ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Tuesday, August 17, 2010 8:47 AM
To: Tesfaye, Getachew
Cc: Hearn, Peter; KOWALSKI David (AREVA); RYAN Tom (AREVA); ROMINE Judy (AREVA)
Subject: FW: DRAFT RESPONSES FOR FSAR Chapter 9 Weekly NRC Telecon
Attachments: Blank Bkgrd.gif; DRAFT RESPONSE RAI 406 Q.09.02.02-114.pdf; DRAFT RESPONSE RAI 406 Q.09.02.02-114rev.pdf

Importance: High

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: KOWALSKI David (RS/NB)
Sent: Tuesday, August 17, 2010 7:25 AM
To: BRYAN Martin (External RS/NB)
Cc: BALLARD Bob (EP/PE); CONNELL Kevin (EP/PP); HUDDLESTON Stephen (EP/PE); BROUGHTON Ronnie (EP/PE); GARDNER Darrell (RS/NB); MCINTYRE Brian (RS/NB); SLOAN Sandra (RS/NB)
Subject: DRAFT RESPONSES FOR FSAR Chapter 9 Weekly NRC Telecon
Importance: High

Marty:

Please transmit to Getachew Tesfaye the attached partial set of DRAFT responses to RAI 406 and 417 questions. If the NRC reviewers have sufficient time to review these responses, they can be discussed at today's (8/17/10) FSAR Chapter 9 Weekly Telecon/GoToMeeting with the NRC, or can be scheduled for a future telecon.

Attached are the following DRAFT response(s):

- Response to RAI 406 - Question 09.02.02-114.
- Response to RAI 417 - Question 09.02.02-120.

Note that these DRAFT responses have not been through the final Licensing review/approval process; nor do they reflect technical editing.

Please call me if you have any questions. Thanks.

David J. Kowalski, P.E.
Principal Engineer
New Plants Regulatory Affairs

AREVA NP Inc.
An AREVA and Siemens company

7207 IBM Drive, Mail Code CLT-2A
Charlotte, NC 28262
Phone: 704-805-2590
Mobile: 704-293-3346

Fax: 704-805-2675
Email: David.Kowalski@areva.com

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1849

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Created By: Martin.Bryan.ext@areva.com

Recipients:
"Hearn, Peter" <Peter.Hearn@nrc.gov>
Tracking Status: None
"KOWALSKI David (AREVA)" <David.Kowalski@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

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Request for Additional Information No. 406(4683, 4664, 4707), Revision 0

5/14/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems
SRP Section: 09.04.01 - Control Room Area Ventilation System
SRP Section: 09.05.01 - Fire Protection Program

Application Section: FSAR Chapter 9

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)
QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)
QUESTIONS for Balance of Plant Branch 1 (SBPA)

09.02.02-114

Follow-up to RAI 334, Question 9.2.2-69 and RAI 174, Question 9.2.2-20

In follow-up RAI 9.2.2-69 the staff concluded that the response and markup of FSAR Tier 2 Section 9.2.2 provided by the applicant for RAI 9.2.2-20 did not specifically demonstrate satisfying the guidance of SRP 9.2.2 Section II 4.G ii. In follow-up RAI 9.2.2-69 the staff noted examples of information needed in the FSAR markup to more completely identify the CCWS thermal barrier cooling design including; (1) Specifically state the CCWS associated with the RCPs can withstand a single, active failure or a moderate-energy crack as defined in Branch Technical Position ASB 3-1, (2) Also credit Seismic Category I, Quality Group C, and ASME Section III Class 3 requirements and (3) to identify that future RCP seal SBO testing would be performed.

The applicant's response to RAI 9.2.2-69 included a detailed explanation and revised markup of FSAR Tier 2 Section 9.2.2. However, the staff's review of this response identified the follow-up questions listed below:

a. In regard to the discussion in the response about mid position failure of a thermal barrier containment isolation valve (CIV) upon attempting transfer of thermal barrier cooling to the other common header:

    1. Describe the type of actions (and priority) that would be needed if the failure occurred with the valve nearly closed resulting in insufficient cooling to all thermal barriers while still preventing transfer to the other common header, that is, permissive not satisfied. Describe if this is considered a common mode loss of thermal barrier cooling.

    2. Describe in the FSAR the acceptability of taking credit for CVCS seal injection in this scenario when the CVCS is only considered an operational system that may not be present in post accident conditions.

3. Describe in the FSAR if the plant design basis requires CCWS thermal barrier cooling to be functional in post accident conditions (besides during all plant operating modes when the RCPs are running).

4. The applicant's response stated that failure of a CCWS CIV to fully close does not place the plant in a four hour TS action statement to close the other CIV in that flowpath but TS 3.6.3 Containment Isolation does apply. The applicant should provide the basis for these conclusions and explain the aspect of TS 3.6.3 that does apply including the applicable LCO duration.

5. Describe in the FSAR if the RCP standstill seal (discussed in the original response) is credited as a safety-related design basis accident mitigation feature or is it intended only for conditions that are beyond the normal design basis.

b. Provide an explanation in the RAI response that demonstrates that the guidance of SRP 9.2.2, Section II 4.G is satisfied by testing that the RCPs can withstand a complete loss of cooling water for 20 minutes without operator action or state that in lieu of testing the CCWS meets Section ii.4.G, item ii. This was not addressed as requested by RAI 9.2.2-69.

Response to Question 09.02.02-114:

a.

1. The RCP Thermal Barrier Cooling Transfer is a Non-Safety Manual function. The Non-safety designation results from single failure criteria and TS requirements to have two OPERABLE CCWS trains aligned to thermal barrier cooling, and the fact that operators would not need to perform the function during an accident. It is an operational function to align the loads to a common header which is fully supported by two trains. The transfer of thermal barrier cooling from one common header to the other common header would be needed if one of the two available trains on the initial common header providing thermal barrier cooling is being placed in maintenance. Per Tech Spec 3.7.7 Required Action A.1, RCP thermal barrier cooling is to be aligned to the common header with two operable CCWS trains within 72 hours if one CCW train is inoperable. In this case, the transfer could occur during normal power operation or during a shutdown. The sequence of closing the first set of CIVs and opening the second set of CIVs determines the time that flow will be interrupted to the RCP thermal barriers. From FSAR Table 6.2.4-1, the closure time of the CIVs for RCP thermal barrier cooling is ≤15 seconds for each valve. Because of the valve interlock associated with the supply of cooling to the loads and the short duration desired to have cooling flow interrupted, a group command is provided. The group command will close all four of the CIVs of the off-going common header simultaneously and open all four of the CIVs of the on-coming header simultaneously. The 15 second closure time of the off-going header CIVs combined with a 15 second opening time of the on-coming header CIVs results in a flow disruption of approximately 30 seconds for the RCP thermal barriers.

   The RCP thermal barrier cooling for each common header (1.B and 2.B) contains two (2) motor operated CIVs on the supply and two (2) motor operated CIVs on the return. Each of the four (4) CIVs inside containment has an uninterruptible emergency power supply. The two outer containment isolation valves on the common 1.B header are normally powered from IEEE division 1. These two valves have a standby emergency power supply of Diesel Generator 1 with Diesel Generator 2 as the alternate emergency power supply. The two outer containment isolation valves on the common 2.B header are normally powered from IEEE division 4. These two valves have a standby emergency power supply of Diesel Generator 4 with Diesel Generator 3 as the alternate emergency power supply. Refer to FSAR Chapter 8 for the discussion related to normal and emergency power supplies.

The RCP thermal barrier cooling transfer consists of closing the open group of CIVs (KAB30 AA049/050/051/052 (Common 1.b) or KAB30 AA053/054/055/056 (Common 2.b)) and as soon as one of the two supply valves (KAB30 AA049/050 (Common 1.b) KAB30 AA053/054 (Common 2.b)) and one of the two return valves (KAB30 AA051/052 (Common 1.b) or KAB30 AA055/056 (Common 2.b)) indicate valve closure, the other group of CIVs (KAB30 AA049/050/051/052 (Common 1.b) or KAB30 AA053/054/055/056 (Common 2.b)) is opened. In case a CIV fails to open on the final header, another transfer is automatically performed back to the initial configuration. This automatic feature to revert back to the initial configuration is built into the thermal barrier cooling transfer command. Refer to U.S. EPR FSAR Section 9.2.2.6.1.3 for a description of the RCP Thermal Barrier Cooling Transfer.

In the scenario where the thermal barrier cooling transfer is initiated and there is a LOOP within the 15 second valve closure window of time with a mechanical single failure of one of the four valves to close, the transfer permissive requirement of 1 out of 2 of the initial supply valves to close and 1 out of 2 of the initial return valves to close would still be satisfied and the thermal barrier transfer would be completed with the second set of CIVs valves opening.

In the scenario where the thermal barrier cooling transfer is initiated and there is a LOOP with a single failure of the Diesel Generator supplying the outer containment isolation valve, the 1 out of 2 permissive on the initial valves would be completed by the inside containment isolation valves that have uninterruptible power supplies. The thermal barrier transfer would be completed with the second set of CIVs opening.

The CCWS Containment Isolation Valves (CIVs) for RCP Thermal Barrier Cooling are not actuated upon receipt of SI, CI-1 or CI-2 signals so they remain open during and after a DBA. The containment isolation valves associated with each of the common headers providing this cooling flow to the thermal barriers would not be cycled to test Containment Isolation operability during normal power operation because of the potential impact on operating RCPs.

The RCP shaft seal system is made up of a series of three seals and a standstill seal. During normal plant operation, water from the CVCS provides normal seal cooling. CCWS is continuously aligned to the thermal barrier coolers as the safety related backup to CVCS. The CVCS injects directly into the #1 seal and the flow goes down, past the thermal barrier and into the RCS. If seal injection is lost, then reactor coolant flows up through the thermal barrier and into the seal. CVCS water cools the seal when CVCS is operable. When CVCS is not operable, Reactor Coolant (cooled by the thermal barrier) provides cooling to the seal. The standstill seal is not credited as a safety-related design basis accident mitigation feature. It intended only for conditions that are beyond DBA.

The RCP shaft seal system is designed to withstand without damage, the following three operating conditions so that additional margins are provided to recover service water in efforts to minimize plant down time:

- Loss of CVCS water injection to the #1 shaft during continuous operation or pump shutdown with seal cooling provided by the thermal barrier

- Loss of CCWS cooling water to the thermal barrier heat exchanger during continuous operation or with the pump shutdown, with seal cooling provided by CVCS seal injection

- Concurrent loss of #1 shaft seal injection from CVCS and thermal barrier cooling from CCWS if one of the two functions is recovered in 2 minutes or less

In the absence of RCP seal injection via CVCS and RCP thermal barrier cooling via CCWS the RCP shaft seal average leakage is assumed to be ≤ 25 gpm until the standstill seal system closes (Refer to the Response to RAI 174 Question 9.2.2-20). The RCP shaft seal system is designed to withstand a concurrent loss of CVCS seal injection and CCWS flow to the thermal barriers for two minutes provided one of the two functions is recovered in two minutes. A reduction or loss of CCWS flow to any of the RCP thermal barriers is recognized in the control room by individual flow indication devices in the return piping from each thermal barrier (refer to FSAR Figure 9.2.2-2 sheets 3 and 4 of 7 and Figure 9.2.2-3 sheets 3 and 4 of 8). A reduction or loss if CVCS seal injection flow to the RCPs is recognized in the control room by a totaling flow indication device outside containment and individual flow indication devices for each RCP seal (refer to FSAR figure 9.3.4-1). Refer to the Response to RAI 53 Question 19-206 for the discussion related to simultaneous loss of thermal barrier cooling and seal injection flow. If CCWS flow to the thermal barriers is not recovered after two minutes, the seals will heat up and the discussion above related to seal leakage and the standstill seal closure would be in effect. Refer to FSAR section 15.6 for the U.S. EPR LOCA Analysis.

2. In accordance with Section B 3.7.7 in the FSAR, Action Item A.1 requires that if one CCW train is inoperable, action must be taken to align the RCP thermal barrier cooling common loop to a common header capable of being supplied by two operable CCW trains within 72 hours. In this condition, the CCWS can perform the RCP thermal barrier cooling function given a single failure. The 72 hour completion time is reasonable, based on the low probability of a postulated accident occurring during this period.

   In accordance with Action Items B.1, if two CCW trains are inoperable, action must be taken to restore one train to operable status within 72 hours. In accordance with Action Item C.1 and C.2, if a CCW train cannot be restored to operable status within the associated completion time, the unit must be placed in at least Mode 3 with 6 hours and in Mode 5 within 36 hours.

   Prior to an accident, it is expected that CCWS cooling to the Reactor Coolant Pumps is available. This is ensured by Tech Spec 3.7.7. Credit is not taken for the CVCS to ensure cooling to the RCP shaft seals. During a LOOP, there is no need for the operator to transfer cooling to another CCWS train. Power to the previously running CCWS train will be restored based on EDG load sequencing. Since the CIVs for thermal barrier cooling remain open during and after a DBA, there is no need for the operator to transfer thermal barrier cooling.

Based on the above, a loss of CCW cooling to the RCP thermal barriers will not create a loss of CVCS seal injection to the RCPs and if the CCWS flow is restored within the specified LCO action times it is not necessary to assume a DBA in combination with a loss of CCW cooling to the RCP thermal barriers.

3. Thermal Barrier cooling is required for all modes of operation, including DBA, where the RCS is pressurized and therefore relying on RCP seal integrity to maintain the Reactor Coolant Pressure Boundary. This is an initial condition in the accident analysis and is ensured by Tech Spec 3.7.7. CCWS is the only safety-related cooling to the RCP thermal barriers. Technical Specifications require thermal barrier cooling to be supplied to the RCP's to ensure this initial condition (i.e. thermal barrier cooling is active) prior to an accident. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include this information.

4. Failure of a CCWS CIV for RCP Thermal Barrier cooling to close renders the CCWS system inoperable per Tech Spec 3.7.7 as this condition would degrade flow to the RCP thermal barriers. In effect, this would render each of the two trains capable of supplying the common header aligned to thermal barrier cooling inoperable for thermal barrier cooling because neither of the trains could provide thermal barrier cooling. This condition would put the CCW system in an LCO condition and full CCW flow would need to be restored to the RCP thermal barrier coolers or the unit must be placed in at least Mode 3 within 6 hours and in Mode 5 within 36 hours in accordance with Section B 3.7.7 - Actions C.1 and C.2 of the FSAR. LCO 3.6.3 Note 3 under Actions states "Enter applicable conditions and Required Actions for systems made inoperable by Containment Isolation Valves". This again would go back to Tech Spec LCO 3.7.7 as stated above.

   In the event that a CIV of the off-going header fails in mid position and is not restored to the original full open position or closed to allow the CIVs of the on-coming header to open and CVCS seal injection is available, there is no priority requirement for the operator. If a CIV of the off-going header fails in mid-position and is not restored to full open position or closed to allow the CIVs of the on-coming header to open and CVCS seal injection is not available, one of the two flows (CCWS or CVCS) must be restored within two minutes. Loss of CCW cooling to the RCP thermal barrier coolers does not impact the operation of the CVCS. Therefore, assuming a concurrent loss of seal injection to the RCPs should not be required in the short term.

   Related to Tech Spec 3.6.3, the Containment Isolation function on the RCP thermal barrier supply side is maintained by one of the two motor operated CIVs if one of the two fails to close. The Containment Isolation function is maintained on the RCP thermal barrier return piping by one of the two motor operated CIVs if one of the two fails to close.

5. The RCP standstill seal is not credited as a safety-related design basis accident mitigation feature. It intended only for conditions that are beyond DBA.

b. As previously stated in the Response to RAI 174, Question 9.2.2-20 the RCP shaft seal will be SBO tested to determine the average leakage prior to closure of the standstill

The CCWS meets the guidance of SRP 9.2.2 as being designed for single failure and built to ASME III Class 3. Refer to U.S. EPR FSAR Sections 9.2.2.1 and 9.2.2.2.1. The CCWS piping, valves and components supplying the RCP thermal barriers is Seismic Category I, Quality Group C, ASME III Class 3 with the exception of the CIVs and piping between the CIVs, which are Seismic Category I, Quality Group B, ASME III Class 2.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 9.2.2 and 14.2 and Tier 1 Section 2.7.1 will be revised as described in the response and indicated on the enclosed markup.

containment isolation valves (CIVs) in the RCP thermal barrier cooling path on the supply and return side of CCWS common 1b cannot be opened unless the CIVs on both the supply and return side of common 2b are closed and vice-versa.

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

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

The design of the Component Cooling Water System (CCWS) minimizes and withstands adverse transients (i.e., water hammer) and meets functional performance requirements for all operating modes including postulated DBA consistent with the guidance for water hammer prevention and mitigation found in NUREG-0927 (Reference 6).

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

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

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

The design incorporates controls and instrumentation to support operating and maintenance procedures to provide adequate measures to avoid water hammer.

One non-safety-related train comprises the dedicated CCWS. This train cools the SAHRS train, is supplied demineralized makeup water by the dedicated CCWS injection pump, is cooled by its assigned dedicated ESWS train, and is provided backup power from its assigned station blackout diesel generator (SBODG). The dedicated CCWS train consists of one main pump, one dedicated ESWS-cooled HX, one surge

CCWS Response to a LOOP

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

CCWS Switchover Valve Interlock

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

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

Thermal Barrier Isolation

The following actions indicate a fault of a RCP thermal barrier:

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

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

CCWS Containment Isolation Valve Interlock

Either the common 1.b or 2.b headers can provide cooling to the RCP thermal barriers. To maintain strict train separation of the redundant CCWS division supplying either common header to confirm that a fault affects no more than one train, the CIVs (KAB30 AA049/051/052/053/055/056) are interlocked. The CCWS CIVs from the common 1.b header (KAB30 AA049/051/052) must be closed prior to opening the CIVs from the common 2.b header (KAB30 AA053/055/056), and vice versa.

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

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

In case of a failure to close of a switchover valve on the initial train or lack of opening of a switchover valves on the final train, another switchover is automatically done to the initial configuration. Refer to Section 7.6.1.2.3 for a more detailed description.

CCWS Surge Tank Makeup

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

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

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

RCP Thermal Barrier Cooling Transfer

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

In case a CIV fails to close on the initial common header or lack of valve opening of a CIV on the final header, another transfer is automatically performed back to the initial configuration.

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

CCWS Temperature Control

Normally, the CCWS heat exchanger bypass control valve (KAA10/20/30/40 AA112) is manually positioned in order to maintain a CCWS normal temperature greater than 59°F and less than 100.4°F. An alarm is relayed to the operator in the MCR when the temperature is near the MIN2 or MAX2 temperature limit.

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

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

Manual Start and Trip of a Train

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

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

Dedicated CCWS Control

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

- Dedicated CCWS pump (KAA80 AP001).
- Dedicated CCWS makeup pump (KAA80 AP201).
- Dedicated CCWS tank outlet valve (KAA80 AA020).

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

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

- CCWS Train 1 common 1.a supply and return switchover valves close.
- CCWS Train 1 common 1.b supply and return switchover valves close.

3.30 Perform step 3.29 for CCWS Train 2 supplying common 2.b header to verify appropriate responses.

3.31 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Surge Tank Makeup function. Verify the following action occurs:

- DWDS supply isolation valve responds to CCWS surge tank level changes.

3.32 Perform step 3.31 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.33 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Temperature Control function.

3.33.1 Simulate two of three CCWS Train 1 temperature sensors less than MIN1. Verify that the Train 1 heat exchanger bypass valve opens by 10 percent of its 0-100 percent range at 1 minute intervals until 2 of 3 temperature measurements are greater than MIN1, or the valve is fully open.

3.33.2 Simulate two out of three CCWS Train 1 temperature sensors greater than MAX1. Verify that the Train 1 heat exchanger bypass valve closes by 10 percent of its 0-100 percent range at 1 minute intervals until 2 of 3 temperature measurements are less than MAX1, or the valve is fully closed.

3.34 Perform step 3.33 for CCWS Trains 2, 3, and 4 to verify appropriate responses~~Perform Steps 3.14 through 3.24 for CCWS Trains 2, 3, and 4 to verify appropriate responses~~.

3.35 Verify that CCWS common 1.b header is supplying RCP thermal barrier cooling, then perform test of RCP thermal barrier isolation function.

3.35.1 Simulate high flow above threshold value on the return of RCP1 thermal barrier. Verify that RCP1 thermal barrier isolation valves close.

3.35.2 Simulate high pressure above threshold value on the return of RCP1 thermal barrier. Verify that RCP1 thermal barrier isolation valves close.

3.35.3 Perform steps 3.35.1 and 3.35.2 for RCP 2, 3, and 4 thermal barriers.

3.36 Perform step 3.35 for common 2.b header supplying RCP thermal barrier cooling to verify appropriate responses.

RAI 406, Question 9.2.2-114 FSAR Insert "A"

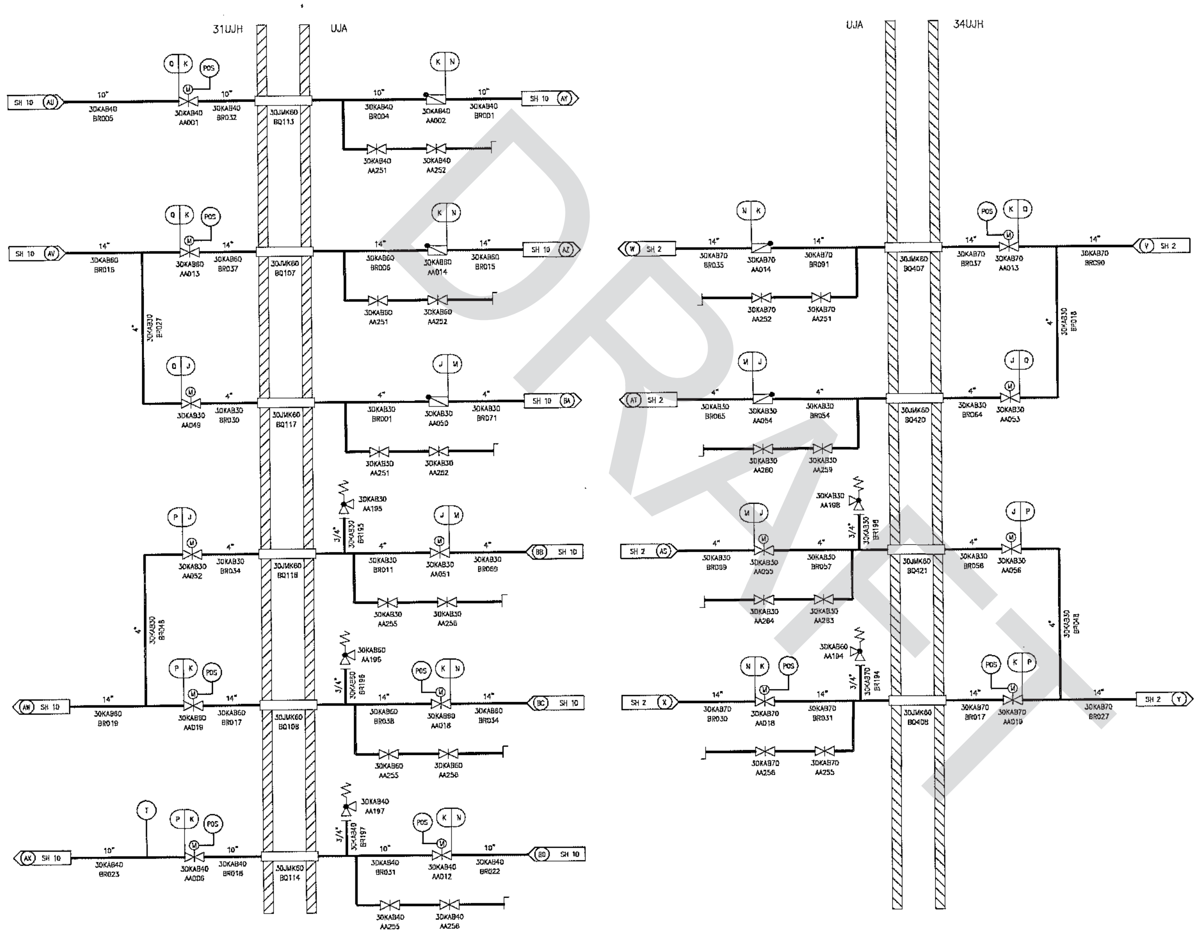
3.37 Verify that CCWS common 1.b header is supplying RCP thermal barrier cooling, then perform test of thermal barrier transfer revert back feature.

3.37.1 Simulate closure of closure of Common 1.B RCP thermal barrier CIVs and failure of one or more Common 2.B RCP thermal barrier CIVs to open. Verify that RCP thermal barrier transfer reverts back to Common 1.B supplying cooling flow to all four RCP thermal barriers.

3.38 Verify that CCWS common 2.b header is supplying RCP thermal barrier cooling, then perform test of thermal barrier transfer revert back feature.

3.38.1 Simulate closure of closure of Common 2.B RCP thermal barrier CIVs and failure of one or more Common 1.B RCP thermal barrier CIVs to open. Verify that RCP thermal barrier transfer reverts back to Common 2.B supplying cooling flow to all four RCP thermal barriers.

Figure 9.2.2-2—Component Cooling Water System Common Loop 1
Sheet 7 of 7



JMK – PIPING PENETRATIONS
KAB – COMPONENT COOLING WATER SYSTEM COMMON HEADER

UJA – REACTOR BUILDING
31UJH – SAFEGUARD BUILDING MECHANICAL, DIVISION 1
34UJH – SAFEGUARD BUILDING MECHANICAL, DIVISION 4

NOTE: COMMON 1 AND 2 CONTAINMENT PENETRATION DETAILS.

DESIGN AREA	SSC QUALITY GROUP	DESIGN PRESSURE PSIG	DESIGN TEMPERATURE °F	SSC SEISMIC CLASS
J	B	2535	664	I
M	C	2535	664	I
K	B	175	338	I
N	C	175	338	I
P	C	175	225	I
Q	C	175	225	I

KAB15T2

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement Sheet 7 of 11

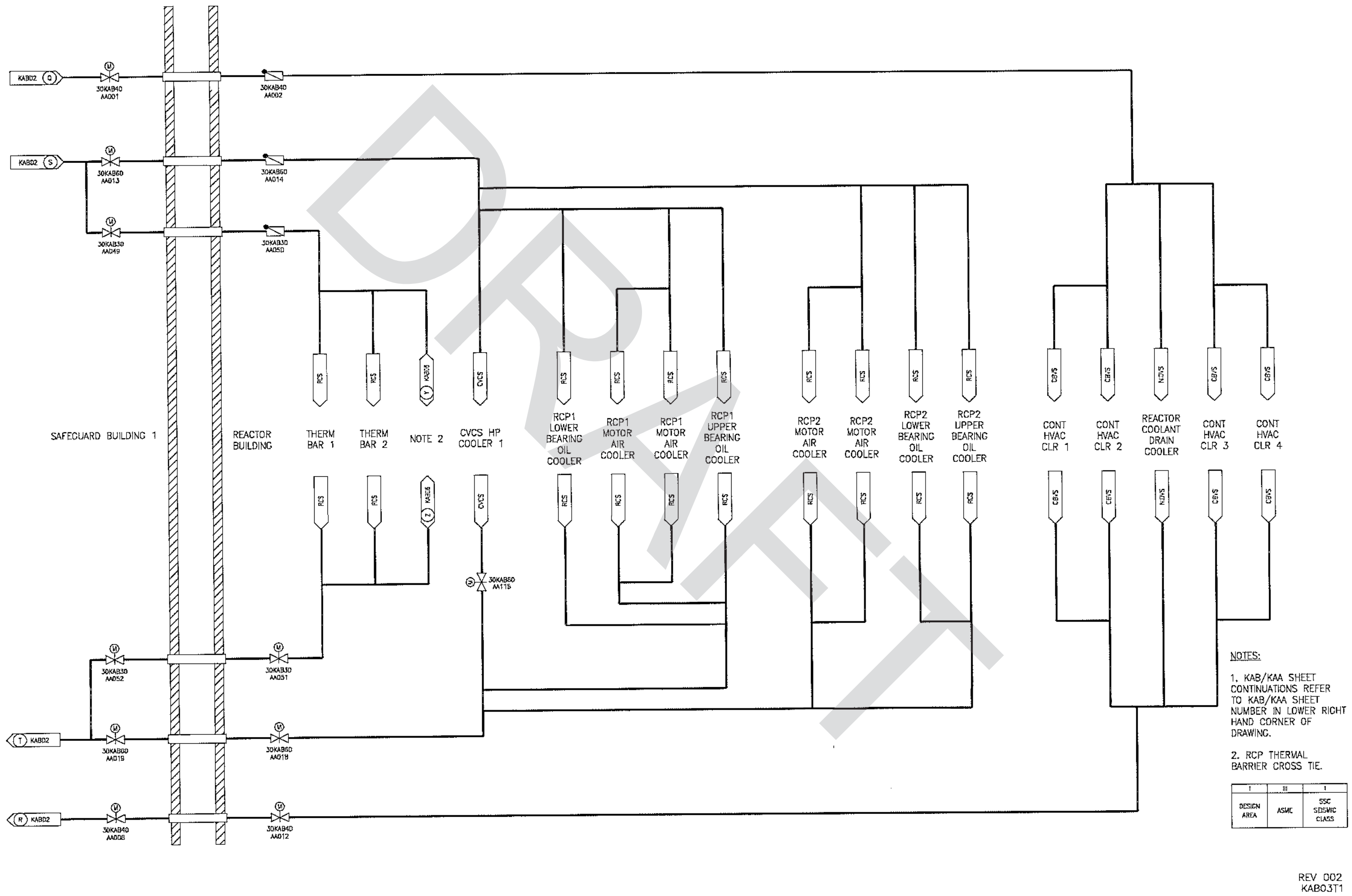


Figure 2.7.1-1—Component Cooling Water System Functional Arrangement Sheet 10 of 11

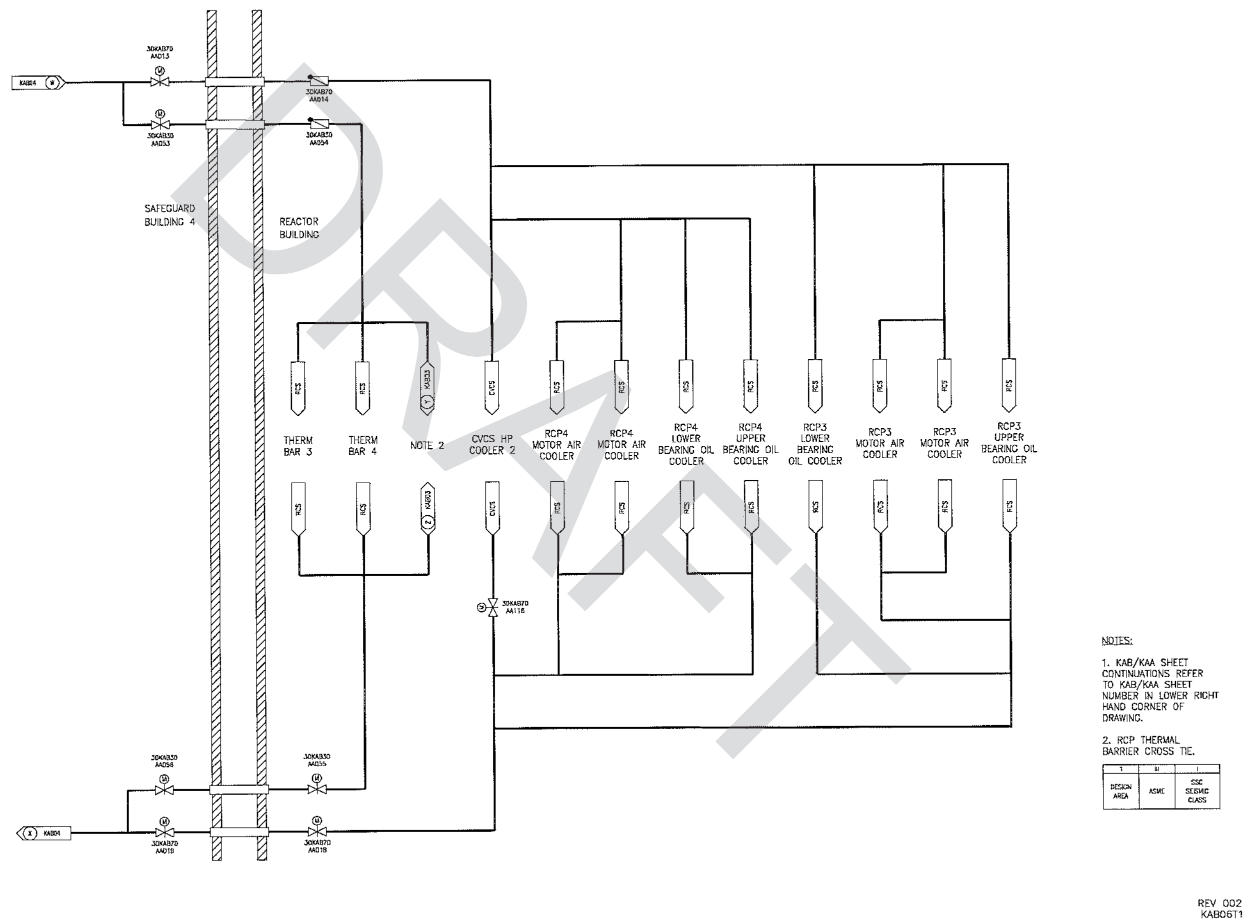


Table 2.7.1-1—Component Cooling Water System Equipment Mechanical Design (7 Sheets)

Description	Tag Number [1]	Location	ASME Code Section III	Function	Seismic Category
Common Header 1b RCP Thermal Barriers Containment Isolation Valves	KAB30AA049 KAB30AA051 KAB30AA052	Safeguard Building 1 Reactor Building Safeguard Building 1	Yes	Close (Manually Initiated)	I
Common Header 1b RCP Thermal Barriers 1/2 Upstream Containment Isolation Check Valve	KAB30AA050	Reactor Building	Yes	Prevent Backflow	I
Common Header 2b RCP Thermal Barriers Containment Isolation Valves	KAB30AA053 KAB30AA055 KAB30AA056	Safeguard Building 4 Reactor Building Safeguard Building 4	Yes	Close (Manually Initiated)	I
Common Header 2b Containment Supply Isolation Check Valve	KAB30AA054	Reactor Building	Yes	Close	I
Common Header 1b Non-Safety Loads Containment Isolation Valves	KAB40AA001 KAB40AA006 KAB40AA012	Safeguard Building 1 Reactor Building Safeguard Building 1	Yes	Close	I
Common Header 1b Containment Supply Isolation Check Valve	KAB40AA002	Reactor Building	Yes	Close	I
Common Header 2b Auxiliary Building and Waste Building Isolation Valves	KAB50AA001 KAB50AA006 KAB50AA004	Safeguard Building 4 Safeguard Building 4 Safeguard Building 4	Yes	Close	I
Common Header 2b Auxiliary and Waste Building Return Isolation Check Valve	KAB50AA008	Safeguard Building 4	Yes	Close	I

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (7 Sheets)

Description	Tag Number (1)	Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Common Header 1b Safety Related Loads Containment Isolation Valves	KAB60AA013	Safeguard Building 1	1^N 2^A	Yes	Yes	Pos	Open-Close
	KAB60AA018	Reactor Building	4^N 3^A				
	KAB60AA019	Safeguard Building 1	1^N 2^A				
Common Header 2b Safety Related Loads Containment Isolation Valves	KAB70AA013	Safeguard Building 4	4^N 3^A	Yes	Yes	Pos	Open-Close
	KAB70AA018	Reactor Building	1^N 2^A				
	KAB70AA019	Safeguard Building 4	4^N 3^A				
Common Header 1b RCP Thermal Barriers Containment Isolation Valves	KAB30AA049	Safeguard Building 1	1^N 2^A	Yes	Yes	Pos	Open-Close
	KAB30AA051	Reactor Building	4^N 3^A				
	KAB30AA052	Safeguard Building 1	1^N 2^A				

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (7 Sheets)

Description	Tag Number (1)	Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Common Header 2b RCP Thermal Barriers Containment Isolation Valves	KAB30AA053	Safeguard Building 4	4^N 3^A	Yes	Yes	Pos	Open-Close
	KAB30AA055	Reactor Building	1^N 2^A				
	KAB30AA056	Safeguard Building 4	4^N 3^A				
Surge Tank Demin. Water Makeup Isolation Valves	KAA10AA027	Safeguard Building 1	1^N 2^A	N/A	Yes	Pos	Open-Close
	KAA20AA027	Safeguard Building 2	2^N 1^A				
	KAA30AA027	Safeguard Building 3	3^N 4^A				
	KAA40AA027	Safeguard Building 4	4^N 3^A				
Common Header 1a Fuel Pool Cooling Heat Exchanger 1 Downstream Control Valve	KAB10AA134	Fuel Building	1^N 2^A	N/A	Yes	NA / NA	NA / NA
Common Header 2a Fuel Pool Cooling Heat Exchanger 2 Downstream Control Valve	KAB20AA134	Fuel Building	4^N 3^A	N/A	Yes	NA / NA	NA / NA

Request for Additional Information No. 406(4683, 4664, 4707), Revision 0

5/14/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems
SRP Section: 09.04.01 - Control Room Area Ventilation System
SRP Section: 09.05.01 - Fire Protection Program

Application Section: FSAR Chapter 9

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)
QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)
QUESTIONS for Balance of Plant Branch 1 (SBPA)

09.02.02-114

Follow-up to RAI 334, Question 9.2.2-69 and RAI 174, Question 9.2.2-20

In follow-up RAI 9.2.2-69 the staff concluded that the response and markup of FSAR Tier 2 Section 9.2.2 provided by the applicant for RAI 9.2.2-20 did not specifically demonstrate satisfying the guidance of SRP 9.2.2 Section II 4.G ii. In follow-up RAI 9.2.2-69 the staff noted examples of information needed in the FSAR markup to more completely identify the CCWS thermal barrier cooling design including; (1) Specifically state the CCWS associated with the RCPs can withstand a single, active failure or a moderate-energy crack as defined in Branch Technical Position ASB 3-1, (2) Also credit Seismic Category I, Quality Group C, and ASME Section III Class 3 requirements and (3) to identify that future RCP seal SBO testing would be performed.

The applicant's response to RAI 9.2.2-69 included a detailed explanation and revised markup of FSAR Tier 2 Section 9.2.2. However, the staff's review of this response identified the follow-up questions listed below:

a. In regard to the discussion in the response about mid position failure of a thermal barrier containment isolation valve (CIV) upon attempting transfer of thermal barrier cooling to the other common header:

   1. Describe the type of actions (and priority) that would be needed if the failure occurred with the valve nearly closed resulting in insufficient cooling to all thermal barriers while still preventing transfer to the other common header, that is, permissive not satisfied. Describe if this is considered a common mode loss of thermal barrier cooling.

   2. Describe in the FSAR the acceptability of taking credit for CVCS seal injection in this scenario when the CVCS is only considered an operational system that may not be present in post accident conditions.

3. Describe in the FSAR if the plant design basis requires CCWS thermal barrier cooling to be functional in post accident conditions (besides during all plant operating modes when the RCPs are running).

4. The applicant's response stated that failure of a CCWS CIV to fully close does not place the plant in a four hour TS action statement to close the other CIV in that flowpath but TS 3.6.3 Containment Isolation does apply. The applicant should provide the basis for these conclusions and explain the aspect of TS 3.6.3 that does apply including the applicable LCO duration.

5. Describe in the FSAR if the RCP standstill seal (discussed in the original response) is credited as a safety-related design basis accident mitigation feature or is it intended only for conditions that are beyond the normal design basis.

b. Provide an explanation in the RAI response that demonstrates that the guidance of SRP 9.2.2, Section II 4.G is satisfied by testing that the RCPs can withstand a complete loss of cooling water for 20 minutes without operator action or state that in lieu of testing the CCWS meets Section ii.4.G, item ii. This was not addressed as requested by RAI 9.2.2-69.

Response to Question 09.02.02-114:

a.

1. The RCP Thermal Barrier Cooling Transfer is a Non-Safety Manual function. The Non-safety designation results from single failure criteria and TS requirements to have two OPERABLE CCWS trains aligned to thermal barrier cooling, and the fact that operators would not need to perform the function during an accident. It is an operational function to align the loads to a common header which is fully supported by two trains. The transfer of thermal barrier cooling from one common header to the other common header would be needed if one of the two available trains on the initial common header providing thermal barrier cooling is being placed in maintenance. Per Tech Spec 3.7.7 Required Action A.1, RCP thermal barrier cooling is to be aligned to the common header with two operable CCWS trains within 72 hours if one CCW train is inoperable. In this case, the transfer could occur during normal power operation or during a shutdown. The sequence of closing the first set of CIVs and opening the second set of CIVs determines the time that flow will be interrupted to the RCP thermal barriers. From FSAR Table 6.2.4-1, the closure time of the CIVs for RCP thermal barrier cooling is ≤15 seconds for each valve. Because of the valve interlock associated with the supply of cooling to the loads and the short duration desired to have cooling flow interrupted, a group command is provided. The group command will close all four of the CIVs of the off-going common header simultaneously and open all four of the CIVs of the on-coming header simultaneously. The 15 second closure time of the off-going header CIVs combined with a 15 second opening time of the on-coming header CIVs results in a flow disruption of approximately 30 seconds for the RCP thermal barriers.

   The RCP thermal barrier cooling for each common header (1.B and 2.B) contains two (2) motor operated CIVs on the supply and two (2) motor operated CIVs on the return. Each of the four (4) CIVs inside containment has an uninterruptible emergency power supply. The two outer containment isolation valves on the common 1.B header are normally powered from IEEE division 1. These two valves have a standby emergency power supply of Diesel Generator 1 with Diesel Generator 2 as the alternate emergency power supply. The two outer containment isolation valves on the common 2.B header are normally powered from IEEE division 4. These two valves have a standby emergency power supply of Diesel Generator 4 with Diesel Generator 3 as the alternate emergency power supply. Refer to FSAR Chapter 8 for the discussion related to normal and emergency power supplies.

The RCP thermal barrier cooling transfer consists of closing the open group of CIVs (KAB30 AA049/050/051/052 (Common 1.b) or KAB30 AA053/054/055/056 (Common 2.b)) and as soon as one of the two supply valves (KAB30 AA049/050 (Common 1.b) KAB30 AA053/054 (Common 2.b)) and one of the two return valves (KAB30 AA051/052 (Common 1.b) or KAB30 AA055/056 (Common 2.b)) indicate valve closure, the other group of CIVs (KAB30 AA049/050/051/052 (Common 1.b) or KAB30 AA053/054/055/056 (Common 2.b)) is opened. In case a CIV fails to open on the final header, another transfer is automatically performed back to the initial configuration. This automatic feature to revert back to the initial configuration is built into the thermal barrier cooling transfer command. Refer to U.S. EPR FSAR Section 9.2.2.6.1.3 for a description of the RCP Thermal Barrier Cooling Transfer.

In the scenario where the thermal barrier cooling transfer is initiated and there is a LOOP within the 15 second valve closure window of time with a mechanical single failure of one of the four valves to close, the transfer permissive requirement of 1 out of 2 of the initial supply valves to close and 1 out of 2 of the initial return valves to close would still be satisfied and the thermal barrier transfer would be completed with the second set of CIVs valves opening.

In the scenario where the thermal barrier cooling transfer is initiated and there is a LOOP with a single failure of the Diesel Generator supplying the outer containment isolation valve, the 1 out of 2 permissive on the initial valves would be completed by the inside containment isolation valves that have uninterruptible power supplies. The thermal barrier transfer would be completed with the second set of CIVs opening.

The CCWS Containment Isolation Valves (CIVs) for RCP Thermal Barrier Cooling are not actuated upon receipt of SI, CI-1 or CI-2 signals so they remain open during and after a DBA. The containment isolation valves associated with each of the common headers providing this cooling flow to the thermal barriers would not be cycled to test Containment Isolation operability during normal power operation because of the potential impact on operating RCPs.

The RCP shaft seal system is made up of a series of three seals and a standstill seal. During normal plant operation, water from the CVCS provides normal seal cooling. CCWS is continuously aligned to the thermal barrier coolers as the safety related backup to CVCS. The CVCS injects directly into the #1 seal and the flow goes down, past the thermal barrier and into the RCS. If seal injection is lost, then reactor coolant flows up through the thermal barrier and into the seal. CVCS water cools the seal when CVCS is operable. When CVCS is not operable, Reactor Coolant (cooled by the thermal barrier) provides cooling to the seal. The standstill seal is not credited as a safety-related design basis accident mitigation feature. It intended only for conditions that are beyond DBA.

The RCP shaft seal system is designed to withstand without damage, the following three operating conditions so that additional margins are provided to recover service water in efforts to minimize plant down time:

- Loss of CVCS water injection to the #1 shaft during continuous operation or pump shutdown with seal cooling provided by the thermal barrier
- Loss of CCWS cooling water to the thermal barrier heat exchanger during continuous operation or with the pump shutdown, with seal cooling provided by CVCS seal injection
- Concurrent loss of #1 shaft seal injection from CVCS and thermal barrier cooling from CCWS if one of the two functions is recovered in 2 minutes or less

In the absence of RCP seal injection via CVCS and RCP thermal barrier cooling via CCWS the RCP shaft seal average leakage is assumed to be ≤ 25 gpm until the standstill seal system closes (Refer to the Response to RAI 174 Question 9.2.2-20). The RCP shaft seal system is designed to withstand a concurrent loss of CVCS seal injection and CCWS flow to the thermal barriers for two minutes provided one of the two functions is recovered in two minutes. A reduction or loss of CCWS flow to any of the RCP thermal barriers is recognized in the control room by individual flow indication devices in the return piping from each thermal barrier (refer to FSAR Figure 9.2.2-2 sheets 3 and 4 of 7 and Figure 9.2.2-3 sheets 3 and 4 of 8). A reduction or loss if CVCS seal injection flow to the RCPs is recognized in the control room by a totaling flow indication device outside containment and individual flow indication devices for each RCP seal (refer to FSAR figure 9.3.4-1). Refer to the Response to RAI 53 Question 19-206 for the discussion related to simultaneous loss of thermal barrier cooling and seal injection flow. If CCWS flow to the thermal barriers is not recovered after two minutes, the seals will heat up and the discussion above related to seal leakage and the standstill seal closure would be in effect. Refer to FSAR section 15.6 for the U.S. EPR LOCA Analysis.

2. In accordance with Section B 3.7.7 in the FSAR, Action Item A.1 requires that if one CCW train is inoperable, action must be taken to align the RCP thermal barrier cooling common loop to a common header capable of being supplied by two operable CCW trains within 72 hours. In this condition, the CCWS can perform the RCP thermal barrier cooling function given a single failure. The 72 hour completion time is reasonable, based on the low probability of a postulated accident occurring during this period.

   In accordance with Action Items B.1, if two CCW trains are inoperable, action must be taken to restore one train to operable status within 72 hours. In accordance with Action Item C.1 and C.2, if a CCW train cannot be restored to operable status within the associated completion time, the unit must be placed in at least Mode 3 with 6 hours and in Mode 5 within 36 hours.

   Prior to an accident, it is expected that CCWS cooling to the Reactor Coolant Pumps is available. This is ensured by Tech Spec 3.7.7. Credit is not taken for the CVCS to ensure cooling to the RCP shaft seals. During a LOOP, there is no need for the operator to transfer cooling to another CCWS train. Power to the previously running CCWS train will be restored based on EDG load sequencing. Since the CIVs for thermal barrier cooling remain open during and after a DBA, there is no need for the operator to transfer thermal barrier cooling.

Based on the above, a loss of CCW cooling to the RCP thermal barriers will not create a loss of CVCS seal injection to the RCPs and if the CCWS flow is restored within the specified LCO action times it is not necessary to assume a DBA in combination with a loss of CCW cooling to the RCP thermal barriers.

3. Thermal Barrier cooling is required for all modes of operation, including DBA, where the RCS is pressurized and therefore relying on RCP seal integrity to maintain the Reactor Coolant Pressure Boundary. This is an initial condition in the accident analysis and is ensured by Tech Spec 3.7.7. CCWS is the only safety-related cooling to the RCP thermal barriers. Technical Specifications require thermal barrier cooling to be supplied to the RCP's to ensure this initial condition (i.e. thermal barrier cooling is active) prior to an accident. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include this information.

4. Failure of a CCWS CIV for RCP Thermal Barrier cooling to close renders the CCWS system inoperable per Tech Spec 3.7.7 as this condition would degrade flow to the RCP thermal barriers. In effect, this would render each of the two trains capable of supplying the common header aligned to thermal barrier cooling inoperable for thermal barrier cooling because neither of the trains could provide thermal barrier cooling. This condition would put the CCW system in an LCO condition and full CCW flow would need to be restored to the RCP thermal barrier coolers or the unit must be placed in at least Mode 3 within 6 hours and in Mode 5 within 36 hours in accordance with Section B 3.7.7 - Actions C.1 and C.2 of the FSAR. LCO 3.6.3 Note 3 under Actions states "Enter applicable conditions and Required Actions for systems made inoperable by Containment Isolation Valves". This again would go back to Tech Spec LCO 3.7.7 as stated above.

   In the event that a CIV of the off-going header fails in mid position and is not restored to the original full open position or closed to allow the CIVs of the on-coming header to open and CVCS seal injection is available, there is no priority requirement for the operator. If a CIV of the off-going header fails in mid-position and is not restored to full open position or closed to allow the CIVs of the on-coming header to open and CVCS seal injection is not available, one of the two flows (CCWS or CVCS) must be restored within two minutes. Loss of CCW cooling to the RCP thermal barrier coolers does not impact the operation of the CVCS. Therefore, assuming a concurrent loss of seal injection to the RCPs should not be required in the short term.

   Related to Tech Spec 3.6.3, the Containment Isolation function on the RCP thermal barrier supply side is maintained by one of the two motor operated CIVs if one of the two fails to close. The Containment Isolation function is maintained on the RCP thermal barrier return piping by one of the two motor operated CIVs if one of the two fails to close.

5. The RCP standstill seal is not credited as a safety-related design basis accident mitigation feature. It intended only for conditions that are beyond DBA.

b. As previously stated in the Response to RAI 174, Question 9.2.2-20 the RCP shaft seal will be SBO tested to determine the average leakage prior to closure of the standstill seal system, and prior to the SBO test, an analysis will be performed to evaluate o-ring extrusion gaps and clearances within the shaft seal in SBO conditions. An SBO test on the standstill seal will be done separately. Refer to U.S. EPR FSAR Section 5.4.1.2.1 for information related to the RCP seal design as it relates to a loss of seal cooling and the conditions under which the standstill seal is normally used.

   The CCWS meets the guidance of SRP 9.2.2 as being designed for single failure and built to ASME III Class 3. Refer to U.S. EPR FSAR Sections 9.2.2.1 and 9.2.2.2.1. The CCWS piping, valves and components supplying the RCP thermal barriers is Seismic Category I, Quality Group C, ASME III Class 3 with the exception of the CIVs and piping between the CIVs, which are Seismic Category I, Quality Group B, ASME III Class 2.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 9.2.2 and 14.2 and Tier 1 Section 2.7.1 will be revised as described in the response and indicated on the enclosed markup.

containment isolation valves (CIVs) in the RCP thermal barrier cooling path on the supply and return side of CCWS common 1b cannot be opened unless the CIVs on both the supply and return side of common 2b are closed and vice-versa.

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

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

The design of the Component Cooling Water System (CCWS) minimizes and withstands adverse transients (i.e., water hammer) and meets functional performance requirements for all operating modes including postulated DBA consistent with the guidance for water hammer prevention and mitigation found in NUREG-0927 (Reference 6).

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

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

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

The design incorporates controls and instrumentation to support operating and maintenance procedures to provide adequate measures to avoid water hammer.

One non-safety-related train comprises the dedicated CCWS. This train cools the SAHRS train, is supplied demineralized makeup water by the dedicated CCWS injection pump, is cooled by its assigned dedicated ESWS train, and is provided backup power from its assigned station blackout diesel generator (SBODG). The dedicated CCWS train consists of one main pump, one dedicated ESWS-cooled HX, one surge

CCWS Response to a LOOP

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

CCWS Switchover Valve Interlock

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

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

Thermal Barrier Isolation

The following actions indicate a fault of a RCP thermal barrier:

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

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

CCWS Containment Isolation Valve Interlock

Either the common 1.b or 2.b headers can provide cooling to the RCP thermal barriers. To maintain strict train separation of the redundant CCWS division supplying either common header to confirm that a fault affects no more than one train, the CIVs (KAB30 AA049/051/052/053/055/056) are interlocked. The CCWS CIVs from the common 1.b header (KAB30 AA049/051/052) must be closed prior to opening the CIVs from the common 2.b header (KAB30 AA053/055/056), and vice versa.

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

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

In case of a failure to close of a switchover valve on the initial train or lack of opening of a switchover valves on the final train, another switchover is automatically done to the initial configuration. Refer to Section 7.6.1.2.3 for a more detailed description.

CCWS Surge Tank Makeup

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

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

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

RCP Thermal Barrier Cooling Transfer

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

In case a CIV fails to close on the initial common header or lack of valve opening of a CIV on the final header, another transfer is automatically performed back to the initial configuration.

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

CCWS Temperature Control

Normally, the CCWS heat exchanger bypass control valve (KAA10/20/30/40 AA112) is manually positioned in order to maintain a CCWS normal temperature greater than 59°F and less than 100.4°F. An alarm is relayed to the operator in the MCR when the temperature is near the MIN2 or MAX2 temperature limit.

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

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

Manual Start and Trip of a Train

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

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

Dedicated CCWS Control

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

- Dedicated CCWS pump (KAA80 AP001).
- Dedicated CCWS makeup pump (KAA80 AP201).
- Dedicated CCWS tank outlet valve (KAA80 AA020).

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

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

- CCWS Train 1 common 1.a supply and return switchover valves close.
- CCWS Train 1 common 1.b supply and return switchover valves close.

3.30 Perform step 3.29 for CCWS Train 2 supplying common 2.b header to verify appropriate responses.

3.31 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Surge Tank Makeup function. Verify the following action occurs:

- DWDS supply isolation valve responds to CCWS surge tank level changes.

3.32 Perform step 3.31 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.33 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Temperature Control function.

3.33.1 Simulate two of three CCWS Train 1 temperature sensors less than MIN1. Verify that the Train 1 heat exchanger bypass valve opens by 10 percent of its 0-100 percent range at 1 minute intervals until 2 of 3 temperature measurements are greater than MIN1, or the valve is fully open.

3.33.2 Simulate two out of three CCWS Train 1 temperature sensors greater than MAX1. Verify that the Train 1 heat exchanger bypass valve closes by 10 percent of its 0-100 percent range at 1 minute intervals until 2 of 3 temperature measurements are less than MAX1, or the valve is fully closed.

3.34 Perform step 3.33 for CCWS Trains 2, 3, and 4 to verify appropriate responses~~Perform Steps 3.14 through 3.24 for CCWS Trains 2, 3, and 4 to verify appropriate responses~~.

3.35 Verify that CCWS common 1.b header is supplying RCP thermal barrier cooling, then perform test of RCP thermal barrier isolation function.

3.35.1 Simulate high flow above threshold value on the return of RCP1 thermal barrier. Verify that RCP1 thermal barrier isolation valves close.

3.35.2 Simulate high pressure above threshold value on the return of RCP1 thermal barrier. Verify that RCP1 thermal barrier isolation valves close.

3.35.3 Perform steps 3.35.1 and 3.35.2 for RCP 2, 3, and 4 thermal barriers.

3.36 Perform step 3.35 for common 2.b header supplying RCP thermal barrier cooling to verify appropriate responses.

RAI 406, Question 9.2.2-114 FSAR Insert “A”

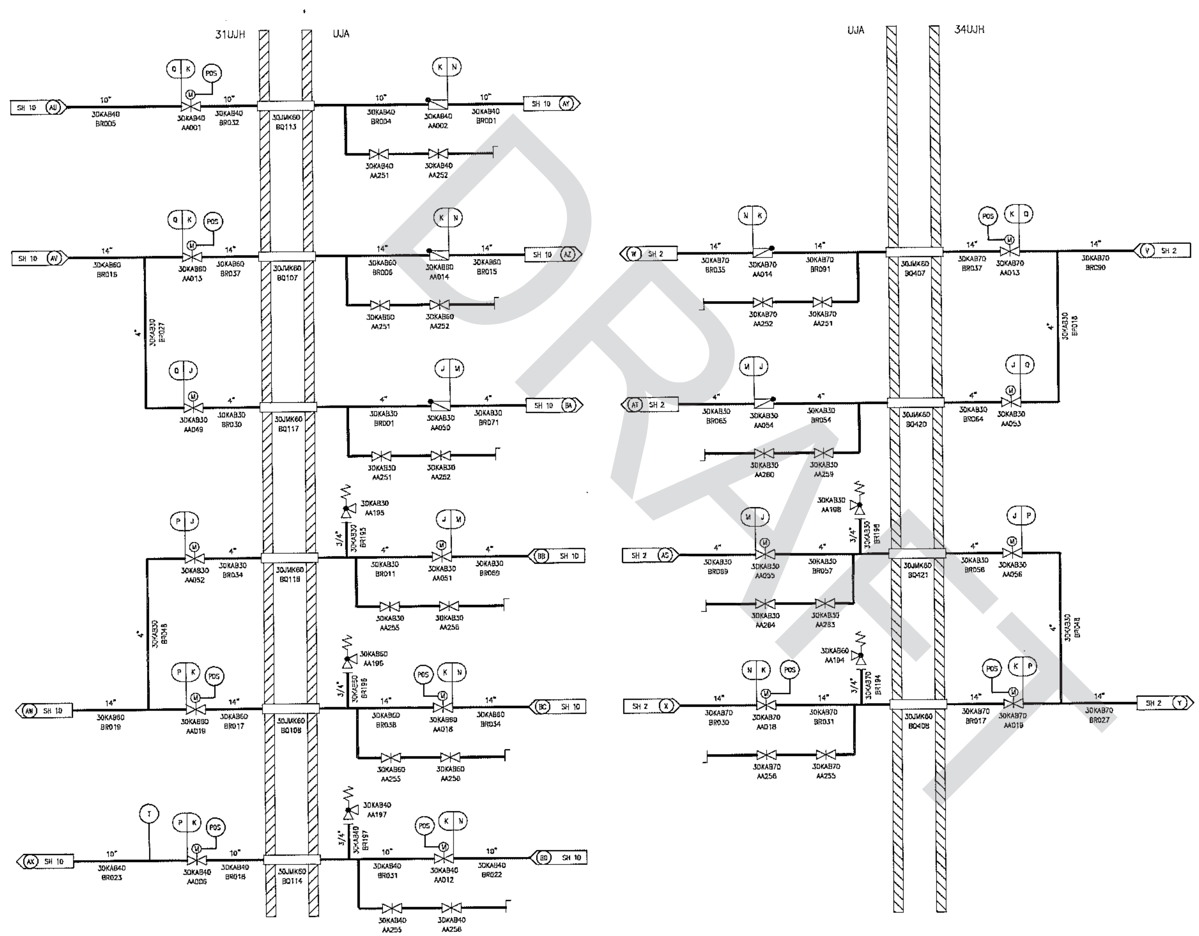
3.37 Verify that CCWS common 1.b header is supplying RCP thermal barrier cooling, then perform test of thermal barrier transfer revert back feature.

3.37.1 Simulate closure of closure of Common 1.B RCP thermal barrier CIVs and failure of one or more Common 2.B RCP thermal barrier CIVs to open. Verify that RCP thermal barrier transfer reverts back to Common 1.B supplying cooling flow to all four RCP thermal barriers.

3.38 Verify that CCWS common 2.b header is supplying RCP thermal barrier cooling, then perform test of thermal barrier transfer revert back feature.

3.38.1 Simulate closure of closure of Common 2.B RCP thermal barrier CIVs and failure of one or more Common 1.B RCP thermal barrier CIVs to open. Verify that RCP thermal barrier transfer reverts back to Common 2.B supplying cooling flow to all four RCP thermal barriers.

Figure 9.2.2-2—Component Cooling Water System Common Loop 1
Sheet 7 of 7



JMK – PIPING PENETRATIONS
KAB – COMPONENT COOLING WATER SYSTEM COMMON HEADER

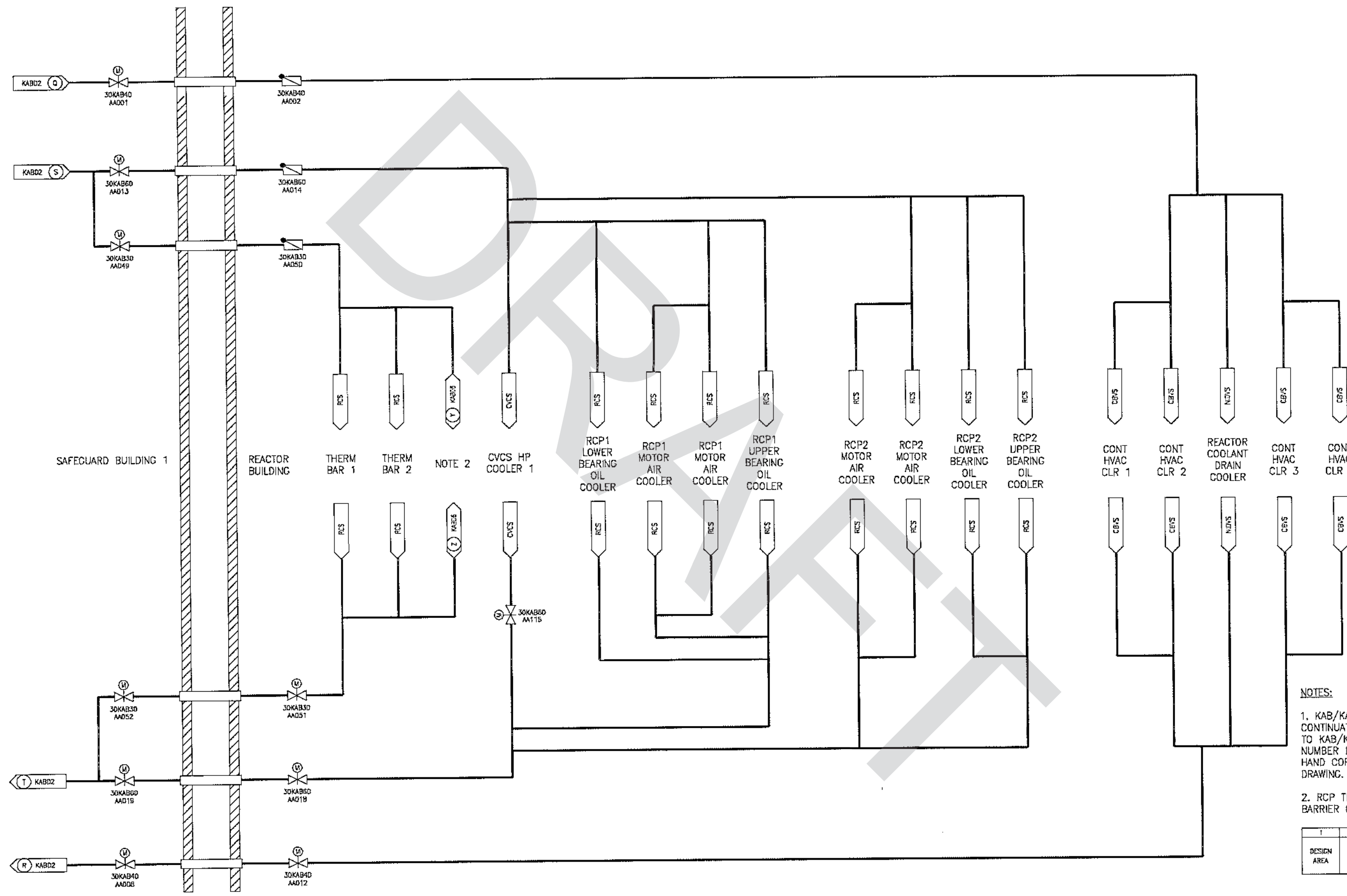
UJA – REACTOR BUILDING
31UJH – SAFEGUARD BUILDING MECHANICAL, DIVISION 1
34UJH – SAFEGUARD BUILDING MECHANICAL, DIVISION 4

NOTE: COMMON 1 AND 2 CONTAINMENT PENETRATION DETAILS.

DESIGN AREA	SSC QUALITY GROUP	DESIGN PRESSURE PSIG	DESIGN TEMPERATURE °F	SSC SEISMIC CLASS
J	B	2535	664	I
M	C	2535	664	I
K	B	175	338	I
N	C	175	338	I
P	C	175	225	I
Q	C	175	225	I

KAB15T2

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 7 of 11



NOTES:

1. KAB/KAA SHEET CONTINUATIONS REFER TO KAB/KAA SHEET NUMBER IN LOWER RIGHT HAND CORNER OF DRAWING.

2. RCP THERMAL BARRIER CROSS TIE.

I	III	I
DESIGN AREA	ASME	SSC SEISMIC CLASS

REV 002
KAB03T1

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement Sheet 10 of 11

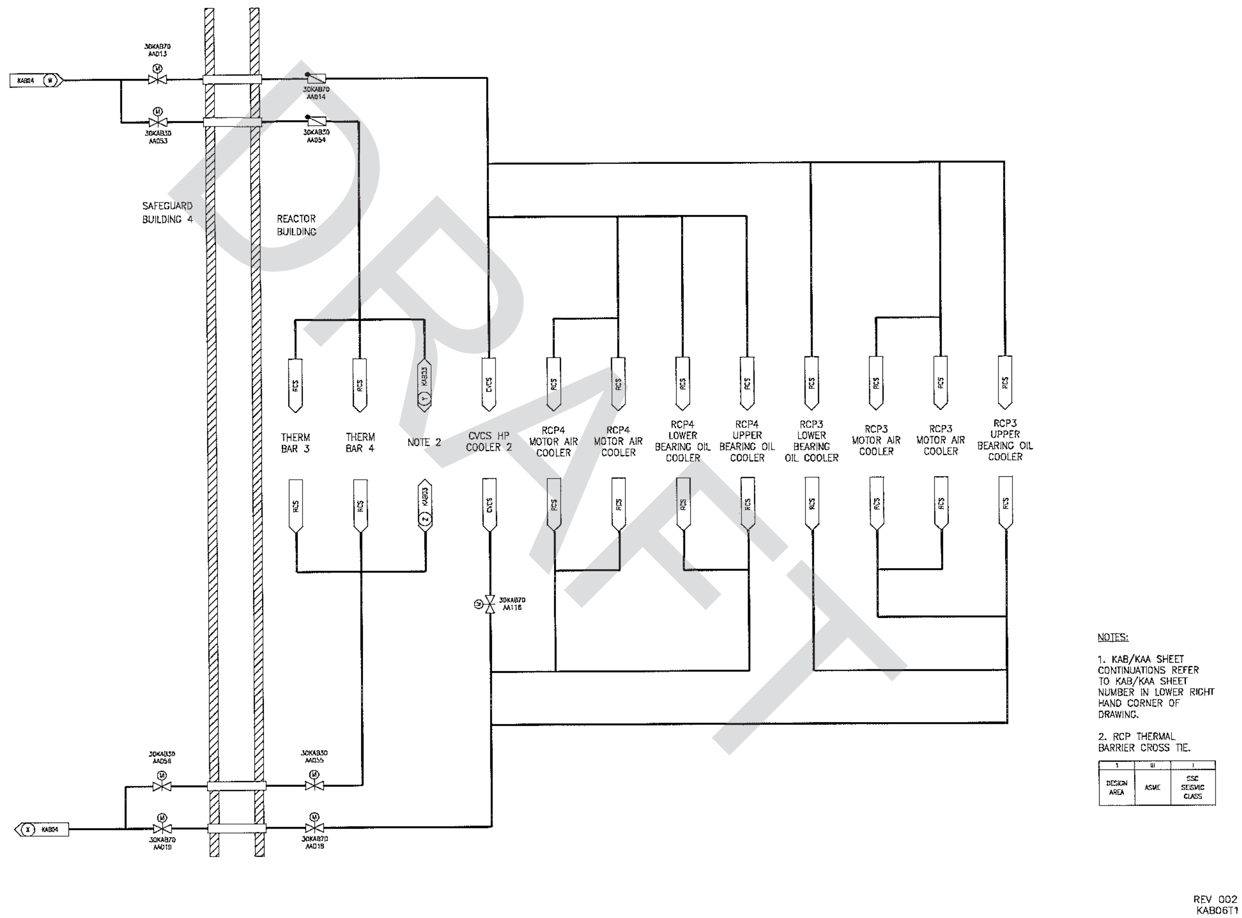


Table 2.7.1-1—Component Cooling Water System Equipment Mechanical Design (7 Sheets)

Description	Tag Number [1]	Location	ASME Code Section III	Function	Seismic Category
Common Header 1b RCP Thermal Barriers Containment Isolation Valves	KAB30AA049 KAB30AA051 KAB30AA052	Safeguard Building 1 Reactor Building Safeguard Building 1	Yes	Close (Manually Initiated)	I
Common Header 1b RCP Thermal Barriers 1/2 Upstream Containment Isolation Check Valve	KAB30AA050	Reactor Building	Yes	Prevent Backflow	I
Common Header 2b RCP Thermal Barriers Containment Isolation Valves	KAB30AA053 KAB30AA055 KAB30AA056	Safeguard Building 4 Reactor Building Safeguard Building 4	Yes	Close (Manually Initiated)	I
Common Header 2b Containment Supply Isolation Check Valve	KAB30AA054	Reactor Building	Yes	Close	I
Common Header 1b Non-Safety Loads Containment Isolation Valves	KAB40AA001 KAB40AA006 KAB40AA012	Safeguard Building 1 Reactor Building Safeguard Building 1	Yes	Close	I
Common Header 1b Containment Supply Isolation Check Valve	KAB40AA002	Reactor Building	Yes	Close	I
Common Header 2b Auxiliary Building and Waste Building Isolation Valves	KAB50AA001 KAB50AA006 KAB50AA004	Safeguard Building 4 Safeguard Building 4 Safeguard Building 4	Yes	Close	I
Common Header 2b Auxiliary and Waste Building Return Isolation Check Valve	KAB50AA008	Safeguard Building 4	Yes	Close	I

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (7 Sheets)

Description	Tag Number [1]	Location	IEEE Class 1E [2]	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Common Header 1b Safety Related Loads Containment Isolation Valves	KAB60AA013 KAB60AA018 KAB60AA019	Safeguard Building 1 Reactor Building Safeguard Building 1	1^N 2^A 4^N 3^A 1^N 2^A	Yes	Yes	Pos	Open-Close
Common Header 2b Safety Related Loads Containment Isolation Valves	KAB70AA013 KAB70AA018 KAB70AA019	Safeguard Building 4 Reactor Building Safeguard Building 4	4^N 3^A 1^N 2^A 4^N 3^A	Yes	Yes	Pos	Open-Close
Common Header 1b RCP Thermal Barriers Containment Isolation Valves	KAB30AA049 KAB30AA051 KAB30AA052	Safeguard Building 1 Reactor Building Safeguard Building 1	1^N 2^A 4^N 3^A 1^N 2^A	Yes	Yes	Pos	Open-Close

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (7 Sheets)

Description	Tag Number (1)	Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Common Header 2b RCP Thermal Barriers Containment Isolation Valves	KAB30AA053	Safeguard Building 4	4^N 3^A	Yes	Yes	Pos	Open-Close
	KAB30AA055	Reactor Building	1^N 2^A				
	KAB30AA056	Safeguard Building 4	4^N 3^A				
Surge Tank Demin. Water Makeup Isolation Valves	KAA10AA027	Safeguard Building 1	1^N 2^A	N/A	Yes	Pos	Open-Close
	KAA20AA027	Safeguard Building 2	2^N 1^A				
	KAA30AA027	Safeguard Building 3	3^N 4^A				
	KAA40AA027	Safeguard Building 4	4^N 3^A				
Common Header 1a Fuel Pool Cooling Heat Exchanger 1 Downstream Control Valve	KAB10AA134	Fuel Building	1^N 2^A	N/A	Yes	NA / NA	NA / NA
Common Header 2a Fuel Pool Cooling Heat Exchanger 2 Downstream Control Valve	KAB20AA134	Fuel Building	4^N 3^A	N/A	Yes	NA / NA	NA / NA