ArevaEPRDCPEm Resource

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Subject: U.S. EPR Design Certification Application RAI No. 351 (4112, 4163), FSAR Ch. 9
Attachments: RAI_351_SBPA_4112_4163.doc

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on December 19, 2009, and discussed with your staff on January 13, 2010. No changes were made to the draft RAI as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
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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)

09.02.05-22

Follow-up to RAI 175, Question 9.2.5-04:

The ultimate heat sink (UHS) must be able to withstand natural phenomena without the loss of function in accordance with General Design Criteria (GDC) 2 requirements. The system description does not explain the functioning and maximum allowed combined seat leakage of safety-related boundary isolation valves at the UHS basin to ensure UHS integrity and operability during seismic events and other natural phenomena. Consequently, additional information needs to be included in Tier 2 Section 9.2.5 of the Final Safety Analysis Report (FSAR) to fully describe: (a) the assurance of UHS integrity and operability by the safety-related boundary isolation valves so that common-cause simultaneous failure of all non-safety-related UHS piping will not compromise the UHS safety functions during seismic events, (b) provide the maximum allowed combined seat leakage that assures that the safety-related UHS boundary isolation valves and periodic testing that will be performed to ensure that the specified limit will not be exceeded, and (c) a description of any other performance assumptions that pertain to the boundary isolation valves or other parts of the system including blowdown that are necessary to assure the capability of the UHS to perform its safety functions during natural phenomena. In addition, under FSAR, Section 9.2.5.5, “Safety Evaluation,” it states that “The UHS pump buildings and cooling towers are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other natural phenomena.” However, there is no mention of the piping system being designed to meeting these conditions.

Based on the staff’s review of the applicant's response to RAI 9.2.5-04 (ID1817/6797) AREVA #175, Supplement 1, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The applicant response indicates that non-safety-related system piping is seismically analyzed for adverse interaction with safety-related structures, systems, and components and refers to FSAR Tier 2, Section 3.7.3.8, for additional information. However, the response did not address the effects of flooding due to failure of non-safety-related piping associated with the essential service water system and the ultimate heat sink, and additional information is needed to assure that the consequences of flooding in this regard will not pose a threat to safety-related equipment. Additionally, since the blowdown piping for the cooling tower basins is non-safety-related, the effects of cooling tower basin overflow due to torrential rains and hurricanes need to be addressed. The FSAR should be revised to include this information as appropriate.

09.02.05-23

Follow-up to RAI 175, Question 9.2.5-05:

Standard Review Plan (SRP) 9.2.5 Section III, paragraph 1 endorses confirmation of the overall arrangement of the ultimate heat sink (UHS). The description and piping and instrumentation diagram (P&IDs) are incomplete or inaccurate and the Final Safety Analysis Report (FSAR) needs to be revised to address the following considerations:

a. Pipe sizes are not shown on the P&ID (Figure 9.2.5-1, "Ultimate Heat Sink Piping and Instrumentation Diagram"), and the system description in Section 9.2.5 does not explain the criteria that were used in establishing the appropriate pipe sizes (such as limiting flow velocities).
b. The system description in Section 9.2.5 does not provide design details such as system operating temperatures, pressures, fan speeds, and flow rates for all operating modes and alignments.
c. Figure 9.2.5-1 does not show the location of indications (e.g., local, remote panel, control room), and identify the instruments that provide input to a process computer and/or have alarm and automatic actuation functions.
d. Figure 9.2.5-1 does not show identify the normal valve positions are, identify the valves that are locked in position, and identify the valves with automatic functions; and these design features are not described in Section 9.2.5.
e. Figure 9.2.5-1 shows the UHS bypass but flow rates are not provided for low load/low ambient temperature conditions to maintain essential service water (ESW) cold water temperature within established limits.
f. The UHS fan alarms are not discussed in the FSAR.
g. Figure 9.2.5-1 does not show the cooling tower basin instruments (level and temperature).

Based on the staff's review of the applicant's response to RAI 9.2.5-05 (ID1817/6798) AREVA #175, Supplement 1, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The applicant's response for Items (d) and (g) refer to Tier 2 FSAR Section 9.2.1 for information pertaining to certain UHS valves and instruments. The description and piping and instrumentation diagram for the UHS should show those items that are part of the UHS and Tier 2 FSAR Section 9.2.5 should address these items accordingly. Likewise, Tier 2 FSAR Section 9.2.1 should describe and address those items that are designated as part of the essential service water system. Consequently, Tier 2 FSAR Sections 9.2.1 and 9.2.5 and associated figures need to be revised to clearly indicate which items are included within their respective scopes and to describe those items accordingly. The following additional items are also related to this issue:

a. Dedicated and emergency ESWS blowdown are not shown on FSAR Tier 2 Figure 9.2.5-1 as UHS support systems
b. Interface flange connections are not shown on FSAR Tier 2 Figure 9.2.5-1 for the dedicated and emergency ESWS blowdown support system.

c. FSAR Tier 2 Figure 9.2.1-1, Sheet 3, and Figure 9.2.5-1 both show that the chemical treatment system is only connected to the normal makeup system and not to the safety-related emergency makeup system. This appears to be in error and the applicant should correct or explain.

The information provided in response to Items (d) and (e) needs to be reflected in Tier 2 FSAR Sections 9.2.1 and/or 9.2.5 as appropriate.

The responses for Items (a), (b), (c), and (f) indicate that many of the design details will be developed later in the design process. Consequently, these items will remain open pending submittal of the requested information and a schedule for providing this information needs to be established.

09.02.05-24

Follow-up to RAI 175, Question 9.2.5-06:

Final Safety Analysis Report (FSAR) Tier 2 Section 9.2.5 states that the ultimate heat sink (UHS) is sized to provide adequate cooling capacity to dissipate essential service water system (ESWS) heat loads, however, insufficient information is provided to confirm this capability. Table 9.2.5-2 provides some technical information for the dual cell forced draft ESW cooling towers, but no heat rejection rate is provided that would support confirmation of sufficient cooling capability. Standard Review Plan (SRP) 9.2.5 Section III, paragraph 2.B of “Evaluation Procedures" instructs the reviewer to verify whether “the UHS can dissipate the maximum possible total heat load including that of a loss of coolant accident (LOCA) under the worst combination of adverse environmental conditions.” Provide key assumptions and inputs for the bounding design calculations that demonstrate sufficient capability and margin. Additional information that is needed includes (for example):

1. Key assumptions and inputs (including justification) for calculations that demonstrate sufficient heat rejection capability to meet maximum predicted heat loads and define the available margin with limited system temperatures and pressures. These assumptions should include sufficient margin to account for uncertainties in the analysis, anticipated degradation in performance over time, and fluctuations in the frequency of electric current. These calculations should be made available for staff audit
2. Justification for the detrmination that the wet bulb correction of 1˚F is sufficient for potential tower interferences; (FSAR Tier 2 Table 9.2.5-2).
3. Performance curves that show the minimum required tower heat rejection capability verses time (including spent fuel pool cooling) for post LOCA cooldown, and cooldown to cold shutdown conditions following a reactor trip with and without offsite power available.
4. Explanation of the monitoring of UHS heat rejection capability to ensure adequate performance over time.

Based on the staff’s review of the applicant's response to RAI 9.2.5-06 (ID1817/6799) AREVA #175, Supplement 3, the following were determined as unresolved and needed further clarification/resolution by the applicant.

Except for the information that was provided for Item 2, the response to RAI 9.2.5-06 (AREVA RAI No. 175, Supplement 3) was found to be incomplete. The response to Item 1 generally described the determination of the heat loads, but the question was focused on assuring the heat transfer capability of the cooling towers; therefore, Item 1 remains to be addressed. Also, in order to assure adequate heat transfer capability, the quality of water in the cooling tower basin must be specified and maintained in accordance with cooling tower specifications. Because blowdown for the cooling tower basins is not safety-related, maintaining the necessary water quality for 30-day post-accident, long-term cooling is a major consideration that also needs to be addressed in the response to this item. Additionally, COL information items and Tier 1 interface requirements should be established as appropriate to address this consideration.

The response for Item 3 indicated that performance curves for the cooling towers would not be available until later in the design process. The staff can not complete its evaluation of the UHS without the bounding vendor specifications and performance curves for the cooling towers. Furthermore, this information is needed in order to demonstrate adequate performance during the initial test program. Consequently, this item remains open pending submittal of the information that was requested and a schedule for providing this information needs to be established.

The response to Item 4 refers to the response that was given in AREVA RAI No. 119 for Question 9.2.1-10 (found in Supplement 4) for a description of the monitoring of the UHS to ensure adequate performance over time. The staff found that the information that was provided pertains to the essential service water system and does not address considerations that are specific to cooling towers, including the implementation of vendor recommendations. Consequently, this item will remain open pending submittal of the information that was requested and a schedule for providing this information needs to be established.

09.02.05-25

Follow-up to RAI 175, Question 9.2.5-07:

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 the proper understanding of the function and operation of the ESWS ultimate heat sink (UHS) cooling tower fans is necessary for compliance with GDC 44 since these components support the overall system safety functions including accident mitigation. Accordingly the following questions are provided:

Final Safety Analysis Report (FSAR) Tier 2 Section 9.2.5.4 states that the cooling tower fans have multi-speed drives that have the capability of operating in the reverse directions for short periods in cold weather for deicing purposes. The staff identified the following questions relative to these important components:

1. Describe the seismic class and electrical class (1E) of the fans and fan motors in Section 9.2.5.
2. Provide a description in Section 9.2.5 of bounding fan mechanical properties (e.g. capacity, speeds etc).

3. Confirm that the associated ESWS train is considered inoperable when the fans are operated in the reverse direction for deicing purposes. Confirm that reverse direction operation is bounded by Allowable Outage Times in the Technical Specifications (TS).
4. Since the fans receive an automatic signal in response to an accident, confirm that the TS will bound the scenerio of an accident occurring during reverse fan operation.
5. Provide in either FSAR Section 9.2.1 or 9.2.5 a description of UHS/ESW cooling tower fan automatic start in response to an accident.
6. Describe the selection meth for the proper fan speed during normal/ accident conditions (automatic process or a manual operator action).
7. Describe the speed at which fans on a standby train will be started in response to an accident signal and provide the normal speed for a fan that was previously in operation.
8. Describe the indications and controls for the fans provided to the operator in the main control room (MCR).
9. With respect to the non safety related (NSR) dedicated train; describe the emergency power source for the division four cooling tower fans (used by the dedicated train) during severe accidents. Similarly, describe the emergency power source for the dedicated train filter and motor operated valves. This should be identified in the FSAR.

Based on the staff's review of the applicant's response to RAI 9.2.5-07 (ID1817/6801) AREVA #175, Supplement 2, the following were determined as unresolved and needed further clarification/resolution by the applicant.

With regard to Items 1 and 3, the information that was provided needs to be reflected in Tiers 1 and 2 of the FSAR as appropriate. The procedures referred to in the response for Item 3 need to be specified in FSAR Tier 2, Chapter 13.

The response for Item 4 indicates that FSAR Tier 2, Section 9.2.5.4, will be revised to indicate that cooling tower fans operating in the reverse direction at the onset of a DBA are secured and brought to a complete stop before reenergizing to operate at full speed in the forward direction. Additional clarification in the FSAR is required to specify that these actions are automatic and do not require operator action. Also, the time it takes for the fans to achieve full speed in the forward direction and the impact of this delay on accident mitigation (either assuming all cooling tower fans are affected or this is not possible) also needs to be described in the FSAR.

The response for Items 2 and 8 indicated that the requested information would not be available until later in the design stage since it is dependent on vendor selection. Consequently, these items will remain open pending submittal of the information that was requested and a schedule for providing this information needs to be established.

09.02.05-26

Follow-up to RAI 175, Question 9.2.5-08:

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.” This function must also be met in the event of a loss of off-site power and a single failure. The staff noted that assurance of separation between safety and non-safety portions of the system is therefore necessary for compliance with GDC 44.

Final Safety Analysis Report (FSAR) Figures 2.7.11-1 (Tier 1) and 9.2.1-1 (Tier 2) show a safety/ non-safety-related interface at the outlet of safety-related cooling tower blowdown motor operated isolation valve 30PEB10/20/30/40 AA016 (typical) and emergency blowdown motor operated isolation valve 30PEB10/20/30/40 AA003. Further no mention of automatic isolation of the normal blowdown path was located by the staff in either FSAR Tier 1 Section 2.7.11 or Tier 2, Section 9.2.5 of the ultimate heat sink (UHS). This question also relates to Regulatory Position C.1 of RG 1.27, “Ultimate Heat Sink for Nuclear Power Plants”

The staff noted that it was likely that the normal cooling tower basin blowdown path will be open on more than one train during plant operation. Describe the prevention of the continued loss of basin water volume through this line in case of an accident when basin makeup may be unavailable for the first 72 hours. Describe in the FSAR if the blowdown valve automatically closes or is manually closed.

Based on the staff’s review of the applicant's response to RAI 9.2.5-08 (ID1817/6802) AREVA #175, Supplement 2, the following were determined as unresolved and needed further clarification/resolution by the applicant.

With regard to isolation of makeup water, the applicant’s description appears to attribute automatic isolation of the normal non-safety related makeup water path on DBA initiation to the “ESW emergency makeup water system.” The staff finds this terminology confusing since the normal and emergency makeup water flow paths are each provided with independent safety-related motor- operated isolation valves; 30PED10/20/30/40 AA019 (normal makeup) and AA021 (emergency makeup). For example, the proposed markup for U.S. EPR Tier 1 Section 2.7.11 states;

"The ESW emergency makeup water system and blowdown system isolation valves provide automatic isolation of the tower basins under DBA conditions to prevent loss of tower water inventory."

The staff found the above terminology is unclear since it is the “normal” non-safety-related makeup path that is subject to automatic isolation while the “emergency” makeup path is normally closed. The applicant is therefore requested to clarify the response and both associated FSAR markups to eliminate this confusion.

Also, the staff noted that guidance provided in SRP 14.3, Appendix C, paragraph II.B “System Specific ITAAC Entries,” Subparagraph vii “Initiation Logic,” may apply to these valves, which function to automatically isolate NSR piping on a safety injection signal. The subject SRP 14.3 guidance includes the following:

“If a system/component has a direct safety function it typically receives automatic signals to perform some action. This includes start, isolation, etc. The system ITAAC capture these aspects related to the direct safety function.”

Accordingly, the applicant is also requested to address the need for system ITAAC in U.S. EPR FSAR Tier 1 Section 2.7.11 for confirmation of the automatic NSR piping isolation function of the subject valves on a safety injection signal.

09.02.05-27

Follow-up to RAI 175, Question 9.2.5-09:

In order to satisfy system flow requirements, the ultimate heat sink (UHS) design must assure that the minimum net positive suction head (NPSH) for the essential service water system (ESWS) pumps will be met for all postulated conditions, including consideration of vortex formation. Standard Review Plan (SRP) 9.2.5 Section III, paragraph 3.C specifies confirmation that the maximum design cooling water temperature is not exceeded under the worst combination of adverse environmental conditions, in conjunction with a design basis accident. Final Safety Analysis Report (FSAR) Tier 2 Table 9.2.5-1 indicates the maximum required ESWS design basis accident (DBA) temperature is 35˚C (95˚F) and FSAR Tier 2 Section 16 Technical Specification Surveillance Requirement (SR) 3.7.8.2 requires UHS basin temperature during plant operation to be maintained less than or equal to 32.2˚C (90˚F). This indicates that the maximum basin temperature increase during worst case design basis conditions is 2.8˚C (5˚F). However, there is no explanation of the relationship between these temperatures or the calculation basis used to determine the 2.8˚C (5˚F) temperature increase in FSAR Section 9.2.5. As such, the following questions are provided:

1. Provide key assumptions and inputs in FSAR Section 9.2.5 for calculations that establish the basis and define design margin for the minimum basin water level, maximum basin volume loss and maximum temperature increase during the first 72 hours when basin water makeup is assumed to be lost and after the minimum makeup water flow (300 gpm) is established; include consideration of vortex formation. These calculations should be made available for staff audit
2. Provide the heat load associated with ESWS pump mechanical work and ESWS pump room cooler in this analysis. The heat loads/flows should be listed in FSAR Tier 2 Table 9.2.5-1.
3. Provide an explanation in FSAR Tier 2 Section 9.2.5 for; (1) the relationship between 32.2˚C (90˚F) and 35˚C (95˚F), (2) the analysis used to determine the accident temperature increase and why it is conservative.
4. Provided in FSAR Tier 1 Section 2.7.11 the maximum temperature for the cooling tower water volume.

Based on the staff’s review of the applicant's response to RAI 9.2.5-09 (ID1817/6804) AREVA #175, Supplement 2, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The response to Item 1 referred to FSAR Tier 2 Section 9.2.1 (AREVA RAI No. 119, Question 9.2.1-08) for establishing the minimum cooling tower basin water level. However, this information needs to be included or referenced in FSAR Tier 2 Section 9.2.5. In addition to the meteorological conditions in FSAR Tier 2 Table 2.1-3 that are referred to, the methodology and key analytical assumptions and inputs (including excess margin and conservatisms) that were used in establishing the total water usage over the most limiting 72 hour period need to be described in FSAR Tier 2 Section 9.2.5. The FSAR description needs to specify what this water volume is. Also, the minimum required cooling tower basin water level needs to be established and specified in FSAR Tier 2 Section 9.2.5 by adding the minimum required water usage volume to the minimum water level that is needed to satisfy essential service water pump NPSH and vortexing considerations. Similarly, the methodology and key analytical assumptions and inputs (including excess margin and conservatisms, and information provided in FSAR Tier 2 Table 2.1-4) that were used in establishing the maximum increase in the basin water temperature, and what this maximum temperature is, needs to be described in FSAR Tier 2 Section 9.2.5.

With regard to Item 2, the response only addressed the heat rejected by the essential service water pump air cooled motor and did not address heat input due to pump mechanical work. As noted in guidance provided by SRP 9.2.5 Paragraph III.1A, pump mechanical work is one of the UHS heat inputs considered by the design. Since the ESWS pumps are relatively large, the energy imparted to the pumped fluid as heat should be included with the other UHS heat loads. In contrast, pump motor ambient heat should be included in the ESWS pump room cooler heat load. These heat load inputs need to be described and included in the FSAR along with the other heat loads that have been identified and addressed.

With regard to Item 3, in response to part (1) the applicant explained that the UHS basin temperature is maintained less than or equal to 32.2 °C (90 °F) during normal plant operation so that the maximum UHS basin temperature for the duration of a DBA of 35 °C (95 °F) is not exceeded. The associated markup of FSAR Tier 2 Section 9.2.5 needs to be expanded to make it clear what 35 °C (95 °F) represents (e.g. the maximum design basis UHS basin temperature for the duration of a DBA). Also, the basis for all ESWS temperatures that are listed in Table 9.2.5-1 needs to be included in the FSAR Tier 2 description.

In response to part (2) of Item 3, the applicant explained that the maximum basin temperature was based on an (81 °F) wet bulb temperature with 1 percent exceedance, and that it was highly unlikely that these climate conditions could occur simultaneously with a DBA. However, the staff considers the 1 percent exceedance wet bulb temperature to be nonconservative for this application because higher temperatures that are less than two hours in duration can cause UHS temperature limits to be exceeded. Additionally, the staff noted that use of this 1 percent exceedance value appears to be inconsistent with the information provided in FSAR Tier 2 Table 2.1-4. Therefore, additional explanation and justification is needed to ensure that temperature assumptions are conservative.

09.02.05-28

Follow-up to RAI 175, Question 9.2.5-11:

General Design Criteria (GDC) 44 requires systems to transfer heat from structures, systems, and components important to safety to a ultimate heat sink under accident conditions. Fermi 2, as part of their design bases, has a nitrogen brake system to prevent overspeed from the design basis tornado. During a design basis tornado, the brake will engage and disengage a number of times. Since two groups of fan are provided for each safety related cooling tower and each cooling tower is divisionally separated, provide justification that a safety related fan braking system is not required for the design basis tornado.

Based on the staff's review of the applicant's response to RAI 9.2.5-11 (ID1817/6806) AREVA #175, Supplement 1, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The applicant's response indicated that the specific method to be used to protect the UHS (i.e., cooling tower fans) from the effects of tornado will be determined in coordination with the cooling tower manufacturer later in the design process. In addition to the impact of tornado on the cooling tower fans, especially differential pressure effects, the impact of differential pressure effects on other equipment located within the cooling tower structure (e.g., capability to function, potential to become missile/debris hazard) needs to be addressed as well. Consequently, this item will remain open pending submittal of the information that was requested and a schedule for providing this information needs to be established.

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.

09.02.05-30

Follow-up to RAI 175, Question 9.2.5-17:

Standard Review Plan (SRP) 9.2.5 Section III, paragraph 1 requires confirmation of the overall arrangement of the ultimate heat sink (UHS). The staff reviewed the descriptive information, arrangement, design features, environmental qualification, performance requirements, and interface information provided in Tier 1 Final Safety Analysis Report (FSAR) Section 2.7.11 to confirm completeness and consistency with the plant design basis as described in Tier 2 Section 9.2.5. The staff found that the Tier 1 information is incomplete, inconsistent, inaccurate, or that clarification is needed with respect to the following considerations:

a. Although the Introduction Section in Chapter 1 of the Tier 1 FSAR states that the information in the Tier 1 portion of the FSAR is extracted from the detailed information contained in Tier 2, the staff found that much of the information provided in FSAR Tier 1 is not described in Tier 2 FSAR Section 9.2.5 (e.g., equipment locations, valve functional requirements, indication and control information, priority actuation and control system description and functions, automatic actuation and interlock details, valve failure modes, and harsh environment considerations). This Tier 1 information needs to be added to Tier 2.
b. FSAR Tier 1 does not stipulate that the ultimate heat sink (UHS) is accessible for performing periodic inspections as required by General Design Criteria (GDC) 45.
c. FSAR Tier 1 does not stipulate that the UHS design provide for flow testing of makeup water for accident and emergency conditions.
d. FSAR Tier 1 does not stipulate that the essential service water system (ESWS) pumps are protected from debris from the cooling towers.
e. FSAR Tier 1 does not stipulate that the safety related UHS outdoor piping is adequately protected from the elements and postulated hazards.
f. Tier 1, Figure 2.7.11-1, “Essential Service Water System Functional Arrangement,” does not show nominal pipe sizes for the UHS, which are necessary for design certification. This table does not show design information for the UHS fans.
g. Tier 1, Table 2.7.11-2, “Essential Service Water System Equipment I&C and Electrical Design,” does not include information pertaining to the UHS fans and corresponding power supplies.

h. The point of Note 2 for Tier 1, Table 2.7.11-2 is not clear since it does not appear to pertain to anything on the table. However, this appears to be due to an oversight whereby dedicated ESWS components are not listed in the table.
i. The discussion under Item 6 Tier 1 of Table 2.7.11-2 related to environmental qualification is inconsistent with the information provided in Table 2.7.11-2 in that no equipment is listed in the table for harsh environment considerations.

Based on the staff's review of the applicant's response to RAI 9.2.5-17 (ID1817/6814) AREVA #175, Supplement 3, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The applicant's response to Item (b) focuses on inservice inspection requirements, while the question that was asked focuses on the requirement specified by 10 CFR 50, Appendix A, General Design Criterion (GDC) 45. GDC 45 requires that "the cooling water system shall be designed to permit appropriate periodic inspections of important components, such as heat exchangers and piping, to assure the integrity and capability of the system." Therefore, the capability to perform periodic inspections of important components needs to be described in FSAR Tier 2 and ITAAC need to be established to confirm this aspect of the design.

With regard to the response to Item (d), the staff does not agree that screens and filters that are solely for equipment protection are not safety significant. Filters and screens are relied upon to ensure that debris, aquatic organisms, and other material that find their way into the cooling tower basins do not adversely impact the capability of the essential service water system and ultimate heat sink to perform their safety functions. Without the screens and filters, pumps and valves can be damaged and rendered inoperable, heat exchanger tubes and cooling tower spray nozzles can become clogged, and heat transfer surfaces can become fouled. Therefore, ITAAC are needed to confirm the installation and proper mesh size of the filters and screens that are relied upon. Additionally, FSAR Tier 2 Sections 9.2.1 and 9.2.5 need to be revised to describe important filter and screen design specifications such as maximum allowed differential pressure and mesh size, including the bases for these specifications.

The response to Item (e) indicates that the UHS does not have any safety-significant outdoor piping within the scope of design certification. Based on this, the staff agrees that ITAAC are not needed to confirm adequate protection of exposed equipment. However, ITAAC are needed to confirm that ESWS and UHS piping and components are not exposed to the elements and postulated hazards. Additionally, based upon further review, the staff found that additional information needs to be included in the FSAR to address freeze protection considerations, especially for divisions that are in standby and for those parts of the cooling tower that are exposed and vulnerable to cold weather conditions.

The response to Item (f) refers to a response that was provided to RAI 9.2.1-22 (AREVA RAI No. 119, Supplement 1). The response indicates that line sizing details will be identified later in the design process. Consequently, this item remains open pending submittal of the information that was requested and a schedule for providing this information needs to be established.

In response to second part of Item (f), the applicant stated that design information for the UHS fans will be added to FSAR Tier 1, Table 2.7.11-2, "Essential Service Water

System Equipment I&C and Electrical Design," as part of the response to Item (g) of this RAI. The staff noted that the FSAR markup of Table 2.7.11-2 does not specify alternate power supplies for the two fans in Essential Service Water (ESW) Building 4. In this regard, additional information is needed to explain why an alternate power source is not specified for the ESW Building 4 cooling tower fans since they are necessary to support operation of the dedicated ESW train. The dedicated ESW train is provided to mitigate accidents that are beyond the design basis when normal backup power may not be available. Therefore, the applicant should specify an alternate power source for these fans similar to that shown for several other dedicated ESW train components in FSAR Tier 1 Table 2.7.11-2.

09.02.05-31

Follow-up to RAI 175, Question 9.2.5-18:

Standard Review Plan (SRP) 9.2.5 Section III, paragraph 1 requires confirmation of the overall arrangement of the ultimate heat sink (UHS). The staff reviewed the information provided in Tier 1, Table 2.7.11-3, "Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)," to confirm that the proposed ITAAC are adequate for EPR design certification. However, the staff found that the proposed ITAAC are incomplete, inconsistent, inaccurate, or that clarification is needed as follows:

1. Item 2.1 only refers to functional arrangement, but it should refer to functional arrangement and design details since nominal pipe size is an important consideration that needs to be verified, as it pertains to the ultimate heat sink (UHS).

2. Item 2.3 is incomplete in that it does not address physical separation criteria for outdoor piping and components such as for the UHS fans.

3. Provide an ITAAC for the UHS/ESW fans are (proper accident response, operating capability in various speeds including reverse).

4. Need to include under several existing item, such as 7.1, the performance of the UHS fans since neither the UHS fans are listed under Tables 2.7.11-2 or 2.7.11-3. Quantitative acceptance criteria need to be established for all ITAAC as applicable (flow rates, heat transfer rates, completion times, etc.).

Based on the staff's review of the applicant's response to RAI 9.2.5-18 (ID1817/6816) AREVA #175, Supplement 2, the following were determined as unresolved and needed further clarification/resolution by the applicant.

With regard to Item 3, the staff does not agree with the assertion that fan performance is not safety significant. In fact, fan performance is critical for establishing the cooling tower heat removal capability that is necessary to satisfy accident analysis assumptions. Therefore, an ITAAC is necessary to confirm that fan performance in high speed (with one fan operating separately and with both fans operating simultaneously) satisfies the manufacturer's specifications for the cooling tower design. An ITAAC is also needed to confirm that both cooling tower fans operating simultaneously through all speed combinations (including reverse) will not result in unacceptable vibrations or other deleterious conditions. Additionally, Standard Review Plan Section 14.3, Appendix C, Paragraph II.B.vii, entitled, “Initiation Logic,” states: “If a system/component has a direct safety function it typically receives automatic signals to perform some action. This includes start, isolation, etc. The system ITAAC capture these aspects related to the direct safety function…” Therefore, an ITAAC is also needed to confirm proper fan response to an accident.

Also, based on further review of the ITAAC that are proposed in FSAR Tier 1 Section 2.7.11, Table 2.7.11-3, “Essential Service Water System ITAAC,” the staff identified the following additional items that need to be addressed:

a. An ITAAC is needed to confirm the seismic adequacy of the cooling towers and their component parts (fill material, nozzles, wind drift eliminators).

b. With regard to the ITAAC that are specified by Item 7.1, the commitment refers to the “ESW UHS as listed in Table 2.7.11-1.” Table 2.7.11-1 includes all of the mechanical equipment that is included in the essential service water system (ESWS), but does not include the cooling towers, components that are included in the cooling tower design, and the cooling tower basins. Therefore, the UHS part of the ESWS is not really listed in Table 2.7.11-1 and it is not clear what this commitment means and what is actually being accomplished by this ITAAC. Consequently, additional thought is required to establish ITAAC that are meaningful and appropriate for the ESWS and UHS designs. Along these lines, ITAAC need to be established to confirm that important design specifications and features have been properly implemented (to the extent that they have not been established elsewhere). For example, inspections should be conducted to confirm that the cooling towers have been constructed in accordance with manufacturer drawings and specifications (e.g., elevations, dimensions, materials, piping, fill, wind drift eliminators, spray nozzles). Likewise, ITAAC are needed to confirm that the cooling tower basins have been constructed in accordance with design specifications (e.g., elevations, dimensions, materials, screens, penetrations). Also, ITAAC should be established for the ESWS (e.g., elevations, materials, height of pump impeller above the bottom of the basin, valve and pipe sizes, pump specifications, heat exchanger specifications, filter size and specifications).

c. The ITAAC specified by Item 7.2 should be revised to also recognize vortex effects since this is more limiting than net positive suction head considerations.

d. The acceptance criteria for the ITAAC specified by Item 7.6 should be revised to indicate that the required flow rate is “greater than or equal to” the value specified.

e. An ITAAC needs to be established to confirm that the cooling towers, with the minimum specified water inventory available and for the most limiting conditions that are assumed for heat removal, are capable of removing the design-basis heat load without exceeding the maximum specified temperature limit for ESWS. A transient analysis should be completed by qualified individuals with the results documented in a report that includes performance curves for the cooling towers being used for the specific conditions of interest, such as limiting meteorology, initial water volume and quality, no filter backwash and blowdown, and no makeup or blowdown flow for the initial 72 hours. After 72 hours, makeup water of specified flow rate and water quality is provided for the remainder of the 30 day period, but no blowdown or filter backwash is provided consistent with design basis assumptions. The report should show how the water temperature in the cooling tower basin will trend over time; and the effect of concentrated impurities in the cooling tower basin on ESWS flow rate and cooling tower performance, and how the water quality at the end of the 30 day period compares with manufacturer's specifications, should be assessed. The report should include a listing of the limiting assumptions and inputs that were used, as well as an uncertainty analysis that demonstrates conservative results. The qualifications of the individuals performing the analysis and independent verification, and their certification of the accuracy of the information in the report should also be included, as well as a discussion of the analytical methods and modeling that were used, and a listing of references that are pertinent to the analysis that was performed.

f. An ITAAC needs to be established to confirm that the cooling towers, with the minimum specified water inventory available and for the most limiting conditions that are assumed for water usage, are capable of removing the design basis heat load without the water inventory dropping below the minimum required level in the cooling tower basin. A report similar to the one referred to in (e) above should be prepared demonstrating acceptable performance. Note that because water usage is higher in this case, impurities in the water will be more concentrated at the end of the 30 day period and may have a more severe impact on ESWS flow rate and cooling tower performance.

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.

09.02.05-33

Follow-up to RAI 175, Question 9.2.5-20:

10 CFR 52.47(a)25 relates to requirements for site specific items to be identified by the design certification (DC) applicant that must be addressed by the combined operating license (COL) applicant.

1. As a result of this review the staff recommended the addition of a new item to address the final selection of ultimate heat sink (UHS) system piping materials. Accordingly, Final Safety Analysis Report (FSAR) Tier 2 paragraph 9.2.5.3.2 indicates that system materials are selected that are suitable to the site location, UHS fluid properties and site installation. The staff noted that for some site locations the selection of service water system materials in combination with chemical treatment and ongoing inspection programs have proven to be essential for continued assurance of system integrity. Accordingly, the staff recommended that a new COL item be added to FSAR Tier 2 Table 1.8-2, "U.S. EPR Combined License Information Items," that states "A COL applicant that references the U.S. EPR Design Certification will identify the site specific

materials selected for UHS piping and components, including the bases for the selections."

2. The staff noted in FSAR Tier 2, Section 9.2.5.2, "System Description" several COL items including UHS makeup water, blowdown and chemical treatment for the control of bidfouling. In accordance with 10 CFR52.47, part 24 a conceptual design of makeup water and blowdown is needed in order to aid the staff it is review and to determine the adequacy of the interface requirements.

3. The staff has identified that Item 2.3-10 which states "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". This item may need clarification due to Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plant", Rev 2, Jan 1976, Section C3, which states in part the UHS should consist of at least two highly reliable water sources.

Based on the staff's review of the applicant's response to RAI 9.2.5-20 (ID1817/7156) AREVA #175, Supplement 2, the following were determined as unresolved and needed further clarification/resolution by the applicant.

In general, the staff found that the conceptual design information that was provided was not sufficiently detailed to demonstrate how NRC regulations and review criteria (such as Regulatory Guide 1.27) are satisfied by the conceptual design. The descriptive information should include the design-bases for the UHS support systems and explain how they are achieved for the certified design, including how applicable NRC requirements and review criteria are satisfied by the conceptual designs. The descriptive information and figures should clearly indicate what parts (if any) are included within the scope of the certified design (the staff noted that this distinction was not made on proposed Figure 9.2.5-2). Based on this more detailed description, Tier 1 interface requirements should be established as appropriate. Therefore, both the descriptive information and the figure that was provided need to be revised accordingly.

09.02.05-34

Follow-up to RAI 175, Question 9.2.5-12:

General Design Criteria (GDC) 45 requires the ultimate heat sink (UHS) to be designed so that periodic inspections of piping and components can be performed to assure that the integrity and capability of the system will be maintained over time. The staff finds the design to be acceptable if the Final Safety Analysis Report (FSAR) describes inspection program requirements that will be implemented and are considered to be adequate for this purpose. While Tier 2 FSAR Section 9.2.5.6 indicates that periodic inspections will be performed, the extent and nature of these inspections and procedural controls that will be implemented to assure that the UHS is adequately maintained over time were not described. Furthermore, the accessibility and periodic inspection safety related buried piping and the cooling tower spray header system and tower fill is of particular interest. Consequently, additional information needs to be provided in the FSAR to describe the extent and nature of inspections that will be performed and procedural controls that will be implemented commensurate with this requirement.

Based on the staff's review of the applicant's response to RAI 9.2.5-12 (ID1817/6807) AREVA #175, Supplement 1, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The applicant's response indicated that the extent and nature of periodic inspections of piping and components that will be performed, and the procedural controls that will be implemented to assure that the UHS is adequately maintained over time, will be developed later in the design process. Consequently, this item will remain open pending submittal of the information that was requested and a schedule for providing this information needs to be established.

09.02.05-35

Follow-up to RAI 175, Question 9.2.5-13:

General Design Criteria (GDC) 46 requires the ultimate heat sink (UHS) to be designed so that periodic pressure and functional testing of components can be performed to assure the structural and leak tight integrity of system components, the operability and performance of active components, and the operability of the system as a whole and performance of the full operational sequences that are necessary for accomplishing the UHS safety functions. The staff finds the design to be acceptable if the Final Safety Analysis Report (FSAR) describes pressure and functional test program requirements that will be implemented and are considered to be adequate for this purpose. While Tier 2 FSAR Section 9.2.5.6 indicates that periodic testing will be performed, the extent and nature of these tests and procedural controls that will be implemented to assure continued UHS structural and leak tight integrity and system operability over time were not described. Consequently, additional information needs to be provided in the FSAR to describe the extent and nature of testing that will be performed and procedural controls that will be implemented commensurate with this requirement.

Based on the staff's review of the applicant's response to RAI 9.2.5-13 (ID1817/6808) AREVA #175, Supplement 2, the following were determined as unresolved and needed further clarification/resolution by the applicant.

The applicant's response is incomplete in that it did not address the extent and nature of testing that will be performed and procedural controls that will be implemented to periodically confirm that the cooling towers remain capable of removing the design-basis heat load over time, including confirmation that the limiting assumptions remain valid. Also, based upon further review, the staff determined that cooling tower design details, such as manufacturer specifications and recommendations, performance characteristics, drawings showing overall dimensions, and manufacturer recommendations regarding operation, maintenance and upkeep need to be evaluated. Consequently, additional information needs to be provided and reflected in the FSAR as appropriate to fully address this question.

09.05.01-75

Follow-up to RAI 20, Question 09.05.01-35

RAI Question 09.05.01-35 response added new FSAR Section 9.5.1.2.2, "Alternate Compliance with Regulatory Guide 1.189." Alternate compliance is provided due to lack of automatic fire suppression for electrical cable systems and electrical cabinets and a lack of detection for inside cabinets outside of the MCR. RAI Question 09.05.01-35 response stated that the basis for this is as follows:

> The U.S. EPR is a four divisional design. Generally, each of the four divisions outside of the MCR and the Reactor Building are in divisional Safeguard Buildings separated from each other by 3 hour fire-rated barriers. Fire detection is provided in areas containing cables important to safety. Cable trays are accessible for manual fire fighting and manual hose stations and portable extinguishers are provided throughout the facility. Area smoke detection is provided where electrical cabinets are located and manual hose stations and portable extinguishers are provided throughout the facility. Spatial separation is provided between cabinets.
>
> Having each safety division in fully separated buildings from redundant divisions and the fact that there are four safety divisions make it possible for the loss of any one division not to impact safe shutdown capability. There is a high probability that even with loss of one division from fire an extra division beyond the minimum required for safe shutdown will be available.

As stated above the four divisional buildings design concept exception is generally valid. The MCR, Cable Floor, MCR Under Floor Area, RSS Area, and Reactor Building are identified exceptions to the above. The applicant needs to verify if other areas of the plant that are important to safety and that are also subdivided in four divisions such as the Essential Service Water Buildings and the Emergency Power Generating Buildings also follow the above suppression and detection design identified for the Safeguards Buildings.

For fire protection systems (FPSs) or features out of- service or impaired in areas such as the Safeguards Buildings one division out of four will be out of service. For this one division out of service the licensee would follow technical specifications (TS) which, for example, for one EDG or one ESW division out of service there is 120 days to restore to service. However, since 120 days is about one third of a year, compensatory actions should be in place when one or more divisions are out of service since a fire in one of the other functional divisions assuming 1 division is out of service would only leave the minimum of 2 functional divisions which would remove any defense in depth that the third functional division gave and remove the basis for this exception or alternate compliance to RG 1.189. FSAR Section 9.5.1.4 states "The FPP addresses the inspection, testing, and maintenance of FPSs and features. Disabled or impaired FPSs and features are controlled by a permit system. Procedures and practices also establish appropriate compensatory actions for FPSs or features out of service or impaired." The applicant needs to be more specific when compensatory actions are to be in place especially for areas where a third available train is being credited as defense in depth to justify an exception or alternate compliance to RG 1.189.

The applicant also needs to identify for areas of the plant that are not separated into four divisional buildings such as the Nuclear Auxiliary Building, and other areas important to safety not specifically identified in RG 1.189, such as the Turbine Building, Diesel Generator Rooms, Pump Rooms, etc, what suppression and detection criteria will be used for electrical cable systems and electrical cabinets since the four divisional buildings exception criteria is not applicable.

Additionally, for systems/components that are not physically separated into four separate divisions each in its own divisional building such as MSIVs, Feedwater, atmospheric dump valves (main steam to atmosphere), Emergency Feedwater, Letdown, Charging, and Reactor and Pressurizer Head relief valves and vent valves, the applicant needs to describe how safe-shutdown is achieved. Specifically, the applicant needs to identify how safe shutdown is achieved for a fire that leaves any of the safe-shutdown equipment associated with the above systems inoperable. As an example, the applicant should describe how safe shutdown is achieved for a fire in a MSIV room that leaves the applicable MSIV valve inoperable due to hot shorts that could prevent the MSIV from closing. The applicant also needs to relate how the buildings these systems are located in relate to the above issue of what suppression and detection criteria will be used for electrical cable systems and electrical cabinets since the four divisional buildings exception criteria is not applicable.