ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Thursday, July 29, 2010 8:57 AM
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 RAI 418 Q.14.03.07-35.pdf; DRAFT RESPONSE RAI 397 Q.09.02.02-108.pdf; DRAFT RESPONSE RAI 406 Q.09.02.02-114.pdf; DRAFT RESPONSE RAI 417 Q.09.02.02-121.pdf

Importance: High

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: KOWALSKI David J (AREVA NP INC)
Sent: Thursday, July 29, 2010 7:42 AM
To: BRYAN Martin (EXT)
Cc: BALLARD Robert W (AREVA NP INC); CONNELL Kevin J (AREVA NP INC); BROUGHTON JR Ronnie T (AREVA NP INC); HARTSELL Jody M (AREVA NP INC); HUDDLESTON Stephen C (AREVA NP INC); GARDNER George Darrell (AREVA NP INC); MCINTYRE Brian (AREVA NP INC); SLOAN Sandra M (AREVA NP INC)
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 345, 397, 406 and 417 questions. These responses will be discussed at today's (7/29/10) FSAR Chapter 9 Weekly Telecon/GoToMeeting with the NRC.

Attached are the following DRAFT responses:

- Response to RAI 397 - Question 09.02.02-108.
- Response to RAI 406 - Question 09.02.02-114.
- Response to RAI 417 - Question 09.02.02-121.
- Response to RAI 418 - Question 14.03.07-35.

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
New Plants Regulatory Affairs

AREVA NP Inc.
An AREVA and Siemens company

7207 IBM Drive, Mail Code CLT-2A
Charlotte, NC 28262
Phone: 704-805-2590
Mobile: 704-293-3346

Fax: 704-805-2675
Email: David.Kowalski@areva.com

Hearing Identifier: AREVA_EPR_DC_RAIs
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Created By: Martin.Bryan.ext@areva.com

Recipients:
"Hearn, Peter" <Peter.Hearn@nrc.gov>
Tracking Status: None
"KOWALSKI David (AREVA)" <David.Kowalski@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

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Request for Additional Information No. 418(4742), Revision 0

6/8/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 14.03.07 - Plant Systems - Inspections, Tests, Analyses, and Acceptance Criteria
Application Section: 14.3.7

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

14.03.07-35

Follow-up to RAI 182, Question 14.3-10

Based on the staff's review of the applicant's response to RAI 14.3-10, the following issues have been identified.

Discrepancies were noted between the description of various components in Tier 1 and Tier 2. Tier 1 information in Table 2.7.1-2, "Component Cooling Water System Equipment I&C and Electrical Design," indicates that the "MCR/RSS controls" on safety related pumps, valves, etc are "start-stop" or "open-close". Typical main control room controls are pull-to-lock (which means will not start on a control signal), on, off, auto. Also, motor operated valves (MOVs) and air operated valves (AOVs) are auto-manual, or open-close-auto. Based on the details provided by the applicant in Tier 2, Section 9.2.2, Component Cooling Water System," (CCWS) many of the CCWS components operate in automatic and have manuals main control room (MCR) controls. The applicant should clarify Tier 1 Table 2.7.1-2 to address (for example but not limited too):

a. Describe how the CCWS pump automatically starts if the only controls are start-stop.
b. Describe how the CCWS switchover valves automatically operates during a low surge tank level if the controls are only open-close.
c. Describe how the CCWS heat exchanger control valve automatically controls CCWS outlet temperature if the controls are only open-close.

Based on the staff's review of other FSAR Tier 1 tables, this is a generic issue related to all MCR/RSS controls.

Table 2.7.1-3, Component Cooling Water System ITAAC," Item 7.1 was modified and the CCW heat exchanger area and heat transfer coefficient was added to include heat exchanger performance. This markup does not appear to be correct since the heat transfer rates was not identified as 'Acceptance Criteria'.

Response to Question 14.03.07-35:

a, b and c. The features listed in the “MCR/RSS” column of the U.S. EPR FSAR Tier 1 tables are intended to be the minimum required manual controls that must be available to operators in the Main Control Room and Remote Shutdown Station. This information is not intended to negate any of the automatic features designed into a given system.

Refer to the Response to RAI 417, Question 9.2.2-121 for Table 2.7.1-3 ITAAC related to CCWS heat transfer rate.

FSAR Impact:

The U.S. EPR FSAR will not be revised as a result of this response.

Request for Additional Information No. 397(4644, 4680), 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: 09.02.05 - Ultimate Heat Sink

Application Section: 9.2

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

Question 09.02.02-108:

Follow-up to RAI 334, Question 9.2.2-60 and RAI 174, Question 9.2.2-11

In RAI 9.2.2-60 the applicant was asked several follow-up questions in regard to addressing hydraulic transients such as water hammer and two phase flow the CCWS design. The questions included: (1) specifically address the potential for two-phase flow as identified in NRC Generic Letter 96-06, (2) explain the means by which the CCWS withstands “adverse transients,” and (3) provide details on I&C design features to avoid water hammer.

The staff’s review of the applicant’s response provided for RAI 9.2.2-60 identified the follow-up questions, as described below:

a. The applicant needs to provide an explanation of preventing or mitigating two phase flow in the return pipes from any CCWS heat exchanger exposed to post accident conditions inside containment. The response should address heat exchangers that may be automatically isolated (e.g. Containment HVAC) as well as those that can remain in service (e.g. RCP and, CVCS HP cooler loads etc). For this response the applicant needs to provide assurance that CCWS worst case fluid outlet temperatures will remain below saturation for the expected fluid pressure conditions.

b. The applicant needs to explain the mitigation of a hydraulic transient that could result from automatic closing of the 10 second switchover valve by the time sequence of opening the LHSI isolation valve. The discussion should include the source and relative timing of valve initiating signals as well as valve stroke timing for the 18” butterfly valve (AA005) to provide assurance that the LHSI path will open in time to support switchover valve closure. The applicant should also add a discussion of this water hammer mitigating design feature in FSAR Tier 2 Section 9.2.2.

c. Describe if a similar water hammer transient concern exists upon automatic isolation of non-safety loads outside of containment by fast closing hydraulic valves (i.e. 80AA0015,16,19 and 50AA001, 004 and 006). Several control signals are discussed in FSAR Tier 2 Section 9.2.2 that will automatically initiate closure of these fast closing hydraulic valves (e.g. a mismatch in flow between the inlet and outlet). Describe if design features are also provided to mitigate the potential for a water hammer transient for this scenario.

d. The applicant should identify the indications and controls referenced in the initial response to RAI 174, Supplemental 2 (page 2), that will help to avoid water hammer and add them to the appropriate sections of the FSAR (for example FSAR Tier 1 and FSAR Tier 2 Section 9.2.2 and Chapter 14).

Response to Question 09.02.02-108:

a) A review of the CCWS design confirmed the CCWS prevents or mitigates two-phase flow in return pipes from CCWS users inside the reactor building by having return water temperature in the piping below the saturation temperature at the system operating pressure. The following table summarizes the maximum heat loads and outlet temperatures for each CCWS user inside the reactor building assuming the DBA CCWS supply temperature of 113°F to each user. Note that many of these users would be isolated in a DBA and the maximum supply temperature they would receive is 100.4°F.

User	Description	Maximum Heat Load (10^6 BTU/hr)	CCWS Outlet Temperature (°F)
RCP 1-4 Thermal Barrier	Thermal Barrier cooler for each RCP	0.3915	132.8
RCP 1-4 Motor Air Coolers	Motor Air coolers for each RCP	1.075	133.3
RCP 1-4 Upper Bearing Oil Coolers	Upper Bearing oil cooler for each RCP	1.305	122.9
RCP 1-4 Lower Bearing Oil Coolers	Lower Bearing oil cooler for each RCP	0.0819	122.3
KBA11/12 AC001	CVCS HP Coolers 1 and 2	30.71	148.2
KLA61/63 AC001/003	Containment HVAC Coolers	1.365	122.5
KTA10 AC001	Primary Effluents Heat Exchanger	1.996	130.8

At the CCWS pump head of 199.7 ft (86.56 psi) listed in FSAR Table 9.2.2-1 the saturation temperature is 317.54°F. The highest outlet temperature from any reactor building user supplied with CCWS water at 113°F is 148.2°F. This maximum temperature is calculated using the maximum CVCS heat load that would be applied to CCWS during plant heat-up conditions. Note that these are bounding conditions when each of these users would receive flow.

Upon receipt of a Containment Isolation Stage II signal the following heat exchangers are isolated.

- CVCS HP Coolers
- RCP Motor Air Coolers
- RCP Oil Bearing Coolers

- Containment HVAC Coolers
- Primary Effluents Heat Exchanger

During a DBA the CCWS users listed above are automatically isolated. With these users isolated, there will be no supply flow and no return flow from these users. The return piping from each Containment HVAC cooler, the primary effluents heat exchanger and each CVCS HP Cooler contains a thermal relief valve to protect these portions of the system during times when they may be isolated. The return piping from each RCP motor cooler and oil bearing cooler combine together to form a common return for each RCP. Each of these four common RCP motor return pipes contains a thermal relief valve to protect those portions of the system during times when they may be isolated.

b) The opening of the LHSI heat exchanger isolation valve is not intended to be used as a hydraulic transient mitigation feature. The stroke time of 30 seconds for this valve precludes it from mitigating a potential hydraulic transient caused by the isolation of the common header switchover valves. After closure of the common header switchover valve and a low flow conditions is sensed at the CCWS heat exchanger outlet, the LHSI heat exchanger isolation valve will open because flow is less than the minimum threshold.

   The 10 second closure time of the common header switchover valve is not considered an instantaneous closure that would create large pressure waves in the system. The relative short length of piping between the pump discharge and the common header isolation valve allows for less of a pressure buildup in the system. This results from the switchover valve still being partially open when the rarefaction wave returns to the valve.

c) There is no water hammer transient concern upon automatic isolation of the non-safety loads outside on containment by fast closing hydraulic valves KAB50 AA001/004/006 and KAB80 AA015/016/019. The 10 second closure time of the common header switchover valve is not considered an instantaneous closure that would create large pressure waves in the system.

d) There are no specific controls and instrumentation to provide measures to avoid water hammer. Water hammer testing will be covered in the Response to RAI 417, Question 9.2.2-122. U.S. EPR FSAR Section 9.2.2 will be revised to update this information.

FSAR Impact:

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

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

Vents are provided for venting components and piping at high points in liquid filled systems that can become normally idle and in which voids could occur. These vents are located for ease of operation and testing on a periodic basis. All drains and vents of the CCWS including surge tank overflow are routed to the nuclear island drain and vent systems.

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

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

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

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

All components and piping are carbon steel, except the demineralized feedwater line, which is stainless steel, and the CCWS HX tubes and dedicated CCWS HX tubes which

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

5/14/2010

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

09.02.02-114

Follow-up to RAI 334, Question 9.2.2-69 and RAI 174, Question 9.2.2-20

In follow-up RAI 9.2.2-69 the staff concluded that the response and markup of FSAR Tier 2 Section 9.2.2 provided by the applicant for RAI 9.2.2-20 did not specifically demonstrate satisfying the guidance of SRP 9.2.2 Section II 4.G ii. In follow-up RAI 9.2.2-69 the staff noted examples of information needed in the FSAR markup to more completely identify the CCWS thermal barrier cooling design including; (1) Specifically state the CCWS associated with the RCPs can withstand a single, active failure or a moderate-energy crack as defined in Branch Technical Position ASB 3-1, (2) Also credit Seismic Category I, Quality Group C, and ASME Section III Class 3 requirements and (3) to identify that future RCP seal SBO testing would be performed.

The applicant's response to RAI 9.2.2-69 included a detailed explanation and revised markup of FSAR Tier 2 Section 9.2.2. However, the staff's review of this response identified the follow-up questions listed below:

a. In regard to the discussion in the response about mid position failure of a thermal barrier containment isolation valve (CIV) upon attempting transfer of thermal barrier cooling to the other common header:

   1. Describe the type of actions (and priority) that would be needed if the failure occurred with the valve nearly closed resulting in insufficient cooling to all thermal barriers while still preventing transfer to the other common header, that is, permissive not satisfied. Describe if this is considered a common mode loss of thermal barrier cooling.

   2. Describe in the FSAR the acceptability of taking credit for CVCS seal injection in this scenario when the CVCS is only considered an operational system that may not be present in post accident conditions.

3. Describe in the FSAR if the plant design basis requires CCWS thermal barrier cooling to be functional in post accident conditions (besides during all plant operating modes when the RCPs are running).

4. The applicant's response stated that failure of a CCWS CIV to fully close does not place the plant in a four hour TS action statement to close the other CIV in that flowpath but TS 3.6.3 Containment Isolation does apply. The applicant should provide the basis for these conclusions and explain the aspect of TS 3.6.3 that does apply including the applicable LCO duration.

5. Describe in the FSAR if the RCP standstill seal (discussed in the original response) is credited as a safety-related design basis accident mitigation feature or is it intended only for conditions that are beyond the normal design basis.

b. Provide an explanation in the RAI response that demonstrates that the guidance of SRP 9.2.2, Section II 4.G is satisfied by testing that the RCPs can withstand a complete loss of cooling water for 20 minutes without operator action or state that in lieu of testing the CCWS meets Section ii.4.G, item ii. This was not addressed as requested by RAI 9.2.2-69.

Response to Question 09.02.02-114:

a.

1. The RCP Thermal Barrier Cooling Transfer is a Non-Safety Manual function. The transfer of thermal barrier cooling from one common header to the other common header would be needed if one of the two available trains on the initial common header providing thermal barrier cooling is being placed in maintenance. Per Tech Spec 3.7.7 Required Action A.1, RCP thermal barrier cooling is to be aligned to the common header with two operable CCWS trains within 72 hours if one CCW train is inoperable. In this case, the transfer could occur during normal power operation or during a shutdown. The sequence of closing the first set of CIVs and opening the second set of CIVs determines the time that flow will be interrupted to the RCP thermal barriers. From FSAR Table 6.2.4-1, the closure time of the CIVs for RCP thermal barrier cooling is ≤15 seconds for each valve. Because of the valve interlock associated with the supply of cooling to the loads and the short duration desired to have cooling flow interrupted, a group command is provided. The group command will close all three of the CIVs of the off-going common header simultaneously and open all three of the CIVs of the on-coming header simultaneously. The 15 second closure time of the off-going header CIVs combined with a 15 second opening time of the on-coming header CIVs results in a flow disruption of approximately 30 seconds for the RCP thermal barriers.

   The RCP thermal barrier cooling transfer consists of closing the open group of CIVs (KAB30 AA049/051/052 (Common 1.b) or KAB30 AA053/055/056 (Common 2.b)) and as soon as all valves indicate valve closure, the other group of CIVs (KAB30 AA049/051/052 (Common 1.b) or KAB30 AA053/055/056 (Common 2.b)) is opened. In case a CIV fails to close on the initial common header or lack of valve opening on the final header, another transfer is automatically performed back to the initial configuration. This automatic feature to revert back to the initial configuration is built into the thermal barrier cooling transfer command. Refer to U.S. EPR FSAR Section 9.2.2.6.1.3 for a description of the RCP Thermal Barrier Cooling Transfer.

In the event that a CIV of the off-going header fails in mid position and is not fully closed or restored to the original full open position, the CVCS seal injection will continue to operate and there is no immediate concern for the operator to restore full CCW flow to the RCP thermal barrier coolers. In this condition, the partially open CCW CIV valve could limit CCW flow to the RCP thermal barrier coolers however, it will not impact the operability of the CCWS to cool other components or the ability of the CVCS to supply seal injection to the RCP shaft seals. This same scenario is true if the initial CCW common header RCP thermal barrier CIVs close and a CIV of the on-coming common header is stuck in a partially open position. This condition would put the CCW system in an LCO condition and full CCW flow would need to be restored to the RCP thermal barrier coolers or the unit must be placed in at least Mode 3 within 6 hours and in Mode 5 within 36 hours in accordance with Section B 3.7.7 - Actions C.1 and C.2 of the FSAR.

The CCWS Containment Isolation Valves (CIVs) for RCP Thermal Barrier Cooling are not actuated upon receipt of SI, CI-1 or CI-2 signals so they remain open during and after a DBA. The containment isolation valves associated with each of the common headers providing this cooling flow to the thermal barriers would not be cycled to test Containment Isolation operability during normal power operation because of the potential impact on operating RCPs.

2. In accordance with Section B 3.7.7 in the FSAR, Action Item A.1 requires that if one CCW train is inoperable, action must be taken to align the RCP thermal barrier cooling common loop to a common header capable of being supplied by two operable CCW trains within 72 hours. In this condition, the CCWS can perform the RCP thermal barrier cooling function given a single failure. The 72 hour completion time is reasonable, based on the low probability of a postulated accident occurring during this period. U.S. EPR FSAR Section 3.7.7 will be revised to include a confirmation of CVCS flow to the RCP seals prior to RCP thermal barrier transfer within the CCWS.

   In accordance with Action Items B.1, if two CCW trains are inoperable, action must be taken to restore one train to operable status within 72 hours. In accordance with Action Item C.1 and C.2, if a CCW train cannot be restored to operable status within the associated completion time, the unit must be placed in at least Mode 3 with 6 hours and in Mode 5 within 36 hours.

   Prior to an accident, it is expected that CCWS cooling to the Reactor Coolant Pumps is available. This is ensured by Tech Spec 3.7.7. Credit is not taken for the CVCS to ensure cooling to the RCP shaft seals. During a LOOP, there is no need for the operator to transfer cooling to another CCWS train. Power to the previously running CCWS train will be restored based on EDG load sequencing. Since the CIVs for thermal barrier cooling remain open during and after a DBA, there is no need for the operator to transfer thermal barrier cooling.

   Based on the above, a loss of CCW cooling to the RCP thermal barriers will not create a loss of CVCS seal injection to the RCPs and if the CCWS flow is restored within the specified LCO action times it is not necessary to assume a DBA in combination with a loss of CCW cooling to the RCP thermal barriers.

3. Thermal Barrier cooling is required for all modes of operation, including DBA, where the RCS is pressurized and therefore relying on RCP seal integrity to maintain the Reactor Coolant Pressure Boundary. This is an initial condition in the accident analysis and is ensured by Tech Spec 3.7.7. CCWS is the only safety-related cooling to the RCP thermal barriers. Technical Specifications require thermal barrier cooling to be supplied to the RCP's to ensure this initial condition (i.e. thermal barrier cooling is active) prior to an accident. U.S. EPR FSAR Tier 2, Section 9.2.2 will be revised to include this information.

4. Failure of a CCWS CIV for RCP Thermal Barrier cooling to close renders the CCWS system inoperable per Tech Spec 3.7.7 as this condition would degrade flow to the RCP thermal barriers. In effect, this would render each of the two trains capable of supplying the common header aligned to thermal barrier cooling inoperable for thermal barrier cooling because neither of the trains could provide thermal barrier cooling. This condition would put the CCW system in an LCO condition and full CCW flow would need to be restored to the RCP thermal barrier coolers or the unit must be placed in at least Mode 3 within 6 hours and in Mode 5 within 36 hours in accordance with Section B 3.7.7 - Actions C.1 and C.2 of the FSAR. LCO 3.6.3 Note 3 under Actions states "Enter applicable conditions and Required Actions for systems made inoperable by Containment Isolation Valves". This again would go back to Tech Spec LCO 3.7.7 as stated above.

   In the event that a CIV of the off-going header fails in mid position and is not restored to the original full open position or closed to allow the CIVs of the on-coming header to open and CVCS seal injection is available, there is no priority requirement for the operator. If a CIV of the off-going header fails in mid-position and is not restored to full open position or closed to allow the CIVs of the on-coming header to open and CVCS seal injection is not available, one of the two flows (CCWS or CVCS) must be restored within two minutes. Loss of CCW cooling to the RCP thermal barrier coolers does not impact the operation of the CVCS. Therefore, assuming a concurrent loss of seal injection to the RCPs should not be required in the short term.

5. The RCP standstill seal is not credited as a safety-related design basis accident mitigation feature. It intended only for conditions that are beyond DBA.

b. Refer to the Response to RAI 174, Question 9.2.2-20 for information related to RCP seal SBO testing. Refer to U.S. EPR FSAR Section 5.4.1.2.1 for information related to the RCP seal design as it relates to a loss of seal cooling and the conditions under which the standstill seal is normally used.

   The CCWS meets the guidance of SRP 9.2.2 as being designed for single failure and built to ASME III Class 3. Refer to U.S. EPR FSAR Sections 9.2.2.1 and 9.2.2.2.1. The CCWS piping, valves and components supplying the RCP thermal barriers is Seismic Category I, Quality Group C, ASME III Class 3 with the exception of the CIVs and piping between the CIVs, which are Seismic Category I, Quality Group B, ASME III Class 2.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.2 and 3.7.7 will be revised as described in the response and indicated on the enclosed markup.

~~supply and return side of Common 2b are closed, and vice-versa. If one CCWS train is inoperable, RCP thermal barrier cooling will be aligned to the CCWS common header with two operable CCWS trains.~~

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

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

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

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

3.7 PLANT SYSTEMS

3.7.7 Component Cooling Water (CCW) System

LCO 3.7.7 Four CCW trains shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

---NOTE---
Enter applicable Conditions and Required Actions of LCO 3.4.6, "RCS Loops - MODE 4," for residual heat removal loops made inoperable by CCW System.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One CCW train inoperable.	A.1	---------------NOTE------------- Required Action A.1 is not applicable if CCW trains are inoperable in both CCW headers supplying the reactor coolant pump (RCP) thermal barrier cooling common loop and Condition B is entered. ------------------------------------	
		Align RCP thermal barrier cooling common loop to the CCW header with two OPERABLE CCW trains.	72 hours
	<u>AND</u>		
	A.2	Restore CCW train to OPERABLE status.	120 days
B. Two CCW trains inoperable.	B.1	Restore one CCW train to OPERABLE status.	72 hours

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

6/8/2010

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

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

09.02.02-121

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

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

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

From the markup of ESWS Tier 2 Section 9.2.1, Page 9.2-3

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

From the markup of CCWS Tier 2 Section 9.2.2, Page 9.2-20

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

The applicant should provide clarifications as shown below:

1. The FSAR description should state that the identified power sources are applicable to the entire dedicated train (pump, valves, components etc.) not just the pump as stated in the ESWS markup.

2. The FSAR description should be corrected since Tier 1 Table 2.7.1-2 and Table 2.7.11-2 which identified normal power for the dedicated train is from Class 1E Division 4, conflicts with the CCWS markup of Section 9.2.2 states that the normal source is off-site power.

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

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

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

Response to Question 09.02.02-121:

Part (i)2 and (i)3:

1. A review of the CCWS and ESWS confirmed the identified power sources are applicable to the entire dedicated train for each system. U.S. EPR FSAR Section 9.2.1 will be revised to include this information.
2. A review of the CCWS and ESWS confirmed normal power for the dedicated train of each system is from Class 1E Division 4. U.S. EPR FSAR Section 9.2.2 will be revised to include this information.
3. Refer to the Response to 1 and 2 above for the Tier 2 Sections 9.2.1 and 9.2.2 addition of the description related to alternate power from an EDG or SBODG. Refer to the Response to RAI 345 Question 9.2.1-26 for the addition of this information in Tier 1 Section 2.7.11. U.S. EPR FSAR Tier 1 Table 2.7.1-3 will be revised to include this information.

Part (i)5:

A review of the CCWS confirmed the Class 1E power source for hydraulic fluid pumps that are associated with each hydraulic valve. The common header switchover valves (KAA10/20/30/40 AA006/010/032/033) will be designed to fail as is on loss of power to their hydraulic pilot circuits. The Safety Related isolation valves used to isolate the non-safety related portions of the system (KAB50 AA001/004/006 and KAB80 AA015/016/019) will be designed to fail closed on loss of power to their hydraulic pilot circuits. U.S. EPR FSAR Tier 1, Table 2.7.1-2 will be revised to add hydraulic fluid pumps to the current discussion related to pilot valves for the hydraulically operated valves.

Part (m):

A review of the CCWS confirmed the DBA heat load for the CCWS heat exchanger of 291.8E+06 BTU/hr. Refer to the Response to RAI 406 Question 9.2.2-110 for details related to the CCWS heat exchanger design data. U.S. EPR FSAR Tier 1 Table 2.7.1-3 will be revised to include this information.

FSAR Impact:

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

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

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

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

9.2.1.3 Component Description

9.2.1.3.1 Safety-Related Essential Service Water Pumps

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

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

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

which performs a containment isolation function is classified Seismic Category I. This equipment is located in buildings designed to Seismic Category I requirements.

~~CCWS equipment that does not serve safety-related functions but is routed proximate to other safety-related structures, systems and components (SSC) is classified Seismic Category II to prevent loss of function of safety-related SSC.~~

CCWS users, which are not classified Seismic Category I, can be isolated by Seismic Category I fast-acting isolation valves in case of external hazards.

The Seismic Category I fast-acting isolation valves for non-safety-related CCWS users are hydraulically operated and designed to close in less than 10 seconds. The CCWS common header switchover valves are also fast-acting hydraulically operated valves with a closure time of less than 10 seconds. These switchover valves can be used to isolate the common headers to conserve the system capacity to cool the safety-related SIS users directly associated with the CCWS train.

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

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

Each physically separated CCWS safety-related train includes:

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

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (7 Sheets)

Description	Tag Number [1]	Location	IEEE Class 1E [2]	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Common Header 1b Safety Related Loads CVCS HP Cooler 1 Downstream Control Valve	KAB60AA116	Reactor Building	NA	N/A	Yes	Pos	Open-Close
Common Header 2b Safety Related Loads CVCS HP Cooler 2 Downstream Control Valve	KAB70AA116	Reactor Building	NA	N/A	Yes	Pos	Open-Close
Dedicated CCWS Surge Tank Isolation Valve	KAA80AA020	Safeguards Building 4	4	N/A	Yes	Pos	Open-Close
Dedicated CCWS Surge Tank Nitrogen Supply Valve	KAA80AA021	Safeguards Building 4	4	N/A	Yes	Pos	Open-Close
Dedicated CCWS Demin Water Makeup Water Supply Valve	KAA80AA202	Safeguards Building 4	4	N/A	Yes	Pos	Open-Close
Dedicated CCWS Pump	KAA80AP001	Safeguards Building 4	4	N/A	Yes	On-Off / NA	Start-Stop / NA
Dedicated CCWS Demin Water Makeup Pump	KAA80AP201	Safeguards Building 4	4	N/A	Yes	On-Off / NA	Start-Stop / NA

To provide reliability of the switchover function, an uninterruptible power supply (UPS) is provided to the hydraulic actuation pilot valves. A failure of the electrical distribution system does not inhibit the transfer of the common header to the non-faulted train.

The non-safety load isolation valves are also fast-acting, hydraulically-operated valves. Each hydraulically-operated valve has multiple solenoid-operated pilot valves. Each pilot valve is powered from a different Class 1E uninterruptible power supply division to provide redundancy.~~The difference between the isolation and switchover valves is in the actuation of the pilot valves. The pilot valves for the non-safety load isolation valves are de-energized to open and bleed off the hydraulic fluid pressure.~~

LHSI Heat Exchanger Isolation Valves

These valves are motor-operated valves. The valves are normally closed to prevent dilution of the LHSI fluid and may be opened when necessary to provide an adequate flow path to support long term pump operation. The valves automatically open when the train associated LHSI system is placed into service.

LHSI Pump Seal Fluid Cooler Isolation Valves

These valves are motor-operated valves. The valves are normally closed to prevent dilution of the LHSI fluid and automatically open when the train associated LHSI system is placed into service.

Containment Isolation Valves

The CCWS containment isolation valves are motor-operated valves. The normally open valves provide the means for containment isolation to maintain the integrity of the containment penetrations and thus prevent the release of potentially radioactive material during a design based accident. The containment isolation valves for non-safety-related loads are automatically closed by containment isolation actuation signals. The containment isolation valves for the RCP thermal barrier coolers are not provided with a containment isolation signal but may be remote manually closed from the control room if required.

9.2.2.3 System Operation

9.2.2.3.1 Normal System Operation

The safety-related CCWS is a four train concept which allows sharing of operational and safety users during normal operation and to separate them in case of design and beyond design based accidents. Each physically separated train consists of a main pump, motor cooler, an HX, surge tank, sample piping with permanently installed radiation monitor, a chemical addition tank and pairs of common header isolation valves. Each train also supplies cooling to the associated MHSI pump motor cooler and

Table 2.7.1-2—Component Cooling Water System Equipment I&C and Electrical Design (7 Sheets)

Description	Tag Number (1)	Location	IEEE Class 1E (2)	EQ – Harsh Env.	PACS	MCR/RSS Displays	MCR/RSS Controls
Safety Chilled Water Chiller CCWS Flow Control Valve	KAA22AA101	Safeguards Building 2	2^N 1^A	N/A	Yes	NA / NA	NA / NA
Safety Chilled Water Chiller CCWS Flow Control Valve	KAA32AA101	Safeguards Building 3	3^N 4^A	N/A	Yes	NA / NA	NA / NA

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

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

3) Each hydraulically operated valve has multiple solenoid-operated pilot valves. Each pilot valve is powered from a different Class 1E uninterruptible power supply division to provide redundancy.

Table 2.7.1-3—Component Cooling Water System ITAAC (7 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
		b. Components listed as harsh environment in Table 2.7.1-2 will be inspected to verify installation in accordance with the construction drawings including the associated wiring, cables and terminations. Deviations to the construction drawings will be reconciled to the EQDP.b. For equipment listed for harsh environment in Table 2.7.1-2, an inspection will be performed of the as-installed Class 1E equipment and the associated wiring, cables and terminations.	b. Inspection reports exists and conclude that the components listed in Table 2.7.1-2 as harsh environment has been installed per the construction drawings and any deviations have been reconciled to the EQDP.b. Inspection concludes the as-installed Class 1E equipment and associated wiring, cables, and terminations as listed in Table 2.7.1-2 for harsh environment conform to the design.
7.1	The CCWS heat exchanger as listed in Table 2.7.1-1 has the capacity to transfer the design heat load to the ESWS system.	Tests and analyses will be performed to demonstrate the capability of the CCWS heat exchanger as listed in Table 2.7.1-1 to transfer the heat load to the ESWS.	A report exists and concludes that the ESWS has the capacity to remove the design heat load via the heat exchanger listed in Table 2.7.1-1.The CCW heat exchanger satisfies the required heat transfer of an equivalent combined product of the heat exchanger area of 39963 ft^2 and the overall heat transfer coefficient of 360 $BTU/hr*ft^2*°F$.
7.2	The pumps listed in Table 2.7.1-1 have sufficient NPSHA.	Testing and analyses will be performed to verify NPSHA for pumps listed in Table 2.7.1-1.	A report exists and concludes that tThe pumps listed in Table 2.7.1-1 have NPSHA that is greater than net positive suction head required (NPSHR) at system run-out flow with consideration for minimum allowable surge tank water level (as corrected to account for actual temperature and atmospheric conditions).