9.2.2 Component Cooling Water System

The component cooling water system (CCWS) is a closed loop cooling water system that, in conjunction with the essential service water system (ESWS) and the ultimate heat sink (UHS), removes heat generated from the plants safety-related and non-safety components connected to the CCWS. Heat transferred by these components to the CCWS is rejected to the ESWS via the component cooling water heat exchangers (HX).

The four safety-related trains of the CCWS cool the safety-related equipment, as required, during all phases of operation. Two non-safety-related branches of the CCWS cool the common users located inside the Fuel Building (FB), Reactor Building (RB), Radioactive Waste Processing Building (RWB), and Nuclear Auxiliary Building (NAB). The four independent safety-related trains provide enough capability that the loss of one train from a single component failure, with a second train down for maintenance, will not impair the ability of the CCWS to meet its safety-related functional requirements.

One additional non-safety-related train comprises the dedicated CCWS that cools the severe accident heat removal system (SAHRS).

The CCWS fluid serves as a barrier preventing radioactive fluid from the components it cools from leaking into the environment. It also serves as a barrier against the leakage of untreated service water into the containment or reactor systems.

9.2.2.1 Design Bases

The CCWS safety-related trains are:

- Protected from the effects of natural phenomena;
  - Earthquakes, tornadoes, hurricanes, floods, and external missiles.
  - Designed to function following such events (GDC 2).
- Designed to the Seismic Category assigned by RG 1.29 (Seismic Category I) and therefore will remain functional after a safe shutdown earthquake (SSE) (GDC 2).
- Designed to remain functional in spite of the postulated hazards of internal missiles, pipe whipping and discharging fluids (GDC 4).
- Not shared among nuclear power units (GDC 5).
- Designed to remain functional despite a single active component failure coincident with the loss of either the offsite or onsite power source (GDC 44).
- Designed to permit appropriate periodic inspection of important components to provide for integrity and capability of the system (GDC 45).

- Designed to permit appropriate periodic pressure and functional testing to make sure of (1) the structural and leak-tight integrity of its components, (2) the operability and the performance of the active components of the system, and (3) the operability of the system as a whole and, under conditions as close to the design as practical, the performance of the full operational sequence that brings the system into operation for reactor shutdown and for loss of coolant accidents (LOCA), including operation of applicable portions of the protection system and the transfer between normal and emergency power sources (GDC 46).

- Designed to permit isolation of lines that penetrate the primary containment to maximize containment isolation integrity (GDC 57).

- Designed to provide acceptable performance for all environments anticipated under normal, testing, and design basis conditions in compliance with the requirements of 10 CFR 50.49.

- Supplied by highly reliable and diverse power and control systems in conformance with the guidance of RG 1.32.

- Provides cooling to the thermal barrier of the reactor coolant pump (RCP) seals during all plant operating modes when the RCPs are running. (Thermal barrier cooling does not isolate due to an accident signal.)

The non-safety-related dedicated CCWS train is available on demand, in the unlikely event of a severe accident, to cool the SAHRS.

Consistent with the requirements of 10 CFR 20.1406, the U.S. EPR design, including the component cooling water system, is designed, to the extent practicable, to minimize contamination of the facility and the environment, and facilitate eventual decommissioning. Minimization of contamination and radioactive waste generation is described in Section 12.3.6.5.3.

9.2.2.2 System Description

9.2.2.2.1 General Description

The CCWS design complies with applicable industry codes and standards, and regulatory requirements, commensurate with the function of each of the safety-related components. As such, the CCWS components are fabricated, installed, and maintained in compliance with:

- ASME Boiler and Pressure Vessel (BPV) Code Section III, (Reference 1) Class 2 and 3 components.

- ASME Power Piping Code B31.1 (Reference 2).

- ASME BPV Code Section VIII, (Reference 3) non-safety-related components.

- Electrical redundancy and separation as specified in IEEE Std 603 (Reference 4).

- Seismic Category I and important-to-safety components as defined in RG 1.29.
- Environmental qualification as specified in 10 CFR 50.49.

The CCWS is a four train system configured to allow sharing of operational and safety-related users among the trains during normal operation, while always maintaining train separation with rapid isolation capability of the non-safety-related users in the event of an accident. The trains form pairs; trains 1 and 2 form one pair, and trains 3 and 4 the other pair. During normal operation, one or both trains in each associated pair can be in operation to cool the two common sets of users. Depending on the system user requirements, heat loads, and flow rates, and depending on the existing plant operating condition, the CCWS may have two, three, or all four trains in operation. System design parameters and flow requirements are listed in Table 9.2.2-1—CCWS Design Parameters and Table 9.2.2-2—CCWS User Requirements Summary.

Trains may be added or dropped as necessary to maintain the CCWS HX outlet temperature above the minimum required and below the maximum allowed and maintain the individual CCWS pump steady-state operating flow between the minimum required and the maximum allowed values. Idle CCWS trains are available and isolated from the common headers to provide safety injection system (SIS) availability if necessary. Maintenance on a CCWS train during power operation is possible.

During normal operation and design basis events, the CCWS provides the cooling function for the safety injection system/residual heat removal system (SIS/RHRS) and the safety chilled water system (SCWS) of divisions 2 and 3. The CCWS also transfers decay heat from the fuel pool cooling system (FPCS) whenever fuel is stored in the spent fuel pool. The CCWS additionally cools the thermal barriers of the RCP seals during all plant operating modes when the RCPs are running. Upon receipt of a containment isolation signal, the CCWS responds to protect the integrity of the containment pressure boundary.

During normal operation the temperature at the outlet of the CCWS heat exchanger must be greater than 59°F and lower than 100.4°F. During a DBA, CCWS heat exchanger outlet temperature must be lower than 113°F.

The expected CCWS pump suction temperatures for the various operational alignments are enveloped by a temperature of 190°F. The 190°F temperature is conservatively based on CCWS heat exchanger DBA inlet temperature (181°F) plus margin. The 181°F inlet temperature results from a maximum allowed CCWS heat exchanger outlet temperature 113°F for DBA conditions.

The CCWS flow rate is automatically controlled for those users which have been determined to have a limited operating temperature range for support of stable operation, while less temperature-sensitive users remain at a fixed flow resistance during all operating conditions. These fixed flow rates are adjusted once during plant commissioning with the system in its most demanding flow configuration (system flow balancing), and is reaffirmed regularly throughout the plant life by periodic surveillance, to make sure there is adequate required user flow for all operating conditions. It is not expected that the CCWS flow balance will require adjustment after the initial flow balance has been established.

For the accident analysis it is assumed that one CCWS train is unavailable due to maintenance or other activity and a second train fails to perform its function, leaving only two trains available for the event. Upon receipt of a safety injection and containment isolation Stage 1 actuation, the reactor protection system starts the CCWS pumps and opens the low head safety injection/residual heat removal (LHSI/RHR) isolation valves (CCWS flow to the LHSI/RHR HXs and LHSI pump coolers in trains 2 and 3) of the trains not initially in operation. The non-safety-related common users outside of the RB and the containment ventilation and reactor coolant drain tank (RCDT) cooler inside the RB are isolated. A subsequent containment isolation Stage 2 signal isolates the RCP and CVCS loads inside the RB except for the RCP seals thermal barrier coolers.

For the analysis, the accident is assumed to occur with coincident loss of offsite power (LOOP). The loss of one train is assumed to occur due to single failure, the most limiting of which is loss of one electrical division. This loss also results in the incidental loss of the associated emergency core cooling system (ECCS) and ESWS trains. This sequence is detailed in Chapter 15. Throughout accident mitigation and recovery, one of the remaining available CCWS trains cools the LHSI/RHR HX and the other provides additional cooling to the remaining safety loads, with both CCWS trains cooled by their associated ESWS trains.

Leaks in the CCWS, either in or out, will be apparent from various indications, and must be promptly isolated for repair or other corrective action. For instance, leakage of reactor coolant into the CCWS from an RHR HX tube, RCP seal thermal barrier, or other source is identified by increased activity in the CCWS fluid as detected by a continuous monitor or routine sampling, and is also indicated by an unexpected increasing level in the surge tank. The RCP thermal barrier leakage is detected by indication of a high outlet flow from the barrier or an elevated return temperature (or both). The operational pressure gradient of the cooling chain makes in-leakage of service water unlikely. Out-leakage from the system is indicated by an unexpected decrease in surge tank level, indicated by a noticeable increase in automatic makeup flow, visible leakage in the accessible areas or change in reactor coolant chemistry identified during routine sampling. For significant out-leakage from the CCWS, a rapid drop of the CCW level in the corresponding surge tank would trigger automatic inhibition of common users transfer of that train on sufficiently low level, and subsequent isolation of the common header upon reaching the low level isolation setpoint. This conserves the system capacity to cool the safety-related SIS users directly associated with the CCWS train. The system configuration also enables all such leaks to be readily isolated to prevent release of radioactive fluid, excessive dilution or chemical contamination of the reactor coolant.

CCWS equipment that provides cooling to the SIS/RHRS; spent fuel pool; reactor coolant pump (RCP), including the thermal barrier; safety chillers; and equipment which performs a containment isolation function is classified Seismic Category I. This equipment is located in buildings designed to Seismic Category I requirements.

CCWS users, which are not classified Seismic Category I, can be isolated by Seismic Category I fast-acting isolation valves in case of external hazards.

The Seismic Category I fast-acting isolation valves for non-safety-related CCWS users are hydraulically operated and designed to close in less than 10 seconds. The CCWS common header switchover valves are also fast-acting hydraulically operated valves with a closure time of less than 10 seconds. These switchover valves can be used to isolate the common headers to conserve the system capacity to cool the safety-related SIS users directly associated with the CCWS train. The common header switchover valves (KAA10/20/30/40 AA006/010/032/033) will be designed to fail “as-is” on loss of power to the hydraulic pilot circuit while the isolation valves (KAB50 AA001/004/006 and KAB80 AA015/016/019) for the non-safety-related CCWS users will be designed to fail “closed” on loss of power to the hydraulic pilot circuit.

The four separate, independently powered safety cooling trains of the CCWS, combined with high standards for system design, installation and maintenance, provides assurance that the system will fulfill its safety-related function under the most demanding postulated conditions in spite of its most limiting credible single failure.

During severe accidents, containment heat is removed by the dedicated cooling chain, consisting of the SAHRS, dedicated CCWS, and dedicated ESWS. This dedicated CCWS train is normally in standby operation and is manually started if needed. In case of loss of the dedicated CCWS or ESWS division, the SAHRS cooling chain is lost. This condition is outside the DBA. The dedicated CCWS train supports beyond design basis accident mitigation, and is powered by Class 1E electrical Division 4 and is capable of being supplied by the onsite electrical power supplies that are backed by an EDG or SBO diesel generator.

Each physically separated CCWS safety-related train includes:

- A main system pump fitted with a recirculation line and pump motor cooling line.

- An HX, cooled by ESWS, with a parallel flow bypass line with control valve to maintain CCW minimum temperature during cold weather and low-load operation.
- A concrete, steel lined surge tank connected to the pump suction line with sufficient capacity to compensate for CCWS normal leaks or component draining.
- A sampling line with continuous radiation monitor.
- A chemical additive supply line.
- Isolation valves to separate the safety-related train from the common load set.

Each CCWS safety-related train supplies cooling to its respective CCWS and medium head safety injection (MHSI) pumps and motors and associated LHSI/RHR HXs, and trains 2 and 3 cool their respective LHSI pumps and motors. The LHSI pumps and motors of trains 1 and 4 are cooled by the SCWS.

The SCWS chillers for divisions 2 and 3 are supplied by CCWS trains 1 or 2, and 3 or 4, respectively. The piping branch that supplies the SCWS Divisions 2 and 3 is installed between the hydraulically operated common header switchover valve and a manual isolation valve. These manual isolation valves (KAA20/30 AA013/014) are normally open in each CCWS operating mode. These valves are closed only during plant shutdown for maintenance activities on the 1.B and 2.B headers. For operational conveniences, this allows the water-cooled SCWS to be operated. These valves are equipped with position indication in the MCR to notify operators when the valves are closed. This enables continuous availability of the safety chillers during testing or CCWS common header maintenance activity and allows for equitable distribution of operating time for each of the CCWS safety-related trains. The CCWS safety-related trains are shown in Figure 9.2.2-1—Component Cooling Water System Trains 1 through 4.

The non-safety-related operational loads are supplied by two separate isolable headers designated common 1 and common 2. Common 1 may be aligned for service from either safety-related trains 1 or 2, and common 2 may be aligned to safety-related trains 3 or 4. Each common header branches into subheaders further designated “a” and “b” (i.e., common 1.a, 1.b, 2.a, and 2.b). Headers 1.a and 2.a, which cool FPCS trains 1 and 2, respectively, are separate from the other operational loads to provide continued cooling of the spent fuel. Headers 1.b and 2.b cool the remaining operational CCWS loads. Each of the common b-loops is isolable from the associated safety train by two fast-acting hydraulic valves, one installed in each train supply line and the other in the return line.

Common 1.b or 2.b headers cool multiple loads throughout the plant. The loads for each (b) header are summarized in Table 9.2.2-3—CCWS Common Header Users.

RCP 1, 2, 3 and 4 thermal barriers are capable of being cooled from either common header.

Either CCWS common 1b or 2b headers can provide cooling to the RCP thermal barriers. CCWS supply to the RCP thermal barriers is able to withstand a single, active failure or a moderate-energy crack because of the thermal barrier cross tie that provides cooling from either common header, thus allowing cooling supply from any of the four CCWS trains. To meet single failure criteria for the RCP thermal barrier cooling function, the thermal barrier load is required to be cooled by a CCWS common header, which is capable of being connected to two operable CCWS trains. If a CCWS train is out of service for maintenance or because of a single failure, the operators have 72 hours to align RCP thermal barrier cooling to the CCWS common header that has two CCWS supply trains available. If a single failure removes one of the two trains available for that common header, the operator does not have the option to align RCP thermal barrier cooling to a common header with two operable CCWS trains, but there are still two operable CCWS trains available (one for each common header) for thermal barrier cooling. In the event of an RCP thermal barrier fault such as a tube rupture, this single RCP thermal barrier is isolated via inlet and outlet isolation valves in the RCS. A fault of a single RCP thermal barrier does not isolate the entire common header supply to the remaining operable thermal barriers. To maintain strict CCWS train separation for thermal barrier cooling, an interlocking function is required. The containment isolation valves (CIVs) in the RCP thermal barrier cooling path on the supply and return side of CCWS common 1b cannot be opened unless one of the two CIVs on the supply side and one of the two CIVs on the return side are closed and vice-versa.

Thermal barrier cooling is required for each mode of operation, including DBA, where the RCS is pressurized and, therefore, relies on RCP seal integrity to maintain the reactor coolant pressure boundary. Credit is not taken for the CVCS to verify cooling to the RCP shaft seals. In the event that both CCWS flow to the RCP thermal barriers and CVCS seal injection are not available (i.e., if one of the two flows (CCWS or CVCS) is not restored within two minutes) the RCP seals are expected to degrade. Refer to Sections 5.4.1.2.1 and 8.4.2.6.2 for details related to the RCP seal design and standstill seal, and Section 15.6 for the U.S. EPR LOCA analysis.

The CCWS piping, valves and components supplying the RCP thermal barriers is Seismic Category I, Quality Group C, ASME III Class 3 with the exception of the CIVs and the piping between the CIVs, which are Seismic Category I, Quality Group B, ASME III Class 2.

The four inside motor operated CIVs in the RCP thermal barrier cooling path are provided with uninterruptible power.

The non-safety-related CCWS loads in the NAB and RWB can be quickly isolated from the rest of the CCWS by fast-closing hydraulic valves, as required. The non-safety-related common branches of the CCWS trains are shown in Figure 9.2.2-2—Component Cooling Water System Common Loop 1, and Figure 9.2.2-3—Component Cooling Water System Common Loop 2.

The design of the Component Cooling Water System (CCWS) minimizes and withstands adverse transients (i.e., water hammer) and meets functional performance requirements for all operating modes including postulated DBA consistent with the guidance for water hammer prevention and mitigation found in NUREG-0927 (Reference 3).

The CCW system design minimizes the potential for dynamic flow instabilities by avoiding high line velocities and specifying valve opening and closing speeds that are low enough to prevent damaging pressure increases.

Vents are provided for venting components and piping at high points in liquid filled systems that can become normally idle and in which voids could occur. These vents are located for ease of operation and testing on a periodic basis. All drains and vents of the CCWS including surge tank overflow are routed to the nuclear island drain and vent systems.

Consideration has been made to avoid voiding, which can occur following pump shutdown or during standby by placing the pumps and CCWS users at an elevation below the water level of the surge tanks. Means are provided for a slow and controlled fill of those portions of the CCW system where voiding could occur after pump shutdown or during standby.

The 10 second closure time of the common header switchover valves and the fast-acting hydraulically operated isolation valves for non-safety-related CCWS users is not considered an instantaneous closure that would create large pressure waves in the system.

One non-safety-related train comprises the dedicated CCWS. This train cools the SAHRS train, is supplied demineralized makeup water by the dedicated CCWS injection pump, is cooled by its assigned dedicated ESWS train, and is provided backup power from its assigned station blackout diesel generator (SBODG). The dedicated CCWS train consists of one main pump, one dedicated ESWS-cooled HX, one surge tank connected to the suction line to keep the system filled and maintain adequate head to prevent in-leakage of radioactive fluids from the SAHRS HX, a connection to the demineralized water distribution system with an injection pump for inventory makeup, a chemical additive supply connection, and associated piping, fittings, and valves. The dedicated CCWS surge tank is charged by nitrogen over pressurization, which allows compressible compensation for fluid expansion and contraction and helps provide that any potential coolant leakage is into rather than out of the SAHRS. The dedicated CCWS train is shown in Figure 9.2.2-4—Component Cooling Water System Dedicated CCWS Trains.

In general, butterfly valves are used in the CCWS for isolation service (open or closed), not for throttling. In those applications where a butterfly valve is used in the CCWS and is subject to substantial throttling service for extended periods, design provisions will prevent consequential pipe wall thinning immediately downstream of the valves. Such design provisions include the use of erosion resistant materials, the use of thick wall pipe, and provision of straight pipe lengths immediately downstream of the affected valves.

All components and piping are carbon steel, except the demineralized feedwater line, which is stainless steel, and the CCWS HX tubes and dedicated CCWS HX tubes which are of a suitable corrosion resistant metal. Table 9.2.2-4—Power Supplies for CCWS Valves identifies the CCWS valves that are provided with normal and alternate power supplies per Section 8.3.1.1.1.

The CCWS has non-seismic piping and components in the following locations:

- Safeguards Buildings (SB) 1, 2, 3 and 4.
- Nuclear Auxiliary Building (NAB).
- Reactor Building Annulus.
- Fuel Building (FB).
- Radioactive Waste Processing Building (RWPB).

Non-seismic portions of the CCWS are isolated from safety-related SSC by either physical separation or by the use of physical barriers. Failure of the non-seismic portions of the CCWS does not adversely affect the control room nor does it result in excessive radiological release..

9.2.2.2.2 Component Description

Table 3.2.2-1 provides the seismic and other design classifications for the components in the CCWS.

CCWS Pumps

CCWS pumps are sized to provide the capacity to support system flow requirements during penalizing conditions. To accomplish this, design margins are added to the limiting requirements (volumetric flow and head). The pump design flow of 18,294 gpm shown in Table 9.2.2-1 includes an approximate 15 percent margin above the required maximum pump flow. The pump head of 199.7 ft in Table 9.2.2-1 includes an approximate 15 percent margin above the required maximum pump head.

The CCWS pumps are part of the safety-related cooling trains.

The four pumps are centrifugal type. The pump motor is cooled by an air-water cooler supplied by CCWS itself. The pump and motor are horizontally mounted on a common base plate. The pump and motor bearings are oil lubricated and are air cooled.

Motor heaters are provided on the motors and are energized when the pump is not in operation to prevent the formation of condensation.

During normal operating conditions, two of the four pumps are operating.

Dedicated CCWS Pump

The dedicated CCWS pump is non-safety-related and is in standby during normal plant operation.

The pump is centrifugal type. The pump motor is cooled by an air-water cooler supplied by the CCWS itself. The pump and motor are horizontally mounted on a common base plate. The pump and motor bearings are oil lubricated and are air cooled.

A motor heater is provided on the motor and is energized when the pump is not in operation to prevent the formation of condensation.

Dedicated CCWS Makeup Pump

The water supply pump is a positive displacement piston type to increase the head of the demineralized water distribution system (DWDS) supply to adjust the level of the pressurized surge tanks. To prevent flow pulses and to limit system vibration a pulsation damper is installed just downstream of the piston pump.

CCWS Heat Exchangers

The CCWS HXs are horizontal tube and shell type HXs. The CCW is circulated on the shell side and the ESWS supplies cooling water on the tube side. Current analysis assuming a representative constant heat transfer coefficient indicates that 124.93 MBTU/hr combined with CCWS and ESWS flow rates will require the greatest heat transfer area for the CCWS heater exchanger. For final procurement, a 10 percent margin for tube plugging will be required. The DBA case will require a minimum additional margin of 10 percent above the specified tube plugging allowance of 10 percent.

Dedicated CCWS Heat Exchanger

The dedicated CCWS HX is a horizontal tube and shell type HX. CCWS circulates on the shell side and the ESWS supplies cooling water on the tube side.

CCWS Surge Tanks

The CCWS surge tanks are concrete structures with a steel liner. Each tank is connected to the suction side of its respective train CCWS pump.

Each surge tank has sufficient storage capacity to compensate for normal system leaks or component draining. Makeup water is supplied from the DWDS.

The required surge tank water volume to account for system leakage in a post-seismic event with no available makeup is dependent on the assumed system alignment. For the CCWS, the assumed leakage paths are through each of the (2) 16” Common A header isolation valves and the (2) 24” Common B header isolation valves. Pump seal leakage and miscellaneous valve packing leakage is also considered for each CCWS train. The leakage rate for the CCWS valves is based on ASME QME-1 for flow control valves that are also intended to serve as isolation valves. ASME QME-1 identifies a nominal leakage rate of 0.6 $in.^3$/hr/NPS of nominal valve size. Pump seal leakage of 100 cubic centimeters per hour and miscellaneous valve packing leakage of 250 cubic centimeters per hour is included in the leakage calculation for each train.

The total required volume of water for 7 days of operation with no makeup system is 50.4 gallons. Each CCWS surge tank is designed to include a required water volume of 750 gallons to accommodate potential system leakage for 7 days continuous for 24 hours with no makeup source in post-seismic conditions. This reserve volume of 750 gallons for each CCWS surge tank allows each train to accommodate a total train leakage of approximately 4 gallons per hour continuous for 24 hours per day for 7 days in the event that normal demineralized water makeup is not available.

For defense-in-depth, each CCWS surge tank maintains a post-seismic emergency makeup connection for water supply from the Seismic II fire water distribution system inside the Nuclear Island. The fire water distribution system is designed to remain functional after an SSE (Refer to Section 9.5.1.2.1).

Dedicated CCWS Surge Tank

The dedicated CCWS surge tank is connected to the dedicated CCWS pump suction line.

The surge tank makeup is provided from the DWDS and nitrogen overpressure is provided to prevent a leak of radioactive fluids into the dedicated CCWS from the SAHRS.

The surge tank is provided with overpressure protection.

Common Header Switchover Valves

The common header switchover valves are fast-acting, hydraulically operated valves.

The valves provide the physical train separation for the support of the common cooling loads. They are used to transfer cooling of the common users during normal plant operation or in the event of a failure during a design basis event.

The valves are interlocked so that two trains may not be simultaneously connected to the same common header. The stroke time of these fast-acting valves is sufficient to minimize the interruption of cooling to the CCWS loads.

To provide reliability of the switchover function, each hydraulically operated common header switchover valve has multiple solenoid operated pilot valves and hydraulic fluid pumps. The solenoid operated pilot valves and hydraulic fluid pumps are each powered from different Class 1E divisions..

The non-safety load isolation valves are also fast-acting, hydraulically-operated valves. Each hydraulically-operated valve has multiple solenoid-operated pilot valves and hydraulic fluid pumps. Pilot valves and hydraulic fluid pumps are powered from different Class 1E divisions to provide redundancy.

LHSI Heat Exchanger Isolation Valves

These valves are motor-operated valves. The valves are normally closed to prevent dilution of the LHSI fluid and may be opened when necessary to provide an adequate flow path to support long term pump operation. The valves automatically open when the train associated LHSI system is placed into service.

LHSI Pump Seal Fluid Cooler Isolation Valves

These valves are motor-operated valves. The valves are normally closed to prevent dilution of the LHSI fluid and automatically open when the train associated LHSI system is placed into service.

Containment Isolation Valves

The CCWS containment isolation valves are motor-operated valves. The normally open valves provide the means for containment isolation to maintain the integrity of the containment penetrations and thus prevent the release of potentially radioactive material during a design based accident. The containment isolation valves for non-safety-related loads are automatically closed by containment isolation actuation signals. The containment isolation valves for the RCP thermal barrier coolers are not provided with a containment isolation signal but may be remote manually closed from the control room if required.

9.2.2.3 System Operation

9.2.2.3.1 Normal System Operation

The safety-related CCWS is a four train concept which allows sharing of operational and safety users during normal operation and to separate them in case of design and beyond design based accidents. Each physically separated train consists of a main pump, motor cooler, an HX, surge tank, sample piping with permanently installed radiation monitor (refer to Section 11.5.4.4 and Table 11.5-1, Monitors R-35 through R-38), a chemical addition tank and pairs of common header isolation valves. Each train also supplies cooling to the associated MHSI pump motor cooler and the LHSI HX. The CCWS trains 2 and 3 also provide cooling to the LHSI pump motor and seal water coolers.

During normal operations, one or two trains can be in operation in each pair of associated trains (trains 1 and 2 or trains 3 and 4) to cool the two common sets of users (common 1.b (2.b), with or without common 1.a (2.a)). Each of the common headers may be split so that one of the two associated trains is supplying the common 1.a (2.a) header and the other is supplying the common 1.b (2.b) header to enhance cooling efficacy of the cooling chain.

The common 1.a header provides cooling to the first FPCS train and the common 2.a header provides cooling to the second FPCS train. These are separated from the other operational loads (1.b and 2.b) that the CCWS supplies to maintain FPCS cooling capacity during maintenance or plant outages.

Each train in operation:

- Cools the fluid in a closed loop through the CCWS exchanger.
- Provides recirculation in the surge tank for CCW mixing.
- Cools the main auxiliary pumps coolers (SIS and CCWS pumps).
- Is continuously sampled for radioactivity leakage into the CCWS using the permanently installed radiation monitor (refer to Section 11.5.4.4 and Table 11.5-1, Monitors R-35 through R-38).

For each of common headers (1 and 2), the associated safety-related trains are isolated from each other by the four switchover isolation valves located on the supply and return side of each common header sub-loop (a and b).

The permissive for the switchover valve of the on-coming CCWS train is by limit switch of the switchover valve of the off-going CCWS train. The switchover valve of the off-going train must signal "Closed" prior to the switchover valve of the on-coming train being allowed to open. Train separation of the redundant CCWS divisions is provided to confirm that a fault affects no more than one train. To achieve this, the switchover valves are interlocked. The following valve groupings cannot be simultaneously opened to prohibit more than one train from being connected to a common header:

- Common 1.A – 30KAA10AA032/033 with 30KAA20AA032/033.
- Common 2.A – 30KAA30AA032/033 with 30KAA40AA032/033.
- Common 1.B – 30KAA10AA006/010 with 30KAA20AA006/010.
- Common 2.B – 30KAA30AA006/010 with 30KAA40AA006/010.

The following common header switchover sequences are defined for the CCWS:

- Normal Switchover.

  During normal plant and system operation, switchover of the common headers is periodically done by the plant operators to verify the operability of the CCWS trains (system surveillances) and to equalize the run time of each CCWS pump. The normal switchover is a remote manual actuation from the MCR.

- Automatic Backup Switchover.

  The automatic backup switchover sequence functions to limit the loss of flow to common 1.b (2.b) users in case of failure of a CCWS train supplying the common 1.b (2.b) or common 1.a and 1.b (2.a and 2.b) headers. This function confirms the supply of safety-related loads (e.g., RCP thermal barrier) connected to the common 1.b (2.b) header. This switchover function is an automatic function.

During the normal switchover sequence and automatic backup switchover sequence, flow to all CCWS users on the common headers is momentarily degraded. The quick-closing hydraulically operated switchover valves are designed to close and open within 10 seconds. During the maximum allowed time for the closing and opening sequence (20 seconds), there is a potential for increased temperatures in the systems supplied with CCWS via the common headers. Systems that depend on CCWS cooling from the common headers are designed for transients caused by the switchover sequences.

Depending on the system user requirements, heat loads and flow rates, and depending upon the current plant operation, the CCWS can be configured with two, three or four trains in operation.

The following criterion drives CCWS operation with two, three or four trains:

- CCW temperature at the outlet of CCWS HX must be above the minimum required and below the maximum allowed.

- CCWS pump steady state operating flow must be between the minimum required and the maximum allowable.

For some users, the CCWS flow rate will be controlled automatically, while the others stay at fixed flow resistance during all operating conditions. Flow rates through CCWS users are adjusted once during plant commissioning with the most penalizing configuration (system flow balancing). After this, the minimum required user flow rate is always maintained whatever the plant operating condition. The system flow balance is reaffirmed regularly throughout the plant life during periodic surveillances. The expected cooling flow rate through system users, with fixed flow resistance, can reach approximately 140 percent of the required flow. Manual adjustments of flow balancing devices generally are not required during the normal plant operating cycle.

To make sure that the CCWS pump operates within the allowable range, system operation is limited. The allowed system configurations for a train are as follows:

- One train supplies only its associated SIS users (train-related LHSI HX and LHSI/MHSI pumps).

- One train supplies the common 1.a (2.a) header (common FPCS loads) and associated LHSI users.

- One train supplies only the common 1.b (2.b) header (main common user group).

- One train supplies the common 1.b (2.b) header and associated LHIS users.

- One train supplies the common 1.a and 1.b (2.a and 2.b) headers.

- One train supplies the common 1.a and 1.b (2.a and 2.b) headers and its LHSI users without the maximum flow rate through the CVCS and FPCS HXs.

For pump protection, the following configurations for an operating train are not permitted:

- One train cannot be isolated from the common headers and also from the LHSI/RHR HX.

- One train cannot supply only the common 1.a (2.a) header.

- One train cannot supply the common 1.a and 1.b (2.a and 2.b) header and its LHSI users with the maximum flow rate through the CVCS and FPCS HXs.

Forbidden configurations lead to operations with abnormal flow rate and are subject to automatic system protection.

CCWS leakage (e.g., valve packing and pump seals) is compensated for by a makeup of demineralized water to the CCWS surge tanks. This makeup is controlled by the automatic opening and closing of the DWDS supply isolation valve. This isolation valve is a motor-operated safety-related valve that is part of the CCWS.

Depending upon the ESWS temperature, the CCWS temperature could be too low. The HX bypass control valve is positioned in order to maintain a CCWS HX outlet temperature greater than the minimum allowable.

During normal plant and system operation, switchover of the common headers is periodically done by the plant operators to verify the operability of the CCWS trains (system surveillances) via the normal switchover sequence.

Hot Shutdown

After the reactor is shut down, the RCS is cooled by the steam generators down to a temperature of 250°F. During the beginning of this state, CCWS has the same configuration as in power operation. At the end of this state, four CCWS trains will be in operation.

Two CCWS trains are in operation, aligned and ready to remove residual heat from the RCS via the associated LHSI trains as soon as they are placed in RHR operation.

The remaining two CCWS trains continue to cool the two common headers, and are ready to provide their SIS functions if necessary.

Cool Down Procedure

Cooling by Two CCWS trains—RCS Temperature < 250°F

Two LHSI trains are operating in the residual heat removal (RHR) mode and are removing residual heat from the RCS to the heat sink. The associated CCWS trains cool the LHSI/RHR HXs. The other two trains cool the common 1 header (trains 1 or 2) and common 2 header (trains 3 or 4).

This configuration is the same as for Hot Shutdown.

During the plant cooldown and before depressurization of the RCS, it is necessary to purify the RCS fluid. The two CVCS charging pumps are running and the two CVCS HP coolers are supplied by the CCWS.

Cooling by Four CCWS trains—RCS Temperature <212°F

The two CCWS trains cooling the common headers are connected to their corresponding LHSI/RHR trains. Within these two trains, heat to be removed from the LHSI/RHR HX is controlled by throttling the LHSI/RHR HX bypass to limit the CCWS HX outlet temperature to the maximum allowable.

The FPCS HX is cooled by either the common 1 or 2 header. Flow through the second FPCS HX could be secured to increase the efficiency in that connected CCWS train.

Configurations discussed above consider the availability of the four CCWS/LHSI trains. When only three trains are used for the RHR operation, a delay in the cooldown process will occur, depending on the ESWS temperature.

Refueling

At the beginning of the core unloading process, the CCWS is supporting core cooling for the fuel in the reactor vessel and cooling the FPCS also, at the minimum flow. At the end of the core unloading process, the CCWS is only supporting the cooling of the spent fuel pool (SFP) with cooling provided to both FPCS HXs at the maximum rate. Cooling of the common headers is maintained during core unloading.

CCWS is not analyzed to simultaneously cool a LHSI HX, the Common 1.b (2.b) header, and the Common 1.a (2.a) header with maximum cooling to the FPCS HX.

It is expected that both FPCS HXs are in operation, with the first FPCS HX cooled by a CCWS train at the maximum required flow and the second FPCS HX cooled at the minimum flow. The CCWS train supplying cooling to the FPCS HX at the maximum rate must not also be connected to common 1.b (2.b) header.

During the core unloading process, the CCWS flow rate through the second FPCS HX can be increased from the control room by opening the motor-operated flow control valve on the outlet of the FPCS HX. The CCWS flow rate through the FPCS HXs depends on the ESWS temperatures and actual decay heat load.

As the fuel is transferred from the RCS to the SFP, the required cooling to the RHR system decreases and the required cooling to the FPCS increases. To maintain the CCWS pump within its normal operating range, the cooling to the LHSI HX must be isolated for the CCWS train also connected to the second FPCS HX, prior to increasing flow from the minimum value. Another possibility is to transfer the cooling of the second FPCS HX to a train not also cooling the common 1.b (2.b) header.

Core Unloaded

When the core is completely unloaded into the SFP, the two CCWS trains supplying the common 1.a and 2.a headers cool both FPCS HXs at the maximum flow rate, and other required common 1.b or 2.b users for this mode. Two CCWS trains can be out for maintenance if they do not supply the same common header (1 or 2 and 3 or 4).

Abnormal System Operation

Large Loss of Water

CCWS Safety-Related Trains

A large water loss occurring in a CCWS train leads to a significant loss of system fluid and consequently to a drop of the CCW level in the corresponding surge tank.

The following leakage detection sequence is initiated when the surge tank level is less than the MIN2 setpoint:

1. The non-safety-related piping, located in the NAB and RWB, is isolated by fast-closing valves if there is a difference between the measured flow rate at the inlet and outlet of each branch. This is an indication of a leak, localized on the branch.
2. If the surge tank level drops below the MIN3 setpoint, the leak may be located in safety-related piping on the common header. The common headers are then isolated by closing of the switchover valves of the faulted train. The goal of this actuation is to provide availability of the train for its SIS users.
3. If the surge tank level continues to decrease below the MIN4 setpoint after the switchover valves are closed, the leak is located on the corresponding train. After reaching level MIN4, the associated CCWS train pump is tripped.

Dedicated Trains

In case of a pipe break, the dedicated CCWS surge tank pressure will decrease and the makeup pump will automatically start to maintain the pressure. If the water leak is greater than the capacity of the makeup pump to replace, a low level is reached in the tank, at which point the tank is automatically isolated to prevent nitrogen injection into the pump suction piping. The train pumps are correspondingly tripped and the train is unavailable.

Loss of one ESWS Train

CCWS Safety-Related Trains

In case of loss of one ESWS train, an automatic backup switchover is performed to allow the cooling of the common headers using the available train. In case of a loss of an ESWS train, the corresponding CCWS train can be kept in operation supplying its safety users (SIS users) so long as the CCWS operating temperature is lower than 100.4°F, the maximum operating temperature for safety users.

Dedicated Train

The dedicated CCWS train is cooled by the dedicated ESWS train. In case of a loss of the dedicated ESWS train, the associated dedicated CCWS train is also lost.

Loss of a CCWS train

CCWS Safety-Related Trains

In case of loss of one CCWS train, an automatic backup switchover is done to allow the cooling of the common a or b headers (or both) with the available train. The restoration of cooling to the "a" headers is a manual sub-function of the automatic backup switchover.

Dedicated Train

In case of a loss of the dedicated CCWS train, the entire SAHRS cooling chain is lost.

Active Failure

CCWS Safety-Related Trains

In case of loss of a CCWS pump, an automatic backup switchover is done to allow for cooling of the common a or b headers (or both) with the available train. The restoration of cooling to the "a" headers is a manual sub-function of the automatic backup switchover.

Dedicated Train

In the event of the loss of the dedicated CCWS pump, the train is lost. If the makeup pump is lost, water makeup from the DWDS is also lost. With a water leak within the dedicated CCWS train, a low level will eventually be reached in the tank and the tank will be automatically isolated. The main dedicated CCWS pump is then tripped, leaving the train unavailable.

CCWS Protection Against RCS Dilution

Tube Rupture Inside RHR Heat Exchanger

When the LHSI is not operating in the RHR mode, an HX failure causes a leak from the CCWS to the SIS. The following protections have been designed to avoid RCS dilution:

- When a LHSI pump is not in operation, the isolation valve upstream and a check valve downstream of the RHRS HX prevents any leakage from the CCWS to the RHRS. When the isolation of the LHSI HX is not possible, flow being used for pump protection, an alarm informs the operator of the potential risk. The operator can sample directly the content of the water boxes of the HX via a dedicated sampling line.

- Before connecting an LHSI train for the first time to the RCS in the RHR mode, the relevant LHSI pump is started on its minimum flow line through the in-containment refuelling water storage tank. This second line of defense permits detection of the failed HX.

- When a LHSI pump is started on its minimum flow line or on the closed loop, a faulty HX causes leakage into the CCWS. This leakage is detected by the train radiation monitor or an uncontrolled level rise in the CCWS surge tank (refer to Section 11.5.4.4 and Table 11.5-1, Monitors R-35 through R-38).
- Provisions are required to minimize the risk of CCWS leakage during maintenance on the LHSI trains. The component boundary can be verified via a pressure test on the CCWS side or a pressure test of the RHR/LHSI.

Failure of a LHSI Pump Seal Fluid Cooler

When a LHSI pump is not in operation, the isolation valve upstream and a check valve downstream of the seal cooler prevent any leakage from the CCWS to the RHRS.

Tube Rupture Inside Thermal Barrier

The possibility of diluting the RCS via a faulty RCP thermal barrier exists only when the RCS is in a low pressure state.

After a predetermined time delay (≈15 minutes), which allows for RCP coast down and when the RCS pressure is low, the CCWS will be automatically isolated from the RCP thermal barrier via the CCW inlet and outlet isolation valves.

Tube Rupture Inside a CVCS HP Cooler

A leak from the CVCS into the CCWS will be detected by radiation monitors (refer to Table 11.5-1, Monitors R-51 through R-54) on the CCWS return lines from each of the CVCS HP coolers. A high radiation alarm from either of these monitors will trigger automatic isolation of the affected CVCS HP cooler via motor-operated valves (KBA 11/12 AA001/003) in the CVCS (See Figure 9.3.4-1 and Section 11.5.4.17 and Monitors R-51 and R-52 (CCWS Common Loop 1) and R-53 and R-54 (CCWS Common Loop 2)).

RCS Cooldown with Less Than 3 Trains

If less than three trains of the plant cooling chain (RHR, CCW, ESW) are available, stabilization of the RCS temperature is achievable. If the RCS must be cooled to cold shutdown conditions, it may be necessary to remove non-essential CCWS user loads from operation.

This may be necessary only during peak summer conditions, and an excessive throttling (bypassing) of the LHSI HX to limit the CCWS temperatures late in the cooldown process is an indication of the need to do so.

Accident Operating Conditions

Safeguard Building LOCA or LOCA Coupled With Unavailability of Two CCWS/SIS Trains

This accident condition postulates the unavailability of one CCWS train due to a single failure with another train in maintenance. Upon receipt of a safety injection and containment isolation stage 1 actuation, the reactor protection system (RPS) starts the CCWS trains not in operation by:

- Starting of the CCWS pumps not initially in operation.
- Opening the LHSI/RHR isolation valves of the train not initially in operation.
- Opening the LHSI pump seal cooler isolation valves (KAA22/32AA013).
- Isolation of the non-safety-related common users outside the Reactor Building.
- Isolation of the containment ventilation and RCDT loads inside the Reactor Building on Common Header 1.b (containment isolation stage 1).

For previously running pumps, the following sequence applies:

- Opening the LHSI/RHR isolation valves.
- Opening the LHSI pump seal cooler isolation valves (KAA22/32AA013).
- Isolation of the non-safety-related common users outside the Reactor Building.
- Isolation of the containment ventilation and RCDT loads inside the Reactor Building on Common Header 1.b (containment isolation stage 1).

Upon actuation of a containment isolation stage 2 signal issued from the RPS, the RCP and CVCS loads inside the RB are isolated (not including the RCP thermal barriers).

Loss of Offsite Power

CCWS Safety-Related Trains

In case of LOOP, the four CCWS trains are still available for operation. The four CCWS pumps belonging to the four trains receive emergency power supplied by the main emergency diesel generators (EDG). Previously operating CCWS trains return to operation according to the EDG load sequencing and standby trains remain in idle unless other start orders are received during the EDG load sequencing.

Beyond Design Basis Events (Dedicated CCWS)

CCWS Safety-Related Trains

The CCWS trains are kept in operation unless they are unavailable due to a failure. If they are unavailable (e.g., a severe accident), the dedicated CCWS train can be used. When the CCWS trains are unavailable during SBO, RCP seal cooling is not available. To mitigate leakage from RCP seal failure during this event, the RCPs are supplied with a standstill seal, an alternative to seal cooling, which limits seal leakage to 0.5 gpm.

Dedicated Train

The dedicated CCWS train provides for removal of the heat from the SAHRS during accidents with the potential to result in core melt. It is also actuated in case of beyond design basis scenarios such as failure of the LHSI during small break loss of coolant accident (SBLOCA) and loss of LHSI or MHSI.

SAHRS Leakage

Radiation contamination from in-leakage from the SAHRS is mitigated by operation of the CCWS dedicated train KAA80 at a higher pressure than the SAHRS components. In the event of in-leakage from the SAHRS, radiation monitor R-64 monitors the cooling water return line and, in the event of high activity, alerts the operator so appropriate action can be taken.

9.2.2.4 Safety Evaluation

The CCWS safety-related components and piping are installed in a physically hardened building (divisions 2 and 3) and separate buildings (divisions 1 and 4) 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(B), and 3.8 provide the bases for the adequacy of the structural design of these structures.

The CCWS is designed to remain functional after an SSE. Section 3.7(B).2 and Section 3.9(B) provide the design loading conditions that were considered. Sections 3.5 and 3.6 provide the hazards analyses to verify safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

Because only a single division of the CCWS is lost in the event of the postulated hazards of internal missiles, pipe whipping, and discharging fluids, the system safety-related functions are not prevented.

The four division design of the CCWS provides complete redundancy; therefore, no single failure will compromise the CCWS system safety-related functions. Each division of the CCWS is independent of any other division. The common 1 and common 2 non-safety-related users can be isolated from the safety-related portion of the CCWS by automatic isolation valves without compromising the safety-related function of the system.

The CCWS is powered from emergency powered distribution busses. Each electrical division is functionally independent and physically separated so that a single failure in one division will not affect another division. In case of a LOOP, each safety-related division is powered by a separate EDG.

The four safety-related divisions of the CCWS are not shared with other units. An accident in one unit will not impair the ability of the CCWS in another unit from conducting an orderly shutdown and cooldown of the remaining units.

Considering a single failure and preventative maintenance, one CCWS division may be out of service for maintenance and a second division lost to a single failure, but the ability to reach a safe shutdown state can be achieved by the remaining two CCWS divisions coincident with LOOP.

The CCWS is initially tested following the program given in Chapter 14. Periodic inservice functional testing is done in accordance with Section 9.2.2.5.

In the event of an LOCA during power operations, the RPS (refer to Section 7.3) initiates a safety injection and containment isolation phase 1 signal. The CCWS divisions previously not in operation are automatically started by the process. Containment isolation is detailed in Section 6.2.4.

Remote manual isolation of the RCP thermal barrier coolers is provided to isolate the thermal barrier in the event of a leak in the HX.

9.2.2.5 Inspection and Testing Requirements

Preliminary operational testing of the CCWS is conducted with the system cold and aligned for normal power. An accident signal is initiated, and the breakers on the lines supplying offsite power are tripped so that operation of the EDGs is tested in conjunction with the CCWS. System testing provides the following verifications of system performance:

- Satisfactory generation and transmission of the accident signal.
- Proper operation of the EDGs, including sequential load pickup.
- Within specification valve operating times.
- Within specification pump starting times.
- Within specification pump delivery rates.

Refer to Section 14.2, Test # 046, for initial plant testing of the CCWS.

The installation and design of the CCWS provides accessibility for the performance of periodic testing and inservice inspection with limited personnel exposure. Normal operation of the CCWS with alignments to the common headers allows for pump flow testing at conditions as close to design basis as possible. Periodic testing of all safety-related equipment verifies its availability and ability to fulfill its functions. Inservice testing and inspection requirements are in accordance with the ASME BPV Code, Section XI (Reference 5).

Sections 3.9 and 6.6 outline the inservice testing and inspections. Refer to technical specifications in Chapter 16 (SR 3.7.7) for surveillance requirements that provide for the continued operability of the CCWS.

9.2.2.6 Instrumentation Requirements

The CCWS trains are monitored and controlled from the main control room (MCR) through the process information and control system (PICS), which provides the normal indication, manual control, alarm functions, and the safety information and control system (SICS). These systems process and display information provided through the safety automation system (SAS) from the protection system (PS), which actuates the CCWS function as required by plant process safety parameters, and the process automation system (PAS), which monitors less critical process information.

Upon receipt of a safety injection signal, automatically initiated by the PS, the four CCWS trains start supplying all MHSI pump motor coolers and LHSI pump and motor coolers (except the train 1 and 4 LHSI pumps and motor coolers, which are cooled by SCWS), and the four LHSI HXs. The non-safety-related users outside of the RB are isolated. The progression of this sequence is:

1. The CCWS pumps start.
2. The LHSI HX isolation valves open.
3. The trains 2 and 3 LHSI pump seal cooler isolation valves open.
4. The isolation valves for non-safety-related users outside the RB are closed

This sequence optimizes the CCWS to cool the SIS pumps and the LHSI HXs. The simultaneous operation of the LHSI HX isolation valves (opening) and of the non-safety-related isolation valves (closing) maintains the pump operation in a safe range. There is no automatic order from the protection system to configure HX bypass control valves.

Upon receipt of a containment isolation stage 1 signal, automatically initiated by the PS, the containment HVAC and RCDT users in the RB are isolated. This achieves containment isolation and maximizes the CCW flow rate through the LHSI HX in the event of a coincident safety injection signal.

Upon receipt of a containment isolation stage 2 signal, automatically initiated by the PS, the RCP and CVCS loads inside the RB (except the RCP thermal barriers) isolate.

9.2.2.6.1 Control Features and Interlocks

The following control features and interlocks provide CCW, interfacing, and ancillary systems and equipment protection during normal operation:

9.2.2.6.1.1 CCWS Automatic I&C Safety-Related Functions

Automatic Backup Switchover Sequence

Train automatic backup switchover is performed if common 1.b (2.b) header is supplied by a CCWS train and any of the following are realized:

- Loss of CCWS pump (KAA10/20/30/40 AP001), sensed with a low CCWS pump discharge pressure.
- Loss of one ESWS train (PEB10/20/30/40 AP001).
- Low flow rate to system users.

Train automatic backup switchover limits loss of flow to common 1.b (2.b) users in case of failure of a train supplying the common 1.b (2.b) or common 1.a and 1.b (2.a and 2.b) headers.

Train automatic backup switchover consists of:

- Close switchover valves (KAA10/20/30/40 AA006/010) on the initial train and open LHSI heat exchanger isolation valve (KAA12/22/32/42 AA005).
- Open common 1.b (2.b) switchover valves (KAA10/20/30/40 AA006/010) on the on-coming train.
- Start CCWS pump (KAA10/20/30/40 AP001) on the on-coming train.

The on-coming train common 1.a (2.a) sub-header switchover valve may then be manually opened. The functional logic is shown on Figure 7.3-33.

Emergency CCWS Temperature Control

An open CCWS heat exchanger bypass line can cause CCWS temperature to be greater than 100.4°F.

To prevent this condition, the bypass control valve of the CCWS heat exchanger (KAA10 AA112) is automatically stepped closed in approximate 10 percent increments when the heat exchanger outlet is near the high temperature threshold (MAX1). The valve is stepped closed until MAX1 is cleared.

This temperature control function is required during all plant modes of operation, when the CCWS (KAA10/20/30/40) is energized. The functional logic is shown on Figure 7.3-34.

Emergency Leak Detection Sequence

Leakage can occur in a CCWS train, which leads to a loss of system fluid and consequently in a drop in the CCWS level in the corresponding surge tank.

The following leakage detection sequence is initiated when the surge tank level is less than the MIN2 set point:

- The common user automatic and normal switchover sequence is inhibited to avoid the transfer of the faulted piping on the associated train. The non-safety-related branches are isolated by fast closing valves if there is a flow mismatch between the inlet and outlet of the users supply and return lines.

If the surge tank level continues to decrease to less than the MIN3 setpoint, the common headers are isolated by closure of the switchover valves (KAA10/20/30/40 AA006/010/032/033) and the switchover sequence is prohibited.

If the surge tank level continues to decrease to less than MIN4 set point, the associated CCWS train pump is tripped and the common user sets switchover sequence function is unlocked to allow supplying of the common users by the opposite train capable of supplying the common header. The DWDS supply isolation valve (KAA10/20/30/40 AA027) is also closed in order to avoid DW water supply to a train with a leak.

The surge tank level is detected by two redundant analog level measurements. The functional logic is shown on Figure 7.3-35.

Switchover Valves Leakage or Failure

In the event of a switchover valve seat leakage or failure and depending upon the difference in pressure between the two CCWS trains, a water transfer could occur. If the water transfer leads to a MAX2 surge tank level in one of the two associated trains and a MIN3 surge tank level on the other, the common users are automatically isolated from the safety trains. This action allows both trains to perform their main safety-related function. The function logic is shown on Figure 7.3-36.

Safety Chilled Water Condenser Supply Water Flow Control

The SCWS chillers of Trains 2 and 3 are cooled by one of two associated CCWS common headers. They are isolable from all other associated Common header users by means of manual valves ((KAA22/32AA003/004). They are fitted with a three-way flow control valve (KAA22/32AA101) that is controlled by the chiller condenser refrigerant pressure. The function logic is shown in Figure 7.3-37.

CCWS Actuation from Safety Injection Signal

Upon receipt of a safety injection signal, the four CCWS trains are started, supplying all SIS pump coolers and the four LHSI heat exchangers. The non-safety-related users outside of the RB are also isolated.

The system response optimizes the CCWS to cool the SIS pumps and LHSI heat exchangers. The following CCWS actuations are automatically initiated:

- Start CCWS pumps (KAA10/20/30/40 AP001), if not previously running.
- Open LHSI HX isolation valves (KAA12/22/32/42 AA005).
- Open LHSI pump seal cooler isolation valves (KAA22/32 AA013).
- Close isolation valves for non-safety related users outside of RB (KAB50 AA001/004/006 & KAB80 AA015/016/019).

Simultaneous operation of LHSI heat exchanger isolation valves (opening) and non-safety-related user isolation valves (closing) maintains pump operation in a safe range.

A safety injection signal initiates a concurrent containment isolation Stage 1 signal.

CCWS Operation from Containment Isolation Stage 1

Upon receipt of a containment isolation stage 1 signal, CONT HVAC and NI DVS users in the RB are isolated via closure of KAB40 AA001/006/012.

This system response isolates these users, confirms the containment isolation function is met, and allows a maximum cooling flow rate through the LHSI heat exchanger in the event of a coincident safety injection signal.

CCWS Operation from Containment Isolation Stage 2

Upon receipt of a containment isolation stage 2 signal, the RCP and CVCS loads inside the RB are isolated (not including the RCP thermal barriers) via closure of KAB60/70 AA013/018/019.

CCWS Response to a LOOP

In case of LOOP, operating CCWS trains are de-energized. Previously operating CCWS trains return to operation according to the EDG load sequencing and standby trains remain idle, unless other start signals are received during EDG load sequencing.

CCWS Switchover Valve Interlock

Train separation of redundant CCWS divisions confirms that a fault affects no more than one train via a switchover valve interlock. To prohibit more than one train from being connected to a common header, the following groupings of valves cannot be simultaneously opened:

- Common 1.a – KAA10AA032/033 with KAA20AA032/033.
- Common 2.a – KAA30AA032/033 with KAA40AA032/033.
- Common 1.b – KAA10AA006/010 and KAA20AA006/010.
- Common 2.b – KAA30AA006/010 and KAA40AA006/010.

The functional logic is shown on Figure 7.6-1.

CCWS RCP Thermal Barrier Containment Isolation Valve Interlock

Either the common 1.b or 2.b headers can provide cooling to the RCP thermal barriers. To maintain strict train separation of the redundant CCWS division supplying either common header to confirm that a fault affects no more than one train, the CIVs (KAB30 AA049/050/051/052/053/054/055/056) are interlocked. One of the two common 1.b supply valves (KAB30 AA049/050) and one of the two common 1.b return valves (KAB30 AA051/052) must be closed prior to opening the CIVs from the common 2.b header (KAB30 AA053/054/055/056), and vice versa. The functional logic is shown on Figure 7.6-2.

To maintain cooling to the RCP thermal barriers an interlock function is required to open the CIVs on the common header removed from service (common 1.b or 2.b) when a CIV on the common header in service (common 2.b or 1b, respectively) is closed. The functional logic is shown on Figure 7.6-12.

9.2.2.6.1.2 CCWS Manual I&C Safety-Related Functions

CCWS Manual Control

Safety-related manual controls are provided for the operators in the MCR as a backup to the SR system automation. Manual control capabilities are provided in the MCR for the following CCWS components:

- CCWS pump (30KAA10/20/30/40 AP001).
- CCWS switchover valves (30KAA10/20/30/40 AA006/010/032/033).
- CCWS heat exchanger bypass valve (KAA10/20/30/40 AA112).
- Non-safety-related branch Isolation valves (KAB50 AA001/004/006, KAB80 AA015/016/019).
- CIVs.

CCWS Common 1.a (2.a) Manual Supply

When the common 1.b (2.b) header supply is automatically transferred to the common header associated CCWS train via the automatic switchover sequence, the common 1.a (2.a) header is also isolated and no automation is foreseen to switchover the common 1.a (2.a) header. To re-establish cooling of the FPCS, the opening of switchover valves (KAA10/20/30/40 AA032/033) is performed in the MCR.

9.2.2.6.1.3 CCWS Non-Safety-Related Functions

Normal Switchover Sequence

During normal plant operation, switchover of the common headers is periodically done by the plant operators to confirm operability of CCWS trains (system surveillances) and equalize run time of each CCWS pump. This switchover sequence is a manual action performed from the MCR.

This action is normally done when only one train is in operation on a pair of two associated trains.

This switchover consists of the following sequential actions:

- Start ESWS pump (PEB10/20/30/40 AP001).
- Start CCWS pump (KAA10/20/30/40 AP001).
- Open LHSI heat exchanger isolation valve on the on-coming train as mini flow line (KAA12/22/32/42 AA005).
- Close switchover valves (KAA10/20/30/40 AA006/010/032/033) on the off-going train and open of the train associated LHSI heat exchanger isolation valve (KAA12/22/32/42 AA005).
- Open switchover valves (KAA10/20/30/40 AA006/010/032/033) on the on-coming train.

Unavailability of a CCWS train (low level on the surge tank, loss of pump) inhibits the common user switchover to this train.

In case of a failure to close of a switchover valve on the initial train or lack of opening of a switchover valves on the final train, another switchover is automatically done to the initial configuration.

CCWS Surge Tank Makeup

A CCWS train can operate as long as the water level in the CCWS surge tank is maintained between the MIN1 and MAX1 levels. This non-safety-related function maintains the CCWS surge tank level within design limits during normal plant operation.

Small CCWS leakage is compensated for with demineralized water via operation of the DWDS supply isolation valve (KAA10/20/30/40 AA027):

- When the surge tank water level lowers to the MIN1 level, the DWDS supply isolation valve (KAA10/20/30/40 AA027) is automatically opened.
- When the surge tank water level reaches the MAX1 level, the DWDS supply isolation valve is automatically closed.

RCP Thermal Barrier Cooling Transfer

Either the common 1.b or 2.b headers can provide cooling to the RCP thermal barriers. Because of the valve interlock associated with the supply of cooling to these loads and the short duration desired to have cooling flow isolated, a group command is provided. The RCP thermal barrier cooling transfer consists of closing the open group of CIVs (KAB30 AA049/050/051/052, common 1.b or KAB30 AA053/054/055/056, common 2.b) and as soon as one of the two supply valves on the initial header and one of the two return valves on the initial header indicate closure, the other group of CIVs (KAB30 AA049/050/051/052, common 1.b or KAB30 AA053/054/055/056, common 2.b) are opened.

In case a CIV fails to open on the final header, another transfer is automatically performed back to the initial configuration.

In the event that one CCWS train is inoperable, RCP thermal barrier cooling is aligned to the CCWS common header that is supported by two operable CCWS trains within 72 hours per Chapter 16, Technical Specification 3.7.7.

RCP Thermal Barrier Isolation

A fault of an RCP thermal barrier is recognized by the following indications:

- A high flow above a threshold value measured with a flow element in the CCWS piping on the return from each RCP thermal barrier.

- A high pressure above a threshold value measured with a pressure sensor in the RCS piping on the return from each RCP thermal barrier.

Isolation valves at inlet (JEB10/20/30/40 AA021) and outlet (JEB10/20/30/40 AA003) of each RCP thermal barrier (as shown in Figure 5.1-4) are used to automatically isolate the faulted thermal barrier from the CCWS. High radiation in the CCWS does not initiate automatic isolation of CCWS cooling to the RCP thermal barriers. Isolation of faulted RCP thermal barrier only affects that RCP; it does not affect the CCWS cooling of the other three RCP thermal barriers or thermal barrier cross tie.

CCWS Temperature Control

Normally, the CCWS heat exchanger bypass control valve (KAA10/20/30/40 AA112) is manually positioned in order to maintain a CCWS normal temperature greater than 59°F and less than 100.4°F. This is a remote manual operation from the MCR. An alarm is relayed to the operator in the MCR when the temperature is near the MIN2 or MAX2 temperature limit. The non-safety automatic controls will not be enabled while the valve is in the remote manual mode. Remote manual control can only occur if there is no automatic Class 1E function operating on the valve. The automatic Class 1E functions, which are addressed in Section 9.2.2.6.1, will override other manual or automatic non-safety control functions.

To avoid a CCWS temperature less than 59°F, the bypass control valve of the CCWS heat exchanger (KAA10 AA112) is automatically stepped opened when the heat exchanger outlet is near the low temperature threshold (MIN1). The valve is stepped open in 10 percent increments every one minute until the temperature measured at the heat exchanger outlet is above the threshold value or the bypass valve is fully open.

During normal plant operation, an open CCWS heat exchanger bypass line can cause CCWS temperature to be greater than 100.4°F. To prevent this condition, the bypass control valve of the CCWS heat exchanger (KAA10 AA112) is automatically stepped closed in approximate 10 percent increments when the heat exchanger outlet is near the high temperature threshold (MAX1). The valve is stepped closed until MAX1 is cleared.

Manual Start and Trip of a Train

During normal operation, the CCWS trains are started to align the CCWS configuration to meet the operational needs of the plant.

When the pump is shutdown, the LHSI heat exchanger isolation valve (KAA12/22/32/42 AA005) is closed after a time delay to avoid risks of leakage from a CCWS train through the corresponding SIS train.

Dedicated CCWS Control

The dedicated CCWS train is manually actuated from the MCR when needed during severe accident conditions. Control is provided for the follow components:

- Dedicated CCWS pump (KAA80 AP001).
- Dedicated CCWS makeup pump (KAA80 AP201).
- Dedicated CCWS tank outlet valve (KAA80 AA020).
- Dedicated CCWS makeup isolation valve (KAA80 AA202).
- Dedicated CCWS tank nitrogen isolation valve (KAA80 AA021).

System monitoring instrumentation transmits the following signals:

- Pump discharge flow rate.
- SAHRS heat exchanger CCWS return flow.
- Surge tank pressure.
- SAHRS heat exchanger CCWS inlet temperature.
- Dedicated CCWS heat exchanger inlet and outlet temperatures.

Dedicated CCWS Surge Tank Water Makeup

Water makeup is accomplished with the makeup pump (KAA80 AP201) and is isolated by motor-operated valve (KAA80 AA202), which is normally closed.

Water makeup is automatically initiated when a low level is reached.

Dedicated CCWS Circuit Pressurization

The nitrogen in the dedicated CCWS surge tanks (KAA80 BB001) pressurizes the dedicated CCWS train to a pressure greater than the SAHRS. It also compensates for the water expansion and contraction resulting from a temperature change in the system fluid.

The nitrogen isolation valve (KAA80 AA021) can be manually opened from the MCR.

Information about the nitrogen quantity in the tank assists the operator in controlling the nitrogen makeup (derived from the pressure, temperature and water level in the tank).

The tank is protected against over pressurization by a safety valve (KAA80 AA193) connected to the gas space of the tank.

The surge tanks are isolated from the main circuit with the tank outlet isolation valve (KAA80 AA020) to avoid nitrogen expansion in the main circuit in case of large break.

9.2.2.6.1.4 CCWS Pump Control, Protection and Monitoring

High Bearings Temperatures

An alarm is relayed to the operator in the MCR when the pump bearing temperature or the motor bearing temperature is near the first threshold value. The second threshold value trips the pump.

High Windings Temperatures

An alarm is relayed to the operator in the MCR when the motor stator windings temperature is near the first threshold value. The second threshold value trips the pump.

9.2.2.6.1.5 Additional Control Features and Interlocks

Each CCWS pump is interlocked with its associated LHSI/RHR HX supply valve so that when the pump is stopped the supply valve closes, following a delay to allow for pump coast down. This action prevents potential leakage of the CCWS into the SIS train.

In the event of a pump low flow condition, the associated LHSI HX isolation valve automatically opens to provide a minimum flow path for CCWS pump protection. In the event of a pump high flow condition, the FPCS HX outlet flow control valve is closed to its minimum opening mechanical stop position to reduce the CCWS flow rate and to maintain normal pump operation.

The CCWS surge tanks are instrumented with level indication and graduated level control and equipment protection set points designated from lowest to highest level (MIN4, MIN3, MIN2, MIN1, MAX1, MAX2, MAX3 and MAX4). A CCWS train can operate continuously so long as the water level in its surge tank is maintained between MIN1 and MAX1.

Detection of increasing radiation in the CCWS from the CVCS HP coolers indicates leakage and triggers automatic isolation of the affected CVCS HP cooler via motor-operated valves (KBA11/12 AA001/003) in the CVCS. Refer to Section 11.5.4.17 and Table 11.5-1 (Monitors R-51 through R-54) for details on the associated radiation monitoring equipment.

Leakage of reactor coolant into the CCWS from such trains as the LHSI HXs is also indicated by increasing radiation in the CCWS and prompts isolation of the train. Refer to Section 11.5.4.4 and Table 11.5-1 (Monitors R-35 through R-38) for details on the associated radiation monitoring equipment.

Manual or automatic actuation of a CCWS pump automatically actuates the corresponding ESWS pump.

The CCWS is designed with redundant level indication for each surge tank that is transmitted to the control room. The demineralized water makeup line for each CCWS surge tank contains a flow indication device that transmits to the control room. The combination of continuously monitored tank level and demineralized water makeup flow in real time provides the operators the ability to retrieve trending data on surge tank levels and normal makeup flow at any time and for any range of operating time. The ability to retrieve and analyze this data in real time from the MCR provides operators the ability to realize when 7 day train leakage is trending near a threshold value. This provides the operators the ability to take corrective action prior to exceeding the maximum allowed 7 day train leakage. Trending CCWS surge tank levels is important to the operation of the system in post-seismic operation because the CCWS is designed to maintain a reserve volume of water in each tank to allow the system to operate for 7 days after an earthquake with no operator action if normal makeup from demineralized water is not available.

Surveillance Requirement 3.7.7.2 is written to verify CCWS train leakage on a 31 day frequency.

9.2.2.6.1.6 RCP Thermal Barrier Temperature Monitoring

The return temperature from each RCP thermal barrier is continuously monitored in the MCR using temperature elements in the outlet of each thermal barrier as indicated in Figure 9.2.2-2, Sheets 3 and 4, and Figure 9.2.2-3, Sheets 3 and 4. High temperature indication initiates an alarm in the MCR.

9.2.2.7 CCWS Failure Modes and Effects Analysis

A failure modes and effects analysis (FMEA) for the component cooling water system (CCWS) is provided in Table 9.2.2-5.

Mission success criteria for the CCWS includes:

1. Following a design basis event: Any two CCWS supply trains operating, with supply to the associated SIS/RHR loads, supply to at least one set of Common 1.A/2.A fuel pool cooling loads and supply to the safety-related loads (RCP thermal barriers, CVCS pump motor coolers, CVCS letdown HP cooler, water cooled division of the safety chilled water system) on at least one set of Common 1.B/2.B operating loads.

2. During normal power operation (NPO): At least one CCWS supply train operating for each pair of common fuel pool cooling and common operating loads (one CCW train carrying the Common 1.A and Common 1.B loads and one CCW train carrying the Common 2.A and 2.B loads).

Operating procedures included in the FMEA table for the CCWS will be developed by the COL applicant as described in Section 13.5.

9.2.2.8 References

1. ASME Boiler and Pressure Vessel Code, Section III: "Rules for Construction of Nuclear Facility Components," Class 2 and 3 Components, The American Society of Mechanical Engineers, 2004.

2. ANSI/ASME B31.1-2004, "Power Piping," The American Society of Mechanical Engineers, 2004.

3. ASME Boiler and Pressure Vessel Code, Section VIII: "Rules for Construction of Pressure Vessels," The American Society of Mechanical Engineers, 2004.

4. IEEE Std 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1998.

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

3. NUREG-0927, Serkiz, A.W., Technical Report, "Evaluation of Water-Hammer Experience in Nuclear Power Plants," U.S. Nuclear Regulatory Commission, May 1983.

Table 9.2.2-1—CCWS Design Parameters

Description	Technical Data
Component Cooling Water Pump (KAA10/20/30/40 AP001	
Number	4
Type	Centrifugal Pump
Flow rate max.	18,294 gpm
Pump head min (at max flow rate)	199.7 ft
Dedicated Component Cooling Water Pump (KAA80 AP001)	
Number	1
Type	Centrifugal Pump
Flow Rate	2439.2 gpm
Pump Head	175.2 ft
Component Cooling Water Surge Tank KAA10/20/30/40 BB001)	
Number	4
Volume	950 ft^3
Dedicated Component Cooling Water Surge Tank (KAA80 BB001)	
Number	1
Volume	75 ft^3
Component Cooling Water HX (KAA10/20/30/40 AC001)	
Number	4
Heat Load (DBA)	293.35 x 10^6 Btu/hr
Dedicated Component Cooling Water HX (KAA80 AC001	
Number	1
Heat Load	51.2 x 10^6 Btu/hr

Table 9.2.2-2—CCWS User Requirements Summary
Sheet 1 of 2

Component	KKS	Heat Load (106 BTU/hr)	Required Flow (106 lb/hr)	Comments
CCWS Main Trains 1 and 4				
CCWS Pump Motor Cooler	KAA10/40 AC002	0.0955	0.0302	
LHSI Heat Exchanger	JNG10/40 AC001	152.8	2.984	Normal Cooldown when CCW train is only connected to the train SIS users (1)
		36.54	2.1906	Normal Cooldown when CCW train is only connected to the CCW common header (1)
		241	2.1906	DBA
MHSI Pump Motor Cooler	JND10/40 AP001	0.0239	0.0265	
CCWS Main Trains 2 and 3				
CCWS Pump Motor Cooler	KAA20/30 AC002	0.0955	0.0302	
LHSI Heat Exchanger	JNG20/30 AC001	152.8	2.984	Normal Cooldown when CCW train is only connected to the train SIS users (1)
		36.54	2.1906	Normal Cooldown when CCW train is also connected to the CCW common header (1)
		241	2.1906	DBA
MHSI Pump Motor Cooler	JND20/30 AP001	0.0239	0.0265	
LHSI Pump Motor Cooler	JNG20/30 AP001	0.1262	0.0141	
LHSI Sealing Fluid Cooler	JNG20/30 AP001	0.0341	0.0062	Flow isolated when LHSI pump is out of service for dilution prevention

Table 9.2.2-2—CCWS User Requirements Summary
Sheet 2 of 2

Component	KKS	Heat Load (106 BTU/ hr)	Required Flow (106 lb/ hr)	Comments
Common Header 1				
Fuel Pool Cooling Hx	FAK10 AC001	29	0.8818	Normal Operations
		67.62	2.645	Refueling
Safety Chiller	QKA20 AC002	5.705	0.514	
RCP Thermal Barrier	N/A	1.566	0.0792	Thermal Barriers 1-4 can be cooled by Common header 1 or 2
Additional Operational Users	QNA, QNB, JEB, KBA, KLA, KTA, QUC, KUA	69.86	4.11	
Common Header 2				
Fuel Pool Cooling Hx	FAK20 AC001	29	0.8818	Normal Operations
		67.62	2.645	Refueling
Safety Chiller	QKA30 AC002	5.705	0.514	
RCP Thermal Barrier	N/A	1.566	0.0792	Thermal Barriers 1-4 can be cooled by Common header 1 or 2
Additional Operational Users	QNA, QNB, JEB, KBA, QUC, KUA, LCQ, KBF, KBG, KPC, KPF	86.29	4.29	
Dedicated CCWS Train				
Severe Accident Heat Removal System Heat Exchanger	JMQ40 AC001/004	50.5	1.104	

Note:

1. A CCWS train aligned only to the train SIS users has a higher heat removal capacity than a CCWS train that is also aligned to the common header plus the CCWS train SIS users. Flow that would normally go to the common header is used for additional heat removal capacity from the SIS users.

Table 9.2.2-3—CCWS Common Header Users
Sheet 1 of 3

System	User Description
Common 1.b	
Reactor Coolant	RCP1 Motor Air Cooler
	RCP1 Motor Air Cooler
	RCP1 Lower Bearing Oil Cooler
	RCP1 Upper Bearing Oil Cooler
	RCP2 Motor Air Cooler
	RCP2 Motor Air Cooler
	RCP2 Lower Bearing Oil Cooler
	RCP2 Upper Bearing Oil Cooler
	RCP1 Thermal Barrier[1]
	RCP2 Thermal Barrier[1]
	RCP3 Thermal Barrier[1]
	RCP4 Thermal Barrier[1]
Containment Building Ventilation	Containment HVAC Cooler 1
	Containment HVAC Cooler 2
	Containment HVAC Cooler 3
	Containment HVAC Cooler 4
Nuclear Island Drain and Vent	Primary Effluents HX
Chemical and Volume Control	CVCS HP Cooler 1
	Charging Pump Motor Cooler 1
	Charging Pump Oil Cooler 1
	Charging Pump Motor Cooler 1
Nuclear Sampling	RCS/PZR
	RCS/HL1
Steam Generator Blowdown Sampling	Secondary Sampling HX SG1
	Secondary Sampling HX SG2
Operational Chilled Water	OCWS Chiller
	OCWS Chiller
	OCWS Chiller
Safety Chilled Water	SCWS Condenser Train 2

Table 9.2.2-3—CCWS Common Header Users
Sheet 2 of 3

System	User Description
Common 2.b	
Reactor Coolant	RCP3 Motor Air Cooler
	RCP3 Motor Air Cooler
	RCP3 Lower Bearing Oil Cooler
	RCP3 Upper Bearing Oil Cooler
	RCP4 Motor Air Cooler
	RCP4 Motor Air Cooler
	RCP4 Lower Bearing Oil Cooler
	RCP4 Upper Bearing Oil Cooler
	RCP1 Thermal Barrier[1]
	RCP2 Thermal Barrier[1]
	RCP3 Thermal Barrier[1]
	RCP4 Thermal Barrier[1]
Chemical and Volume Control	CVCS HP Cooler 2
	Charging Pump Motor Cooler 2
	Charging Pump Oil Cooler 2
	Charging Pump Motor Cooler 2
Steam Generator Blowdown Sampling	Secondary Sampling HX SG3
	Secondary Sampling HX SG4
Nuclear Sampling	RCS/HL3
Operational Chilled Water	OCWS Chiller
	OCWS Chiller
	OCWS Chiller
Steam Generator Blowdown	Second Stage Cooler
Coolant Treatment	Seal Water Cooler
	Condenser
	Gas Cooler
	After Cooler
	Condensate Cooler
	Reflux Condenser
	Gas Cooler

Table 9.2.2-3—CCWS Common Header Users
Sheet 3 of 3

System	User Description
Coolant Degasification	Condenser
	Gas Cooler
Solid Water	Condenser
	Condenser
	Condenser
	Vacuum Unit
Liquid Waste Processing	Vent Gas Cooler
	Seal Water Cooler
	Cooler for Injection Water
	Distillate Cooler
Safety Chilled Water	SCWS Condenser Train 3

Notes:

1. Either CCWS Common 1.b or 2.b headers can provide cooling to the RCP thermal barriers.

Table 9.2.2-4—Power Supplies for CCWS Valves
Sheet 1 of 2

Description	Tag Number	IEEE Class 1E	
		Normal	Alternate
Heat Exchanger Bypass Valve	KAA10AA112	1	2
Heat Exchanger Bypass Valve	KAA20AA112	2	1
Heat Exchanger Bypass Valve	KAA30AA112	3	4
Heat Exchanger Bypass Valve	KAA40AA112	4	3
LHSI HX Isolation Valve	KAA12AA005	1	2
LHSI HX Isolation Valve	KAA22AA005	2	1
LHSI HX Isolation Valve	KAA32AA005	3	4
LHSI HX Isolation Valve	KAA42AA005	4	3
LHSI Pump Seal Cooler Isolation Valve	KAA22AA013	2	1
LHSI Pump Seal Cooler Isolation Valve	KAA32AA013	3	4
Common 1.b Header Non-Safety Loads	KAB40AA001	1	2
	KAB40AA006	1	2
	KAB40AA012	4	3
Common 1.b Header Safety-Related Loads	KAB60AA013	1	2
	KAB60AA018	4	3
	KAB60AA019	1	2
Common 2.b Header Safety-Related Loads	KAB70AA013	4	3
	KAB70AA018	1	2
	KAB70AA019	4	3
Common 1.a Header Fuel Pool Cooling HX Downstream Control Valve	KAB10AA134	1	2
Common 2.a Header Fuel Pool Cooling HX Downstream Control Valve	KAB20AA134	4	3
Common 1.b Header RCP Thermal Barrier Containment Isolation Valves	KAB30AA049	1	2
	KAB30AA051	4	3
	KAB30AA052	1	2
Common 2.b Header RCP Thermal Barrier Containment Isolation Valves	KAB30AA053	4	3
	KAB30AA055	1	2
	KAB30AA056	4	3

Table 9.2.2-4—Power Supplies for CCWS Valves
Sheet 2 of 2

Description	Tag Number	IEEE Class 1E	
		Normal	Alternate
Surge Tank Demineralized Water Makeup Isolation Valves	KAA10AA027	1	2
	KAA20AA027	2	1
	KAA30AA027	3	4
	KAA40AA027	4	3

Next File