ABB
ASEA BROWN BOVERI

May 3, 1993
LD-93-074

Docket 52-002

Attention: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SYSTEM 80+™ Supplemental Information for Additional Submittal #1 Design Descriptions and ITAAC

Dear Sirs:

Attached is information requested by the staff to supplement information on the System 80+ design descriptions which is already on the docket.

ABB-CE has initiated an Integrated Review of the CESSAR-DC and Design Descriptions/ITAAC to ensure consistency among and within these documents. It is possible that changes to the attached material may be necessary should the review uncover any inconsistencies. It is our intention to incorporate such changes in our final amendment targeted for June 30, 1993.

If you have questions related to this material, please contact me or Mr. John Rec (203-285-2861).

Very truly yours,

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For reference purposes only. Not intended to comprise a part of either the Tier 1 or Tier 2 System 80+ submittal.

SUPPORTIVE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

1. Amplifying Information for the Station Service Water System

a) Confirmation of the SSWS heat dissipation capacity during operation, shutdown, refueling, and design basis accident conditions will be performed as part of the CCWS heat dissipation capacity analysis. (See CCWS Amplifying Information.)

The analysis will demonstrate that only one station service water pump matched with one component cooling water heat exchanger receiving component cooling water flow is required to operate during post design basis accident conditions. The analysis will also demonstrate that each Division of the SSWS matched with one operating CCWS Division has a heat dissipation capacity to achieve and maintain cold shutdown.

2. CESSAR-DC Chapter 14 Tests Applicable to the SSWS

See CESSAR-DC Section 14.2.12.1.78

9.2 WATER SYSTEMS

9.2.1 STATION SERVICE WATER SYSTEM

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The Station Service Water System (SSWS) is an open system that takes suction from the Ultimate Heat Sink (UHS) and provides cooling water to remove heat released by plant systems, structures and components. The SSWS returns the heated water to the ultimate heat sink. The SSWS cools the Component Cooling Water System (CCWS) which in turn cools essential and non-essential reactor auxiliary loads. The SSWS is shown in Figure 9.2.1-1. I

9.2.1.1 Design Bases

9.2.1.1.1 Safety Design Bases

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Safety design bases applicable to the SSWS are as follows:

A. The SSWS, in conjunction with the Component Cooling Water System (CCWS) and ultimate heat sink, is capable of removing sufficient heat from the essential heat exchangers to ensure a safe reactor shutdown and cooling following a postulated accident coincident with a loss of offsite power.

B. The SSWS is capable of maintaining the component cooling water supply temperature of 120°F or less following the design basis accident under the most adverse historical meteorological conditions consistent with the intent of Regulatory Guide 1.27. I

C. A single failure of any component in the SSWS will not impair the ability of the SSWS to meet its functional requirements.

D. Adverse environmental occurrences will not impair the ability of the SSWS to meet its functional requirements.

E. The SSWS is designed to detect leakage from the system.

F. The SSWS is designed to minimize the effects of long-term corrosion, silt, mud and organic buildup.

G. The SSWS is designed to withstand the effects of a Safe Shutdown Earthquake (SSE). E

H. Components of the SSWS are capable of being fully tested during normal plant operation. In addition, parts and components shall be accessible for inspection ~~at any time~~.

Amendment I
December 21, 1990

I. All essential SSWS components are fully protected from floods, tornado missile damage, internal missiles, pipe breaks and whip, jet impingement and interaction with non-seismic systems in the vicinity.

J. The system is designed to minimize the potential for water hammer by providing for adequate filling and high point venting.

9.2.1.1.2 Power Generation Design Basis

Power generation design bases pertinent to the SSWS are as follows: I

A. The SSWS, in conjunction with the CCWS and SCS, is designed to cool the reactor coolant from 350°F to 140°F through the shutdown cooling heat exchangers and the component cooling water heat exchangers. The reactor coolant system can be cooled to 140°F within 24 hours after reactor shutdown by first cooling the reactor coolant to 350°F through the steam generators and then cooling to 140°F by utilizing both divisions of the SCS, CCWS, and SSWS. The cooling rate of the reactor coolant does not exceed the administrative limit of 75°F/hr.

B. The SSWS, in conjunction with the CCWS, is designed to provide a maximum cooling water temperature of 120°F to all components required to operate during a normal shutdown. E J

C. The SSWS, in conjunction with the CCWS, is designed to provide a maximum component cooling water temperature of 105°F or less during normal operating modes. I

D. The SSWS through the CCWS is designed to provide cooling water to the RCPs, letdown heat exchanger, sample heat exchangers, ~~non-essential~~ normal chilled water condensers, and other non-essential reactor auxiliary cooling loads. J

9.2.1.1.3 Codes and Standards

The SSWS and associated components are designed in accordance with applicable codes and standards. The design conforms with General Design Criteria 2, 4, 5, 44, 45 and 46 and the intent of the Standard Review Plan. E

Manual start and stop actuation of the station service water pumps is provided from the control room to override automatic actuation.

9.2.1.2 System Description

The SSWS consists of two separate, redundant, open loop, safety-related divisions. Each division cools one of two divisions of the CCWS, which in turn cools 100% of the safety-related loads. The SSWS operates at a lower pressure than the CCWS to prevent contamination of the CCWS with raw water. E

Each division of the SSWS consists of two pumps, two strainers, two sump pumps, and associated piping, valves, controls and instrumentation. The station service water pumps circulate cooling water to the component cooling water heat exchanger and back to the ultimate heat sink. Provisions are made to ensure a continuous flow of cooling water under normal and accident conditions. Controls are provided in the control room to manually align station service water flow to the component cooling water heat exchangers.

9.2.1.2.1 Components Description

Table 9.2.1-2 lists component design parameters. Each component is also described in the following sections. Table 9.2.1-3 lists the active valves for the SSWS. These valves are described in Section 9.2.1.2.1.8.

9.2.1.2.1.1 SSWS Pumps

Four identical station service water pumps are provided, two pumps per division. Typically, each pump provides 100% of the required flow for post-LOCA conditions. During normal operation only one pump per division is ~~required to be~~ operating. The second pump in the respective division will automatically start on a low pump discharge pressure signal. This is indicative of a failure of the operating pump. I

The pumps are of the vertical centrifugal type and are installed in the station service water pump structure. ~~They are installed such that they meet the minimum required NPSH at the simultaneous occurrence of the UHS pond draw-down, maximum pond temperature, maximum flow through the screens and piping to the pits, and assuming the safety grade screens are 50% clogged.~~ The station service water pump motor coolers receive cooling water from their respective station service water pump discharge at all times while the pump is in operation. The pump motors and all other electrical equipment in the pump structure are located above the maximum flood elevation.

The pump motors are connected to their associated 4160 volt Class 1E Auxiliary Power System. In the event offsite power is lost, the pumps are stopped and restarted in accordance with the diesel generator's load sequencing.

The sizing of the station service water pumps is based on the following operating mode requirements: E

Normal power operation	- 1 pump per division operating
Normal shutdown (24 hours)	- 4 pumps operating J
Safety-grade shutdown (36 hours)	- 2 pumps required, in a single division ~~1 per division or 2 in one division (corresponding with the operating CCW heat exchanger)~~ E
Post-LOCA	- 1 pump required, (corresponding with the operating CCW heat exchanger)

ADD INSERT A

The station service water pumps are provided with at least 7% margin in head at the pump design point. The head versus flow curve is continuously rising from the design point to shut-off.

The minimum available NPSH is the smaller of (1) 25 percent of, or (2) 10 feet greater than the required NPSH specified by the pump vendor.

9.2.1.2.1.2 SSWS Pump Structure

The pump structure is a Seismic Category I design.

The UHS inlet to the station service water pumps is equipped with a safety grade screen system (see Section 9.2.1.2.1.4). I

9.2.1.2.1.3 Piping, Valves, and Fittings

Piping to and from the CCW heat exchangers is corrosion resistant. Materials are to be selected on a site-specific basis to be compatible with the ultimate heat sink makeup water chemistry and water treatment. All safety-related piping, valves, and fittings are supplied in accordance with ASME Code Section III, Class 3.

All material exposed to the raw water will be tested at typical operating temperatures with similar station service water chemistry to evaluate the adequacy of the materials. J

The supply and return piping to and from system components in a division is physically separated from the supply and return lines in the redundant division. E

During normal power operation as cooling requirements increase, the additional pump in a division may be needed.

CESSAR-DC Attachment (Refer to page 9.2-5)

INSERT A:

The available NPSH is calculated at the highest expected operating temperature and flow, at the normal water elevations, and assuming the traveling screens are 50% clogged. The available NPSH exceeds the required NPSH for worst case UHS water elevations for all operation, flow, and temperature conditions. (Note: For worst case UHS water elevation, the margins previously specified need not apply.)

9.2.1.2.1.8 Active Valves

The following valves are required to maintain their functional capability during a safe plant shutdown. The active valves are listed on Table 9.2.1-3.

A. Station Service Water Pump Discharge Check Valves

Valves SW-1302, SW-1303, SW-2302, and SW-2303 are required to function during a safe plant shutdowr. I

B. Station Service Water Strainer Backwash Valves

Valves SW-100, SW-101, SW-102, SW-103, SW-104, SW-105, SW-106, SW-107, SW-108, SW-109, SW-110, SW-111, SW-200, SW-201, SW-202, SW-203, SW-204, SW-205, SW-206, SW-207, SW-208, SW-209, SW-210, and SW-211 are required for a safe unit shutdown. These valves are provided with electric motor operators. J

C. Component Cooling Water Heat Exchanger Isolation Valves

Valves SW-120, SW-121, SW-122, SW-123, SW-220, SW-221, SW-222, and SW-223 are required to function during a safe plant shutdown. These valves are provided with electric motor operators and can be remotely operated from the control room.

9.2.1.2.1.9 Electric Power Supply - SSWS Emergency Power Requirement

Safety related components for their respective divisional Class 1E busses. I

e ~~E~~ach division of the SSWS receive~~s~~ power from ~~its associated Class 1E Auxiliary Power System~~. In the event of loss of offsite power, this power system is supplied by the emergency diesel generators. There are two diesel generators, either of which is capable of supplying power for the operation of one division of the necessary safety equipment. Division 1 essential components are aligned to Emergency Load Centers A or C and Division 2 essential components are aligned to Emergency Load Centers B or D.

The emergency load center and channel designation for the SSW pumps, valves, and controls are given in Table 9.2.1-4. (Note: each pump start/stop control is from a different channel.)

9.2.1.2.2.2 Normal Operation

Typically, during normal operation one station service water pump and one component cooling water heat exchanger per division is in service. Station service water is supplied to the component cooling water heat exchangers that are in service and receiving heat loads from the CCWS.

9.2.1.2.2.3 Unit Shutdown

Both divisions of the SSWS (four station service water pumps and four component cooling water heat exchangers) are required to accomplish a normal reactor shutdown, that is, a reactor coolant temperature of 140°F in 24 hours. Although a normal reactor shutdown is accomplished by operation of both SSWS divisions, shutdown and cooldown over 36 hours is possible with use of a single division.

9.2.1.2.2.4 Refueling Operations

Both divisions of the SSWS (four station service water pumps and four component cooling water heat exchangers) are required to be in service during refueling.

9.2.1.2.2.5 Emergency Operation

One station service water pump and corresponding component cooling water heat exchanger is required to operate during post-LOCA. The SSWS will operate for the required nominal 30 days following a postulated LOCA without requiring any makeup water to the UHS and without requiring any blowdown (that is, from non-open heat sinks such as a cooling pond) for salinity control. Provisions for non-essential makeup water and blowdown are discussed in Section 9.2.5.

9.2.1.2.2.6 Loss of Offsite Power

A loss of offsite power results in the shutdown and restarting of the station service water pumps in accordance with the diesel generator load sequencing.

9.2.1.3 Safety Evaluation

Safety evaluations, numbered to conform to the safety design bases, are as follows:

TABLE 9.2.1-4 (Cont'd)

(Sheet 3 of 3)

STATION SERVICE WATER SYSTEM
EMERGENCY POWER REQUIREMENTS

Station Service Water System Controls

Controls	Emergency Channel
Station Service Water Pump 1A Start/Stop	A
Station Service Water Pump 1B Start/Stop	C
Station Service Water Pump 2A Start/Stop	B
Station Service Water Pump 2B Start/Stop	D
Station Service Water Strainer 1A Start/Stop	A
Station Service Water Strainer 1B Start/Stop	C
Station Service Water Strainer 2A Start/Stop	B
Station Service Water Strainer 2B Start/Stop	D

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For reference purposes only. Not intended to comprise a part of either the Tier 1 or Tier 2 System 80+ submittal.

REFERENCE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

Relationship of the Safety Analysis to the SSWS

The Safety Analysis assumes that the SSWS removes the heat loads from the CCWS heat exchangers.

REFERENCE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

Relationship of the PRA to the SSWS

1) Each SSWS division has two Station Service Water pumps per Division.

2) The SSWS is precluded from entering the Nuclear Island.

REFERENCE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

Relationship of the Shutdown Risk Evaluation to the SSWS

None

SUPPORTIVE INFORMATION FOR COMPONENT COOLING WATER SYSTEM (2.7.6)

1. Amplifying Information for the CCWS

[NOTE: The limiting Design Basis Accident heat dissipation rate is specified as an Interface Requirement for the Ultimate Heat Sink as specified in the SSWS (Section 2.7.5). The CCWS, SSWS, and the UHS operating in combination must be shown to be capable of dissipating at least this heat rate.]

a) Confirmation of the CCWS heat dissipation capacity during operation, shutdown, refueling, and design basis accident conditions will be performed. An analysis will be performed based on the as built CCWS serviced components and measured flow rates. The analysis will be based on the following:

1) CCWS flow to cooled components for each plant mode

2) SSWS flow to each component cooling water heat exchanger

3) Design basis station service water inlet temperature

4) Vendor heat exchanger data

The analysis will demonstrate that only one component cooling water pump matched with one component cooling water heat exchanger is required to operate during post-accident conditions. The analysis will also demonstrate that each Division has a heat dissipation capacity to achieve and maintain cold shutdown.

b) Confirmation of the pressure relief capacity provided for each reactor coolant pump will be performed. An analysis will be performed based on the as-built CCWS components. The analysis will be based on quantity of the relieved fluid and fluid temperature.

The analysis will demonstrate that the pressure relief capacity provided for each reactor coolant pump is sized to accept the maximum expected in-leakage from a reactor coolant pump high pressure seal cooler or throttle seal cooler tube rupture.

2. CESSAR-DC Chapter 14 Tests Applicable to the CCWS

See CESSAR-DC Section 14.2.12.1.79

9.2.2 COMPONENT COOLING WATER SYSTEM

The Component Cooling Water System (CCWS) is shown in Figure 9.2.2-1. Table 9.2.2-3 lists the essential and non-essential nuclear component heat loads for the CCWS. I

9.2.2.1 Design Bases

9.2.2.1.1 Safety Design Bases

Safety design bases applicable to the CCWS are as follows: E

A. The CCWS, in conjunction with the Station Service Water System (SSWS) and the Ultimate Heat Sink (UHS), is capable of removing sufficient heat from the essential heat exchangers to ensure a safe reactor shutdown and cooling following a postulated accident coincident with a loss of offsite power. I

B. The CCWS, in conjunction with the SSWS, is capable of maintaining the outlet temperature of the component cooling water (CCW) heat exchanger within the limits of 65°F and 120°F during a design basis accident with loss of offsite power.

C. A single failure of any component in the CCWS will not impair the ability of the CCWS to meet its functional requirements. E

D. Adverse environmental occurrences will not impair the ability of the CCWS to meet its functional requirements.

E. The CCWS is designed to detect leakage of radioactive water into the CCWS and to detect loss of component cooling water volume.

F. The essential cooling loop piping and components are designed in accordance with ~~ANSI~~ Safety Class 3 requirements. Containment isolation valves and containment penetration piping are designed in accordance with ~~ANSI~~ Safety Class 2 requirements. J

G. The CCWS is designed to withstand the effects of a safe shutdown earthquake (SSE).

H. Components of the CCWS are capable of being fully tested during normal plant operation. In addition, parts and components are accessible for inspection ~~at any time~~. E

I. There will be no flow degradation to safety components if the non-essential and the spent fuel pool headers fail to isolate when required.

J. All essential CCWS components are fully protected from floods, tornado missile damage, internal missiles, pipe breaks and whip, jet impingement, and interaction with non-seismic systems in the vicinity.

K. The system is designed to minimize the potential for water hammer by providing for adequate filling and high point venting.

The CCWS is a closed loop cooling water system which cools components and heat exchangers located in the Nuclear Island. Heat transferred by these components to the CCWS is rejected to the SSWS via the CCW heat exchangers.

9.2.2.1.2 Power Generation Design Basis I

Power generation design bases pertinent to the CCWS are as follows:

A. The CCWS, in conjunction with the Shutdown Cooling System (SCS) and SSWS, is designed to cool the reactor coolant from 350°F to 140°F through the shutdown cooling and component cooling water heat exchangers. The reactor coolant can be cooled to 140°F within 24 hours after reactor shutdown by first cooling the reactor coolant to 350°F through the steam generators and then cooling to 140°F by utilizing both divisions of the SCS, CCWS, and SSWS. The cooling rate of the reactor coolant will not exceed the administrative limit of 75°F/hr. E

B. The CCWS, in conjunction with the SSWS, is designed to provide a maximum cooling water temperature of 120°F to all components required to operate during a normal shutdown. J

C. The CCWS, in conjunction with the SSWS, is designed to provide cooling water to the reactor coolant pumps, letdown heat exchanger, sample heat exchangers, ~~non-essential~~ normal chilled water condensers, and other non-essential reactor auxiliary cooling loads. E J

D. The CCWS is designed to accommodate a thermal expansion from 65°F to 150°F. I

E. The CCWS, in conjunction with the SSWS, is designed to provide component cooling water temperature of 105°F or less during normal operating modes.

F. The CCWS provides protection against station service water leakage into the reactor coolant system.

G. The CCWS provides protection against release of radiological contamination into the environment via the UHS.

H. The CCWS is designed to minimize the effects of long-term corrosion.

9.2.2.1.3 Codes and Standards

The CCWS and associated components are designed in accordance with applicable codes and standards. The design conforms with General Design Criteria 2, 4, 5, 44, 45, and 46, and the intent of the Standard Review Plan.

9.2.2.1.4 Interface Requirements

The Component Cooling Water (CCW) Heat Exchanger Structure is an out of scope item which shall be provided by the applicant. The licensee shall verify that the following interface requirements are met to ensure adequacy with the System 80+™ Standard Design:

A. The CCW Heat Exchanger Structure shall meet Seismic Category I requirements.

B. The CCW Heat Exchanger Structure shall withstand the effects of the following events:

   1. Natural phenomena, including SSE, floods, tornados, and ~~hurricanoes~~. hurricanes

   2. Externally and internally generated missiles.

   3. Fire and sabotage.

C. The CCW Heat Exchanger Structure shall be located to minimize the amount of SSWS piping and equipment surfaces exposed to the corrosion and fouling effects of the service water. An evaluation shall be performed to select the preferred location based on site specific conditions.

D. The CCW Heat Exchanger Structure shall provide physical barriers to maintain divisional separation of CCWS components.

E. The CCW Heat Exchanger Structure shall provide compartmentalization of the heat exchangers such that service water leaks and spills can be kept out of floor drains which are processed through the Liquid Waste Management System.

Heat is removed from the CCWS by the flow of station service water through the tube side of the component cooling water heat exchangers.

6. The CCW Heat Exchanger Structure Ventilation System shall be controlled from the main control room. Instrumentation and controls shall be provided in accordance with ANSI/ANS 59.2.

The CCW heat exchangers are also out of scope items. A reference horizontal shell and tube heat exchanger is discussed in the following sections, however a plate type heat exchanger may be substituted. Sites selecting the plate type heat exchanger shall provide strainer protection against debris or arrangements which allow backflushing on the service water side. J

9.2.2.2 System Description

The CCWS consists of two separate, independent, redundant, closed loop, safety related divisions. Either division of the CCWS is capable of supporting 100% of the cooling functions required for a safe reactor shutdown.

water cooling
One component cooling water pump and heat exchanger (matched with operating SSWS division) is required to operate during post-LOCA. Cooling to the spent fuel pool heat exchanger(s) and the non-essential ~~loop~~ header(s) is isolated on a SIAS. If these headers fail to isolate, the idle component cooling water pump in the respective loop will automatically start on a low pump differential pressure signal. This assures that there is no flow degradation to the essential components. I

The CCWS operates at a higher pressure than the SSWS, ~~This prevents~~ thus preventing the leakage of station service water into the CCWS in the event of a CCW heat exchanger tube leak.

Each division of the CCWS includes two heat exchangers, a surge tank, two component cooling water pumps, a chemical addition tank, a component cooling water radiation monitor, two sump pumps, a component cooling water heat exchanger structure sump pump, piping, valves, controls, and instrumentation. No cross connections between the two divisions exist.

~~Each division consists of an essential and non-essential cooling loop. The essential loops are composed of ANSI Safety Class 3 piping and components. The non-essential loops are composed of non-nuclear safety piping and components, with the exception of the containment isolation valves and penetration piping which are ANSI Safety Class 2.~~

DELETE AND ADD INSERT A

CESSAR-DC Attachment (Refer to page 9.2-23)

INSERT A

The CCWS provides cooling water to the essential components and non-essential components listed in Section 9.2.2.2.2. Essential components are supplied component cooling water by means of Safety Class 3 cooling loops. Non-essential components are supplied component cooling water by means of non-nuclear safety class cooling loops with the exception of the charging pump miniflow heat exchangers and the charging pump motor coolers which are supplied component cooling water by means of Safety Class 3 cooling loops. Containment isolation valves and penetration piping are designed in accordance with Safety Class 2 requirements.

The non-essential ~~heat loads~~ headers and the spent fuel pool cooling heat exchangers, ~~with the exception of the RCP heat loads,~~ are isolated ~~from the essential loads~~ automatically on an SIAS. The non-essential ~~heat loads~~ headers and the RCP ~~heat loads~~ headers isolate on a low-low surge tank level signal.

DELETE

~~The CCWS provides cooling water to the essential components and non-essential components listed in Section 9.2.2.2.2. Heat is removed from the CCWS by the flow of station service water through the tube side of the component cooling water heat exchangers.~~

Makeup water to the CCWS is normally supplied by the Demineralized Water Makeup System, described in Section 9.2.3. If the Demineralized Water Makeup System is unavailable, such as during an accident, a backup makeup water line of Seismic Category I construction is provided. This essential safety-related makeup water source is from the Station Service Water System (SSWS). A removable spool piece is placed in this line to prevent inadvertent addition of station service water.

Surge tanks, one per division, are connected to the suction piping of the component cooling water pumps. The surge tanks are located at the system's high point to facilitate venting and filling. System leakage is replaced with water from the Demineralized Water Makeup System. Both of the makeup water supplies, sump and demineralized water, are integrated and recorded. An assured Seismic Category I makeup source, which is not utilized during normal operation, is available to each surge tank from the corresponding division of the Station Service Water System.

The CCWS serves as an intermediate cooling water system between the Reactor Coolant System (RCS) and the SSWS. A radiation monitor is provided at the outlet of the component cooling water pumps to detect any radioactive leakage into the CCWS. This monitor is indicated and alarmed in the control room.

The wetted surfaces in the CCWS are of materials compatible with the cooling water chemistry. The major portion of the CCWS is constructed with carbon steel. The system water chemistry is controlled for the prevention of long term corrosion. Organic fouling and inorganic buildups are controlled by proper water treatment. The use of demineralized water and corrosion inhibitors will minimize these problems.

9.2.2.2.1.1 Component Cooling Water Heat Exchangers

Four component cooling water heat exchangers are provided, two per division, to handle the essential and non-essential cooling requirements. The heat exchangers are sized to provide cooling water at no greater than 105°F during normal operation and at no greater than 120°F during shutdown or post-LOCA operating modes. I

Each operational mode requires a different alignment of component cooling water heat exchangers. These requirements are listed below: E

Normal Power Operation	- 1 HX per division
Normal shutdown (24 hours)	- all 4 HXs
Safety grade shutdown (36 hours)	- 2 HXs required ~~1 per division or~~ ~~2~~ in a single division ~~(this arrangement is dependent upon final heat exchanger sizing)~~ I
Post-LOCA	- 1 HX in either division E

~~This provides an installed spare for all operating modes, except for normal shutdown cooling.~~

The component cooling water heat exchangers are horizontal, single pass, fixed tubesheet, counterflow heat exchangers with straight tubes. Heat is transferred from the component cooling water to the station service water through the component cooling water heat exchangers. Although a horizontal heat exchanger with straight tubes is specified for this design, specific stations can replace these heat exchangers with a plate type. I

Station service water flows through the tube side of the component cooling water heat exchangers to facilitate their cleaning and maintenance. Adequate tube pull space is provided. The tube side is operated at a lower pressure than the shellside as noted in Section 9.2.2.2. J

The shell side carries the component cooling water. This closed loop shell side water is initially supplied with demineralized water from the Demineralized Water Makeup System (Section 9.2.3).

The heat exchanger fouling factors are based and documented for each heat exchanger in accordance with TEMA (Tubular Exchanger Manufacturers Association) standards and the system water chemistry. An appropriate margin in heat exchanger area is provided to allow for tube plugging. I

During normal power operation as cooling requirements increase, the additional heat exchanger in a division may be needed.

The maximum flow velocity for nominal flow conditions in the tubes is in accordance with Heat ~~Exchanger~~ Exchange Institute (HEI) standards for power plant heat exchangers. The tube velocity for nominal flow conditions is not less than 3 ft./second. I

The component cooling water heat exchanger tube and tubesheet materials are selected on a site specific basis to be compatible with the site Ultimate Heat Sink makeup water chemistry and water treatment. J

The material selected for the component cooling water heat exchanger tubes exposed to service water in a fresh water environment with a maximum chloride concentration of less than 200 ppm and less than 500 ppm is Type 304L stainless steel and Type 316L stainless steel, respectively. An alternative material with improved corrosion resistance may be specified. I

For component cooling water heat exchanger tubes in a service water environment of salt or brackish water, titanium or AL-6XN stainless steel is specified. J

The component cooling water heat exchanger tubesheet materials are specified as follows:

A. For 304L stainless steel tubes: 304L stainless-clad carbon steel or solid stainless steel tube sheets. I

B. For 316L stainless steel tubes: 316L stainless-clad carbon steel or solid stainless steel tube sheets.

C. For AL-6XN stainless steel tubes: solid 304L or 316L stainless steel tube sheets.

D. For titanium tubes: solid titanium tube sheets are preferable, however, solid 304L stainless steel or solid 316L stainless steel tube sheets can be specified.

J

Manual start and stop actuation of the component cooling water pumps is provided from the control room to override automatic actuation. Typically,

9.2.2.2.1.2 Component Cooling Water Pumps

Four identical component cooling water pumps are provided, two pumps per division. ~~D~~during normal operation, only one pump per division is ~~required to be~~ in service. If cooling water flow requirements exceed the capacity of this one pump, the second pump in the same loop will automatically start on a low pump differential pressure signal. This signal can be an indication of either a failure of the running pump or an increase in cooling water flow requirements. I

A component cooling water pump high differential pressure signal opens the containment spray heat exchanger isolation valve associated with that division. This assures a minimum flow path for the component cooling water pump.

Pump sizing is based on the following:

Normal power operation	- 1 pump in each division E
Normal shutdown (24 hours)	- 4 pumps J
Safety-grade shutdown (36 hours)	- 2 pumps required, ~~1 per division or~~ ~~2~~ in a single division ~~(matched with operating heat exchangers)~~ E
Post-LOCA	- 1 pump required (matched with operating heat exchanger) I

~~This provides an installed spare for all operating modes except normal shutdown cooling.~~ E

The pumps are of a double suction centrifugal design with a horizontally split casing for ease of maintenance. Mechanical seals are provided to minimize leakage. The component cooling water surge tank is located at a higher elevation than the component cooling water pumps. This will ensure flooded suction and maintain a constant pressure at the suction side of the pump. Each CCW pump motor is connected to a separate Class 1E Emergency Load Center. In the event offsite power is lost, the pumps are stopped and restarted in accordance with the diesel generators' load sequencing. I

The component cooling water pumps are provided with at least a 7 percent margin in head at the pump design point. The head versus flow curve is continuously rising from the design point to shut-off.

During normal power operation as cooling requirements increase, the additional pump in a division may be needed.

These valves can be manually opened and closed from the control room.

A. Non-Essential Supply Header Isolation Valves

Valves CC-102, CC-122, CC-202, and CC-222 are pneumatically controlled valves that fail closed on loss of instrument air. These valves close to terminate component cooling water flow to the non-essential equipment in the event of an accident. These valves automatically close on an SIAS or low-low component cooling water surge tank level signal. The valve closure times are adequate to prevent complete loss of surge tank volume due to a break in the non-safety piping.

B. Non-Essential Return Header Isolation Valves

Valves CC-103, CC-123, CC-203, and CC-223 isolate the non-essential return headers from the essential return headers in the event of an accident. These valves are pneumatically controlled and fail closed on loss of instrument air. They automatically close on an SIAS or low-low component cooling water surge tank level signal. The valve closure times are adequate to prevent complete loss of surge tank volume due to a break in the non-safety piping.

C. Shutdown Cooling Heat Exchangers 1 and 2 Control Valves

Valves CC-110 and CC-210 provide a constant component cooling water flow of 11,000 gpm to their respective heat exchangers. The valves are pneumatically controlled and fail open on loss of instrument air. These valves are provided with travel stops to restrict maximum flow.

D. Shutdown Cooling Heat Exchangers 1 and 2 Isolation Valves

Valves CC-111 and CC-211 provide component cooling water flow isolation for the shutdown cooling heat exchangers. These valves are provided with electric motor operators and can be manually opened and closed from the control room.

E. Spent Fuel Pool Cooling Heat Exchangers 1 and 2 Isolation Valves

Valves CC-113 and CC-213 close to terminate component cooling water flow to the spent fuel pool cooling heat exchangers in the event of an accident. These valves are provided with electric motor operators and automatically close on SIAS. ~~A manual override is provided in the control room so that flow can be reestablished, heat load permitting, to the heat exchangers during a design basis accident.~~ These valves can be manually opened and closed from the control room. During a design basis accident, flow can be reestablished heat load permitting.

These valves can be manually opened and closed from the control room.

F. Spent Fuel Pool Cooling Heat Exchangers 1 and 2 Control Valves

Valves CC-112 and CC-212 provide constant flow to their respective heat exchangers. These valves are pneumatically controlled and fail open on loss of instrument air. Travel stops are provided to restrict the maximum flow.

G. Containment Spray Heat Exchangers 1 and 2 Isolation Valves

Valves CC-114 and CC-214 provide component cooling water flow isolation for the containment spray heat exchangers. These valves are provided with electric motor operators.
a These valves open automatically on high component cooling water pump differential pressure ~~CSAS, or can be opened manually from the control room~~. signal or on a CSAS. These valves can be manually opened and closed from the control room.

H. Component Cooling Water Heat Exchangers 1A, 1B, 2A, and 2B Bypass Control Valves I

Valves CC-100, CC-101, CC-200, and CC-201 regulate the component cooling water heat exchanger bypass flow. These valves modulate the component cooling water bypass flow to maintain a relatively constant component cooling water outlet temperature. The service water flow remains constant. These valves are pneumatically operated and are required to fail closed. These valves automatically close on an SIAS.

I. Component Cooling Water Heat Exchanger Isolation Valves

Valves CC-106, CC-107, CC-108, CC-109, CC-206, CC-207, CC-208, and CC-209 are required to function during a safe plant shutdown. These valves are provided with electric motor operators and can be remotely operated from the control room.

J. Component Cooling Water Pump Discharge Check Valves

Valves CC-1302, CC-1303, CC-2302, and CC-2303 are required to function during a safe plant shutdown. In the event that one of the pumps ceases to produce flow and pressure head, J these valves prevent flow reversal through the nonoperating pump.

K. Component Cooling Water Surge Tank Vacuum Breakers

The CCWS surge tank vacuum breakers are required to function I during a safe plant shutdown.

L. Containment Isolation Valves

The following containment isolation valves close upon receipt of a Containment Isolation Actuation Signal (CIAS):

Supply to the letdown heat exchanger: CC-240, CC-241

Return from the letdown heat exchanger: CC-242, CC-243 J

The following containment isolation valves are automatically closed on a low-low CCW surge tank level:

CC-130, CC-131 - Supply to reactor coolant pumps 1A and 1B

CC-230, CC-231 - Supply to reactor coolant pumps 2A and 2B I

CC-136, CC-137 - Return from reactor coolant pumps 1A and 1B

CC-236, CC-237 - Return from reactor coolant pumps 2A and 2B

These valves can be manually opened or closed from the control room should leakage be detected.

~~M. Chemical and Volume Control System (CVCS) Supply Header Isolation Valves~~

~~Valves CC-160 and CC-260 provide component cooling water flow isolation for the CVCS Supply Headers (i.e., supply to the Charging Pump Motor Cooler and Charging Pump Miniflow Heat Exchanger in division 1 and to the Charging Pump Motor Cooler and Charging Pump Miniflow Heat Exchanger in division 2, respectively). These valves are provided with electric motor operators and can be manually opened and closed from the control room.~~ J

M ~~N~~. Electric Power Supply - CCWS Emergency Power Requirements

Safety related components for

e ~~E~~ach division of the CCWS receives power from ~~its associated 4,160 volt Class 1E Auxiliary Power System~~. In the event of loss of offsite power, the Auxiliary Power System is supplied by the diesel generators. There are two diesel generators, either of which is capable of supplying 100% power for the operation of one division of the necessary safety equipment. Division 1 essential components are aligned to Emergency Load Centers A or C and Division 2 essential components are aligned to Emergency Load Centers B or D. I

their respective divisional Class 1E busses with the exception of containment ... instrumentation and controls.

The Emergency Load Center and channel designation for the CCW pumps, valves, and controls are given in Table 9.2.2-6. (Note: Each pump start/stop control is from a different channel.)

9.2.2.2.2 System Operation and Control I

The CCWS has two 100% capacity divisions, each with 100% redundancy of safety related components. Each division is connected to its corresponding SSWS division through the component cooling water heat exchanger. The component cooling water heat exchangers serve as a pressure-thermal barrier between the SSWS and CCWS. Each division has a 100% heat dissipation capacity to obtain safe cold shutdown. Heat is transferred from the shell side to the tube side of the CCW heat exchanger and J dissipated by the SSWS to the UHS.

At least one CCW pump is operational in each division for all operating modes. If cooling requirements exceed the capacity of one CCW pump, the second pump in that division will automatically start on a low pump differential pressure signal. This signal is indicative of a failure of the running pump or an increase in cooling water flow requirements.

The ~~outlet~~ temperature of the component cooling water leaving each component cooling water heat exchanger is regulated by the component cooling water heat exchanger bypass control valve (CC-100, CC-101, CC-200, and CC-201). As the temperature of the component cooling water leaving the heat exchanger rises, the bypass valve closes which allows more component cooling water to flow through the heat exchanger and be cooled. The CCWS is designed to maintain a relatively constant component cooling water supply temperature to its heat loads. I

Each division of the CCWS provides cooling for the following redundant safety related components.

A. Shutdown cooling heat exchangers (2 total, 1 per division).

B. Shutdown cooling mini-flow heat exchangers (2 total, 1 per division).

C. Safety injection pump motor coolers (4 total, 2 per division).

D. Containment spray heat exchangers (2 total, 1 per division).

E. Shutdown cooling pump motor coolers (2 total, 1 per division).

H. Sample heat exchangers (14 total, serviced by division 2 - 8 Primary Sample Heat Exchangers and 6 Steam Generator Primary Sample Heat Exchangers).

I. Gas stripper (1 total, serviced by division 2). J

J. Boric acid concentrator (1 total, serviced by division 2).

K. ~~Non-essential~~ Normal chilled water condensers (4 total, 2 per division)

L. Charging pump motor coolers (2 total, 1 per division).

M. Instrument air compressor (4 total, 2 per division).

9.2.2.2.2.1 Unit Startup

I

Typically during a unit startup, cooling water is supplied to all equipment except for the containment spray heat exchangers and possibly one spent fuel pool cooling heat exchanger. This requires the use of both divisions of the component cooling water system, two ~~component cooling~~ CCW heat exchangers, and four ~~component cooling~~ CCW pumps. Certain components will not be in service at all times therefore allowing for a reduction in CCWS load. J I

9.2.2.2.2.2 Normal Operation

Generally during normal operation, one CCW pump and one CCW heat exchanger (matched with operating pump) is required in each division. As the cooling requirements increase, additional system equipment may be needed. Cooling flow is supplied to all components except the containment spray heat exchangers, the shutdown cooling heat exchangers, and possibly one spent fuel pool cooling heat exchanger. The CCWS temperature is maintained at no greater than 105°F. J

9.2.2.2.2.3 Unit Shutdown

Both divisions of the CCWS (4 heat exchangers and 4 pumps) are required to accomplish a normal reactor shutdown, that is to cool the reactor coolant from normal operating temperature to 140°F within 24 hours of reactor shutdown. A normal reactor shutdown entails cooling the reactor coolant to 350°F through the steam generators and then cooling to 140°F by utilizing both divisions of the SCS, CCWS, and SSWS. Cooling water flow to the shutdown cooling heat exchangers is manually aligned from the control room I

for normal or safety grade shutdown. The CCWS, in conjunction with the SSWS, is designed to provide a maximum cooling water temperature of 120°F to the shutdown cooling heat exchangers during normal shutdown.

Typically, during initial shutdown cooling, cooling water is supplied to all components except the containment spray heat exchangers and the spent fuel pool cooling heat exchangers. However, during final shutdown cooling, cooling water is supplied to all components except the containment spray heat exchangers and possibly one spent fuel pool cooling heat exchanger.

9.2.2.2.2.4 Refueling Operations

With both divisions of the CCWS supplying cooling water, (i.e., four CCW pumps and four CCW heat exchangers), the RCS will be at 120°F, refueling temperature, at 96 hours after reactor shutdown. The component cooling water temperature will peak at 120°F at the initiation of shutdown and decreases to 105°F prior to refueling. Component cooling water flow is supplied to all components other than the containment spray heat exchangers. The heat load on the shutdown cooling heat exchanger is from the reactor decay heat.

Both divisions of the CCWS are required to maintain the spent fuel pool bulk water temperature at or below 120°F. This requires that both spent fuel pool heat exchangers are supplied with component cooling water at the design flow rate.

9.2.2.2.2.5 Emergency Operation

headers

The non-essential supply and return header isolation valves, CC-102, CC-103, CC-122, CC-123, CC-202, CC-203, CC-222, and CC-223 isolate component cooling water flow to the non-essential ~~equipment~~ on a SIAS or low-low component cooling water surge tank level signal.

The isolation valves to the RCP supply and return headers isolate on a low-low component cooling water surge tank level signal.

Only one component cooling water pump and heat exchanger (matched with operating pump) is required to operate during post-LOCA. Cooling water to the spent fuel pool cooling heat exchangers is automatically isolated on a SIAS by valves CC-113 and CC-213. Operator action is required to reestablish flow to the spent fuel pool cooling heat exchangers.

C. The CCWS is composed of two physically separate, independent, full-capacity divisions each of which is powered from separate Class 1E Auxiliary Power Systems and separate diesel generators. This ensures that a single failure does not impair the system's effectiveness. Refer to Table 9.2.2-2 for the single failure analysis. E I E

D. Components of the CCWS are installed in buildings that protect against adverse environmental conditions.

E. Leakage into or out of the CCWS is detected by the surge tank high, low, and low-low level alarms in the control room. Radiation monitors indicate leakage of radioactive fluids into the CCWS. Also, grab samples are utilized as a means of detecting leakage into the CCWS. I J

F. ~~This~~ The statement in Section 9.2.2.1.1 is self explanatory.

G. The essential portions of the CCWS are Seismic Category I.

H. Components of the CCWS are capable of being fully tested during normal operation since one pump from each division is operating at full flow conditions. ASME Code Section XI, in service pump tests may be satisfactory performed without violation of Technical Specifications. I

I. Automatic start of the CCW pumps on a low CCW pump differential pressure signal ensures that flow degradation to the safety related components is prevented. This situation could occur if the non-essential and spent fuel pool heat exchanger isolation valves fail to close during a Design Basis Accident (DBA). This ensures adequate flow to the essential components when required. J I

J. Components of the CCWS are located such that flooding, tornado missile damage, internal missile, pipe breaks and whip, jet impingement and interaction with non-seismic systems from any source would not impair the system's functional requirements. The two divisions of the CCWS are physically separated and are routed such as to be protected from the above mentioned sources.

K. To prevent damage to components and piping, the system is designed to minimize the potential for water hammer by providing adequate filling and high point venting.

16. Component cooling water pump motor coolers 1A, 1B, 2A, and 2B inlet and outlet pressures. J

17. Essential chilled water condensers 1 and 2 inlet and outlet pressures. I

18. Charging pump mini-flow heat exchangers 1 and 2 inlet and outlet pressures. J

19. Charging pump motor coolers 1 and 2 inlet and outlet pressures. I

20. Instrument air compressor 1A, 1B, 2A, and 2B inlet and outlet pressures. J

21. Normal ~~Non-essential~~ chilled water condensers 1A, 1B, 2A, and 2B inlet and outlet pressures. I

22. Emergency feedwater pump motor coolers 1 and 2 inlet and outlet pressures.

23. Spent fuel pool cooling pump motor coolers 1 and 2 inlet and outlet pressures. J

24. Containment spray heat exchangers 1 and 2 inlet and outlet pressures. I

25. Containment spray mini-flow heat exchangers 1 and 2 inlet and outlet pressures.

26. Shutdown cooling mini-flow heat exchangers 1 and 2 inlet and outlet pressures.

27. Sample heat exchangers (each) inlet and outlet pressures. J

D. Controls - Component Cooling Water Pump Differential Pressure I

When a low CCW pump differential pressure signal is actuated, the idle pump in that division automatically starts. This signal is indicative of a failure of the operating pump or an increase in cooling water flow requirements.

A component cooling water pump high differential pressure signal opens the containment spray heat exchanger isolation valve associated with that division. This provides a minimum flow path for the component cooling water pump.

J

12. Instrument air compressor 1A, 1B, 2A, and 2B outlet temperatures. J

13. Normal ~~Non-essential~~ chilled water condensers 1A, 1B, 2A, and 2B outlet temperatures.

E. Controls

1. Component Cooling Water Heat Exchanger Outlet Temperature I

   Component cooling water heat exchanger bypass control valves, CC-100, CC-101, CC-200, and CC-201, are modulated to maintain a 95°F minimum heat exchanger outlet temperature.

2. Letdown Heat Exchanger Temperature Control

   Letdown heat exchanger valve, CC-244, is modulated to control the letdown heat exchanger outlet temperature on the CVCS side.

3. Charging Pump Mini-Flow Heat Exchanger Temperature Control J

   Charging pump mini-flow heat exchanger control valves, CC-145 and CC-245, are modulated to control outlet temperature of the CVCS side of the heat exchanger.

E. Alarms

Component cooling water heat exchanger high and low outlet temperature is alarmed in the control room.

9.2.2.5.3 **Flow**

A. Local Indication

Local indication is provided for the following process flow parameters: I

1. Spent fuel pool cooling heat exchangers 1 and 2 outlet flows. J

2. Shutdown cooling heat exchangers 1 and 2 outlet flows. I

3. Shutdown cooling pump motor coolers 1 and 2 outlet flows.

22. Diesel generator engine jacket water cooler 1 and 2 outlet flows.

23. Diesel generator engine starting air aftercoolers 1A, 1B, 2A, and 2B outlet flows. I

24. Component cooling water pump motor coolers 1 and 2 outlet flows.

25. Essential chilled water condensers 1 and 2 outlet flows.

26. Charging pump mini-flow heat exchangers 1 and 2 outlet flow. J

27. Charging pump motor coolers 1 and 2 outlet flows. I

28. Instrument air compressor 1A, 1B, 2A, and 2B outlet flows. J

29. Normal ~~Non-essential~~ chilled water condensers 1A, 1B, 2A and 2B outlet flows.

30. Makeup water to surge tanks 1 and 2 inlet flows. I

B. Control Room Indication

Control room indication is provided for component cooling heat exchangers 1A, 1B, 2A, and 2B outlet flows and component cooling water pumps 1A, 1B, 2A, and 2B discharge flows. J

C. Test Points

Flow test points are provided for the component cooling water heat exchangers 1A, 1B, 2A, and 2B outlet flows. I J

D. Controls

The following essential heat exchangers have control valves that modulate their outlet flow. I

1. Spent fuel pool cooling heat exchangers 1 and 2: CC-112 and CC-212.

2. Shutdown cooling heat exchangers 1 and 2: CC-110 and CC-210.

16. Diesel generator engine starting air aftercoolers 1A, 1B, 2A, and 2B low outlet flows.

17. Component cooling water pump motor coolers 1A, 1B, 2A, and 2B low outlet flows. J

18. Essential chilled water condensers 1 and 2 low outlet flows. I

19. Charging pump motor coolers 1 and 2 low outlet flows.

20. Instrument air compressor 1A, 1B, 2A and 2B low outlet flows.

21. ~~Non-essential~~ Normal chilled water condensers 1A, 1B, 2A, and 2B low outlet flows. J

22. Component cooling water heat exchangers 1A, 1B, 2A, and 2B low and high outlet flows.

23. Component cooling water pumps 1A, 1B, 2A, and 2B low and high outlet flows.

24. Component cooling water radiation monitors 1 and 2 low outlet flows.

9.2.2.5.4 Level

A. Component Cooling Water Surge Tank Level I

Level indication is provided in the control room for component cooling water surge tanks 1 and 2. High level, demineralized water automatic supply, low level, and low-low level alarms are provided in the control room.

A low-low level ~~alarm~~ signal isolates the non-essential headers and the RCP headers ~~from the essential headers in the event of a pipe break in the non-safety related system.~~ from the remaining portions of the system. J

B. Component Cooling Water Sump Level I

The component cooling water sumps 1 and 2 water levels are indicated and a high level alarm is provided in the control room. Each component cooling water sump pump is automatically started at a specified sump level, and the pumps are automatically stopped at sump low level.

C. Component Cooling Water Heat Exchanger Structure Sump Level

Component cooling water heat exchanger structure sumps 1 and 2 water levels are indicated and a high level alarm is

TABLE 9.2.2-3 (Cont'd)

(Sheet 3 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

NORMAL OPERATION

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)
Boric Acid Concentrator	0	1	14	0	1	700
~~Non-Essential~~ Normal Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

TOTAL HEAT LOAD PER DIVISION 1 = 42.9385 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 78.9815 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 15159 gpm
TOTAL FLOW PER DIVISION 2 = 13419 gpm

I

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TABLE 9.2.2-3 (Cont'd)

(Sheet 6 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

SHUTDOWN COOLING (INITIAL)

Component	Number With Heat Load Div. 1	Div. 2	Total Heat Load (E+06 Btu/hr)	Number Receiving Flow Div. 1	Div. 2	Total Flow (gpm)
Boric Acid Concentrator	0	1	14	0	1	700
Normal ~~Non-Essential~~ Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

TOTAL HEAT LOAD PER DIVISION 1 = 139.4825 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 187.8455 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 23159 gpm
TOTAL FLOW PER DIVISION 2 = 25909 gpm

I

J

TABLE 9.2.2-3 (Cont'd)

(Sheet 9 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

SHUTDOWN COOLING (FINAL) I

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)
Boric Acid Concentrator	0	1	14	0	1	700
~~Non-Essential~~ Normal Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

J

TOTAL HEAT LOAD PER DIVISION 1 = 64.5705 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 78.4235 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 28159 gpm
TOTAL FLOW PER DIVISION 2 = 24954 gpm

TABLE 9.2.2-3 (Cont'd)

(Sheet 10 of 16)

TYPICAL COMPONENT COOLING WATER SYSTEM HEAT LOADS AND FLOW REQUIREMENTS

REFUELING OPERATIONS

I

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow	
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)	
Shutdown Cooling Heat Exchangers	1	1	51	1	1	26000	
Shutdown Cooling Pump Motor Coolers	1	1	0.222	1	1	60	
Shutdown Cooling Mini-Flow Heat Exchangers	1	1	1.36	1	1	320	
Safety Injection Pump Motor Coolers	0	0	0	2	2	160	J
Containment Spray Heat Exchangers	0	0	0	0	0	0	
Containment Spray Pump Motor Coolers	0	0	0	1	1	60	
Containment Spray Mini-Flow Heat Exchangers	0	0	0	1	1	320	
Component Cooling Water Pump Motor Coolers	2	2	0.82	2	2	354	
Spent Fuel Pool Cooling Pump Motor Coolers	1	1	1.24	1	1	80	
Emergency Feedwater Pump Motor Coolers	0	0	0	1	1	60	
Spent Fuel Pool Cooling Heat Exchangers	1	1	22.4	1	~~0~~ 1	10000	
Diesel Generator Engine Jacket Water Coolers	0	0	0	1	1	2000	
Diesel Generator Engine Starting Air Aftercoolers	0	0	0	2	2	100	

TABLE 9.2.2-3 (Cont'd)

(Sheet 12 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

REFUELING OPERATIONS

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)
Boric Acid Concentrator	0	1	14	0	1	700
Normal ~~Non-Essential~~ Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

TOTAL HEAT LOAD PER DIVISION 1 = 50.8135 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 82.4135 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 28159 gpm
TOTAL FLOW PER DIVISION 2 = 29919 gpm

I

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TABLE 9.2.2-3 (Cont'd)

(Sheet 15 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

DESIGN BASIS ACCIDENT

I

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)
Boric Acid Concentrator	0	0	0	0	0	0
Normal ~~Non-Essential~~ Chilled Water Condensers	0	0	0	0	0	0
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	0	0	0	0	0	0

J

TOTAL HEAT LOAD PER DIVISION 1 = 142.9502 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 140.3932 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 12059 gpm
TOTAL FLOW PER DIVISION 2 = 12059 gpm

TABLE 9.2.2-5 (Cont'd)

(Sheet 2 of 3)

ACTIVE VALVES, COMPONENT COOLING WATER SYSTEM

I

Valve Number	Safety Function	Valve Type	ASME Section III Code Class	Actuator Type
CC-137	Close	Butterfly	2	Electric Motor
CC-1507	Operate	Swing Check	2	None
CC-1548	Operate	Swing Check	2	None
~~CC-160~~	~~Close~~	~~Butterfly~~	~~3~~	~~Electric Motor~~
~~CC-1717~~	~~Operate~~	~~Swing Check~~	~~2~~	~~None~~
CC-200	Close	Throttle	3	Pneumatic
CC-201	Close	Throttle	3	Pneumatic
CC-202	Close	Butterfly	3	Pneumatic
CC-203	Close	Butterfly	3	Pneumatic
CC-206	Operate	Butterfly	3	Electric Motor
CC-207	Operate	Butterfly	3	Electric Motor
CC-208	Operate	Butterfly	3	Electric Motor
CC-209	Operate	Butterfly	3	Electric Motor
CC-210	Open	Throttle	3	Pneumatic
CC-211	Operate	Butterfly	3	Electric Motor
CC-212	Open	Throttle	3	Pneumatic
CC-213	Close	Butterfly	3	Electric Motor
CC-214	Open	Butterfly	3	Electric Motor
CC-222	Close	Butterfly	3	Pneumatic

J

I

J

TABLE 9.2.2-5 (Cont'd)

(Sheet 3 of 3)

ACTIVE VALVES, COMPONENT COOLING WATER SYSTEM

I

Valve Number	Safety Function	Valve Type	ASME Section III Code Class	Actuator Type
CC-223	Close	Butterfly	3	Pneumatic
CC-230	Close	Butterfly	2	Electric Motor
CC-2302	Operate	Swing Check	3	None
CC-2303	Operate	Swing Check	3	None
CC-231	Close	Butterfly	2	Electric Motor
CC-236	Close	Butterfly	2	Electric Motor
CC-237	Close	Butterfly	2	Electric Motor
CC-240	Close	Butterfly	2	Electric Motor
CC-241	Close	Butterfly	2	Electric Motor
CC-242	Close	Butterfly	2	Electric Motor
CC-243	Close	Butterfly	2	Electric Motor
CC-2507	Operate	Swing Check	2	None
CC-2548	Operate	Swing Check	2	None
~~CC-260~~	~~Close~~	~~Butterfly~~	~~3~~	~~Electric Motor~~
CC-2622	Operate	Swing Check	2	None
CC-2628	Operate	Swing Check	2	None
~~CC-2717~~	~~Operate~~	~~Swing Check~~	~~2~~	~~None~~

J

TABLE 9.2.2-6 (Cont'd)

(Sheet 2 of 3)

COMPONENT COOLING WATER SYSTEM
EMERGENCY POWER REQUIREMENTS

Component Cooling Water System Motor-Operated Valves (Cont'd)

Valve	Emergency Channel
CC-113	C
CC-114	C
CC-211	B
CC-213	D
CC-214	D
~~CC-160~~	~~A~~
~~CC-260~~	~~B~~

Component Cooling Water System Controls

Controls	Emergency Channel
Component Cooling Water Pump 1A Start/Stop	A
Component Cooling Water Pump 1B Start/Stop	C
Component Cooling Water Pump 2A Start/Stop	B
Component Cooling Water Pump 2B Start/Stop	D
Non-essential Header 1 Supply and Return Isolation Valves CC-102 and CC-103, Open/Close	A
Non-essential Header 1 Supply and Return Isolation Valves CC-122 and CC-123, Open/Close	C
Non-essential Header 2 Supply and Return Isolation Valves CC-202 and CC-203, Open/Close	B
Non-essential Header 2 Supply and Return Isolation Valves CC-222 and CC-223, Open/Close	D

I
J
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I
J

REFERENCE INFORMATION FOR COMPONENT COOLING WATER SYSTEM (2.7.6)

Relationship of the Safety Analysis to the CCWS

The Safety Analysis assumes the CCWS removes heat loads generated by the components connected to the CCWS during design basis accident conditions.

For reference purposes only. Not intended to comprise a part of either the Tier 1 or Tier 2 System 80+ submittal.

REFERENCE INFORMATION FOR COMPONENT COOLING WATER SYSTEM
(2.7.6)

Relationship of the PRA to the CCWS

1) The supply and return lines from components in a Division are completely separated from the supply and return lines in the redundant Division.

2) The ESF Actuation System signals isolate the non-safety related portion of the CCWS following an accident condition, except cooling for the RCPs, charging pump motor coolers, and charging pump miniflow heat exchangers.

REFERENCE INFORMATION FOR COMPONENT COOLING WATER SYSTEM (2.7.6)

Relationship of the Shutdown Risk Evaluation to the CCWS

A Seismic Category I makeup line is provided to each CCWS Division from the SSWS via a spoolpiece which can be connected.

ABB
ASEA BROWN BOVERI

ABB-CENP DOCUMENT DISTRIBUTION/APPROVAL

CONTRACT (No. & NAME)/TASK	ATTACHED DOCUMENT No.	ORIGINATOR	INITIAL
System 80+	LD-93-074	G. Hess	GH.

TITLE OF ATTACHED DOCUMENT System 80+ Supplemental Information for Additional Submittal #1 Design Descriptions and ITAAC

QUALITY RECORD: YES (NOTE A) / NO (circled: NO)

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Note A: This form must be included with the attached document when designated as a quality record.

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May 3, 1993
LD-93-074

Docket 52-002

Attention: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SYSTEM 80+™ Supplemental Information for Additional Submittal #1 Design Descriptions and ITAAC

Dear Sirs:

Attached is information requested by the staff to supplement information on the System 80+ design descriptions which is already on the docket.

ABB-CE has initiated an Integrated Review of the CESSAR-DC and Design Descriptions/ITAAC to ensure consistency among and within these documents. It is possible that changes to the attached material may be necessary should the review uncover any inconsistencies. It is our intention to incorporate such changes in our final amendment targeted for June 30, 1993.

If you have questions related to this material, please contact me or Mr. John Rec (203-285-?861).

Very truly yours,

COMBUSTION ENGINEERING, INC.

G. L. Hess for

C. B. Brinkman
Acting Director
Nuclear Systems Licensing

cc: T. Boyce (NRC)
T. Wambach (NRC)
P. Lang (DOE)
J. Trotter (EPRI)
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For reference purposes only. Not intended to comprise a part of either the Tier 1 or Tier 2 System 80+ submittal.

SUPPORTIVE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

1. Amplifying Information for the Station Service Water System

a) Confirmation of the SSWS heat dissipation capacity during operation, shutdown, refueling, and design basis accident conditions will be performed as part of the CCWS heat dissipation capacity analysis. (See CCWS Amplifying Information.)

The analysis will demonstrate that only one station service water pump matched with one component cooling water heat exchanger receiving component cooling water flow is required to operate during post design basis accident conditions. The analysis will also demonstrate that each Division of the SSWS matched with one operating CCWS Division has a heat dissipation capacity to achieve and maintain cold shutdown.

2. CESSAR-DC Chapter 14 Tests Applicable to the SSWS

See CESSAR-DC Section 14.2.12.1.78

9.2 WATER SYSTEMS

9.2.1 STATION SERVICE WATER SYSTEM

The Station Service Water System (SSWS) is an open system that takes suction from the Ultimate Heat Sink (UHS) and provides cooling water to remove heat released by plant systems, structures and components. The SSWS returns the heated water to the ultimate heat sink. The SSWS cools the Component Cooling Water System (CCWS) which in turn cools essential and non-essential reactor auxiliary loads. The SSWS is shown in Figure 9.2.1-1.

9.2.1.1 Design Bases

9.2.1.1.1 Safety Design Bases

Safety design bases applicable to the SSWS are as follows:

A. The SSWS, in conjunction with the Component Cooling Water System (CCWS) and ultimate heat sink, is capable of removing sufficient heat from the essential heat exchangers to ensure a safe reactor shutdown and cooling following a postulated accident coincident with a loss of offsite power.

B. The SSWS is capable of maintaining the component cooling water supply temperature of 120°F or less following the design basis accident under the most adverse historical meteorological conditions consistent with the intent of Regulatory Guide 1.27.

C. A single failure of any component in the SSWS will not impair the ability of the SSWS to meet its functional requirements.

D. Adverse environmental occurrences will not impair the ability of the SSWS to meet its functional requirements.

E. The SSWS is designed to detect leakage from the system.

F. The SSWS is designed to minimize the effects of long-term corrosion, silt, mud and organic buildup.

G. The SSWS is designed to withstand the effects of a Safe Shutdown Earthquake (SSE).

H. Components of the SSWS are capable of being fully tested during normal plant operation. In addition, parts and components shall be accessible for inspection ~~at any time~~.

I. All essential SSWS components are fully protected from floods, tornado missile damage, internal missiles, pipe breaks and whip, jet impingement and interaction with non-seismic systems in the vicinity.

J. The system is designed to minimize the potential for water hammer by providing for adequate filling and high point venting.

9.2.1.1.2 Power Generation Design Basis

Power generation design bases pertinent to the SSWS are as follows: I

A. The SSWS, in conjunction with the CCWS and SCS, is designed to cool the reactor coolant from 350°F to 140°F through the shutdown cooling heat exchangers and the component cooling water heat exchangers. The reactor coolant system can be cooled to 140°F within 24 hours after reactor shutdown by first cooling the reactor coolant to 350°F through the steam generators and then cooling to 140°F by utilizing both divisions of the SCS, CCWS, and SSWS. The cooling rate of the reactor coolant does not exceed the administrative limit of 75°F/hr.

E

B. The SSWS, in conjunction with the CCWS, is designed to provide a maximum cooling water temperature of 120°F to all components required to operate during a normal shutdown. J

C. The SSWS, in conjunction with the CCWS, is designed to provide a maximum component cooling water temperature of 105°F or less during normal operating modes. I

D. The SSWS through the CCWS is designed to provide cooling water to the RCPs, letdown heat exchanger, sample heat exchangers, normal ~~non-essential~~ chilled water condensers, and other non-essential reactor auxiliary cooling loads. J

9.2.1.1.3 Codes and Standards

The SSWS and associated components are designed in accordance with applicable codes and standards. The design conforms with General Design Criteria 2, 4, 5, 44, 45 and 46 and the intent of the Standard Review Plan. E

9.2.1.2 System Description

The SSWS consists of two separate, redundant, open loop, safety-related divisions. Each division cools one of two divisions of the CCWS, which in turn cools 100% of the safety-related loads. The SSWS operates at a lower pressure than the CCWS to prevent contamination of the CCWS with raw water. E

Each division of the SSWS consists of two pumps, two strainers, two sump pumps, and associated piping, valves, controls and instrumentation. The station service water pumps circulate cooling water to the component cooling water heat exchanger and back to the ultimate heat sink. Provisions are made to ensure a continuous flow of cooling water under normal and accident conditions. Controls are provided in the control room to manually align station service water flow to the component cooling water heat exchangers.

9.2.1.2.1 Components Description

Table 9.2.1-2 lists component design parameters. Each component is also described in the following sections. Table 9.2.1-3 lists the active valves for the SSWS. These valves are described in Section 9.2.1.2.1.8.

9.2.1.2.1.1 SSWS Pumps

Typically,

Four identical station service water pumps are provided, two pumps per division. Manual start and stop actuation of the station service water pumps is provided from the control room to override automatic actuation. Each pump provides 100% of the required flow for post-LOCA conditions. during normal operation only one pump per division is ~~required to be~~ operating. The second pump in the respective division will automatically start on a low pump discharge pressure signal. This is indicative of a failure of the operating pump. I

The pumps are of the vertical centrifugal type and are installed in the station service water pump structure. ~~They are installed such that they meet the minimum required NPSH at the simultaneous occurrence of the UHS pond draw-down, maximum pond temperature, maximum flow through the screens and piping to the pits, and assuming the safety grade screens are 50% clogged.~~ The station service water pump motor coolers receive cooling water from their respective station service water pump discharge at all times while the pump is in operation. The pump motors and all other electrical equipment in the pump structure are located above the maximum flood elevation.

The pump motors are connected to their associated 4160 volt Class 1E Auxiliary Power System. In the event offsite power is lost, the pumps are stopped and restarted in accordance with the diesel generator's load sequencing.

The sizing of the station service water pumps is based on the following operating mode requirements: E

Normal power operation	- 1 pump per division operating
Normal shutdown (24 hours)	- 4 pumps operating J
Safety-grade shutdown (36 hours)	- 2 pumps required, in a single division ~~1 per division or 2 in one division (corresponding with the operating CCW heat exchanger)~~ E
Post-LOCA	- 1 pump required, (corresponding with the operating CCW heat exchanger)

ADD INSERT A

The station service water pumps are provided with at least 7% margin in head at the pump design point. The head versus flow curve is continuously rising from the design point to shut-off.

The minimum available NPSH is the smaller of (1) 25 percent of, or (2) 10 feet greater than the required NPSH specified by the pump vendor.

9.2.1.2.1.2 SSWS Pump Structure

The pump structure is a Seismic Category I design.

The UHS inlet to the station service water pumps is equipped with a safety grade screen system (see Section 9.2.1.2.1.4). I

9.2.1.2.1.3 Piping, Valves, and Fittings

Piping to and from the CCW heat exchangers is corrosion resistant. Materials are to be selected on a site-specific basis to be compatible with the ultimate heat sink makeup water chemistry and water treatment. All safety-related piping, valves, and fittings are supplied in accordance with ASME Code Section III, Class 3.

All material exposed to the raw water will be tested at typical operating temperatures with similar station service water chemistry to evaluate the adequacy of the materials. J

The supply and return piping to and from system components in a division is physically separated from the supply and return lines in the redundant division. E

During normal power operation as cooling requirements increase, the additional pump in a division may be needed.

CESSAR-DC Attachment (Refer to page 9.2-5)

INSERT A:

The available NPSH is calculated at the highest expected operating temperature and flow, at the normal water elevations, and assuming the traveling screens are 50% clogged. The available NPSH exceeds the required NPSH for worst case UHS water elevations for all operation, flow, and temperature conditions. (Note: For worst case UHS water elevation, the margins previously specified need not apply.)

9.2.1.2.1.8 Active Valves

The following valves are required to maintain their functional capability during a safe plant shutdown. The active valves are listed on Table 9.2.1-3.

A. Station Service Water Pump Discharge Check Valves

Valves SW-1302, SW-1303, SW-2302, and SW-2303 are required to function during a safe plant shutdown. I

B. Station Service Water Strainer Backwash Valves

Valves SW-100, SW-101, SW-102, SW-103, SW-104, SW-105, SW-106, SW-107, SW-108, SW-109, SW-110, SW-111, SW-200, SW-201, SW-202, SW-203, SW-204, SW-205, SW-206, SW-207, SW-208, SW-209, SW-210, and SW-211 are required for a safe unit shutdown. These valves are provided with electric motor operators. J

C. Component Cooling Water Heat Exchanger Isolation Valves

Valves SW-120, SW-121, SW-122, SW-123, SW-220, SW-221, SW-222, and SW-223 are required to function during a safe plant shutdown. These valves are provided with electric motor operators and can be remotely operated from the control room.

9.2.1.2.1.9 Electric Power Supply - SSWS Emergency Power Requirement I

Safety related components for their respective divisional Class 1E busses.

e~~E~~ach division of the SSWS receive~~s~~ power from ~~its associated Class 1E Auxiliary Power System~~. In the event of loss of offsite power, this power system is supplied by the emergency diesel generators. There are two diesel generators, either of which is capable of supplying power for the operation of one division of the necessary safety equipment. Division 1 essential components are aligned to Emergency Load Centers A or C and Division 2 essential components are aligned to Emergency Load Centers B or D.

The emergency load center and channel designation for the SSW pumps, valves, and controls are given in Table 9.2.1-4. (Note: each pump start/stop control is from a different channel.)

9.2.1.2.2.2 Normal Operation

Typically, d~~D~~uring normal operation one station service water pump and one component cooling water heat exchanger per division is in service. Station service water is supplied to the component cooling water heat exchangers that are in service and receiving heat loads from the CCWS. I

9.2.1.2.2.3 Unit Shutdown

Both divisions of the SSWS (four station service water pumps and four component cooling water heat exchangers) are required to accomplish a normal reactor shutdown, that is, a reactor coolant temperature of 140°F in 24 hours. Although a normal reactor shutdown is accomplished by operation of both SSWS divisions, shutdown and cooldown over 36 hours is possible with use of a single division.

9.2.1.2.2.4 Refueling Operations

Both divisions of the SSWS (four station service water pumps and four component cooling water heat exchangers) are required to be in service during refueling.

9.2.1.2.2.5 Emergency Operation I

One station service water pump and corresponding component cooling water heat exchanger is required to operate during post-LOCA. The SSWS will operate for the required nominal 30 days following a postulated LOCA without requiring any makeup water to the UHS and without requiring any blowdown (that is, from non-open heat sinks such as a cooling pond) for salinity control. Provisions for non-essential makeup water and blowdown are discussed in Section 9.2.5.

9.2.1.2.2.6 Loss of Offsite Power

A loss of offsite power results in the shutdown and restarting of the station service water pumps in accordance with the diesel generator load sequencing.

9.2.1.3 <u>Safety Evaluation</u>

Safety evaluations, numbered to conform to the safety design bases, are as follows:

TABLE 9.2.1-4 (Cont'd)

(Sheet 3 of 3)

STATION SERVICE WATER SYSTEM
EMERGENCY POWER REQUIREMENTS

Station Service Water System Controls

Controls	Emergency Channel
Station Service Water Pump 1A Start/Stop	A
Station Service Water Pump 1B Start/Stop	C
Station Service Water Pump 2A Start/Stop	B
Station Service Water Pump 2B Start/Stop	D
Station Service Water Strainer 1A Start/Stop	A
Station Service Water Strainer 1B Start/Stop	C
Station Service Water Strainer 2A Start/Stop	B
Station Service Water Strainer 2B Start/Stop	D

I

REFERENCE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

Relationship of the Safety Analysis to the SSWS

The Safety Analysis assumes that the SSWS removes the heat loads from the CCWS heat exchangers.

For reference purposes only. Not intended to comprise a part of either the Tier 1 or Tier 2 System 80+ submittal.

REFERENCE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

Relationship of the PRA to the SSWS

1) Each SSWS division has two Station Service Water pumps per Division.

2) The SSWS is precluded from entering the Nuclear Island.

For reference purposes only. Not intended to comprise a part of either the Tier 1 or Tier 2 System 80+ submittal.

REFERENCE INFORMATION FOR STATION SERVICE WATER SYSTEM (2.7.5)

Relationship of the Shutdown Risk Evaluation to the SSWS

None

SUPPORTIVE INFORMATION FOR COMPONENT COOLING WATER SYSTEM (2.7.6)

1. Amplifying Information for the CCWS

[NOTE: The limiting Design Basis Accident heat dissipation rate is specified as an Interface Requirement for the Ultimate Heat Sink as specified in the SSWS (Section 2.7.5). The CCWS, SSWS, and the UHS operating in combination must be shown to be capable of dissipating at least this heat rate.]

a) Confirmation of the CCWS heat dissipation capacity during operation, shutdown, refueling, and design basis accident conditions will be performed. An analysis will be performed based on the as built CCWS serviced components and measured flow rates. The analysis will be based on the following:

   1) CCWS flow to cooled components for each plant mode

   2) SSWS flow to each component cooling water heat exchanger

   3) Design basis station service water inlet temperature

   4) Vendor heat exchanger data

   The analysis will demonstrate that only one component cooling water pump matched with one component cooling water heat exchanger is required to operate during post-accident conditions. The analysis will also demonstrate that each Division has a heat dissipation capacity to achieve and maintain cold shutdown.

b) Confirmation of the pressure relief capacity provided for each reactor coolant pump will be performed. An analysis will be performed based on the as-built CCWS components. The analysis will be based on quantity of the relieved fluid and fluid temperature.

   The analysis will demonstrate that the pressure relief capacity provided for each reactor coolant pump is sized to accept the maximum expected in-leakage from a reactor coolant pump high pressure seal cooler or throttle seal cooler tube rupture.

2. CESSAR-DC Chapter 14 Tests Applicable to the CCWS

   See CESSAR-DC Section 14.2.12.1.79

9.2.2 COMPONENT COOLING WATER SYSTEM

The Component Cooling Water System (CCWS) is shown in Figure 9.2.2-1. Table 9.2.2-3 lists the essential and non-essential nuclear component heat loads for the CCWS.

9.2.2.1 Design Bases

9.2.2.1.1 Safety Design Bases

Safety design bases applicable to the CCWS are as follows:

A. The CCWS, in conjunction with the Station Service Water System (SSWS) and the Ultimate Heat Sink (UHS), is capable of removing sufficient heat from the essential heat exchangers to ensure a safe reactor shutdown and cooling following a postulated accident coincident with a loss of offsite power.

B. The CCWS, in conjunction with the SSWS, is capable of maintaining the outlet temperature of the component cooling water (CCW) heat exchanger within the limits of 65°F and 120°F during a design basis accident with loss of offsite power.

C. A single failure of any component in the CCWS will not impair the ability of the CCWS to meet its functional requirements.

D. Adverse environmental occurrences will not impair the ability of the CCWS to meet its functional requirements.

E. The CCWS is designed to detect leakage of radioactive water into the CCWS and to detect loss of component cooling water volume.

F. The essential cooling loop piping and components are designed in accordance with ~~ANSI~~ Safety Class 3 requirements. Containment isolation valves and containment penetration piping are designed in accordance with ~~ANSI~~ Safety Class 2 requirements.

G. The CCWS is designed to withstand the effects of a safe shutdown earthquake (SSE).

H. Components of the CCWS are capable of being fully tested during normal plant operation. In addition, parts and components are accessible for inspection ~~at any time~~.

I. There will be no flow degradation to safety components if the non-essential and the spent fuel pool headers fail to isolate when required.

J. All essential CCWS components are fully protected from floods, tornado missile damage, internal missiles, pipe breaks and whip, jet impingement, and interaction with non-seismic systems in the vicinity.

K. The system is designed to minimize the potential for water hammer by providing for adequate filling and high point venting.

The CCWS is a closed loop cooling water system which cools components and heat exchangers located in the Nuclear Island. Heat transferred by these components to the CCWS is rejected to the SSWS via the CCW heat exchangers.

9.2.2.1.2 Power Generation Design Basis I

Power generation design bases pertinent to the CCWS are as follows:

A. The CCWS, in conjunction with the Shutdown Cooling System (SCS) and SSWS, is designed to cool the reactor coolant from 350°F to 140°F through the shutdown cooling and component cooling water heat exchangers. The reactor coolant can be cooled to 140°F within 24 hours after reactor shutdown by first cooling the reactor coolant to 350°F through the steam generators and then cooling to 140°F by utilizing both divisions of the SCS, CCWS, and SSWS. The cooling rate of the reactor coolant will not exceed the administrative limit of 75°F/hr. E

B. The CCWS, in conjunction with the SSWS, is designed to provide a maximum cooling water temperature of 120°F to all components required to operate during a normal shutdown. J

C. The CCWS, in conjunction with the SSWS, is designed to provide cooling water to the reactor coolant pumps, letdown heat exchanger, sample heat exchangers, ~~non-essential~~ chilled water condensers, and other non-essential reactor auxiliary cooling loads. E J

normal

D. The CCWS is designed to accommodate a thermal expansion from 65°F to 150°F. I

E. The CCWS, in conjunction with the SSWS, is designed to provide component cooling water temperature of 105°F or less during normal operating modes.

J

F. The CCWS provides protection against station service water leakage into the reactor coolant system.

G. The CCWS provides protection against release of radiological contamination into the environment via the UHS. I

H. The CCWS is designed to minimize the effects of long-term corrosion.

9.2.2.1.3 Codes and Standards

The CCWS and associated components are designed in accordance with applicable codes and standards. The design conforms with General Design Criteria 2, 4, 5, 44, 45, and 46, and the intent of the Standard Review Plan. E

9.2.2.1.4 Interface Requirements

The Component Cooling Water (CCW) Heat Exchanger Structure is an out of scope item which shall be provided by the applicant. The licensee shall verify that the following interface requirements are met to ensure adequacy with the System 80+™ Standard Design:

A. The CCW Heat Exchanger Structure shall meet Seismic Category I requirements.

B. The CCW Heat Exchanger Structure shall withstand the effects of the following events: J

   1. Natural phenomena, including SSE, floods, tornados, and ~~hurricanses~~. hurricanes

   2. Externally and internally generated missiles.

   3. Fire and sabotage.

C. The CCW Heat Exchanger Structure shall be located to minimize the amount of SSWS piping and equipment surfaces exposed to the corrosion and fouling effects of the service water. An evaluation shall be performed to select the preferred location based on site specific conditions.

D. The CCW Heat Exchanger Structure shall provide physical barriers to maintain divisional separation of CCWS components.

E. The CCW Heat Exchanger Structure shall provide compartmentalization of the heat exchangers such that service water leaks and spills can be kept out of floor drains which are processed through the Liquid Waste Management System.

Heat is removed from the CCWS by the flow of station service water through the tube side of the component cooling water heat exchangers.

6. The CCW Heat Exchanger Structure Ventilation System shall be controlled from the main control room. Instrumentation and controls shall be provided in accordance with ANSI/ANS 59.2.

The CCW heat exchangers are also out of scope items. A reference horizontal shell and tube heat exchanger is discussed in the following sections, however a plate type heat exchanger may be substituted. Sites selecting the plate type heat exchanger shall provide strainer protection against debris or arrangements which allow backflushing on the service water side. J

9.2.2.2 System Description

The CCWS consists of two separate, independent, redundant, closed loop, safety related divisions. Either division of the CCWS is capable of supporting 100% of the cooling functions required for a safe reactor shutdown.

One component cooling water pump and cooling heat exchanger (matched with operating SSWS division) is required to operate during post-LOCA. Cooling water to the spent fuel pool cooling heat exchanger(s) and the non-essential header(s) ~~loop~~ is isolated on a SIAS. If these headers fail to isolate, the idle component cooling water pump in the respective loop will automatically start on a low pump differential pressure signal. This assures that there is no flow degradation to the essential components. I

The CCWS operates at a higher pressure than the SSWS, ~~This prevents~~ thus preventing the leakage of station service water into the CCWS in the event of a CCW heat exchanger tube leak.

Each division of the CCWS includes two heat exchangers, a surge tank, two component cooling water pumps, a chemical addition tank, a component cooling water radiation monitor, two sump pumps, a component cooling water heat exchanger structure sump pump, piping, valves, controls, and instrumentation. No cross connections between the two divisions exist.

~~Each division consists of an essential and non-essential cooling loop. The essential loops are composed of ANSI Safety Class 3 piping and components. The non-essential loops are composed of non-nuclear safety piping and components, with the exception of the containment isolation valves and penetration piping which are ANSI Safety Class 2.~~

DELETE AND ADD INSERT A

CESSAR-DC Attachment (Refer to page 9.2-23)

INSERT A

The CCWS provides cooling water to the essential components and non-essential components listed in Section 9.2.2.2.2. Essential components are supplied component cooling water by means of Safety Class 3 cooling loops. Non-essential components are supplied component cooling water by means of non-nuclear safety class cooling loops with the exception of the charging pump miniflow heat exchangers and the charging pump motor coolers which are supplied component cooling water by means of Safety Class 3 cooling loops. Containment isolation valves and penetration piping are designed in accordance with Safety Class 2 requirements.

The non-essential ~~heat loads~~ headers and the spent fuel pool cooling heat exchangers, ~~with the exception of the RCP heat loads,~~ are isolated ~~from the essential loads~~ automatically on an SIAS. The non-essential ~~heat loads~~ headers and the RCP ~~heat loads~~ headers isolate on a low-low surge tank level signal.

DELETE

~~The CCWS provides cooling water to the essential components and non-essential components listed in Section 9.2.2.2.2. Heat is removed from the CCWS by the flow of station service water through the tube side of the component cooling water heat exchangers.~~

Makeup water to the CCWS is normally supplied by the Demineralized Water Makeup System, described in Section 9.2.3. If the Demineralized Water Makeup System is unavailable, such as during an accident, a backup makeup water line of Seismic Category I construction is provided. This essential safety-related makeup water source is from the Station Service Water System (SSWS). A removable spool piece is placed in this line to prevent inadvertent addition of station service water.

Surge tanks, one per division, are connected to the suction piping of the component cooling water pumps. The surge tanks are located at the system's high point to facilitate venting and filling. System leakage is replaced with water from the Demineralized Water Makeup System. Both of the makeup water supplies, sump and demineralized water, are integrated and recorded. An assured Seismic Category I makeup source, which is not utilized during normal operation, is available to each surge tank from the corresponding division of the Station Service Water System.

H

The CCWS serves as an intermediate cooling water system between the Reactor Coolant System (RCS) and the SSWS. A radiation monitor is provided at the outlet of the component cooling water pumps to detect any radioactive leakage into the CCWS. This monitor is indicated and alarmed in the control room.

The wetted surfaces in the CCWS are of materials compatible with the cooling water chemistry. The major portion of the CCWS is constructed with carbon steel. The system water chemistry is controlled for the prevention of long term corrosion. Organic fouling and inorganic buildups are controlled by proper water treatment. The use of demineralized water and corrosion inhibitors will minimize these problems.

9.2.2.2.1.1 Component Cooling Water Heat Exchangers

Four component cooling water heat exchangers are provided, two per division, to handle the essential and non-essential cooling requirements. The heat exchangers are sized to provide cooling water at no greater than 105°F during normal operation and at no greater than 120°F during shutdown or post-LOCA operating modes. I

Each operational mode requires a different alignment of component cooling water heat exchangers. These requirements are listed below: E

Normal Power Operation	- 1 HX per division
Normal shutdown (24 hours)	- all 4 HXs
Safety grade shutdown (36 hours)	- 2 HXs required ~~1 per division or~~ ~~2~~ in a single division ~~(this arrangement is dependent upon final heat exchanger sizing)~~ I
Post-LOCA	- 1 HX in either division E

~~This provides an installed spare for all operating modes, except for normal shutdown cooling.~~

The component cooling water heat exchangers are horizontal, single pass, fixed tubesheet, counterflow heat exchangers with straight tubes. Heat is transferred from the component cooling water to the station service water through the component cooling water heat exchangers. Although a horizontal heat exchanger with straight tubes is specified for this design, specific stations can replace these heat exchangers with a plate type. I

Station service water flows through the tube side of the component cooling water heat exchangers to facilitate their cleaning and maintenance. Adequate tube pull space is provided. The tube side is operated at a lower pressure than the shellside as noted in Section 9.2.2.2. J

The shell side carries the component cooling water. This closed loop shell side water is initially supplied with demineralized water from the Demineralized Water Makeup System (Section 9.2.3).

The heat exchanger fouling factors are based and documented for each heat exchanger in accordance with TEMA (Tubular Exchanger Manufacturers Association) standards and the system water chemistry. An appropriate margin in heat exchanger area is provided to allow for tube plugging. I

During normal power operation as cooling requirements increase, the additional heat exchanger in a division may be needed.

The maximum flow velocity for nominal flow conditions in the tubes is in accordance with Heat ~~Exchanger~~ Exchange Institute (HEI) standards for power plant heat exchangers. The tube velocity for nominal flow conditions is not less than 3 ft./second.

The component cooling water heat exchanger tube and tubesheet materials are selected on a site specific basis to be compatible with the site Ultimate Heat Sink makeup water chemistry and water treatment.

The material selected for the component cooling water heat exchanger tubes exposed to service water in a fresh water environment with a maximum chloride concentration of less than 200 ppm and less than 500 ppm is Type 304L stainless steel and Type 316L stainless steel, respectively. An alternative material with improved corrosion resistance may be specified.

For component cooling water heat exchanger tubes in a service water environment of salt or brackish water, titanium or AL-6XN stainless steel is specified.

The component cooling water heat exchanger tubesheet materials are specified as follows:

A. For 304L stainless steel tubes: 304L stainless-clad carbon steel or solid stainless steel tube sheets.

B. For 316L stainless steel tubes: 316L stainless-clad carbon steel or solid stainless steel tube sheets.

C. For AL-6XN stainless steel tubes: solid 304L or 316L stainless steel tube sheets.

D. For titanium tubes: solid titanium tube sheets are preferable, however, solid 304L stainless steel or solid 316L stainless steel tube sheets can be specified.

Manual start and stop actuation of the component cooling water pumps is provided from the control room to override automatic actuation. Typically,

9.2.2.2.1.2 Component Cooling Water Pumps

Four identical component cooling water pumps are provided, two pumps per division. during normal operation, only one pump per division is ~~required to be~~ in service. If cooling water flow requirements exceed the capacity of this one pump, the second pump in the same loop will automatically start on a low pump differential pressure signal. This signal can be an indication of either a failure of the running pump or an increase in cooling water flow requirements. I

A component cooling water pump high differential pressure signal opens the containment spray heat exchanger isolation valve associated with that division. This assures a minimum flow path for the component cooling water pump.

Pump sizing is based on the following:

Normal power operation	- 1 pump in each division	E
Normal shutdown (24 hours)	- 4 pumps	J
Safety-grade shutdown (36 hours)	- 2 pumps required, ~~1 per division or~~ ~~2~~ in a single division ~~(matched with operating heat exchangers)~~	E
Post-LOCA	- 1 pump required (matched with operating heat exchanger)	I

~~This provides an installed spare for all operating modes except normal shutdown cooling.~~ E

The pumps are of a double suction centrifugal design with a horizontally split casing for ease of maintenance. Mechanical seals are provided to minimize leakage. The component cooling water surge tank is located at a higher elevation than the component cooling water pumps. This will ensure flooded suction and maintain a constant pressure at the suction side of the pump. Each CCW pump motor is connected to a separate Class 1E Emergency Load Center. In the event offsite power is lost, the pumps are stopped and restarted in accordance with the diesel generators' load sequencing. I

The component cooling water pumps are provided with at least a 7 percent margin in head at the pump design point. The head versus flow curve is continuously rising from the design point to shut-off.

During normal power operation as cooling requirements increase, the additional pump in a division may be needed.

These valves can be manually opened and closed from the control room.

A. Non-Essential Supply Header Isolation Valves

Valves CC-102, CC-122, CC-202, and CC-222 are pneumatically controlled valves that fail closed on loss of instrument air. These valves close to terminate component cooling water flow to the non-essential equipment in the event of an accident. These valves automatically close on an SIAS or low-low component cooling water surge tank level signal. The valve closure times are adequate to prevent complete loss of surge tank volume due to a break in the non-safety piping.

B. Non-Essential Return Header Isolation Valves

Valves CC-103, CC-123, CC-203, and CC-223 isolate the non-essential return headers from the essential return headers in the event of an accident. These valves are pneumatically controlled and fail closed on loss of instrument air. They automatically close on an SIAS or low-low component cooling water surge tank level signal. The valve closure times are adequate to prevent complete loss of surge tank volume due to a break in the non-safety piping.

C. Shutdown Cooling Heat Exchangers 1 and 2 Control Valves

Valves CC-110 and CC-210 provide a constant component cooling water flow of 11,000 gpm to their respective heat exchangers. The valves are pneumatically controlled and fail open on loss of instrument air. These valves are provided with travel stops to restrict maximum flow.

D. Shutdown Cooling Heat Exchangers 1 and 2 Isolation Valves

Valves CC-111 and CC-211 provide component cooling water flow isolation for the shutdown cooling heat exchangers. These valves are provided with electric motor operators and can be manually opened and closed from the control room.

E. Spent Fuel Pool Cooling Heat Exchangers 1 and 2 Isolation Valves

Valves CC-113 and CC-213 close to terminate component cooling water flow to the spent fuel pool cooling heat exchangers in the event of an accident. These valves are provided with electric motor operators and automatically close on SIAS. ~~A manual override is provided in the control room so that flow can be reestablished, heat load permitting, to the heat exchangers during a design basis accident.~~ These valves can be manually opened and closed from the control room. During a design basis accident, flow can be reestablished heat load permitting.

These valves can be manually opened and closed from the control room.

Amendment J
April 30, 1992

F. Spent Fuel Pool Cooling Heat Exchangers 1 and 2 Control Valves

Valves CC-112 and CC-212 provide constant flow to their respective heat exchangers. These valves are pneumatically controlled and fail open on loss of instrument air. Travel stops are provided to restrict the maximum flow.

G. Containment Spray Heat Exchangers 1 and 2 Isolation Valves

Valves CC-114 and CC-214 provide component cooling water flow isolation for the containment spray heat exchangers. These valves are provided with electric motor operators. a These valves open automatically on high component cooling water pump differential pressure ~~CSAS, or can be opened manually from the control room~~. signal or on a CSAS. These valves can be manually opened and closed from the control room.

H. Component Cooling Water Heat Exchangers 1A, 1B, 2A, and 2B Bypass Control Valves I

Valves CC-100, CC-101, CC-200, and CC-201 regulate the component cooling water heat exchanger bypass flow. These valves modulate the component cooling water bypass flow to maintain a relatively constant component cooling water outlet temperature. The service water flow remains constant. These valves are pneumatically operated and are required to fail closed. These valves automatically close on an SIAS.

I. Component Cooling Water Heat Exchanger Isolation Valves

Valves CC-106, CC-107, CC-108, CC-109, CC-206, CC-207, CC-208, and CC-209 are required to function during a safe plant shutdown. These valves are provided with electric motor operators and can be remotely operated from the control room.

J. Component Cooling Water Pump Discharge Check Valves

Valves CC-1302, CC-1303, CC-2302, and CC-2303 are required to function during a safe plant shutdown. In the event that one of the pumps ceases to produce flow and pressure head, these valves prevent flow reversal through the nonoperating pump. J

K. Component Cooling Water Surge Tank Vacuum Breakers

The CCWS surge tank vacuum breakers are required to function during a safe plant shutdown. I

L. Containment Isolation Valves

The following containment isolation valves close upon receipt of a Containment Isolation Actuation Signal (CIAS):

Supply to the letdown heat exchanger: CC-240, CC-241

Return from the letdown heat exchanger: CC-242, CC-243 J

The following containment isolation valves are automatically closed on a low-low CCW surge tank level:

CC-130, CC-131 - Supply to reactor coolant pumps 1A and 1B

I

CC-230, CC-231 - Supply to reactor coolant pumps 2A and 2B

CC-136, CC-137 - Return from reactor coolant pumps 1A and 1B

CC-236, CC-237 - Return from reactor coolant pumps 2A and 2B

These valves can be manually opened or closed from the control room should leakage be detected.

~~M. Chemical and Volume Control System (CVCS) Supply Header Isolation Valves~~

~~Valves CC-160 and CC-260 provide component cooling water flow isolation for the CVCS Supply Headers (i.e., supply to the Charging Pump Motor Cooler and Charging Pump Miniflow Heat Exchanger in division 1 and to the Charging Pump Motor Cooler and Charging Pump Miniflow Heat Exchanger in division 2, respectively). These valves are provided with electric motor operators and can be manually opened and closed from the control room.~~ J

M ~~N~~. Electric Power Supply - CCWS Emergency Power Requirements

Safety related components for

e ~~E~~ach division of the CCWS receives power from ~~its associated 4,160 volt Class 1E Auxiliary Power System~~. In the event of loss of offsite power, the Auxiliary Power System is supplied by the diesel generators. There are two diesel generators, either of which is capable of supplying 100% power for the operation of one division of the necessary safety equipment. Division 1 essential components are aligned to Emergency Load Centers A or C and Division 2 essential components are aligned to Emergency Load Centers B or D. I

their respective divisional Class 1E busses with the exception of containment ... instrumentation and controls.

The Emergency Load Center and channel designation for the CCW pumps, valves, and controls are given in Table 9.2.2-6. (Note: Each pump start/stop control is from a different channel.)

9.2.2.2.2 System Operation and Control I

The CCWS has two 100% capacity divisions, each with 100% redundancy of safety related components. Each division is connected to its corresponding SSWS division through the component cooling water heat exchanger. The component cooling water heat exchangers serve as a pressure-thermal barrier between the SSWS and CCWS. Each division has a 100% heat dissipation capacity to obtain safe cold shutdown. Heat is transferred from the shell side to the tube side of the CCW heat exchanger and J dissipated by the SSWS to the UHS.

At least one CCW pump is operational in each division for all operating modes. If cooling requirements exceed the capacity of one CCW pump, the second pump in that division will automatically start on a low pump differential pressure signal. This signal is indicative of a failure of the running pump or an increase in cooling water flow requirements.

The ~~outlet~~ temperature of the component cooling water leaving each component cooling water heat exchanger is regulated by the component cooling water heat exchanger bypass control valve (CC-100, CC-101, CC-200, and CC-201). As the temperature of the component cooling water leaving the heat exchanger rises, the bypass valve closes which allows more component cooling water to flow through the heat exchanger and be cooled. The CCWS is designed to maintain a relatively constant component cooling water supply temperature to its heat loads. I

Each division of the CCWS provides cooling for the following redundant safety related components.

A. Shutdown cooling heat exchangers (2 total, 1 per division).

B. Shutdown cooling mini-flow heat exchangers (2 total, 1 per division).

C. Safety injection pump motor coolers (4 total, 2 per division).

D. Containment spray heat exchangers (2 total, 1 per division).

E. Shutdown cooling pump motor coolers (2 total, 1 per division).

H. Sample heat exchangers (14 total, serviced by division 2 - 8 Primary Sample Heat Exchangers and 6 Steam Generator Primary Sample Heat Exchangers).

I. Gas stripper (1 total, serviced by division 2). J

J. Boric acid concentrator (1 total, serviced by division 2).

K. ~~Non-essential~~ Normal chilled water condensers (4 total, 2 per division)

L. Charging pump motor coolers (2 total, 1 per division).

M. Instrument air compressor (4 total, 2 per division).

9.2.2.2.2.1 Unit Startup

I

Typically during a unit startup, cooling water is supplied to all equipment except for the containment spray heat exchangers and possibly one spent fuel pool cooling heat exchanger. This requires the use of both divisions of the component cooling water system, two ~~component cooling~~ CCW heat exchangers, and four ~~component cooling~~ CCW pumps. Certain components will not be in service at all times therefore allowing for a reduction in CCWS load. J I

9.2.2.2.2.2 Normal Operation

Generally during normal operation, one CCW pump and one CCW heat exchanger (matched with operating pump) is required in each division. As the cooling requirements increase, additional system equipment may be needed. Cooling flow is supplied to all components except the containment spray heat exchangers, the shutdown cooling heat exchangers, and possibly one spent fuel pool cooling heat exchanger. The CCWS temperature is maintained at no greater than 105°F. J

9.2.2.2.2.3 Unit Shutdown

Both divisions of the CCWS (4 heat exchangers and 4 pumps) are required to accomplish a normal reactor shutdown, that is to cool the reactor coolant from normal operating temperature to 140°F within 24 hours of reactor shutdown. A normal reactor shutdown entails cooling the reactor coolant to 350°F through the steam generators and then cooling to 140°F by utilizing both divisions of the SCS, CCWS, and SSWS. Cooling water flow to the shutdown cooling heat exchangers is manually aligned from the control room I

for normal or safety grade shutdown. The CCWS, in conjunction with the SSWS, is designed to provide a maximum cooling water temperature of 120°F to the shutdown cooling heat exchangers during normal shutdown.

Typically, during initial shutdown cooling, cooling water is supplied to all components except the containment spray heat exchangers and the spent fuel pool cooling heat exchangers. However, during final shutdown cooling, cooling water is supplied to all components except the containment spray heat exchangers and possibly one spent fuel pool cooling heat exchanger.

9.2.2.2.2.4 Refueling Operations

With both divisions of the CCWS supplying cooling water, (i.e., four CCW pumps and four CCW heat exchangers), the RCS will be at 120°F, refueling temperature, at 96 hours after reactor shutdown. The component cooling water temperature will peak at 120°F at the initiation of shutdown and decreases to 105°F prior to refueling. Component cooling water flow is supplied to all components other than the containment spray heat exchangers. The heat load on the shutdown cooling heat exchanger is from the reactor decay heat.

Both divisions of the CCWS are required to maintain the spent fuel pool bulk water temperature at or below 120°F. This requires that both spent fuel pool heat exchangers are supplied with component cooling water at the design flow rate.

9.2.2.2.2.5 Emergency Operation

The non-essential supply and return header isolation valves, CC-102, CC-103, CC-122, CC-123, CC-202, CC-203, CC-222, and CC-223 isolate component cooling water flow to the non-essential ~~equipment~~ headers on a SIAS or low-low component cooling water surge tank level signal.

The isolation valves to the RCP supply and return headers isolate on a low-low component cooling water surge tank level signal.

Only one component cooling water pump and heat exchanger (matched with operating pump) is required to operate during post-LOCA. Cooling water to the spent fuel pool cooling heat exchangers is automatically isolated on a SIAS by valves CC-113 and CC-213. Operator action is required to reestablish flow to the spent fuel pool cooling heat exchangers.

C. The CCWS is composed of two physically separate, independent, full-capacity divisions each of which is powered from separate Class 1E Auxiliary Power Systems and separate diesel generators. This ensures that a single failure does not impair the system's effectiveness. Refer to Table 9.2.2-2 for the single failure analysis. E I E

D. Components of the CCWS are installed in buildings that protect against adverse environmental conditions.

E. Leakage into or out of the CCWS is detected by the surge tank high, low, and low-low level alarms in the control room. Radiation monitors indicate leakage of radioactive fluids into the CCWS. Also, grab samples are utilized as a means of detecting leakage into the CCWS. I J

F. ~~This~~ The statement in Section 9.2.2.1.1 is self explanatory.

G. The essential portions of the CCWS are Seismic Category I.

H. Components of the CCWS are capable of being fully tested during normal operation since one pump from each division is operating at full flow conditions. ASME Code Section XI, in service pump tests may be satisfactory performed without violation of Technical Specifications. I

I. Automatic start of the CCW pumps on a low CCW pump differential pressure signal ensures that flow degradation to the safety related components is prevented. This situation could occur if the non-essential and spent fuel pool heat exchanger isolation valves fail to close during a Design Basis Accident (DBA). This ensures adequate flow to the essential components when required. J I

J. Components of the CCWS are located such that flooding, tornado missile damage, internal missile, pipe breaks and whip, jet impingement and interaction with non-seismic systems from any source would not impair the system's functional requirements. The two divisions of the CCWS are physically separated and are routed such as to be protected from the above mentioned sources.

K. To prevent damage to components and piping, the system is designed to minimize the potential for water hammer by providing adequate filling and high point venting.

16. Component cooling water pump motor coolers 1A, 1B, 2A, and 2B inlet and outlet pressures. J

17. Essential chilled water condensers 1 and 2 inlet and outlet pressures. I

18. Charging pump mini-flow heat exchangers 1 and 2 inlet and outlet pressures. J

19. Charging pump motor coolers 1 and 2 inlet and outlet pressures. I J

20. Instrument air compressor 1A, 1B, 2A, and 2B inlet and outlet pressures.

21. Normal ~~Non-essential~~ chilled water condensers 1A, 1B, 2A, and 2B inlet and outlet pressures. I

22. Emergency feedwater pump motor coolers 1 and 2 inlet and outlet pressures.

23. Spent fuel pool cooling pump motor coolers 1 and 2 inlet and outlet pressures. J

24. Containment spray heat exchangers 1 and 2 inlet and outlet pressures. I

25. Containment spray mini-flow heat exchangers 1 and 2 inlet and outlet pressures.

26. Shutdown cooling mini-flow heat exchangers 1 and 2 inlet and outlet pressures.

27. Sample heat exchangers (each) inlet and outlet pressures. J

D. Controls - Component Cooling Water Pump Differential Pressure I

When a low CCW pump differential pressure signal is actuated, the idle pump in that division automatically starts. This signal is indicative of a failure of the operating pump or an increase in cooling water flow requirements.

A component cooling water pump high differential pressure signal opens the containment spray heat exchanger isolation valve associated with that division. This provides a minimum flow path for the component cooling water pump. J

12. Instrument air compressor 1A, 1B, 2A, and 2B outlet temperatures. J

13. Normal ~~Non-essential~~ chilled water condensers 1A, 1B, 2A, and 2B outlet temperatures.

E. Controls

1. Component Cooling Water Heat Exchanger Outlet Temperature I

Component cooling water heat exchanger bypass control valves, CC-100, CC-101, CC-200, and CC-201, are modulated to maintain a 95°F minimum heat exchanger outlet temperature.

2. Letdown Heat Exchanger Temperature Control

Letdown heat exchanger valve, CC-244, is modulated to control the letdown heat exchanger outlet temperature on the CVCS side.

3. Charging Pump Mini-Flow Heat Exchanger Temperature Control J

Charging pump mini-flow heat exchanger control valves, CC-145 and CC-245, are modulated to control outlet temperature of the CVCS side of the heat exchanger.

E. Alarms

Component cooling water heat exchanger high and low outlet temperature is alarmed in the control room.

9.2.2.5.3 **Flow**

A. Local Indication

Local indication is provided for the following process flow parameters: I

1. Spent fuel pool cooling heat exchangers 1 and 2 outlet flows. J

2. Shutdown cooling heat exchangers 1 and 2 outlet flows. I

3. Shutdown cooling pump motor coolers 1 and 2 outlet flows.

22. Diesel generator engine jacket water cooler 1 and 2 outlet flows.

23. Diesel generator engine starting air aftercoolers 1A, 1B, 2A, and 2B outlet flows.

24. Component cooling water pump motor coolers 1 and 2 outlet flows.

25. Essential chilled water condensers 1 and 2 outlet flows.

26. Charging pump mini-flow heat exchangers 1 and 2 outlet flow.

27. Charging pump motor coolers 1 and 2 outlet flows.

28. Instrument air compressor 1A, 1B, 2A, and 2B outlet flows.

29. Normal ~~Non essential~~ chilled water condensers 1A, 1B, 2A and 2B outlet flows.

30. Makeup water to surge tanks 1 and 2 inlet flows.

B. Control Room Indication

Control room indication is provided for component cooling heat exchangers 1A, 1B, 2A, and 2B outlet flows and component cooling water pumps 1A, 1B, 2A, and 2B discharge flows.

C. Test Points

Flow test points are provided for the component cooling water heat exchangers 1A, 1B, 2A, and 2B outlet flows.

D. Controls

The following essential heat exchangers have control valves that modulate their outlet flow.

1. Spent fuel pool cooling heat exchangers 1 and 2: CC-112 and CC-212.

2. Shutdown cooling heat exchangers 1 and 2: CC-110 and CC-210.

16. Diesel generator engine starting air aftercoolers 1A, 1B, 2A, and 2B low outlet flows.

17. Component cooling water pump motor coolers 1A, 1B, 2A, and 2B low outlet flows.

18. Essential chilled water condensers 1 and 2 low outlet flows.

19. Charging pump motor coolers 1 and 2 low outlet flows.

20. Instrument air compressor 1A, 1B, 2A and 2B low outlet flows.

21. ~~Non-essential~~ Normal chilled water condensers 1A, 1B, 2A, and 2B low outlet flows.

22. Component cooling water heat exchangers 1A, 1B, 2A, and 2B low and high outlet flows.

23. Component cooling water pumps 1A, 1B, 2A, and 2B low and high outlet flows.

24. Component cooling water radiation monitors 1 and 2 low outlet flows.

9.2.2.5.4 Level

A. Component Cooling Water Surge Tank Level

Level indication is provided in the control room for component cooling water surge tanks 1 and 2. High level, demineralized water automatic supply, low level, and low-low level alarms are provided in the control room.

A low-low level ~~alarm~~ signal isolates the non-essential headers and the RCP headers ~~from the essential headers in the event of a pipe break in the non-safety related systems~~ from the remaining portions of ~~the~~ system.

B. Component Cooling Water Sump Level

The component cooling water sumps 1 and 2 water levels are indicated and a high level alarm is provided in the control room. Each component cooling water sump pump is automatically started at a specified sump level, and the pumps are automatically stopped at sump low level.

C. Component Cooling Water Heat Exchanger Structure Sump Level

Component cooling water heat exchanger structure sumps 1 and 2 water levels are indicated and a high level alarm is

TABLE 9.2.2-3 (Cont'd)

(Sheet 3 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

NORMAL OPERATION

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)
Boric Acid Concentrator	0	1	14	0	1	700
Normal ~~Non-Essential~~ Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

I

J

TOTAL HEAT LOAD PER DIVISION 1 = 42.9385 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 78.9815 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 15159 gpm
TOTAL FLOW PER DIVISION 2 = 13419 gpm

TABLE 9.2.2-3 (Cont'd)

(Sheet 6 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

SHUTDOWN COOLING (INITIAL)

I

Component	Number With Heat Load Div. 1	Number With Heat Load Div. 2	Total Heat Load (E+06 Btu/hr)	Number Receiving Flow Div. 1	Number Receiving Flow Div. 2	Total Flow (gpm)
Boric Acid Concentrator	0	1	14	0	1	700
~~Non-Essential~~ Normal Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

J

TOTAL HEAT LOAD PER DIVISION 1 = 139.4825 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 187.8455 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 23159 gpm
TOTAL FLOW PER DIVISION 2 = 25909 gpm

TABLE 9.2.2-3 (Cont'd)

(Sheet 9 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

SHUTDOWN COOLING (FINAL)

I

Component	Number With Heat Load Div. 1	Number With Heat Load Div. 2	Total Heat Load (E+06 Btu/hr)	Number Receiving Flow Div. 1	Number Receiving Flow Div. 2	Total Flow (gpm)
Boric Acid Concentrator	0	1	14	0	1	700
Normal ~~Non-Essential~~ Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

J

TOTAL HEAT LOAD PER DIVISION 1 = 64.5705 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 78.4235 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 28159 gpm
TOTAL FLOW PER DIVISION 2 = 24954 gpm

TABLE 9.2.2-3 (Cont'd)

(Sheet 10 of 16)

TYPICAL COMPONENT COOLING WATER SYSTEM HEAT LOADS AND FLOW REQUIREMENTS

REFUELING OPERATIONS

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)
Shutdown Cooling Heat Exchangers	1	1	51	1	1	26000
Shutdown Cooling Pump Motor Coolers	1	1	0.222	1	1	60
Shutdown Cooling Mini-Flow Heat Exchangers	1	1	1.36	1	1	320
Safety Injection Pump Motor Coolers	0	0	0	2	2	160
Containment Spray Heat Exchangers	0	0	0	0	0	0
Containment Spray Pump Motor Coolers	0	0	0	1	1	60
Containment Spray Mini-Flow Heat Exchangers	0	0	0	1	1	320
Component Cooling Water Pump Motor Coolers	2	2	0.82	2	2	354
Spent Fuel Pool Cooling Pump Motor Coolers	1	1	1.24	1	1	80
Emergency Feedwater Pump Motor Coolers	0	0	0	1	1	60
Spent Fuel Pool Cooling Heat Exchangers	1	1	22.4	1	~~0~~ 1	10000
Diesel Generator Engine Jacket Water Coolers	0	0	0	1	1	2000
Diesel Generator Engine Starting Air Aftercoolers	0	0	0	2	2	100

TABLE 9.2.2-3 (Cont'd)

(Sheet 12 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

REFUELING OPERATIONS

Component	Number With Heat Load Div. 1	Number With Heat Load Div. 2	Total Heat Load (E+06 Btu/hr)	Number Receiving Flow Div. 1	Number Receiving Flow Div. 2	Total Flow (gpm)
Boric Acid Concentrator	0	1	14	0	1	700
~~Non-Essential~~ Normal Chilled Water Condensers	1	1	24	2	2	12000
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	1	1	0.585	2	2	200

TOTAL HEAT LOAD PER DIVISION 1 = 50.8135 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 82.4135 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 28159 gpm
TOTAL FLOW PER DIVISION 2 = 29919 gpm

I

J

TABLE 9.2.2-3 (Cont'd)

(Sheet 15 of 16)

TYPICAL COMPONENT COOLING WATER SYTEM HEAT LOADS AND FLOW REQUIREMENTS

DESIGN BASIS ACCIDENT

I

Component	Number With Heat Load		Total Heat Load	Number Receiving Flow		Total Flow
	Div. 1	Div. 2	(E+06 Btu/hr)	Div. 1	Div. 2	(gpm)
Boric Acid Concentrator	0	0	0	0	0	0
Normal ~~Non-Essential~~ Chilled Water Condensers	0	0	0	0	0	0
Instrument Air Compressor Oil Coolers, Intercoolers, Jacket Coolers, and Aftercoolers	0	0	0	0	0	0

J

TOTAL HEAT LOAD PER DIVISION 1 = 142.9502 E+06 Btu/hr
TOTAL HEAT LOAD PER DIVISION 2 = 140.3932 E+06 Btu/hr

TOTAL FLOW PER DIVISION 1 = 12059 gpm
TOTAL FLOW PER DIVISION 2 = 12059 gpm

TABLE 9.2.2-5 (Cont'd)

(Sheet 2 of 3)

ACTIVE VALVES, COMPONENT COOLING WATER SYSTEM

I

Valve Number	Safety Function	Valve Type	ASME Section III Code Class	Actuator Type
CC-137	Close	Butterfly	2	Electric Motor
CC-1507	Operate	Swing Check	2	None
CC-1548	Operate	Swing Check	2	None
~~CC-160~~	~~Close~~	~~Butterfly~~	~~3~~	~~Electric Motor~~
~~CC-1717~~	~~Operate~~	~~Swing Check~~	~~2~~	~~None~~
CC-200	Close	Throttle	3	Pneumatic
CC-201	Close	Throttle	3	Pneumatic
CC-202	Close	Butterfly	3	Pneumatic
CC-203	Close	Butterfly	3	Pneumatic
CC-206	Operate	Butterfly	3	Electric Motor
CC-207	Operate	Butterfly	3	Electric Motor
CC-208	Operate	Butterfly	3	Electric Motor
CC-209	Operate	Butterfly	3	Electric Motor
CC-210	Open	Throttle	3	Pneumatic
CC-211	Operate	Butterfly	3	Electric Motor
CC-212	Open	Throttle	3	Pneumatic
CC-213	Close	Butterfly	3	Electric Motor
CC-214	Open	Butterfly	3	Electric Motor
CC-222	Close	Butterfly	3	Pneumatic

J

I

J

TABLE 9.2.2-5 (Cont'd)

(Sheet 3 of 3)

ACTIVE VALVES, COMPONENT COOLING WATER SYSTEM

Valve Number	Safety Function	Valve Type	ASME Section III Code Class	Actuator Type
CC-223	Close	Butterfly	3	Pneumatic
CC-230	Close	Butterfly	2	Electric Motor
CC-2302	Operate	Swing Check	3	None
CC-2303	Operate	Swing Check	3	None
CC-231	Close	Butterfly	2	Electric Motor
CC-236	Close	Butterfly	2	Electric Motor
CC-237	Close	Butterfly	2	Electric Motor
CC-240	Close	Butterfly	2	Electric Motor
CC-241	Close	Butterfly	2	Electric Motor
CC-242	Close	Butterfly	2	Electric Motor
CC-243	Close	Butterfly	2	Electric Motor
CC-2507	Operate	Swing Check	2	None
CC-2548	Operate	Swing Check	2	None
~~CC-260~~	~~Close~~	~~Butterfly~~	~~3~~	~~Electric Motor~~
CC-2622	Operate	Swing Check	2	None
CC-2628	Operate	Swing Check	2	None
~~CC-2717~~	~~Operate~~	~~Swing Check~~	~~2~~	~~None~~

I

J

TABLE 9.2.2-6 (Cont'd)

(Sheet 2 of 3)

COMPONENT COOLING WATER SYSTEM
EMERGENCY POWER REQUIREMENTS

Component Cooling Water System Motor-Operated Valves (Cont'd)

Valve	Emergency Channel
CC-113	C
CC-114	C
CC-211	B
CC-213	D
CC-214	D
~~CC-160~~	~~A~~
~~CC-260~~	~~B~~

Component Cooling Water System Controls

Controls	Emergency Channel
Component Cooling Water Pump 1A Start/Stop	A
Component Cooling Water Pump 1B Start/Stop	C
Component Cooling Water Pump 2A Start/Stop	B
Component Cooling Water Pump 2B Start/Stop	D
Non-essential Header 1 Supply and Return Isolation Valves CC-102 and CC-103, Open/Close	A
Non-essential Header 1 Supply and Return Isolation Valves CC-122 and CC-123, Open/Close	C
Non-essential Header 2 Supply and Return Isolation Valves CC-202 and CC-203, Open/Close	B
Non-essential Header 2 Supply and Return Isolation Valves CC-222 and CC-223, Open/Close	D

For reference purposes only. Not intended to comprise a part of either the Tier 1 or Tier 2 System 80+ submittal.

REFERENCE INFORMATION FOR COMPONENT COOLING WATER SYSTEM (2.7.6)

Relationship of the Safety Analysis to the CCWS

The Safety Analysis assumes the CCWS removes heat loads generated by the components connected to the CCWS during design basis accident conditions.

REFERENCE INFORMATION FOR COMPONENT COOLING WATER SYSTEM (2.7.6)

Relationship of the PRA to the CCWS

1) The supply and return lines from components in a Division are completely separated from the supply and return lines in the redundant Division.

2) The ESF Actuation System signals isolate the non-safety related portion of the CCWS following an accident condition, except cooling for the RCPs, charging pump motor coolers, and charging pump miniflow heat exchangers.

REFERENCE INFORMATION FOR COMPONENT COOLING WATER SYSTEM (2.7.6)

Relationship of the Shutdown Risk Evaluation to the CCWS

A Seismic Category I makeup line is provided to each CCWS Division from the SSWS via a spoolpiece which can be connected.