ArevaEPRDCPEm Resource

From:	BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent:	Wednesday, October 13, 2010 11:41 AM
To:	Tesfaye, Getachew
Cc:	DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); KOWALSKI David (AREVA)
Subject:	Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9, supplement 6
Attachments:	RAI 406 Supplement 6 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided a technically correct and complete response to two of the eight questions in RAI No. 406, a technically correct and partial response to one question in RAI No. 406, and a schedule for the remaining questions, on July 16, 2010. Supplement 1 response to RAI No. 406 was sent on August 31, 2010 to provide a revised schedule. Supplement 2 response to RAI No. 406 was sent on September 14, 2010 to provide a technically correct and complete response to one question and a technically correct and partial response to one question. Supplement 3, Supplement 4 and Supplement 5 responses to RAI No. 406 were sent on September 23, 2010, September 29, 2010 and October 1, 2010, respectively, to provide a revised schedule.

The attached file, "RAI 406 Supplement 6 Response US EPR DC.pdf" provides technically correct and complete responses to three of the remaining four questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 406 Question 09.02.02-109, 09.02.02-110 and 09.02.02-114.

The following table indicates the respective pages in the response document, "RAI 406 Supplement 6 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 406 — 09.02.02-109	2	6
RAI 406 — 09.02.02-110	7	12
RAI 406 — 09.02.02-114	13	17

The schedule for a technically correct and complete response to the remaining question remains the same and is provided below.

Question #	Response Date
RAI 406 — 09.04.01-2	October 29, 2010

Sincerely,

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: BRYAN Martin (External RS/NB)
Sent: Friday, October 01, 2010 2:21 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9, supplement 5

Getachew,

AREVA NP Inc. provided a technically correct and complete response to two of the eight questions in RAI No. 406, a technically correct and partial response to one question in RAI No. 406, and a schedule for the remaining questions, on July 16, 2010. Supplement 1 response to RAI No. 406 was sent on August 31, 2010 to provide a revised schedule. Supplement 2 response to RAI No. 406 was sent on September 14, 2010 to provide a complete response to one question and a technically correct and partial response to one question and a revised schedule for the remaining four questions. Supplement 3 and Supplement 4 response to RAI No. 406 was sent on September 23, 2010 and September 29, 2010 to provide a schedule for the four remaining responses.

Since the response to questions 09.02.02-109, 110, and 114 are being processed, a revised schedule is provided in this email. The response date to 09.04.01-2 remains unchanged.

The schedule for technically correct and complete responses to the remaining questions is provided below.

Question #	Response Date
RAI 406 — 09.02.02-109	October 14, 2010
RAI 406 — 09.02.02-110	October 14, 2010
RAI 406 — 09.02.02-114	October 14, 2010
RAI 406 — 09.04.01-2	October 29, 2010

Sincerely,

Martin (Marty) C. Bryan
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From: BRYAN Martin (External RS/NB)
Sent: Wednesday, September 29, 2010 2:59 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); KOWALSKI David (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9, supplement 4

Getachew,

AREVA NP Inc. provided a technically correct and complete response to two of the eight questions in RAI No. 406, a technically correct and partial response to one question in RAI No. 406, and a schedule for the remaining questions, on July 16, 2010. Supplement 1 response to RAI No. 406 was sent on August 31, 2010 to provide a revised schedule. Supplement 2 response to RAI No. 406 was sent on September 14, 2010 to provide a complete response to one question and a technically correct and partial response to one question and a revised schedule for the remaining four questions. Supplement 3 response to RAI No. 406 was sent on September 23, 2010 to provide a schedule for the four remaining responses.

To provide additional time for interaction and feedback from the staff, a revised schedule is provided in this email for the response to question 09.04.01-2. The response date to the other three questions remains unchanged.

The schedule for technically correct and complete responses to the remaining questions is provided below.

Question #	Response Date
RAI 406 — 09.02.02-109	October 1, 2010
RAI 406 — 09.02.02-110	October 1, 2010
RAI 406 — 09.02.02-114	October 1, 2010
RAI 406 — 09.04.01-2	October 29, 2010

Sincerely,

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From: BRYAN Martin (External RS/NB)
Sent: Thursday, September 23, 2010 6:06 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB); BALLARD Bob (EP/PE); GARDNER Darrell (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9, supplement 3

Getachew,

AREVA NP Inc. provided a technically correct and complete response to two of the eight questions in RAI No. 406, a technically correct and partial response to one question in RAI No. 406, and a schedule for the remaining questions, on July 16, 2010. Supplement 1 response to RAI No. 406 was sent on August 31, 2010 to provide a revised schedule. Supplement 2 response to RAI No. 406 was sent on September 14, 2010 to provide a complete response to one question and a technically correct and partial response to one question and a revised schedule for the remaining four questions.

Since the responses to three of the remaining questions are being processed, a revised schedule is provided in this email. The other response date remains unchanged.

The schedule for technically correct and complete responses to the remaining questions is provided below.

Question #	Response Date
RAI 406 — 09.02.02-109	October 1, 2010
RAI 406 — 09.02.02-110	October 1, 2010
RAI 406 — 09.02.02-114	October 1, 2010
RAI 406 — 09.04.01-2	September 29, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
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From: BRYAN Martin (External RS/NB)
Sent: Tuesday, September 14, 2010 6:03 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9, supplement 2

Getachew,

AREVA NP Inc. provided a technically correct and complete response to two of the eight questions in RAI No. 406, a technically correct and partial response to one question in RAI No. 406, and a schedule for the remaining questions, on July 16, 2010. Supplement 1 response to RAI No. 406 was sent on August 31, 2010 to provide a revised schedule.

The attached file, "RAI 406 Supplement 2 Response US EPR DC.pdf" provides a technically correct and complete response to one question and a technically correct and partial response to one question.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 406 Question 09.02.02-112.

The following table indicates the respective pages in the response document, "RAI 406 Supplement 2 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 406 — 09.02.02-112	2	9
RAI 406 — 09.02.02-113 (Part a)	10	10

Since the remaining responses are being processed, a revised schedule is provided in this e-mail.

The schedule for technically correct and complete responses to the questions has been revised as provided below.

Question #	Response Date
RAI 406 — 09.02.02-109	September 23, 2010
RAI 406 — 09.02.02-110	September 23, 2010
RAI 406 — 09.02.02-114	September 23, 2010
RAI 406 — 09.04.01-2	September 29, 2010

Sincerely,

Martin (Marty) C. Bryan

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From: BRYAN Martin (External RS/NB)
Sent: Tuesday, August 31, 2010 10:52 AM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9, supplement 1

Getachew,

AREVA NP Inc. provided a technically correct and complete response to two of the eight questions in RAI No. 406, a technically correct and partial response to one question in RAI No. 406, and a schedule for the remaining questions, on July 16, 2010. Since responses to the remaining questions are being processed, a revised schedule is provided in this email.

On July 19, 2010, a DRAFT response to Question 09.04.01-2 was submitted to the NRC for review and comment. As of today, AREVA NP has not received any feedback from the NRC staff on this question. The remaining five questions are being processed as final responses based on previous interactions with the staff.

The schedule for technically correct and complete responses to the remaining questions is provided below.

Question #	Response Date
RAI 406 — 09.02.02-109	September 14, 2010
RAI 406 — 09.02.02-110	September 14, 2010
RAI 406 — 09.02.02-112	September 14, 2010
RAI 406 — 09.02.02-113 (Part a)	September 14, 2010
RAI 406 — 09.02.02-114	September 14, 2010
RAI 406 — 09.04.01-2	September 29, 2010

Sincerely,

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From: BRYAN Martin (EXT)
Sent: Friday, July 16, 2010 3:01 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); KOWALSKI David J (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 406 Response US EPR DC.pdf" provides a technically correct and complete response to two of the eight questions and a technically correct and partial response to one question.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 406 Questions 09.02.02-111, 09.02.02-113 (Part d) and 09.05.01-77.

The following table indicates the respective pages in the response document, "RAI 406 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 406 — 09.02.02-109	2	4
RAI 406 — 09.02.02-110	5	5
RAI 406 — 09.02.02-111	6	6
RAI 406 — 09.02.02-112	7	8
RAI 406 — 09.02.02-113	9	9
RAI 406 — 09.02.02-114	10	10
RAI 406 — 09.04.01-2	11	11
RAI 406 — 09.05.01-77	12	13

A complete answer is not provided for six of the questions. The schedule for technically correct and complete responses to these questions is provided below.

Question #	Response Date
RAI 406 — 09.02.02-109	August 31, 2010
RAI 406 — 09.02.02-110	August 31, 2010
RAI 406 — 09.02.02-112	August 31, 2010
RAI 406 — 09.02.02-113 (Part a)	August 31, 2010
RAI 406 — 09.02.02-114	August 31, 2010
RAI 406 — 09.04.01-2	August 31, 2010

SincerelyMartin (Marty) C. Bryan
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, June 16, 2010 8:27 AM
To: ZZ-DL-A-USEPR-DL
Cc: Wheeler, Larry; Segala, John; Lee, Samuel; Peng, Shie-Jeng; McKirgan, John; McCann, Edward; Dreisbach, Jason; Hearn, Peter; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No.406(4683,4664,4707), FSAR Ch. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on May 14, 2010, and discussed with your staff on June 15, 2010. Drat RAI Question 09.04.01-2 was modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 2124

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB7107E35783)

Subject: Response to U.S. EPR Design Certification Application RAI No.406, FSAR Ch. 9, supplement 6
Sent Date: 10/13/2010 11:41:22 AM
Received Date: 10/13/2010 11:41:53 AM
From: BRYAN Martin (EXTERNAL AREVA)

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

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RAI 406 Supplement 6 Response US EPR DC.pdf		573360

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 406(4683, 4664, 4707), Supplement 6

6/16/2010

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)

Question 09.02.02-109:

Follow-up to RAI 334, Question 9.2.2-61 and RAI 174, Question 9.2.2-12

In RAI 9.2.2-61 the staff identified a group of follow-up items in regard to CCWS design information that was found to be missing, inconsistent or inaccurate. Staff review of the applicant's response to 9.2.2-61 provided in RAI 334, Supplement 1, identified the follow-up Questions listed below.

Part (1): In the response to RAI 9.2.2-61 Part 1, the applicant noted that pipe sizes were identified on FSAR Tier 2, P&IDs Figures 9.2.2-1, 2, 3 and 4. While this response is acceptable, the staff noted that some pipe sizes were still missing from Figure 9.2.2-1 for: (1) normal surge tank makeup demineralized water and (2) emergency surge tank makeup water.

Part (3): In follow-up RAI 9.2.2-61 Part (3) the applicant was asked to provide detail design for I&C. In response the applicant stated that the CCWS control logic has been identified and referenced information provided in Section 9.2.2.6.1 "Control Features and Interlocks," which has been totally revised and reorganized in the FSAR markup provided with RAI 334, Supplement 1.

The staff's review of the markup of Section 9.2.2.6.1 identified the follow-up items listed below:

1. Page 9.2-43 of the markup proposes to add a new section entitled "CCWS Automatic I&C Safety-Related Functions." "Emergency Backup Switchover Sequence" addresses the case where "automatic" CCWS train switchover has failed this sequence implies that remote manual actions (from the control room) are needed to complete the switchover. The sequence should be revised in the FSAR to clearly state automatic actions and manual actions since it is confusing.
2. The FSAR should clearly explain the differences between the various types of common header switchovers that are described; (1) automatic, (2) emergency backup, (3) emergency, (4) normal and (5) semi-automatic. Similarly, on FSAR mark-up page 9.2-47 under "Normal Switchover Sequence" make it clear where the description "semi-automatic" applies.
3. Page 9.2-43 includes a description under "Emergency CCWS Temperature Control," that the bypass control valve closes when at a high temperature threshold of MAX 1. Describe if the valve goes fully closed at MAX1 or is stepped closed until MAX1 is cleared. This statement is confusing based on the staff's review of "CCWS Temperature Controls" on FSAR markup page 9.2-48. Also the last sentence states "this temperature control function is required during all plant modes of operation, except for SBO, when the CCWS (KAA10/20/30/40) is energized." Provide clarification of the SBO exception in the FSAR.
4. Page 9.2-44, "Emergency Leak Detection Sequence," third bullet from top states that if surge tank level continues to drop to less than MIN4 then the switchover sequence function is unlocked to allow supplying the common users by the "associated train". Clarify in the FSAR the basis for the restoration of flow to the common users, which were isolated at MIN3.
5. Page 9.2-45, "Thermal Barrier Isolation," the following clarifications are needed:
   a. Since both bullets list indications; the heading, "the following actions indicate" should be corrected.

b. The statement about high radiation not performing an isolation conflicts with Section 9.2.2.6.1.5, “Additional Controls Features and Interlocks,” (page 9.2-50) which states “only the RCP thermal barrier and CVCS HP cooler leaks results in automatic isolation of the failed user”. This quote is described under “detection of increased radiation” bullet and should be clarified in the FSAR. Thermal barrier isolation is based on pressure or high flow only.

c. Operating experiences with thermal barrier cracks indicate that among the various parameters utilized for early detection of cracks on the thermal barrier housing, the variation in exit temperature from the component cooling system water coil was the only one to be considered sufficiently representative and reliable. Describe in your FSAR the utilization of the CCWS temperature monitoring for the determination of degraded thermal barrier conditions and include any trip functions based on temperature rise in CCWS from the thermal barrier.

6. Page 9.2-46, fourth bullet lists valve AA015 twice and should be corrected in the FSAR.

7. Page 9.2-48, “CCWS Temperature Control,” described the CCW Hx bypass valve control that during normal operation the CCW Hx bypass valve is stepped ‘closed’ when the heat exchanger outlet temperature reaches MAX1. Clarify in the FSAR the step increments of the valve (for example 10% increments) and what is the end position of the valve (full closed or is this a temperature setpoint).

   Also describe in the FSAR if the bypass control valve is “manually positioned” in the field or manually positioned by the main control room operator in the control room on the control room display. While in “remote manual” describe in the FSAR if the automatic controls still function to control valve position based on control signals.

8. Page 9.2-49, “Dedicated CCWS Circuit Pressurization,” describe in the FSAR the means for preventing the nitrogen gas from entering the dedicated train piping system.

Part (4): In Part 4 of RAI 9.2.2-61 the applicant was asked to provide the detail design for valve positions. The applicant’s response included a list of CCWS valve responses to a safety injection. The staff noted the list of CCWS CCSs automatic system realignments that result from a safety injection signal (FSAR markup Page 9.2-44) needs to be considered for addition to the Tier 1 design description and ITAAC. This is references in SRP 14.3, Appendix C, page 14.3-26, paragraph V.I.

Part 6: In Part 6 the applicant was asked to simplify the 24 page CCWS functional arrangement drawing in Tier 1 (Figure 2.7.1-1). Accordingly the applicant provided a simplified version (11 pages) of Figure 2.7.1-1. The staff found the revised drawings were acceptable but noted that pipe transitions between ASME Class 2 and Class 3 need to be added as appropriate for the CCWS containment penetrations. This is based on SRP 14.3, Appendix C, page 14.3-35, “Figure Check List”. The applicant needs to correct the Tier 1 FSAR markup accordingly.

Part 7b: In Part 7(b) of RAI 9.2.2-12 the staff asked the applicant if the non-safety load hydraulic isolation valves operated in the same manner as the common header switchover valves described in FSAR Tier 2 Section 9.2.2.2. In response the applicant explained that the difference between the switchover valves and non-safety load isolation valves was in the actuation of the pilot valves. The switchover valve pilots are energized to open and bleed off the hydraulic fluid while the non-safety load isolation valve pilots are de-energized to open. The applicant also provided a markup of FSAR Tier 2 Section 9.2.2.2 consistent with this explanation. In follow-up RAI 9.2.2-61 Part 7b the staff asked the applicant to explain the reason for the difference. However, in response the applicant stated that details of the pilot valve operation are part of vendor supplied information and that the vendor will be provided with details of system operation along with I&C logic requirements for all hydraulic valves. The vendor is required to develop an appropriate pilot operating system. The applicant also provided a markup to remove the description previously added to FSAR Tier 2 Section 9.2.2.2 and stated that information would be added when available from the vendor.

Since the details of the pilot valve will be added to the FSAR at a later date all inaccurate information presently in the FSAR related to these pilot valves should be removed (FSAR markup page 9.2-27 to 28 presently describes pilot valve operation). Once this new information is available, Tier 1 ITAACs should be considered for proper valve performance and the pilot valves should be added to the Tier 2 failure mode and effects analyses table related to single failure. The staff will consider this an open item until this information is added to the FSAR and has been evaluated by the staff.

Response to Question 09.02.02-109:

Part (1)

Normal surge tank makeup from demineralized water is through a 2-inch line. Refer to the Response to RAI 406, Question 09.02.02-112 for a discussion of the emergency post-seismic makeup line.

Part (3):

1. The “emergency backup switchover sequence” is an automatic safety-related function defined in U.S. EPR FSAR Tier 2, Section 9.2.2.6.1.1, “CCWS Automatic I&C Safety-Related Functions”. There are no manual operator actions from the main control room (MCR) associated with this function.

   U.S. EPR FSAR Tier 2, Section 9.2.2.6.1 states that “Train backup switchover is performed if common 1.b (2.b) header is not isolated coincident with,” meaning that if a train is aligned to the common 1.b (2.b) header for common user cooling (common 1.b (2.b) switchover valves open) and any of the three indications listed are realized, an automatic switchover is performed to provide cooling to the common header from the opposite train associated with the common header.

2. The following common header switchover sequences are defined for the component cooling water system (CCWS):

   – Normal Switchover.

     During normal plant and system operation, switchover of the common headers is periodically done by the plant operators to verify the operability of the CCWS trains (system surveillances), and to equalize the run time of each CCWS pump. The normal switchover is a remote manual actuation from the MCR. U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 will be revised to include this information.

   – Automatic Backup Switchover.

The automatic backup switchover sequence functions to limit the loss of flow to common 1.b (2.b) users in case of failure of a CCWS train supplying the common 1.b (2.b) or common 1.a and 1.b (2.a and 2.b) headers. This function confirms the supply of safety-related loads (e.g., reactor coolant pump (RCP) thermal barrier) connected to the common 1.b (2.b) header. This switchover function is an automatic function. U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 will be revised to include this information.

3. The CCWS heat exchanger (HX) bypass valve steps closed in 10 percent increments until MAX1 is cleared in “Normal” and “Emergency” CCWS temperature control.

   The CCWS is not credited in station blackout (SBO) mitigation and is not backed by the SBO diesels. The temperature control function is not required in SBO.

4. “Associated train” in this discussion relates to the opposite train that is capable of supplying the common header. When MIN4 is reached, it is determined that the leak is in the main train portion of the system. Cooling of the common header from the other train can be restored.

5a. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to state: “A fault of an RCP thermal barrier is recognized by the following indications:”

5b. Increased radiation in the CCWS does not actuate automatic isolation of the RCP thermal barriers. U.S. EPR FSAR Tier 2, Section 9.2.2 states that RCP thermal barrier automatic isolation is based on high flow or high pressure indication. U.S. EPR FSAR Tier 2, Section 9.2.2.6.1.5, “Additional Control Features and Interlocks,” bullet four states that increasing radiation in the CCWS from the chemical and volume control system (CVCS) high pressure (HP) coolers indicates leakage and triggers automatic isolation of the affected CVCS HP cooler. The last sentence of U.S. EPR FSAR Tier 2, Section 9.2.2.6.1.5, fourth bullet only states RCP thermal barrier and CVCS HP cooler leaks result in automatic isolation of the failed users. This sentence will be deleted from U.S. EPR FSAR Tier 2, Section 9.2.2.6.1.5 for clarity.

5c. The return temperature from each RCP thermal barrier is continuously monitored in the MCR by temperature elements in the CCWS piping at the outlet of each thermal barrier. There are no automatic trip functions associated with high temperature readings on the outlet of the RCP thermal barriers. A high outlet temperature on a RCP thermal barrier will initiate an alarm in the MCR.

6. The correct valves for U.S. EPR FSAR Tier 2, Section 9.2.2, bullet four are KAB50 AA001/004/006, KAB80 AA015/016/019. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include this information.

7. The CCWS HX bypass valve is stepped closed in approximate 10 percent increments. The valve is stepped closed until MAX1 is cleared.

   The CCWS HX bypass valve will be manually positioned by the operator in the MCR. The non-safety-related automatic controls will not be enabled while the valve is in the remote manual mode. Remote manual control can only occur if there is no automatic Class 1E function operating on the valve. The automatic Class 1E functions override other manual or automatic non-safety-related control functions.

   U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include this information.

8. The dedicated CCWS tank is a diaphragm tank with a nitrogen fill connection for the nitrogen side of the diaphragm. A relief valve protects the expansion tank. A humidity sensor is installed in the nitrogen region of the diaphragm expansion tank. The DCS issues an alarm indicating a leaking diaphragm if humidity exceeds a pre-determined limit. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include this information.

Part (4):

A review of the design of the CCWS confirms the system response to a safety injection signal (SIS). The system response will be added to U.S. EPR FSAR Tier 1, Section 2.7.1 and Table 2.7.1-3.

Part (6):

Pipe transitions between ASME Class 2 and Class 3 for the CCWS have been confirmed. U.S. EPR FSAR Tier 1, Figure 2.7.1 will be revised to include this information. U.S. EPR FSAR Tier 1, Figure 2.7.1 will also be revised to include the radiation monitors for the main CCWS trains and the radiation monitors on the inlet and outlet of the CVCS HP coolers that were originally included in the Response to RAI 174, Supplement 2, Question 09.02.02-30.

Part (7b):

Refer to the Responses to RAI 397, Question 9.2.2-107 and Question 9.2.2-108 for U.S. EPR FSAR Tier 1 and Tier 2 changes related to hydraulic valve operation and pilot valve Class 1E redundant power supply.

FSAR Impact:

U.S. EPR FSAR Tier 1, Section 2.7.1, Table 2.7.1-3 and Figure 2.7.1-1 and U.S. EPR FSAR Tier 2, Section 9.2.2 and Figure 9.2.2-1 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-110:

Follow-up to RAI 334, Question 9.2.2-62 and RAI 174, Question 9.2.2-13

In RAI 9.2.2-62 the applicant was requested to determine CCWS minimum heat transfer and flow requirements for the various plant operating modes and accident conditions. The applicant previously stated this information would not be available until later in the design process. In response to RAI 9.2.2-62 the applicant provided a FSAR markup that included FSAR Tier 2 Table 9.2.2-2, "CCWS User Requirements," with heat load and flow information. The staff's review of this information identified the follow-up questions discussed below:

a. The applicant should provide a summary table in the FSAR to identify the total system flow and heat load requirements for normal and accident conditions as well as an assessment in the RAI response of margin by comparison with the design heat transfer and flow capacities for the CCWS heat exchanger and CCWS pump, respectively.

b. Explain the basis for the CCW LHSI heat exchanger DBA heat load (241 MBTU/Hr) in the markup of Table 9.2.2-2 and explain its difference from the DBA heat load identified elsewhere in the FSAR. For example both Tables 9.2.2-1 and 9.2.5-1 identify a DBA heat load of 291.3 MBTU/Hr. This should be explained in the FSAR.

c. Table 9.2.2-2 states that RCP motor air and bearing oil coolers isolate on a Stage 1 Containment isolation signal. However, FSAR Tier 2 Section 9.2.2 indicates that these loads isolate at Stage 2. This table should also state that the CVCS HP coolers isolate at Stage 2. These discrepancies should be corrected in the FSAR.

d. Describe in the RAI response the differences between the CCW Fuel Pool Cooling heat load for normal refueling (47.8 MBTU/Hr) which is significantly greater than the heat load for a full core offload (33.78 MBTU/Hr), see Table 9.2.2-2. The applicant should consider an explanatory note to the FSAR table for clarification of these heat loads.

e. The dedicated heat exchanger capacity is missing from FSAR Tier 2 Table 9.2.2-1. This information should be added to the FSAR.

f. For Table 9.2.2-2, sheet 1 identifies LHSI Hx heat load and flow values for the two cooldown conditions below. Explain in the RAI response the difference for the CCW heat load and flow being significantly less when the CCW train is connected to both the SIS users and the common header and when compared to only being connected to the SIS users (difference of 116 E6 BTU/hr). The applicant should consider adding an explanatory note to the FSAR Table.

Condition	Heat Load (MBTU/Hr)	Flow (10^6 Lb/Hr)
Normal Cooldown when CCW train is only connected to SIS users	152.8	2.984
Normal Cooldown when CCW train is also connected to the common header	36.54	2.1906

Response to Question 09.02.02-110:

a) A review of the component cooling water system (CCWS) confirms the system heat load and user flow requirements for normal and accident conditions. Table 09.02.02-110-1 summarizes the heat load and flow requirements used for determining the heat exchanger

(HX) design case. The CCWS user flow listed in Table 09.02.02-110-1 is the total flow that exits the CCWS HX and is distributed to the users. This is not the total pump discharge flow.

Due to variations in heat load, required flow and “U” for each CCWS operational alignment, the combined “UA” value is used to determine the design case for each CCWS HX. The design parameters for these operational cases will be provided to the HX vendor. The vendor will factor these system parameters into the design of the HX with the design constraint that the HX must meet the highest required combined “UA” of each case. The vendor will determine the best combination of “U” and “A” to meet these requirements. By meeting this requirement for the highest required combined “UA,” the HX design will have margin for other operational alignments. The design basis accident (DBA) cases assume an essential service water (ESW) inlet temperature of 95°F with a CCWS outlet temperature of 110°F. The value of 110°F accounts for instrument uncertainty in the maximum allowed CCWS outlet temperature of 113°F. The reactor coolant system (RCS) cooldown cases assume an ESW inlet temperature of 90°F with a CCWS outlet temperature of 99.2°F. The RCS heatup cases assume an ESW inlet temperature of 92°F with a CCWS outlet temperature of 99.2°F. The value of 99.2°F accounts for instrument uncertainty in the maximum allowed CCWS outlet temperature of 100.4°F for normal operations cases. No correction factor is assumed in the log mean temperature difference (LMTD) calculations. The CCWS inlet temperatures for the LMTD calculations include an addition of 0.9°F to account for CCWS pump heat that is added to the fluid as is passes through the pump. This pump heat is calculated from the pump work and the smallest of the required user flows in Table 09.02.02-110-1. The smallest required flow leads to the largest temperature increase in the pump. This value of 0.9°F is added to each case.

The highest required combined “UA” of 12.99E+06 BTU/hr-°F results from RCS heatup, with CCWS Train 3 or 4 Connected to Common 2. This case yields the highest required combined “UA” due to low temperature deltas in the system during this operational alignment. The LMTD for this case is calculated with an essential service water system (ESWS) inlet temperature of 92°F and a CCWS outlet temperature of 99.2°F for normal operations. 99.2°F accounts for instrument uncertainty in the maximum allowed CCWS outlet temperature of 100.4°F. An example area calculation for this case assuming a U of 360 BTU/hr*ft^2*°F yields a required area of 36,074 ft^2. Considering a 10 percent margin for tube plugging, the HX design area for this example case becomes 39,681 ft^2. For the DBA case, the design of the CCWS HX requires a minimum additional margin of 10 percent above the specified 10 percent tube plugging allowance.

Calculation of UA values for different modes of HX operation provides a reasonable initial basis for comparison prior to selection of a final HX design. The physical parameter of heat transfer area required for each case would provide a more accurate basis for comparison. The required area can not be reliably determined without detailed HX design information necessary to support calculation of the overall heat transfer coefficient (U), which varies for each case. Operating modes for the CCWS with the highest UA value also have significantly higher component cooling water (CCW) flow rates. Higher flow rates increase U and require lower heat transfer area, changing the design margin comparisons based on UA values. Because this information will not be known until final procurement, the DBA case requires a minimum additional margin of 10 percent above the specified 10 percent tube plugging allowance. This confirms that adequate safety margin is provided for the DBA case irrespective of the final CCWS HX design.

A review of the design of the CCWS confirms the highest required pump discharge flow results from any of the trains connected to either of the common headers during normal operation. This normal operation alignment connects every CCWS user simultaneously (including safety injection system (SIS) users). Table 09.02.02-110-2 summarizes the pump discharge flow requirements used for determining the pump design flow rate. The CCWS pump discharge flow listed in Table 09.02.02-110-2 is the total flow through the pump. This flow includes flow through the four-inch surge tank recirculation line that does not go through the CCWS HX. In addition to the recirculation flow, the normal operations flow requirement for the CVCS high pressure (HP) coolers is greater than the CVCS HP cooler required flow in the cooldown alignment. These factors result in a higher required total pump discharge flow as compared to the user required CCWS flow through the HX for heatup and cooldown cases.

The expected CCWS pump suction temperatures for the various operational alignments are enveloped by a temperature of 190°F. 190°F is conservatively based on CCWS HX DBA inlet temperature (181°F) plus margin. The 181°F DBA inlet temperature results from water exiting the CCWS HX at the maximum allowed outlet temperature of 113°F for DBA conditions. Using water at 190°F converts to a required flow of 15862 gpm. Applying the pump margin of 15.33 percent (as indicated in the Response to RAI 334, Question 09.02.02-63) to the highest required pump discharge flow of 15862 gpm results in a design pump flow of 18294 gpm.

A pump design flow rate of 18294 gpm provides margin for operational alignments where the total user required flow is less than 15862 gpm. Table 09.02.02-110-3 summarizes the margin in the CCWS pump flow for normal operations and DBA cases.

The surge tank recirculation line flow has no effect on the heat transfer margins of the CCWS HXs. The surge tank recirculation flow is included in the pump flow design case. The surge tank recirculation flow does not go through the CCWS HX to be distributed to CCWS users, and that flow is not used in the HX design case and margin calculations. For the HX design case and margin calculations, only the CCWS user flows are considered.

U.S. EPR FSAR Tier 2, Tables 9.2.2-1 and 9.2.2-2 will be revised to update the CCWS flow requirements. U.S. EPR FSAR Tier 2, Tables 9.2.2-7 and 9.2.2-8 will be added to summarize CCWS heat load and flow requirements for various operational alignments. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include the heat transfer and pump discharge flow margins for the DBA case.

b) A review of the CCWS confirms the CCWS low head safety injection (LHSI) HX DBA heat load of 241 MBTU/hr. The LHSI HX DBA heat load of 241 MBTU/hr is the decay heat removed by the LHSI system to the CCWS HX. The medium head safety injection (MHSI) and LHSI pump heat loads are listed as individual values in U.S. EPR FSAR Tier 2, Table 9.2.2-2. U.S. EPR FSAR Tier 2, Table 9.2.2-1 and 9.2.5-1 will be revised to update the CCWS DBA heat load that is applied to the ultimate heat sink (UHS).

A review of the design of the CCWS confirms the CCWS HX DBA heat load on the UHS of 293.35 MBTU/hr. This heat load is equal to the LHSI HX DBA heat load of 241 MBTU/hr shown in U.S. EPR FSAR Tier 2, Table 9.2.2-2, plus the additional loads from the CCWS common header users aligned during a DBA. The value of 293.35 MBTU/hr in U.S. EPR FSAR Tier 2, Tables 9.2.2-1 and 9.2.5-1 is the total DBA heat load that the CCWS is required to reject to the UHS. The design of the UHS is required to account for this CCWS heat load plus any additional DBA heat loads that directly impact the UHS. Refer to U.S. EPR FSAR Tier 2, Section 9.2.5 for a description of the design of the UHS. Table 09.02.02-110-4 summarizes the CCWS user loads for the DBA condition (the limiting DBA case results from Train 1 or 2 aligned to Common 1).

U.S. EPR FSAR Tier 2, Table 9.2.5-1 will be revised to update the CCWS HX DBA heat load.

c) Refer to the Response to Part a) for the revision to U.S. EPR FSAR Tier 2, Table 9.2.2-2.

d) Refer to the Response to Part a) for the revision to U.S. EPR FSAR Tier 2, Table 9.2.2-2.

e) A review of the design of the CCWS confirms the dedicated CCWS HX capacity of 51.2 MBTU/hr. The value of 50.5 MBTU/hr listed in U.S. EPR FSAR Tier 2, Table 9.2.2-2 is only the severe accident heat removal system (SAHRS) HX heat load on the dedicated CCWS train. The dedicated CCWS HX design parameter of 51.2 MBTU/hr includes the additional SAHRS pump cooler loads that are directly cooled by the dedicated CCWS.

f) Refer to the Response to Part a) for the revision to U.S. EPR FSAR Tier 2, Table 9.2.2-2.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.2.2.1, Table 9.2.2-1, Table 9.2.2-2, Table 9.2.2-7, Table 9.2.2-8, and Table 9.2.5-1 will be revised as described in the response and indicated on the enclosed markup.

Table 09.02.02-110-1—Summary of Heat Load and Flow Requirements

CCWS Operational Alignment	Reqd Heat Transfer (10^6 BTU/hr)	CCWS User Flow (10^6 lbm/hr)	ESWS Flow (10^6 lbm/hr)	LMTD (°F)	UA (10^6 BTU/hr-°F)
RCS Cooldown; CCWS Train Not Connected to a Common Header	153.06	3.061	7.54	20.89	7.33
RCS Cooldown; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	120.00	7.212	7.54	9.99	12.01
RCS Cooldown; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	97.52	6.31	7.54	10.82	9.01
RCS Heatup; CCWS Train 1 or 2 Connected to Common 1	108.38	5.765	7.54	9.61	11.28
RCS Heatup; CCWS Train 3 or 4 Connected to Common 2	124.93	5.943	7.54	9.62	12.99
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	293.35	4.434	7.54	26.64	11.01
DBA – CCWS Train 3 or 4 aligned to Common 2 Header	292.95	4.419	7.54	26.64	10.98

Table 09.02.02-110-2—Summary of Pump Discharge Flow Requirements

CCWS Operational Alignment	CCWS Pump Discharge Flow (10^6 lbm/hr)	CCWS Pump Discharge Flow (gpm)
Normal Operation; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	7.5	15494
Normal Operation; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	7.678	15862
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	4.434	9160
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	4.419	9129

Table 09.02.02-110-3—Summary of Margin in CCWS Pump Flow for Normal Operation and DBA Cases

CCWS Operational Alignment	CCWS Pump Discharge Flow (gpm)	Pump Design Flow (gpm)	Margin in Pump Flow (%)
Normal Operation; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	15494	18294	18
Normal Operation; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	15862		15
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	9160		100
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	9129		100

Table 09.02.02-110-4—Summary of CCWS User Loads for DBA Condition

			Reqd HT	
Designation of equipment		# of comp/train	per comp	per train
Name	KKS		10^6 BTU/hr	10^6 BTU/hr
CCWS pump MAC	KAA10/20 AC002	1	0.0955	0.0955
LHSI hx	JNG10/20 AC001	1	241.0	241.0
LHSI pump MAC	JNG10/20 AP001	1	0.1262	0.1262
LHSI seal fluid cooler	JNG10/20 AP001	1	0.0341	0.0341
MHSI pump MAC	JND10/20 AP001	1	0.0239	0.0239
Charging pump motor air cooler	KBA31 AP001	1	0.1706	0.1706
Charging pump oil cooler	KBA31 AP001	1	0.1706	0.1706
Charging pump seal water cooler	KBA31 AP001	1	0.1706	0.1706
CVCS HP cooler	KBA11 AC001	1	6.9	6.9
RCP lower bearing oil cooler	JEB10/20 AC001	2	0.0819	0.1638
RCP motor air cooler	JEB10/20 AC002/003	4	1.075	4.3
RCP thermal barrier	N/A	4	0.3915	1.566
RCP upper bearing oil cooler	JEB10/20 AC004	2	1.305	2.61
Nuke Sample Coolers	KUA20/30 AC001	2	0.3958	0.7916
QKA Chiller	QKA20 AC001	1	5.705	5.705
SFP heat exchanger	FAK20 AC001	1	29.00	29.00
SG Sample Coolers	QUC11/12 AC001	2	0.2593	0.5186
		Total		**293.35**

Question 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 reactor coolant pump (RCP) thermal barrier cooling transfer is a non-safety-related manual function. The non-safety-related designation results from single failure criteria and technical specification (TS) requirements to have two operable component cooling water system (CCWS) trains aligned to thermal barrier cooling. Operators would not need to perform the function during an accident. This 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 in maintenance. U.S. EPR FSAR Tier 2, Chapter 16, TS Section 3.7.7, Required Action A.1 states that the RCP thermal barrier cooling must be aligned to the common header with two operable CCWS trains within 72 hours if one component cooling water (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 containment isolation valves (CIVs) and opening the second set of CIVs determines the time that flow will be interrupted to the RCP thermal barriers. From U.S. EPR FSAR Tier 2, 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 the four CIVs of the off-going common header simultaneously and open the four 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 motor operated CIVs on the supply and two motor operated CIVs on the return. Each of the four CIVs inside containment has an uninterruptible emergency power supply. The two outer CIVs 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 (DG) 1 with DG 2 as the alternate emergency power supply. The two outer CIVs on the common 2.B header are normally powered from IEEE Division 4. These two valves have a standby emergency power supply of DG 4 with DG 3 as the alternate emergency power supply. Refer to U.S. EPR FSAR Tier 2, Chapter 8 for a discussion of the 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)). When 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 automatically 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 Tier 2, Section 9.2.2.6.1.3 for a description of the RCP thermal barrier cooling transfer.

When the thermal barrier cooling transfer is initiated and there is a loss of offsite power (LOOP) within the 15 second valve closure with a mechanical single failure of one of the four valves to close, the transfer permissive requirement of one out of two of the initial supply valves to close and one out of two of the initial return valves to close would be satisfied and the thermal barrier transfer would be completed with the second set of CIVs valves opening.

When the thermal barrier cooling transfer is initiated and there is a LOOP with a single failure of the DG supplying the outer containment isolation valve, the one out of two permissive on the initial valves would be completed by the inside CIVs that have uninterruptible power supplies. The thermal barrier transfer would be completed with the second set of CIVs opening.

The CCWS CIVs for RCP thermal barrier cooling are not actuated upon receipt of SI, CI-1, or CI-2 signals, and they remain open during and after a design basis accident (DBA). The CIVs 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 composed of a series of three seals and a standstill seal. During normal plant operation, water from the chemical and volume control system (CVCS) provides normal seal cooling. The CCWS is continuously aligned to the thermal barrier coolers as the safety-related backup to CVCS. The CVCS injects directly into the number 1 seal cavity and splits, with a portion of the flow flowing up through the shaft seal and the remainder of the flow flowing down past the thermal barrier and into the reactor coolant system (RCS). If seal injection is lost, then reactor coolant flows up through the thermal barrier and into the seal. When the CVCS is not available to provide normal RCP seal cooling, 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 number 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 (HX) during continuous operation or with the pump shutdown, with seal cooling provided by CVCS seal injection.
- Concurrent loss of number 1 shaft seal injection from CVCS and thermal barrier cooling from CCWS if one of the two functions is recovered in two minutes or less.

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 U.S. EPR FSAR Tier 2, Figure 9.2.2-2, sheets 3 and 4 and Figure 9.2.2-3, sheets 3 and 4). A reduction or loss of 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 U.S. EPR FSAR Tier 2, Figure 9.3.4-1). Refer to the Response to RAI 53, Question 19-206 for a discussion of 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, resulting in increased seal leakage and the standstill seal closure would be in effect. Refer to U.S. EPR FSAR Tier 2, Section 15.6 for the U.S. EPR loss of coolant accident (LOCA) analysis. 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 09.02.02-20).

a.2 In accordance with U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section B 3.7.7, 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 U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section B 3.7.7, Action Item 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 U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section B 3.7.7, 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 within six hours and in Mode 5 within 36 hours.

Prior to an accident, it is expected that CCWS cooling to the RCPs is available. This is verified by U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section 3.7.7. Credit is not taken for the CVCS to verify cooling to the RCP shaft seals. During a LOOP, the operator is not required to transfer cooling to another CCWS train. Power to the previously running CCWS train will be restored based on emergency diesel generator (EDG) load sequencing. Because 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 this response, a loss of CCW cooling to the RCP thermal barriers will not create a loss of CVCS seal injection to the RCPs. If the CCWS flow is restored within the specified limiting conditions for operation (LCO) action times, it is unnecessary to assume a DBA in combination with a loss of CCW cooling to the RCP thermal barriers.

a.3 Thermal barrier cooling is required for the modes of operation, including DBA, where the RCS is pressurized and relies on RCP seal integrity to maintain the reactor coolant pressure boundary. This is an initial condition in the accident analysis and is verified by U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section 3.7.7. The CCWS is the only safety-related cooling to the RCP thermal barriers. Technical Specifications require thermal barrier cooling to be supplied to the RCPs to verify 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.

a.4 Refer to the Response to Part a.1 above for a discussion of the RCP thermal barrier transfer.

Related to U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section 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.

a.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 stated in the Response to RAI 174, Question 09.02.02-20, the RCP shaft seal will be station blackout (SBO) tested to determine the average leakage prior to closure of the standstill seal system. An SBO test on the standstill seal will be done separately. Refer to

U.S. EPR FSAR Tier 2, Section 5.4.1.2.1 for information regarding 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 Tier 2, Sections 9.2.2.1 and 9.2.2.2.1 for more information. 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.

The following sections of the U.S. EPR FSAR will be revised to include this information:

- Tier 1, Table 2.7.1-1—Component Cooling Water System Equipment Mechanical Design.
- Tier 1, Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design.
- Tier 2, Table 3.9.6-2—Inservice Valve Testing Program Requirements.
- Tier 2, Table 6.2.4-1—Containment Penetration, Isolation Valve, and Actuator Data.
- Tier 2, Figure 9.2.2-2—Component Cooling Water System Common Loop 1.
- Tier 2, Section 7.6.1.2.3, Section 9.2.2.2.1, Section 9.2.2.6.1, and Section 14.2.12.5.5.

FSAR Impact:

U.S. EPR FSAR Tier 1, Section 2.7.1 and U.S. EPR FSAR Tier 2, Section 3.9.6, Section 6.2.4, Section 7.6.1, Section 9.2.2, and Section 14.2.12 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

2.7 Support Systems

2.7.1 Component Cooling Water System

1.0 Description

The component cooling water system (CCWS) is a safety related closed loop cooling water system comprising four divisions that remove heat generated from safety related and non-safety related components connected to the CCWS. Heat transferred from these components to the CCWS is rejected to the essential service water system (ESWS) via the component cooling water heat exchangers.

The CCWS provides the following significant safety related functions:

- The CCWS provides the transport of the heat from the safety injection system (SIS) and residual heat removal system (RHRS) to the ESWS.
- The CCWS provides the cooling of the thermal barrier of the reactor coolant pump (RCP) seals during all plant operating modes when the RCPs are running. There is a cross-connect in the header that supplies cooling to the RCP thermal barriers to allow thermal barrier cooling from either CCWS Common 1b or 2b headers. The cross-connect is inside containment, downstream of the CIVs on each of the Common 1b and 2b headers.
- The CCWS provides heat removal from the safety chilled water system (SCWS) divisions 2 and 3.
- The CCWS provides the removal of the decay heat from the fuel pool cooling water heat exchanger.
- The CCWS containment isolation valves close upon receipt of a containment isolation signal.

The CCWS provides the following significant non-safety-related functions:

- The non-safety-related dedicated CCWS train removes heat from the severe accident heat removal system (SAHRS).

2.0 Arrangement

2.1 The functional arrangement of the CCWS is as shown on Figure 2.7.1-1—Component Cooling Water System Functional Arrangement.

2.2 The location of CCWS equipment is as listed in Table 2.7.1-1—Component Cooling Water System Equipment Mechanical Design.

2.3 Physical separation exists between divisions of the CCWS.

3.0 Mechanical Design Features

3.1 Deleted.

3.2 Check valves will function as listed in Table 2.7.1-1.

3.3 Deleted.

3.4 Components identified as Seismic Category I in Table 2.7.1-1 can withstand seismic design basis loads without a loss of the function listed in Table 2.7.1-1.

3.5 Deleted.

3.6 Deleted.

3.7 Deleted.

3.8 Deleted.

3.9 CCWS piping shown as ASME Code Section III on Figure 2.7.1-1 is designed in accordance with ASME Code Section III requirements.

3.10 CCWS piping shown as ASME Code Section III on Figure 2.7.1-1 is installed in accordance with an ASME Code Section III Design Report.

3.11 Pressure boundary welds in CCWS piping shown as ASME Code Section III on Figure 2.7.1-1 are in accordance with ASME Code Section III.

3.12 CCWS piping shown as ASME Code Section III on Figure 2.7.1-1 retains pressure boundary integrity at design pressure.

3.13 CCWS piping shown as ASME Code Section III on Figure 2.7.1-1 is installed and inspected in accordance with ASME Code Section III requirements.

3.14 Components listed in Table 2.7.1-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

3.15 Components listed in Table 2.7.1-1 as ASME Code Section III are fabricated in accordance with ASME Code Section III requirements.

3.16 Pressure boundary welds on components listed in Table 2.7.1-1 as ASME Code Section III are in accordance with ASME Code Section III requirements.

3.17 Components listed in Table 2.7.1-1 as ASME Code Section III retain pressure boundary integrity at design pressure.

3.18 Components listed in Table 2.7.1-1 as ASME Code Section III are installed in accordance with ASME Code Section III requirements.

4.0 I&C Design Features, Displays and Controls

4.1 Displays listed in Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design are retrievable in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.7.1-2.

4.2 The CCWS equipment controls are provided in the MCR and the RSS as listed in Table 2.7.1-2.

4.3 Equipment listed as being controlled by a priority and actuator control system (PACS) module in Table 2.7.1-2 responds to the state requested by a test signal.

4.4 A CCWS low flow condition automatically opens the low head safety injection (LHSI)/residual heat removal (RHR) heat exchanger (HX) inlet valve.

4.5 A surge tank level of MIN3 automatically isolates the associated train common header switchover valves.

4.6 Deleted.

4.7 A flowrate difference between the supply and return from the Nuclear Auxiliary Building (NAB) and the Radioactive Waste Building (RWB) automatically isolates the non-safety-related branch.

4.8 Loss of one CCWS train initiates an automatic switchover to allow cooling of the common ‘a’ and/or ‘b’ headers.

4.9 Deleted.

4.10 CCWS train separation to RCP thermal barriers is maintained by interlocks provided on the supply and return thermal barrier containment isolation valves. The interlocks require that CIVs associated with one common header be closed before the other common header CIVs can be opened.

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

4.12 Upon receipt of a SIS, the four CCWS trains are started, supplying SIS pump coolers and the four LHSI heat exchangers. The non-safety-related users outside of the Reactor Building are also isolated. The following CCWS actuations are automatically initiated:

- Start operable CCWS pumps (KAA10/20/30/40 AP001), if not previously running.
- Open LHSI HX isolation valves (KAA 12/22/32/43 AA005).
- Open LHSI pump seal cooler isolation valves (KAA22/32 AA013).
- Close isolation valves for non-safety-related users outside of the Reactor Building (KAB50 AA001/004/0006 and KAB80 AA015/016/019).

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

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Description	Tag Number (1)	Location	ASME Code Section III	Function	Seismic Category
Common Header 1.b RCP Thermal Barriers Containment Isolation Valves	KAB30AA049 KAB30AA050 KAB30AA051 KAB30AA052	Safeguard Building 1 Reactor Building Reactor Building Safeguard Building 1	Yes	Close (Manually Initiated)	I
~~Common Header 1.b RCP Thermal Barriers 1/2 Upstream Containment Isolation Check Valve~~	~~KAB30AA050~~	~~Reactor Building~~	~~Yes~~	~~Prevent Backflow~~	~~I~~
Common Header 2.b RCP Thermal Barriers Containment Isolation Valves	KAB30AA053 KAB30AA054 KAB30AA055 KAB30AA056	Safeguard Building 4 Reactor Building Reactor Building Safeguard Building 4	Yes	Close (Manually Initiated)	I
~~Common Header 2.b Containment Supply Isolation Check Valve~~	~~KAB30AA054~~	~~Reactor Building~~	~~Yes~~	~~Close~~	~~I~~
Common Header 1.b Non-Safety Loads Containment Isolation Valves	KAB40AA001 KAB40AA006 KAB40AA012	Safeguard Building 1 Reactor Building Safeguard Building 1	Yes	Close	I
Common Header 1.b Containment Supply Isolation Check Valve	KAB40AA002	Reactor Building	Yes	Close	I
Common Header 2.b Auxiliary Building and Waste Building Isolation Valves	KAB50AA001 KAB50AA006 KAB50AA004	Safeguard Building 4 Safeguard Building 4 Safeguard Building 4	Yes	Close	I
Common Header 2.b 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 1.b Safety Related Loads Containment Isolation Valves	KAB60AA013 KAB60AA018 KAB60AA019	Safeguard Building 1 Reactor Building Safeguard Building 1	1N 2A 4N 3A 1N 2A	Yes	Yes	Pos	Open-Close
Common Header 2.b Safety Related Loads Containment Isolation Valves	KAB70AA013 KAB70AA018 KAB70AA019	Safeguard Building 4 Reactor Building Safeguard Building 4	4N 3A 1N 2A 4N 3A	Yes	Yes	Pos	Open-Close
Common Header 1.b RCP Thermal Barriers Containment Isolation Valves	KAB30AA049 KAB30AA050 KAB30AA051 KAB30AA052	Safeguard Building 1 Reactor Building Reactor Building Safeguard Building 1	1N 2A 4N 3A 4N 3A 1N 2A	Yes	Yes	Pos	Open-Close

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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 2.b RCP Thermal Barriers Containment Isolation Valves	KAB30AA053	Safeguard Building 4	4N 3A	Yes	Yes	Pos	Open-Close
09.02.02-114	KAB30AA054	Reactor Building	1N 2A				
	KAB30AA055	Reactor Building	1N 2A				
	KAB30AA056	Safeguard Building 4	4N 3A				
Surge Tank Demin. Water Makeup Isolation Valves	KAA10AA027	Safeguard Building 1	1N 2A	N/A	Yes	Pos	Open-Close
	KAA20AA027	Safeguard Building 2	2N 1A				
	KAA30AA027	Safeguard Building 3	3N 4A				
	KAA40AA027	Safeguard Building 4	4N 3A				
Common Header 1.a Fuel Pool Cooling Heat Exchanger 1 Downstream Control Valve	KAB10AA134	Fuel Building	1N 2A	N/A	Yes	NA / NA	NA / NA

Table 2.7.1-3—Component Cooling Water System ITAAC (8 Sheets)

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Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
4.12	Upon receipt of an SIS, the following CCWS actuations are automatically initiated: • Start operable CCWS pumps (KAA10/20/30/40 AP001), if not previously running. • Open LHSI HX isolation valves (KAA 12/22/32/43 AA005). • Open LHSI pump seal cooler isolation valves (KAA22/32 AA013). • Close isolation valves for non-safety-related users outside of the Reactor Building (KAB50 AA001/004/0006 and KAB80 AA015/016/019).	A test will be performed using test signals	The following components respond as specified below when activated by a safety injection test signal: • CCWS operable pumps (KAA10/20/30/40 AP001) start (if not previously running). • LHSI HX isolation valves (KAA12/22/32/43 AA005) open. • LHSI pump seal cooler isolation valves (KAA22/32 AA013) open. • Isolation valves for non-safety-related users outside of Reactor Building (KAB50 AA001/004/0006 and KAB80 AA015/016/019) close.
5.1	The components designated as Class 1E in Table 2.7.1-2 are powered from the Class 1E division as listed in Table 2.7.1-2 in a normal or alternate feed condition.	a. Testing will be performed for components designated as Class 1E in Table 2.7.1-2 by providing a test signal in each normally aligned division. b. Testing will be performed for components designated as Class 1E in Table 2.7.1-2 by providing a test signal in each division with the alternate feed aligned to the divisional pair.	a. The test signal provided in the normally aligned division is present at the respective Class 1E component identified in Table 2.7.1-2. b. The test signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E component identified in Table 2.7.1-2.
5.2	Valves listed in Table 2.7.1-2 fail as-is on loss of power.	Testing will be performed for the valves listed in Table 2.7.1-2 to fail as-is on loss of power.	Following loss of power, the valves listed in Table 2.7.1-2 fail as-is.

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

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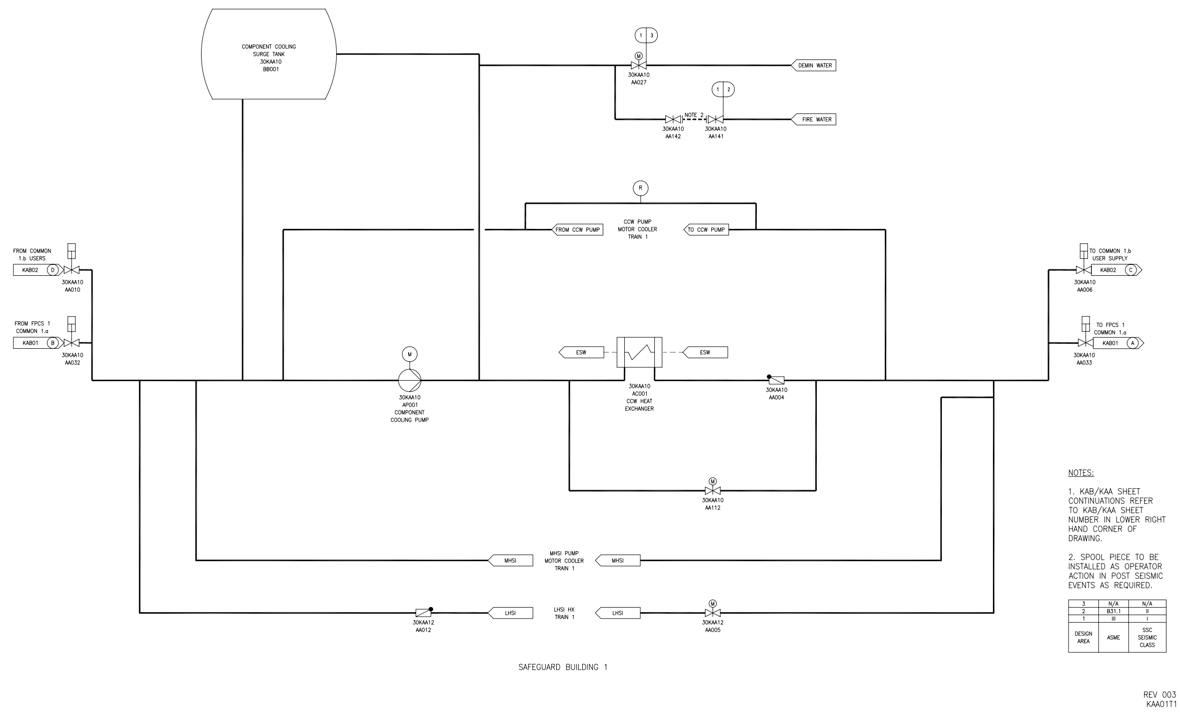

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 2 of 11

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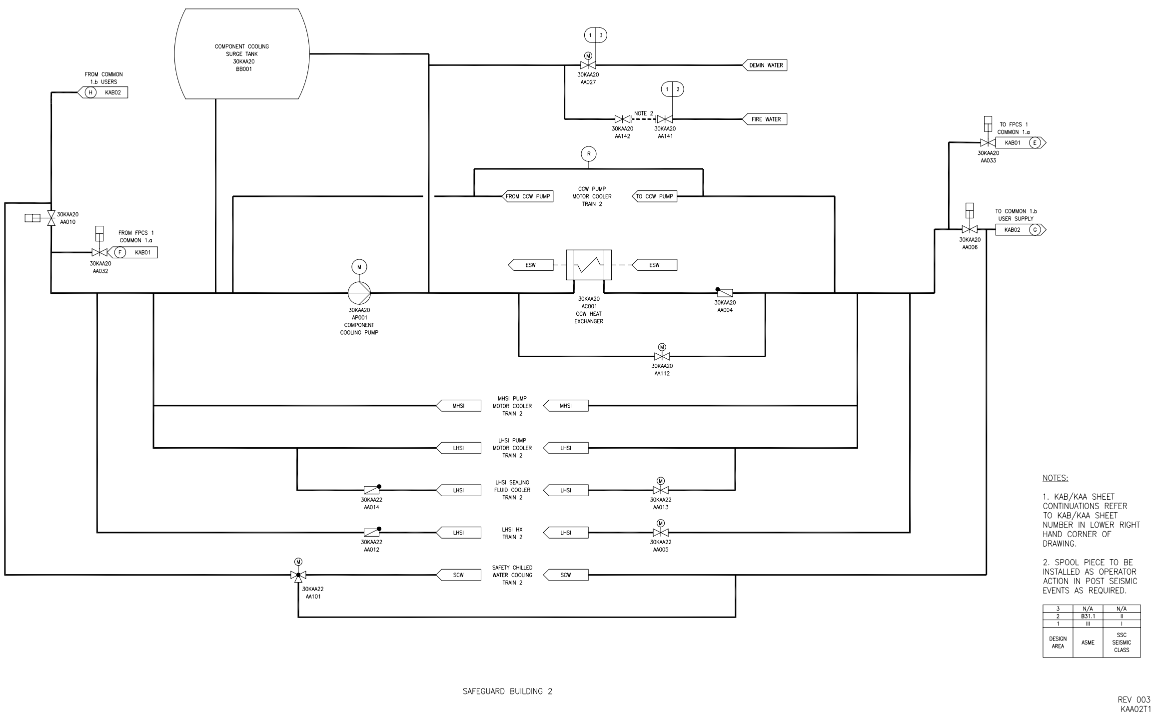

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 3 of 11

09.02.02-109 (Part 6)

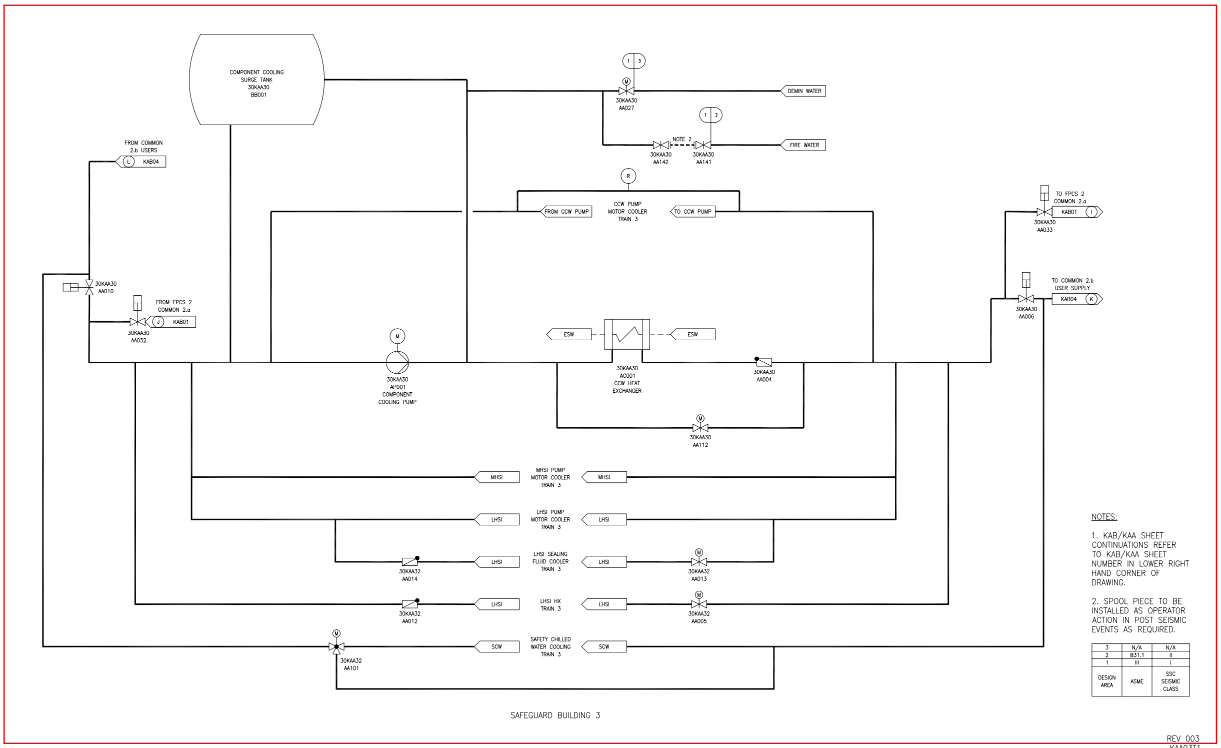

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 4 of 11

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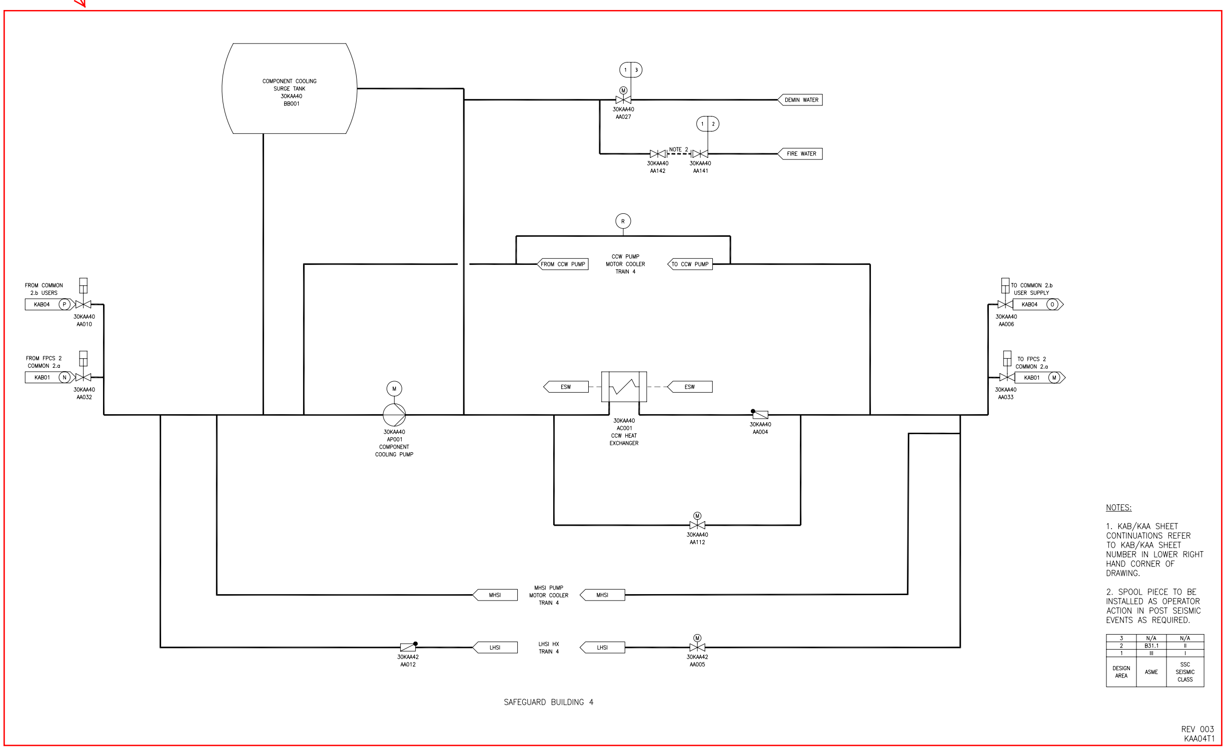

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 7 of 11

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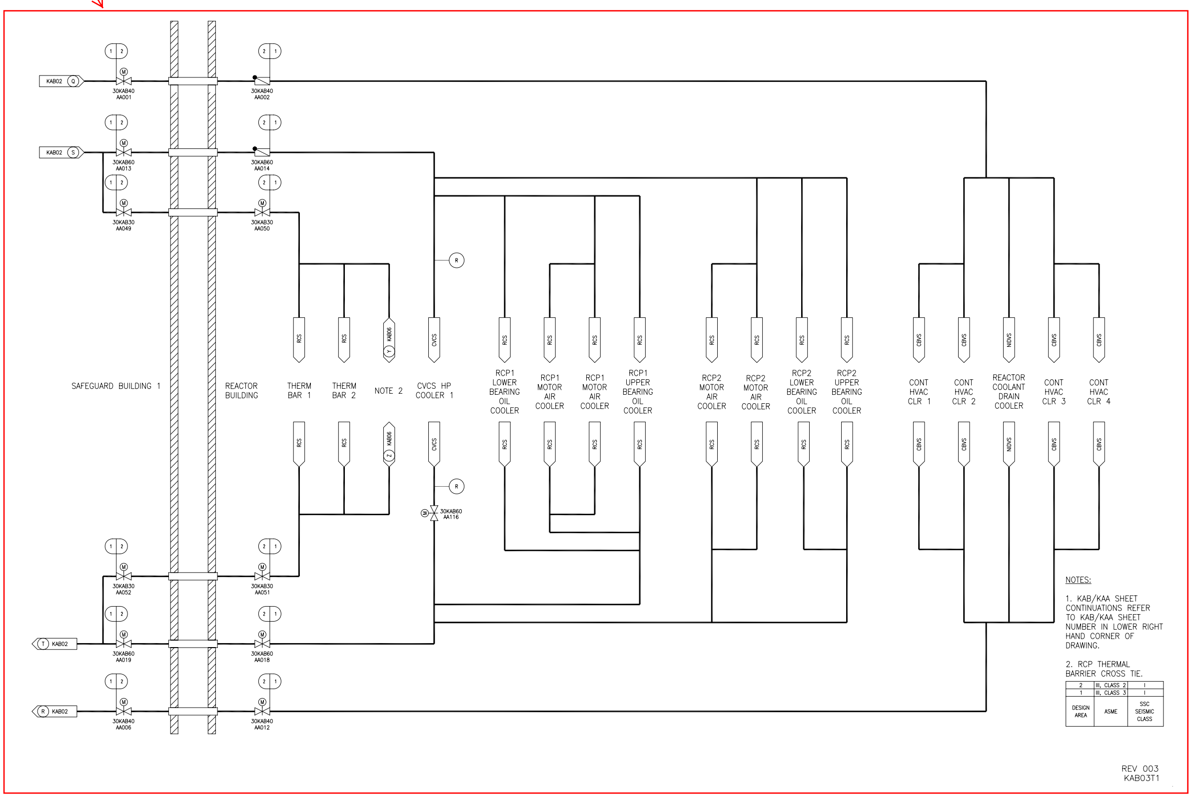

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Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
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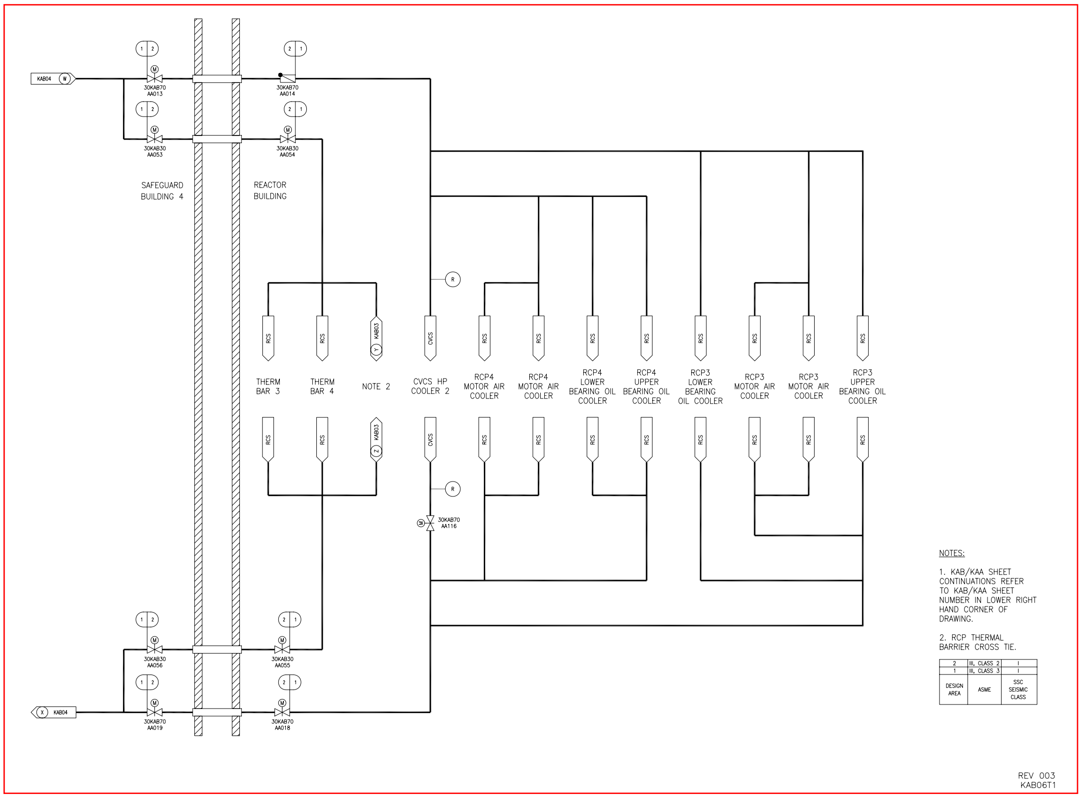

Table 3.9.6-2—Inservice Valve Testing Program Requirements (Sheet 49 of 97)

Valve Identification Number[1]	Description/ Valve Function	Valve Type[2]	Valve Actuator[3]	ASME Code Class[4]	ASME OM Code Category[5]	Active / Passive[6]	Safety Position[7]	Test Required[8,10]	Test Frequency[9]	Comments
30KAA30AA014	Common 2.B Return Manual Isolation Valve	BF	MA	3	B	A	O/C	ET	5Y	
30KAB10AA192	RV Downstream Common 1B	RV	SA	3	C	A	O/C	ET LT	10Y 10Y	
30KAB80AA015	Supply Isolation Operational Chilled Water Users	BF	HO	3	A	A	C	ET ST LT PI	Q Q 2Y 2Y	
30KAB80AA016	Supply Isolation Operational Chilled Water Users	BF	HO	3	A	A	C	ET ST LT PI	Q Q 2Y 2Y	
30KAB80AA019	Return Isolation Operational Chilled Water Users	BF	HO	3	A	A	C	ET ST LT PI	Q Q 2Y 2Y	
30KAB80AA020	Return Common 1B	CK	SA	3	C	A	C	ET	Q	
30KAB30AA049	RCP Thermal Barrier 1 and 2 Supply Outside CIV	GT	MO	2	A	A	C	ET ST LT PI	Q Q 2Y 2Y	LT per 10 CFR 50, Appendix J
30KAB30AA050	Supply Thermal Barrier 1 and 2 Inside CIV	~~CK~~GT	~~SA~~MO	2	A/~~C~~	A	C	ET ST LT PI	~~CS~~Q ~~RF~~Q ~~2Y~~2Y 2Y	LT per 10 CFR 50, Appendix J

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Table 3.9.6-2—Inservice Valve Testing Program Requirements (Sheet 51 of 97)

Valve Identification Number[1]	Description/ Valve Function	Valve Type[2]	Valve Actuator[3]	ASME Code Class[4]	ASME OM Code Category[5]	Active / Passive[6]	Safety Position[7]	Test Required[8,10]	Test Frequency[9]	Comments
30KAB40AA194	RV Downstream Cont. HVAC	RV	SA	3	C	A	O/C	ET LT	10Y 10Y	
30KAB60AA013	Supply KBA, RCP 1 and 2 Outside CIV	GT	MO	2	A	A	C	ET ST LT PI	Q Q 2Y 2Y	LT per 10 CFR 50, Appendix J
30KAB60AA014	Supply RCP 1and 2 Inside CIV	CK	SA	2	A/C	A	C	ET LT PI	CS RF 2Y	LT per 10 CFR 50, Appendix J
30KAB60AA018	Return KBA, RCP 1 and 2 Inside CIV	GT	MO	2	A	A	C	ET ST LT PI	Q Q 2Y 2Y	LT per 10 CFR 50, Appendix J
30KAB60AA019	Return KBA, RCP 1 and 2 Outside CIV	GT	MO	2	A	A	C	ET ST LT PI	Q Q 2Y 2Y	LT per 10 CFR 50, Appendix J
30KAB60AA191	RV Return CVCS HP CL1	RV	SA	3	C	A	O/C	ET LT	10Y 10Y	
30KAB10AA193	RV Downstream FPCS HX1	RV	SA	3	C	A	O/C	ET LT	10Y 10Y	
30KAB20AA192	RV Downstream Common 2B	RV	SA	3	C	A	O/C	ET LT	10Y 10Y	
30KAB30AA054	Supply Thermal Barrier 3 and 4 Inside CIV	~~CK~~GT	~~SA~~MO	2	A~~/C~~	A	C	ET ST LT PI	~~CS~~Q ~~RF~~Q ~~2Y~~2Y 2Y	LT per 10 CFR 50, Appendix J

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Table 6.2.4-1—Containment Penetration, Isolation Valve, and Actuator Data
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Penetration No.	GDC Req.	System Name	Fluid	Line Size (in)	Essent System	Potent Bypass Path	Valve Number	Valve Location	LLRT	Valve Type and Operator	Primary Actuation	Secondary Actuation	Normal Position	Shutdown Position	Post Accident Position	Power Failure Position	Cont. Isolation Signal	Valve Closure Time	Power Source
60BQ114	57	CCWS return HVAC & PEH	water	10.0	no	no	KAB40 AA006	outside	C	gate/ MOV	PS	RM	open	o/c	close	as-is	stage 1	≤ 50 sec	31BNB03
60BQ117	57	CCWS supply to RCP	water	4.0	yes	no	KAB30 AA050	inside	C	09.02.02-114 ~~swing check~~gate/ MOV	~~self~~RM	~~self~~RM	open	open	open	~~n/a~~as-is	~~n/a~~no	~~n/a~~≤ 15 sec	~~n/a~~34BRA
60BQ117	57	CCWS supply to RCP	water	4.0	yes	no	KAB30 AA049	outside	C	gate/ MOV	RM	RM	open	open	open	as-is	no	≤ 15 sec	31BNB03
60BQ118	57	CCWS return RCP	water	4.0	yes	no	KAB30 AA052	outside	C	gate/ MOV	RM	RM	open	open	open	as-is	no	≤ 15 sec	31BNB03
60BQ118	57	CCWS return RCP	water	4.0	yes	no	KAB30 AA051	inside	C	gate/ MOV	RM	RM	open	open	open	as-is	no	≤ 15 sec	34BRA
60BQ407	57	CCWS & CVCS to RCP	water	12.0	no	no	KAB70 AA014	inside	C	swing check	self	self	open	o/c	close	n/a	n/a	n/a	n/a
60BQ407	57	CCWS & CVCS to RCP	water	12.0	no	no	KAB70 AA013	outside	C	gate/ MOV	PS	RM	open	o/c	close	as-is	stage 2	≤ 60 sec	34BNB03
60BQ408	57	CCWS & CVCS return RCP	water	12.0	no	no	KAB70 AA018	inside	C	gate/ MOV	PS	RM	open	o/c	close	as-is	stage 2	≤ 60 sec	31BRA
60BQ408	57	CCWS & CVCS return RCP	water	12.0	no	no	KAB70 AA019	outside	C	gate/ MOV	PS	RM	open	o/c	close	as-is	stage 2	≤ 60 sec	34BNB03
60BQ420	57	CCWS supply to RCP	water	4.0	yes	no	KAB30 AA054	inside	C	09.02.02-114 ~~swing check~~gate/ MOV	~~self~~RM	~~self~~RM	open	open	open	~~n/a~~as-is	~~n/a~~no	~~n/a~~≤ 15 sec	~~n/a~~31BRA
60BQ420	57	CCWS supply to RCP	water	4.0	yes	no	KAB30 AA053	outside	C	gate/ MOV	RM	RM	open	open	open	as-is	no	≤ 15 sec	34BNB03
60BQ421	57	CCWS return RCP	water	4.0	yes	no	KAB30 AA055	inside	C	gate/ MOV	RM	RM	open	open	open	as-is	no	≤ 15 sec	31BRA

is prompted to manually acknowledge P12, which allows the isolation valves to be closed before RCS pressure is reduced below the accumulator pressure.

A pressure region exists below the P12 pressure threshold where the accumulators are required to be available but Plant Technical Specifications allow an accumulator isolation valve to be closed for a short period of time. To accommodate operation in this pressure region, an automatic 'open' signal is sent to the accumulator isolation valves when an SIS actuation occurs. The SIS actuation function is described in Section 7.3.1.2.

Two redundant ALU within a division send the automatic opening signal to the isolation valve of the corresponding accumulator (i.e., PS division one opens the isolation valve related to the train 1 accumulator). This arrangement precludes a single actuator logic unit (ALU) failure from preventing the opening of a valve. Any other single failure which could prevent opening of a valve, such as failure of a PACS module or of the valve itself, is detected immediately by failure of the valve to open. Corrective actions can then be taken before continued increase in pressure.

The operational status of the PS on a divisional basis is provided to the operator. Indications and alarms are provided to the operator regarding the state of the P12 permissive signal. Additionally, the following indications are provided to the operator to verify correct operation of the interlock:

- Pressure and level of each accumulator.
- Open or closed position of each accumulator isolation valve.

7.6.1.2.3 Interlocks Isolating Redundant CCWS Trains

The CCWS is comprised of four closed-loop, safety-related supply trains that function to cool and transfer heat load from safety users to the heat sink. The common loads cooled by the CCWS consist of two separate sets, referred to as Common-1 and Common-2. The Common-1 header is supplied by either CCW train one or train two while the Common-2 header is supplied by either CCW train three or train four. Each common header is further divided into two sub-headers designated as Common 1a and 1b or Common 2a and 2b.

The operation of the CCWS is described in Section 9.2.2.

Interlocks are provided so that no two redundant CCWS trains are connected to the same common header at the same time. Each CCWS train is provided with four switchover valves to perform the required train separation.

CCWS train one has a single valve on the supply side and a single valve on the return side of Common 1a. Train two also has a single valve on both the supply and return sides of Common 1a. These valves are interlocked so that both valves (supply and return) on train one must be closed before either valve on train two can be opened. Likewise, both valves on train two must be closed before either valve on train one can be opened. The same valve arrangement and interlocks are provided relative to Common 1b to provide separation between trains one and two, and on Common 2a and 2b to provide separation between trains three and four. The functional logic for the switchover valve interlock is shown in Figure 7.6-1.

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Another interlocking function is required concerning the cooling paths of the Common 1b and Common 2b headers toward the reactor coolant pump (RCP) thermal barriers. Either the Common 1b or 2b headers can provide cooling to the RCP thermal barriers. To maintain strict CCWS train separation, the containment isolation valves (CIV) on the RCP thermal barriers cooling path on the supply and return side of Common 1b cannot be opened unless ~~the CIVs on both the supply and return side of~~one of the two CIVs on the supply side and one of the two CIVs on the return side of Common 2b are closed, and vice versa. The functional logic for the CIV interlock is shown in Figure 7.6-2.

The interlock functions maintaining separation between redundant CCWS trains are performed by the SAS. Each switchover valve is assigned to a SAS division based on the CCWS train it belongs to (i.e., switchover valves on train one are assigned to SAS division one). Each division of SAS acquires position information from the valves to which it is assigned, and controls those same valves. In any SAS division, the information about the position of valves in other trains that is needed to control a switchover valve is provided via network connection by the SAS division which acquires the information. For example, the positions of the train two valves on the supply and return of Common 1a are acquired by SAS division two. This information is transmitted to SAS division one to perform the interlock function for the train one valves on the supply and return of Common-1a.

The interlock function concerning the CIVs is also performed by the SAS, but is only performed in divisions one and four. The CIVs are assigned to SAS divisions for control based on which electrical division provides power to the valves (i.e., valves powered by electrical division one are controlled by SAS division one). The closed position indications of the CIVs on Common-1b are used to allow opening of the CIVs on Common 1a, and vice versa.

Redundant SAS controllers are provided in each division, and redundant networks are used between the divisions so that no single failure within the SAS can result in inadvertent connection of redundant CCWS trains. Each valve is equipped with redundant open/closed position sensors so that a single sensor failure does not result in inadvertent connection of redundant CCWS trains. While each switchover valve is controlled by one I&C division, multiple PACS modules in that division, acting on multiple solenoid devices, are required in order to change the position of a switchover valve. Therefore, a single PACS module failure does not result in inadvertent

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

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

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

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

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

The CCWS flow rate is automatically controlled for those users which have been determined to have a limited operating temperature range for support of stable operation, while less temperature-sensitive users remain at a fixed flow resistance during all operating conditions. These fixed flow rates are adjusted once during plant commissioning with the system in its most demanding flow configuration (system flow

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

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

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

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

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

9.2.2.2.2 Component Description

Refer to Section 3.2 for details of the seismic and system quality group classification of the CCWS, CCW structures, and CCW components.

CCWS Pumps

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CCWS pumps are sized to provide the capacity to support system flow requirements during penalizing conditions. To accomplish this, design margins are added to the limiting ~~flow~~ requirements (volumetric flow and head). The pump design flow of 18,294 gpm shown in Table 9.2.2-1 includes an approximate 15 percent margin above the required maximum pump flow. The pump head of 199.7 ft in Table 9.2.2-1 includes an approximate 15 percent margin above the required maximum pump head. ~~The required design margins of the CCWS pumps are given in Table 9.2.2-5—Design Margins of CCWS Pumps.~~

~~Margin is combined using the square root of the sum of the squares method to prevent system over design which challenges system operation during normal operation. Considering that margin must be available for system flow balancing, the margin provided for this purpose is added using a straight summation to that combined using the square root of the sum of the squares (e.g., wear, testing uncertainty, grid frequency deviations). The margin (penalties) to be applied to the pump design conditions are as follows:~~

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Pump head design margin: $\sqrt{(10\%)^2 + (2\%)^2 + (3.31\%)^2} + 5\% = 15.72\%$

Pump flow design margin: $\sqrt{(10\%)^2 + (2\%)^2 + (1.67\%)^2} + 5\% = 15.33\%$

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

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

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

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

Dedicated CCWS Pump

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

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

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

Dedicated CCWS Makeup Pump

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

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CCWS Heat Exchangers

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

Dedicated CCWS Heat Exchanger

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

CCWS Surge Tanks

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

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

The required surge tank water volume to account for system leakage in a post-seismic event with no available makeup is dependent on the assumed system alignment. For the CCWS, the assumed leakage paths are through each of the (2) 16" Common A header isolation valves and the (2) 24" Common B header isolation valves. Pump seal leakage and miscellaneous valve packing leakage is also considered for each CCWS train. The leakage rate for the CCWS valves is based on ASME QME-1 for flow control valves that are also intended to serve as isolation valves. ASME QME-1 simultaneously opened to prohibit more than one train from being connected to a common header:

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

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

- Normal Switchover.

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

- Automatic Backup Switchover.

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

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

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

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

- CCW temperature at the outlet of CCWS HX must be above the minimum required and below the maximum allowed.
- CCWS pump steady state operating flow must be between the minimum required and the maximum allowable.

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

During normal plant and system operation, switchover of the common headers is periodically done by the plant operators to verify the operability of the CCWS trains (system surveillances) via the normal switchover sequence. 09.02.02-109

Hot Shutdown

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

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

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

Cool Down Procedure

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

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

This configuration is the same as for Hot Shutdown.

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

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

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

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

Dedicated Train

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

Loss of a CCWS train

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CCWS Safety-Related Trains

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

Dedicated Train

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

Active Failure

CCWS Safety-Related Trains

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

Dedicated Train

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

CCWS Protection Against RCS Dilution

Tube Rupture Inside RHR Heat Exchanger

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

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

9.2.2.6.1 Control Features and Interlocks

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

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9.2.2.6.1.1 CCWS Automatic I&C Safety-Related Functions

~~Emergency~~Automatic Backup Switchover Sequence

Train automatic backup switchover is performed if common 1.b (2.b) header is ~~not isolated coincident with~~supplied by a CCWS train and any of the following are realized:

- Loss of CCWS pump (KAA10/20/30/40 AP001).
- Loss of one ESWS train (PEB10/20/30/40 AP001).
- Low flow rate to system users.

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

Train automatic backup switchover consists of:

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

The on-coming train common .a sub-header switchover valve may then be manually opened.

Emergency CCWS Temperature Control

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

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

This temperature control function is required during all plant modes of operation, ~~except for SBO,~~ when the CCWS (KAA10/20/30/40) is energized.

Emergency Leak Detection Sequence

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

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

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- The common user ~~emergency~~automatic and normal switchover sequence is inhibited to avoid the transfer of the faulted piping on the associated train. The non-safety-related branches are isolated by fast closing valves if there is a flow mismatch between the inlet and outlet of the users supply and return lines.
- If the surge tank level continues to decrease to less than the MIN3 setpoint, the common headers are isolated by closure of the switchover valves (KAA10/20/30/40 AA006/010/032/033) and the switchover sequence is prohibited.
- If the surge tank level continues to decrease to less than MIN4 set point, the associated CCWS train pump is tripped and the common user sets switchover sequence function is unlocked to allow supplying of the common users by the ~~associated~~opposite train capable of supplying the common header. The DWDS supply isolation valve (KAA10/20/30/40 AA027) is also closed in order to avoid DW water supply to a train with a leak.

The surge tank level is detected by two redundant analog level measurements.

CCWS Actuation from Safety Injection Signal

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

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

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

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

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

CCWS Operation from Containment Isolation Stage 1

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

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

CCWS Operation from Containment Isolation Stage 2

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

CCWS Response to a LOOP

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

CCWS Switchover Valve Interlock

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

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

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Thermal Barrier Isolation

~~The following actions indicate a fault of a RCP thermal barrier~~A fault of an RCP thermal barrier is recognized by the following indications:

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

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

CCWS Containment Isolation Valve Interlock

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

Switchover Valves Leakage or Failure

In the event of a switchover valve seat leakage or failure and depending upon the difference in pressure between the two CCWS trains, a water transfer can occur. If the water transfer leads to a MAX2 in one of the two associated trains and MIN3 on the other, the common users are automatically isolated from the safety trains.

9.2.2.6.1.2 CCWS Manual I&C Safety-Related Functions

CCWS Manual Control

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

- CCWS pump (30KAA10/20/30/40 AP001).
- CCWS switchover valves (30KAA10/20/30/40 AA006/010/032/033).
- CCWS heat exchanger bypass valve (KAA10/20/30/40 AA112).
- Non-safety-related branch Isolation valves (KAB50 AA001/004/006, KAB80 AA015/~~015~~016/019).
- CIVs.

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

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

9.2.2.6.1.3 CCWS Non-Safety-Related Functions

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Normal Switchover Sequence

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

This action is normally done when only one train is in operation on a pair of two associated trains. ~~In the semi-automatic normal switchover sequence, all the parameters which can be checked before the actuation of the valves are done to increase the reliability of the sequence.~~

This switchover consists of the following sequential actions:

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

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

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

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

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In case a CIV fails to ~~close~~open ~~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.

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CCWS Temperature Control

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

1E functions, which are addressed in Section 9.2.2.6.1, will override other manual or automatic non-safety control functions.

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

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

Manual Start and Trip of a Train

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

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

Dedicated CCWS Control

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

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

System monitoring instrumentation transmits the following signals:

- Pump discharge flow rate.
- SAHRS heat exchanger CCWS return flow.
- Surge tank pressure.

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9.2.2.6.1.6 RCP Thermal Barrier Temperature Monitoring

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

9.2.2.7 CCWS Failure Modes and Effects Analysis

A failure modes and effects analysis (FMEA) for the component cooling water system (CCWS) is provided in Table 9.2.2-6.

Mission success criteria for the CCWS includes:

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

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

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

9.2.2.8 References

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

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

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

4. IEEE Std 603-1991, “IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers, 1991.

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

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Table 9.2.2-1—CCWS Design Parameters

Description	Technical Data
Component Cooling Water Pump (KAA10/20/30/40 AP001	
Number	4
Type	Centrifugal Pump
Flow rate max.	~~17,768~~18,294 gpm
Pump head min (at max flow rate)	199.7 ft
Dedicated Component Cooling Water Pump (KAA80 AP001)	
Number	1
Type	Centrifugal Pump
Flow Rate	~~2678~~2439.2 gpm
Pump Head	~~180~~175.2 ft
Component Cooling Water Surge Tank KAA10/20/30/40 BB001)	
Number	4
Volume	950 ft^3
Dedicated Component Cooling Water Surge Tank (KAA80 BB001)	
Number	1
Volume	75 ft^3
Component Cooling Water HX (KAA10/20/30/40 AC001)	
Number	4
Heat Load (DBA)	~~291.3~~293.35 x 10^6 Btu/hr
Dedicated Component Cooling Water HX (KAA80 AC001	
Number	1
Heat Load	51.2 x 10^6 Btu/hr

Table 9.2.2-2—CCWS User Requirements Summary
Sheet 1 of 5

Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
CCWS Main Trains 1 and 4				
CCWS Pump Motor Cooler	KAA10/40 AC002	0.0955	0.0302	
LHSI Heat Exchanger	JNG10/40 AC001	152.8	2.984	Normal Cooldown when CCW train is only connected to the train SIS users (1)
		36.54	2.1906	Normal Cooldown when CCW train is only connected to the CCW common header (1)
		241	2.1906	DBA
MHSI Pump Motor Cooler	JND10/40 AP001	0.0239	0.0265	
CCWS Main Trains 2 and 3				
CCWS Pump Motor Cooler	KAA20/30 AC002	0.0955	0.0302	
LHSI Heat Exchanger	JNG20/30 AC001	152.8	2.984	Normal Cooldown when CCW train is only connected to the train SIS users (1)
		36.54	2.1906	Normal Cooldown when CCW train is also connected to the CCW common header (1)
		241	2.1906	DBA
MHSI Pump Motor Cooler	JND20/30 AP001	0.0239	0.0265	
LHSI Pump Motor Cooler	JNG20/30 AP001	0.1262	0.0141	
LHSI Sealing Fluid Cooler	JNG20/30 AP001	0.0341	0.0062	Flow isolated when LHSI pump is out of service for dilution prevention
Common Header 1				
Fuel Pool Cooling Hx	FAK10 AC001	29	0.8818	Normal Operations
		67.62	2.645	Refueling

Table 9.2.2-2—CCWS User Requirements Summary
Sheet 2 of 5

Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
Safety Chiller	QKA20 AC002	5.705	0.514	
RCP Thermal Barrier	N/A	1.566	0.0792	Thermal Barriers 1-4 can be cooled by
Additional Operational Users	QNA, QNB, JEB, KBA, KLA, KTA, QUC, KUA	69.86	4.11	
Common Header 2				
Fuel Pool Cooling Hx	FAK20 AC001	29	0.8818	Normal Operations
		47.8	2.645	Refueling
Safety Chiller	QKA30 AC002	5.705	0.514	
RCP Thermal Barrier	N/A	1.566	0.0792	Thermal Barriers 1-4 can be cooled by
Additional Operational Users	QNA, QNB, JEB, KBA, QUC, KUA, LCQ, KBF, KBG, KPC, KPF	86.29	4.29	
Dedicated CCWS Train				
Severe Accident Heat Removal System Heat Exchanger	JMQ40 AC001/004	50.5	1.104	
~~**Fuel Pool Cooling System**~~				
~~Fuel Pool Cooling Heat Exchanger~~	~~30FAK10/20 AC001~~	~~29~~	~~0.8818~~	~~Normal Operations~~
		~~47.8~~	~~2.645~~	~~Normal Refueling~~
		~~33.78~~	~~2.645~~	~~Refueling (full off-load)~~
~~**Reactor Coolant System**~~				
~~RCP Lower Bearing Oil Cooler~~	~~JEB10/20/30/40 AC001~~	~~0.0819~~	~~0.0088~~	~~Cooling Isolated with Containment Isolation (CI) Stage 1 Signal~~
~~RCP Motor Air Cooler~~	~~JEB10/20/30/40 AC002/003~~	~~1.075~~	~~0.0529~~	
~~RCP Upper Bearing Oil Cooler~~	~~JEB10/20/30/40 AC004~~	~~1.305~~	~~0.1323~~	
~~RCP Thermal Barrier~~	~~N/A~~	~~0.3915~~	~~0.0198~~	~~Not Isolated with CI-1 or CI-2~~
~~**Safety Injection and Residual Heat Removal System**~~				
~~MHSI Pump Motor Cooler~~	~~JND10/20/30/40 AP001~~	~~0.239~~	~~0.0265~~	

Table 9.2.2-2—CCWS User Requirements Summary
Sheet 3 of 5

Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
LHSI Heat Exchanger	JNG10/20/30/40 AC001	152.8	2.984	Normal cooldown when CCW train is only connected to the train SIS users
		36.54	2.1906	Normal cooldown when CCW train is also connected to the CCW common header
		241	2.1906	DBA
LHSI Pump Motor Cooler	JNG20/30 AP001	0.1262	0.0141	
LHSI Sealing Fluid Cooler	JNG20/30 AP001	0.0341	0.0062	Flow isolated when LHSI pump is out of service for dilution prevention
Severe Accident Heat Removal System				
SAHRS Heat Exchanger	JMQ40 AC001	47.77	1.106	Cooled by dedicated CCWS
SAHRS Pump Seal Watercooler	JMQ40 AC003	0.0593	0.0053	Cooled by dedicated CCWS
SAHRS Pump Motor Cooler	JMQ40 AC002	0.089	0.0079	Cooled by dedicated CCWS
SAHRS Pump Bearing Cooler	JMQ40 AC004	0.0223	0.002	Cooled by Dedicated CCWS
Volume Control System				
CVCS HP Cooler	KBA11/12 AC001	30.71	0.873	Plant Heatup
		14.3	0.2968	Normal Load
		6.9	0.1228	Plant Cooldown
Charging Pump Motor Cooler	KBA31/32 AP001	0.1706	0.0198	
Charging Pump Oil Cooler	KBA31/32 AP001	0.1706	0.0025	
Charging Pump Seal Water Cooler	KBA31/32 AP001	0.1706	0.0033	
Coolant Treatment System				

Table 9.2.2-2—CCWS User Requirements Summary
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Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
~~After Cooler~~	~~KBF25 AC001~~	~~0.6824~~	~~0.0381~~	~~Cooling Isolated with Safety Injection (SI) Signal~~
~~Condensate Cooler~~	~~KBF20 AC006~~	~~0.9315~~	~~0.0262~~	
~~Condenser~~	~~KBF20 AC003~~	~~0.6824~~	~~0.019~~	
~~Gas Cooler~~	~~KBF20 AC004~~	~~0.0358~~	~~0.002~~	
~~Gas Cooler~~	~~KBF40 AC004~~	~~0.0481~~	~~0.0027~~	
~~Reflux Cooler~~	~~KBF40 AC003~~	~~0.9622~~	~~0.0262~~	
~~Seal Water Cooler~~	~~KBF35 AC001~~	~~0.1297~~	~~0.0071~~	
~~Coolant Degasification System~~				
~~CDS Condenser~~	~~KBG10 AC002~~	~~8.131~~	~~0.4524~~	~~Cooling Isolated with SI Signal~~
~~CDS Gas Cooler~~	~~KBG10 AC003~~	~~0.6244~~	~~0.0349~~	
~~Containment Ventilation System~~				
~~Containment HVAC Cooler 1/2/3/4~~	~~KLA61/63 AC001/003~~	~~1.365~~	~~0.1437~~	~~Cooling Isolated with CI Stage 1 Signal~~
~~Solid Waste System~~				
~~Condenser~~	~~KPC30/40/50 AC001~~	~~0.0341~~	~~0.0024~~	~~Cooling Isolated with SI Signal~~
~~Vacuum Unit~~	~~KPC60 AC001~~	~~0.0239~~	~~0.0048~~	

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Table 9.2.2-2—CCWS User Requirements Summary
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Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
Liquid Waste Processing System				
Distillate Cooler	KPF11 AC004	0.3583	0.0167	Cooling Isolated with SI Signal
Gas Cooler	KPF11 AC003	1.365	0.0397	
Injection Water Cooler	KPF11 AC006	0.0409	0.0024	
Seal Water Cooler	KPF11 AC007	0.1297	0.0071	
Nuclear Island Drain and Vent System				
Reactor Coolant Drain Cooler	KTA10 AC001	1.996	0.1124	Cooling Isolated with CI Stage 1 Signal
Nuclear Sampling System				
Nuclear Sampling (RCS/HL3)	KUA10 AC001	0.3958	0.0147	
Nuclear Sampling (RCS/HL3)	KUA20 AC001	0.3958	0.0147	
Nuclear Sampling (RCS/PZR)	KUA30 AC001	0.3958	0.0147	
Steam Generator Blowdown System				
SGBS Second Stage Cooler	LCQ51 AC003/004	10.03	0.1932	Cooling Isolated with SI Signal; Heat Exchangers are in series and the heat transfer listed is the combined load.
Safety Chilled Water System				
Safety Chiller	QKA20/30 AC002	4.123	0.373	
Operational Chilled Water System				
OCWS (QNA)	QNA21/22/23/24 AC002	11.84	0.986	Cooling Isolated with SI Signal
OCWS (QNB)	QNB62/63 AC002	1.269	0.119	
Sampling System for Condensate Systems				
SG Secondary Sampling (SG1)	QUC11 AC001	0.2593	0.0097	
SG Secondary Sampling (SG2)	QUC12 AC002	0.2593	0.0097	
SG Secondary Sampling (SG3)	QUC13 AC003	0.2593	0.0097	
SG Secondary Sampling (SG4)	QUC14 AC004	0.2593	0.0097	

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Note:

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

Table 9.2.2-5—Design Margins of CCWS Pumps

	Parameter	Margin	Basis
Pump Wear (In-Service Testing) Tolerances	Required Pump TDH	-10%	(1)
	Required Design Flow		
Plant Testing Instrument Uncertainty	Required Pump TDH	±2%	(1)
	Required Design Flow		
Frequency Variations	Required Pump TDH	±3.31%	(2)
	Required Design Flow	±1.67%	
Pump Manufacturing Tolerances and Testing	Required Pump TDH	+3%	(3)
	Required Design Flow		
System Flow Balancing	Required Pump TDH	5%	(4)
	Required Design Flow		

Notes:

1. ASME OM Code – 2004, Subsection ISTB-3400

2. Northeast Power Coordinating Council (NPCC) Document A-03, "Emergency Operation Criteria," defines a reduced grid frequency transient of 57 Hz (5 percent) for three seconds that ramps to 59 Hz over five minutes. New generating plants are expected to be designed to stay on line during this transient. This transient is bounded by National Electrical Manufacturers Association requirements so that the motors continue to operate successfully. However, a corresponding reduction in speed would result in a reduction in pump performance. Based on the preliminary nature of the requirement and the short duration of the transient, a +/- 1 Hz variation will be used.

3. Manufacturing tolerance (+) need only to be considered for the determination of design pressure or run-out flow by specifying a guaranteed minimum pump curve, including shop performance test instrument uncertainty.

4. Margin is applied to the system flow requirements to accommodate system flow balancing. For the controlling user, it is expected that the head loss associated with this increased flow could vary by four percent.

Table 9.2.2-7—CCWS Heat Load Summary

CCWS Operational Alignment	Heat Load (10^6 BTU/hr)
RCS Heat-up CCWS Train 1or 2 Connected to Common 1	108.38
RCS Heat-up CCWS Train 3 or 4 Connected to Common 2	124.93[1]
RCS Cooldown CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	120
RCS Cooldown CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	97.52
RCS Cooldown CCWS Trains Not Connected to a Common Header	153.06
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	293.35
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	292.95

Notes:

1. Current analysis assuming a representative constant heat transfer coefficient indicates that 124.93 MBTU/hr combined with CCWS and ESWS flow rates will require the greatest heat transfer area for the CCWS heat exchanger. For final procurement, a 10 percent margin for tube plugging will be required. The DBA case will require a minimum additional margin of 10 percent above the specified 10 percent tube plugging allowance.

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Table 9.2.2-8—CCWS Pump Flow Summary

CCWS Operational Alignment	CCWS Pump Discharge Flow (10^6 lbm/hr)[1]	CCWS Pump Discharge Flow (gpm)[1]
Normal Operation; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	7.5	15494
Normal Operation; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	7.678	15862
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	4.434	9160
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	4.419	9129

Notes:

1. The total required pump flow in each alignment includes recirculation flow to each CCWS surge tank. The margins discussed in Section 9.2.2 are applied to the highest calculated required flow. Applying the margin to the largest calculated total flow requirement envelopes the required flow for all CCWS pumps in any operating mode.

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Figure 9.2.2-1—Component Cooling Water System Trains 1 through 4
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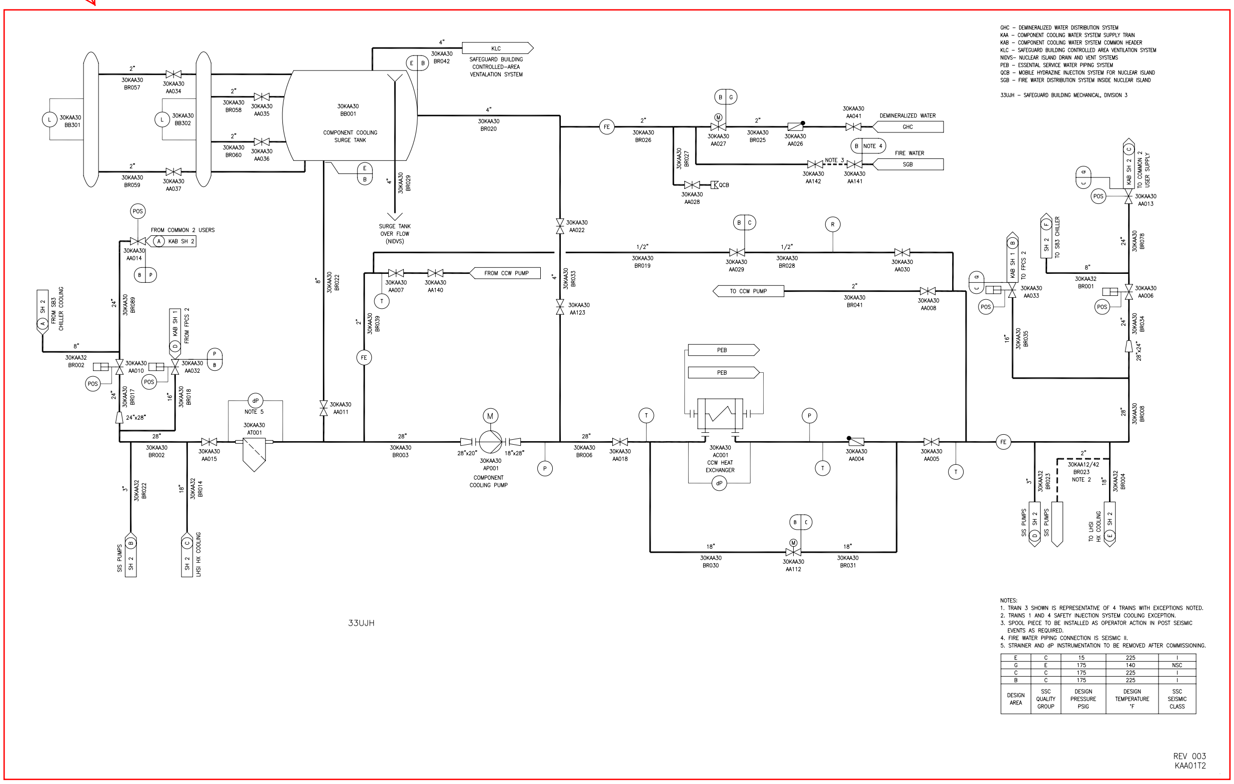

DESIGN AREA	SSC QUALITY GROUP	DESIGN PRESSURE PSIG	DESIGN TEMPERATURE °F	SSC SEISMIC CLASS
E	C	15	225	I
G	E	175	140	NSC
C	C	175	225	I
B	C	175	225	I

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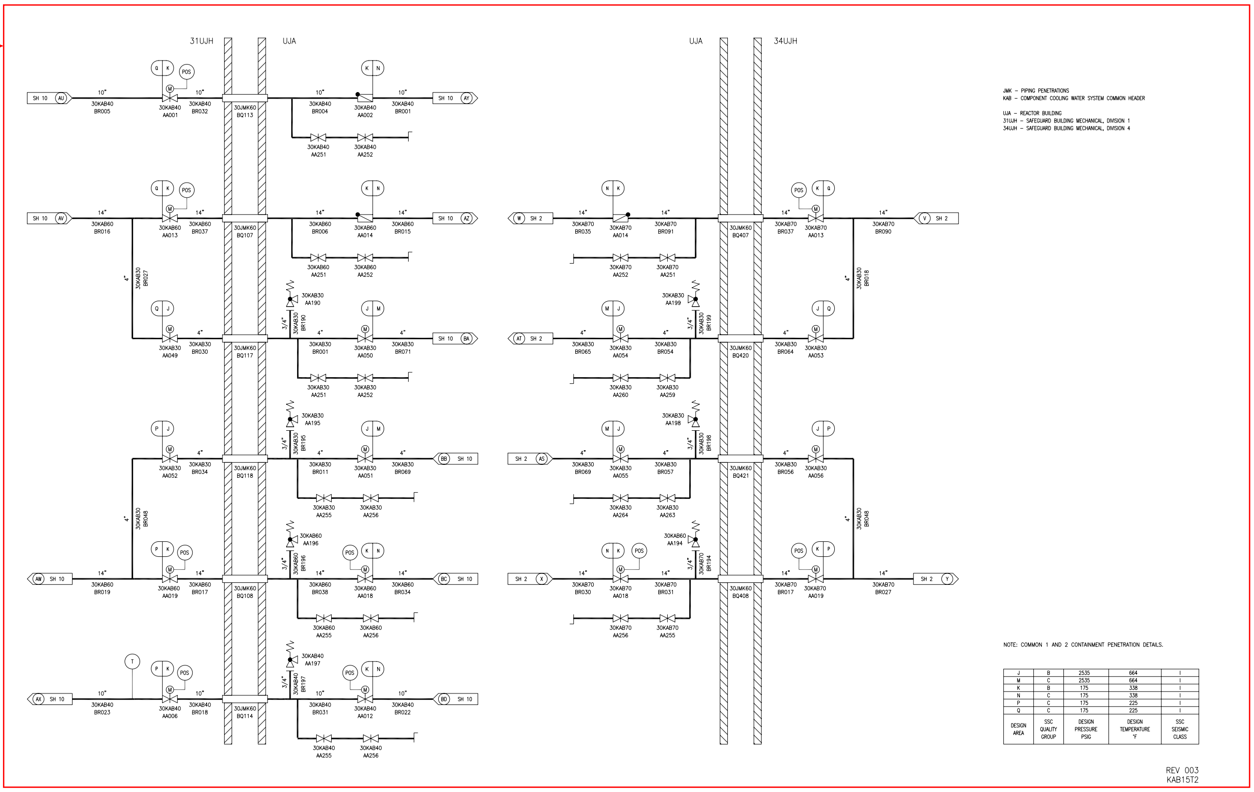

DESIGN AREA	SSC QUALITY GROUP	DESIGN PRESSURE PSIG	DESIGN TEMPERATURE °F	SSC SEISMIC CLASS
J	B	2535	664	I
M	C	2535	664	I
K	B	175	338	I
N	C	175	338	I
P	C	175	225	I
Q	C	175	225	I

Table 9.2.5-1—Ultimate Heat Sink System Interface

Component	Max Heat Load MBTU/hr	Total Required ESW Flow (10^6 lb_m/hr)	Required ESW Temperature	Comments
CCWS heat exchanger	128.1	7.540 min	≤92°F	Normal Operation
	120.1	7.540 min	≤90°F	Spring/Fall Outage Cooldown
	~~291.3~~293.35[1]	7.540 min	≤95°F	DBA
Dedicated CCWS heat exchanger	~~48.64~~51.2 (nominal)	~~1.205~~1.102 min	≤95°F	Severe Accident
EDG heat exchanger	22.0	1.06	≤95°F	
ESW pump room cooler for 31/32/33/34 UQB	0.619	0.0685	≤ 95°F	Normal Operations Shutdown/ Cooldown and DBA
ESW pump room cooler for 34 UQB	0.314	0.0347	≤ 95°F	Severe Accident - ESW flow supplied by dedicated ESW pump

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Notes:

1. The CCWS heat exchanger load on the UHS in DBA is equal to the LHSI DBA heat load of 241 x 106 Btu/hr in Table 9.2.2-2 plus the additional loads from the CCWS common users.

2.2 Potable and sanitary water systems instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system required for operation of the potable and sanitary water systems are complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 The potable and sanitary water systems suction supplies are being maintained at the water level (pressure) specified in the design documents.

3.0 TEST METHOD

3.1 Verify potable and sanitary water systems measured pump and system flow meet design specifications.

3.2 Verify that potable and sanitary water systems interlocks and protective features perform as designed.

4.0 DATA REQUIRED

4.1 Pump operating data.

4.2 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The potable and sanitary water systems meet design requirements (refer to Section 9.2.4):

5.1.1 System flow is within design limits.

5.1.2 Supplied water meets design requirements.

14.2.12.5.5 Component Cooling Water System (Test #046)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the CCWS to provide treated cooling water under the following conditions:

1.1.1 Normal unit operation.

1.1.2 During unit cooldown.

1.1.3 During refueling.

1.1.4 During an emergency situation.

1.2 To demonstrate that system response to a simulated ESF actuation signal is as designed.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.4 To demonstrate the CCWS is adequately designed and constructed to prevent water hammer.

2.0 PREREQUISITES

2.1 Construction activities on the CCWS have been completed.

2.2 CCWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Plant systems required to support testing are functional, or temporary systems are installed and functional.

3.0 TEST METHOD

3.1 Demonstrate that operation of the surge tanks and their controls is within design limits.

3.2 Demonstrate that system and component flow paths, flow rates, and pressure drops including head versus flow verification for the CCW pumps is within design limits.

3.2.1 Verify that pump starts/stops, valve realignments resulting from automatic switchover, RCP thermal barrier transfer, automatic valve closures and pump trips occur without introducingObserve the system during operation for the following water hammer indications:

- Noise.
- Pipe movement.
- Pipe support or restraint damage.
- Leakage.
- Damaged valves or equipment.
- Pressure spikes or waves.

3.3 Perform a pump head versus flow verification for CCW pumps.

3.3.1 $NPSH_a \geq NPSH_R$.

3.3.2 Starting time (motor start time and time to reach rated flow).

3.4 Verify the stroke closure time of the CCWS switchover valves.

3.5 Verify that the start of a CCWS pump generates a starting of the corresponding ESWS train.

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.7 Observe response of power-operated valves upon loss of motive power (refer to Section 9.2.2 for anticipated response).

3.8 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.9 Verify pump control from the PICS.

3.10 Demonstrate the ability of the CCWS in conjunction with the RHRS and essential service water system to perform a plant cooldown during HFT.

3.11 Verify that the RCP thermal barriers can be supplied by either the 1.b or 2.b common header. Demonstrate that the supply can be realigned with the RCPs operating during HFT.

3.12 Verify that the fire protection makeup to the CCW surge tank meets design flow rates.

3.13 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.14 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS common 1.b ~~Emergency~~Automatic Backup Switchover function.

3.14.1 Initiate a failure of CCWS Train 1 by simulating a signal for CCWS Train 1 discharge pressure less than or equal to MIN1. Verify the following actions occur:

- CCWS Train 1 common 1.b supply and return switchover valves close.
- CCWS Train 1 LHSI heat exchanger isolation valve opens.
- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.
- RCP thermal barrier flow returns to normal.

3.14.2 Initiate a failure of CCWS Train 1 by simulating a signal for loss of ESWS Train 1. Verify the following actions occur:

- CCWS Train 1 common 1.b supply and return switchover valves close.
- CCWS Train 1 LHSI heat exchanger isolation valve opens.
- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.
- RCP thermal barrier flow returns to normal.

3.14.3 Initiate a failure of CCWS Train 1 by simulating a signal for main train (flow through CCW pump and heat exchanger, with or without flow through common headers) flow rate less than or equal to MIN1. Verify the following actions occur:

- CCWS Train 1 common 1.b supply and return switchover valves close.
- CCWS Train 1 LHSI heat exchanger isolation valve opens.

- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.
- RCP thermal barrier flow returns to normal.

3.15 Perform step 3.14 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.16 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Emergency Temperature Control function by simulating two out of three Train 1 temperature sensors greater than MAX1. Verify the following action occurs:

- CCWS Train 1 heat exchanger bypass valve closes until MAX1 is cleared (or the valve is fully closed).

3.17 Perform step 3.16 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.18 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Emergency Leak Detection function.

3.18.1 Simulate a CCWS Train 1 surge tank level signal less than or equal to MIN2 and simulate a flow mismatch between the inlet and outlet of the common 1.b header (~~main common user group~~non-safety related branches). Verify the following actions occur:

- KAB80 AA015/016/019~~CCWS common 1.b non-safety users isolation~~ valves close.
- Normal and Automatic Switchover functions are inhibited~~CCWS common 1.b supply outer RB isolation valve closes~~.

3.18.2 Simulate a CCWS Train 1 surge tank level signal less than or equal to MIN3. Verify the following actions occur:

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

3.18.3 Simulate a CCWS Train 1 surge tank level signal less than or equal to MIN4. Verify the following actions occur:

- DWDS supply isolation valve closes.
- CCWS common 1.b Automatic~~Emergency~~ Backup Switchover function is enabled.
- CCWS Train 1 pump trips and CCWS Train 2 pump automatically starts~~CCWS Emergency Temperature Control function is enabled~~.

3.19 Perform step 3.18 for CCWS Trains 2, 3, and 4 to verify appropriate responses. For common 2.b testing with Trains 3 and 4 valves KAB50 AA001/004/006 close.

3.20 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Actuation from Safety Injection function by simulating a safety injection signal to CCWS. Verify the following actions occur:

- CCWS Train 1/2/3/4 pumps start automatically (if not previously running).
- CCWS Train 1/2/3/4 LHSI heat exchanger isolation valves KAA12/22/32/42 AA005 open.
- Isolation valves for non-safety-related users outside the Reactor Building (KAB50 AA001/004/006 and KAB80 AA015/016/019) closeCCWS common 2 non-safety users supply isolation valve closes.
- LHSI pump seal cooler isolation valves (KAA22/32 AA013) openCCWS common 2 non-safety users upstream and downstream isolation valves close.
- CCWS common 1.b NAB non-safety users isolation valves close.

3.21 Perform step 3.20 for CCWS Trains 2, 3 and 4 to verify appropriate responses.

3.22 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Operation from Stage 1 Containment Isolation signal and CCWS Operation from Stage 2 Containment Isolation signal functions.

3.22.1 Simulate a containment stage 1 isolation signal to CCWS. Verify the following actions occur:

- CCWS containment isolation valves KAB40 AA001/006/012 closeCCWS common 1 supply outer containment isolation valve closes.
- CCWS common 1 return inner and outer containment isolation valves close.

3.22.2 Simulate a containment stage 2 isolation signal to CCWS. Verify the following actions occur:

- CCWS containment isolation valves KAB60/70 AA013/018/019 closeCCWS common 1 safety users supply outer containment isolation valve closes.
- CCWS common 1 safety users return inner and outer containment isolation valves close.
- CCWS common 2 safety users supply outer containment isolation valve closes.
- CCWS common 2 safety users return inner and outer containment isolation valves close.

3.23 Perform step 3.22 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.24 Verify that CCWS Train 1 is supplying the common 1.a header (fuel pool cooling and safety injection loads) and the common 1.b header (main common user group) then perform test of CCWS Response to a LOOP function by simulating a loss of offsite power to CCWS. Verify the following actions occur:

- ~~CCWS common 2 safety users return inner and outer containment isolation valves close.~~
- CCWS Train 1 starts upon receipt of a Protection System signal.

3.25 Perform step 3.24 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.26 Verify that CCWS Train 1 is supplying the common 1.a header (fuel pool cooling and safety injection loads) and the common 1.b header (main common user group) then perform test of CCWS Switchover Valve Interlock function. Verify the following groupings of valves cannot be simultaneously opened to prohibit more than one train from being connected to a common header:

- KAA10 AA033/032 with KAA20 AA033/32.~~CCWS Train 1 common 1.a switchover valves with Train 2 common 1.a switchover valves~~
- KAA30 AA033/032 with KAA40 AA033/32.~~CCWS Train 3 common 2.a switchover valves with Train 4 common 2.a switchover valves~~
- KAA10 AA006/010 with KAA20 AA006/010.~~CCWS Train 1 common 1.b switchover valves with Train 2 common 1.b switchover valves~~
- KAA30 AA006/010 with KAA40 AA006/010.~~CCWS Train 3 common 2.b switchover valves with Train 4 common 2.b switchover valves~~

3.27 Verify that CCWS Train 1 or 2 is supplying the common 1.b header (main common user group), then perform test of CCWS RCP Thermal Barrier Containment Isolation Valve Interlock function. Verify the following action occurs:

- KAB30 AA049/051/052 must be closed prior to opening KAB30 AA053/055/056 and vice versa~~CCWS common Train 1.b and 2.b can not be placed into service at the same time~~.

3.28 Perform step 3.27 for CCWS Train 3 or 4 supplying common 2.b header to verify appropriate responses.

3.29 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Switchover Valve Leakage or Failure function by simulating CCWS Train 1 surge tank level less than MIN3 and CCWS surge tank 2 level greater than MAX2. Verify the following actions occur:

- 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 responsesPerform 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.

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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 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 each of the 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 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 each of the four RCP thermal barriers.

4.0 DATA REQUIRED

4.1 Record pump head versus flow and operating data for each pump.

4.2 Flow balancing data including flow to each component and throttle valve positions.

4.3 Setpoints of alarms interlocks and controls.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Temperature data during cooldown.

4.8 Response of CCW System to SIAS, CIAS, surge tank level signal, and CCW header differential flow signal.

5.0 ACCEPTANCE CRITERIA

5.1 The CCWS meets design requirements (refer to Section 9.2.2):

5.1.1 Operation of the surge tanks and their controls is within design limits.

5.1.2 System and component flow paths, flow rates, and pressure drops including head versus flow verification for the CCW pumps is within design limits.

5.1.3 Pump head versus flow verification for CCW pumps is within design limits.

5.1.4 Response to safety-related simulated signals meets design requirements.

5.1.5 Non-safety-related headers and RCP headers are isolated on simulated signals.