2.3.3 Severe Accident Heat Removal System

1.0 Description

The severe accident heat removal system (SAHRS) is a dedicated cooling water system for the primary containment to support mitigation of beyond design basis events (BDBEs). The system does not operate during normal plant operations or design basis accidents.

The SAHRS provides the following safety related functions:

- Containment isolation.

The SAHRS provides the following non-safety related functions:

- Passive cooling of the core melt stabilization system (CMSS).
- Active spray for environmental control of the containment atmosphere.
- Active recirculation cooling of the CMSS and containment.

2.0 Arrangement

2.1 The functional arrangement of the SAHRS is as shown in Figure 2.3.3-1—SAHRS Functional Arrangement.

2.2 The location of the SAHRS equipment is as listed in Table 2.3.3-1—SAHRS Equipment Mechanical Design.

3.0 Mechanical Design Features

3.1 Equipment listed in Table 2.3.3-1 as ASME Boiler and Pressure Vessel (BPV) Code Section III is designed and tested to ASME BPV Code Section III.

3.2 Check valves listed in Table 2.3.3-1 will function as listed in Table 2.3.3-1.

3.3 Piping indicated in Figure 2.3.3-1 as ASME BPV Code Section III is designed, welded and tested in accordance with ASME BPV Code Section III.

3.4 Equipment identified as Seismic Category I in Table 2.3.3-1 can withstand a design basis seismic load without loss of function as listed in Table 2.3.3-1.

3.5 Supports for piping shown as ASME BPV Code Section III on Figure 2.3.3-1 will be designed per ASME BPV Code Section III.

3.6 Specifications exist for components listed as ASME BPV Code Section III in Table 2.3.3-1.

3.7 Specifications exist for piping shown as ASME BPV Code Section III on Figure 2.3.3-1.

3.8 Specifications exist for supports for piping shown as ASME BPV Code Section III on Figure 2.3.3-1.

4.0 I&C Design Features, Displays and Controls

4.1 The SAHRS equipment controls are provided in the MCR as listed in Table 2.3.3-2—SAHRS Equipment I&C and Electrical Design.

4.2 Actuators listed as being controlled by a Priority Actuation and Control System (PACS) module in Table 2.3.3-2 are controlled by a PACS module.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.3.3-2 are powered from the Class 1E division as listed in Table 2.3.3-2 in a normal or alternate feed condition.

5.2 Valves listed in Table 2.3.3-2 fail as-is on loss of power.

6.0 Environmental Qualifications

6.1 Equipment listed in Table 2.3.3-2 for harsh environment can perform the function in Table 2.3.3-1 following exposure to the design basis environments for the time required.

7.0 Equipment and System Performance

7.1 The SAHRS heat exchanger as listed in Table 2.3.3-1 has the capacity to transfer the design heat load to the component cooling water system (CCWS).

7.2 Class 1E valves listed in Table 2.3.3-2 perform the functions listed in Table 2.3.3-1 under system design conditions.

7.3 Containment isolation valves listed in Table 2.3.3-1 close within the containment isolation response time following initiation of a containment isolation signal.

8.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.3.3-3—SAHRS Inspections, Tests, Analyses, and Acceptance Criteria, specifies the inspections, tests, analyses, and acceptance criteria for the SAHRS.

Table 2.3.3-1—SAHRS Equipment Mechanical Design (2 Sheets)

Equipment Description	Equipment Tag Number (1)	Equipment Location	ASME Code Section III	Function	Seismic Category
SAHRS Suction Side Containment Isolation Valve	30JMQ40 AA001	Safeguard Building 4	Yes	Open-Close (Containment Isolation)	I
SAHRS Pump	30JMQ40 AP001	Safeguard Building 4	No	N/A	N/A
SAHRS Heat Exchanger	30JMQ40 AC001	Safeguard Building 4	No	N/A	N/A
Spray Function Outside Containment Isolation Valve	30JMQ41 AA001	Safeguard Building 4	Yes	Open-Close (Containment Isolation)	I
Active Cooling Function Outside Containment Isolation Valve	30JMQ42 AA001	Safeguard Building 4	Yes	Open-Close (Containment Isolation)	I
IRWST Backflush Function Outside Containment Isolation Valve	30JMQ43 AA001	Safeguard Building 4	Yes	Close (Containment Isolation)	I
Spray Function Inside Containment Isolation Check Valve	30JMQ41 AA002	Reactor Building	Yes	Open-Close	I
Active Cooling Function Inside Containment Isolation Check Valve	30JMQ42 AA002	Reactor Building	Yes	Open-Close	I
IRWST Backflush Function Inside Containment Isolation	30JMQ43 AA002	Reactor Building	Yes	Close	I

Table 2.3.3-1—SAHRS Equipment Mechanical Design (2 Sheets)

Equipment Description	Equipment Tag Number (1)	Equipment Location	ASME Code Section III	Function	Seismic Category
Check Valve					
Spray Header	30JMQ41 BR004	Reactor Building	No	N/A	II
Passive Cooling Function Flow Reducer	30JMQ42 BP001	Reactor Building	Yes	N/A	I
Passive Cooling Function Flow Reducer	30JMQ42 BP003	Reactor Building	Yes	N/A	I
Passive Flooding Line Isolation Valve	30JMQ42 AA003	Reactor Building	No	Open (Corium Cooling)	II
Passive Flooding Line Isolation Valve	30JMQ42 AA005	Reactor Building	No	Open (Corium Cooling)	II

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

Table 2.3.3-2—SAHRS Equipment I&C and Electrical Design

Equipment Description	Equipment Tag Number (1)	Equipment Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR Displays	MCR Controls
SAHRS Suction Side Containment Isolation Valve	30 JMQ 40 AA001	Safeguard Building 4	$1^N,2^A$	Yes	Yes	Yes	Open-Close
SAHRS Pump	30 JMQ 40 AP001	Safeguard Building 4	4^N	No	Yes	N/A	Start-Stop
Spray Function Outside Containment Isolation Valve	30 JMQ 41 AA001	Safeguard Building 4	$4^N,3^A$	Yes	Yes	Yes	Open-Close
Active Cooling Function Outside Containment Isolation Valve	30 JMQ 42 AA001	Safeguard Building 4	$4^N,3^A$	Yes	Yes	Yes	Open-Close
IRWST Backflush Function Outside Containment Isolation Valve	30 JMQ 43 AA001	**SAFEGUARD BUILDING 4**	**$4^N,3^A$**	Yes	Yes	Yes	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, while ^{A} denotes the division the component is powered from when alternate feed is implemented.

Table 2.3.3-3—SAHRS Inspections, Tests, Analyses, and Acceptance Criteria (5 Sheets)

	Commitment Wording	Inspection, Analysis or Test	Acceptance Criteria
2.1	The functional arrangement of the SAHRS is as shown on Figure 2.3.3-1.	Inspections of the as-built system as shown on Figure 2.3.3-1 will be conducted.	The as-built SAHRS conforms with the functional arrangement as shown in Figure 2.3.3-1.
2.2	The location of the SAHRS equipment is as listed in Table 2.3.3-1.	An inspection will be performed of the location of the equipment listed in Table 2.3.3-1.	The equipment listed in Table 2.3.3-1 is located as listed in Table 2.3.3-1.
3.1	The components designated as ASME Code Section III in Table 2.3.3-1 are designed to ASME BPV Code Section III requirements.	Inspections will be conducted of ASME design, NDE and hydrostatic test reports for the components listed as ASME BPV Code Section III in Table 2.3.3-1.	A report exists and concludes that the components listed as ASME BPV Code Section III in Table 2.3.3-1 have been designed and hydrostatically tested in accordance ASME BPV Code Section III requirements.
3.2	Check valves listed in Table 2.3.3-1 will function as listed in Table 2.3.3-1.	Tests will be performed for the operation of the check valves listed in Table 2.3.3-1.	The check valves listed in Table 2.3.3-1 perform the functions listed in Table 2.3.3-1.
3.3a	The piping identified as being within the ASME BPV Code Section III boundary as indicated in Figure 2.3.3-1 has been designed in accordance with ASME BPV Code Section III requirements including seismic loads.	Analysis of the as-designed piping will be performed in accordance with ASME BPV Code Section III requirements for the piping indicated in Figure 2.3.3-1.	ASME BPV Code Section III stress reports exist and conclude that the as-designed piping identified as ASME BPV Code Section III in Figure 2.3.3-1 meets ASME BPV Code Section III design requirements.

Table 2.3.3-3—SAHRS Inspections, Tests, Analyses, and Acceptance Criteria (5 Sheets)

	Commitment Wording	Inspection, Analysis or Test	Acceptance Criteria
3.3b	The piping identified as being within the ASME BPV Code Section III boundary as indicated in Figure 2.3.3-1 has been welded and hydrostatically tested in accordance with ASME BPV Code Section III.	Inspections will be conducted of the as-built piping as indicated in Figure 2.3.3-1 for the following: Welding has been performed per ASME BPV Code Section III. Hydrostatic testing per ASME BPV Code Section III was performed.	A report exists and concludes that the piping as indicated in Figure 2.3.3-1 as ASME BPV Code Section III has been welded in accordance with ASME BPV Code Section III welding requirements. A report exists and concludes that the piping as indicated in Figure 2.3.3-1 as ASME BPV Code Section III has been hydrostatically tested in accordance with ASME BPV Code Section III requirements.
3.4	Equipment identified as Seismic Category I in Table 2.3.3-1 can withstand a design basis seismic load without loss of function as listed in Table 2.3.3-1.	a. Inspection will be performed of the equipment identified as Seismic Category I in Table 2.3.3-1. 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 2.3.3-1.	a. A report exists and concludes that the equipment designated as Seismic Category I in Table 2.3.3-1 is installed as designed. b. A report exists and concludes that the equipment designated as Seismic Category I in Table 2.3.3-1 can withstand a design basis seismic load without loss of function.

Table 2.3.3-3—SAHRS Inspections, Tests, Analyses, and Acceptance Criteria (5 Sheets)

	Commitment Wording	Inspection, Analysis or Test	Acceptance Criteria
3.5	Supports for piping shown as ASME BPV Code Section III on Figure 2.3.3-1 will be designed per ASME BPV Code Section III.	An analysis will be performed.	a. Supports for piping shown as ASME BPV Code Section III on Figure 2.3.3-1 are designed to ASME BPV Code Section III. b. Snubbers have been identified, including those analyzed for fatigue for piping shown as ASME BPV Code Section III on Figure 2.3.3-1. c. Support mass is less than ten percent of the adjacent pipe span for piping shown as ASME BPV Code Section III on Figure 2.3.3-1.
3.6	Specifications exist for components listed as ASME BPV Code Section III in Table 2.3.3-1.	An inspection will be performed.	Specifications exist for components listed as ASME BPV Code Section III in Table 2.3.3-1.
3.7	Specifications exist for piping shown as ASME BPV Code Section III on Figure 2.3.3-1.	An inspection will be performed.	Specifications exist for piping identified as ASME BPV Code Section III on Figure 2.3.3-1.
3.8	Specifications exist for supports for piping shown as ASME BPV Code Section III on Figure 2.3.3-1.	An inspection will be performed.	Specifications exist for supports for piping shown as ASME BPV Code Section III on Figure 2.3.3-1.
4.1	Controls exist in the MCR as identified in Table 2.3.3-2.	Tests will be performed for the existence of control signals from the MCR to the equipment listed in Table 2.3.3-2.	The controls listed in Table 2.3.3-2 as being in the MCR exist in the MCR.
4.2	Actuators listed as being controlled by a PACS module in Table 2.3.3-2 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 2.3.3-2. An inspection will be performed on the actuation of the actuator.	The actuators listed as being controlled by a PACS module in Table 2.3.3-2 actuate to the state requested by the test signal.

Table 2.3.3-3—SAHRS Inspections, Tests, Analyses, and Acceptance Criteria (5 Sheets)

	Commitment Wording	Inspection, Analysis or Test	Acceptance Criteria
5.1	The components designated as Class 1E in Table 2.3.3-2 are powered from the Class 1E division as listed in Table 2.3.3-2 in a normal or alternate feed condition.	Testing will be performed for components designated as Class 1E in Table 2.3.3-2 by providing a test signal in each normally aligned division. Testing will be performed for components designated as Class 1E in Table 2.3.3-2 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 2.3.3-2. 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 2.3.3-2.
5.2	Valves listed in Table 2.3.3-2 fail as-is on loss of power.	Testing will be performed for the valves listed in Table 2.3.3-2 to fail as-is on loss of power.	Following loss of power, the valves listed in Table 2.3.3-2 fail as-is.
6.1	Components listed as Class 1E in Table 2.3.3-2, that are designated as harsh environment, will perform the function listed in Table 2.3.3-1 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 2.3.3-2 to perform the function listed in Table 2.3.3-1 for the environmental conditions that could occur before and during a design basis accident. 6.1b For equipment listed for harsh environment in Table 2.3.3-2, an inspection will be performed of the as-installed Class 1E equipment and the associated wiring, cables and terminations.	6.1a A report exists and concludes that the Class 1E equipment listed for harsh environment in Table 2.3.3-2 can perform the function listed in Table 2.3.3-1 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 2.3.3-2 for harsh environment conform with the design.
7.1	The SAHRS heat exchanger as listed in Table 2.3.3-1 has the capacity to transfer the design heat load to the CCWS.	Tests and analyses will be performed to demonstrate the capability of the SAHRS heat exchanger as listed in Table 2.3.3-1 to transfer the heat load to the CCWS.	A report exists and concludes that the SAHRS system has the capacity to remove the design heat load via the heat exchanger listed in Table 2.3.3-1.

Table 2.3.3-3—SAHRS Inspections, Tests, Analyses, and Acceptance Criteria (5 Sheets)

	Commitment Wording	Inspection, Analysis or Test	Acceptance Criteria
7.2	Class 1E valves listed in Table 2.3.3-2 perform the function listed in Table 2.3.3-1 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 2.3.3-2 to change position as listed in Table 2.3.3-1 under system design conditions.	The as-installed valve changes position as listed in Table 2.3.3-1 under system design conditions.
7.3	Containment isolation valves listed in Table 2.3.3-1 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 2.3.3-1 to close within the containment isolation response time following initiation of a containment isolation signal.	A report exists and concludes that the containment isolation valves listed in Table 2.3.3-1 close within the required times following initiation of a containment isolation signal: 30JMQ40 AA001 $\leq$ 60 sec. 30JMQ41 AA001 $\leq$ 60 sec. 30JMQ42 AA001 $\leq$ 60 sec. 30JMQ43 AA001 $\leq$ 60 sec.