ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Monday, August 02, 2010 5:36 PM
To: Tesfaye, Getachew
Cc: Hearn, Peter; KOWALSKI David (AREVA)
Subject: FW: DRAFT RESPONSES FOR FSAR Chapter 9 Weekly NRC Telecon
Attachments: Blank Bkgrd.gif; DRAFT RESPONSE to NRC Comments RAI 361 Q.09.02.02-97.pdf; DRAFT FSAR Changes RAI 361 Q.09.02.02-95.pdf; DRAFT RESPONSE RAI 361 Q.09.02.02-95.pdf; DRAFT RESPONSE RAI 361 Q.09.02.02-97 FMEA TABLE.pdf; DRAFT RESPONSE RAI 361 Q.09.02.02-101.pdf; DRAFT RESPONSE RAI 361 Q.09.02.02-102.pdf; DRAFT RESPONSE RAI 406 Q.09.02.02-110.pdf

Importance: High

Responses to be reviewed at tomorrow's Ch 9 call.

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From: KOWALSKI David (RS/NB)
Sent: Monday, August 02, 2010 5:25 PM
To: BRYAN Martin (EXT)
Cc: BALLARD Bob (EP/PE); CONNELL Kevin J (AREVA NP INC); BROUGHTON Ronnie (EP/PE); HARTSELL Jody (EP/PE); HUDDLESTON Stephen (EP/PE); EDWARDS Harold (EP/PE); GARDNER Darrell (RS/NB); SLOAN Sandra (RS/NB); MCINTYRE Brian (RS/NB)
Subject: DRAFT RESPONSES FOR FSAR Chapter 9 Weekly NRC Telecon
Importance: High

Marty:

Please transmit to Getachew Tesfaye the attached partial set of DRAFT responses to RAI 361 and 406 questions. These responses will be discussed at tomorrow's (8/3/10) FSAR Chapter 9 Weekly Telecon/GoToMeeting with the NRC.

Attached are the following DRAFT responses:

- Response to RAI 361 - Question 09.02.02-95 (shown in two pdf files - response and FSAR changes).
- Response to RAI 361 - Question 09.02.02-97 (provides AREVA response to NRC comments and updated FMEA table).
- Response to RAI 361 - Question 09.02.02-101.
- Response to RAI 361 - Question 09.02.02-102.
- Response to RAI 406 - Question 09.02.02-110.

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

Please call me if you have any questions. Thanks.

David J. Kowalski, P.E.
Principal Engineer
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From: BRYAN Martin (EXTERNAL AREVA)

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DRAFT FSAR Changes RAI 361 Q.09.02.02-95.pdf	865287	
DRAFT RESPONSE RAI 361 Q.09.02.02-95.pdf	226359	
DRAFT RESPONSE RAI 361 Q.09.02.02-97 FMEA TABLE.pdf	244671	
DRAFT RESPONSE RAI 361 Q.09.02.02-101.pdf	434429	
DRAFT RESPONSE RAI 361 Q.09.02.02-102.pdf	224421	
DRAFT RESPONSE RAI 406 Q.09.02.02-110.pdf	800379	

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Priority: High
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RAI 361 S1 (Q9.2.2-97 – Section 9.2.8)

1. General comment – the FMEA for Section 9.2.8 should look like the proposed FMEA for Section 9.2.2 (all Chapter 9 FMEA should appear the same – same columns).

AREVA response: In telecon on 7/27/2010, NRC indicated that table format is not a requirement. Format used is similar to Table 10.4.9-3 for EFWS.

Sheet 1 comments

2. Item 2 (expansion tank) “Failure of Train 4 Tank (Train 1 out for maintenance)….cooling function remains for Div 3 and 4 served by Train 3 tank” Not sure we agree with this unless action is taken to isolate the Train 4 tank (manual or automatic) which is not described.

AREVA response: The expansion tank is a passive component with a confined mass of nitrogen. It is sized to serve two cross-tie divisions. Unless there is an external leak, the nitrogen confined in the upper part of the vertical tank would remain confined in the short term, even if the diaphragm has ruptured. A humidity sensor in the nitrogen space detects high humidity which would indicate leak or rupture of the diaphragm. High humidity activates an alarm in the control room.

3. Item 3 (pump) “…start standby Train 3 SCWS which will continue to supply both Div 3 and 4.” How? Shouldn’t this read “standby train 3 SCWS automatically starts which will continue to supply…..”?

AREVA response: FMEA changed in accordance with comment.

4. Item 4 (chiller-air cooled) “failure of the chiller in Train 2” –the train 2 chiller is a water cooled chiller and should be part of the failure mode for the air-cooled chiller. Recommend swapping the opening sentence to Train 2 out for maintenance and failure of the Train 1 chiller. “…start standby Train 3 SCWS which will continue to supply both Div 3 and 4.” How? Shouldn’t this read “standby train 3 SCWS automatically starts which will continue to supply…..”? Same comment from the pump section.

AREVA response: FMEA changed in accordance with comment.

5. Item 5 (air cooled chiller) – “yes, bounded by above item” – which one?

AREVA response: FMEA changed in accordance with comment.

Sheet 2 comments

6. Item 2 (bypass control valve) “….failure occurs in Train 4 bypass valve, switch to the standby Train 3 in cross-tied pair 3 & 4.” How? Automatically? Manually? Based on what? Alarm?

AREVA response: FMEA changed in accordance with comment.

Sheet 3 comments

7. Item 1 (flow control valve SAC) “Cooling function remains for Div 3 and 4.” And Train 1 as well correct? “Train 3 can be administratively….” This statement doesn’t make sense. How are the Train 3 SAC users affected in cross tie alignment if only the Train 4 flow control valve closes?

AREVA response: Additional information is provided in the FMEA.

8. Item 2 (flow control valve SAB) Same two comments as for SAC.

AREVA response: Additional information is provided in the FMEA.

9. Item 4 (cross-tie valves) cross tie valves need to be manually closed within 24 hours – should be listed in the FMEA if the operator do not close this valve on time. “Train 2 can be administratively……” Isn’t this train already running? If the cross tie closes, isn’t it still cooling Train 2?

AREVA response: The closure of cross-tie valves after 24 hours will be addressed in the response to RAI 361 Question 09.02.02-103. Yes, at the time of the fail closed event, SCWS Train 2 would be running, but since divisional pair 1 and 2 would no longer be cross-tied, only one pump in Train 2 would be needed to supply Div 2.

Sheet 4 comments

10. Item 1 (cross-tie valves): Same comments as Sheet 3/Item 4

See AREVA response for item 9 above.

11. Item 6 (LHSI) - consider adding that rad monitor would detect tube rupture.

AREVA response: FMEA changed in accordance with comment.

12. Note 7: “Two compressor units provide the design capacity for each SCWS train.” Aren’t the chillers (and therefore the compressors) designed to handle the capacity for TWO SCWS trains. Isn’t that the whole basis for cross-tie operation? Also, it would be better to be clear how these compressors work. Does the 3rd compressor auto start if the 1st or 2nd fails? If not, does the chiller trip on 50% compressor such that the chiller would have to be restarted manually with the two good compressors in operation?

AREVA response: Two compressor units provide the design capacity for each SCWS train, and each SCWS train provides chilled water to two divisions of user exchangers. In cross-tie operation, if there is a problem with compressor operation in the operating SCWS train, automatic switch-over to the standby SCWS train occurs.

13. Note 8: “The bypass valve in the standby division is closed.” This bypass valve needs to be described as part of the automatic logic for the standby train starting on loss of an operating pump/chiller (i.e. in RAI question 101)

AREVA response: FMEA changed in accordance with comment.

Table 3.9.6-2—Inservice Valve Testing Program Requirements
Sheet 90 of 100

Valve Identification Number[1]	Description/ Valve Function	Valve Type[2]	Valve Actuator[3]	ASME Code Class[4]	ASME OM Code Category[5]	Active / Passive[6]	Safety Position[7]	Test Required[8,10]	Test Frequency[9]	Comments
30QKA30AA101	QK Bypass Control Valve-MOV, Div 3	GB	MO	3	B	A	O/C	ET PI	Q 2Y	
30QKA30AA191	QK System Press Relief Valve, Div 3	RV	SA	3	C	A	O/C	ET LT PI	10Y 10Y 2Y	
30QKA40AA003	QK pump #1 Disch Check Valve, Div 4	CK	SA	3	C	A	O/C	ET	Q	
30QKA40AA011	QK QCB Check Valve, Div 4	CK	SA	3	C	A	O/C	ET	Q	
30QKA40AA018	QK pump #2 Disch Check Valve, Div 4	CK	SA	3	C	A	O/C	ET	Q	
30QKA40AA101	QK Bypass Control Valve-MOV, Div 4	GB	MO BF	3	B	A	O/C	ET PI	Q 2Y	
30QKA40AA191	QK System Press Relief Valve, Div 4	RV	SA	3	C	A	O/C	ET LT PI	10Y 10Y 2Y	
30QKA10AA002	Pump Isolation Valve, Div 1	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA10AA004	Pump Isolation Valve, Div 1	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA10AA006	Pump Isolation Valve, Div 1	~~PL~~	MA	3	B	P	O/C	ET	5Y	

Revised IAW RAI 361, Q 09.02.02-95c

Table 3.9.6-2—Inservice Valve Testing Program Requirements
Sheet 91 of 100

Valve Identification Number[1]	Description/ Valve Function	Valve Type[2]	Valve Actuator[3]	ASME Code Class[4]	ASME OM Code Category[5]	Active / Passive[6]	Safety Position[7]	Test Required[8,10]	Test Frequency[9]	Comments
30QKA10AA017	Pump Isolation Valve, Div 1	~~PL~~ BF	MA	3	B	P	O/C	ET	5Y	
30QKA10AA019	Pump Isolation Valve, Div 1	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA20AA002	Pump Isolation Valve, Div 2	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA20AA004	Pump Isolation Valve, Div 2	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA20AA006	Pump Isolation Valve, Div 2	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA20AA017	Pump Isolation Valve, Div 2	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA20AA019	Pump Isolation Valve, Div 2	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA30AA002	Pump Isolation Valve, Div 3	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA30AA004	Pump Isolation Valve, Div 3	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA30AA006	Pump Isolation Valve, Div 3	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA30AA017	Pump Isolation Valve, Div 3	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA30AA019	Pump Isolation Valve, Div 3	~~PL~~	MA	3	B	P	O/C	ET	5Y	

Revised IAW RAI 361, Q 09.02.02-95c

Table 3.9.6-2—Inservice Valve Testing Program Requirements
Sheet 92 of 100

Valve Identification Number[1]	Description/ Valve Function	Valve Type[2]	Valve Actuator[3]	ASME Code Class[4]	ASME OM Code Category[5]	Active / Passive[6]	Safety Position[7]	Test Required[8,10]	Test Frequency[9]	Comments
30QKA40AA002	Pump Isolation Valve, Div 4	~~PL~~ BF	MA	3	B	P	O/C	ET	5Y	
30QKA40AA004	Pump Isolation Valve, Div 4	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA40AA006	Pump Isolation Valve, Div 4	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA40AA017	Pump Isolation Valve, Div 4	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKA40AA019	Pump Isolation Valve, Div 4	~~PL~~	MA	3	B	P	O/C	ET	5Y	
30QKB10AA001	30SAB10AC001 Isolation Valve, Div 1	PL	MA	3	B	P	O/C	ET	5Y	
30QKB10AA004	30SAB10AC001 Isolation Valve, Div 1	PL	MA	3	B	P	O/C	ET	5Y	
30QKB20AA001	30SAB20AC001 Isolation Valve, Div 2	PL	MA	3	B	P	O/C	ET	5Y	
30QKB20AA004	30SAB20AC001 Isolation Valve, Div 2	PL	MA	3	B	P	O/C	ET	5Y	
30QKB30AA001	30SAB30AC001 Isolation Valve, Div 3	PL	MA	3	B	P	O/C	ET	5Y	

Insert 2

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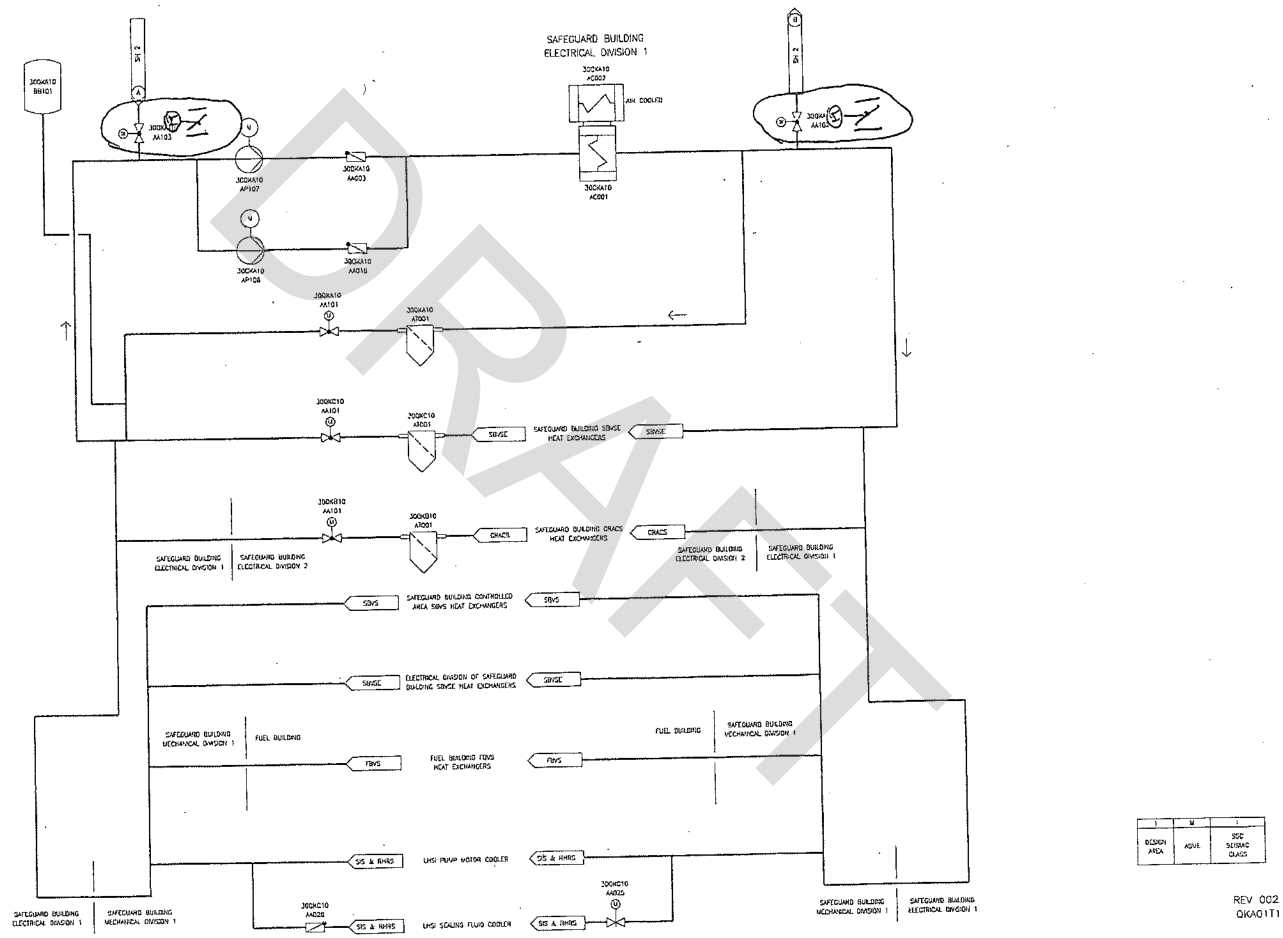
Revised IAW RAI 361, Q 09.02.02 - 95C

Figure 2.7.2-1—Safety Chilled Water System Functional Arrangement
Sheet 1 of 4



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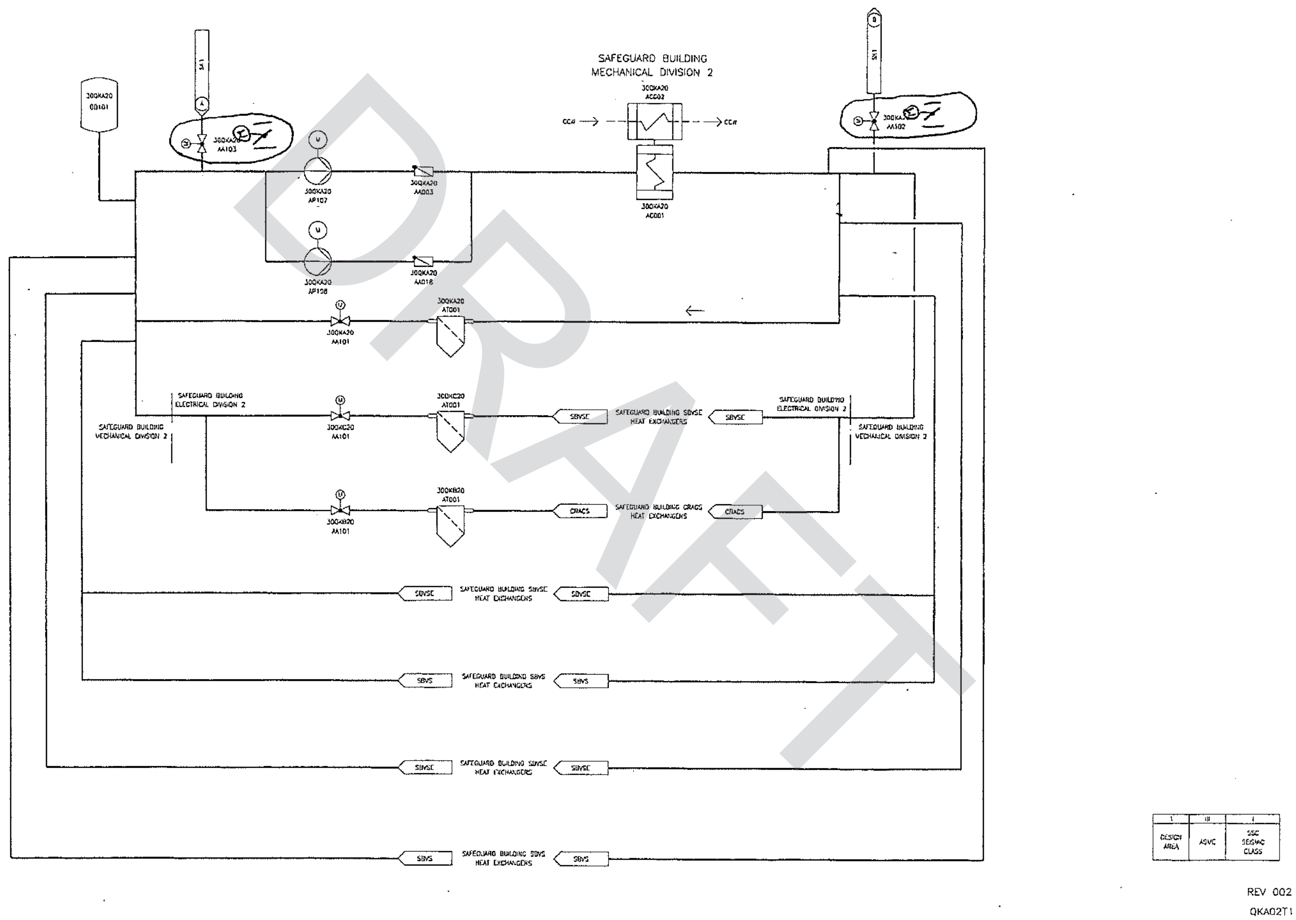
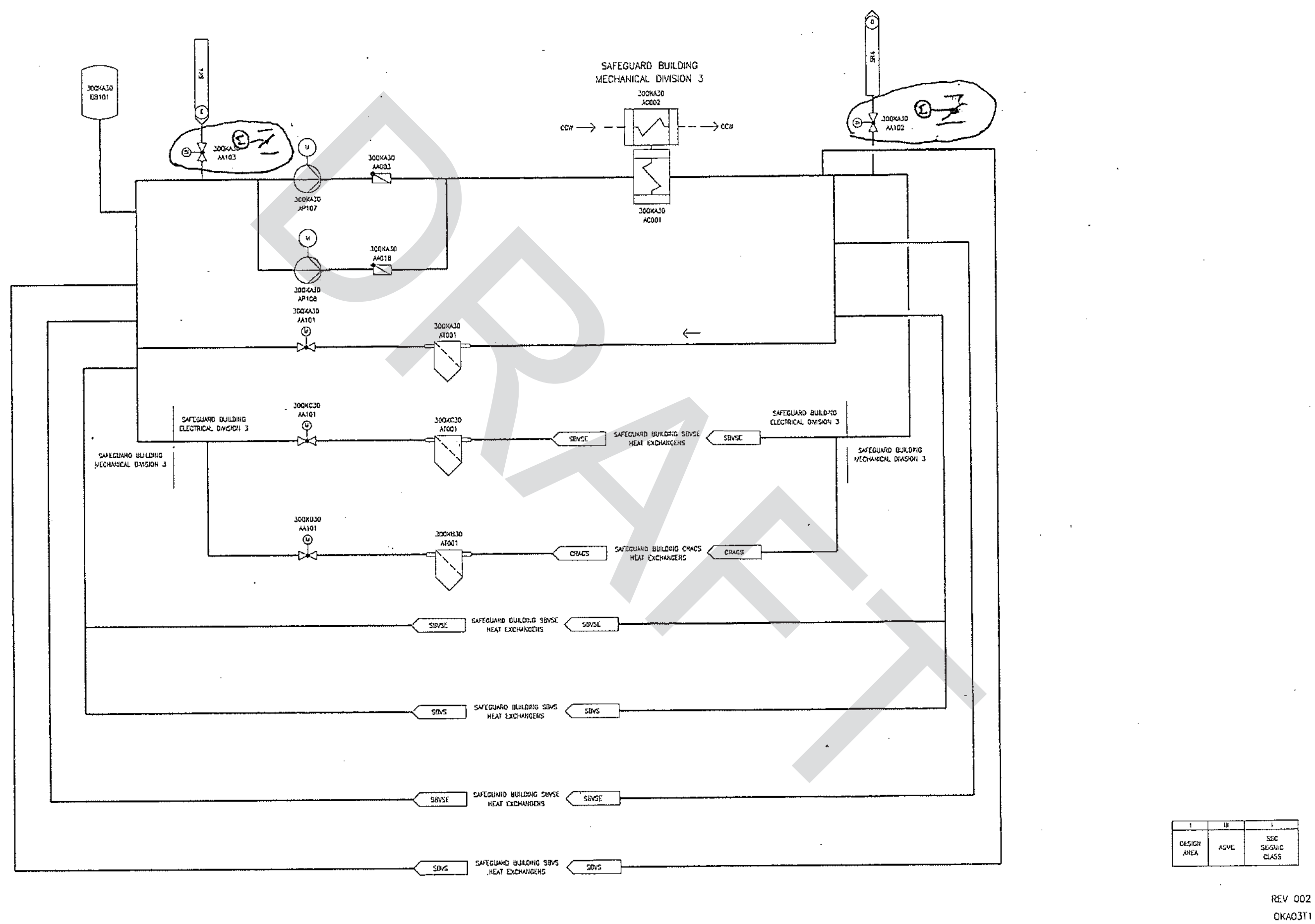
Revised IAW RAI 361 Q 09.02.02-95c

Figure 2.7.2-1—Safety Chilled Water System Functional Arrangement
Sheet 2 of 4



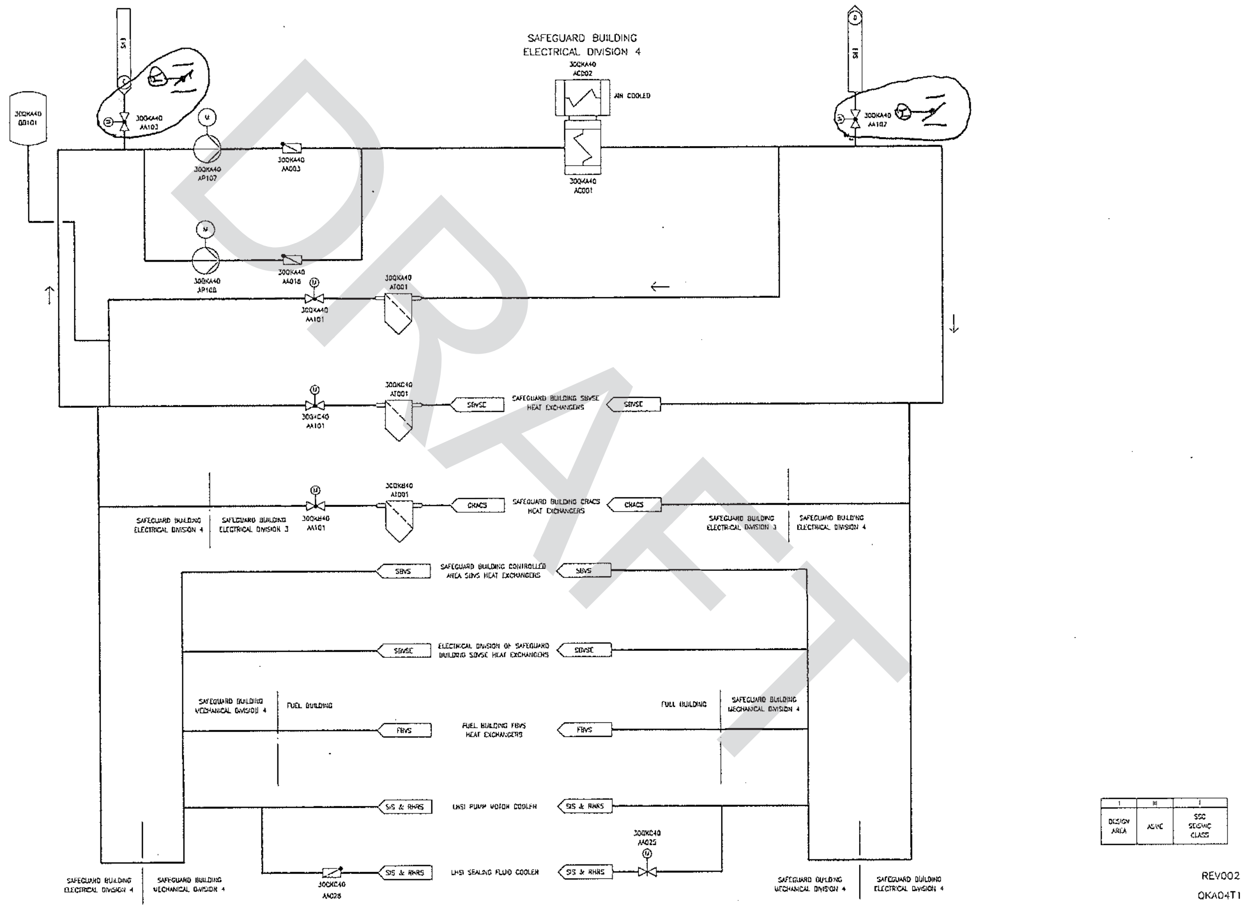
Revised IAW RAI 361 Q 09.02.02-95c

Figure 2.7.2-1—Safety Chilled Water System Functional Arrangement
Sheet 3 of 4



Revised IAW RAI 361 Q 09.02.02-95c

Figure 2.7.2-1—Safety Chilled Water System Functional Arrangement
Sheet 4 of 4



Revised IAW RAI 361 Q 09.02.02-95c

Next File

To allow ~~divisional maintenance~~ maintenance (e.g., ~~maintenance~~ on emergency diesel generators), the required SCWS ~~safety-related components are alternately~~ fed from the adjacent division to provide adequate cooling of certain safety-related components during a design basis event.

Insert 1

9.2.8.4 Safety Evaluation

- The SCWS is designed as Seismic Category I as described in Section 3.2 to operate in all plant modes of operation including design basis events. The SCWS divisions are located in SBs 1 to 4, respectively. The SBs are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7~~(B)~~, and Section 3.8 provide the bases for the adequacy of the structural design of these buildings.

- The SCWS is designed to remain functional after a safe shutdown earthquake. Section 3.7~~(B).2 and Section 3.9(B)~~ provide the design loading conditions that were considered. Section 3.5, Section 3.6, and Section 9.5.1 provide the hazards analyses to make sure that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

- A four train design with interconnection of Train 1 and Train 2 or interconnection of Train 3 and Train 4 of the SCWS fulfills the single failure criteria. ~~Redundant safety systems (one per SB) are strictly separated within the SBs into four divisions. This divisional separation is provided for electrical and mechanical safety systems.~~ The four ~~divisions~~trains of safety-related systems are consistent with an N+2 safety concept. The four SCWS trains are backed up by the EDGs. Two of these trains, in Divisions 1 and 4, are also backed up by the SBO diesels.

Delete

- Structures, systems and components important to safety in the SCWS are not shared with any other co-located nuclear reactor units.

- Preoperational testing of the SCWS is performed as described in Chapter 14.0. Periodic inservice functional testing is done in accordance with Section 9.2.8.5.

- Section 6.6 provides the ASME Boiler and Pressure Vessel (BPV) Code, Section XI (Reference 1) requirements that are appropriate for the SCWS.

- Section 3.2 delineates the quality group classification and seismic category applicable to the safety-related portion of this system. Table 9.5.4-1 shows that the components meet the design and fabrication codes given in Section 3.2. All the power supplies and control functions necessary for safe function of the SCWS are Class IE, as described in Chapter 7 and Chapter 8.

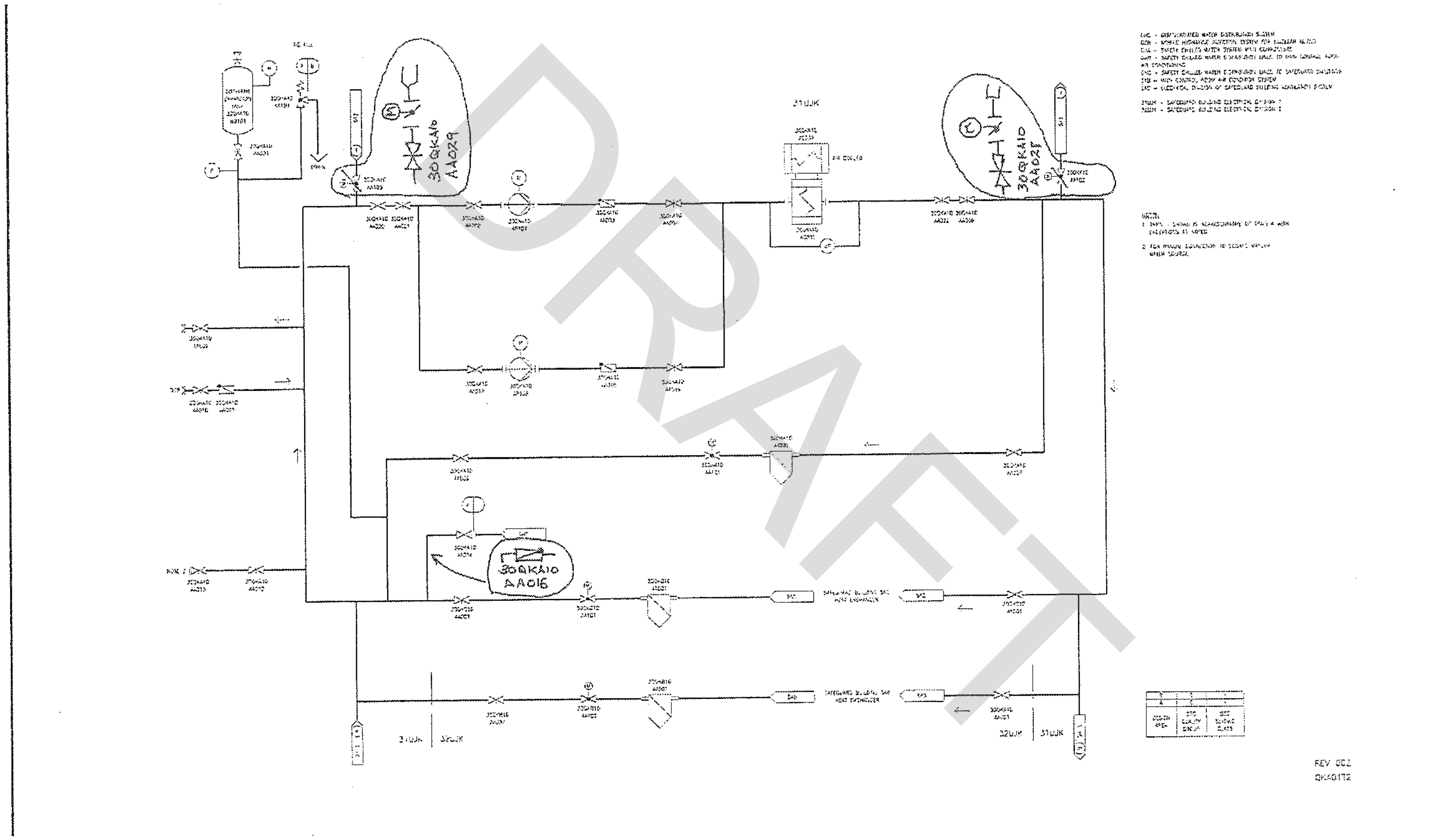
- Cooling diversity is created between the load heat sinks of Divisions 1 and 4, and Divisions 2 and 3. Division 1 and 4 chillers are air cooled, and Division 2 and 3 chillers are water cooled by the component cooling water system (CCWS).

- A process radiation monitor is provided in Trains 1 and 4 of the SCWS, downstream of the LHSI pump mechanical seal heat exchanger to monitor for

Next File

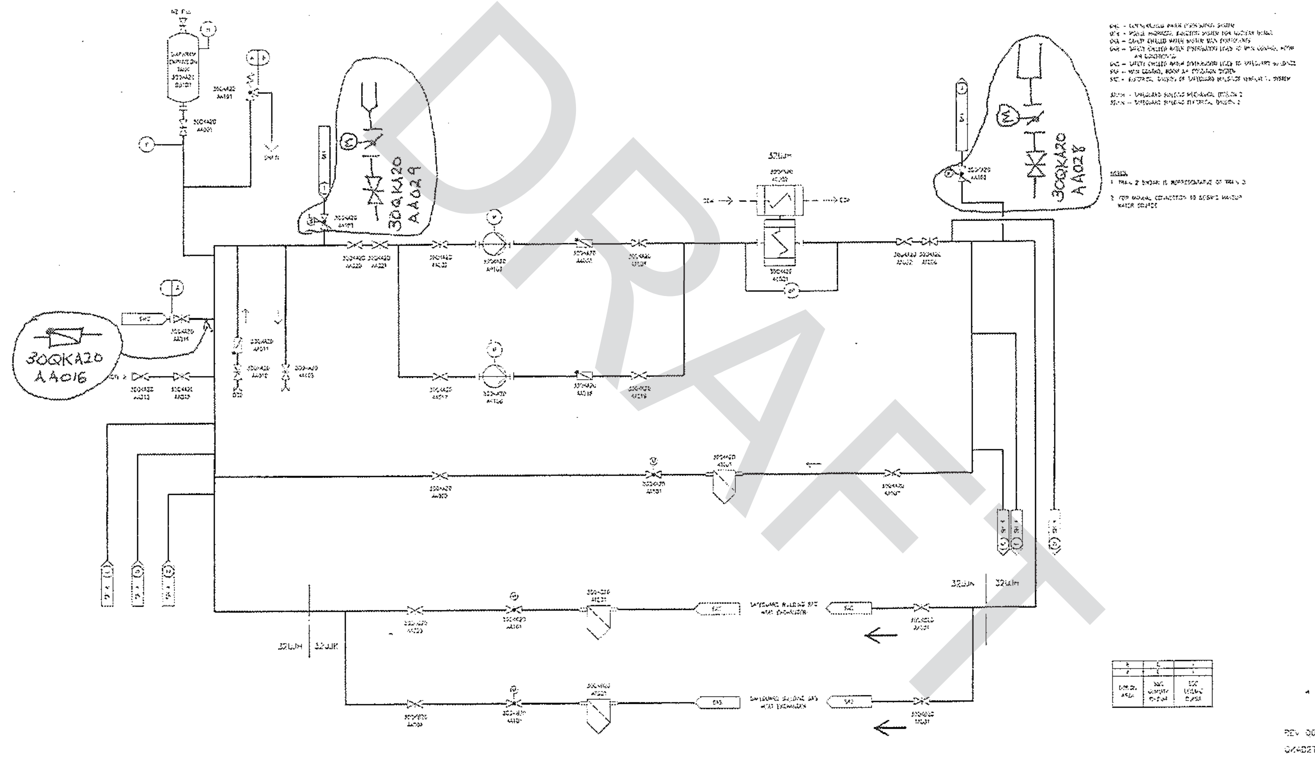
Revised IAW RAI 361, Q 09.02.02-95 a and b

Figure 9.2.8-1—Safety Chilled Water System Diagram
Sheet 1 of 4



Revised IAW RAI 361 Q 09.02.02-95c

Figure 9.2.8-1—Safety Chilled Water System Diagram
Sheet 2 of 4



Revised IAW RAI 361 Q 09.02.02-95 c and d

RAI 361, Markup, Inserts

[Q 09.02.02-95 a & b]

1. In case of loss of off-site power, each SCWS division is powered from its associated emergency diesel generator (EDG). To allow divisional maintenance (e.g., maintenance on EDGs), the SCWS safety-related motor operated flow control valves and the motor operated cross-tie valves are powered from the normal 1E power division or alternately fed from the adjacent class 1E power division. In cross-tie operation, this provides the capability to operate the SCWS flow control valves in two cross-tied trains, if necessary switch to the standby train in the divisional pair, or if necessary close the cross-tie valves. Division 2 is the alternate feed for Division 1 and vice versa. Division 4 is the alternate feed for Division 3 and vice versa.

2. Attached.

Insert 2
pg 1 of 2 Insert to US EPR FSAR Table 3.9.6-2, RAI 361, Q 09.02.02-95C

Valve Identification Number	Description/ Valve Function	Valve Type	Valve Actuator	ASME Code Class	ASME OM Code Category	Active/ Passive	Safety Position	Test Required	Test Frequency	Comments
30QKA10AA016	Demin Water Check Valve	CK	SA	3	C	A	O/C	ET	Q	
30QKA20AA016	Demin Water Check Valve	CK	SA	3	C	A	O/C	ET	Q	
30QKA30AA016	Demin Water Check Valve	CK	SA	3	C	A	O/C	ET	Q	
30QKA40AA016	Demin Water Check Valve	CK	SA	3	C	A	O/C	ET	Q	
30QKA10AA020	Pump and Chiller Isolation Valve, Div. 1	BF	MA	3	B	P	O/C	ET	5Y	
30QKA10AA021	Pump and Chiller Isolation Valve, Div. 1	BF	MA	3	B	P	O/C	ET	5Y	
30QKA10AA022	Pump and Chiller Isolation Valve, Div. 1	BF	MA	3	B	P	O/C	ET	5Y	
30QKA20AA020	Pump and Chiller Isolation Valve, Div. 2	BF	MA	3	B	P	O/C	ET	5Y	
30QKA20AA021	Pump and Chiller Isolation Valve, Div. 2	BF	MA	3	B	P	O/C	ET	5Y	
30QKA20AA022	Pump and Chiller Isolation Valve, Div. 2	BF	MA	3	B	P	O/C	ET	5Y	
30QKA30AA020	Pump and Chiller Isolation Valve, Div. 3	BF	MA	3	B	P	O/C	ET	5Y	
30QKA30AA021	Pump and Chiller Isolation Valve, Div. 3	BF	MA	3	B	P	O/C	ET	5Y	
30QKA30AA022	Pump and Chiller Isolation Valve, Div. 3	BF	MA	3	B	P	O/C	ET	5Y	
30QKA40AA020	Pump and Chiller Isolation Valve, Div. 4	BF	MA	3	B	P	O/C	ET	5Y	
30QKA40AA021	Pump and Chiller Isolation Valve, Div. 4	BF	MA	3	B	P	O/C	ET	5Y	
30QKA40AA022	Pump and Chiller Isolation Valve, Div. 4	BF	MA	3	B	P	O/C	ET	5Y	
30QKA10AA028	Cross-tie Manual Isolation Valve, Div. 1	BF	MA	3	B	P	O/C	ET	5Y	
30QKA10AA029	Cross-tie Manual Isolation Valve, Div. 1	BF	MA	3	B	P	O/C	ET	5Y	
30QKA20AA028	Cross-tie Manual Isolation Valve, Div. 2	BF	MA	3	B	P	O/C	ET	5Y	

Insert 2
pg 2 of 2

Insert to US EPR FSAR Table 3.9.6-2 - RAI 361 Q 09.02.02-95c

30QKA20AA029	Cross-tie Manual Isolation Valve, Div. 2	BF	MA	3	B	P	O/C	ET	5Y	
30QKA30AA028	Cross-tie Manual Isolation Valve, Div. 3	BF	MA	3	B	P	O/C	ET	5Y	
30QKA30AA029	Cross-tie Manual Isolation Valve, Div. 3	BF	MA	3	B	P	O/C	ET	5Y	
30QKA40AA028	Cross-tie Manual Isolation Valve, Div. 4	BF	MA	3	B	P	O/C	ET	5Y	
30QKA40AA029	Cross-tie Manual Isolation Valve, Div. 4	BF	MA	3	B	P	O/C	ET	5Y	

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 09.02.02-95:

Follow-up to RAI 174, Question 09.02.02-53

Standard Review Plan (SRP) Section 9.2.2, which is being utilized as guidance for the review of the safety chilled water system (SCWS), specifies in Section III confirmation of the overall arrangement of the component cooling system (CCWS) in the Final Safety Analysis Report (FSAR). 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.

a. The staff noted that Tier 1 Table 2.7.2-2, "Safety Chilled Water System Equipment I&C and Electrical Design," identifies normal and alternate power supplies for the motor-operated SCWS cross-tie valves, but the valve power supplies are not described anywhere in the proposed Tier 2 FSAR sections provided in the response.
b. Provide a description of these power supplies in the Tier 2 portion of the FSAR.
c. Update FSAR Table 3.9.6-2, "In-service Valve Testing Program Requirements" to include the motor-operated cross-tie valves.
d. Add the SCWS flow direction arrows to the Figure 9.2.8-1 (Sheets 1 through 4), "Safety Chilled Water Diagram," to confirm the directional flows in various sections of pipe under both independent and cross-tie alignments.

Response to Question 09.02.02-95:

a. The last paragraph in U.S. EPR FSAR Tier 2, Section 9.2.8.3.2 will be revised to describe the alternate power supplies to the motor operated valves in more detail.

The N+2 concept described in U.S. EPR FSAR Tier 2, Section 9.2.8.4 does not apply due to the change to cross-tie design; therefore, the sentence will be deleted.

b. See above response.

c. FSAR Table 3.9.6-2, "In-service Valve Testing Program Requirements" is updated to include the motor-operated cross-tie valves. Also changes to the table include some large diameter valves that are changed from plug valves to butterfly valves, and some manually operated valves are added to the table. A check valve is added to each SCWS train demineralized water source connection to prevent backflow and/or contamination of the demineralized water system.

d. Refer to response to RAI 174 Supplement 5, Question 09.02.02-53, markup Figure 9.2.8-1 (Sheets 1 through 4). Flow direction arrows will be added where needed. The sheet-to-sheet continuation arrows provide an indication of flow direction. On sheets 1 through 4, the supply side is on the right and the return side is on the left. For cross-tie operation, flow can be in either direction in the cross-tie lines depending on which SCWS train is in operation. For example if SCWS Train 1 is the operating train in divisional pair 1 & 2, starting on sheet 1, approximately half the total flow is through Train 1 cross-tie supply valve 30QKA10AA102 (continuation to sheet 2) then through Train 2 cross-tie supply valve 30QKA20AA102, and then to Division 2 user heat exchangers. Similarly, on the return side, starting on Sheet 2, return flow is from the Division 2 user heat exchangers through the Train 2 cross-tie return valve 30QKA20AA103 (continuation to sheet 1) then through Train 1 cross-tie return valve 30QKA10AA103 and then to the suction side of the Train 1 pumps. As shown on sheet 1, on the supply side, the other approximate half of the total flow goes to the Division 1 user heat exchangers and returns to the suction side of the Train 1 pumps.

FSAR Impact:

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

b. See a. above.

c. U.S. EPR FSAR Tier 2, Table 3.9.6-2, “In-service Valve Testing Program Requirements” will be revised as described in the response and indicated in the attached markup. Also U.S. EPR FSAR Tier 1, Figure 2.7.2-1 – Safety Chilled Water System Functional Arrangement, Sheets 1 – 4 will be revised and U.S. EPR FSAR Tier 2, Figure 9.2.8-1 – Safety Chilled Water System Diagram, Sheets 1 and 2 will be revised.

d. U.S. EPR FSAR Tier 2, Figure 9.2.8-1 (Sheet 2) will be revised as described in the response and indicated in the attached markup.

Table 9.2.8-4-- Safety Chilled Water System Failure Analysis

Sheet 1 of 4

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.
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, standby Train 3 SCWS starts automatically 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 2 is out for maintenance, and failure of the chiller in Train 1 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, standby Train 3 SCWS starts automatically 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 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 above two items for the SCWS air cooled chiller.

Component	Component Function	Failure Mode	Failure Mechanism	Failure Symptoms/Effect	Can SCWS Satisfy Mission Success Criteria? Notes (1), (2), (3), (4)
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, standby Train 4 SCWS starts automatically 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, automatically 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.
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 30QKC40AA101 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.

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 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, 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 30QKB40AA101 does not affect overall SCWS operation, cooling function remains for Div 1, 2, 3 and 4 except for the affected SAB 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.
Cross-tie Valves 30QKA10/20/30/40 AA102	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 30QKA10/20/30/40 AA103	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.

Component	Component Function	Failure Mode	Failure Mechanism	Failure Symptoms/Effect	Can SCWS Satisfy Mission Success Criteria? Notes (1), (2), (3), (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.
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. Radiation monitor will detect contamination.	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 is 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 includes 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 automatically closed.

RAI 361

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 is started and the operating train is stopped.

In US EPR FSAR Tier 2, Section 9.2.8.6, the faults that cause deactivation of the pumps and chiller unit in an operating train of SCWS are indicated. In cross-tie operation, any of these faults causes a switch-over to the standby train in the divisional pair. In cross-tie operation, the effects of failure of two pumps in the operating train are the same as the effects of failure of a single pump.

Refer to response to RAI 356, Questions 09.02.02-92 and 93 for additional information concerning starting and stopping of SCWS pumps. Refer to response to RAI 356, Question 09.02.02-86 for additional information on SCWS instrumentation and controls.

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.

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, so 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, check for water leaks and provide makeup water.

   Refer to 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. Refer to response to RAI 174, Question 09.02.02-53 markup of US EPR FSAR Tier 2, Section 9.2.8.6.
   "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."

FSAR Impact:

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

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 9.2.8-1 will be revised as described in the response and indicated in the attached markup.

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

possible leakage of radioactive fluid from the heat exchanger. Otherwise, migration of radioactive material from potentially radioactive systems is prevented with a minimum of two heat exchanger barriers. Radiation monitors are in the CCWS to detect radioactive contamination entering and exiting the system.

9.2.8.5 Inspection and Testing Requirements

Prior to initial plant startup, a comprehensive performance test will be performed to verify that the design performance of the system and individual components is attained. Refer to Section 14.2, Test #052, for initial plant testing of the SCWS.

After the plant is brought into operation, periodic tests and inspections of the SCWS components and subsystems are performed to verify proper operation. Scheduled tests and inspections are necessary to verify system operability.

The installation and design of the SCWS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leak tight integrity and its availability and ability to fulfill its functions.

Inservice inspection and testing requirements are in accordance with Section XI of the ASME Code (Reference 1) and the ASME OM Code (Reference 2).

Section 3.9.6 and Section 6.6 describe the inservice testing and inspection requirements, respectively. Refer to Section 16.0, Surveillance Requirement (SR) 3.7.9 for surveillance requirements that verify continued operability of the SCWS.

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. [Insert]

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.

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 ~~below a set limit~~to MIN-1, an alarm is issued for operators to check nitrogen

Revised IAW RAI 361 Q 09.02.02-101c

RAI 361 Q 09.02.02-101c FSAR markup insert

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.

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 09.02.02-102:

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. Under seismic or post-accident conditions with the demineralized water unavailable for safety chilled water system (SCWS) makeup, the expansion tanks should contain sufficient water volume to assure reliable system operation without makeup for at least seven days. 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 the cross-tied configuration, the staff requests the applicant describe whether the expansion tank in the non-operating train is isolated from the system. If not, address precluding of the SCWS design from the sluicing of water between the two expansion-tanks as system loads cycle (or on trip of a chiller and start of the standby unit) and describe the tanks volume requirements to account for sluicing. If isolated, describe the operation of the expansion tank isolation valves during operation and accident conditions.

Response to Question 09.02.02-102:

In cross-tie operation, the expansion tank in the standby train is not mechanically isolated.

Sluicing is not significant because the two cross-tied expansion tanks are not close together. One tank is in one Safeguard Building and the other tank in the pair is in another Safeguard Building. The cross-tied expansion tanks are not at the same elevation. Train 2 tank is several floor elevations lower than Train 1 tank. Train 3 tank is several floor elevations lower than Train 4 tank. The pipe size (2 inches) connecting each tank to the system is small relative the system pipe size. The elastomeric material of the expansion tank diaphragm and the compressed nitrogen confined above the diaphragm have a dampening effect on pressure pulsations in the system. Should momentary instability between two cross-connected expansion tanks occur, the instability would be dampened quickly due to the effects of the diaphragm, the compressed nitrogen, resistance of the long length of piping between tanks and resistance of the small diameter piping at the tank connection.

Refer to information concerning sizing of expansion tank in the response to RAI 356, Question 09.02.02-91.

FSAR Impact:

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

Response to

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

6/16/2010

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

Application Section: FSAR Chapter 9

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

Question 09.02.02-110:

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

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

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

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

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

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

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

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

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

Response to Question 09.02.02-110:

a. A review of the CCWS confirmed the system heat load and user flow requirements for normal and accident conditions. The following table summarizes the heat load and flow requirements used for determining the heat exchanger design case. Note that the CCWS user flow listed in this table is the total flow that exits the CCWS heat exchanger and is distributed to the users. This is not the total pump discharge flow.

Due to variations in heat load, required flow and “U” for each CCWS operational alignment, the combined “UA” value is used to determine the design case for each CCWS heat exchanger. The design parameters for these operational cases will be provided to the heat exchanger vendor. The vendor will factor these system parameters into the design of the heat exchanger with the design constraint that the heat exchanger must meet the highest required combined “UA” of all cases. The vendor will determine the best combination of “U” and “A” to meet these requirements. By meeting this requirement for the highest required combined “UA”, the heat exchanger design will have margin for all other operational alignments. The DBA cases assume an ESW inlet temperature of 95°F with a CCWS outlet temperature of 110°F. The value of 110°F is used to account for instrument uncertainty in the maximum allowed CCWS outlet temperature of 113°F. The RCS cooldown cases assume an ESW inlet temperature of 90°F with a CCWS outlet temperature of 99.2°F. The RCS heatup cases assume an ESW inlet temperature of 92°F with a CCWS outlet temperature of 99.2°F. The value of 99.2°F is used to account for instrument uncertainty in the maximum allowed CCWS outlet temperature of 100.4°F for normal operations cases. No correction factor is assumed in the LMTD calculations.

CCWS Operational Alignment	Reqd Heat Transfer (10^6 BTU/hr)	CCWS User Flow (10^6 lbm/hr)	ESWS Flow (10^6 lbm/hr)	LMTD (°F)	UA (10^6 BTU/hr-°F)
RCS Cooldown; CCWS Train Not Connected to a Common Header	153.1	3.061	7.54	20.60	7.43
RCS Cooldown; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	118.4	7.071	7.54	9.71	12.19
RCS Cooldown; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	124.9	7.055	7.54	9.76	12.79
RCS Heatup; CCWS Train 1 or 2 Connected to Common 1	106.8	5.624	7.54	9.41	11.35
RCS Heatup; CCWS Train 3 or 4 Connected to Common 2	123.4	5.802	7.54	9.44	13.07
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	291.8	4.299	7.54	27.01	10.80
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	291.4	4.278	7.54	27.12	10.74

The highest required combined “UA” of 13.07E+06 BTU/hr-°F results from RCS Heatup; CCWS Train 3 or 4 Connected to Common 2. This case yields the highest required combined “UA” due to low temperature deltas in the system during this operational alignment. The LMTD for this case is calculated with an ESWS inlet temperature of 92°F and a CCWS outlet temperature of 99.2°F for normal operations. 99.2°F is used to account for instrument uncertainty in the maximum allowed CCWS outlet temperature of 100.4°F. An example area calculation for this case assuming a U of 360 BTU/hr*ft^2*°F yields a required area of 36,311 ft^2. Considering a 10% margin for tube plugging, the heat exchanger design area for this example case becomes 39,942 ft^2. The design of the CCWS heat exchanger will require a minimum additional margin of 10 percent above the specified 10 percent tube plugging allowance.

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

A review of the CCWS confirmed the highest required pump discharge flow results from any of the trains connected to either of the common headers during normal operation. This normal operation alignment has all CCWS users connected simultaneously (including SIS users). The following table summarizes the pump discharge flow requirements used for determining the pump design flow rate. Note that the CCWS pump discharge flow listed in this table is the total flow through the pump. This flow includes flow through the 4 inch surge tank recirculation line that does not go through the CCWS heat exchanger. In addition to the recirculation flow, the normal operations flow requirement for the CVCS HP coolers is greater than the CVCS HP cooler required flow in the cooldown alignment. These factors result in a higher required total pump discharge flow as compared to the user required CCWS flow through the heat exchanger for heatup and cooldown cases.

The expected CCWS pump suction temperatures for the various operational alignments are enveloped by a temperature of 190°F. The 190°F temperature is conservatively based on CCWS heat exchanger DBA inlet temperature (181°F) plus margin. The 181°F DBA inlet temperature would be a result of water exiting the CCWS heat exchanger at the maximum allowed outlet temperature of 113°F for DBA conditions. Using water at 190°F this converts to a required flow of 15570 gpm. Applying the pump margin of 15.33% from the Response to RAI 334, Question 9.2.2-

63 to the highest required pump discharge flow of 15570 gpm results in a design pump flow of 17957 gpm.

CCWS Operational Alignment	CCWS Pump Discharge Flow (10^6 lbm/hr)	CCWS Pump Discharge Flow (gpm)
Normal Operation; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	7.359	15203
Normal Operation; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	7.537	15570
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	4.407	9104
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	4.386	9061

A pump design flow rate of 17957 gpm provides margin for operational alignments where the total user required flow is less than 15570 gpm. The following table summarizes the margin in the CCWS pump flow for normal operations and DBA cases.

CCWS Operational Alignment	CCWS Pump Discharge Flow (gpm)	Pump Design Flow (gpm)	Margin in Pump Flow (%)
Normal Operation; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	15203	17957	18
Normal Operation; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	15570		15
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	9104		97
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	9061		98

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

U.S. EPR FSAR, Tier 2, Tables 9.2.2-1 and 9.2.2-2 will be revised to update the CCWS flow requirements. Tier 2 Tables 9.2.2-6 and 9.2.2-7 will be added to summarize CCWS heat load and flow requirements for various operational alignments. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include the heat transfer and pump discharge flow margins for the DBA case.

b. A review of the CCWS confirmed the CCWS LHSI heat exchanger DBA heat load of 241 MBTU/hr. The LHSI heat exchanger DBA heat load of 241 MBTU/hr is the decay heat removed by the LHSI system to the CCWS heat exchanger. The MHSI and LHSI pump heat loads are specifically listed as individual values in FSAR Table 9.2.2-2. U.S EPR FSAR Tier 2, Table 9.2.2-1 and 9.2.5-1 will be revised to update the CCWS DBA heat load that is applied to the Ultimate Heat Sink.

A review of the CCWS design confirmed the CCWS heat exchanger DBA heat load on the Ultimate Heat Sink (UHS) of 291.8 MBTU/hr. This heat load is equal to the LHSI heat exchanger DBA heat load of 241 MBTU/hr from Table 9.2.2-2 plus the additional loads from the CCWS common header users aligned during a DBA. The value of 291.8 MBTU/hr in Tables 9.2.2-1 and 9.2.5-1 is the total DBA heat load that the CCWS is required to reject to the UHS. The design of the UHS is required to account for this CCWS heat load plus any additional DBA heat loads that directly impact the UHS. Refer to U.S. EPR FSAR Section 9.2.5 for a discussion on the UHS design. The following table summarizes the CCWS user loads for the DBA condition (the limiting DBA case results from Train 1 or 2 aligned to Common 1).

			Reqd HT	
Designation of equipment		**# of comp/train**	**per comp**	**per train**
Name	**KKS**		**10^6 BTU/hr**	**10^6 BTU/hr**
CCWS pump MAC	KAA10/20 AC002	1	0.0955	0.0955
LHSI hx	JNG10/20 AC001	1	241.0	241.0
LHSI pump MAC	JNG10/20 AP001	1	0.1262	0.1262
LHSI seal fluid cooler	JNG10/20 AP001	1	0.0341	0.0341
MHSI pump MAC	JND10/20 AP001	1	0.0239	0.0239
Charging pump motor air cooler	KBA31 AP001	1	0.1706	0.1706
Charging pump oil cooler	KBA31 AP001	1	0.1706	0.1706
Charging pump seal water cooler	KBA31 AP001	1	0.1706	0.1706
CVCS HP cooler	KBA11 AC001	1	6.9	6.9
RCP lower bearing oil cooler	JEB10/20 AC001	2	0.0819	0.1638
RCP motor air cooler	JEB10/20 AC002/003	4	1.075	4.3
RCP thermal barrier	N/A	4	0.3915	1.566
RCP upper bearing oil cooler	JEB10/20 AC004	2	1.305	2.61
Nuke Sample Coolers	KUA20/30 AC001	2	0.3958	0.7916
QKA Chiller	QKA20 AC001	1	4.123	4.123
SFP heat exchanger	FAK20 AC001	1	29.00	29.00
SG Sample Coolers	QUC11/12 AC001	2	0.2593	0.5186
		Sum		**291.8**

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

c. Refer to the Response to part (a) of RAI 406, Question 9.2.2-110 for the update of U.S. EPR FSAR Table 9.2.2-2.

d. Refer to the Response to part (a) of RAI 406, Question 9.2.2-110 for the update of U.S. EPR FSAR Table 9.2.2-2.

e. A review of the CCWS confirmed the Dedicated CCWS Heat Exchanger capacity of 51.2 MBTU/hr. The value of 50.5 MBTU/hr listed in 9.2.2-2 is only the SAHRS heat exchanger heat load on the Dedicated CCWS train. The Dedicated CCWS heat exchanger design parameter of 51.2 MBTU/hr includes the additional SAHRS pump cooler loads that are directly cooled by the Dedicated CCWS.

f. Refer to the Response to part (a) of RAI 406, Question 9.2.2-110 for the update of U.S. EPR FSAR Table 9.2.2-2.

FSAR Impact:

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

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

U.S. EPR FSAR, Tier 2 Tables 9.2.2-6 and 9.2.2-7 will be added as described in the response and indicated on the enclosed markup.

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

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

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

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

The CCWS flow rate is automatically controlled for those users which have been determined to have a limited operating temperature range for support of stable operation, while less temperature-sensitive users remain at a fixed flow resistance during all operating conditions. These fixed flow rates are adjusted once during plant commissioning with the system in its most demanding flow configuration (system flow balancing), and is reaffirmed regularly throughout the plant life by periodic surveillance, to make sure there is adequate required user flow for all operating conditions. It is not expected that the CCWS flow balance will require adjustment after the initial flow balance has been established.

FSAR Section 9.2.2.2.1 Insert for RAI 406; 9.2.2-110

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

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

Pump head design margin:	$\sqrt{(10\%)^2 + (2\%)^2 + (3.31\%)^2} + 5\% = 15.72\%$
Pump flow design margin:	$\sqrt{(10\%)^2 + (2\%)^2 + (1.67\%)^2} + 5\% = 15.33\%$

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

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

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

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

Dedicated CCWS Pump

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

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

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

Dedicated CCWS Makeup Pump

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

CCWS Heat Exchangers

The CCWS HXs are horizontal tube and shell type HXs. The CCW is circulated on the shell side and the ESWS supplies cooling water on the tube side.

Dedicated CCWS Heat Exchanger

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

Table 9.2.2-1—CCWS Design Parameters

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

Table 9.2.2-2—CCWS User Requirements
Sheet 1 of 4

Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
Fuel Pool Cooling System				
Fuel Pool Cooling Heat Exchanger	30FAK10/20 AC001	29	0.8818	Normal Operations
		47.8	2.645	Normal Refueling
		33.78	2.645	Refueling (full off-load)
Reactor Coolant System				
RCP Lower Bearing Oil Cooler	JEB10/20/30/40 AC001	0.0819	0.0088	Cooling Isolated with Containment Isolation (CI) Stage 1 Signal
RCP Motor Air Cooler	JEB10/20/30/40 AC002/003	1.075	0.0529	
RCP Upper Bearing Oil Cooler	JEB10/20/30/40 AC004	1.305	0.1323	
RCP Thermal Barrier	N/A	0.3915	0.0198	Not Isolated with CI-1 or CI-2
Safety Injection and Residual Heat Removal System				
MHSI Pump Motor Cooler	JND10/20/30/40 AP001	0.239	0.0265	
LHSI Heat Exchanger	JNG10/20/30/40 AC001	152.8	2.984	Normal cooldown when CCW train is only connected to the train SIS users
		36.54	2.1906	Normal cooldown when CCW train is also connected to the CCW common header
		241	2.1906	DBA
LHSI Pump Motor Cooler	JNG20/30 AP001	0.1262	0.0141	
LHSI Sealing Fluid Cooler	JNG20/30 AP001	0.0341	0.0062	Flow isolated when LHSI pump is out of service for dilution prevention
Severe Accident Heat Removal System				
SAHRS Heat Exchanger	JMQ40 AC001	47.77	1.106	Cooled by dedicated CCWS
SAHRS Pump Seal Watercooler	JMQ40 AC003	0.0593	0.0053	Cooled by dedicated CCWS

Table 9.2.2-2—CCWS User Requirements
Sheet 2 of 4

Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
SAHRS Pump Motor Cooler	JMQ40 AC002	0.089	0.0079	Cooled by dedicated CCWS
SAHRS Pump Bearing Cooler	JMQ40 AC004	0.0223	0.002	Cooled by Dedicated CCWS
Volume Control System				
CVCS HP Cooler	KBA11/12 AC001	30.71	0.873	Plant Heatup
		14.3	0.2968	Normal Load
		6.9	0.1228	Plant Cooldown
Charging Pump Motor Cooler	KBA31/32 AP001	0.1706	0.0198	
Charging Pump Oil Cooler	KBA31/32 AP001	0.1706	0.0025	
Charging Pump Seal Water Cooler	KBA31/32 AP001	0.1706	0.0033	
Coolant Treatment System				
After Cooler	KBF25 AC001	0.6824	0.0381	Cooling Isolated with Safety Injection (SI) Signal
Condensate Cooler	KBF20 AC006	0.9315	0.0262	
Condenser	KBF20 AC003	0.6824	0.019	
Gas Cooler	KBF20 AC004	0.0358	0.002	
Gas Cooler	KBF40 AC004	0.0481	0.0027	
Reflux Cooler	KBF40 AC003	0.9622	0.0262	
Seal Water Cooler	KBF35 AC001	0.1297	0.0071	
Coolant Degasification System				
CDS Condenser	KBG10 AC002	8.131	0.4524	Cooling Isolated with SI Signal
CDS Gas Cooler	KBG10 AC003	0.6244	0.0349	
Containment Ventilation System				
Containment HVAC Cooler 1/2/3/4	KLA61/63 AC001/003	1.365	0.1437	Cooling Isolated with CI Stage 1 Signal
Solid Waste System				
Condenser	KPC30/40/50 AC001	0.0341	0.0024	Cooling Isolated with SI Signal
Vacuum Unit	KPC60 AC001	0.0239	0.0048	

Table 9.2.2-2—CCWS User Requirements
Sheet 3 of 4

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

Table 9.2.2-2—CCWS User Requirements
Sheet 4 of 4

Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lb/hr)	Comments
SG Secondary Sampling (SG4)	QUC14 AC004	0.2593	0.0097	
FPCS Heat Exchanger			30FAK10/20 AC001	0.8818
RCP Thermal Barrier			N/A	0.0198
LHSI Heat Exchanger			30JNG10/20/30/40 AC001	2.1906
SCWS Chiller			30QKA20/30 AC002	0.3730

RAI 406, Q 9.2.2-110 FSAR Insert 'A'

Table 9.2.2-2 - CCWS User Requirements Summary

Component	KKS	Heat Load (10^6 BTU/hr)	Required Flow (10^6 lbm/hr)	Comments
CCWS Main Trains 1 and 4				
CCWS Pump Motor Cooler	KAA10/40 AC002	0.0955	0.0302	
LHSI Heat Exchanger	JNG10/40 AC001	152.8	2.984	Normal Cooldown when CCW train is only connected to the train SIS users (1)
		36.54	2.1906	Normal Cooldown when CCW train is also connected to the CCW common header (1)
		241	2.1906	DBA
MHSI Pump Motor Cooler	JND10/40 AP001	0.0239	0.0265	
CCWS Main Trains 2 and 3				
CCWS Pump Motor Cooler	KAA20/30 AC002	0.0955	0.0302	
LHSI Heat Exchanger	JNG20/30 AC001	152.8	2.984	Normal Cooldown when CCW train is only connected to the train SIS users (1)
		36.54	2.1906	Normal Cooldown when CCW train is also connected to the CCW common header (1)
		241	2.1906	DBA
MHSI Pump Motor Cooler	JND20/30 AP001	0.0239	0.0265	
LHSI Pump Motor Cooler	JNG20/30 AP001	0.1262	0.0141	
LHSI Sealing Fluid Cooler	JNG20/30 AP001	0.0341	0.0062	Flow isolated when LHSI pump is out of service for dilution prevention
Common Header 1				
Fuel Pool Cooling Hx	FAK10 AC001	29	0.8818	Normal Operations
		67.62	2.645	Refueling
Safety Chiller	QKA20 AC002	4.123	0.373	
RCP Thermal Barrier	N/A	1.566	0.0792	Thermal Barriers 1-4 can be cooled by
Additional Operational Users	QNA, QNB, JEB, KBA, KLA, KTA, QUC, KUA	69.86	4.11	
Common Header 2				
Fuel Pool Cooling Hx	FAK20 AC001	29	0.8818	Normal Operations
		47.8	2.645	Refueling
Safety Chiller	QKA30 AC002	4.123	0.373	
RCP Thermal Barrier	N/A	1.566	0.0792	Thermal Barriers 1-4 can be cooled by
Additional Operational Users	QNA, QNB, JEB, KBA, QUC, KUA, LCQ, KBF, KBG, KPC, KPF	86.29	4.29	
Dedicated CCWS Train				
Severe Accident Heat Removal System Heat Exchanger	JMQ40 AC001/004	50.5	1.104	

Notes:

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

RAI 406, Q 9.2.2-110 FSAR Insert 'B'

Table 9.2.2-6 - CCWS Heat Load Summary

CCWS Operational Alignment	Heat Load (10^6 BTU/hr)
RCS Heat-up CCWS Train 1or 2 Connected to Common 1	106.8
RCS Heat-up CCWS Train 3 or 4 Connected to Common 2	123.4 (1)
RCS Cooldown CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	118.4
RCS Cooldown CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	124.9
RCS Cooldown CCWS Trains Not Connected to a Common Header	153.1
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	291.8
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	291.4

Notes:

1. Current analysis assuming a representative constant heat transfer coefficient indicates that 123.4 MBTU/hr combined with CCWS and ESWS flow rates will require the greatest heat transfer area for the CCWS heat exchanger. For final procurement a 10% margin for tube plugging will be required. The DBA case will require a minimum additional margin of 10% above the specified 10% tube plugging allowance.

RAI 406, Q 9.2.2-110 FSAR Insert 'C'

Table 9.2.2-7 - CCWS Pump Flow Summary

CCWS Operational Alignment	CCWS Pump Discharge Flow (10^6 lbm/hr) (1)	CCWS Pump Discharge Flow (gpm) (1)
Normal Operation; CCWS Train 1 or 2 Connected to Common 1 Plus Train Specific SIS Users	7.359	15203
Normal Operation; CCWS Train 3 or 4 Connected to Common 2 Plus Train Specific SIS Users	7.537	15570
DBA - CCWS Train 1 or 2 aligned to Common 1 Header	4.407	9104
DBA - CCWS Train 3 or 4 aligned to Common 2 Header	4.386	9061

Notes:

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

Table 9.2.5-1—Ultimate Heat Sink System Interface

Component	Max Heat Load MBTU/hr	Total Required ESW Flow (10^6 lb_m/hr)	Required ESW Temperature	Comments
CCWS heat exchanger	128.1	7.540 min	≤92°F	Normal Operation
	120.1	7.540 min	≤90°F	Spring/Fall Outage Cooldown
	291.3	7.540 min	≤95°F	DBA
Dedicated CCWS heat exchanger	48.64	1.205 min	≤95°F	Severe Accident
EDG heat exchanger	22.0	1.06	≤95°F	
ESW pump room cooler for 31/32/ 33/34 UQB	0.619	~~137.6 gpm~~0.0685	≤ 95°F	Normal Operations Shutdown/ Cooldown and DBA
ESW pump room cooler for 34 UQB	0.314	~~69.8 gpm~~0.0347	≤ 95°F	Severe Accident - ESW flow supplied by dedicated ESW pump