## 2.3.3 Severe Accident Heat Removal System

### Design Description

### 1.0 System 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.
- Provides integrity of the IRWST boundary.

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 described in the Design Description of Section 2.3.3, Tables 2.3.3-1—SAHRS Equipment Mechanical Design. and 2.3.3-2—SAHRS Equipment I&C and Electrical Design, and as shown on Figure 2.3.3-1—SAHRS Functional Arrangement.

2.2 Deleted.

### 3.0 Mechanical Design Features

3.1 Pumps and valves listed in Table 2.3.3-1 will be functionally designed and qualified such that each pump and valve is capable of performing its intended function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including design basis accident conditions.

3.2 Check valves listed in Table 2.3.3-1 will function to change position as listed in Table 2.3.3-1 under normal operating conditions.

3.3 Deleted.

3.4 Equipment identified as Seismic Category I in Table 2.3.3-1 can withstand seismic design basis loads without a loss of safety function(s).

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3.14 ASME Code Class 2 piping systems are designed in accordance with ASME Code Section III requirements.

3.15 As-built ASME Code Class 2 components listed in Table 2.3.3-1 are reconciled with the design requirements.

3.16 Pressure-boundary welds in ASME Code Class 2 components listed in Table 2.3.3-1 meet ASME Code Section III non-destructive examination requirements.

3.17 ASME Code Class 2 components listed in Table 2.3.3-1 retain their pressure-boundary integrity at their design pressure.

3.18 ASME Code Class 2 components listed in Table 2.3.3-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

## 4.0 I&C Design Features, Displays, and Controls

4.1 Controls on the PICS operator workstations in the MCR and the RSS perform the function listed in Table 2.3.3-2.

4.2 Equipment listed as being controlled by a priority and actuator control system (PACS) module in Table 2.3.3-2 responds to the state requested and provides drive monitoring signals back to the PACS module. The PACS module will protect the equipment by terminating the output command upon the equipment reaching the requested state.

## 5.0 Electrical Power Design Features

5.1 Equipment 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 Deleted.

## 6.0 Environmental Qualifications

6.1 Equipment designated as harsh environment in Table 2.3.3-2 can perform the function listed in Table 2.3.3-1 under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.

## 7.0 Equipment and System Performance

7.1 The SAHRS pump delivers water to the Reactor Containment.

7.2 Class 1E valves listed in Table 2.3.3-2 will function to change position as listed in Table 2.3.3-1 under normal operating conditions.

7.3 Deleted.

## Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.3.3-3 lists the SAHRS ITAAC.

**Table 2.3.3-1—SAHRS Equipment Mechanical Design**

| Description | Tag Number(1) | Location | ASME Code Section III | Function | Seismic Category |
|---|---|---|---|---|---|
| SAHRS Pump | 30JMQ40AP001 | Safeguard Building 4 | No | N/A | II |
| SAHRS Heat Exchanger | 30JMQ40AC001 (Shell 1)<br>30JMQ40AC004 (Shell 2) | Safeguard Building 4 | No | N/A | II |
| Spray Header | 30JMQ41BR004 | Reactor Building | No | N/A | II |
| Passive Cooling Function Flow Reducer | 30JMQ42BP001 | Reactor Building | Yes | N/A | I |
| Passive Cooling Function Flow Reducer | 30JMQ42BP003 | Reactor Building | Yes | N/A | I |
| Passive Flooding Line Isolation Valve | 30JMQ42AA003 | Reactor Building | No | Open (Corium Cooling) | II |
| Passive Flooding Line Motorized Isolation Valve | 30JMQ42AA004 | Reactor Building | Yes | Open (Corium Cooling) | I |
| Passive Flooding Line Isolation Valve | 30JMQ42AA005 | Reactor Building | No | Open (Corium Cooling) | II |
| Passive Flooding Line Motorized Isolation Valve | 30JMQ42AA006 | Reactor Building | Yes | Open (Corium Cooling) | I |
| SAHRS – CIV | 30JMQ40AA001 | Safeguard Building 4 | Yes | Open/Close | I |
| SAHRS – CIV | 30JMQ41AA001 | Safeguard Building 4 | Yes | Open/Close | I |
| SAHRS Check Valve – CIV | 30JMQ41AA002 | Reactor Building | Yes | Open/Close | I |
| SAHRS – CIV | 30JMQ42AA001 | Safeguard Building 4 | Yes | Open/Close | I |
| SAHRS Check Valve – CIV | 30JMQ42AA002 | Reactor Building | Yes | Open/Close | I |
| SAHRS – CIV | 30JMQ43AA001 | Safeguard Building 4 | Yes | Close | I |
| SAHRS Check Valve – CIV | 30JMQ43AA002 | Reactor Building | Yes | Close | I |

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**

| Description | Tag Number(1) | Location | IEEE Class 1E(2)(3) | EQ – Harsh Env. | PACS | MCR Displays | MCR Controls |
|---|---|---|---|---|---|---|---|
| SAHRS Pump | 30JMQ40AP001 | Safeguard Building 4 | $4^{N}$ | Yes | Yes | Start-Stop | Start-Stop |
| SAHRS – CIV | 30JMQ40AA001 | Safeguard Building 4 | $1^{N}$<br>$2^{A}$ | Yes | Yes | Open/Close | Open/Close |
| SAHRS – CIV | 30JMQ41AA001 | Safeguard Building 4 | $4^{N}$<br>$3^{A}$ | Yes | Yes | Open/Close | Open/Close |
| SAHRS – CIV | 30JMQ42AA001 | Safeguard Building 4 | $4^{N}$<br>$3^{A}$ | Yes | Yes | Open/Close | Open/Close |
| SAHRS – CIV | 30JMQ43AA001 | Safeguard Building 4 | $4^{N}$<br>$3^{A}$ | Yes | Yes | 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 equipment is normally powered from, while $^{A}$ denotes the division equipment is powered from when alternate feed is implemented.

3. Safety electrical equipment in the SAHRS are being qualified for DBEs, not beyond DBEs.

**Table 2.3.3-3—Severe Accident Heat Removal System ITAAC**
**Sheet 1 of 5**

| Commitment Wording | | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| 2.1 | The functional arrangement of the SAHRS is as described in the Design Description of Section 2.3.3, Tables 2.3.3-1 and 2.3.3-2, and as shown on Figure 2.3.3-1. | An inspection of the as-built SAHRS functional arrangement will be performed. | The SAHRS conforms to the functional arrangement as described in the Design Description of Section 2.3.3, Tables 2.3.3-1 and 2.3.3-2, and as shown on Figure 2.3.3-1. |
| 2.2 | Deleted. | Deleted. | Deleted. |
| 3.1 | Pumps and valves listed in Table 2.3.3-1 will be functionally designed and qualified such that each pump and valve is capable of performing its intended function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including design basis accident conditions. | Tests or type tests of pumps and valves will be performed to demonstrate that the pumps and valves function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including design basis accident conditions. | A report concludes that the pumps and valves listed in Table 2.3.3-1 are capable of performing their intended function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including design basis accident conditions. |
| 3.2 | Check valves listed in Table 2.3.3-1 will function to change position as listed in Table 2.3.3-1 under normal operating conditions. | Tests will be performed to verify the ability of check valves to change position under normal operating conditions. | The check valves change position as listed in Table 2.3.3-1 under normal operating conditions. |
| 3.3 | Deleted. | Deleted. | Deleted. |
| 3.4 | Equipment identified as Seismic Category I in Table 2.3.3-1 can withstand seismic design basis loads without a loss of safety function(s). | a. Type tests, analyses, or a combination of type tests and analyses will be performed on the equipment identified as Seismic Category I in Table 2.3.3-1 using analytical assumptions, or under conditions, which bound the Seismic Category I design requirements. | a. Test/analysis reports conclude that the equipment identified as Seismic Category I in Table 2.3.3-1 can withstand seismic design basis loads without a loss of safety function(s). |

**Table 2.3.3-3—Severe Accident Heat Removal System ITAAC**
**Sheet 2 of 5**

| Commitment Wording | | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| | | b. An inspection will be performed of the as-built equipment identified as Seismic Category I in Table 2.3.3-1 to verify that the equipment, including anchorage, are installed in a condition bounded by the tested or analyzed condition. | b. Inspection reports conclude that the equipment identified as Seismic Category I in Table 2.3.3-1, including anchorage, are installed in a condition bounded by the tested or analyzed condition. |
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| 3.6 | Deleted. | Deleted. | Deleted. |
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| 3.10 | Deleted. | Deleted. | Deleted. |
| 3.11 | Deleted. | Deleted. | Deleted. |
| 3.12 | Deleted. | Deleted. | Deleted. |
| 3.13 | Deleted. | Deleted. | Deleted. |
| 3.14 | ASME Code Class 2 piping systems are designed in accordance with ASME Code Section III requirements. | An inspection of piping design and analysis documentation required by ASME Code Section III will be performed. {{DAC}} | ASME Code Section III Design Report(s) exist that meet the requirements of NCA-3550 and conclude that the design of ASME Code Class 2 piping systems complies with the requirements of ASME Code Section III. {{DAC}} |
| 3.15 | As-built ASME Code Class 2 components listed in Table 2.3.3-1 are reconciled with the design requirements. | A reconciliation analysis of ASME Code Class 2 components will be performed. | ASME Code Design Report(s) exist that meet the requirements of NCA-3550, conclude that the design reconciliation has been completed for as-built ASME Code Class 2 components listed in Table 2.3.3-1, and document that the results of the reconciliation analysis comply with the requirements of ASME Code Section III. |

**Table 2.3.3-3—Severe Accident Heat Removal System ITAAC**
**Sheet 3 of 5**

| Commitment Wording | | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| 3.16 | Pressure-boundary welds in ASME Code Class 2 components listed in Table 2.3.3-1 meet ASME Code Section III non-destructive examination requirements. | An inspection of the as-built pressure-boundary welds in ASME Code Class 2 components will be performed. | ASME Code reports(s) exist that conclude that ASME Code Section III requirements are met for non-destructive examination of pressure-boundary welds in ASME Code Class 2 components listed in Table 2.3.3-1. |
| 3.17 | ASME Code Class 2 components listed in Table 2.3.3-1 retain their pressure-boundary integrity at their design pressure. | A hydrostatic test will be conducted on ASME Code Class 2 components that are required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of ASME Code Class 2 components listed in Table 2.3.3-1 comply with the requirements of ASME Code Section III. |
| 3.18 | ASME Code Class 2 components listed in Table 2.3.3-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | An inspection of the as-built construction activities and documentation for ASME Code Class 2 components will be conducted. | ASME Code Data Report(s) exist that conclude that ASME Code Class 2 components listed in Table 2.3.3-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 4.1 | Controls on the PICS operator workstations in the MCR perform the function listed in Table 2.3.3-2. | Tests will be performed using controls on the PICS operator workstations in the MCR. | Controls on the PICS operator workstations in the MCR perform the function listed in Table 2.3.3-2. |
| 4.2 | Equipment listed as being controlled by a PACS module in Table 2.3.3-2 responds to the state requested and provides drive monitoring signals back to the PACS module. The PACS module will protect the equipment by terminating the output command upon the equipment reaching the requested state. | A test will be performed using test input signals to verify equipment controlled by a PACS module responds to the state requested and provides drive monitoring signals back to the PACS module. | Equipment listed as being controlled by a PACS module in Table 2.3.3-2 responds to the state requested and provides drive monitoring signals back to the PACS module. The PACS module will protect the equipment by terminating the output command upon the equipment reaching the requested state. |

**Table 2.3.3-3—Severe Accident Heat Removal System ITAAC**
**Sheet 4 of 5**

| Commitment Wording | | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| 5.1 | Equipment 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. | a. Testing will be performed by providing a test input signal in each normally aligned division. | a. The test input signal provided in the normally aligned division is present at the respective Class 1E equipment identified in Table 2.3.3-2. |
| | | b. Testing will be performed by providing a test input signal in each division with the alternate feed aligned to the divisional pair. | b. The test input signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E equipment identified in Table 2.3.3-2. |
| 5.2 | Deleted. | Deleted. | Deleted. |

**Table 2.3.3-3—Severe Accident Heat Removal System ITAAC**
**Sheet 5 of 5**

| Commitment Wording | | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|
| 6.1 | Equipment designated as harsh environment in Table 2.3.3-2 can perform the function listed in Table 2.3.3-1 under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions. | a. Type tests or type tests and analysis will be performed to demonstrate the ability of the equipment designated as harsh environment in Table 2.3.3-2 to perform the function listed in Table 2.3.3-1 under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.<br>b. An inspection will be performed of the as-built equipment designated as harsh environment in Table 2.3.3-2 to verify that the equipment, including the associated cables, wiring, and terminations located in a harsh environment, are bounded by the type test or combination of type tests and analyses. | a. EQDPs conclude that the equipment designated as harsh environment in Table 2.3.3-2 can perform the function listed in Table 2.3.3-1 under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions, including the time required to perform the listed function.<br>b. A report exists and concludes that the equipment designated as harsh environment in Table 2.3.3-2, including the associated cables, wiring, and terminations located in a harsh environment, are bounded by the type test or combination of type tests and analyses. |
| 7.1 | The SAHRS pump delivers water to the Reactor Containment. | Tests will be performed to verify the SAHRS pump delivers water to the Reactor Containment. | The SAHRS pump delivers a minimum flow of 232 lbm/s to the Reactor Containment. |
| 7.2 | Class 1E valves listed in Table 2.3.3-2 will function to change position as listed in Table 2.3.3-1 under normal operating conditions. | Tests will be performed to verify the ability of Class 1E valves to change position under normal operating conditions. | Class 1E valves listed in Table 2.3.3-2 change position as listed in Table 2.3.3-1 under normal operating conditions. |
| 7.3 | Deleted. | Deleted. | Deleted. |

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