ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Thursday, October 28, 2010 11:18 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 351 Q.09.02.05-32.pdf; DRAFT FSAR Changes RAI 351 Q.09.02.05-29.pdf; DRAFT FSAR Markup RAI 351 Q.09.02.05-32.pdf; DRAFT RESPONSE RAI 351 Q.09.02.05-29.pdf

Importance: High

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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 351 questions. These responses will be discussed at today's (10/28/10) FSAR Chapter 9 Weekly Telecon/GoToMeeting with the NRC.

Attached are the following DRAFT response(s):

- Response to RAI 351 - Question 09.02.05-29 and supporting FSAR changes.
- Response to RAI 351 - Question 09.02.05-32 and supporting FSAR changes. (This response was discussed during the 10-26-10 telecon.)

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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Response to

Request for Additional Information No. 351(4112, 4163), Revision 1

01/15/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.02.05 - Ultimate Heat Sink
SRP Section: 09.05.01 - Fire Protection Program

Application Section: FSAR Chapter 9

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

Question 09.02.05-32:

Follow-up to RAI 176, Question 14.2.94:

Final Safety Analysis Report (FSAR) Tier 2 Section 14.2.12.5.8 describes initial test for the UHS (Test #049). The NRC staff identified the following issues with test abstract #049:

1. Section 14.2.12.5.8.4.1, "Data Required," includes "UHS makeup, blowdown air flowrates." Blowdown air flowrates are not described in the FSAR. Please clarify what is meant by blowdown air flowrates.
2. The following design features and functions identified in Section 9.2.5 of the EPR FSAR are not included in test abstract #049. Please revise the abstract to include the following tests or justify their exclusion:
    a. Confirmation that "normal and emergency" makeup flowrate meets design flow
    b. Confirmation that chemical injection meets design flow
    c. Confirmation that cooling tower fan performance at various speeds (including the reverse direction for cold weather deicing purposes) is satisfactory
    d. Confirmation that the cooling tower flow bypass functions properly (also for cold weather protection)

Based on the staff's review of the applicant's response to RAI 14.2.94 (ID1833/7333) AREVA #176, the following were determined as unresolved and needed further clarification/resolution by the applicant.

In Item 2.c, the staff requested that the applicant expand FSAR Tier 2 Chapter 14.2, Pre Operational Test 049, Paragraph 3.1, to confirm the capability of the cooling tower fans to operate in all speeds, including the reverse direction. This will demonstrate fan functionality in all operating modes prior to plant operation, and Technical Specification Surveillance 3.7.19.3 will provide continued assurance of fan operability after the initial test program has been completed. In response to this RAI, Paragraph 3.1.2 was added to Test #049 to verify fan operation in reverse, but fan testing to confirm functionality in the forward speeds was not included. The applicant needs to address functionality testing in the forward speeds in Test #049.

Additionally, based upon further review, the staff also determined that confirmation of cooling tower performance during the power ascension test program is necessary. A substantial heat load is needed to adequately confirm that the cooling tower heat removal and water usage rates satisfy design basis considerations. Consequently, UHS cooling tower performance testing should be completed during the power ascension test program. Design-basis conditions should be simulated to the extent possible and the actual cooling tower water usage and heat removal rates should be monitored, extrapolated, and analyzed as necessary to confirm satisfactory performance. This will also serve to establish a benchmark that can be used for periodically assessing performance and determining when actions are needed to address degraded conditions. Therefore, a test procedure needs to be developed and included in FSAR Tier 2, Chapter 14 for testing performance of the UHS cooling towers during the power ascension test program consistent with the guidance provided by Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Appendix A, Items 1.f and 5.x.

Response to Question 09.02.05-32:

Item (3)

Tier 2 Section 14.2.12.5.5 will be revised to include performance testing of the UHS during a normal cooldown condition in hot functional testing, as described in Insert 1. The performance test would place one train of RHR into service when the RCS temperature is within the upper RHR operating band. Each train of the cooling chain, including the UHS, would be employed and the thermal-hydraulic performance would be monitored. Cooling chain performance would be determined by extrapolating test data using design data. Conducting the performance test during a cooldown in hot functional testing is recommend because the most significant heat load on the UHS can be provided during this time.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 14.2.12.5.5 will be revised as described in the response and indicated on the enclosed markup.

Insert 1

1.4 To demonstrate the ability of the CCWS in conjunction with the RHR system, ESW system and the UHS to perform a plant cooldown during hot functional testing. Testing will be performed on each safety related cooling chain trains.

Insert 2

2.5 A thermal hydraulic model of the safety related cooling chain (RHR, CCW, ESW, and UHS) is available to analyze data from the cooldown. The data will have to be extrapolated to design conditions in order to determine system performance.

Insert 3

3.37 [Added in response to RAI 406 Question 114]

3.38 [Added in response to RAI 406 Question 114]

3.39 Ensure that all available loads are placed on the safety related cooling chain train that is to be tested.

3.40 Perform a cooldown test of the safety related cooling chain by placing the RHR system into service at the upper limit of operation.

3.41 Perform a cooldown test while operating all four RCPs and minimizing steam generator cooling.

3.42 Ensure UHS make-up water flow and blowdown flows are isolated.

3.43 Collect the following cooldown data:

3.43.2 RHR heat exchanger.

- RHR flow through the heat exchanger.
- CCW flow through the heat exchanger.
- Inlet and outlet RHR temperature.
- Inlet and outlet CCW temperature on the RHR heat exchanger.
- RHR pressure
- CCW pressure

3.43.3 CCW heat exchanger.

- CCW flow through the heat exchanger.
- ESW flow through the heat exchanger.
- Inlet and outlet CCW temperature.
- Inlet and outlet ESW temperature on the CCW heat exchanger.
- CCW pressure
- ESW pressure

3.43.4 UHS performance data

3.44 Analyze the cooldown data using the thermal-hydraulic model at multiple operating points.

3.45 Perform step 3.39 through 3.44 for each cooling chain train.

Insert 4

4.9 RHR, CCW, ESW, and UHS thermal-hydraulic performance data.

Insert 5

5.1.9 Verify the ability of the CCWS in conjunction with the RHRS, ESWS, and UHS to perform a plant cooldown during hot functional testing.

5.1.9.1 Using performance data from the cooldown determine that the RHR heat exchanger meets design requirements.

5.1.9.2 Using performance data from the cooldown determine that the CCW heat exchanger meets design requirements.

5.1.9.3 Using performance data from the cooldown determine that the UHS meets design requirements.

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 4 of 37

Item No.	Description	Section
2.3-9	A COL applicant that references the U.S EPR design certification will also provide estimates of annual average atmospheric dispersion (χ/Q values) and deposition (D/Q values) for 16 radial sectors to a distance of 50 miles (80 km) from the plant as part of its environmental assessment.	2.3.4
2.3-10	A COL applicant that references the U.S. EPR design certification will describe the means for providing UHS makeup sufficient to meet the maximum evaporative and drift water loss after 72 hours through the remainder of the 30 day period consistent with RG 1.27.	2.3.1.1
2.4-1	A COL applicant that references the U.S. EPR design certification will provide a site-specific description of the hydrologic characteristics of the plant site.	2.4.1
2.4-2	A COL applicant that references the U.S. EPR design certification will identify site-specific information related to flood history, flood design considerations, and effects of local intense precipitation.	2.4.2
2.4-3	A COL applicant that references the U.S. EPR design certification will provide site-specific information to describe the probable maximum flood of streams and rivers and the effect of flooding on the design.	2.4.3
2.4-4	A COL applicant that references the U.S. EPR design certification will verify that the site-specific potential hazards to the safety-related facilities due to the failure of upstream and downstream water control structures are within the hydrogeologic design basis.	2.4.4
2.4-5	A COL applicant that references the U.S. EPR design certification will provide site-specific information on the probable maximum surge and seiche flooding and determine the extent to which safety-related plant systems require protection. The applicant will also verify that the site-specific characteristic envelope is within the design maximum flood level, including consideration of wind effects.	2.4.5
2.4-6	A COL applicant that references the U.S. EPR design will provide site-specific information and determine the extent to which safety-related facilities require protection from tsunami effects, including Probable Maximum Tsunami Flooding.	2.4.6
2.4-7	A COL applicant that references the U.S. EPR design certification will provide site-specific information regarding ice effects and design criteria for protecting safety-related facilities from ice-produced effects and forces with respect to adjacent water bodies.	2.4.7

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 21 of 37

Item No.	Description	Section
9.1-1	A COL applicant that references the U.S. EPR design certification will provide site-specific information on the heavy load handling program, including a commitment to procedures for heavy load lifts in the vicinity of irradiated fuel or safe shutdown equipment, and crane operator training and qualification.	9.1.5.2.5
9.2-1	A COL applicant that references the U.S. EPR design certification will provide site specific information for the UHS support systems such as makeup water, blowdown, and chemical treatment (to control biofouling).	9.2.5.2
9.2-2	A COL applicant that references the U.S. EPR design certification will provide site-specific details related to the sources and treatment of makeup to the potable and sanitary water system along with a simplified piping and instrument diagram.	9.2.4.2.1
9.2-3	The raw water supply system (RWSS) and the design requirements of the RWSS are site-specific and will be addressed by the COL applicant.	9.2.9
9.2-4	A COL applicant that references the U.S. EPR design certification will provide a description of materials that will be used for the essential service water system (ESWS) at their site location, including the basis for determining that the materials being used are appropriate for the site location and for fluid properties that apply.	9.2.1.3.5
9.2-5	A COL applicant that references the U.S. EPR design certification will provide a description of materials that will be used for the UHS at their site location, including the basis for determining that the materials being used are appropriate for the site location and for the fluid properties that apply.	9.2.5.2
9.4-1	A COL applicant that references the U.S. EPR design certification will provide site-specific design information for the turbine building ventilation system (TBVS).	9.4.4
9.4-2	A COL applicant that references the U.S. EPR design certification will provide site-specific design information for the switchgear building ventilation system, turbine island (SWBVS).	9.4.4
9.5-1	A COL applicant referencing the U.S. EPR certified design will identify additional site-specific communication locations necessary to support effective communication between plant personnel in all vital areas of the plant during normal operation, as well as during accident conditions.	9.5.2.3
9.5-2	A COL applicant that references the U.S. EPR design certification will submit site specific information to address the Regulatory Guide 1.189, Regulatory Position C.1.7.1, Design and Procurement Document Control.	Table 9.5.1-1 C.1.7.1

INSERT

9.2-6	A COL Applicant that references the U.S. EPR design certification will confirm that the highest average site-specific wet bulb and dry bulb temperatures over a 72-hour period from a 30-year hourly regional climatological data set are bounded by the values presented in Table 9.2.5-3.	9.2.5.3
9.2-7	A COL Applicant that references the U.S. EPR design certification will confirm that the worst combination of site-specific wet bulb and dry bulb temperatures over a 24-hour period from a 30-year hourly regional climatological data set are bounded by the values presented in Table 9.2.5-4.	9.2.5.3
9.2-8	Water makeup to the UHS cooling tower basin beyond 72 hours is site-specific. A COL applicant that references the U.S. EPR design certification will confirm that the 300 gpm UHS makeup is sufficient to meet the maximum evaporative and drift water loss after 72 hours through the remainder of the 30 day period consistent with RG 1.27.	9.2.5.3

whichever is greater. Snow pack and snowfall are adjusted for density differences and ground level values are adjusted to represent appropriate weights on roofs.

A COL applicant that references the U.S. EPR design certification will provide site-specific characteristics for regional climatology.

2.3.1.2 Meteorological Data for Evaluating the Ultimate Heat Sink

As described in Section 9.2.5, the ultimate heat sink (UHS) is designed to operate for a nominal 30 days following a LOCA without requiring any makeup water to the source, or it must be demonstrated that replenishment or use of an alternate or additional water supply can provide continuous capability of the heat sink to perform its safety-related functions. The tower basin contains a minimum 72-hour supply of water.

Meteorological conditions resulting in the maximum evaporative and drift loss of water for the UHS over a 72 hour period are presented in Table 9.2.5-3. The UHS cooling tower basin is designed considering the air temperature data of Table 2.1-1 and maintains its cooling function for the Table 9.2.5-3 meteorological conditions.

Water makeup to the UHS cooling tower basin beyond 72 hours is site-specific. A COL applicant that references the U.S. EPR design certification will describe the means for providing UHS makeup sufficient to meet the maximum evaporative and drift water loss after 72 hours through the remainder of the 30 day period consistent with RG 1.27.

Meteorological conditions resulting in minimum water cooling are presented in Table 9.2.5-4. These conditions reflect a 1 day period where evaporative cooling is at a minimum. The UHS heat loads peak and decline within the first day, such that extending the 1 day meteorological profile for 5 consecutive days does not cause the UHS cooling tower basin water temperature to exceed the maximum temperature of 95°F listed in Table 9.2.5-2. The potential for water freezing in the UHS water storage facility is addressed in Section 2.4.

2.3.2 Local Meteorology

A COL applicant that references the U.S. EPR design certification will provide site-specific characteristics for local meteorology.

2.3.3 Onsite Meteorological Measurement Program

A COL applicant that references the U.S. EPR design certification will provide the site-specific, onsite meteorological measurement program.

Each cooling tower basin is sized to provide for a minimum 72-hour supply of cooling water to the associated ESW division under design basis accident (DBA) conditions assuming loss of normal makeup water capability. In the event of torrential rains and hurricanes, water would enter through the air inlet and air outlet area of the cooling tower portion of the Essential Service Water Buildings. Refer to Figure 3.8-95 through Figure 3.8-102 for details of the Essential Service Water Building. As the water level reaches the high level, an alarm in the control room will alert the operator. Operator action is performed to remove water from the cooling tower basin through the use of the safety related emergency blowdown to maintain normal water level. Therefore, no adverse effects on the safety related equipment is anticipated within the ESW pump room if the water level rises due to torrential rains and hurricanes.

9.2.5.3.2 Piping, Valves, and Fittings

System materials are selected that are suitable to the site location, UHS fluid properties and site installation. System materials that come into contact with one another are chosen to minimize galvanic corrosion. All safety-related piping, valves, and fittings are in accordance with ASME Code Section III, Class 3 (Reference 1).

Inservice testing of valves will be performed as described in Section 3.9.6.3. Leakage rates for boundary isolation valves that require testing are based on ASME OM Code, Subsection ISTC (Reference 2).

UHS valve functions are addressed in Section 9.2.1.3.5.

9.2.5.3.3 Cooling Tower Basin

The 72-hour basin water volume is the minimum water volume that must be present in a basin to accommodate system water inventory losses experienced in the basin due to ultimate heat sink (UHS) tower operation under the worst case environmental conditions, and with the highest essential service water (ESW) heat load for a 72-hour period, without incurring pump damage during operation.

UHS tower blowdown is automatically secured during the initial 72-hour post-accident period through system instrumentation and control design features, so the only significant system water inventory losses are due to evaporation, tower drift, and valve seat leakage and seepage.

Meteorological conditions resulting in the maximum evaporative and drift loss of water for the UHS over a 72-hour period are presented in Table 9.2.5-3—Design Values for Maximum Evaporation and Drift Loss of Water from the UHS.

Meteorological conditions for the U.S. EPR that result in minimum cooling tower cooling that are the worst combination of controlling parameters (wet bulb and dry bulb), including diurnal variations for the first 24 hours of a DBA LOCA, are presented in Table 9.2.5-4 and do not result in a maximum ESWS supply temperature from the UHS basin exceeding 95°F.

9.2.5.4 System Operation

The safety related ESWS pumps cooling water from the cooling tower basin to supply ESWS loads and back to the mechanical draft cooling tower. The four safety-related divisions of the UHS are powered by Class 1E electrical buses and are emergency powered by the emergency diesel generators (EDG).

The non-safety-related dedicated ESWS pumps cooling water from the division four cooling tower basin to the dedicated system heat load and back to the division four mechanical draft cooling tower during SA and beyond DBAs.

The cooling tower fans are driven with multi-speed drives that are capable of fan operation in the reverse direction. Consistent with vendor recommendations, the fan may be operated in the reverse direction for short periods to minimize ice buildup at the air inlets. To prevent or eliminate ice buildup within the cooling tower fill during low load/low temperature operation, multiple methods are utilized. Operation of a cooling tower fan in the reverse direction is the last option used if all other airside control methods fail to remove ice buildup. When a cooling tower fan is operated in the reverse direction to eliminate ice build-up, the system (associated train) is considered operable. Upon receipt of a safety injection (SI) signal, any fan(s) operating in the reverse direction will automatically trip and re-start following coast-down, and accelerate to full speed in the forward direction to dissipate the maximum heat to the environment. Similarly, upon receipt of an SI signal, cooling tower fans in the standby train(s) will automatically start and accelerate to full speed, and the cooling tower fans in the operating train(s) will continue to operate at full speed. If the fans in the operating train(s) are operating at reduced speed at the onset of a DBA, they will be automatically switched to full speed upon receipt of an SI signal, to dissipate the maximum heat to the environment. All of these actions are automatic following the receipt of an SI signal and do not require operator action.

Cooling tower fan start time, as well as the time required for fan coast-down, re-start and acceleration to full speed of a fan(s) operating in reverse, have no impact on the ability of the UHS cooling towers to mitigate the consequences of a DBA. Fans start automatically and accelerate to full speed in response to an SI signal. With respect to cooling tower fan start time, it is noted that the peak heat load on the ESW System occurs hours after the start of the DBA, and thus, hours after the fans have started and accelerated to full speed in response to an SI signal. In the case of cooling tower fans operated in reverse to eliminate ice from the fill, this operating mode is utilized only for brief periods of time (e.g., minutes) during cold weather, when the ESW System temperature is well below the design cold water temperature, and, consequently capable of accommodating the initial heat load. The time to change from reverse fan replenishment or use of an alternate or additional water supply can provide continuous capability of the heat sink to perform its safety-related functions. The tower basin contains a minimum 72-hour supply of water. After the initial 72 hours, the site--specific emergency makeup water system will provide sufficient flow rates of makeup water to compensate for system volume losses for the remaining 27 days. The normal blowdown isolation valves and the normal filter blowdown isolation valves provide automatic isolation of the ESWS from downstream non-safety-related blowdown piping under DBA conditions to prevent loss of ESW inventory. The emergency blowdown isolation valves and the emergency filter blowdown isolation valves provide automatic isolation of the ESWS under DBA conditions to prevent loss of ESW inventory. The emergency blowdown discharges outside of the Eeesmtial Service Water Pump Building (ESWPB) at an elevation above the flood level. The emergency blowdown pipe exiting the building is protected from tornado generated missiles by the building structure. The normal and emergency blowdown isolation valves provide automatic isolation of the ESWS from downstream non-safety-related blowdown piping under DBA conditions to prevent loss of ESW inventory. The ESW emergency makeup water system also provides isolation of the normal makeup water system from the tower basins under DBA conditions to prevent loss of ESW inventory.

The heat load after 72 hours post-DBA is lower than the peak heat load due to a reduction in the decay heat from the reactor. Consequently, the makeup flow rate required after 72 hours is lower than the peak condition. Since the UHS basin contains at least 72 hours of water inventory for the DBA, in combination with the worst ambient evaporation conditions, the UHS emergency makeup is not required to start until after 72 hours. At that point, the makeup requirements are diminished. The minimum makeup supply rate is based on the maximum evaporation rate over a 72 hour period post-DBA and considers such losses as drift, seepage and valve seat leakage.

COL applicants that reference the U.S. EPR will verify that the makeup water supply is sufficient for the ambient conditions corresponding to their plant location. Refer to Table 1.8-2, Item number 2.3-10. In accordance with Section 3.4.3.9, ESWPBs are physically separated by division and connected to their respective ESW cooling tower. The flooding analysis considers a postulated pipe failure in the ESWS piping to be the bounding internal flooding source. In the event of an ESWS piping failure in the building, the affected division of the ESWS is considered lost. As indicated in Section 3.4.1, if there is a failure of one division of ESWS and one division is out for maintenance, there are two remaining divisions of ESWS to perform the system safety function.

9.2.5.6 Inspection and Testing Requirements

Prior to initial plant startup, a comprehensive preoperational test is performed to demonstrate the ability of the ESWS and UHS to supply cooling water as designed

2.2 Potable and sanitary water systems instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system required for operation of the potable and sanitary water systems are complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 The potable and sanitary water systems suction supplies are being maintained at the water level (pressure) specified in the design documents.

3.0 TEST METHOD

3.1 Verify potable and sanitary water systems measured pump and system flow meet design specifications.

3.2 Verify that potable and sanitary water systems interlocks and protective features perform as designed.

4.0 DATA REQUIRED

4.1 Pump operating data.

4.2 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The potable and sanitary water systems meet design requirements (refer to Section 9.2.4):

5.1.1 System flow is within design limits.

5.1.2 Supplied water meets design requirements.

14.2.12.5.5 Component Cooling Water System (Test #046)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the CCWS to provide treated cooling water under the following conditions:

1.1.1 Normal unit operation.

1.1.2 During unit cooldown.

1.1.3 During refueling.

1.1.4 During an emergency situation.

1.2 To demonstrate that system response to a simulated ESF actuation signal is as designed.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.4 To demonstrate the CCWS is adequately designed and constructed to prevent water hammer.

2.0 PREREQUISITES

2.1 Construction activities on the CCWS have been completed.

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

2.3 Test instrumentation is available and calibrated.

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

3.0 TEST METHOD

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

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

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

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

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

3.3.1 $NPSH_a \geq NPSH_R$.

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

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

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

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

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

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

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

3.9 Verify pump control from the PICS.

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

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

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

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

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

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

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

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

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

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

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

- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.
- RCP thermal barrier flow returns to normal.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.0 DATA REQUIRED

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

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

4.3 Setpoints of alarms interlocks and controls.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Temperature data during cooldown.

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

5.0 ACCEPTANCE CRITERIA

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

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

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

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

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

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

5.1.6 System valves meet design requirements.

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

5.1.8 Verify pump control from the PICS.

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

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

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

Question 09.02.05-29:

Follow-up to RAI 175, Question 9.2.5-16:

General Design Criteria (GDC) 44 requires that "A system to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided." The staff noted in GDC 44 that adequate emergency makeup is also necessary.

Final Safety Analysis Report (FSAR) Tier 2, Table 9.2.5-2 identifies a maximum essential service water system (ESWS) cooling tower evaporation rate of 2.16 m^3/min (571 gpm). However, Technical Specification Surveillance (TS) 3.7.8.7 requires periodic confirmation that safety-related ESW basin makeup is greater than or equal to 1.14 m^3/min (300 gpm). Regulatory Position C.1 of Regulatory Guide (RG) 1.27 states that, "A cooling supply of less than 30 days may be acceptable if it can be demonstrated that replenishment or use of an alternative water supply can be effected to assure the continued ability of the sink to perform its safety functions…"

- Explain the basis in FSAR 9.2.5 for why the basin makeup to be less than the maximum evaporation rate.
- Describe in the FSAR Section 9.2.5 the basis for the Technical Specification minimum 1.14 m^3/min (300 gpm).

Based on the staff's review of the applicant's response to RAI 9.2.5-16 (ID1817/6812) AREVA #175, Supplement 1, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The cooling water inventory that is required for the certified design and the increase in water temperature were established based in part on the plant-specific meteorological data provided in FSAR Tier 2 Tables 2.1-3 and 2.1-4. A COL information item is needed to confirm that when the same analyses are performed by the COL applicant (i.e., same methodologies, assumptions, conservatisms, etc.) using plant-specific meteorological data in place of the data that was used for the certified design, they demonstrate that the water inventory and temperature increase are bounded by the values that were calculated for the certified design.

On a related matter, COL Information Item 2.3-10 appears to be redundant to COL Information Item 9.2-1, and COL Information Item 2.3-10 should be revised to more directly focus on establishing plant-specific meteorological conditions in place of those provided in FSAR Tier 2 Tables 2.1-3 and 2.1-4. This information would then be used by COL applicants to confirm the adequacy of UHS water inventory and cooling capability in accordance with a new COL information item as referred to above.

Response to Question 09.02.05-29:

Note that FSAR Tables 2.1-3 and 2.1-4 were relocated to Tables 9.2.5-3 and 9.2.5-4, respectively in Revision 2 of the U.S. EPR FSAR. The response below is based on the relocated table information.

A new COL information item will be added to FSAR Section 9.2.5.3 to require that the COL Applicant confirm that the highest average site-specific wet bulb-dry and bulb temperatures over a 72-hour period from a 30-year hourly regional climatological data set are bounded by the values presented in U.S. EPR FSAR Table 9.2.5-3. Additionally, a new COL information item will be added to FSAR Section 9.2.5.3 to require that the COL Applicant confirm that the worst combination of site-specific wet bulb and dry bulb temperatures over a 24-hour period from a 30-year hourly regional climatological data set are bounded by the values presented in Table 9.2.5-4.

COL information item 2.3-10 will be deleted and relocated to FSAR Section 9.2.5.3 and will be revised to require that the COL applicant confirm that the 300 gpm UHS makeup is sufficient to meet the maximum evaporative and drift water loss after 72 hours through the remainder of the 30 day period consistent with RG 1.27.