ArevaEPRDCPEm Resource

From:	Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent:	Friday, April 03, 2009 5:08 PM
To:	Getachew Tesfaye
Cc:	KOWALSKI David J (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject:	Response to U.S. EPR Design Certification Application RAI No. 174, Supplement 2
Attachments:	RAI 174 Supplement 2 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided responses to 8 of the 49 questions of RAI No. 174 on February 27, 2009. Supplement 1 response to RAI No. 174 was sent on March 13, 2009 to address 4 of the remaining questions.

The attached file, “RAI 174 Supplement 2 Response US EPR DC.pdf” provides technically correct and complete responses to 11 of the remaining 37 questions, as committed.

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 174 Questions 09.02.02-11, 09.02.02-16, 09.02.02-18, 09.02.02-19, 09.02.02-21, 09.02.02-23, 09.02.02-24, 09.02.02-25, 09.02.02-30 and 09.02.02-34.

The following table indicates the respective pages in the response document, “RAI 174 Supplement 2 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 174 — 09.02.02-11	2	2
RAI 174 — 09.02.02-16	3	5
RAI 174 — 09.02.02-18	6	8
RAI 174 — 09.02.02-19	9	12
RAI 174 — 09.02.02-21	13	14
RAI 174 — 09.02.02-22	15	16
RAI 174 — 09.02.02-23	17	18
RAI 174 — 09.02.02-24	19	19
RAI 174 — 09.02.02-25	20	20
RAI 174 — 09.02.02-30	21	22
RAI 174 — 09.02.02-34	23	24

The schedule for a technically correct and complete response to the remaining questions is unchanged and provided below.

Question #	Response Date
RAI 174 — 09.02.02-7	May 20, 2009
RAI 174 — 09.02.02-8	May 20, 2009
RAI 174 — 09.02.02-9	May 20, 2009
RAI 174 — 09.02.02-12 (Parts 6, 7 and 8)	May 20, 2009
RAI 174 — 09.02.02-20	May 20, 2009
RAI 174 — 09.02.02-28	May 20, 2009
RAI 174 — 09.02.02-29	May 20, 2009
RAI 174 — 09.02.02-31	May 20, 2009
RAI 174 — 09.02.02-32	May 20, 2009
RAI 174 — 09.02.02-35	May 20, 2009

RAI 174 — 09.02.02-36	May 20, 2009
RAI 174 — 09.02.02-37	May 20, 2009
RAI 174 — 09.02.02-38	May 20, 2009
RAI 174 — 09.02.02-39 (Parts f and g)	May 20, 2009
RAI 174 — 09.02.02-42	May 20, 2009
RAI 174 — 09.02.02-43	May 20, 2009
RAI 174 — 09.02.02-44	May 20, 2009
RAI 174 — 09.02.02-45	May 20, 2009
RAI 174 — 09.02.02-46	May 20, 2009
RAI 174 — 09.02.02-47	May 20, 2009
RAI 174 — 09.02.02-48	May 20, 2009
RAI 174 — 09.02.02-51	May 20, 2009
RAI 174 — 09.02.02-52	May 20, 2009
RAI 174 — 09.02.02-53	May 20, 2009
RAI 174 — 09.02.02-54	May 20, 2009
RAI 174 — 09.02.02-55	May 20, 2009

Sincerely,

Ronda Pederson

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From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, March 13, 2009 4:56 PM
To: 'Getachew Tesfaye'
Cc: KOWALSKI David J (AREVA NP INC); DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 174, Supplement 1

Getachew,

AREVA NP Inc. provided responses to 8 of the 49 questions of RAI No. 174 on February 27, 2009. The attached file, “RAI 174 Supplement 1 Response US EPR DC.pdf” provides technically correct and complete responses to 4 of the remaining 41 questions, as committed.

The following table indicates the respective pages in the response document, “RAI 174 Supplement 1 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 174 — 09.02.02-39 (Parts a though e)	2	3
RAI 174 — 09.02.02-40	4	4
RAI 174 — 09.02.02-41	5	5
RAI 174 — 09.02.02-49	6	6

RAI 174 — 09.02.02-50	7	7

The schedule for a technically correct and complete response to the remaining questions is unchanged and provided below.

Question #	Response Date
RAI 174 — 09.02.02-7	May 20, 2009
RAI 174 — 09.02.02-8	May 20, 2009
RAI 174 — 09.02.02-9	May 20, 2009
RAI 174 — 09.02.02-11	April 3, 2009
RAI 174 — 09.02.02-12 (Parts 6, 7 and 8)	May 20, 2009
RAI 174 — 09.02.02-16	April 3, 2009
RAI 174 — 09.02.02-18	April 3, 2009
RAI 174 — 09.02.02-19	May 20, 2009
RAI 174 — 09.02.02-20	May 20, 2009
RAI 174 — 09.02.02-21	May 20, 2009
RAI 174 — 09.02.02-22	April 3, 2009
RAI 174 — 09.02.02-23	May 20, 2009
RAI 174 — 09.02.02-24	May 20, 2009
RAI 174 — 09.02.02-25	April 3, 2009
RAI 174 — 09.02.02-28	May 20, 2009
RAI 174 — 09.02.02-29	May 20, 2009
RAI 174 — 09.02.02-30	April 3, 2009
RAI 174 — 09.02.02-31	May 20, 2009
RAI 174 — 09.02.02-32	May 20, 2009
RAI 174 — 09.02.02-34	May 20, 2009
RAI 174 — 09.02.02-35	May 20, 2009
RAI 174 — 09.02.02-36	May 20, 2009
RAI 174 — 09.02.02-37	May 20, 2009
RAI 174 — 09.02.02-38	May 20, 2009
RAI 174 — 09.02.02-39 (Parts f and g)	May 20, 2009
RAI 174 — 09.02.02-42	May 20, 2009
RAI 174 — 09.02.02-43	May 20, 2009
RAI 174 — 09.02.02-44	May 20, 2009
RAI 174 — 09.02.02-45	May 20, 2009
RAI 174 — 09.02.02-46	May 20, 2009
RAI 174 — 09.02.02-47	May 20, 2009
RAI 174 — 09.02.02-48	May 20, 2009
RAI 174 — 09.02.02-51	May 20, 2009
RAI 174 — 09.02.02-52	May 20, 2009
RAI 174 — 09.02.02-53	May 20, 2009
RAI 174 — 09.02.02-54	May 20, 2009
RAI 174 — 09.02.02-55	May 20, 2009

Sincerely,

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Sent: Friday, February 27, 2009 5:46 PM
To: 'Getachew Tesfaye'
Cc: DELANO Karen V (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. 174, FSAR Ch. 9

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 174 Response US EPR DC.pdf" provides technically correct and complete responses to 8 of the 49 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 174 Questions 09.02.02-10, 09.02.02-17 and 09.02.02-33.

The following table indicates the respective pages in the response document, "RAI 174 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 174 — 09.02.02-7	2	2
RAI 174 — 09.02.02-8	3	3
RAI 174 — 09.02.02-9	4	4
RAI 174 — 09.02.02-10	5	6
RAI 174 — 09.02.02-11	7	7
RAI 174 — 09.02.02-12	8	10
RAI 174 — 09.02.02-13	11	11
RAI 174 — 09.02.02-14	12	12
RAI 174 — 09.02.02-15	13	14
RAI 174 — 09.02.02-16	15	16
RAI 174 — 09.02.02-17	17	17
RAI 174 — 09.02.02-18	18	19
RAI 174 — 09.02.02-19	20	21
RAI 174 — 09.02.02-20	22	22
RAI 174 — 09.02.02-21	23	23
RAI 174 — 09.02.02-22	24	24
RAI 174 — 09.02.02-23	25	25
RAI 174 — 09.02.02-24	26	26
RAI 174 — 09.02.02-25	27	27
RAI 174 — 09.02.02-26	28	28
RAI 174 — 09.02.02-27	29	29
RAI 174 — 09.02.02-28	30	30
RAI 174 — 09.02.02-29	31	31
RAI 174 — 09.02.02-30	32	32
RAI 174 — 09.02.02-31	33	34
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RAI 174 — 09.02.02-33	37	37
RAI 174 — 09.02.02-34	38	38
RAI 174 — 09.02.02-35	39	39
RAI 174 — 09.02.02-36	40	40
RAI 174 — 09.02.02-37	41	41
RAI 174 — 09.02.02-38	42	42
RAI 174 — 09.02.02-39	43	43
RAI 174 — 09.02.02-40	44	44
RAI 174 — 09.02.02-41	45	45
RAI 174 — 09.02.02-42	46	46
RAI 174 — 09.02.02-43	47	47
RAI 174 — 09.02.02-44	48	48
RAI 174 — 09.02.02-45	49	49
RAI 174 — 09.02.02-46	50	50
RAI 174 — 09.02.02-47	51	51
RAI 174 — 09.02.02-48	52	52
RAI 174 — 09.02.02-49	53	53
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RAI 174 — 09.02.02-52	56	56
RAI 174 — 09.02.02-53	57	57
RAI 174 — 09.02.02-54	58	58
RAI 174 — 09.02.02-55	59	59

A complete answer is not provided for 41 of the 49 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	**Response Date**
RAI 174 — 09.02.02-7	May 20, 2009
RAI 174 — 09.02.02-8	May 20, 2009
RAI 174 — 09.02.02-9	May 20, 2009
RAI 174 — 09.02.02-11	April 3, 2009
RAI 174 — 09.02.02-12 (Parts 6, 7 and 8)	May 20, 2009
RAI 174 — 09.02.02-16	April 3, 2009
RAI 174 — 09.02.02-18	April 3, 2009
RAI 174 — 09.02.02-19	May 20, 2009
RAI 174 — 09.02.02-20	May 20, 2009
RAI 174 — 09.02.02-21	May 20, 2009
RAI 174 — 09.02.02-22	April 3, 2009
RAI 174 — 09.02.02-23	May 20, 2009
RAI 174 — 09.02.02-24	May 20, 2009
RAI 174 — 09.02.02-25	April 3, 2009
RAI 174 — 09.02.02-28	May 20, 2009
RAI 174 — 09.02.02-29	May 20, 2009
RAI 174 — 09.02.02-30	April 3, 2009
RAI 174 — 09.02.02-31	May 20, 2009
RAI 174 — 09.02.02-32	May 20, 2009
RAI 174 — 09.02.02-34	May 20, 2009
RAI 174 — 09.02.02-35	May 20, 2009
RAI 174 — 09.02.02-36	May 20, 2009
RAI 174 — 09.02.02-37	May 20, 2009

RAI 174 — 09.02.02-38	May 20, 2009
RAI 174 — 09.02.02-39 (Parts a though e) RAI 174 — 09.02.02-39 (Parts f and g)	March 13, 2009 May 20, 2009
RAI 174 — 09.02.02-40	March 13, 2009
RAI 174 — 09.02.02-41	March 13, 2009
RAI 174 — 09.02.02-42	May 20, 2009
RAI 174 — 09.02.02-43	May 20, 2009
RAI 174 — 09.02.02-44	May 20, 2009
RAI 174 — 09.02.02-45	May 20, 2009
RAI 174 — 09.02.02-46	May 20, 2009
RAI 174 — 09.02.02-47	May 20, 2009
RAI 174 — 09.02.02-48	May 20, 2009
RAI 174 — 09.02.02-49	March 13, 2009
RAI 174 — 09.02.02-50	March 13, 2009
RAI 174 — 09.02.02-51	May 20, 2009
RAI 174 — 09.02.02-52	May 20, 2009
RAI 174 — 09.02.02-53	May 20, 2009
RAI 174 — 09.02.02-54	May 20, 2009
RAI 174 — 09.02.02-55	May 20, 2009

Sincerely,

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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, January 28, 2009 3:56 PM
To: ZZ-DL-A-USEPR-DL
Cc: Larry Wheeler; John Segala; Peter Wilson; Peter Hearn; Joseph Colaccino; Michael Miernicki; Meena Khanna; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 174 (1806, 1810),FSAR Ch. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on January 9, 2009, and discussed with your staff on January 22, 2009. No changes were made to the draft RAI 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: 373

Mail Envelope Properties (5CEC4184E98FFE49A383961FAD402D31CDFA62)

Subject: Response to U.S. EPR Design Certification Application RAI No. 174, Supplement 2
Sent Date: 4/3/2009 5:08:03 PM
Received Date: 4/3/2009 5:08:08 PM
From: Pederson Ronda M (AREVA NP INC)

Created By: Ronda.Pederson@areva.com

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Files	**Size**	**Date & Time**
MESSAGE	12227	4/3/2009 5:08:08 PM
RAI 174 Supplement 2 Response US EPR DC.pdf		585776

Options
Priority: Standard
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Sensitivity: Normal
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Recipients Received:

Response to

Request for Additional Information No. 174 (1806, 1810), Supplement 2, Revision 0

01/28/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems
Application Section: 9.2.2

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

Question 09.02.02-11:

NRC Generic Letter (GL) 96-06 identifies concerns with hydrodynamic effects of water hammer during design events such as loss of coolant accidents.

Justify that the design and operation of the U.S. EPR CCWS addresses the waterhammer and two-phase flow concerns discussed in GL 96-06, ”Assurance of Equipment Operability and Containment Integrity During design Basis Accident Conditions“, and justify that these issues do not pose a problem for CCWS. Note that guidance for water hammer prevention and mitigation is provided in NUREG-0927, “Evaluation of Water Hammer Occurrence in Nuclear Power Plants”.

Response to Question 09.02.02-11:

The design of the component cooling water system (CCWS) minimizes and withstands adverse transients (i.e., water hammer) and meets functional performance requirements for all operating modes including postulated design basis accidents (DBA) consistent with the guidance for water hammer prevention and mitigation found in NUREG-0927.

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

Vents are provided for venting components and piping at high points in liquid filled systems that can become normally idle and in which voids could occur. These vents are located for ease of operation and testing on a periodic basis.

To avoid voiding, which can occur following pump shutdown or during standby, the pumps and CCWS users are placed at an elevation below the water level of the surge tanks. Means are provided for a slow and controlled fill of those portions of the CCWS where voiding could occur after pump shutdown or during standby.

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

Inservice testing requirements are described in U.S. EPR FSAR Tier 2, Section 3.9.6; and inservice inspection requirements are discussed in U.S. EPR FSAR Tier 2, Section 6.6.

U.S. EPR FSAR Tier 2, Section 9.2.2.1 will be revised to include this additional information concerning water hammer in the CCWS.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.2.1 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-16:

Standard Review Plan (SRP) 9.2.2 Section III, requires confirmation of the overall arrangement of the component cooling system (CCWS). Tier 2 FSAR Sections 9.2.2.2.2 and 7.6.1.2.3 provide a description of the hydraulic operated common header switchover valves and switchover of the common headers is mentioned in several areas of the text. In order for the staff to complete its evaluation associated with the switchover valves, the FSAR needs to be revised as appropriate (including Piping and Instrumentation Diagrams) to provide clarification as discussed below.

The FSAR Tier 2 Section 9.2.2.2.2 discussion states “They (the switchover valves) are used to transfer cooling of the common users during normal plant operation or in the event of a failure during a design basis event.”

a. Describe the specific process control signals that initiate automatic switchover of a common header. In addition to loss of a component cooling water system (CCWS) or essential service water system (ESWS) pump, describe other signals that will initiate switchover (e.g. low CCWS flow). These should be clearly listed in the FSAR.

b. If not previously running, describe if a loss of a CCWS pump automatically start the ESWS pump (i.e. in addition to the CCWS pump) in the opposite train.

c. If a switchover is initiated by a signal other than loss of a CCWS pump (e.g. loss of an ESWS pump), state if the CCWS pump on the train associated with the failed ESWS pump will automatically trip.

d. Describe how the switchover sequence is initiated by the operators if a safety-related CCWS train is to be removed from service.

e. If a safety injection actuation signal is received and a safety train feeding the common header is lost, describe if spent fuel pool cooling automatically switches over to the redundant train or if the control room operators need to initiate the transfer similar to what is described in Section 9.2.2.6.1 for normal operation.

f. Section 9.2.2.2.2 states that “The (switchover) valves are interlocked so that two trains may not be simultaneously connected to the same common header.” This indicates that the valve connected to the initial safety related CCWS train must close before the switchover valve from the opposite header begins to open in order to maintain train separation. Since this is an important system design feature, it should be described in Section 9.2.2.6, “Control Features and Interlocks,” and the description should make reference to Section 7.6.1.2.3 for a more detailed description.

g. The switchover sequence as presented by the applicant results in a lapse in cooling flow while the switchover valves on one train are closed and the redundant train switchover valves begin to open. Describe how long this lapse in flow exists, how much time is required for switchover completion, and what impact this has on the common header loads.

h. Explain what constitutes excessive valve seat leakage for the single isolation valves that are used between safety-related CCWS trains, what the basis for this determination is, and how performance will be monitored to ensure that excessive seat leakage does not exist. Also, describe the consequences of a failure of one common header switchover valve, discuss operating experience that pertains to these valves and the potential for and likelihood of common mode failures that can occur.

Response to Question 09.02.02-16:

a. The automatic switchover of a common header cooling is initiated in the event of:

- Loss of a CCWS pump sensed with a low CCWS pump discharge pressure.
- Loss of one ESWS train sensed with a low ESWS pump discharge pressure.
- Low flow rate to the CCWS users (e.g., inadvertent closure of handle valve on CCWS train, failure of a manual switchover sequence).

The specific process control signals (e.g., setpoints, control logic) will be identified later in the design process.

Information related to the automatic switchover of a common header is given in U.S. EPR FSAR Tier 2, Section 9.2.2.6.1.

b. To maintain cooling of the safety-related users of the Nuclear Island Cooling Chain, the ESWS is automatically actuated when the associated CCWS train is started.

c. In the event a switchover is initiated by loss of an ESWS pump, the CCWS pump in the train associated with the failed ESWS pump will not automatically trip.

Refer to U.S. EPR FSAR Tier 2, Section 9.2.2.6.1 for a description of this process. This section states "…that the loss of a CCWS pump, ESWS pump, or inadequate cooling flow to affected users will generate a signal to close the affected train switchover valves and open its LHSI (low head safety injection) heat exchanger isolation valve. This gives the associated CCWS train a continued flow path."

d. During normal plant and system operation, switchover of the CCWS common headers is periodically done by plant operators to verify the operability of the CCWS trains (system surveillances) and to equalize the run time of each CCWS pump.

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 parameters which can be checked before actuation of the valves are done to increase the reliability of the sequence.

The switchover consists of the following sequential actions:

- Starting of ESWS pump.
- Starting of CCWS pump.
- Opening LHSI heat exchanger isolation valve on the on-coming train as a mini flow line.
- Closing of the switchover valves on the off-going train and opening of the train associated LHSI heat exchanger isolation valve to avoid water hammer.

- Opening of switchover valves on the on-coming train.

The unavailability of a CCWS train (e.g., low level on the surge tank, loss of pump) inhibits the common users switchover to this train.

If the switchover valves on the initial train fail to close or the switchover valves on the on-coming train fail to open, which may occur if the on-coming train switchover sequence is inhibited due to low surge tank level, the alignment is automatically switched back to the initial configuration.

e. In case of loss of one CCWS or ESWS train, an automatic switchover is performed to allow the cooling of the common headers (“a” and/or “b”) with the available CCWS train.

f. The CCWS switchover valves are interlocked to provide train separation of the redundant CCWS divisions and confirm that a fault affects no more than one train. The switchover valve connected to the initial safety-related CCWS train must close before the switchover valve from the opposite train begins to open in order to maintain train separation. Refer to U.S. EPR FSAR Tier 2, Section 7.6.1.2.3 for a more detailed description.

   U.S. EPR FSAR Tier 2, Section 9.2.2.6 will be revised to reflect this additional information concerning the switchover valves interlock feature.

g. The CCWS common header switchover valves are fast-acting hydraulically operated valves. The valves on the initial train will have a closing time of approximately 10 seconds while valves on the on-coming train will have opening times of approximately 10 seconds. The lapse in cooling flow to the common users does not exceed 20 seconds.

h. Allowable and excessive valve seat leakage will be identified later in the design process. SRP Section 9.2.2 does not require quantification of excessive valve seat leakage for the single isolation valves that are used between safety-related CCWS trains. The technical information that is provided in the application is sufficient to support the development of the NRC’s safety evaluation report as required by the SRP.

   If the switchover valves on the initial train fail to close or the switchover valves on the on-coming train fail to open, which may occur if the on-coming train switchover sequence is inhibited due to low surge tank level, the alignment is automatically switched back to the initial configuration.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.2.6 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-18:

The component cooling water system (CCWS) must be capable of removing heat from systems, structures and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. In order to satisfy system flow requirements, the CCWS design must assure that the minimum net positive suction head (NPSH) for the CCWS pumps will be met for all postulated conditions, including consideration of vortex formation. The staff found that the NPSH requirement for the CCWS pumps was not specified and Tier 2 Final Safety Analysis Report (FSAR) Section 9.2.2 did not describe how the CCWS design will assure that the NPSH requirement for the CCWS pumps is satisfied (including consideration of vortex formation) and how much excess margin is provided by the CCWS design for the most limiting assumptions. Consequently, the FSAR needs to be revised to address the following considerations:

a. The minimum NPSH that is needed for CCWS operation needs to be specified and explained, including how this minimum NPSH requirement is satisfied by the system design when taking vortex formation into consideration and how much excess margin is available for the most limiting case. Sufficient information is needed to enable the staff to independently confirm that the design is adequate in this regard, including limiting assumptions that were used along with supporting justification.

b. The bases for the MIN-MAX surge tank setpoints needs to be explained. Surge tank design details such as system internal volume, temperature extremes that are accommodated by the design, and the maximum leakage rate that is assumed including justification are some of the factors that need to be addressed. Provide in the FSAR key assumptions and conclusion from the design calculations used for sizing the component cooling water system surge tank. These calculations should be made available for staff audit.

c. FSAR Tier 2 Section 9.2.2 surge tank component description states that in case of a seismic event a seismically qualified water supply is available from the fire water system with sufficient capacity to provide for seven days of makeup water. The basis for this conclusion (e.g. required makeup rate and volume) needs to be explained. Also, because makeup water is needed in order to ensure that the CCWS is capable of performing its safety function for at least seven days, the source of water and flow path to the surge tanks should be safety-related, protected from internal and external hazards, and capable of performing its makeup function in the event of a single failure with and without off-site power available. These considerations need to be addressed. Describe how the makeup volume is assured, indications and alarms that are available in the control room and at the remote shutdown panels, and actions that plant operators have to take to provide makeup water to the surge tanks. Isolation valves AA141 and AA142 (which are shown in FSAR Tier 2 Figure 9.2.2-1) should be included on the system diagram in FSAR Tier 1 Section 2.7.1, and appropriate Tier 1 requirements need to be established for the makeup function.

d. As discussed in FSAR Tier 2, Section 9.2.2.6.1, a receipt of a MIN3 surge tank level signal due to water loss from one CCWS safety-related train will block transfer and initiate isolation of the common header associated with that train. The impact of this loss of a common CCWS header on plant operation needs to be explained, including operator actions that are required.

e. As discussed in FSAR Tier 2, Section 9.2.2.6.1, if the surge tank water loss continued to MIN4 surge tank level, the CCWS pump on the affected train will trip. The impact of this pump trip on plant operation with the associated common header blocked (i.e. initiated by the MIN3 signal) needs to be explained, including operator actions that are required.

Response to Question 09.02.02-18:

a. Component cooling water system (CCWS) pump sizing will be determined after the final pump pressures and flow rates are determined. These parameters will depend on CCWS user loads and flow requirements. Net positive suction head available (NPSHA) as well as excess margin will be evaluated based on CCWS pump net positive suction head required (NPSHR) for the limiting CCWS line up. The possibility of vortex formation will also be considered in this analysis.

   SRP Section 9.2.2 does not require an applicant to provide CCWS pump sizing. The technical information that is provided in the application is sufficient to support the development of the NRC's safety evaluation report as required by the SRP.

b. The CCWS surge tank sizing is a function of various factors. The required volume of water storage will be calculated as a function of the maximum allowed CCWS leakage. Also, the open volume to accommodate system fluid expansion and in-leakage will be calculated as a function of the maximum allowable leakage rates (out-leakage and in-leakage). The CCWS MIN-MAX surge tank setpoints will be determined in conjunction with the surge tank sizing.

c. Standard Review Plan (SRP) 9.2.2 Section III.3.C requires closed-loop cooling systems to have sufficient capacity to accommodate expected out-leakage from the system for a period of 7 days or have a seismic make-up source which can be made available within a time frame consistent with the surge tank capacity. Each CCWS surge tank has adequate capacity to accommodate out-leakage of 1 gpm for a period of 1700 minutes (28 hours). The 1700 minutes is the time required to drop the surge tank level from a normal operating level down to MIN1. If the CCWS surge tank level is dropping, operator action can be initiated any time after 1 hour and completed prior to 28 hours to install a spool piece and open the manual isolation valves KAA 10/20/30/40 AA141 and AA142. The spool piece is installed between the isolation valves AA141 and AA142. The 1 gpm out-leakage is important for the following reasons:

   - Leaks greater than 1 gpm are detected via sump monitoring and corrected via operational monitoring and do not pose a compliance concern.

   - This out-leakage scenario is only a concern in post seismic events.

   - Design basis accident (DBA) alarm response procedures for low level in the surge tanks will trigger manual alignment of the fire water distribution system make-up to the CCWS surge tanks.

   - Once the CCWS surge tank level drops to MIN1 which will set off the first alarm, there will be an adequate volume of water to accommodate three hours of out-leakage at 1 gpm prior to operator action.

Indications and alarms that will be available in the MCR and the Remote Shutdown Station will be identified later in the design process. U.S. EPR FSAR Tier 1, Figure 2.7.1-1—Component Cooling Water System Functional Arrangement, Sheets 1 through 4, and U.S. EPR FSAR Tier 2, Figure 9.2.2-1—Component Cooling Water System Trains 1 through 4, Sheet 1 of 2 will be revised to include manual isolation valves AA141 and AA142 as well a note explaining the spool piece insertion. U.S. EPR FSAR Tier 1, Table 2.7.1-1—Component Cooling Water System Equipment Mechanical Design will be revised to include these valves.

d. When the CCWS surge tank level reaches MIN 2, the non-safety-related users on the common header are isolated. If no additional water loss is realized in the CCWS surge tanks, this indicates the leak is in the non-safety-related piping of the common header. If the surge tank level continues to fall to MIN 3, the leak may be on the safety-related portion of the common header. The entire common header is isolated using the common switchover valves of the faulted train (CCWS train with surge tank level decreasing). The goal of this actuation is to maintain the availability of the CCWS train for the safety injection system (SIS) users. The isolation sequence for MIN 2 and MIN 3 surge tank levels is automatic with no operator action required. At this point, if the water level does not drop further than MIN 3, all four CCWS trains are available for SIS cooling and cooling of the other common header is still available from either of its two CCWS main trains.

e. Refer to the Response to Question 09.02.02-18d for a discussion up to MIN 3 level. If the CCWS surge tank level continues to fall to MIN 4 setpoint after the switchover valves are closed, the leak is located on the corresponding train (train with decreasing surge tank level). When the MIN 4 setpoint is reached, the CCWS pump is tripped to prevent feeding the leak. The common header switchover is then inhibited to lock the system in its configuration and an alarm is relayed to the operator. At this point, one CCWS train is inoperable. The other train that feeds the isolated common header is available for its SIS function while the remaining pair of CCWS trains are available for the cooling of the other common header as well as their SIS cooling functions. With one CCWS train inoperable, the plant will have entered Technical Specifications LCO 3.7.7, requiring the cooling of the reactor coolant pump (RCP) thermal barriers to be aligned to the CCWS common header with two operable CCWS trains.

FSAR Impact:

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

Question 09.02.02-19:

The component cooling water system (CCWS) provides essential cooling to the reactor coolant pumps (RCP) thermal barrier. Potential thermal barrier leakage is a concern with such a large pressure differential between the reactor coolant system (RCS) and CCWS. Accordingly, Final Safety Analysis Report (FSAR) Tier 2 Section 9.2.2 includes the following thermal barrier isolation descriptions.

1. Section 9.2.2.2, "System Description," from page 4 states: "The RCP thermal barrier leakage is detected by indication of a high outlet flow from the barrier or an elevated return temperature (or both) which results in an automatic isolation of the CCWS flow through the barrier."
2. Section 9.2.2.3, "System Operation," discusses potential RCS dilution from a thermal barrier tube rupture as follows: "The possibility of diluting the RCS via a faulty RCP thermal barrier exists only when the RCS is in a low pressure state. After a predetermined time delay (≈15 minutes), which allows for RCP coast down and when the RCS pressure is low, the CCWS will be automatically isolated from the RCP thermal barrier via the CCWS inlet and outlet isolation valves."
3. Section 9.2.2.4, "Safety Evaluation," last sentence states: "Remote manual isolation of the RCP thermal barrier coolers is provided to isolate the thermal barrier in the event of a leak in the HX."
4. Section 7.6.1.2.3, "Interlocks Isolating Redundant CCWS Trains" states that the interlock function for the thermal barriers provides CCWS train separation, thus either common header 1b or 2b are in service for all four RCP thermal barriers.
5. Section 9.2.2.6.1, "Control Features and Interlocks" states: "Leakage detection for the RCP thermal barriers is provided by detection of a difference in CCW inlet and outlet flow to the barrier which initiates automatic isolation of CCWS flow from the thermal barrier HX."

The staff identified the following questions in regard to these considerations:

Questions:

a. With regard to item 1 above, the description implies that elevated temperature and radiation in thermal barrier return flow in addition to high return flow rate initiate automatic isolation of the RCP thermal barrier heat exchangers (HXs). Describe in detail any instrumentation and controls (I&C) logic/permissive (need to also show on piping and instrumentation diagrams (P&IDs) and setpoints for automatic isolation and instrumentation that is available for leak detection. Describe how the thermal barrier cross-tie is affected related to this logic.

b. With regard to item 2 above; describe the initiating parameter for RCP isolation due to thermal barrier in leakage, and describe the condition of the RCP (manually or automatically tripped). Describe I&C logic/permissive and setpoints for the isolation based on the 15 minute time delay. Describe how the thermal barrier cross-tie is affected with respect to this logic.

c. With regard to item 3 above; this statement appears to imply that manual isolation of the RCP thermal barriers is required in case of a leaking heat exchanger. Since this is in the safety evaluation section of FSAR Tier 2 Section 9.2.2.4, describe if automatic isolation of a leaking thermal barrier is available during accident conditions and if the thermal barrier cross-tie is affected.

d. Include a discussion in Section 9.2.2 to explain how CCWS train separation is maintained for the thermal barriers similar to what is provided in Section 7.6.1.2.3.

e. The specified action to realign RCP thermal barrier cooling (from Technical Specifications 3.7.7) when one CCW pump is inoperable was not explained in Section 9.2.2.

f. Related to item 4 above, describe how cooling water to the thermal barrier (and RCP seals) is maintained during the following scenario:

   1. Pre-event:

      essential service water (ESW) trips (division 2) with charging pump out of service (no TS LCO) (division 4)

   2. Systems in service:

      charging pump (Div 1), ESW Pump (Div 1) , and CCW pump Div 1 (1b CCW header) with required flow to all 4 RCP thermal barriers– 2b CCW header is interlocked closed with 1b in service due to train separation criteria.

   3. Transient:

      loss-of-offsite power – Div 2, 3, 4 start and load safety buses with a single failure of Div 1 EDG .

g. The following questions are related to item 5 above:

   1. Describe in detail (need to also show on P&IDs) the automatic RCP thermal barrier return flow isolation (and setpoint) capability described above as it applies to the individual RCPs. Describe which valves receive automatic closure signals

   2. The FSAR describes instrumentation that measures the difference between RCP thermal barrier inlet and outlet CCWS flow. Show all the flow instruments provided for each RCP thermal barrier path (only outlet flow instruments were located on P&IDs).

Response to Question 09.02.02-19:

a. The CCWS return flow and temperature from the RCP thermal barriers is measured with the flow elements (FE) and temperature elements (T) shown on U.S. EPR FSAR Tier 2, Figure 9.2.2-2—Component Cooling Water System Common Loop 1 (Sheets 3 and 4), and Figure 9.2.2-3—Component Cooling Water System Common Loop 2 (Sheets 3 and 4). High flow or high temperature indication above a threshold value indicates a fault of a thermal barrier. Isolation valves at the inlet (JEB10/20/30/40 AA021) and outlet (JEB10/20/30/40 AA003) of the RCPs are used to automatically isolate the faulted thermal barrier from the CCWS. Refer to U.S. EPR FSAR Tier 2, Figure 5.1-4—RCS Piping and Instrumentation Diagram (Sheet 4 of 7) for the location of these isolation valves.

The scenario described here would have no effect on the thermal barrier cross-tie. In this scenario, CCWS cooling to one thermal barrier will be isolated. The remaining three thermal barriers will continue to receive cooling flow from the CCWS common header.

b. There is no possibility for thermal barrier in-leakage from the CCWS, when the RCS is operating at normal conditions. The possibility to dilute the RCS via a faulted thermal barrier is only possible when the RCS is at low pressures. To protect against this potential dilution, the CCWS is automatically isolated from the RCP thermal barrier via the inlet and outlet isolation valves JEB10/20/30 AA021/003 when a 15 minute time delay from the time no RCP motor current has been detected and low hot leg narrow range pressure is <MIN 2. The RCP trip can be either manual or automatic.

c. Remote manual isolation of the RCP thermal barriers is provided in addition to the automatic isolation function.

   There is no effect on the thermal barrier cross-tie. In this scenario, CCWS cooling to one thermal barrier is isolated. The remaining three thermal barriers continue to receive cooling flow from the CCWS common header.

d. To maintain CCWS train separation for the RCP thermal barrier cooling, an interlocking function is required. Either CCWS 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 CCWS Common 1b cannot be opened unless the CIVs on both the supply and return side of Common 2b are closed, and vice-versa.

   U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to reflect this additional information concerning the CCWS train separation for the RCP thermal barriers.

e. If one CCWS train is inoperable, RCP thermal barrier cooling is aligned to the CCWS common header with two OPERABLE CCW trains.

   U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to reflect this additional information concerning the CCWS alignment for RCP thermal barrier cooling.

f. This is broken into three parts: pre-event, systems in service, and transient.

   1. In this scenario, with ESW train 2 tripped, cooling of the Common 1 header is automatically switched to CCWS train 1 (if that configuration was not previously aligned). Cooling of the CCWS Common 2 header is aligned to either CCWS train 3 or train 4. RCP thermal barrier cooling is aligned to the Common 2.b header as that header would have two OPERABLE CCW trains.

   2. In this scenario, with no faulted CCW trains (or CCWS support systems), the RCP thermal barrier cooling is aligned to either the Common 1.b or 2.b header. If the Common 2.b RCP thermal barrier cross-tie containment isolation valves are locked closed, the RCP thermal barrier cooling is aligned to the Common 1.b header.

   3. In case of loss of offsite power (LOOP), the four CCWS trains remain available for operation. The four CCWS pumps belonging to the four trains receive emergency

power supplied by the main emergency diesel generators (EDG). Previously operating CCWS trains return to operation according to the EDG load sequencing and standby trains remain in idle unless other start orders are received during the EDG load sequencing. In the event Div 1 EDG failed, RCP thermal barrier cooling is aligned to the Common 2.b header as that header would have two OPERABLE CCW trains.

g. Miscellaneous questions regarding control features and interlocks (refer to Item 5 of question).

 1. The CCWS return flow and temperature from the RCP thermal barriers is measured with the flow elements (FE) and temperature elements (T) shown on 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). High flow or high temperature indication above a threshold value indicates a fault of a thermal barrier. Isolation valves at the inlet (JEB10/20/30/40 AA021) and outlet (JEB10/20/30/40 AA003) of the RCPs are used to automatically isolate the faulted thermal barrier from the CCWS. Refer to U.S. EPR FSAR Tier 2, Figure 5.1-4 (Sheet 4 of 7) for the location of these isolation valves.

    U.S. EPR FSAR Tier 2, Section 9.2.2.2.6.1 will be revised to update the information related to measurement of RCP thermal barrier leakage.

 2. Refer to the Response to Question 09.02.02-19.g.1 for a discussion about this instrumentation. The CCWS U.S. EPR FSAR figures correctly show only outlet flow instrumentation. This outlet flow value is measured against a threshold value.

FSAR Impact:

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

Question 09.02.02-21:

General Design Criteria (GDC) 57 requires at least one shutoff valve for each line that penetrates the containment and is part of a closed system inside containment. Further the isolation valve(s) “shall be either automatic, or locked closed, or capable of remote manual operation.” For the U.S EPR design the component cooling water system return lines that penetrate the containment address this requirement with two motor operated valves one inside and the other outside the containment. Further Final Safety Analysis Report (FSAR) Tier 2 Section 6.2.4.2 states that “Each non essential containment penetration has two isolation barriers in series, and each is actuated by a different protection system division.” However, the following penetrations were found during this review that do not meet this requirement (NOTE there may be others).and the FSAR needs to be revised accordingly to address these apparent discrepancies:

a. Tier 1 FSAR Table 2.7.1-2 and Figure 2.7.1-1 indicate that some containment penetrations have inside and outside safety-related motor operated isolation valves supplied by the same power source. The component cooling water system return line from the containment ventilation coolers provides one such example (Penetration #60BQ114). Describe or verify these valves automatically isolate on a stage 1 containment isolation, describe the basis behind having both the inside (30KAB40 AA012) and outside (30KAB40 AA006) valves identified by Table 2.7.1-2 with power from the same division (1). Note this may be a documentation discrepancy, since FSAR Tier 2 Table 6.2.4-1 (Containment Isolation Valves) lists division 4 power for 30KAB40 AA012.

b. Describe the basis for a similar example provided by the return line from RCP thermal barrier containment isolation valves 30KAB30 AA051 (inside) and AA052 (outside), which are both identified with division 1 power by Table 2.7.1-2; identified as containment penetration #60BQ118 in FSAR Tier 2 Table 6.2.4-1. This also appears for penetration 60BQ108 and valve KAB60 AA018, for penetration 60BQ408 and valve KAB70 AA018, for penetration 60BQ118 and KAB30 AA51, and penetration 60BQ421 and valve KAB30-AA055 related to Table valve IEEE power on Table 2.7.1-2.

Response to Question 09.02.02-21:

a. Component cooling water system (CCWS) containment isolation valves 30KAB40 AA006/012 automatically close on a containment isolation stage 1 signal. Valve KAB40 AA006 is powered from IEEE Electrical Division 1 and valve KAB40 AA012 is powered from IEEE Electrical Division 4.

   U.S. EPR FSAR Tier 1, Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design will be revised to indicate valve KAB40 AA012 is powered from IEEE Electrical Division 4.

b. The CCWS containment isolation valves in question are powered from the following IEEE Electrical Divisions:

   - Penetration #60BQ118

     KAB30 AA051: 4

KAB30 AA052: 1

- Penetration #60BQ108

  KAB60 AA018: 4

  KAB60 AA019: 1

- Penetration #60BQ421

  KAB30 AA055: 1

  KAB30 AA056: 4

- Penetration #60BQ408

  KAB70 AA018: 1

  KAB70 AA019: 4

U.S. EPR FSAR Tier 1, Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design will be revised to indicate the following valve and IEEE electrical division combinations:

KAB30 AA051: 4

KAB60 AA018: 4

KAB30 AA055: 1

KAB70 AA018: 1

FSAR Impact:

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

Question 09.02.02-22:

The component cooling water system (CCWS) must be capable of removing heat from systems, structures and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. Final Safety Analysis Report (FSAR) Tier 2 Section 9.2.2.3 and Section 9.2.2.6 both describe the response sequence of the component cooling water system (CCWS) for a safety injection actuation. Section 9.2.2.3 indicates that the low head safety injection (LHSI) heat exchanger valves (which are normally closed) are opened before the CCWS pumps are started. However, the safety injection sequence identified in Section 9.2.2.6 indicates that the CCWS pump starts before the LHSI valves are opened.

a. Determine which FSAR description is correct and provide clarification as appropriate. State how the CCW pump minimum flow is satisfied if the CCWS pump is started before the LHSI paths opens (state valve opening time) and describe explain this basis in the FSAR.

b. Clarification is needed for the description "isolation of non-safety common header loads outside of containment." This clarification is requested since review of system piping classifications (discussed in Section 9.2.2.4 of this evaluation) found some loads outside of containment such as charging pumps and sampling sink coolers that are also provided with Seismic Category I piping. Specifically, identify what CCWS common header loads are isolated verses what loads are not isolated on a safety injection actuation.

Response to Question 09.02.02-22:

a. U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 *Accident Operating Conditions,* Safeguard Building LOCA or LOCA Coupled With Unavailability of Two CCWS/SIS Trains is correct as written. The response sequence of the CCWS involves the receipt of simultaneous safety injection and containment isolation stage 1 signals. This description deals with starting the CCWS trains not in operation. The CCWS pumps on these trains are maintained in a safe operating range by opening the low head safety injection/residual heat removal (LHSI/RHR) isolation valves prior to starting the pumps.

   U.S. EPR FSAR Tier 2 Section 9.2.2.6 is correct as written. The discussion in this section addresses only the safety injection signal. Upon receipt of a safety injection signal, the four CCWS trains start supplying the medium head safety injection (MHSI) pump motor coolers, LHSI pump and motor coolers (LHSI train 2 and 3 only), and the four LHSI heat exchangers. One or more of the CCWS pumps may already be running to supply common header safety and non-safety related loads when the safety injection signal is received. The CCWS pumps start supplying (i.e., transfer cooling) the safety injection system. To maintain the CCWS pumps in a safe range, the progression is:

   - CCWS pumps start (if not already running).
   - LHSI heat exchanger (HX) isolation valves open.
   - Trains 2 and 3 LHSI pump seal cooler isolation valves open.

- Isolation valves for non-safety related users outside the Reactor Building (RB) are closed.

The simultaneous operation of the LHSI HX valves (opening) and the non-safety-related isolation valves (closing) maintains the CCWS pump operation in a safe range.

b. Upon the receipt of a safety injection signal, the loads from the following systems are isolated from CCWS cooling flow:

- Coolant Treatment System.
- Coolant Degasification System.
- Containment Ventilation System.
- Solid Waste System.
- Liquid Waste System.
- Nuclear Island Drain and Vent System.
- Steam Generator Blowdown System.
- Operational Chilled Water System.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 09.02.02-23:

The component cooling water system (CCWS) must be capable of removing heat from systems, structures and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. Final Safety Analysis Report (FSAR) Tier 2 section 9.2.2.6, "Instrumentation Requirements," discusses the system response to a safety injection signal. The following statement with respect to the component cooling water system (CCWS) heat exchanger is included: "There is no automatic order from the protection system to configure heat exchanger bypass control valves." This statement appears to conflict with FSAR Tier 2 Section 14.2, Special Test 46, Step 3.4b, which includes verification that the CCWS heat exchanger bypass valves close on a safety injection actuation signal (SIAS). Since CCWS heat exchanger heat loads can significantly increase during loss of coolant accident (LOCA), the following considerations need to be addressed:

a. Determine if the CCWS heat exchanger bypass valves automatically close on a safety injection.

b. Clarify whether or not the bypass valves are controlled remote-manually with automatic high and low temperature control overrides during normal operation to maintain acceptable CCW HX outlet temperature.

c. Determine if the bypass valves are automatically controlled (considered a safety function) and determine if the controls remain functional on a safety injection signal. If the valves do not automatically close and do not have functional automatic controls on an accident, describe the controls that are in place for the operators to control the CCW heat exchanger outlet temperature.

Response to Question 09.02.02-23:

a. The CCWS heat exchanger bypass valves do not automatically close on a safety injection signal.

   U.S. EPR FSAR Tier 2, Section 14.2, Test 46, will be revised to delete Step 3.4b. Normally, the CCWS heat exchanger bypass control valve is manually positioned in order to maintain the CCWS temperature in a normal operating range. An alarm is relayed to the operator in the main control room (MCR) when the temperature is near the low (MIN2) or high (MAX2) temperature limit.

b. To avoid a CCWS temperature less than the low temperature limit, the bypass control valve of the CCWS heat exchanger is automatically stepped opened when the heat exchanger outlet temperature is near the low temperature threshold (MIN1). To avoid a CCWS temperature greater than the high temperature limit, the bypass valve is automatically stepped closed when the heat exchanger outlet temperature is near the high-temperature threshold (MAX1).

c. The CCWS bypass valves are automatically controlled and the controls remain functional on a safety injection signal.

   For emergency CCWS temperature control, an open CCWS heat exchanger bypass line could cause the CCWS temperature to be greater than the high temperature limit. To prevent this condition, the CCWS heat exchanger bypass valve is automatically closed when the heat exchanger outlet is near the high temperature threshold (MAX1). In the event that the heat exchanger outlet temperature approached the low temperature threshold (MIN1), the bypass valve is automatically opened.

This temperature control function is required during all plant modes of operation whereby CCWS is energized (i.e., not station blackout (SBO)).

Safety-related manual controls are provided for the operators in the MCR as a backup for this safety-related system automation.

FSAR Impact:

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

Question 09.02.02-24:

The component cooling water system (CCWS) must be capable of removing heat from systems, structures and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. System design features, operating procedures, and surveillance testing must provide adequate assurance that the CCWS safety functions will not be compromised due to damaging water hammer events. Two of the four safety-related trains are normally in operation with the remaining two trains in standby. During an outage, four CCWS trains maybe in operation at the same time as described in Tier 2, Section 9.2.2.3.1. The CCWS description does not adequately consider and address water hammer vulnerabilities in the Final Safety Analysis Report (FSAR) and does not explain how system design features, operating procedures, and periodic surveillance tests provide adequate assurance that the CCWS safety functions will not be compromised by water hammer events.

Response to Question 09.02.02-24:

Refer to the Response to Question 09.02.02-11.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 09.02.02-25:

The component cooling water system (CCWS) must be capable of removing heat from systems, structures and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. Also, 10 CFR 52.47(a)(22) requires that information demonstrating how operating experience insights have been incorporated into the plant design be included in the Final Safety Analysis Report (FSAR). During a recent review of industry operating experience (Information Notice 2007-06, Potential Common Cause Vulnerabilities in Essential Service Water Systems, dated February 9, 2007), the staff found that some licensees were experiencing significant wall thinning of pipe downstream of butterfly valves that were being used to throttle service water flow. In order to assure that this will not occur in the CCWS for the EPR design, the applicant needs to provide additional information in Tier 2 FSAR Section 9.2.2 to describe to what extent butterfly valves will be used to throttle CCWS flow and design provisions that will be implemented to prevent consequential pipe wall thinning from occurring.

Response to Question 09.02.02-25:

For some users, the CCWS flow rate will be automatically controlled, while the other users remain at a fixed flow resistance during all operating conditions. Flow rates through CCWS users are adjusted once during plant startup with the most penalizing configuration (i.e., flow balancing) utilizing fixed orifice plates, gate valves, globe valves and in some cases butterfly valves. After this, the minimum required user flow rate is maintained, irrespective of the plant operating condition. The system flow balance is regularly confirmed throughout the plant life during periodic surveillances. Use of a fixed orifice plate in conjunction with a butterfly valve to establish a fixed flow resistance greatly reduces the probability of pipe erosion which can occur immediately downstream of butterfly valves when valve throttling is severe and for protracted periods.

Design provisions will prevent consequential pipe wall thinning immediately downstream of butterfly valves subject to substantial throttling service for extended periods, including the use of erosion resistant materials, the use of thick wall pipe to incorporate an erosion factor and providing straight pipe lengths immediately downstream of the affected valves.

U.S. EPR FSAR Tier 2, Section 9.2.2.2.1 will be revised to reflect additional information concerning design provisions and the use of butterfly valves for throttling.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.2.2.1 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-30:

Regulatory Guide (RG) 1.21, “Measuring, Evaluation and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquids and Gaseous Effluents from Light Water Cooled Nuclear Power Plants,” indicates that monitoring should be included for anticipated operational occurrences. Standard Review Plan (SRP) 9.2.2, Areas for Review Section I.10, specifies review of the means provided for detecting leakage of radioactivity from one system to another and for precluding its release to the environment. The staff noted that FSAR Tier 2 Section 9.2.2.6 indicates that radiation monitors are provided in a recirculation line for the component cooling water system (CCWS) heat exchanges, part of the thermal barrier piping discharge, and in the return path from the high pressure (HP) chemical and volume control system (CVCS) and coolers inside containment. Furthermore, the applicant stated in FSAR Section 9.2.2.6.1 that automatic isolation is provided (i.e. both CCWS and CVCS) in case of a reactor coolant system (RCS) fluid leak into the CWCS from the HP CVCS cooler that results in a high radiation signal. The CCW heat exchanger recirculation line radiation instrument provides continuous monitoring. The staff found that the following considerations need to be addressed in the FSAR:

a. Many current plants have provisions for automatic isolation of the CCWS surge tank vent on a high radiation signal. Describe the basis for not providing this capability to avoid inadvertent contaminating the ventilation system and in particular, how the requirements specified by 10 CFR 20.1406 are satisfied in this regard.

b. The CCWS radiation monitors are relied upon for satisfying 10 CFR 20.1406 and GDC 64 requirements and are considered to be important system design features. Therefore, these monitors should be identified on FSAR Tier 1 Figure 2.7.1-1.

c. The CCWS and chemical and volume control system (CVCS) valves that close automatically on a high radiation alarm associated with the CCWS return flow from the high pressure CVCS heat exchanger need to be described.

Response to Question 09.02.02-30:

a. The CCWS surge tank vent lines for the U.S. EPR are routed through the Safeguard Building Controlled Area Ventilation System (SBVS). The SBVS radiological filters for iodine removal adsorb airborne radio iodine from the exhaust air in order to mitigate the consequences of accidents which could result in potential offsite exposure. Routing the vent through this filtered system removes the need for automatic isolation valves on the surge tank vent line.

b. U.S. EPR FSAR Tier 1, Figure 2.7.1-1—Component Cooling Water System Functional Arrangement, Sheets 1 through 4, 12 and 18 will be revised to depict these radiation monitors. U.S. EPR FSAR Tier 1, Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design will be revised to include these monitors.

c. A leak from the chemical and volume control system (CVCS) into the CCWS is detected by radiation monitors on the CCW return lines from each of the CVCS HP coolers. A high radiation alarm from either of these monitors initiates automatic isolation of the affected CVCS HP cooler, via motor-operated valves in the CVCS.

U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 will be revised to reflect this additional information concerning the isolation of the CVCS and CCWS on a high radiation alarm.

FSAR Impact:

U.S. EPR FSAR Tier 1, Figure 2.7.1-1 and Table 2.7.1-2, and U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-34:

10CFR50, Appendix B, Section III Design Control, states that measures be established to assure that applicable design bases for SSCs are correctly translated into specifications, drawings, procedures, and instructions. Revise the FSAR to address the following:

a. Several locations in Tier 1 Section 2.7.1 and Tier 2 Section 9.2.2 describe the component cooling water system (CCWS) function for the thermal barriers as “Provides cooling to the thermal barrier of the reactor coolant pump (RCP) seals when seal injection is not available.” This statement implies that CCWS thermal barrier cooling is provided only when chemical and volume control system (CVCS) seal injection is lost. Verify the basis of the thermal barrier cooling and make necessary corrections to include Tier 2, FSAR Section 9.2.2 and Tier 1, FSAR 2.7.1.

b. FSAR Tier 1 Section 2.7.1 Paragraph 4.2 states “The CCWS equipment controls are provided in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.7.1-1.” The reference should be corrected to Table 2.7.1-2, which addresses instrumentation and controls (I&C) and electrical equipment design.

c. In the same Tier 1 Section paragraph 4.4 correct “Residual Head Removal” to Residual Heat Removal AND low CCWS flow automatically opens the low head safety injection (LHSI) and residual heat removal (RHR) heat exchanger inlet valve not the outlet valve as stated. The latter item also needs to be corrected in the commitment item description of ITAAC Table 2.7.1-3.

d. Additionally, in FSAR Tier 1 Section 2.7.1 paragraphs 4.6 and 4.9 both state that the CCWS pump is tripped if surge tank level reaches MIN4. Similarly, ITAAC Table 2.7.1-3 have redundant line items that address both paragraphs 4.6 and 4.9, which are the same. One of the paragraph and the corresponding ITAAC should be deleted.

e. Editorial- FSAR Tier 2 Section 9.2.2.4 safety evaluation, page 9.2.2-30 6th paragraph states “The CCWS is initially tested following the program given in Chapter 14. Periodic inservice functional testing is done in accordance with Section 9.2.2.4.” Correct reference to Section 9.2.2.5.

f. The Cold Shutdown description at the bottom of Tier 2 Section 9.2.2 page 9.2-24, first sentence, states “Cooling by Two CCWS trains—RCS Temperature < 250°F.” However, the FSAR Tier 2 Section 16 Table 1.1-1 definition of “Cold Shutdown” (MODE 5) identifies that “Cold Shutdown” is ≤ 200˚F. Revise FSAR page 9.2-24 description as required.

Response to Question 09.02.02-34:

a. When the reactor coolant pumps (RCP) are in operation, the component cooling water system (CCWS) provides constant cooling water flow to the RCP thermal barriers in all plant modes. This is in addition to the constant RCP seal injection provided from the chemical and volume control system (CVCS). If the CVCS system is unavailable, the CCWS becomes the safety-significant cooling medium for the RCP thermal barriers.

   U.S. EPR FSAR Tier 1, Section 2.7.1 and U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to reflect this information.

b. U.S. EPR FSAR Tier 1, Section 2.7.1, Paragraph 4.2 will be revised to reference Table 2.7.1-2.

c. U.S. EPR FSAR Tier 1, Section 2.7.1, Paragraph 4.4 will be revised to replace “head” with “heat” and “outlet” with “inlet.” Table 2.7.1-3—Component Cooling Water System will be revised to replace “outlet” with “inlet.”

d. Paragraph 4.9 in U.S. EPR FSAR Tier 1, Section 2.7.1 and Item 4.9 in U.S. EPR FSAR Tier 1, Table 2.7.1-3 were both deleted in the Response to RAI 128, Question 14.03.07-18.

e. U.S. EPR FSAR Tier 2, Section 9.2.2.4 will be revised to change the reference for periodic inservice testing to Section 9.2.2.5.

f. For CCWS, the proper description of this section is Cooldown Procedure instead of Cold Shutdown. The Cold Shutdown temperature listed in U.S. EPR FSAR Tier 2, Section 16, Table 1.1-1 ≤ 200°F is correct. The description in U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 for CCWS is for the Cooldown Procedure. There are sub sections that describe the cooling by two CCWS trains at RCS < 250°F and cooling by four CCWS trains at RCS < 212°F.

   U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 “Cold Shutdown” will be revised to state “Cooldown Procedure.”

FSAR Impact:

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

U.S. EPR Final Safety Analysis Report Markups

- Designed to permit appropriate periodic inspection of important components to provide for integrity and capability of the system (GDC 45).

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

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

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

09.02.02-34

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

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

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

9.2.2.2 System Description

9.2.2.2.1 General Description

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

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

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

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

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

- Seismic Category I and important-to-safety components as defined in RG 1.29.

- Environmental qualification as specified in 10 CFR 50.49.

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

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.

09.02.02-34

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 ~~when seal injection is not available~~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.

To meet single-failure criteria for the RCP thermal barrier cooling function, the load is required to be cooled by a common header which is capable of being connected to two operable CCW trains A single failure of a train initiates an automatic system response to transfer the common header to the remaining train.

The CCWS flow rate is automatically controlled for those users which have been determined to have a limited operating temperature range for support of stable operation, while less temperature-sensitive users remain at a fixed flow resistance during all operating conditions. These fixed flow rates are adjusted once during plant commissioning with the system in its most demanding flow configuration (system flow balancing), and is reaffirmed regularly throughout the plant life by periodic surveillance, to make sure there is adequate required user flow for all operating continued cooling of the spent fuel. Headers 1.b and 2.b cool the remaining operational CCWS loads. Each of the common b-loops is isolable from the associated safety train by two fast-acting hydraulic valves, one installed in each train supply line and the other in the return line.

Common 1.b cools RB CCWS loads through two branches. One branch cools RCP 1, RCP 2, and CVCS high pressure (HP) cooler 1. The other branch cools heating ventilation and air conditioning (HVAC) coolers 1, 2, 3, and 4 and the RCDT cooler. Common 1.b also cools CVCS charging pump 1 and sampling system coolers in the FB, and the first chiller of both OCWS subsystems in the NAB.

Common 2.b cools RCP 3, RCP 4, and CVCS HP cooler 2 in the RB; CVCS charging pump 2 and sampling system coolers in the FB; and the second chiller of both OCWS subsystem, liquid, waste, coolant treatment, and boron recycle system users in the NAB and RWB.

09.02.02-19

To maintain CCWS train separation for the RCP thermal barrier cooling, an interlocking function is required. Either CCWS Common 1b or 2b headers can provide cooling to the thermal barriers. To maintain strict separation, the containment isolation valves on the RCP thermal barrier cooling path on the supply and return side of CCWS Common 1b cannot be opened unless the CIVs on both the supply and return side of Common 2b are closed, and vice-versa. If one CCWS train is inoperable, RCP thermal barrier cooling will be aligned to the CCWS common header with two operable CCWS trains.

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

09.02.02-11

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

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

Vents are provided for venting components and piping at high points in liquid filled systems that can become normally idle and in which voids could occur. These vents are located for ease of operation and testing on a periodic basis.

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

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

09.02.02-11

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

09.02.02-25

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

All components and piping are carbon steel, except the demineralized feedwater line, which is stainless steel, and the CCWS HX tubes and dedicated CCWS HX tubes which are of a suitable corrosion resistant metal.

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

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

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

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

- One train cannot be isolated from the common headers and also from the LHSI/RHR HX.
- One train cannot supply only the common 1.a (2.a) header.
- One train cannot supply the common 1.a and 1.b (2.a and 2.b) header and its LHSI users with the maximum flow rate through the CVCS and FPCS HXs.

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

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

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

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.

09.02.02-34

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

~~Cold Shutdown~~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

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

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

- When a LHSI pump is started on its minimum flow line or on the closed loop, a faulty HX causes leakage into the CCWS. This leakage is detected by the train radiation monitor or an uncontrolled level rise in the CCWS surge tank.

- Provisions are required to minimize the risk of CCWS leakage during maintenance on the LHSI trains. The component boundary can be verified via a pressure test on the CCWS side or a pressure test of the RHR/LHSI.

Failure of a LHSI Pump Seal Fluid Cooler

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

Tube Rupture Inside Thermal Barrier

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

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

09.02.02-30

Tube Rupture Inside a CVCS HP Cooler

A leak from the CVCS into the CCWS will be detected by radiation monitors on the CCWS return lines from each of the CVCS HP coolers. A high radiation alarm from either of these monitors will trigger automatic isolation of the affected CVCS HP cooler via motor-operated valves in the CVCS.

RCS Cooldown with Less Than 3 Trains

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

09.02.02-34

The CCWS is initially tested following the program given in Chapter 14. Periodic inservice functional testing is done in accordance with ~~Section 9.2.2.4~~Section 9.2.2.5.

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

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

9.2.2.5 Inspection and Testing Requirements

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

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

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

The installation and design of the CCWS provides accessibility for the performance of periodic testing and inservice inspection with limited personnel exposure. Periodic testing of all safety-related equipment verifies its availability and ability to fulfill its functions. Inservice testing and inspection requirements are in accordance with the ASME BPV Code, Section XI (Reference 5).

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

9.2.2.6 Instrumentation Requirements

The CCWS trains are monitored and controlled from the main control room (MCR) through the process information and control system (PICS), which provides the normal indication, manual control, alarm functions, and the safety information and control system (SICS). These systems process and display information provided

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

- Small CCWS leakage is made up with demineralized water via operation of the DWDS supply isolation valve. When the surge tank water level falls to the MIN1 level, the DWDS supply isolation valve automatically opens. When the surge tank water level rises to MAX1, the DWDS supply isolation valve automatically closes.

- In the event of a more significant leak which causes the surge tank level to fall to MIN2, switchover of the common users to another train is inhibited to avoid transferring the leak. The non-safety-related branches isolate in the event of a flow mismatch between the inlet and outlet of the users supply and return lines. If the surge tank level continues to fall to MIN3, the switchover valves close to isolate the common headers and switchover of the header to another train is prohibited. This action maintains the availability of the train with the faulty piping for cooling of its MHSI and LHSI users. If the surge tank level subsequently falls to MIN4, the CCWS pump is tripped, the DWDS supply isolation valve closes to prevent feeding demineralized water through the leak, the switchover is inhibited in order to lock the system in its configuration, and an alarm is relayed to the operator in the MCR.

- In the event of failure or significant leakage of a switchover valve seat, a water transfer can occur from the pressure differential between two associated CCWS trains. If the water transfer leads to a MAX2 level signal on one of the two associated trains and MIN3 on the other, the common users are automatically isolated from the safety-related trains to conserve the safety-related function of both trains.

09.02.02-19

- Additional leakage detection is provided through segmented differential flow measurements and radiation detection. A high flow indication above a threshold value indicates a fault of a thermal barrier,~~Leakage detection for the RCP thermal barriers is provided by detection of a difference in CCW inlet and outlet flow to the barrier~~ which initiates automatic isolation of CCWS flow from the thermal barrier HX. Detection of increasing radiation in the CCW from the CVCS HP coolers indicates leakage and prompts the isolation of both fluids (CCWS and CVCS). Leakage of reactor coolant into the CCWS from such users as the LHSI HXs is also indicated by increasing radiation in the CCW and prompts isolation of the user. Only the thermal barrier and HP cooler leaks result in an automatic isolation of the failed user. The other leaks trigger MCR alarms and require operator action for isolation.

- To limit the loss of flow to users in either of the common .b subheaders (1.b or 2.b) occurring as a result of loss of a CCWS pump, loss of an ESWS train, or inadequate cooling flow to the affected users due to inadvertent closure of a CCWS valve or failure of a manual switchover sequence, an automatic partial switchover of the affected loop occurs. Either of these conditions will generate a signal to close the affected train switchover valves and open its LHSI HX isolation valve, and open the oncoming train common .b subheader switchover valve and start its CCWS pump. The oncoming train common .a subheader switchover valve may then be opened, and the HX bypass valve positioned, manually. Automatic switchover of the common .a subheader is not necessary since the inertia of the SFP allows adequate time for manual actuation. These actions provide adequate continued cooling flow to the affected common .b subheader users in the event of failure of a train supplying either of the common .b sub-headers (1.b or 2.b), or either of the common 1 or 2 headers (1.a and 1.b, or 2.a and 2.b).

09.02.02-16

- The CCWS switchover valves are interlocked to provide train separation of the redundant CCWS Divisions and to make sure that a fault affects no more than one train. The switchover valve connected to the initial safety-related CCWS train must close before the switchover valve from the opposite train begins to open in order to maintain train separation. If the switchover valves on the initial train fail to close or the switchover valves on the oncoming train fail to open, which may occur if the oncoming train switchover sequence is inhibited due to low surge tank level, the alignment is automatically switched back to its initial configuration. Refer to Section 7.6.1.2.3 for a more detailed description.

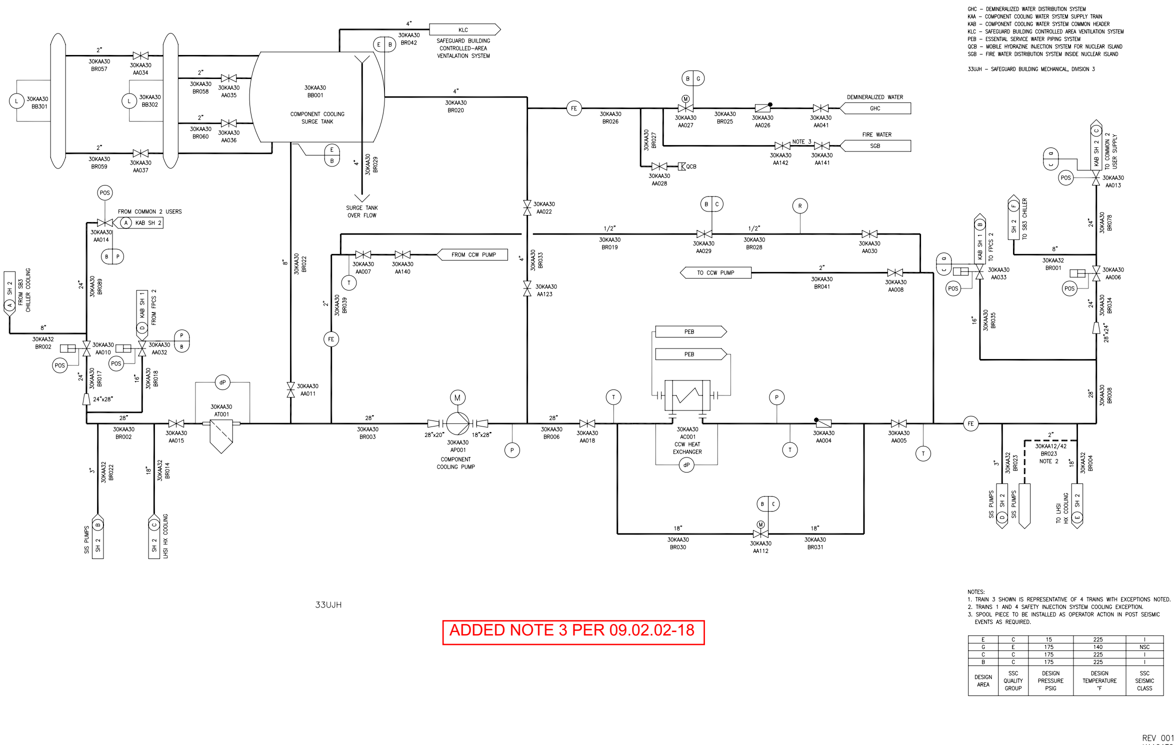
- Normally, the CCWS HX bypass control valve is manually positioned to maintain a normal CCWS outlet temperature slightly greater than the minimum allowable. An alarm in the MCR alerts the operator if the outlet temperature approaches the low temperature limit (decreasing temperature). If the outlet temperature continues to decrease, the CCWS HX bypass control valve automatically throttles open to maintain a CCWS user minimum cooling water inlet temperature greater than the minimum allowable. During warmer operating periods, the HX bypass control valve normally remains closed. In the event of a CCWS HX high outlet temperature condition combined with a bypass valve open signal, which indicates the bypass valve has failed open, the bypass valve automatically closes.

- The non-safety-related dedicated CCWS train is monitored and manually controlled from the PICS or SICS. Indications available from the PICS and SICS include dedicated CCWS main loop flow rate and pressure; dedicated CCWS HX inlet and outlet temperature; dedicated CCWS surge tank pressure, temperature and water level and position indication for critical valves.

- The dedicated CCWS main pump is started manually from the PICS or SICS. The dedicated CCWS main pump trips in the event of surge tank low level, associated dedicated ESWS pump not running or high temperature of the dedicated CCWS pump or pump motor. Manual override of the dedicated CCWS pump protective trips, to preserve cooling for the SAHRS pump, is also available at the PICS and SICS. The PICS and SICS also include controls for the dedicated CCWS surge tanks nitrogen injection and outlet isolation valves.

- Dedicated CCWS surge tank level is maintained automatically. When the surge tank level falls to the low level makeup setpoint (decreasing), the dedicated CCWS makeup valve opens and the dedicated CCWS injection pump starts. The makeup valve closes and the injection pump stops when the surge tank level reaches the high level setpoint (increasing). If the surge tank level falls to the low level isolation setpoint, the surge tank outlet isolation valve closes.

Figure 9.2.2-1—Component Cooling Water System Trains 1 through 4
Sheet 1 of 2



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

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, ~~flowrate~~flow rates, and pressure drops including head versus flow verification for the CCW pumps is within design limits.

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

3.4 Verify the following responses to emergency signals:

09.02.02-23

a. Non-safety-related headers and the spent fuel pool heat exchangers are isolated on an SIAS.

b. ~~CCW heat exchanger bypass valves close on an SIAS.~~

3.5 Verify the non-safety-related headers and RCP headers are isolated on a surge tank low-low level signal.

3.6 Verify a low CCW pump differential pressure signal starts the idle pump in each division.

3.7 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).

3.8 ~~Verify~~Observe response of power-operated valves ~~fail~~ upon loss of motive power ~~as designed~~ (refer to Section 9.2.2 for anticipated response).

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

3.10 Verify pump control from the MCR.

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

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

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.

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- The CCWS provides the cooling of the thermal barrier of the reactor coolant pump (RCP) seals ~~when seal injection is not available~~during all plant operating modes when the RCPs are running.
- 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 and the spent fuel pool cooling system pump room ventilation coolers.
- 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 in 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 ~~The e~~Equipment listed in Table 2.7.1-1 as ASME Code Section III is designed, welded, and hydrostatically tested ~~to~~ in accordance with ASME Code Section III.

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

3.3 Piping indicated in Figure 2.7.1-1 as ASME Code Section III is designed, welded, and tested in accordance with ASME Code Section III.

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

3.5 Supports for piping shown as ASME Section III on Figure 2.7.1-1 will be designed per ASME Section III.

3.6 ~~Specifications exist for components listed as ASME Section III in Table 2.7.1-1~~Deleted.

3.7 ~~Specifications exist for piping shown as ASME Section III on Figure 2.7.1-1~~Deleted.

3.8 Specifications exist for supports for piping shown as ASME Section III on Figure 2.7.1-1.

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-~~1~~2.

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

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

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

4.6 A surge tank level of MIN4 ~~will auto~~automatically trips the associated CCWS pump.

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

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

4.9 ~~If the surge tank level falls to MIN4, the CCWS pump is tripped~~Deleted.

5.0 Electrical Power Design Features

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.

5.2 Valves listed in Table 2.7.1-2 fail as-is on loss of power.

6.0 Environmental Qualifications

6.1 Electrical drivers for equipment listed in Table 2.7.1-2 for harsh environment can perform the safety function in Table 2.7.1-1 following exposure to the design basis environments for the time required.

7.0 Equipment and System Performance

7.1 The CCWS heat exchangers as listed in Table 2.7.1-1 have the capacity to transfer the design heat load to the ESWS.

7.2 The pumps listed in Table 2.7.1-1 have sufficient net positive suction head absolute.

7.3 The CCWS delivers water to the LHSI/RHRS heat exchangers at the ~~required~~ design flow rate ~~and within the required time for core~~to provide cooling ~~due to design basis events~~.

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7.4 The CCWS delivers water to the RCP thermal barrier seals at the required flow. ~~when seal injection is not available.~~

7.5 The CCWS delivers water to Divisions 2 and 3 of the SCWS chiller heat exchangers at the required flow to confirm availability of the SCWS system during design basis events.

7.6 The CCWS delivers water to the spent fuel pool cooling heat exchangers at the required flow to confirm cooling of the spent fuel pool during all plant conditions when spent fuel is in the pool.

7.7 Class 1E valves listed in Table 2.7.1-2 can perform the function listed in Table 2.7.1-1 under system design conditions.

7.8 The CCWS provides for flow testing of ~~the~~ CCWS pumps during plant operation.

7.9 Containment isolation valves listed in Table 2.7.1-1 close within the containment isolation response time following initiation of a containment isolation signal.

8.0 System Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1-3 ~~specifies the inspections, tests, analyses, and acceptance criteria for the~~ lists the CCWS ITAAC.

Table 2.7.1-1—Component Cooling Water System Equipment Mechanical Design (~~9~~10 Sheets)

Equipment Description	Equipment Tag Number (1)	Equipment Location	ASME Code Section III	Function	Seismic Category
Train 1 Surge Tank Makeup Isolation Valve	KAA10AA141	Safeguards Building Division 1	Yes	Open	I
Train 1 Surge Tank Makeup Isolation Valve	KAA10AA142	Safeguards Building Division 1	Yes	Open	I
Train 2 Surge Tank Makeup Isolation Valve	KAA20AA141	Safeguards Building Division 2	Yes	Open	I
Train 2 Surge Tank Makeup Isolation Valve	KAA20AA142	Safeguards Building Division 2	Yes	Open	I
Train 3 Surge Tank Makeup Isolation Valve	KAA30AA141	Safeguards Building Division 3	Yes	Open	I
Train 3 Surge Tank Makeup Isolation Valve	KAA30AA142	Safeguards Building Division 3	Yes	Open	I
Train 4 Surge Tank Makeup Isolation Valve	KAA40AA141	Safeguards Building Division 4	Yes	Open	I
Train 4 Surge Tank Makeup Isolation Valve	KAA40AA142	Safeguards Building Division 4	Yes	Open	I

(1) Equipment tag numbers are provided for information only and are not part of the certified design.

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Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (10~~9~~ Sheets)

Equipment Description	Equipment Tag Number (1)	Equipment Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Containment Isolation Valve							
Common Header 1b Non-Safety Loads Containment Isolation Valve	KAB40 AA012	Reactor Building	~~1~~4	Yes	Yes	Pos	Open-Close
Common Header 1b Safety Related Loads Containment Isolation Valves	KAB60 AA013	Safeguards Building	1	Yes	Yes	Pos	Open-Close
Common Header 1b Safety Related Loads Containment Isolation Valves	KAB60 AA018	Reactor Building	~~1~~4	Yes	Yes	Pos	Open-Close
Common Header 1b Safety Related Loads Containment Isolation Valves	KAB60 AA019	Safeguards Building	1	Yes	Yes	Pos	Open-Close
Common Header 2b Safety Related Loads Containment Isolation Valves	KAB70 AA013	Safeguards Building	4	Yes	Yes	Pos	Open-Close
Common Header 2b Safety Related Loads Containment Isolation Valves	KAB70 AA018	Reactor Building	~~4~~1	Yes	Yes	Pos	Open-Close

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Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (10~~9~~ Sheets)

Equipment Description	Equipment Tag Number (1)	Equipment Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Common Header 2b Safety Related Loads Containment Isolation Valve	KAB70 AA019	Safeguards Building	4	Yes	Yes	Pos	Open-Close
Common Header 1b RCP Thermal Barriers Containment Isolation Valve	KAB30 AA049	Safeguards Building	1	Yes	No	Pos	Open-Close
Common Header 1b RCP Thermal Barriers Containment Isolation Valve	KAB30 AA051	Reactor Building	~~1~~4	Yes	No	Pos	Open-Close
Common Header 1b RCP Thermal Barriers Containment Isolation Valve	KAB30 AA052	Safeguards Building 09.02.02-21	1	Yes	No	Pos	Open-Close
Common Header 2b RCP Thermal Barriers Containment Isolation Valve	KAB30 AA053	Safeguards Building	4	Yes	No	Pos	Open-Close
Common Header 2b RCP Thermal Barriers Containment Isolation Valve	KAB30 AA055	Reactor Building	~~4~~1	Yes	No	Pos	Open-Close
Common Header 2b RCP Thermal Barriers Containment Isolation	KAB30 AA056	Safeguards Building	4	Yes	No	Pos	Open-Close

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (10~~9~~ Sheets)

Equipment Description	Equipment Tag Number (1)	Equipment Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Control Valve							
Operational Chilled Water Temp Control	KAB50 AA111	Safeguards Building	NA	No	No	NA / NA	NA / NA
Operational Chilled Water Temp Control	KAB50 AA112	Safeguards Building	NA	No	No	NA / NA	NA / NA
Operational Chilled Water Temp Control	KAB50 AA113	Safeguards Building	NA	No	No	NA / NA	NA / NA
Coolant Degasification Condenser CCWS Isolation Valve	KAB50 AA122	Safeguards Building	NA	No	No	NA / NA	NA / NA
Operational Chilled Water Temp Control	KAB80 AA101	Safeguards Building	NA	No	No	NA / NA	NA / NA
Operational Chilled Water Temp Control	KAB80 AA102	Safeguards Building	NA	No	No	NA / NA	NA / NA
Operational Chilled Water Temp Control	KAB80 AA103	Safeguards Building	NA	No	No	NA / NA	NA / NA
Train 1 Radiation Monitor	KAA10 CR001	Safeguards Building Division 1	NA	Yes	No	NA / NA	NA / NA
Train 2 Radiation Monitor	KAA20 CR001	Safeguards Building Division 2	NA	Yes	No	NA / NA	NA / NA
Train 3 Radiation Monitor	KAA30 CR001	Safeguards Building Division 3	NA	Yes	No	NA / NA	NA / NA
Train 4 Radiation Monitor	KAA40 CR001	Safeguards Building Division 4	NA	Yes	No	NA / NA	NA / NA

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Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (10~~9~~ Sheets)

Equipment Description	Equipment Tag Number (1)	Equipment Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
CVCS HP Cooler 1 Inlet Radiation Monitor	KAB60 CR001	Reactor Building	NA	Yes	No	NA / NA	NA / NA
CVCS HP Cooler 1 Outlet Radiation Monitor	KAB60 CR002	Reactor Building	NA	Yes	No	NA / NA	NA / NA
CVCS HP Cooler 2 Inlet Radiation Monitor	KAB70 CR001	Reactor Building	NA	Yes	No	NA / NA	NA / NA
CVCS HP Cooler 2 Outlet Radiation Monitor	KAB70 CR002	Reactor Building	NA	Yes	No	NA / NA	NA / NA

(1) Equipment tag numbers are provided for information only and are not part of the certified design.

(2) ^{N} denotes the division the component is normally powered from; ^{A} denotes the division the component is powered from when alternate feed is implemented.

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Table 2.7.1-3—Component Cooling Water System ~~Inspections, Tests, Analyses, and Acceptance Criteria~~ITAAC (~~7~~ ~~9~~10 Sheets)

	Commitment Wording	Inspections, Tests, ~~or~~ ~~Analysis~~Analyses	Acceptance Criteria
4.3	~~Actuators~~ Equipment listed as being controlled by a PACS module in Table 2.7.1-2 responds to the state requested by a test signal~~are controlled by a PACS module~~.	A~~n operational~~ test will be performed using test signals ~~for the actuators being controlled by a PACS module as listed in Table 2.7.1-2. An inspection will be performed on the actuation of the actuator~~.	~~The actuators~~Equipment listed as being controlled by a PACS module in Table 2.7.1-2 ~~actuate~~ responds to the state requested by the test signal.
4.4	A CCWS low flow condition automatically ~~auto~~ opens the LHSI/RHR HX ~~outlet~~inlet valve.	Tests will be performed using ~~simulated~~ test signals to verify the interlock.	The following interlock ~~functions in response to a simulated~~ responds as specified below when activated by a test signal~~.~~: CCWS low flow condition automatically opens the LHSI/RHR HX ~~outlet~~inlet valve.
4.5	A surge tank level of MIN3 automatically~~will auto~~ isolates the associated train common header switchover valves.	Tests will be performed using ~~simulated~~ test signals to verify the interlock.	The following interlock ~~functions in response to a simulated~~ responds as specified below when activated by a test signal~~.~~: Surge tank level of MIN3 automatically isolates the associated train common header switchover valves.
4.6	A surge tank level of MIN4 automatically~~will auto~~ trips the associated CCWS pump.	Tests will be performed using ~~simulated~~ test signals to verify the interlock.	The following interlock ~~functions in response to a simulated~~ responds as specified below when activated by a test signal~~.~~: Surge tank level of MIN4 automatically trips the associated CCWS pump.

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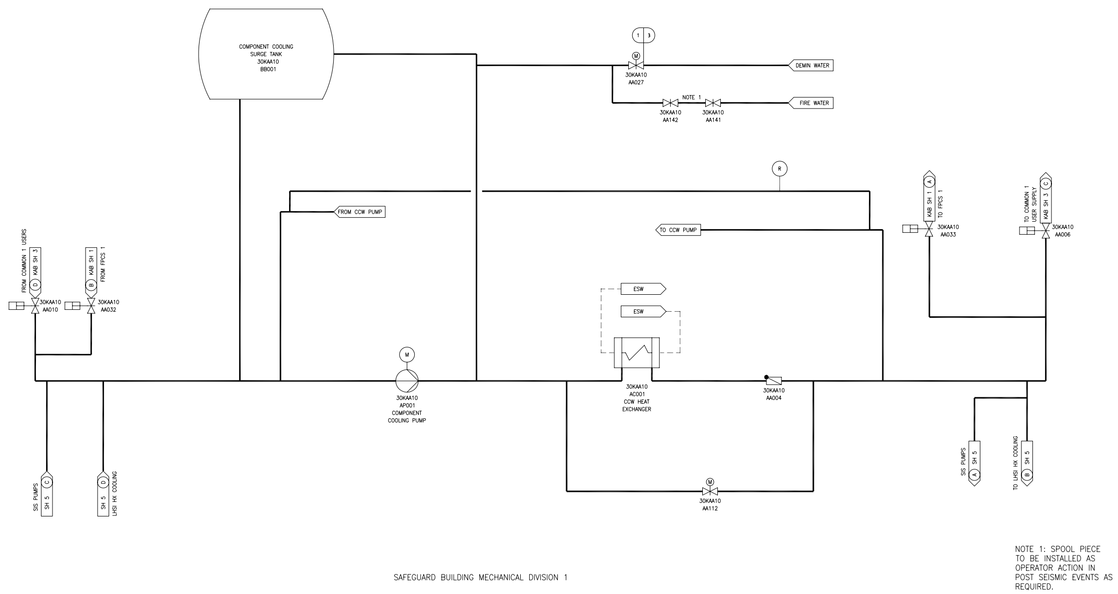
Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 1 of 24

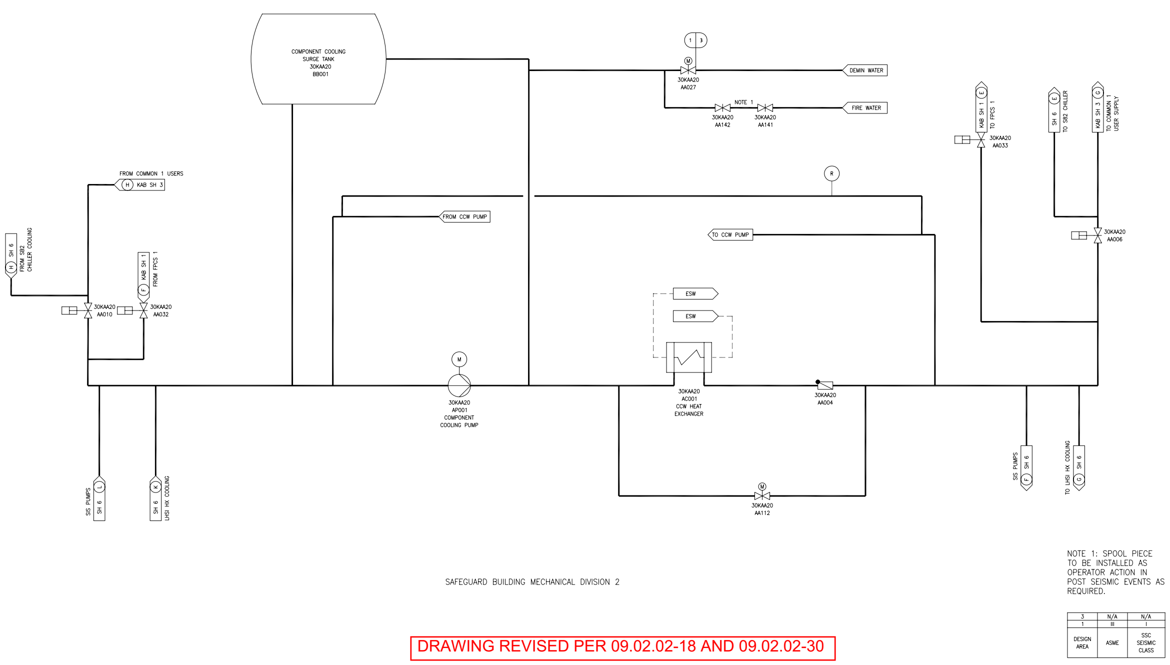


DRAWING REVISED PER 09.02.02-18 AND 09.02.02-30

3	N/A	N/A
1	III	I
DESIGN AREA	ASME	SSC SEISMIC CLASS

REV 001
KAA01T1

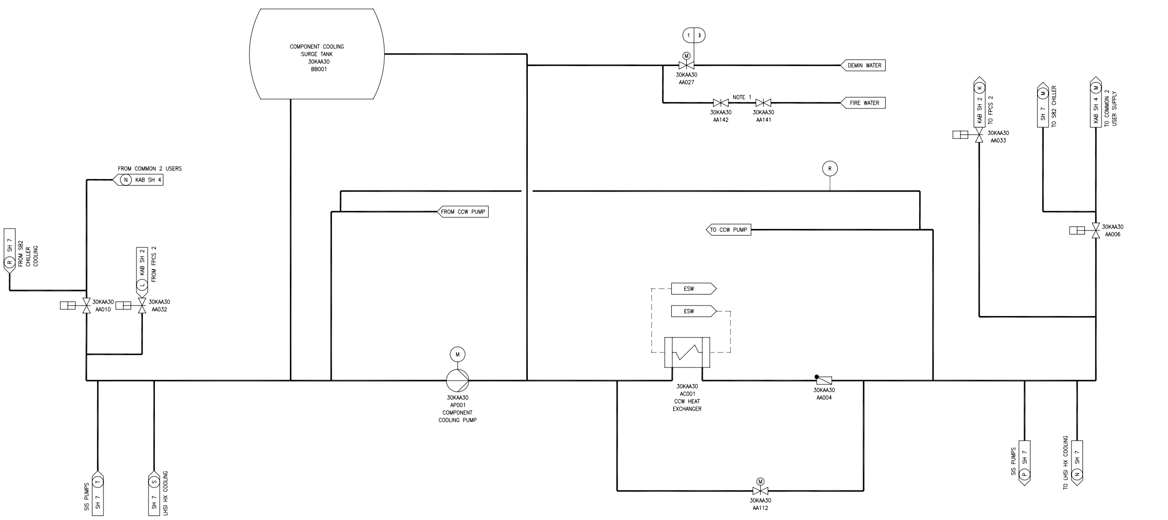
Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 2 of 24



3	N/A	N/A
I	III	I
DESIGN AREA	ASME	SSC SEISMIC CLASS

REV 001
KAA02T1

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 3 of 24



SAFEGUARD BUILDING MECHANICAL DIVISION 3

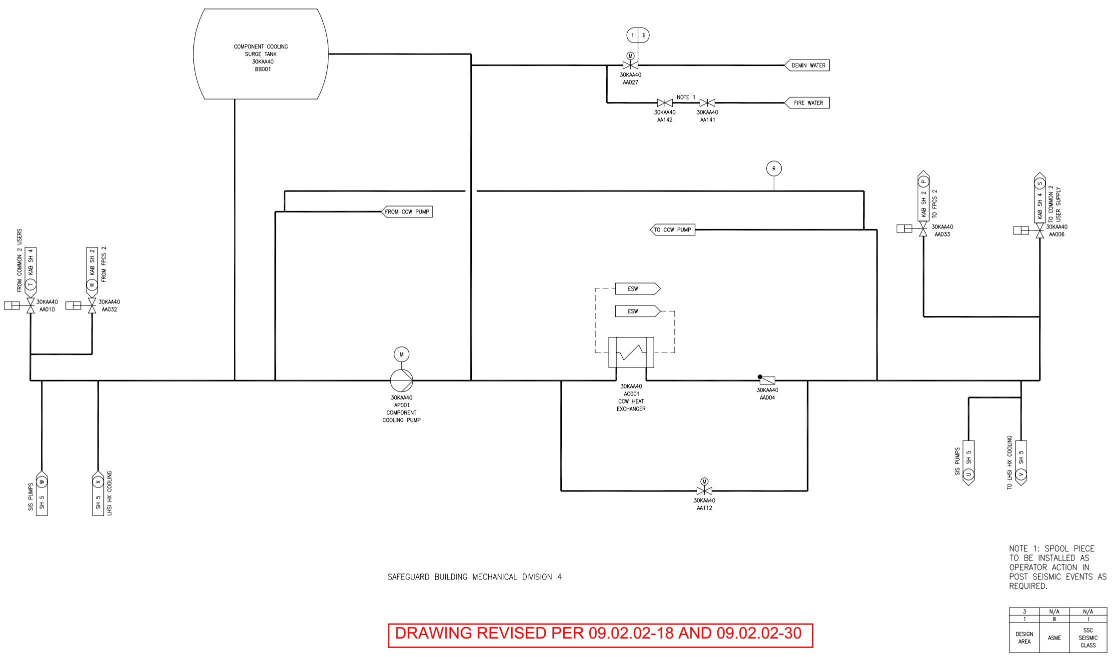
NOTE 1: SPOOL PIECE TO BE INSTALLED AS OPERATOR ACTION IN POST SEISMIC EVENTS AS REQUIRED.

3	N/A	N/A
1	III	I
DESIGN AREA	ASME	SSC SEISMIC CLASS

DRAWING REVISED PER 09.02.02-18 AND 09.02.02-30

REV 001
KAA03T1

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement Sheet 4 of 24



DESIGN AREA	ASME	SSC SEISMIC CLASS
3	N/A	N/A
1	III	I

Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
Sheet 12 of 24

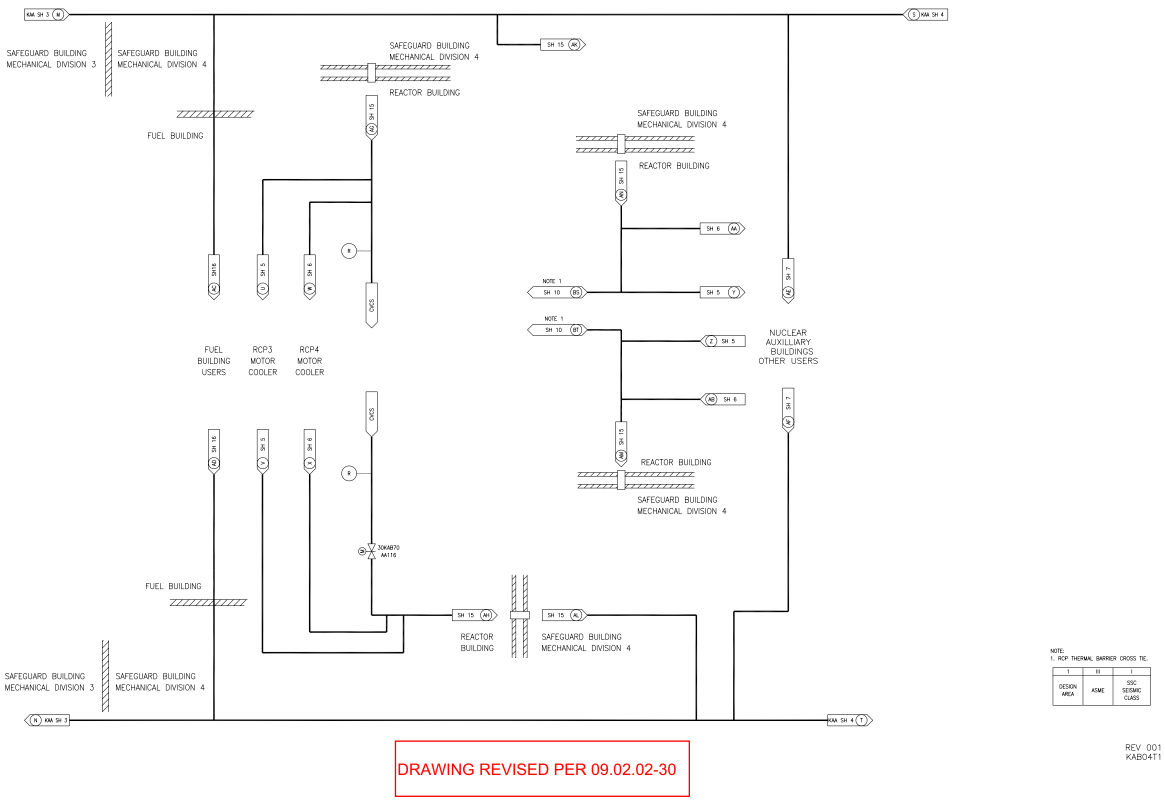


Figure 2.7.1-1—Component Cooling Water System Functional Arrangement
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