor Building	yes (Class 1)	open,close	I
Test Line Isolation Valve Division 1 (Division 4)	30JDH10 AA008 (30JDH40 AA008)	Fuel Building	yes	close	I

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

Table 2.2.7-2 - EBS 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
EBS Pump Division 1 (Division 4)	30JDH10 AP001 (30JDH40 AP001)	Fuel Building	1^N 2^A (4^N) (3^A)	N/A	yes	On-Off/On-Off	Start-Stop/ Start-Stop
Containment Isolation Valve Division 1 (Division 4)	30JDH10 AA006 (30JDH40 AA006)	Fuel Building	1^N 2^A (4^N) (3^A)	N/A	yes	Position/Position	Open-Close/ Open-Close
EBS RCPB Isolation Valve to RCS Cold Leg 1 Division 1	30JDH10 AA015	Reactor Building	1^N 2^A	yes	yes	Position/Position	Open-Close/ Open-Close
EBS RCPB Isolation Valve to RCS Cold Leg 2 Division 1	30JDH20 AA015	Reactor Building	2^N 1^A	yes	yes	Position/Position	Open-Close/ Open-Close
EBS RCPB Isolation Valve to RCS Cold Leg 3 Division 4	30JDH30 AA015	Reactor Building	3^N 4^A	yes	yes	Position/Position	Open-Close/ Open-Close
EBS RCPB Isolation Valve to RCS Cold Leg 4 Division 4	30JDH40 AA015	Reactor Building	4^N 3^A	yes	yes	Position/Position	Open-Close/ Open-Close

Table 2.2.7-2 - EBS 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
Test Line Isolation Valve Division 1 (Division 4)	30JDH10 AA008 (30JDH40 AA008)	Fuel Building	1^{N} 2^{A} (4^{N}) (3^{A})	N/A	yes	Position/Position	Open-Close/ Open-Close

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 2.2.7-3 - EBS Inspections, Tests, Analyses, and Acceptance Criteria (6 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
2.1	The functional arrangement of the EBS is as shown on Figure 2.2.7-1.	Inspections of the as-built system as shown on Figure 2.2.7-1 will be conducted.	The as-built EBS conforms with the functional arrangement as shown in Figure 2.2.7-1.
2.2	The location of the EBS equipment is as listed in Table 2.2.7-1.	An inspection will be performed of the location of the equipment listed in Table 2.2.7-1.	The equipment listed in Table 2.2.7-1 is located as listed in Table 2.2.7-1.
2.3	Physical separation exists between divisions of the EBS.	An inspection will be performed to verify that the divisions of the EBS are provided adequate physical separation in the Fuel Building.	The divisions of the EBS are provided adequate physical separation in the Fuel Building.
3.1	The components designated as ASME Code Section III in Table 2.2.7-1 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 2.2.7-1.	The components listed as ASME Code Section III in Table 2.2.7-1 have been designed and hydrostatically tested in accordance with ASME Code Section III requirements.
3.2	Check valves listed in Table 2.2.7-1 will function as listed in Table 2.2.7-1.	Tests will be performed for the operation of the check valves listed in Table 2.2.7-1.	The check valves listed in Table 2.2.7-1 perform the functions listed in Table 2.2.7-1.
3.3a	The piping identified as being within the ASME Code Section III boundary as indicated in Figure 2.2.7-1 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 2.2.7-1.	The as-designed piping identified as ASME Code Section III in Figure 2.2.7-1 meets ASME Code Section III design requirements.

Table 2.2.7-3 - EBS Inspections, Tests, Analyses, and Acceptance Criteria (6 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
3.3b	The piping identified as being within the ASME Code Section III boundary as indicated in Figure 2.2.7-1 has been welded and hydrostatically tested in accordance with ASME Code Section III.	Inspections will be conducted of the as-built piping as indicated in Figure 2.2.7-1 for the following: Welding has been performed per ASME Code Section III. Hydrostatic testing per ASME Code Section III was performed.	The piping as indicated in Figure 2.2.7-1 as ASME Code Section III has been welded in accordance with ASME Code Section III welding requirements. The piping as indicated in Figure 2.2.7-1 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 2.2.7-1 can withstand a design basis seismic load without loss of function as listed in Table 2.2.7-1.	a. Inspection will be performed of the equipment identified as Seismic Category I in Table 2.2.7-1. b. Type tests, tests, analyses, or a combination of tests and analyses will be performed on the equipment designated as Seismic Category I in Table 2.2.7-1.	a. The equipment designated as Seismic Category I in Table 2.2.7-1 is installed as designed. b. The equipment designated as Seismic Category I in Table 2.2.7-1 can withstand a design basis seismic load without loss of function.
3.5	Supports for piping shown as ASME Section III on Figure 2.2.7-1 will be designed in accordance with ASME Section III.	An analysis will be performed.	a. Supports for piping shown as ASME Section III on Figure 2.2.7-1 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 2.2.7-1. c. Support mass is less than 10% of the adjacent pipe span for piping shown as ASME Section III on Figure 2.2.7-1.

Table 2.2.7-3 - EBS Inspections, Tests, Analyses, and Acceptance Criteria (6 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
3.6	Components listed as ASME Code Class 1 in Table 2.2.7-1 will be analyzed for fatigue per ASME Section III Class 1.	An analysis will be performed.	a. Fatigue analysis has been performed for components listed as ASME Code Class 1 in Table 2.2.7-1. b. For components listed as ASME Code Class 1 in Table 2.2.7-1 operating modes where peak stresses are within 10% of allowable have been identified.
3.7	Specifications exist for components listed as ASME Section III in Table 2.2.7-1.	An inspection will be performed.	Specifications exist for components listed as ASME Section III in Table 2.2.7-1.
3.8	Specifications exist for piping shown as ASME Section III on Figure 2.2.7-1.	An inspection will be performed.	Specifications exist for piping identified as ASME Section III on Figure 2.2.7-1.
3.9	Specifications exist for supports for piping shown as ASME Section III on Figure 2.2.7-1.	An inspection will be performed.	Specifications exist for supports for piping shown as ASME Section III on Figure 2.2.7-1.
4.1	Displays exist or can be retrieved in the MCR and the RSS as identified in Table 2.2.7-2.	Inspections will be performed for the existence or retrieveability of the displays in the MCR or the RSS as listed in Table 2.2.7-2.	The displays listed in Table 2.2.7-2 as being retrieved in the MCR can be retrieved in the MCR. The displays listed in Table 2.2.7-2 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 2.2.7-2.	Tests will be performed for the existence of control signals from the MCR and the RSS to the equipment listed in Table 2.2.7-2.	The controls listed in Table 2.2.7-2 as being in the MCR exist in the MCR. The controls listed in Table 2.2.7-2 as being in the RSS exist in the RSS.

Table 2.2.7-3 - EBS Inspections, Tests, Analyses, and Acceptance Criteria (6 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
4.3	Actuators listed as being controlled by a PACS module in Table 2.2.7-2 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 2.2.7-2. An inspection will be performed on the actuation of the actuator.	The actuators listed as being controlled by a PACS module in Table 2.2.7-2 actuate to the state requested by the signal.
5.1	The components designated as Class 1E in Table 2.2.7-2 are powered from the Class 1E division as listed in Table 2.2.7-2 in a normal or alternate feed condition.	Testing will be performed for components designated as Class 1E in Table 2.2.7-2 by providing a test signal in each normally aligned division. Testing will be performed for components designated as Class 1E in Table 2.2.7-2 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 2.2.7-2. 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 2.2.7-2.
5.2	Valves listed in Table 2.2.7-2 fail as-is on loss of power.	Testing will be performed for the valves listed in Table 2.2.7-2 to fail as-is on loss of power.	Following loss of power, the valves listed in Table 2.2.7-2 fail as-is.

Table 2.2.7-3 - EBS Inspections, Tests, Analyses, and Acceptance Criteria (6 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
6.1	Components listed as Class 1E in Table 2.2.7-2 that are designated as harsh environment will perform the function listed in Table 2.2.7-1 in the environments that exist before and during the time required to perform their 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 2.2.7-2 to perform the function listed in Table 2.2.7-1 for the environmental conditions that could occur before and during a design basis accident. 6.1b. For equipment listed for harsh environment in Table 2.2.7-2, 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 2.2.7-2 can perform the function listed in Table 2.2.7-1 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 2.2.7-2 for harsh environment conform with the design.
7.1	The pumps listed in Table 2.2.7-1 have sufficient NPSHA.	Testing and analyses will be performed to verify adequate NPSHA for pumps listed in Table 2.2.7-1.	The pumps listed in Table 2.2.7-1 have sufficient NPSHA.
7.2	Class 1E valves listed in Table 2.2.7-2 perform the function listed in Table 2.2.7-1 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 2.2.7-2 to change position as listed in Table 2.2.7-1 under system design conditions.	The as-installed valve changes position as listed Table 2.2.7-1 under system design conditions.
7.3	The EBS has provisions to allow flow testing of the EBS pumps during plant operation.	Testing for flow of the EBS pumps back to the EBS tank will be performed.	The flow test line allows EBS pump flow back to the EBS tank.

Table 2.2.7-3 - EBS Inspections, Tests, Analyses, and Acceptance Criteria (6 Sheets)

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
7.4	Containment isolation valves listed in Table 2.2.7-1 close within the containment isolation response time following initiation of a containment isolation signal.	Tests will be performed to demonstrate the ability of the containment isolation valves listed in Table 2.2.7-1 to close within the containment isolation response time following initiation of a containment isolation signal.	The containment isolation valves listed in Table 2.2.7-1 close within the required times following initiation of a containment isolation signal: 30JDH10 AA006 and 30JDH40 AA006 close in less than or equal to 15 seconds.