9.2.8 Safety Chilled Water System

The safety chilled water system (SCWS) supplies refrigerated chilled water to the safety-related heating, ventilation and air conditioning (HVAC) systems and the low head safety injection system (LHSI) pumps and motors in Safeguard Buildings (SB) 1 and 4 and the fuel building ventilation system (FBVS). The SCWS consists of four trains, numbered 1 to 4. Train 1 and Train 2 are interconnected and Train 3 and Train 4 are interconnected.

9.2.8.1 Design Bases

The SCWS provides chilled water as a heat sink to the LHSI pumps and the safety-related HVAC systems, which in turn provides an acceptable environment for safety-related equipment and main control room (MCR) habitability in the event of a design basis accident (DBA) (GDC 44). The SCWS is classified as a safety-related system and has safety-related design functions. The system is designed Seismic Category I. Safety-related systems are required to function following a DBA and are required to achieve and maintain a safe shutdown condition.

Each SCWS train is protected from the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, and floods (GDC 2). The SCWS are located in Seismic Category I Safeguard Buildings, which are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other natural phenomena. The SCWS cross-tie piping will be routed through the stair tower structures between SB 1 and SB 2, and between SB 3 and SB 4. The stair tower structures are Seismic Category I and designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other natural phenomena.

Each train remains functional and performs its intended functions for all postulated environmental conditions or dynamic effects, such as pipe breaks (GDC 4).

Safety functions are performed assuming a single active component failure coincident with the loss of offsite power (GDC 44).

The SCWS is not shared with any other plant unit (GDC 5).

Active components of the SCWS trains are capable of being periodically tested and required inspections can be performed during plant operation (GDC 45 and GDC 46).

The SCWS trains use design and fabrication codes consistent with the safety classification and seismic design criteria provided in Section 3.2. The quality group classification meets the requirements of RG 1.26. The seismic design of the system components meets the guidance of RG 1.29. The power and control functions are designed in accordance with RG 1.32.

The SCWS operates continuously as described for the safety-related function when the plant is in normal conditions of startup, shutdown, power operation, and outages.

9.2.8.2 System Description

9.2.8.2.1 General Description

The SCWS consists of four trains numbered 1 to 4. Each is located in one of the four SBs. Each SCWS train is a closed loop system that supplies chilled cooling water for specified area HVAC air handling units (AHU) and Division 1 and 4 low head safety injection system (LHSI) pump seal coolers and motor coolers. Each train consists of a refrigeration chiller unit, two pumps, expansion tank, valves, and the associated piping and controls.

Normally open, motor-operated, cross-tie valves (MOV) interconnect the supply and return piping of Train 1 with Train 2, and the supply and return piping of Train 3 with Train 4. Each SCWS train is sized to meet the system load requirements of two divisional trains.

The SCWS provides chilled water to the HVAC cooling coils of the main control room (MCR), the electrical division rooms (SBVSE) in the SBs, SB controlled-area ventilation system (SBVS), FBVS, and the LHSI pump seal coolers and motor coolers in SB Divisions 1 and 4.

Bounding system design parameters for all operating conditions are listed on Table 9.2.8-1—Safety Chilled Water Design Parameters for Cross-Tied Operation and Table 9.2.8-2—Safety Chilled Water Design Parameters Each Division Isolated. The SCWS flow diagram is shown in Figure 9.2.8-1—Safety Chilled Water System Diagram. Pipe diameters for the SCWS are based on limiting the flow velocity to a range of 4 to 10 ft/second for normal modes of operation that are expected to occur frequently.

Refer to Section 12.3.6.5.9 for safety chilled water system design features which demonstrate compliance with the requirements of 10 CFR 20.1406.

9.2.8.2.2 Component Description

The general description of the component design features for the SCWS is provided below. Table 3.2.2-1 provides the seismic and other design classifications for the components in the SCWS.

Chilled Water Pumps

Two SCWS pumps in the operating train in each SCWS divisional pair circulate chilled water between the SCWS users in two divisions and the evaporator of the chiller refrigeration unit.

The required flow rate of each SCWS pump is defined by the heat to be removed from the system loads. As a minimum, the pumps are designed to fulfill the corresponding minimal required design mass flow rate under the following conditions:

- Fluctuations in the supplied electrical frequency.
- Increased pipe roughness due to aging and fouling.
- Fouled debris filters.
- Maximum pressure drop through the system heat exchangers.
- Minimum water level in the expansion tank considers net positive suction head to prevent cavitation of the SCWS pump and prevent vortex effects.

Determination of the discharge head of the pumps is based on dynamic pressure losses and head losses of the mechanical equipment of the associated SCWS at full load operation.

Air-Cooled Chiller Refrigeration Unit

SCWS, Trains 1 and 4, each contain one air-cooled chiller refrigeration unit that functions to refrigerate chilled water to its design basis temperature of 41°F for supply to the system users. These chillers are located in dedicated rooms of the SBs. Each chiller contains a condenser, compressors, evaporator, and associated piping and controls. Environmentally safe refrigerants are used in these chillers.

Water-Cooled Chiller Refrigeration Unit

SCWS, Trains 2 and 3, each contain one water-cooled chiller refrigeration unit that functions to refrigerate chilled water to its design bases temperature of 41°F for supply to the HVAC users. These chillers are located in dedicated rooms of the SBs. Each chiller contains a condenser, compressors, evaporator, and associated piping and controls. Environmentally safe refrigerants are used in these chillers.

Diaphragm Expansion Tank

Each SCWS train contains a diaphragm expansion tank with a nitrogen fill connection in each of the SBs. The expansion tank provides for changes in volume, pump NPSH, and establishes a point of reference pressure for the closed-loop system. These tanks are provided with relief valve overpressure protection. The expansion tank nitrogen maintains the operating static pressure to keep the highest point in the SCWS filled. The expansion tank pressure also keeps the SCWS pump suction pressure well above the fluid vapor pressure to enhance available NPSH. The normal water volume in the expansion tank allows for volume displacement due to temperature changes and operating transitions. A complete loss of nitrogen or water volume in an expansion tank will close the cross-tie valves on MIN-2 pressure and trip the SCWS operating pumps of the affected chiller train after reaching MIN-3 pressure.

The SCWS diaphragm expansion tank will contain a reserve volume for seven days of normal SCWS leakage. The leakage rate for each cross-tie supply and return valve is 3.6 in^3/hr. Valve leakage is based on ASME QME-1 that identifies a nominal valve leak rate of 0.6 $in.^3$/hr/NPS of nominal valve size. The seven-day leakage volume also includes leakage of 0.1 gal /hr for valve stem packing, pump seal, tank diaphragm, and any remaining undefined leakage.

Each SCWS expansion tank will include a minimum water volume of 100 gallons to accommodate potential system leakage for seven days continuous for 24 hours with no makeup source in post-seismic conditions of 0.5 gal/hr.

In cross-tie operation, the expansion tank in the standby train in a divisional pair is not isolated from the system. Sluicing of water between two expansion tanks as system loads cycle or on trip of a chiller and start of the standby unit is precluded in the design due to the dampening effect of the diaphragm and the compressed nitrogen, resistance of the long length of piping between tanks, and resistance of the small diameter piping at the tank connection.

Cooling Coils

Multiple HVAC cooling coils in each train receive chilled water for heat removal from selected HVAC users. The SCWS also cools Train 1 and Train 4 LHSI motor cooler and pump seal cooler.

Relief Valves

A relief valve located in each SCWS train protects the chilled water closed loop against high pressure. The relief valve set point will prevent the SCWS pressure from exceeding the system design pressure. The design pressure is based on the total of pump shut-off head, the operating static pressure, and the lowest elevation in the SCWS. The setpoint is established in accordance with ASME Boiler and Pressure Vessel Code, Section III, Class 3 (Reference 1).

Chiller Bypass Valve

The chiller bypass valve installed in the operating SWCS train varies flow returning to the chiller to prevent freezing at the evaporator coil. Upstream filters are provided as a precaution to protect downstream control valves which contain internals sensitive to particle trapping.

Cross-Tie Valves

A cross-tie is established for normal operation between the supply and the return piping of each divisional pair (1/2 or 3/4) of SCWS trains that includes MOVs and associated controls. There are two isolation valves per train (one supply and one return) that are located in their respective Safeguards Buildings. The valves are divisionally powered. During normal operations the cross-tie isolation valves are normally open and only one chiller train is operating.

HVAC Cooling Coil Flow Control Valves

The flow rate through the cooling coils for the electrical division of the safeguards building ventilation system and the ventilation of the main control room air conditioning system are each regulated by a flow control valve positioned by room temperature or manually from the control room to provide the required flow. All other HVAC cooling coils and LHSI are supplied by fixed SCWS flow rates to confirm operability of all loads.

Filters

Liquid filters are installed upstream of the modulating flow control valves to protect throttling surfaces from minor corrosion debris, or debris from maintenance activities. A differential pressure limit across the filter, to allow for 30 days of operation post DBA, is maintained by normal maintenance.

9.2.8.3 System Operation

9.2.8.3.1 Normal Operation

During normal operation, at least one train of the divisional pair is in operation. Either Train 1 or Train 2 chiller provides safety chilled water cooling for all SCW loads within Safeguard Building Divisions 1 and 2, and the associated FBVS load. Likewise, the chiller from either Train 3 or 4 provides safety chilled water cooling for both Safeguard Divisions 3 and 4 and the associated FBVS load. During normal operation, the cross-tie isolation valves (supply and return for both divisions) are normally open. The non-operating chiller and pump(s) are maintained in standby. This configuration also allows for maintenance on the non-operating chiller and pump(s). If the normal operating train pump or chiller fails, a switchover sequence to the standby train is automatically initiated. A planned switchover of the operating train is manually initiated from the MCR.

The chilled water distribution circuit operates with a variable flow rate that is governed by the position of the control valves associated with supplied user loads. A regulated chilled water bypass line is provided between the refrigeration–evaporator outlet line and the return line to prevent freezing. A diaphragm expansion tank is used for equalization of pressure and volumetric expansion and helps maintain the requisite static system pressure. A relief valve on the connecting line prevents the line design pressure from being exceeded. Piping voids associated with potential waterhammer are precluded by the constant pressure maintained in the nitrogen-charged expansion tank in each train.

The SCWS design minimizes the potential for dynamic flow instabilities and water hammer by avoiding high line velocities and has specified closing valve speeds that are slow enough to prevent damaging pressure increases. Vents are provided to vent to fully fill components and piping at high points in which voids could occur. The Nitrogen pressurized expansion tank confirms system high points are retained at positive pressure.

A manually operated make up demineralized water supply is used when water loss resulting from operational measures (e.g., venting and draining) is indicated by an expansion tank pressure instrument.

The SCWS is treated with hydrazine in low concentration for corrosion control. Monitoring of the water chemistry is provided by means of local sampling.

9.2.8.3.2 Abnormal Operation

In the event of a DBA with concurrent loss of offsite power (LOOP) the operating train of a divisional pair receives a “Start” signal to return the operating train to operation after load shed. If an active single failure occurs (assume either the EDG fails to start or the SCW train pump or chiller does not re-start), then the standby train receives a “Start” signal. This sequence confirms that one train of a divisional pair is operating.

The SCWS is powered from the emergency diesel generators (EDG) and continues to function during a DBA. Trains 1 and 4 of the SCWS provide a heat sink to Divisions 1 and 4 LHSI pumps and HVAC systems in the event of a severe accident or station blackout (SBO). Trains 1 and 4 are powered from motor control centers that are re-powered by the station blackout diesels during an SBO event.

Each SCWS expansion tank will maintain a defense in depth post-seismic emergency manual makeup spool piece connection to a seismic makeup water source post seven day water supply from the Seismic II fire water distribution system inside the Nuclear Island. The seismic makeup connection is shown on Figure 9.2.8-1. The fire water distribution system is designed to remain functional after a SSE as described in Section 9.5.1.2.1.

A mechanical or electrical failure of the running SCWS pump results in a switchover to the standby train.

Each refrigeration chiller in the four trains of the SCWS has three 50 percent capacity compressors to provide sufficient operating redundancy and flexibility in the event of a compressor failure. The two remaining chiller compressors provide 100 percent capacity as described in Section 9.2.8.2.1.

In case of loss of off-site power, each SCWS division is powered from its associated emergency diesel generator (EDG). To allow divisional maintenance (e.g., maintenance on EDGs), the SCWS safety-related motor operated flow control valves and the motor operated cross-tie valves are powered from the normal 1E power division or alternately fed from the adjacent class 1E power division. In cross-tie operation, this provides the capability to operate the SCWS flow control valves in two cross-tied trains, if necessary switch to the standby train in the divisional pair, or if necessary close the cross-tie valves. Division 2 is the alternate feed for Division 1 and vice versa. Division 4 is the alternate feed for Division 3 and vice versa.

9.2.8.4 Safety Evaluation

The SCWS is designed as Seismic Category I as described in Section 3.2 to operate in all plant modes of operation including design basis events. The SCWS divisions are located in SBs 1 to 4, respectively. The SBs are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other natural phenomena. Sections 3.3, 3.4, 3.5, 3.7, and 3.8 provide the bases for the adequacy of the structural design of these buildings.

The SCWS is designed to remain functional after a safe shutdown earthquake. Section 3.7 provides the design loading conditions that were considered. Sections 3.5, 3.6, and 9.5.1 provide the hazards analyses to make sure that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

A four train design with interconnection of Train 1 and Train 2, and interconnection of Train 3 and Train 4 of the SCWS fulfills the single failure criteria. The four SCWS trains are backed up by the EDGs. Two of these trains, in Divisions 1 and 4, are also backed up by the SBO diesels.

Structures, systems and components important to safety in the SCWS are not shared with any other co-located nuclear reactor units.

Preoperational testing of the SCWS is performed as described in Chapter 14.0. Periodic inservice functional testing is done in accordance with Section 9.2.8.5.

Section 6.6 provides the ASME Boiler and Pressure Vessel Code, Section XI (Reference 1) requirements that are appropriate for the SCWS.

Section 3.2 delineates the quality group classification and seismic category applicable to the safety-related portion of this system. Table 9.5.4-1 shows that the components meet the design and fabrication codes given in Section 3.2. All the power supplies and control functions necessary for safe function of the SCWS are Class IE, as described in Chapter 7 and Chapter 8.

Cooling diversity is created between the load heat sinks of Train 1 and Train 4, and Train 2 and Train 3. Train 1 and Train 4 chillers are air cooled, and Train 2 and Train 3 chillers are water cooled by the component cooling water system (CCWS).

A process radiation monitor is provided in Trains 1 and 4 of the SCWS, downstream of the LHSI pump mechanical seal cooler to monitor for possible leakage of radioactive fluid from the heat exchanger. Otherwise, migration of radioactive material from potentially radioactive systems is prevented with a minimum of two heat exchanger barriers. Radiation monitors are in the CCWS to detect radioactive contamination entering and exiting the system. Radiation monitors for the SCWS and the CCWS are specified in Table 11.5-1 Monitors R-59, R-60 (SCWS) and R-64 (CCWS).

9.2.8.5 Inspection and Testing Requirements

Prior to initial plant startup, a comprehensive performance test will be performed to verify that the design performance of the system and individual components is attained. Refer to Section 14.2, Test #052, for initial plant testing of the SCWS.

After the plant is brought into operation, periodic tests and inspections of the SCWS components and subsystems are performed to verify proper operation. Scheduled tests and inspections are necessary to verify system operability.

The installation and design of the SCWS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leak tight integrity and its availability and ability to fulfill its functions.

Inservice inspection and testing requirements are in accordance with Section XI of the ASME Code (Reference 1) and the ASME OM Code (Reference 2).

Sections 3.9.6 and 6.6 describe the inservice testing and inspection requirements, respectively. Refer to Section 16.0, Surveillance Requirement (SR) 3.7.9 for surveillance requirements that verify continued operability of the SCWS.

The SCWS expansion tank pressure indication is transmitted to the MCR for the provision of real time trending data on expansion tank pressure and volume equivalent to identify leakage. This provides the operators the ability to take corrective action prior to exceeding the maximum allowed seven day train leakage. The pressure differential in equivalent inches of water is obtained from the pressure indication at the top and bottom of the tank.

A Surveillance Requirement will verify SCWS train leakage on a 24 month frequency. Plant procedures and controls associated with leakage trending will be implemented by the COL applicant.

9.2.8.6 Instrumentation Requirements

The SCWS is controlled by the safety automation system (SAS). The normal indication, manual control, and alarm functions are provided by the process information and control system (PICS). Instrument display location, and input to alarm and automatic or manual functions for instruments shown in Figure 9.2.8-1 are provided in Table 9.2.8-3.

The chiller evaporator outlet temperature is monitored. An alarm occurs if temperature reaches high setpoint. An automatic switchover to the standby train occurs if temperature reaches high-high setpoint.

An automatic switchover to operate the opposite chiller train occurs if the chilled water flow through the evaporator reaches a MIN-2 set point for the running train. Then, if the cross-tie valves are open and the opposite chiller is in stand-by, the opposite (non-running) chiller pumps are automatically started. When differential pressure across the opposite chiller evaporator is greater than MIN-1, then the opposite chiller is automatically started and the initial running chiller train is stopped manually from the MCR.

The following automatic functions represent generic steps in train switchover to be performed or validated as a result of the abnormal condition in the affected train:

- Standby train prerequisites are met for train startup.
- Cross-tie MOVs are open-validate MOV position.
- Start standby train pump 1.
- Start standby train pump 2.
- Start standby train chiller unit.
- Enable the control loop for differential pressure across the evaporator, which starts system flow regulation by the bypass control valve in the standby train.
- Enable the pressure monitoring loop for system pressure.

Annunciation occurs on automatic switchover.

When the standby train is in operation, the following actions are manually initiated from the control room to stop the previously operating train:

- Standby train is in operation – validate operation.
- Stop operating chiller (if running).
- Stop operating train pump 1 (if running).
- Stop operating train pump 2 (if running).
- Disable the operating train pressure monitoring loop for system pressure.
- Close the operating train bypass control valve.
- Disable the operating train control loop for differential pressure across the evaporator.

System pressure is monitored with the aid of two pressure measurements for each train. The two measurements are combined in one measuring point. If the pressure falls to MIN-1, an alarm is issued for operators to check nitrogen charge or provide makeup with demineralized water. The SCWS expansion tank MIN-1 pressure alarm is below the lowest normal system operating pressure with sufficient margin to avoid a spurious alarm. SCWS expansion tank MIN-2 pressure is below MIN-1, but above the inventory margin required for seven days of normal operation. SCWS expansion tank MIN-3 pressure is below the seven day normal makeup margin, but high enough to provide sufficient NPSH and prevent pump cavitation and still retain sufficient inventory margin in the expansion tank.

If the system experiences excessive leakage in excess of system makeup capability, the cross-tie isolation MOVs are closed manually from the MCR on Low-2 system pressure. The non-operating standby train automatically starts on Low-2 pressure. The train without excessive leakage returns to pressure and the train with excessive leakage is manually stopped from the DCS.

If the pressure falls to MIN-3, the following measures are initiated automatically for the affected train:

- Chilled water system “Protection OFF” alarms. The MIN-3 system pressure setpoint trip occurs before the pressure corresponding to the minimum required available NPSH is reached.
- Refrigeration unit shuts down.
- Chilled water circulating pump shuts down.

A humidity sensor is installed in the nitrogen region of the diaphragm expansion tank. This sensor issues a MAX-1 alarm indicating a leaky diaphragm if humidity exceeds a set limit.

To provide a constant water flow through the evaporator for the refrigeration unit, a controlled bypass is implemented between chilled water feed and chilled water return by means of a control valve. The controlled variable is differential pressure across the chiller evaporator.

The affected chilled water system pump and chiller is deactivated by a "Protection OFF" command in the case of the following faults:

- Pump failure.
- MIN-3.
- Minimum pressure limit for the system.
- Emergency power condition–under-voltage shutdown.

In the event of a DBA with LOOP the operating chiller and pumps will restart automatically after power is restored. In the event the operating train fails, the opposite stand-by train starts within one minute. In the event that the cross-tie valves close with one pump running in the operating SCWS division, the second standby pump starts within one minute if the running pump fails.

The SCWS pumps and chiller can be started manually assuming the SCWS is filled and pressurized to the normal operating range in the expansion tank, and if the cross-tie valves are open and the pumps in the opposite division of the pair are not running. If the cross-tie valves are shut and the paired divisions are isolated, then a pump in either or both divisions can be started with the SCWS filled to the normal operating pressure band in the expansion tank. Running pumps will trip on a pump fault, chiller fault, low evaporator flow (MIN-2), or MIN-3 pressure in the expansion tank. In the event of a running pump trip on a pump fault when the cross-tie valves are shut and the division train is operating separate from the other division pair, then the second pump is on stand-by and starts when the SCWS fills to the normal operating pressure band in the expansion tank.

In the event of a DBA with LOOP, the running pumps automatically restart under the EDG loading sequence. The pumps in the opposite train starts if the running pumps fail.

9.2.8.7 References

1. ASME Boiler and Pressure Vessel Code, Section XI: "Rules for Inservice Inspection of Nuclear Facility Components," The American Society of Mechanical Engineers, 2004.

2. ASME OM Code, "Code for Operation and Maintenance of Nuclear Power Plants," The American Society of Mechanical Engineers, 2004 edition.

Table 9.2.8-1—Safety Chilled Water Design Parameters for Cross-Tied Operation

Description	Technical Data
QKA 10/20/30/40 Evaporator refrigeration capacity	4,388,200 Btu/h
QKA 10/40 Condensing capacity	5,705,000 Btu/h
QKA 20/30 Condensing capacity	5,705,000 Btu/h
QKA 10/40 Condenser Air Flow	586,100 ft^3/min
QKA 10/40 Condenser Fan Power (3-50% capacity fans per condenser)	95 hp
QKA 20/30 Condenser CCW cooling flow	1140 gpm
QKA 10/20/30/40 Required Evaporator Chilled Water Flow	1130 gpm
QKA 10/20/30/40 Required Evaporator Chilled Water Outlet Temperature	41 ^{o}F
QKA 10/20/30/40 Required Evaporator Chilled Water Inlet Temperature	50 ^{o}F
QKA 10/20/30/40 Chilled Water Pump AP-107 Required Operating Flow (including margin)	565 gpm
QKA 10/20/30/40 Chilled Water Pump AP-107 Required Operating Head	171 ft
QKA 10/20/30/40 Chilled Water Pump AP-107 Shutoff Head	222 ft
QKA 10/20/30/40 Required Chilled Water Pump AP-107 Hydraulic Horsepower	25 h
SCWS Design Pressure	254 psig

Table 9.2.8-2—Safety Chilled Water Design Parameters Each Division Isolated

Description	Technical Data
QKA 10/40 Evaporator refrigeration capacity	2,394,200 Btu/h
QKA 20/30 Evaporator refrigeration capacity	1,994,000 Btu/h
QKA 10/40 Condensing capacity	3,112,500 Btu/h
QKA 20/30 Condensing capacity	2,592,200 Btu/h
QKA 10/40 Condenser Air Flow	319,740 ft^3/min
QKA 10/40 Condenser Fan Power (3-50% capacity fans per condenser)	52 hp
QKA 20/30 Condenser CCW cooling flow	475 gpm
QKA 10/20/30/40 Required Evaporator Chilled Water Flow	565 gpm
QKA 10/20/30/40 Required Evaporator Chilled Water Outlet Temperature	41 ^oF
QKA 10/20/30/40 Required Evaporator Chilled Water Inlet Temperature	50 ^oF
QKA 10/20/30/40 Chilled Water Pump AP-107 Required Operating Flow (including margin)	565 gpm
QKA 10/20/30/40 Chilled Water Pump AP-107 Required Operating Head	131.93 ft
QKA 10/20/30/40 Chilled Water Pump AP-107 Shutoff Head	172 ft
QKA 10/20/30/40 Required Chilled Water Pump AP-107 Hydraulic Horsepower	19 hp
Design Pressure	254 psig

Table 9.2.8-3—Safety Chilled Water Instrumentation
Sheet 1 of 5

MCR/RSS Display	Alarm/ Action	Function	Purpose
Expansion Tank Humidity Div 1	MAX-1	N/A	MAX-1 alarm alerts operator to leaking or failed tank diaphragm
Div. 1 System Pressure #1 and #2 combined	MAX-1 MAX-2 MIN-1 MIN-2 MIN-3	MIN-2 Manual Isolation Div. 1 and 2 MIN-3 Div 1 Chiller and Pump shutdown	MAX-2 relief/alarm prevent exceeding design pressure MAX-1 alarm alerts operator to high inventory MIN-1 alarm alerts operator to add inventory MIN-2 alarm alerts operators to close cross-tie valves for inventory protection of a division MIN-3 trips operating pumps at pump min NPSH
Evaporator ΔP Div 1	MIN-1 MIN-2 MAX-1	MODULATE Chiller Bypass Valve 30QKA10CG101	MIN-1 chiller freeze protection – incrementally opens valve MIN-2 alarm alerts operator to low evaporator ΔP. MAX-1 incrementally close valve to control flow
Evaporator Flow DIV 1	MIN-1 MIN-2	MIN-2 Train 1 to Train 2 Switchover	MIN-1 alarm alerts operator to low flow MIN-2 indicates normal flow loss in division and auto switch to alternate division
Tank Humidity Measurement DIV 2	MAX-1		MAX-1 alarm alerts operator to leaking or failed tank diaphragm

Table 9.2.8-3—Safety Chilled Water Instrumentation
Sheet 2 of 5

MCR/RSS Display	Alarm/ Action	Function	Purpose
Div. 2 System Pressure #1 and #2 combined	MAX-1 MAX-2 MIN-1 MIN-2 MIN-3	MIN-2 Manual Isolation Div. 1 and 2 MIN-3 DIV 2 Chiller and Pump shutdown	MAX-2 relief/alarm prevent exceeding design pressure MAX-1 alarm alerts operator to high inventory MIN-1 alarm alerts operator to add inventory MIN-2 alarm alerts operators to close cross-tie valves for inventory protection of a division MIN-3 trips operating pumps at pump min NPSH
Evaporator ΔP DIV 2	MIN-1 MIN-2 MAX-1	MODULATE Chiller Bypass Valve 30QKA20CG101	MIN-1 chiller freeze protection – incrementally opens valve MIN-2 alarm alerts operator to low evaporator ΔP. MAX-1 incrementally close valve to control flow
Evaporator Flow DIV 2	MIN-1 MIN-2	MIN-2 Train 2 to Train 1 Switchover	MIN-1 alarm alerts operator to low flow MIN-2 indicates normal flow loss in division and auto switch to alternate division
Tank Humidity Measurement DIV 3	MAX-1		MAX-1 alarm alerts operator to leaking or failed tank diaphragm

Table 9.2.8-3—Safety Chilled Water Instrumentation
Sheet 3 of 5

MCR/RSS Display	Alarm/ Action	Function	Purpose
Div. 3 System Pressure #1 and #2 combined	MAX-1 MAX-2 MIN-1 MIN-2 MIN-3	MIN-2 Manual Isolation Div. 1 and 2 MIN-3 DIV 3 Chiller and Pump shutdown	MAX-2 relief/alarm prevent exceeding design pressure MAX-1 alarm alerts operator to high inventory MIN-1 alarm alerts operator to add inventory MIN-2 alarm alerts operators to close cross-tie valves for inventory protection of a division MIN-3 trips operating pumps at pump min NPSH
Evaporator ΔP DIV 3	MIN-1 MIN-2 MAX-1	MODULATE Chiller Bypass Valve 30QKA30CG101	MIN-1 chiller freeze protection – incrementally opens valve MIN-2 alarm alerts operator to low evaporator ΔP MAX-1 incrementally close valve to control flow
Evaporator Flow DIV 3	MIN-1 MIN-2	MIN-2 Train 3 to Train 4 Switchover	MIN-1 alarm alerts operator to low flow MIN-2 indicates normal flow loss in division and auto switch to alternate division
Tank Humidity Measurement DIV 4	MAX-1		MAX-1 alarm alerts operator to leaking or failed tank diaphragm

Table 9.2.8-3—Safety Chilled Water Instrumentation
Sheet 4 of 5

MCR/RSS Display	Alarm/ Action	Function	Purpose
Div. 4 System Pressure #1 and #2 combined	MAX-1 MAX-2 MIN-1 MIN-2 MIN-3	MIN-2 Manual Isolation Div. 1 and 2 MIN-3 DIV 4 Chiller and Pump shutdown	MAX-2 relief/alarm prevent exceeding design pressure MAX-1 alarm alerts operator to high inventory MIN-1 alarm alerts operator to add inventory MIN-2 alarm alerts operators to close cross-tie valves for inventory protection of a division MIN-3 trips operating pumps at pump min NPSH
Evaporator ΔP DIV 4	MIN-1 MIN-2 MAX-1	MODULATE Chiller Bypass Valve 30QKA40CG101	MIN-1 chiller freeze protection – incrementally opens valve MIN-2 alarm alerts operator to low evaporator ΔP. MAX-1 incrementally close valve to control flow
Evaporator Flow DIV 4	MIN-1 MIN-2	MIN-2 Train 4 to Train 3 Switchover	MIN-1 alarm alerts operator to low flow MIN-2 indicates normal flow loss in division and auto switch to alternate division
Chiller Bypass Valve Position Div 1	N/A	Evaporator Flow Control	Valve position status
Chiller Bypass Valve Position Div 2	N/A	Evaporator Flow Control	Valve position status
Chiller Bypass Valve Position Div 3	N/A	Evaporator Flow Control	Valve position status
Chiller Bypass Valve Position Div 4	N/A	Evaporator Flow Control	Valve position status
SAC Coil Throttle Valve Position Div1	N/A	HVAC Coil Flow Control	Valve position status
SAC Coil Throttle Valve Position Div2	N/A	HVAC Coil Flow Control	Valve position status

Table 9.2.8-3—Safety Chilled Water Instrumentation
Sheet 5 of 5

MCR/RSS Display	Alarm/ Action	Function	Purpose
SAC Coil Throttle Valve Position Div3	N/A	HVAC Coil Flow Control	Valve position status
SAC Coil Throttle Valve Position Div4	N/A	HVAC Coil Flow Control	Valve position status
SAB Coil Throttle Valve Position Div1	N/A	HVAC Coil Flow Control	Valve position status
SAB Coil Throttle Valve Position Div2	N/A	HVAC Coil Flow Control	Valve position status
SAB Coil Throttle Valve Position Div3	N/A	HVAC Coil Flow Control	Valve position status
SAB Coil Throttle Valve Position Div4	N/A	HVAC Coil Flow Control	Valve position status
Division 1 To 2 Cross-connect Supply MOV Position	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
Division 1to 2 Cross-connect Return MOV Position	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
Div 2 To 1 Cross-connect Supply MOV POS	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
Div 2 To 1 Cross-connect Return MOV POS	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
Div 3 To 4 Cross-connect Supply MOV POS	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
Div 3 To 4 Cross-connect Return MOV Position	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
Div 4 To 3 Cross-connect Supply MOV POS	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
Div 4 To 3 Cross-connect Return MOV POS	N/A	Switchover Valve OPEN/CLOSE Confirmation	Valve position status
LHSI Seal Cooler	N/A	OPEN/CLOSE Confirmation	Valve position status

Next File