ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Friday, August 13, 2010 12:41 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); KOWALSKI David (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 417, FSARCh. 9
Attachments: RAI 417 Response US EPR DC.pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 417 Response US EPR DC.pdf" provides a technically correct and complete response to six of the eight 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 417 Questions 09.02.02-115, 09.02.02-116, 09.02.02-117, 09.02.02-119, 09.02.02-121 and 09.02.02-122.

The following table indicates the respective pages in the response document, "RAI 417 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 417 — 09.02.02-115	2	3
RAI 417 — 09.02.02-116	4	4
RAI 417 — 09.02.02-117	5	5
RAI 417 — 09.02.02-118	6	6
RAI 417 — 09.02.02-119	7	7
RAI 417 — 09.02.02-120	8	8
RAI 417 — 09.02.02-121	9	11
RAI 417 — 09.02.02-122	12	13

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

Question #	Response Date
RAI 417 — 09.02.02-118	August 31, 2010
RAI 417 — 09.02.02-120	August 31, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, July 14, 2010 1:34 PM

To: ZZ-DL-A-USEPR-DL
Cc: Wheeler, Larry; Lee, Samuel; Segala, John; Hearn, Peter; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 417(4741), FSARCh. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on June 8, 2010, and discussed with your staff on June 29, 2010. 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: 1839

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Response to

Request for Additional Information No. 417(4741), Revision 0

7/14/2010

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

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

Question 09.02.02-115:

Follow-up to RAI 334, Question 9.2.2-57 and RAI 174, Question 9.2.2-8:

From RAI 9.2.2-8: The component cooling water system (CCWS) must be able to withstand natural phenomena without the loss of function in accordance with General Design Criteria (GDC) 2 requirements. As specified in Standard Review Plan (SRP) Tier 2 Section 9.2.2, staff acceptance is based upon compliance with GDC 2, "Design Basis for Protection Against Natural Phenomena." The staff considers the CCWS to be acceptable with respect to GDC 2 if it satisfies Position C1 and C.2 of Regulatory Guide 1.29, "Seismic Design Classification." Position C1 specifies that safety-related SSCs should satisfy Seismic Category I specifications and Position C2 indicates that the design on non-safety-related SSCs is acceptable if failures do not adversely affect the control room or safety-related SSCs, or result in excessive radiological releases to the environment. Consequently, the applicant needs to include additional information in Tier 2 Section 9.2.2 of the Final Safety Analysis Report (FSAR) to fully describe and address the impact of failures of the non-safety-related parts of the CCWS on the control room and radiological release considerations.

In response to follow-up RAI 9.2.2-57 the applicant provided a detailed markup of FSAR Tier 2 Section 9.2.2 that identified areas of the plant where non-safety, non-seismic CCWS piping was routed and a discussion of the isolation valves that the system design provided for isolation of these areas from the safety related portions of the CCWS system. Since several of the areas identified also contain other safety-related SSCs (e.g. Safeguards Buildings 1 to 4, Reactor Building Annulus etc.) the staff requests that the applicant revise the markup to include a description of the means used to assure that failure of the non-seismic CCWS piping will not adversely impact other safety-related SSCs located in these buildings. For example, the non-safety related headers are as large as 20" diameter. This part of the original RAI (RAI 9.2.2-8) has not been previously addressed; that is, the design of non-safety-related SSCs is acceptable if failures do not adversely affect the control room <u>or safety-related SSCs,</u> or result in excessive radiological releases to the environment". This guidance is found in RG1.29, C.2 which states:

Those portions of SSCs of which continued function is not required but of which failure could reduce the functioning of any plant feature included in items 1.a through 1.q above to an unacceptable safety level or could result in incapacitating injury to occupants of the control room should be designed and constructed so that the SSE would not cause such failure.

In summary the applicant should address the following:

a. The failure of non-seismic CCWS related to safety-related SSCs as addressed in RG 1.29, C.2 should be addressed in the FSAR. The applicant should considered for example, Seismic Category II, geographical separation, impact evaluation, etc. (see FSAR 3.7.3.8, "Interaction of Other Systems with Seismic Category I Systems"), for any portions of the non-safety CCWS that could possible affect safety-related SSCs. This information should be added to the FSAR.

b. The information that was added as part of RAI 9.2.2-57 FSAR mark-up related to the details of the non-seismic CCWS piping, locations and failure consequences should be removed and more of a high level summary added in its place.

Response to Question 09.02.02-115:

a) A review of the component cooling water system (CCWS) design has confirmed the physical location of non-seismic piping and components in the CCWS, and also, the effect of failure of those components on safety-related systems, structures and components (SSC).

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

a. Safeguards Buildings (SB) 1, 2, 3 and 4.

b. Nuclear Auxiliary Building (NAB).

c. Reactor Building (RB) Annulus.

d. Fuel Building (FB).

e. Radioactive Waste Processing Building (RWPB).

Non-seismic portions of the CCWS are isolated from safety-related SSC by either physical separation or the use of physical barriers.

U.S. EPR FSAR Tier 2, Section 9.2.2.1 will be revised to include this information.

b) Refer to the response to Part a of this question.

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 09.02.02-116:

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

During the staff's review of the FSAR markup provided for RAI 334 Supplement 1 and RAI 9.2.2-61, it was noted on page 9.2-44 of Tier 2 Section 9.2.2.6.1, "Control Features and Interlocks" that the CCWS pump trip interlock was omitted from the discussion of the response to MIN4 surge tank level. The staff also found that the corresponding FSAR Tier 1 ITAAC Commitment Item 4.6 had been deleted. While not specifically addressed in RAI 334, the staff was informed that this change was made by the applicant in response to RAI 182 Supplement 4 and guidance from SRP 14.3 was cited as the basis for deletion of the ITAAC for MIN4 CCWS pump trip interlock in FSAR Tier 1 Section 2.7.1. However, staff review of this change found that the MIN4 interlock provides other functions (described below) and therefore questions the applicability of the SRP 14.3 definition "provided solely for equipment protection." The applicant is therefore requested to determine if removal of the Tier 1 ITAAC for MIN4 was appropriate with consideration to the other functions identified below.

a. Since the comment of RAI 182 and the SRP 14.3 guidance appear to apply only to Tier 1 ITAAC, describe the basis in this RAI response for the CCWS pump trip interlock being omitted from the discussion of the response to MIN4 surge tank level on page 9.2-44 of the Tier 2 Section 9.2.2 markup for RAI 334. Furthermore, based on the FSAR markup of the Emergency Backup Switchover Sequence from RAI 9.2.2-61), the tripping of the CCWS pump will automatically start the opposite CCWS train. Therefore, the tripping of a CCWS pump based on MIN4, is not solely for equipment protection but does automatically start the opposite CCWS pump.

b. The description of the MIN4 interlock on page 9.2-44 of the markup indicates that the common header switchover function is unlocked to allow restoration of flow to the common users, which were isolated at MIN3. Since restoration of flow to users on the common header can be important (e.g. RCP thermal barrier coolers), describe the basis for deleting the Tier 1 MIN4 Interlock from the CCWS ITAAC.

Response to Question 09.02.02-116:

a) U.S. EPR FSAR Tier 2, Section 9.2.2.6.1 will be revised to include a description related to a component cooling water system (CCWS) pump trip on a MIN4 tank level. U.S. EPR FSAR Tier 1, Section 2.7.1 and Table 2.7.1-3—Component Cooling Water System ITAAC will also be revised to include this information.

Note: U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 already contains a description related to a CCWS pump trip on a MIN4 tank level.

b) Refer to the response to Part a of this question.

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 9.2.2.6.1 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-117:

Follow-up to RAI 334, Question 9.2.2-63 and RAI 174, Question 9.2.2-14:

The applicant should explain in the RAI response the application of the pump head and flow margins (calculated to be approximate 15-16%) to the pump parameters identified in FSAR Tier 2 Table 9.2.2-1. For example, Table 9.2.2-1 states that the design parameter for the pump is 17,768 gpm and the pump head is 199.7 ft.

The information that was added as part of RAI 9.2.2-63 FSAR mark-up related to the details of the pump head and pump flow margin, including new Table 9.2.2-5, should be removed and more of a high level summary added in its place.

Response to Question 09.02.02-117:

The maximum total required flow for the component cooling water system (CCWS) pumps results from Train 3 being aligned with the Common 2 header, in addition to the train specific safety injection system (SIS) users. This alignment corresponds to a total required flow of 15,570 gpm. The pump design flow of 17,957 in U.S. EPR FSAR Tier 2, Table 9.2.2-1—CCWS Design Parameters is calculated by including approximately 15 percent margin to the calculated maximum required flow of 15,570 gpm.

The total required developed head for the CCWS pumps results from Train 3 being aligned with the Common 2 header, in addition to the train specific SIS users. This alignment corresponds with a total required developed head of 172.6 feet. The pump head of 199.7 feet in U.S. EPR FSAR Tier 2, Table 9.2.2-1 is calculated by including approximately 15 percent margin to the calculated total developed head of 172.6 feet.

U.S. EPR FSAR Tier 2, Section 9.2.2.2.2 will be revised to include this information. U.S. EPR FSAR Tier 2, Table 9.2.2-5—Design Margins of CCWS Pumps will also be deleted.

Refer to the responses to RAI 334, Supplement 1, Question 09.02.02-63 and RAI 406, Supplement 1, Question 09.02.02-110 for details concerning pump design margin and pump design flow, respectively.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.2.2.2 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-118:

Follow-up to RAI 334, Question 9.2.2-66 and RAI 174, Question 9.2.2-17:

The staff's review of the applicant's response and found that the FSAR markup was incomplete in that it did not fully address the basis and requirements for the special single failure requirements applied for RCP Thermal Barrier Cooling. AREVA is requested to expand the proposed FSAR markup to address at least the following key points:

a. Since all four RCP thermal barriers are cooled by one of two common headers, describe the maintaining of this configuration by train separation. Failure-modes and effects analysis have not been provided in the FSAR for any CCWS active failures, in particular the common thermal barrier cooling headers. Single failure includes, but not limited to, operator errors, spurious activation of a valve operator and loss of a cooling water pump.

b. To clarify, SRP 9.2.2, Section III, part 6 states that the SAR description information, P&IDs, CWS drawings, and failure-modes and effects analysis are reviewed by the primary review organization for whether essential portions of the system function following design-basis accidents, assuming a concurrent single active component failure. The applicant should incorporate this information into the FSAR.

c. In addition, this intrusion of air from the surge tank or failures of CCWS users should also be considered into the failure-modes and effects analysis base on operating experience at St. Lucie (LER3352010001R0), from October 16, 2008.

Response to Question 09.02.02-118:

A response to this question will be provided by August 31, 2010.

Question 09.02.02-119:

Follow-up to RAI 334, Question 9.2.2-70 and RAI 174, Question 9.2.2-22

Some of this RAI is editorial in nature.

Part (a)- In Part (a) of follow-up Question 9.2.2-70 the applicant was requested to clarify and state the basis for the Safety Injection (SI) sequences presented in U.S. EPR FSAR Tier 2 Sections 9.2.2.3.1 and 9.2.2.6. The staff's review found the applicant's response unacceptable and noted the following corrections (technical and editorial) are required in the FSAR markups submitted in RAI 334, Supplement 1:

1. Section 9.2.2.3.1 on page 9.2-36 of the mark-up under the heading for "Previously Running Pumps..." At the end of the first bulleted sentence; delete the phrase "of the train not initially in operation," since it does not belong under this heading. Also, "The initiation of each sequence is provided as a group command" should be removed. (editorial)
2. Section 9.2.2.6 on page 9.2-44 of the markup under the heading "CCWS Actuation from a Safety Injection Signal; this sequence needs to recognize that a "Safety Injection Signal" will also initiate a concurrent containment Isolation "Stage 1" signal to isolate CCWS HVAC and NIDVS users in the Reactor Building. Refer to FSAR Tier 2, Section 7.3.1.2.9 "Containment Isolation," and Figure 7.3-20, "Containment Isolation" for justification that stage 1 is initiated by a safety injection signal. (editorial)
3. Section 9.2.2.3.1 was not consistent with Section 9.2.2.6.1 related to SI signal and the opening of the LHSI pump seal cooler. (technical)

Response to Question 09.02.02-119:

1. A review of the component cooling water system (CCWS) design and U.S. EPR FSAR has confirmed that the following two phrases do not apply and will be deleted from U.S. EPR FSAR Tier 2, Section 9.2.2.3.1:

    "of the train not initially in operation." "The initiation of each sequence is provided as group command."

2. The following statement will be added to U.S. EPR FSAR Tier 2, Section 9.2.2.6.1.1:

    "A safety injection signal initiates a concurrent Containment Isolation Stage 1 signal."

3. A review of the U.S. EPR FSAR has confirmed that a description related to an SI signal and the opening of the LHSI pump seal cooler is missing from U.S. EPR FSAR Tier 2, Section 9.2.2.3.1. U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 will be revised to include this description.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.2.3.1 and 9.2.2.6 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-120:

Follow-up to RAI 334, Question 9.2.2-75 and RAI 174, Question 9.2.2-29:

Part (c)- In Part (c) of follow-up RAI 9.2.2-75 to RAI 9.2.2-29 the staff asked the applicant to add a discussion to FSAR Tier 2 Section 9.2.2 relative to the intended use of common header manual isolation valves (e.g. 20/30KAA30 AA013 and AA014 for 1b and 2b common header). The staff also requested the applicant to include a discussion in the RAI response of potential Technical Specifications that may apply if these valves must be closed during power operation. In response to RAI 334 Supplement 1, the applicant stated that these valves were provided only for maintenance isolation purpose to provide the capability for isolation of a common headers (1b or 2b) while still maintaining flow to the Safety Chilled Water System (SCWS).

However, the staff review noted that the applicant's response did not address the potential applicability of Technical Specifications (TS) when the valves are closed (e.g. note A-1 of TS 3.7.7) and no FSAR text markup of Section 9.2.2 was included. The staff noted that closure of these valves would prevent automatic train switchover of the 1b or 2b headers to the opposite pump and the plant would then be forced to shutdown since the 1b or 2b header would be isolated to the reactor coolant pumps for two pumps. Accordingly, the staff considers the capability provided by these valves of sufficient importance to warrant a description in the FSAR Tier 2 Section 9.2.2. The staff also requests that the applicant explain what is meant by the portion of the response that states "This configuration confirms the availability of the safety chillers during normal plant operation when only two CCWS trains are operating."

In summary, the applicant should address the following:

a) The applicant should address the meaning of: "This configuration confirms the availability of the safety chillers during normal plant operation when only two CCWS trains are operating."

b) Since credit is taken for these manual valves to isolate either the 1b or 2b header and provide CCWS flow to the SCWS to maintain operability, this should be discussed in the FSAR in Section 9.2.2.

c) For manual valves 20/30KAA30 AA013 and AA014 for the 1b and 2b common headers, which are required to be manually closed (for example, during maintenance conditions) to maintain system operability, testing should be included that these valves are able to be closed and provide proper isolation.

d) The applicant should include a discussion of potential Technical Specifications that may apply if these valves must be closed in the applicable TS modes.

e) The applicant should explain (from RAI 9.2.2-29) the equalizing of runtimes of each CCWS pump by the closing of these maintenance valves.

Response to Question 09.02.02-120:

A response to this question will be provided by August 31, 2010.

Question 09.02.02-121:

Follow-up to RAI 334, Question 9.2.2-76 and RAI 174, Question 9.2.2-31:

Part (i)2 and Part i(3)- In Parts (i)2 and (i)3 of follow-up RAI 9.2.2-76 the staff asked the applicant to resolve discrepancies with the alternate power source for ESWS and CCWS Dedicated Train Components identified in U.S. EPR FSAR Tier 1 Tables 2.7.1-2 (CCWS) and 2.7.11-2 (ESWS). In Part (i)2 the staff noted that the FSAR markup provided by the applicant in the response to RAI 174, Supplement 3 of Table 2.7.1-2 identified normal power for the Dedicated Train was provided by Class 1E Division 4 with alternate power from Division 3 for some components but not for others. In Part (i)3 the staff asked the applicant to resolve differences in the power source identified in dedicated train components between CCWS Tier 1 Table 2.7.1-2 (markup for RAI 174, Supplement 3) and ESWS Tier 1 Table 2.7.11-2 (From FSAR Rev. 1). For some Dedicated Train components ESWS Table 2.7.11-2 identified Division 4 normal power with alternate power from the SBO EDG while the markup of CCWS Table 2.7.1-2 identified alternate power from division 3.

The response provided by the applicant in RAI 334, Supplement 1 included markups of Tier 1 Tables 2.7.1-2 and Table 2.7.11-2 as well as Tier 2 Sections 9.2.1 (ESWS) and 9.2.2 (CCWS). The staff's review of the applicant's response and markup of Tier 1 Tables 3.7.1-2 and 2.7.11-2 found them acceptable since only normal power was identified from Class 1E Division 4 and the conflicting alternate power sources were deleted. However, the staff review of the markups provided for FSAR Tier 2 Sections 9.2.1 and 9.2.2 noted a difference in the description of the power source for the Dedicated ESWS Train when compared to the markup for CCWS. The staff believes the FSAR description for the power source for the Dedicated ESWS and CCWS trains should be consistent. Accordingly, the applicant is requested to revise the markup provided for FSAR Tier 2, Section 9.2.1 and 9.2.2 to provide consistency. The subject descriptions from the markup are provided below followed by a list of items that require clarification.

<u>From the markup of ESWS Tier 2 Section 9.2.1, Page 9.2-3</u>

The dedicated ESWS pump is powered by Class 1E electrical buses and is capable of being supplied by an EDG or a station blackout diesel generators (SBODG).

<u>From the markup of CCWS Tier 2 Section 9.2.2, Page 9.2-20</u>

The dedicated CCWS train … is normally fed from offsite power and is capable of being supplied by the onsite electrical power supplies that are backed by an EDG or SBO diesel generator.

<u>The applicant should provide clarifications as shown below:</u>

1. The FSAR description should state that the identified power sources are applicable to the entire dedicated train (pump, valves, components etc.) not just the pump as stated in the ESWS markup.
2. The FSAR description should be corrected since Tier 1 Table 2.7.1-2 and Table 2.7.11-2 which identified normal power for the dedicated train is from Class 1E Division 4, conflicts with the CCWS markup of Section 9.2.2 states that the normal source is off-site power.

3. The FSAR description should state the dedicated trains are also capable of being powered by the Division 4 EDG or the SBO DG.

Part (i)5- In Part (i)5 the applicant was asked to describe the basis for CCWS equipment that is provided with alternate power supplies in Tier 2, Section 9.2.2 In RAI 334 Supplement 1 the applicant responded by including new Table 9.2.2-4 "Power Supplies for CCWS Valves" in the markup of U.S. EPR FSAR Tier 2 Section 9.2.2 which is consistent with Tier 1. The Table identifies CCWS motor operated valves that are provided with normal and alternate Class 1E power supplies. The staff noted that Tier 2 Section 8.3.1.1.1, "Emergency Power Supply System," describes the alternate feed alignments which addressed the basis for alternate power in the EPR design for added power flexibility. However, the staff noted that the markup of Tier 1 Table 2.7.1-2 should identify a Class 1E power source for hydraulic fluid pumps that are associated with each hydraulic valve and associated pilot valves. This information should be added to the FSAR.

Part (m)- In Part (m) the staff requested that the applicant define the ESWS/CCWS design heat load in Tier 1 and cited examples of comparable FSAR Tier 1 Sections where this information was provided. In RAI 334 Supplement 1 the applicant responded by referring to the response to RAI 9.2.2-77 for revised CCWS ITAAC. However, the staff's review of the response to RAI 9.2.2-77 found no information was provided in regard to the addition of ITAAC for ESWS/ CCWS Hx heat load. The applicant should provide this information in Tier 1.

Response to Question 09.02.02-121:

Parts (i)2 and (i)3:

1. A review of the component cooling water system (CCWS) and essential service water system (ESWS) design has confirmed that the identified power sources are applicable to the entire dedicated train for each system. U.S. EPR FSAR Tier 2, Section 9.2.1 will be revised to include this information.

   Refer to the response to RAI 345, Supplement 5, Question 09.02.01-26 for additional information related to the dedicated ESWS.

2. A review of the CCWS and ESWS design confirm that normal power for the dedicated train of each system is from Class 1E Division 4. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include this information.

3. Refer to the responses to Parts 1 and 2 of this question for changes to U.S. EPR FSAR Tier 2, Sections 9.2.1 and 9.2.2, related to alternate power from an emergency diesel generator (EDG) or station blackout diesel generator (SBODG).

   Refer to the response to RAI 345, Supplement 5, Question 09.02.01-26 for changes to U.S. EPR FSAR Tier 1, Section 2.7.11 related to the ESWS.

   U.S. EPR FSAR Tier 1, Table 2.7.1-3—Component Cooling Water System ITAAC will be revised to include this information.

Part (i)5:

A review of the CCWS design has confirmed the Class 1E power source for the hydraulic fluid pumps associated with each hydraulic valve. The common header switchover valves (KAA10/20/30/40 AA006/010/032/033) are designed to fail-as-is upon a loss of power to their hydraulic pilot circuits. The safety-related isolation valves used to isolate the non-safety-related portions of the system (KAB50 AA001/004/006 and KAB80 AA015/016/019) are designed to fail-closed upon a loss of power to their hydraulic pilot circuits.

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 hydraulic fluid pumps associated with pilot valves for the hydraulically operated valves.

Part (m):

A review of the CCWS design has confirmed that the design basis accident (DBA) heat load for the CCWS heat exchanger is 291.8E+06 BTU/hr.

Refer to the response to RAI 406, Supplement 1, Question 09.02.02-110 for details concerning the CCWS heat exchanger design data.

U.S. EPR FSAR Tier 1, Table 2.7.1-3—Component Cooling Water System ITAAC will be revised to include this information.

FSAR Impact:

U.S. EPR FSAR Tier 1, Tables 2.7.1-2 and 2.7.1-3, and U.S. EPR FSAR Tier 2, Sections 9.2.1 and 9.2.2 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-122:

Follow-up to RAI 334, Question 9.2.2-77 and RAI 174, Question 9.2.2-32:

In RAI 9.2.2-77 the staff asked the applicant to resolve several follow-up issues in regard to U.S. EPR FSAR Tier 1 Section 2.7.1 ITAAC. The applicant's response to these issues was provided in RAI 334 Supplement 1. However, the staff's review of the response identified the following items that remain unresolved and should be addressed:

Part (2)(d)- In Part (2)(d) the staff asked the applicant to modify the description of Commitment Item 7.4 to assure that the required flow rate would be confirmed to be met when the four Thermal Barriers were connected to either of the common headers. This item was requested by the staff since the four thermal barriers can be connected to either common header each of which is supplied by one of two CCWS pumps. However, the applicant's response only referred to the current ITAAC item and no Tier 1 change was proposed. This item should be resolved by the applicant to state that the design flow rate is for each thermal barrier cooler and tested for each header (1b and 2b).

Part (4)(a)-In Part (4)(a) the staff asked that water hammer be addressed in FSAR Section 14.2, Test #46. The response and FSAR markup did not specifically address 'all operational conditions' which should at the minimum include, but not be limited too;

a. Automatic switchover between divisional trains
b. Thermal barrier transfer between common headers
c. System automatic starts, for example safety injection
d. Valve automatic closures
e. Pumps trips followed by pump automatic starts and emergency diesel generator loading

The applicant should add this information to the FSAR in Chapter 14.2. In addition, a water hammer analysis may be used to identify the bounding scenarios and limit plant testing to only those conditions.

Response to Question 09.02.02-122:

Part (2)(d):

A review of the component cooling water system (CCWS) design confirms the Tier 1 ITAAC for reactor coolant pump (RCP) thermal barrier flow from either Common Header 1.b or 2.b.

U.S. EPR FSAR Tier 1, Section 2.7.1 will be revised to include this information.

Part (4)(a):

A review of the component cooling water system (CCWS) design confirms the additional operational alignments required to test for water hammer potential.

U.S. EPR FSAR Tier 2, Section 14.2 will be revised to include this information.

FSAR Impact:

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

U.S. EPR Final Safety Analysis Report Markups

2.7 Support Systems

2.7.1 Component Cooling Water System

1.0 Description

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

The CCWS provides the following significant safety related functions:

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

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

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

2.0 Arrangement

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

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

2.3 Physical separation exists between divisions of the CCWS.

3.0 Mechanical Design Features

3.1 Deleted.

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

3.3 Deleted.

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

3.5 Deleted.

3.6 Deleted.

3.7 Deleted.

3.8 Deleted.

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

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

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

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

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

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

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

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

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

4.0 I&C Design Features, Displays and Controls

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

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

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

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

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

09.02.02-116

4.6 A surge tank level of MIN4 automatically trips the associated CCWS pump and unlocks the common header switchover function to allow restoration of flow to the common users.~~Deleted~~.

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

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

4.9 Deleted.

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

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

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 Components in Table 2.7.1-2, that are designated as harsh environment, will perform the function listed in Table 2.7.1-1 in the environments that exist during and following design basis events.

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 net positive suction head available (NPSHA) that is greater than net positive suction head required (NPSHR) at system run-out flow.

09.02.02-122

7.3 The CCWS delivers water to the LHSI/RHRS heat exchangers to provide cooling.

7.4 The CCWS delivers water to the RCP thermal barrier ~~seals~~coolers at the required flow~~.~~ from Common 1.B header and also from Common 2.B header.

7.5 The CCWS delivers water to Divisions 2 and 3 of the SCWS chiller heat exchangers.

7.6 The CCWS delivers water to the spent fuel pool cooling heat exchangers.

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 operating conditions.

7.8 The CCWS provides for flow testing of 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.

7.10 The CCWS surge tanks provide adequate capacity for system operation.

8.0 System Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1-3 lists the CCWS ITAAC.

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (6 Sheets)

Description	Tag Number [1]	Location	IEEE Class 1E [2]	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Common Header 1a Fuel Pool Cooling Heat Exchanger 1 Downstream Control Valve	KAB10AA134	Fuel Building	1[N] 2[A]	N/A	Yes	NA / NA	NA / NA
Common Header 2a Fuel Pool Cooling Heat Exchanger 2 Downstream Control Valve	KAB20AA134	Fuel Building	4[N] 3[A]	N/A	Yes	NA / NA	NA / NA
Common Header 1b Safety Related Loads CVCS HP Cooler 1 Downstream Control Valve	KAB60AA116	Reactor Building	NA	N/A	Yes	Pos	Open-Close
Common Header 2b Safety Related Loads CVCS HP Cooler 2 Downstream Control Valve	KAB70AA116	Reactor Building 09.02.02-121	NA	N/A	Yes	Pos	Open-Close
Dedicated CCWS Surge Tank Isolation Valve	KAA80AA020	Safeguard Building 4	4[4]	N/A	Yes	Pos	Open-Close
Dedicated CCWS Surge Tank Nitrogen Supply Valve	KAA80AA021	Safeguard Building 4	4[4]	N/A	Yes	Pos	Open-Close

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (6 Sheets)

09.02.02-121

Description	Tag Number (1)	Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Dedicated CCWS Demin Water Makeup Water Supply Valve	KAA80AA202	Safeguard Building 4	4 (4)	N/A	Yes	Pos	Open-Close
Dedicated CCWS Pump	KAA80AP001	Safeguard Building 4	4 (4)	N/A	Yes	On-Off / NA	Start-Stop / NA
Dedicated CCWS Demin Water Makeup Pump	KAA80AP201	Safeguard Building 4	4 (4)	N/A	Yes	On-Off / NA	Start-Stop / NA
Safety Chilled Water Chiller CCWS Flow Control Valve	KAA22AA101	Safeguard Building 2	2^N 1^A	N/A	Yes	NA / NA	NA / NA
Safety Chilled Water Chiller CCWS Flow Control Valve	KAA32AA101	Safeguard Building 3	3^N 4^A	N/A	Yes	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.

3) Each hydraulically operated valve has multiple solenoid-operated pilot valves and hydraulic fluid pumps. Pilot valves and hydraulic fluid pumps are powered from different Class 1E divisions to provide redundancy. ~~Each pilot valve is powered from a different Class 1E uninterruptible power supply division to provide redundancy.~~

4) Dedicated components are non-Class 1E components but are powered from the Class 1E division as shown.

09.02.02-121

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

09.02.02-116

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
4.5	A surge tank level of MIN3 automatically isolates the associated train common header switchover valves.	Tests will be performed using test signals to verify the interlock.	The following interlock 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 trips the associated CCWS pump and unlocks the common header switchover function to allow restoration of flow to the common users~~Deleted~~.	Tests will be performed using test signals to verify the interlock~~Deleted~~.	The following interlocks respond as specified below when activated by a test signal: • Surge tank level MIN4 automatically trips the associated CCWS pump. • Surge tank level MIN4 unlocks the switchover sequence. This interlock to be verified by performing a switchover sequence in the interlock test for surge tank MIN4 level.~~Deleted~~.
4.7	A flow rate difference between the supply and return from NAB and RWB automatically isolates the non-safety related branch.	Tests will be performed using test signals to verify the interlock.	The following interlock responds as specified below when activated by a test signal: Flow rate difference between the supply and return from NAB and RWB automatically isolates the non-safety related branch.
4.8	Loss of one CCWS train initiates an automatic switchover to allow cooling of the common “a” and/or “b” headers.	Tests will be performed using test signals to verify the interlock.	The following interlock responds as specified below when activated by a test signal: Loss of one CCWS train automatically initiates a switchover to allow cooling of the common “a” and/or “b” headers.
4.9	Deleted.	Deleted.	Deleted.

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

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
6.1	Components in Table 2.7.1-2, that are designated as harsh environment, will perform the function listed in Table 2.7.1-1 in the environments that exist during and following design basis events.	a. Type tests or type tests and analysis will be performed to demonstrate the ability of the components listed as harsh environment in Table 2.7.1-2 to perform the function listed in Table 2.7.1-1 for the environmental conditions that could occur during and following design basis events.	a. Environmental Qualification Data Packages (EQDP) exist and conclude that the components listed as harsh environment in Table 2.7.1-2 can perform the function listed in Table 2.7.1-1 during and following design basis events including the time required to perform the listed function.
		b. Components listed as harsh environment in Table 2.7.1-2 will be inspected to verify installation in accordance with the construction drawings including the associated wiring, cables and terminations. Deviations to the construction drawings will be reconciled to the EQDP.	b. Inspection reports exists and conclude that the components listed in Table 2.7.1-2 as harsh environment has been installed per the construction drawings and any deviations have been reconciled to the EQDP.
7.1	The CCWS heat exchanger as listed in Table 2.7.1-1 has the capacity to transfer the design heat load to the ESWS system.	Tests and analyses will be performed to demonstrate the capability of the CCWS heat exchanger as listed in Table 2.7.1-1 to transfer the heat load to the ESWS. 09.02.02-121	~~The CCW heat exchanger satisfies the required heat transfer of an equivalent combined product of the heat exchanger area of 39963 ft^2 and the overall heat transfer coefficient of 360 BTU/hr*ft^2*°F.~~A report exists and concludes that the CCWS heat exchanger is capable of removing the DBA heat load of 291.8 E+06 BTU/hr with a minimum additional margin of 10% above the specified 10% tube plugging allowance.

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

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
7.2	The pumps listed in Table 2.7.1-1 have NPSHA that is greater than NPSHR at system run-out flow. 09.02.02-122	Testing will be performed to verify NPSHA for pumps listed in Table 2.7.1-1.	The pumps listed in Table 2.7.1-1 have NPSHA that is greater than NPSHR at system run-out flow with consideration for minimum allowable surge tank water level (as corrected to account for actual temperature and atmospheric conditions).
7.3	The CCWS delivers water to the LHSI/RHRS heat exchangers to provide cooling.	Tests and analyses will be performed to determine the CCWS delivery rate under operating conditions.	The CCWS delivers at least a flowrate to each LHSI/RHR heat exchanger of 2.19×10^6 lb/hr.
7.4	The CCWS delivers water to the RCP thermal barrier coolers at the required flow from Common 1.B header and also from Common 2.B header.	Tests and analyses will be performed to determine the CCWS delivery rate under operating conditions.	The CCWS delivers at least a flowrate to the thermal barrier coolers of 0.0198×10^6 lb/hr from Common 1.B header and also from Common 2.B header.
7.5	The CCWS delivers water to Divisions 2 and 3 SCWS chiller heat exchangers.	Tests and analyses will be performed to determine the CCWS delivery rate under operating conditions.	The CCWS delivers at least a flowrate to the safety chilled water chillers of 0.373×10^6 lb/hr.
7.6	The CCWS delivers water to the spent fuel pool heat exchangers.	Tests and analyses will be performed to determine the CCWS delivery rate under operating conditions.	The CCWS delivers at least a flowrate to the spent fuel pool cooling heat exchangers of 0.8818×10^6 lb/hr.
7.7	Class 1E valves listed in Table 2.7.1-2 perform the function listed in Table 2.7.1-1 under system operating conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.7.1-2 to change position as listed in Table 2.7.1-1 under system operating conditions.	The valves change position as listed in Table 2.7.1-1 under system operating conditions.
7.8	The CCWS provides for flow testing of CCWS pumps during plant operation.	A test will be performed.	Normal system alignment allows testing of each CCWS pump during plant operation.

ESWS are powered by Class 1E electrical buses and are emergency powered by the EDGs.

The non-safety-related dedicated division contains a dedicated ESWS pump, debris filter, piping, valves, controls, and instrumentation. The non-safety related ESWS pumps cooling water from the division four UHS cooling tower basin to the dedicated CCWS HX and back to the division four UHS cooling tower during severe accidents (SA). The dedicated ESWS ~~pump~~train is powered by Class 1E electrical ~~buses~~Division 4 and is capable of being supplied by an EDG or a station blackout diesel generator (SBODG).

09.02.02-121

Refer to Section 12.3.6.5.7 for essential service water system design features which demonstrate compliance with the requirements of 10 CFR 20.1406.

9.2.1.3 Component Description

9.2.1.3.1 Safety-Related Essential Service Water Pumps

Each of the four safety-related cooling divisions contains one 100 percent capacity pump. During normal operating conditions, two of the four divisions are operating. The required flow rate of each ESWS pump is defined by the heat to be removed from the system loads. Design parameters are listed in Table 9.2.1-1. The pumps are designed to fulfill the corresponding minimal required design mass flow rate under the following conditions:

- Minimal water level without cavitation.
- Head losses in the cooling water inlet piping according to full power plant operation.
- Fluctuations in the supplied electrical frequency.
- Increased pipe roughness due to aging and fouling.
- Fouled debris filters.
- Maximum pressure drop through the system HXs.
- Minimum water level in cooling tower basin considers minimum submergence requirements to prevent vortex effects, and net positive suction head to prevent cavitation of the ESWS pump.

Determination of the discharge head of the pumps is based on the dynamic pressure losses, the minimum/maximum water levels of the water source, and the head losses of the mechanical equipment of the associated ESWS at full load operation.

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

09.02.02-121

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

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

Each physically separated CCWS safety-related train includes:

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

Each CCWS safety-related train supplies cooling to its respective CCWS and medium head safety injection (MHSI) pumps and motors and associated LHSI/RHR HXs, and tank connected to the suction line to keep the system filled and maintain adequate head to prevent in-leakage of radioactive fluids from the SAHRS HX, a connection to the demineralized water distribution system with an injection pump for inventory makeup, a chemical additive supply connection, and associated piping, fittings, and valves. The dedicated CCWS surge tank is charged by nitrogen over pressurization, which allows compressible compensation for fluid expansion and contraction and helps provide that any potential coolant leakage is into rather than out of the SAHRS. The dedicated CCWS train is shown in Figure 9.2.2-4—Component Cooling Water System Dedicated CCWS Trains.

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

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

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

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

09.02.02-115

Non-seismic portions of the CCWS are isolated from safety-related SSC by either physical separation or by the use of physical barriers. Failure of the non-seismic portions of the CCWS does not adversely affect the control room nor does it result in excessive radiological release.~~The demineralized water distribution system (DWDS) supply to each of the CCWS surge tanks located in SBs 1, 2, 3 and 4 is non-seismic from the DWDS tank up to the Seismic I motor-operated valve (MOV) of the CCWS. A failure in this portion of the CCWS non-seismic piping does not result in excessive radiological release because these portions of the system only carry demineralized quality water. The control room is not adversely affected by a failure of these potions~~

09.02.02-115

~~of the CCWS. The nuclear island drain and vent system (NIDVS) floor drains direct demineralized water leakage to the NIDVS sump, which shuts off the demineralized water supply. At the entrance of the FB, the demineralized water MOVs 30GHC73 AA001/002 are protectively closed if the level limit value of the NIDVS sumps is initiated for SBs 1, 2 or the FB. At the entrance of SB 4, the demineralized water MOVs 30GHC78 AA001/002 are protectively closed if the level limit value of the NIDVS sumps is initiated for SB 3 or 4~~.

~~Operational chilled water system (OCWS) users on the CCWS common 1 header in the NAB are supplied by piping and components that are non-seismic. This portion of the CCWS is routed from SB 1 through the Reactor Building Annulus and FB. The non-seismic portion of piping is isolated from the Seismic I piping on the supply to the OCWS users by two Seismic I isolation valves, and one Seismic I isolation valve and one Seismic I check valve on the return from the OCWS users. A failure of this non-seismic portion of the CCWS does not result in excessive radiological release because there is no potential for radioactive in-leakage to the CCWS from the OCWS. The control room is not adversely affected by a failure of the non-seismic CCWS piping in SB 1, Reactor Building Annulus, FB or the NAB because the control room is located in the Seismic I SB 2.~~

~~OCWS, coolant treatment system, coolant degasification system, steam generator blowdown system, liquid waste processing system and solid waste system users on the CCWS common 2 header in the NAB and RWPB are supplied by non-seismic piping and components. This portion of the CCWS is routed from SB 4 into the NAB and the RWPB. This non-seismic portion of piping is isolated from the Seismic I piping on the supply to the users by two Seismic I isolation valves, and one Seismic I isolation valve and one Seismic I check valve on the return from the users. A failure of this non-seismic portion of the CCWS does not result in excessive radiological release because there is no potential for radioactive in-leakage to the CCWS from these users. The CCWS is at a higher pressure than each of these systems, so the only potential for in-leakage is from CCWS into these systems. The control room is not adversely affected by a failure of the non-seismic CCWS piping in the NAB or the RWPB because the control room is located in the Seismic I SB 2.~~

~~The dedicated CCWS is a non-safety-related system located in SB 4 whose piping and components are non-seismic. This system is used in beyond design basis accidents to transfer heat from the severe accident heat removal system (SAHRS). A failure of this non-seismic portion of the CCWS does not result in excessive radiological release since the pressurized tank in the dedicated CCWS keeps the system at a higher pressure than that of the SAHRS to prevent possible in-leakage of contaminated fluids in the SAHRS. The control room is not adversely affected by a failure of the non-seismic dedicated CCWS piping located in SB 4 because the control room is located in the Seismic I SB 2.~~

~~A fault in CCWS piping is recognized by redundant level indications on each CCWS surge tank. In the event that tank levels drop to MIN 2, the non-safety-related branches automatically isolate if there is a flow mismatch in inlet and outlet of the supply and return lines for the users. The CCWS is a closed-loop cooling water system with the only potential for radioactive in-leakage coming from the high pressure CVCS and RCS.~~

9.2.2.2.2 Component Description

09.02.02-115

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

09.02.02-117

CCWS Pumps

CCWS pumps are sized to provide the capacity to support system flow requirements during penalizing conditions. To accomplish this, design margins are added to the limiting ~~flow~~ requirements (volumetric flow and head). The pump design flow of 17,957 gpm shown in Table 9.2.2-1 includes an approximate 15 percent margin above the required maximum pump flow. The pump head of 199.7 ft in Table 9.2.2-1 includes an approximate 15 percent margin above the required maximum pump head.~~The required design margins of the CCWS pumps are given in Table 9.2.2-5—Design Margins of CCWS Pumps.~~

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

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

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

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

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

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

between valves AA141 and AA142. The manual valves AA141 and AA142 are then opened to provide the emergency makeup.

Plant procedures and controls associated with the installation of the spool piece will be implemented by the COL applicant.

Dedicated CCWS Surge Tank

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

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

The surge tank is provided with overpressure protection.

Common Header Switchover Valves

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

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

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

09.02.02-121

To provide reliability of the switchover function, each hydraulically operated common header switchover valve has multiple solenoid operated pilot valves and hydraulic fluid pumps. The solenoid operated pilot valves and hydraulic fluid pumps are each powered from different Class 1E divisions.~~an uninterruptible power supply (UPS) is provided to the hydraulic actuation pilot valves. A failure of the electrical distribution system does not inhibit the transfer of the common header to the non-faulted train~~.

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

LHSI Heat Exchanger Isolation Valves

These valves are motor-operated valves. The valves are normally closed to prevent dilution of the LHSI fluid and may be opened when necessary to provide an adequate

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

For previously running pumps, the following sequence applies:

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

~~The initiation of each sequence is provided as a group command.~~

09.02.02-119

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

Loss of Offsite Power

CCWS Safety-Related Trains

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

Beyond Design Basis Events (Dedicated CCWS)

CCWS Safety-Related Trains

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

09.02.02-116

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

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

CCWS Actuation from Safety Injection Signal

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

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

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

09.02.02-119

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

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

CCWS Operation from Containment Isolation Stage 1

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

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

CCWS Operation from Containment Isolation Stage 2

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

Table 9.2.2-5—~~Design Margins of CCWS Pumps~~

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

~~Notes:~~

1. ~~ASME OM Code—2004, Subsection ISTB-3400~~
2. ~~Northeast Power Coordinating Council (NPCC) Document A-03, "Emergency Operation Criteria," defines a reduced grid frequency transient of 57 Hz (5 percent) for three seconds that ramps to 59 Hz over five minutes. New generating plants are expected to be designed to stay on line during this transient. This transient is bounded by National Electrical Manufacturers Association requirements so that the motors continue to operate successfully. However, a corresponding reduction in speed would result in a reduction in pump performance. Based on the preliminary nature of the requirement and the short duration of the transient, a +/- 1 Hz variation will be used.~~
3. ~~Manufacturing tolerance (+) need only to be considered for the determination of design pressure or run-out flow by specifying a guaranteed minimum pump curve, including shop performance test instrument uncertainty.~~
4. ~~Margin is applied to the system flow requirements to accommodate system flow balancing. For the controlling user, it is expected that the head loss associated with this increased flow could vary by four percent.~~

09.02.02-117

2.0 PREREQUISITES

2.1 Construction activities on the CCWS have been completed.

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

2.3 Test instrumentation is available and calibrated.

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

3.0 TEST METHOD

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

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

09.02.02-122

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

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

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

3.3.1 $NPSH_a \geq NPSH_R$.

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

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

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

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

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

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

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

3.9 Verify pump control from the PICS.

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

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

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

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

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

09.02.02-122

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

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

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

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

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

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

- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.

09.02.02-122

- RCP thermal barrier flow returns to normal.

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

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

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

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

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

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

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

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

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

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

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

09.02.02-122

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

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

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

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

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

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

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

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

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

09.02.02-122

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

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

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

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

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

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

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

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

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

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

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

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

09.02.02-122

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

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

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

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

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

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

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

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

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

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

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

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

4.0 DATA REQUIRED

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

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

4.3 Setpoints of alarms interlocks and controls.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Temperature data during cooldown.

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

5.0 ACCEPTANCE CRITERIA

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

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

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

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

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

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

5.1.6 System valves meet design requirements.

5.1.7 Alarms, interlocks, indicating instruments, and status lights meet design requirements.

5.1.8 Verify pump control from the PICS.

5.1.9 Verify the ability of the CCWS in conjunction with the RHRS and essential service water system (ESWS) to perform a plant cooldown during HFT.

09.02.02-122

5.1.10 Verify none of the following water hammer indications are present for all operational tests (3.14 through 3.36):

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