ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Friday, October 15, 2010 2:39 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. 361, FSARCh. 9, Supplement 5
Attachments: RAI 361 Supplement 5 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the eleven questions in RAI No. 361 on April 2, 2010. Supplement 1 and Supplement 2 responses to RAI No. 361 were sent on July 1, 2010 and August 31, 2010, respectively, to provide a revised schedule. Supplement 3 response to RAI No. 361 was sent on September 14, 2010 to provide technically correct and complete responses to seven of the eleven questions. Supplement 4 response to RAI No. 361 was sent on September 30, 2010 to provide a revised schedule.

The attached file, "RAI 361 Supplement 5 Response US EPR DC.pdf" provides technically correct and complete responses to three of the four remaining questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the responses to RAI 361 Questions 09.02.02-97, 09.02.02-101 and 09.02.02-103.

The following table indicates the respective pages in the response document, "RAI 361 Supplement 5 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 361 — 09.02.02-97	2	2
RAI 361 — 09.02.02-101	3	6
RAI 361 — 09.02.02-103	7	7

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

Question #	Response Date
RAI 361 — 09.02.02-95	October 27, 2010

Sincerely,

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

From: BRYAN Martin (External RS/NB)
Sent: Thursday, September 30, 2010 8:40 AM

To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); KOWALSKI David (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 361, FSARCh. 9, Supplement 4

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the eleven questions in RAI No. 361 on April 2, 2010. Supplement 1 and Supplement 2 responses to RAI No. 361 were sent on July 1, 2010 and August 31, 2010, respectively, to provide a revised schedule. Supplement 3 response to RAI No. 361 was sent on September 14, 2010 to provide a technically correct and complete response to seven of the questions, and a revised schedule for the remaining 4 remaining question responses.

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

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

Question #	Response Date
RAI 361 — 09.02.02-95	October 27, 2010
RAI 361 — 09.02.02-97	October 15, 2010
RAI 361 — 09.02.02-101	October 15, 2010
RAI 361 — 09.02.02-103	October 15, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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From: BRYAN Martin (External RS/NB)
Sent: Tuesday, September 14, 2010 6:11 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 361, FSARCh. 9, Supplement 3

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the eleven questions in RAI No. 361 on April 2, 2010. Supplement 1 and Supplement 2 responses to RAI No. 361 were sent on July 1, 2010 and August 31, 2010, respectively, to provide a revised schedule.

The attached file, “RAI 361 Supplement 3 Response US EPR DC.pdf” provides technically correct and complete responses to seven of the eleven questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the responses to RAI 361 Questions 09.02.02-94, 09.02.02-96, 09.02.02-98, 09.02.02-99, 09.02.02-100, 09.02.02-102 and 09.02.02-104.

The following table indicates the respective pages in the response document, "RAI 361 Supplement 3 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 361 — 09.02.02-94	2	2
RAI 361 — 09.02.02-96	3	3
RAI 361 — 09.02.02-98	4	5
RAI 361 — 09.02.02-99	6	7
RAI 361 — 09.02.02-100	8	8
RAI 361 — 09.02.02-102	9	9
RAI 361 — 09.02.02-104	10	10

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

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

Question #	Response Date
RAI 361 — 09.02.02-95	September 30, 2010
RAI 361 — 09.02.02-97	September 30, 2010
RAI 361 — 09.02.02-101	September 30, 2010
RAI 361 — 09.02.02-103	September 30, 2010

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From: BRYAN Martin (External RS/NB)
Sent: Tuesday, August 31, 2010 4:03 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 361, FSARCh. 9, Supplement 2

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the eleven questions in RAI No. 361 on April 2, 2010. Supplement 1 of RAI No. 361 was sent on July 1, 2010 to revise the schedule. Since responses to the remaining questions are being processed, a revised schedule is provided in this email.

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

Question #	Response Date
RAI 361 — 09.02.02-94	September 14, 2010
RAI 361 — 09.02.02-95	September 14, 2010
RAI 361 — 09.02.02-96	September 14, 2010
RAI 361 — 09.02.02-97	September 14, 2010
RAI 361 — 09.02.02-98	September 14, 2010
RAI 361 — 09.02.02-99	September 14, 2010

RAI 361 — 09.02.02-100	September 14, 2010
RAI 361 — 09.02.02-101	September 14, 2010
RAI 361 — 09.02.02-102	September 14, 2010
RAI 361 — 09.02.02-103	September 14, 2010
RAI 361 — 09.02.02-104	September 14, 2010

Sincerely,

Martin (Marty) C. Bryan
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From: BRYAN Martin (EXT)
Sent: Thursday, July 01, 2010 4:40 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); KOWALSKI David J (AREVA NP INC); 'Carneal, Jason'
Subject: Response to U.S. EPR Design Certification Application RAI No. 361, FSARCh. 9, Supplement 1

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the eleven questions in RAI No. 361 on April 2, 2010.

To allow time for interaction between AREVA and the NRC staff, a revised schedule is provided in this e-mail.

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

Question #	Response Date
RAI 361 — 09.02.02-94	August 31, 2010
RAI 361 — 09.02.02-95	August 31, 2010
RAI 361 — 09.02.02-96	August 31, 2010
RAI 361 — 09.02.02-97	August 31, 2010
RAI 361 — 09.02.02-98	August 31, 2010
RAI 361 — 09.02.02-99	August 31, 2010
RAI 361 — 09.02.02-100	August 31, 2010
RAI 361 — 09.02.02-101	August 31, 2010
RAI 361 — 09.02.02-102	August 31, 2010
RAI 361 — 09.02.02-103	August 31, 2010
RAI 361 — 09.02.02-104	August 31, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
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702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Friday, April 02, 2010 5:24 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); KOWALSKI David J (AREVA NP INC); WILLIFORD Dennis C (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 361, FSARCh. 9

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 361 Response US EPR DC," provides a schedule since technically correct and complete responses to the eleven questions are not provided.

The following table indicates the respective pages in the response document, "RAI 361 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 361 — 09.02.02-94	2	2
RAI 361 — 09.02.02-95	3	3
RAI 361 — 09.02.02-96	4	4
RAI 361 — 09.02.02-97	5	5
RAI 361 — 09.02.02-98	6	6
RAI 361 — 09.02.02-99	7	7
RAI 361 — 09.02.02-100	8	8
RAI 361 — 09.02.02-101	9	9
RAI 361 — 09.02.02-102	10	10
RAI 361 — 09.02.02-103	11	11
RAI 361 — 09.02.02-104	12	12

The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 361 — 09.02.02-94	July 1, 2010
RAI 361 — 09.02.02-95	July 1, 2010
RAI 361 — 09.02.02-96	July 1, 2010
RAI 361 — 09.02.02-97	July 1, 2010
RAI 361 — 09.02.02-98	July 1, 2010
RAI 361 — 09.02.02-99	July 1, 2010
RAI 361 — 09.02.02-100	July 1, 2010
RAI 361 — 09.02.02-101	July 1, 2010
RAI 361 — 09.02.02-102	July 1, 2010
RAI 361 — 09.02.02-103	July 1, 2010
RAI 361 — 09.02.02-104	July 1, 2010

Sincerely,

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Licensing Advisory Engineer
AREVA NP Inc.

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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, March 04, 2010 2:27 PM
To: ZZ-DL-A-USEPR-DL
Cc: Eul, Ryan; Wheeler, Larry; Lee, Samuel; Segala, John; Hearn, Peter; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 361 (4260), FSARCh. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on January 26, 2010, and discussed with your staff on March 4, 2010. Drat RAI Question 09.02.02-98 was modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

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

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 2139

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB7107EBBB9E)

Subject: Response to U.S. EPR Design Certification Application RAI No. 361, FSARCh. 9, Supplement 5
Sent Date: 10/15/2010 2:39:11 PM
Received Date: 10/15/2010 2:39:15 PM
From: BRYAN Martin (EXTERNAL AREVA)

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

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"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
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Tracking Status: None

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MESSAGE	11785	10/15/2010 2:39:15 PM
RAI 361 Supplement 5 Response US EPR DC.pdf	89561	

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

Response to

Request for Additional Information No. 361, Supplement 1

3/04/2010

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: 09.02.08

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

Question 09.02.02-97:

Follow-up to RAI 174, Question 09.02.02-53

Standard Review Plan (SRP) 9.2.2 Section III, requires review of the failure-modes and effects analyses to determine whether the system can sustain the loss of any active component and whether the system meets minimum requirements (i.e. cooling load and flow) for these failure conditions. Based on the staff's review of the applicant's response to RAI 174, Question 9.2.2-53, Supplement 5 and information provided in the associated markup of the Final Safety Analysis Report (FSAR), Section 9.2.8, "Safety Chilled Water System" the staff found a significant design change to the system. The safety chilled water system (SCWS) design now utilizes "cross-ties" between Trains 1 and 2 and between Trains 3 and 4, instead of the independent four-train system structure utilized in the original design. The staff requests the applicant provide failure-modes and effects analyses for the safety chilled water system (SCWS) including the cross-tie feature.

Response to Question 09.02.02-97:

There is a failure modes and effects analysis (FMEA) including the cross-tie feature.

Results of the FMEA are summarized in a new table, U.S. EPR FSAR Tier 2, Table 9.2.8.-4 Safety Chilled Water System Failure Analysis.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 9.2.8-4 will be added as described in the response and indicated in the attached markup.

Question 09.02.02-101:

Follow-up to RAI 174, Question 09.02.02-53

The safety chilled water system (SCWS) must be capable of removing heat from structures, systems 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. Based on the staff's review of the applicant's response to RAI 174, Question 9.2.2-53, Supplement 5 and information provided in the associated markup of the Final Safety Analysis Report (FSAR), Section 9.2.8, "Safety Chilled Water System" the staff found a significant design change to the system. The safety chilled water system (SCWS) design now utilizes "cross-ties" between Trains 1 and 2 and between Trains 3 and 4, instead of the independent four-train system structure utilized in the original design. In order to satisfy the above requirements, address the following regarding instrumentation and controls (I&C):

a. Clarify the difference between a single pump tripping/failing and multiple pumps tripping/failing along with the logic for maintaining the proper flow to ensure adequate cooling for both trains.

    1. Table 2.7.2-3, "Safety Chilled Water ITAAC," Item 4.4 states that the standby chiller and its pump(s) start on a trip of the running chiller or its pump(s). Describe the SCWS response (i.e. how many pumps start) on a loss of a single pump in the operating train. Also describe the SCWS response to a loss of both pumps in the operating train.

    2. Final Safety Analysis Report (FSAR) Section 9.2.8.6 states that the affected chilled water system train is deactivated by "pump" failure. Clarify if this is deactivation occurs for the loss of a single pump or requires loss of both pumps.

b. FSAR Section 9.2.8.6 indicates the cross-tied loops isolate on low-low system pressure. The staff requests that the applicant address if there is a similar isolation based on low expansion tank level. If not, describe the SCWS would response to a slow leak of the inventory lost but no activation of the low-low pressure trip.

c. Technical Specification (TS) Bases B3.7.9 states that the chiller standby units start on trip of the running chiller. Address the SCWS response to increasing temperatures if the running chiller is overloaded or degraded but not tripped.

d. Address any I&C logic associated with the motor-operated cross-tie valves (auto-close or auto-open) if applicable.

Response to Question 09.02.02-101:

a. For full load, cross-tie operation of SCWS, two pumps in the operating train are required to operate. If one pump fails, the standby train automatically starts and the operating train is manually stopped from the MCR.

    As indicated in the Response to RAI 356, Supplement 4, Question 09.02.02-86, U.S EPR FSAR Tier 2, Section 9.2.8.6 was revised as follows:

    "Instrument display location, and input to alarm and automatic or manual functions for instruments shown in Figure 9.2.8-1 are provided in Table 9.2.8-3.

An automatic switchover to operate the opposite chiller train occurs if the chilled water flow through the evaporator reaches a MIN-2 set point for the running train. Then, if the cross-tie valves are open and the opposite chiller is in stand-by, the opposite (non-running) chiller pumps are started. When differential pressure across the opposite chiller evaporator is greater than MIN-1, then the opposite chiller is automatically started and the initial running chiller train is stopped manually from the MCR."

As indicated in the Response to RAI 356 Supplement 4, Question 09.02.02-92, U.S. EPR FSAR Tier 2, Section 9.2.8.6 was revised as follows:

> "In the event the operating train fails, the opposite stand-by train starts within one minute." This means that within one minute of the fault signal that initiates the automatic switchover sequence, the pumps and the chiller in the standby train will start.
>
> As indicated in the response markup to FSAR Tier 2, Section 9.2.8.6 for RAI 356 Supplement 4 Question 09.02.02-93, "Running pumps will trip on a pump fault, chiller fault, low evaporator flow (MIN-2), or MIN-3 pressure in the expansion tank. In cross-tie operation, any of these faults causes a switchover to the standby train in the divisional pair. In cross-tie operation, the switchover occurs for failure of a single pump or for simultaneous failure of two pumps in the operating train.
>
> The SCWS is designed to withstand the effects of running opposing pumps during auto switchover sequence. During the switchover, at least one bypass control valve in the divisional pair will be operating, which will bypass some of the excess pump flow.
>
> As indicated in response markup to U.S. EPR FSAR Tier 2, Section 9.2.8.2.2 for RAI 356 Supplement 4 Question 09.02.02-86, "The design pressure is based on the total of pump shut-off head, the operating static pressure, and the lowest elevation in the SCWS."

As indicated in the Response to RAI 361 Supplement 1, Question 09.02.02-98, "The initial testing program will include testing to verify that auto train swap to standby train due to pump/chiller failure does not indicate evidence of water hammer."

As indicated in the Response to RAI 361 Supplement 1, Question 09.02.02-100, "FSAR Chapter 14.2 will be revised to include parallel pump testing as part of the initial test program."

SCWS is a closed loop system. Flow direction is from the SCWS pumps discharge, through the chiller unit, to the user heat exchangers, and back to the suction side of the pumps. Reverse flow in the system is prevented by a check valve in each pump discharge line.

The following automatic functions represent generic steps in train switchover to be performed or validated as a result of the abnormal condition in the affected train, and will be added to U.S. EPR FSAR Tier 2, Section 9.2.8.6.

- Standby train prerequisites are met for train startup.

- Cross-tie MOVs are open-validate MOV position.
- Start standby train pump 1.
- Start standby train pump 2.
- Start standby train chiller unit.
- Enable the control loop for differential pressure across the evaporator.
- Enable the pressure monitoring loop for system pressure.
- Annunciation occurs on automatic switchover.

When the standby train is in operation, the following actions will be manually initiated from the control room to stop the previously operating train.

- Standby train is in operation –validate operation.
- Stop operating chiller (if running).
- Stop operating train pump 1 (if running).
- Stop operating train pump 2 (if running).
- Disable the operating train pressure monitoring loop for system pressure.
- Close the operating train bypass control valve.
- Disable the operating train control loop for differential pressure across the evaporator.

b. SCWS pressure is maintained by the nitrogen pressure in the tank. There is no permanently connected nitrogen source and nitrogen supply is not connected during normal operation. Therefore, the effect of a nitrogen leak would be the same as a slow water leak. There is no similar isolation based on low expansion tank level. A slow leak of the inventory would activate a low pressure alarm. The operator would check nitrogen charge, for water leaks, and provide makeup water.

Refer to the Response to RAI 356, Question 09.02.02-86b for additional information on SCWS instrumentation.

c. The chiller evaporator outlet temperature is monitored. An alarm occurs if temperature reaches high set point. An automatic switchover to the standby train occurs if temperature reaches high–high set point.

d. The Response to RAI 174 Supplement 5, Question 09.02.02-53 revised U.S. EPR FSAR Tier 2, Section 9.2.8.6 as follows.

> "If the system experiences excessive leakage in excess of system makeup capability, the cross-tie isolation MOVs close on Low-2 system pressure. The non-operating standby train automatically starts on Low-2 pressure. The train without excessive leakage returns to pressure and the train with excessive leakage is manually stopped from the DCS."

U.S. EPR FSAR Tier 2, Section 9.2.8.6 will be revised to indicate that the cross-tie isolation MOVs are manually closed from the control room.

As indicated in the Response to RAI 356 Supplement 4, Question 09.02.02-86 U.S. EPR FSAR Tier 2, Table 9.2.8-3 was revised as follows:

> Function = “MIN-2 (pressure) Manual Isolation Div. 1 and 2 (for divisional pair 3 and 4 – “Manual Isolation Div. 3 and 4”). Purpose = “MIN-2 alarm alerts operators to close cross-tie valves for inventory protection of a division”.

FSAR Impact:

a) The U.S. EPR FSAR Tier 2, Section 9.2.8.6 will be revised as described in the response and indicated in the attached markup.

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

c) The U.S. EPR FSAR Tier 2, Section 9.2.8.6 will be revised as described in the response and indicated on the enclosed markup.

d) The U.S. EPR FSAR Tier 2, Section 9.2.8.6 will be revised as described in the response and indicated on the enclosed markup.

Question 09.02.02-103:

Follow-up to RAI 174, Question 09.02.02-53

The safety chilled water system (SCWS) must be capable of removing heat from structures, systems 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. Based on the staff's review of the applicant's response to RAI 174, Question 9.2.2-53, Supplement 5 and information provided in the associated markup of the Final Safety Analysis Report (FSAR), Section 9.2.8, "Safety Chilled Water System" the staff found a significant design change to the system. The safety chilled water system (SCWS) design now utilizes "cross-ties" between Trains 1 and 2 and between Trains 3 and 4, instead of the independent four-train system structure utilized in the original design. In Final Safety Analysis Report (FSAR) section 9.2.8.3.2, the applicant states "At or before the end of 24 hours post DBA, the cross-tie isolation valves are manually isolated to protect against a passive failure." The staff request the applicant address the basis for the 24-hour period and the tracking or controlling of this time post accident (i.e. valve timing logic, COL applicant action item for procedures, etc.)

Response to Question 09.02.02-103:

The basis for the 24-hour period is the limiting single failures indicated in U.S. EPR FSAR Tier 2, Section 15.0.0.3.8. The 24-hour period is not a licensing or design requirement.

Unless there is a failure that affects SCWS, post-LOCA operator action is dependent on the condition of the RCS and ECCS; not on the condition of the SCWS.

U.S. EPR FSAR Tier 2, Section 9.2.8.3.2 will be revised by deleting the sentence describing the 24-hour period.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.8.3.2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

used for equalization of pressure and volumetric expansion and helps maintain the requisite static system pressure. A relief valve on the connecting line prevents the line design pressure from being exceeded. Piping voids associated with potential waterhammer are precluded by the constant pressure maintained in the nitrogen-charged expansion tank in each ~~division~~train.

The SCWS design minimizes the potential for dynamic flow instabilities and water hammer by avoiding high line velocities and has specified closing valve speeds that are slow enough to prevent damaging pressure increases. Vents are provided to vent to fully fill components and piping at high points in which voids could occur. The Nitrogen pressurized expansion tank confirms system high points are retained at positive pressure.

A manually operated make up demineralized water supply is used when water loss resulting from operational measures (e.g., venting and draining) is indicated by an expansion tank pressure instrument.

The SCWS is treated with hydrazine in low concentration for corrosion control. Monitoring of the water chemistry is provided by means of local sampling.

9.2.8.3.2 Abnormal Operation

09.02.02-103

In the event of a DBA with concurrent loss of offsite power (LOOP) the operating train of a divisional pair receives a "Start" signal to return the operating train to operation after load shed. If an active single failure occurs (assume either the EDG fails to start or the SCW train pump or chiller does not re-start), then the standby train receives a "Start" signal. This sequence confirms that one train of a divisional pair is operating. ~~At or before the end of 24 hours post DBA, the cross-tie isolation valves are manually isolated to protect against a passive failure.~~

The SCWS is powered from the emergency diesel generators (EDG) and continues to function during a DBA. Trains 1 and 4 of the SCWS provide a heat sink to s~~ystem users and~~Division 1 and 4 LHSI pumps and HVAC systems in the event of a severe accident or station blackout (SBO). Trains 1 and 4 are powered from motor control centers that are re-powered by the station blackout diesels during an SBO event.

Each SCWS expansion tank will maintain a defense in depth post-seismic emergency manual makeup spool piece connection to a seismic makeup water source post seven day water supply from the Seismic II fire water distribution system inside the Nuclear Island. The seismic makeup connection is shown on Figure 9.2.8-1. The fire water distribution system is designed to remain functional after a SSE as described in Section 9.5.1.2.1.~~Under seismic or post-accident conditions, when demineralized water may be unavailable for SCWS makeup, a manual connection to the fire water distribution system is available to provide a seismic makeup source within a time frame consistent~~

A Surveillance Requirement will verify SCWS train leakage on a 24 month frequency. Plant procedures and controls associated with leakage trending will be implemented by the COL applicant.

9.2.8.6 Instrumentation Requirements

The SCWS system is controlled by the safety automation system (SAS). The normal indication, manual control, and alarm functions are provided by the process information and control system (PICS). Instrument display location, and input to alarm and automatic or manual functions for instruments shown in Figure 9.2.8-1 are provided in Table 9.2.8-3.

The chiller evaporator outlet temperature is monitored. An alarm occurs if temperature reaches high setpoint. An automatic switchover to the standby train occurs if temperature reaches high-high setpoint.

09.02.02-101

An automatic switchover to operate the opposite chiller train occurs if the chilled water flow through the evaporator reaches a MIN-2 set point for the running train. Then, if the cross-tie valves are open and the opposite chiller is in stand-by, the opposite (non-running) chiller pumps are automatically started. When differential pressure across the opposite chiller evaporator is greater than MIN-1, then the opposite chiller is automatically started and the initial running chiller train is stopped manually from the MCR.

The following automatic functions represent generic steps in train switchover to be performed or validated as a result of the abnormal condition in the affected train:

- Standby train prerequisites are met for train startup.
- Cross-tie MOVs are open-validate MOV position.
- Start standby train pump 1.
- Start standby train pump 2.
- Start standby train chiller unit.
- Enable the control loop for differential pressure across the evaporator, which starts system flow regulation by the bypass control valve in the standby train.
- Enable the pressure monitoring loop for system pressure.

Annunciation occurs on automatic switchover.

When the standby train is in operation, the following actions are manually initiated from the control room to stop the previously operating train.

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- Standby train is in operation –validate operation.
- Stop operating chiller (if running).
- Stop operating train pump 1 (if running).
- Stop operating train pump 2 (if running).
- Disable the operating train pressure monitoring loop for system pressure.
- Close the operating train bypass control valve.
- Disable the operating train control loop for differential pressure across the evaporator.

System pressure is monitored with the aid of two pressure measurements for each train. The two measurements are combined in one measuring point. If the pressure falls to MIN-1, an alarm is issued for operators to check nitrogen charge or provide makeup with demineralized water. The SCWS expansion tank MIN-1 pressure alarm is below the lowest normal system operating pressure with sufficient margin to avoid a spurious alarm. SCWS expansion tank MIN-2 pressure is below MIN-1, but above the inventory margin required for seven days of normal operation. SCWS expansion tank MIN-3 pressure is below the seven day normal makeup margin, but high enough to provide sufficient NPSH and prevent pump cavitation and still retain sufficient inventory margin in the expansion tank.

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If the system experiences excessive leakage in excess of system makeup capability, the cross-tie isolation MOVs are closed manually from the MCR on Low-2 system pressure. The non-operating standby train automatically starts on Low-2 pressure. The train without excessive leakage returns to pressure and the train with excessive leakage is manually stopped from the DCS.

If the pressure falls to MIN-3, the following measures are initiated automatically for the affected train:

- Chilled water system "Protection OFF" alarms. The MIN-3 system pressure setpoint trip occurs before the pressure corresponding to the minimum required available NPSH is reached.
- Refrigeration unit shuts down.
- Chilled water circulating pump shuts down.

A humidity sensor is installed in the nitrogen region of the diaphragm expansion tank. This sensor issues a MAX-1 alarm indicating a leaky diaphragm if humidity exceeds a set limit.

Table 9.2.8-4—Safety Chilled Water System Failure Analysis
Sheet 1 of 5

Component	Component Function	Failure Mode	Failure Mechanism	Failure Symptoms/Effect	Can SCWS Satisfy Mission Success Criteria? Notes (1), (2), (3), (4)
SCWS 30QKA	Supply Chilled Water to User Exchangers	Passive failure, leak > makeup can handle	Mechanical	System pressure falls below minimum requirement.	Yes. If SCWS Train 1 is out for maintenance (see Note 3 typical) and a failure occurs in Train 2, there is a second SCWS cross-tied pair Trains 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4.
					Yes. If SCWS Train 1 is out for maintenance and a failure occurs in Train 4, Train 2 would remain supplying Div 1 and 2 user exchangers. Cooling function remains for Div 1 and 2. Train 3 can be administratively operated in independent division operation. Shut down 4. If this is performed along with the above, cooling function remains for Div 1, 2, and 3.
SCWS Expansion Tank 30QKA10/20/30/40 BB101	Maintains pressure in the system.	Tank diaphragm fails to maintain system pressure or loss of nitrogen pressure	Mechanical/I&C	System pressure falls below minimum requirement.	YES. For cross-tie operation, two expansion tanks are inter-connected by the cross-tie. Each expansion tank serves two SCWS divisions. If SCWS Train 1 is out for maintenance and a failure occurs in Train 2 tank, there is a second SCWS cross-tied pair Trains 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4.
					YES. For cross-tie operation, two expansion tanks are inter-connected by the cross-tie. Each expansion tank serves two SCWS divisions. If SCWS Train 1 is out for maintenance and a failure occurs in Train 4 tank, cooling function remains for Div 1 and 2 served by Train 2 tank and cooling function remains for Div 3 and 4 served by Train 3 tank. Train 3 can be administratively operated in independent division operation. Shut down 4. If this is performed along with the above, cooling function remains for Div 1, 2, and 3.
SCWS Pump 30QKA10/20/30/40 AP107/108	Provides flow of water to each user.	Pump fails during normal operation	Mechanical, Electrical, I&C	Loss of chilled water flow to the users.	Yes. If SCWS Train 1 is out for maintenance, and failure of one pump in Train 2 occurs, there is a second SCWS cross-tied pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. Train 2 can be administratively operated with one remaining pump in independent division operation. If this is performed along with the above, cooling function remains for Div 2, 3 and 4. Note (5)
					Yes. If SCWS Train 1 is out for maintenance and failure of one pump in Train 4 occurs, start standby Train 3 SCWS which will continue to supply both Div 3 and 4. There is a second SCWS cross-tied pair 1 & 2 with SCWS Train 2 operating that serves Div 1 & 2 user exchangers. Cooling function remains for Div 1, 2, 3 and 4.
SCWS Air Cooled Chiller 30QKA10/40 AH112 Note (6)	Transfers heat from the SCWS water to the refrigerant then transfers heat from the refrigerant to the air flow which is the heat sink for SCWS 1 and 4.	Chiller fails during normal operation.	Mechanical, Electrical, I&C	Loss of ability to provide chilled water at design temperature.	Yes. If SCWS Train 1 is out for maintenance, and failure of the chiller in Train 2 occurs, there is a second SCWS cross-tied pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. Note (7)
					Yes. If SCWS Train 1 is out for maintenance and failure of the chiller in Train 4 occurs, start standby Train 3 SCWS which will continue to supply both Div 3 and 4. There is a second SCWS cross-tied pair 1 & 2 with SCWS Train 2 operating that serves Div 1 & 2 user exchangers. Cooling function remains for Div 1, 2, 3 and 4

Table 9.2.8-4—Safety Chilled Water System Failure Analysis
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Component	Component Function	Failure Mode	Failure Mechanism	Failure Symptoms/Effect	Can SCWS Satisfy Mission Success Criteria? Notes (1), (2), (3), (4)
SCWS Ventilation Equipment for Air Cooled Chiller 30QKA10/40	Transfer heat from SCWS 1 and 4 to Outside Air	Ventilation fails during normal operation	Mechanical, Electrical, I&C	Loss of ability to provide chilled water at design temperature.	Yes. Bounded by the above two items for the SCWS air cooled chiller.
SCWS Water Cooled Chiller 30QKA20/30 AH112 Note (6)	Transfers heat from the SCWS water to the refrigerant then transfers heat from the refrigerant to Component Cooling Water System (CCWS) which is the heat sink for SCWS 2 and 3.	Chiller fails during normal operation.	Mechanical, Electrical, I&C	Loss of ability to provide chilled water at design temperature.	Yes. If SCWS Train 1 is out for maintenance, and failure of the chiller in Train 2 occurs, there is a second SCWS cross-tied pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. Note (7) Loss of Division 2 of CCWS is equivalent to this case.
					Yes. If SCWS Train 1 is out for maintenance and failure of the chiller in Train 3 occurs, start standby Train 4 SCWS which will continue to supply both Div 3 and 4. There is a second SCWS cross-tied pair 1 & 2 with SCWS Train 2 operating that serves Div 1 & 2 user exchangers. Cooling function remains for Div 1, 2, 3 and 4. Loss of Division 3 of CCWS is equivalent to this case.
Bypass Control Valve 30QKA10/20/30/40 AA101	Prevents freezing of the evaporator tubes.	Does not modulate to desired position	Mechanical, Electrical, I&C	Freezing the evaporator tubes	Yes. If SCWS Train 1 is out for maintenance and failure occurs in Train 2 bypass valve, there is a second SCWS cross-tied pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. Note (8)
					Yes, If SCWS Train 1 is out for maintenance and a failure occurs in Train 4 bypass valve, switch to the standby Train 3 in cross-tied pair 3 & 4. Train 2 would remain supplying Div 1 and 2 user exchangers. Cooling function remains for Div 1, 2, 3 and 4. Note (8)
				Valve inadvertently opens, bypassing too much flow. Either the operational division valve or stand-by division valve in each pair.	Yes. If SCWS Train 1 is out for maintenance and a failure occurs in Train 2 bypass valve, there is a second SCWS cross-tie pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4.
					Yes, If SCWS Train 1 is out for maintenance and a failure occurs in Train 4 bypass valve, train 2 would remain supplying Div 1 and 2 user exchangers. Cooling function remains for Div 1 and 2. Train 3 can be administratively operated in independent division operation. Shut down 4. If this is performed along with the above, cooling function remains for Div 1, 2 and 3.

Table 9.2.8-4—Safety Chilled Water System Failure Analysis
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Component	Component Function	Failure Mode	Failure Mechanism	Failure Symptoms/Effect	Can SCWS Satisfy Mission Success Criteria? Notes (1), (2), (3), (4)
Flow Control Valve for 30SAC01/02/03/04 AC001 Valve # 30QKC10/20/30/40 AA101	Controls flow through the HVAC cooling coil 30SAC01/02/03/04 AC001.	Does not modulate to desired position	Mechanical, Electrical, I&C	Loss of control of chilled water flow for the affected SAC exchanger in one division.	Yes. If SCWS Train 1 is out for maintenance and a failure occurs in Train 2 flow control valve, there is a second SCWS cross-tie pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. If the maintenance in SCWS Train 1 does not affect the Train 1 flow control valve 30QKC10AA101, cooling function remains for Div 1, 3 and 4.
					Yes, If SCWS Train 1 is out for maintenance and a failure occurs in Train 4 flow control valve, train 2 would remain supplying Div 1 and 2 user exchangers. Cooling function remains for Div 1 and 2. If failure of the Train 4 flow control valve 30QKC40AA101 does not affect overall SCWS operation, cooling function remains for Div 1, 2, 3 and 4 except for the affected SAC user exchanger. If failure of the Train 4 flow control valve 30QK40AA101 affects overall SCWS operation, Train 3 can be administratively operated in independent division operation. Shut down 4. If this is performed along with the above, cooling remains for Div 1, 2 and 3.
Flow Control Valve for 30SAB01/02/03/04 AC001 Valve # 30QKB10/20/30/40 AA101	Controls flow through the HVAC cooling coil 30SAB01/02/03/04 AC001.	Does not modulate to desired position	Mechanical, Electrical, I&C	Loss of control of chilled water flow for the affected SAB exchanger in one SAB train.	Yes. If SCWS Train 1 is out for maintenance and a failure occurs in Train 2 flow control valve, there is a second SCWS cross-tie pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. If the maintenance in SCWS Train 1 does not affect the Train 1 flow control valve 30QKB10AA101, cooling function remains for Div 1, 2 and 4.
					Yes, If SCWS Train 1 is out for maintenance and a failure occurs in Train 4 flow control valve, train 2 would remain supplying Div 1 and 2 user exchangers. Cooling function remains for Div 1 and 2. If failure of the Train 4 flow control valve 30QKB40AA101 does not affect overall SCWS operation, cooling function remains for Div 1, 2, 3 and 4 except for the affected user exchanger. If failure of the Train 4 flow control valve 30QKB40AA101 affects overall SCWS operation, Train 3 can be administratively operated in independent division operation. Shut down 4. If this is performed along with the above, cooling function remains for Div 1, 2 and 3.
Flow Control Valve for LHSI Pump Seal Cooler Valve # 30QKA10/40 AA025	Controls flow through the LHSI pump seal cooler.	Does not open.	Mechanical, Electrical, I&C	Loss of chilled water flow for the affected LHSI pump in one division.	Yes, If SCWS Train 1 is out for maintenance and a failure occurs in Train 4 flow control valve, there are two CCWS divisions that serve LHSI pumps 2 & 3. Shutdown Div 4 LHSI pump. Div 1 and Div 2 user exchangers continue to be supplied from cross-tied pair 1 & 2 supplied by SCWS Train 2. Continue to operate cross-tied pair 3 and 4. Cooling function remains for Div 1, 2 and 3 LHSI pumps. For other user exchangers, cooling function remains for Div 1, 2, 3 and 4.

Table 9.2.8-4—Safety Chilled Water System Failure Analysis
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Component	Component Function	Failure Mode	Failure Mechanism	Failure Symptoms/Effect	Can SCWS Satisfy Mission Success Criteria? Notes (1), (2), (3), (4)
Cross-tie Valves 30QKA10/20/30/40AA102	Connect supply side of SCWS Div 1 to Div 2 and Div 3 to Div 4.	Fail open	Mechanical, Electrical, I&C	Prevents independent divisional operation which requires cross-tie valves to be closed.	Yes, the associated cross-tie valve in the divisional pair, which is in series with the affected valve, remains closed. No effect on cooling function.
		Fail closed	Mechanical, Electrical, I&C	Prevents cross-tie operation which requires cross-tie valves to be open.	Yes. If SCWS Train 1 is out for maintenance and a cross-tie valve fails closed in Train 2, there is a second SCWS cross-tie pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. Train 2 can be administratively operated in independent division operation. If this is performed along with the above, cooling function remains for Div 2, 3 and 4.
					Yes. If SCWS Train 1 is out for maintenance and a cross-tie valve fails closed in Train 4, there is a second SCWS cross-tie pair 1 & 2 that serves its associated user exchangers. Cooling function remains for Div 1 and 2. Trains 3 and 4 can be administratively operated in independent division operation. If this is performed along with the above, cooling function remains for Div 1, 2, 3 and 4.
Cross-tie Valves 30QKA10/20/30/40AA103	Connect return side of SCWS Div 1 to Div 2 and Div 3 to Div 4	Fail open	Mechanical, Electrical, I&C	Prevents independent divisional operation which requires cross-tie valves to be closed.	Yes, the associated cross-tie valve in the divisional pair, which is in series with the affected valve, remains closed. No effect on cooling function.
		Fail closed	Mechanical, Electrical, I&C	Prevents cross-tie operation which requires cross-tie valves to be open.	Yes. If SCWS Train 1 is out for maintenance and a cross-tie valve fails closed in Train 2, there is a second SCWS cross-tie pair 3 & 4 that serves its associated user exchangers. Cooling function remains for Div 3 and 4. Train 2 can be administratively operated in independent division operation. If this is performed along with the above, cooling function remains for Div 2, 3 and 4.
					Yes. If SCWS Train 1 is out for maintenance and a cross-tie valve fails closed in Train 4, there is a second SCWS cross-tie pair 1 & 2 that serves its associated user exchangers. Cooling function remains for Div 1and 2 Trains 3 and 4 can be administratively operated in independent division operation. If this is performed along with the above, cooling function remains for Div 1, 2, 3 and 4.
SAC HVAC Cooling Coils	Heat transfer via SCWS.	Clogged tubes/ structural degradation/ tube rupture	Mechanical	Loss of heat transfer capabilities.	YES. Bounded by passive failure indicated in first item of this table.
SAB HVAC Cooling Coils	Heat transfer via SCWS.	Clogged tubes/ structural degradation/ tube rupture	Mechanical	Loss of heat transfer capabilities.	YES. Bounded by passive failure indicated in first item of this table.
KLC HVAC Cooling Coils	Heat transfer via SCWS.	Clogged tubes/ structural degradation/ tube rupture	Mechanical	Loss of heat transfer capabilities.	YES. Bounded by passive failure indicated in first item of this table.
KLL HVAC Cooling Coils	Heat transfer via SCWS.	Clogged tubes/ structural degradation/ tube rupture	Mechanical	Loss of heat transfer capabilities.	YES. Bounded by passive failure indicated in first item of this table.

Next File

Table 9.2.8-4—Safety Chilled Water System Failure Analysis
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Component	Component Function	Failure Mode	Failure Mechanism	Failure Symptoms/Effect	Can SCWS Satisfy Mission Success Criteria? Notes (1), (2), (3), (4)
LHSI Pump Motor and Seal Coolers 30JNG10/40 AP001	Heat transfer via SCWS.	Clogged tubes/ structural degradation/ tube rupture	Mechanical	Loss of heat transfer capabilities. For LHSI pump seal cooler, tube rupture could result in contamination of SCWS.	YES. Bounded by passive failure indicated in first item of this table.

Notes:

1. This analysis considers safety chilled water system (SCWS) with loss of off-site power (LOOP) and one SCWS train unavailable due to maintenance with normal cross-tie operation.
2. Mission success requires, for all modes of operation, that SCWS supply chilled water to two divisions of SAC, SAB, and KLC; one division of KLL; and along with component cooling water system, supply two LHSI pumps motor and seal cooler.
3. One SCWS Train 1s assumed to be out for maintenance with the following components out of service: SCWS chiller unit and/or two pumps.
4. SCWS Trains 1 and 4 are essentially identical. SCWS Trains 2 and 3 are essentially identical. The chilled water circuits of all four SCWS trains are essentially identical except for the HVAC user exchangers served. Therefore, this analysis will identify the identical components in the "Component" column and populate the table once.
5. In cross-tie operation two pumps in the operating train of each divisional pair provides flow to 2 user divisions. One pump in independent division operation provides flow to its division.
6. The chiller unit for each SCWS Train 1includes the condenser, evaporator, compressors, and other refrigerant system components.
7. If failure is limited to one compressor, there is redundancy in the compressor units provided by three 50% capacity compressor units in each train. Two compressor units provide the design capacity for each SCWS train. The affected train can be administratively operated with the two remaining compressors.
8. In cross-tie operation the SCWS bypass valve in the operating train of each divisional pair provides the bypass function. The bypass valve in the standby division of each pair is closed.