ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Wednesday, October 06, 2010 6:16 PM
To: Tesfaye, Getachew
Cc: Miernicki, Michael; GARDNER Darrell (AREVA); RYAN Tom (AREVA); Hearn, Peter; ROMINE Judy (AREVA); KOWALSKI David (AREVA); PATTON Jeff (AREVA)
Subject: FW: PUBLIC - Draft Responses to RAI 351
Attachments: Batch 351_Response Package_100510 (PUBLIC).pdf

For tomorrow's chapter 9 call.

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From: GARDNER Darrell (RS/NB)
Sent: Wednesday, October 06, 2010 5:55 PM
To: BRYAN Martin (External RS/NB)
Subject: PUBLIC - Draft Responses to RAI 351

Marty,
please transmit the enclosed draft responses for RAI 351. This package represents a compilation of the individual questions and responses that have been discussed and is provided to facilitate discussions on tomorrow's Chapter 9 call. Note the page 16 of this package contains security sensitive material which has been redacted within this package. A separate email will be provided with the Security Sensitive version.

Note that the response to Question 29 has not yet been provided and will be discussed separately.

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Director, U.S. EPR Licensing Projects
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Response to

Request for Additional Information No. 351, Supplement 2

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 09.02.05-22:

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.

Response to Question 09.02.05-22:

In accordance with Section 3.4.3.9 of the U.S. EPR FSAR, as modified by response to RAI 218 Question 03.04.01-12, the Essential Service Water Pump Buildings (ESWPB) are physically separated by division and connected to their respective cooling tower. The flooding analysis considers a postulated pipe failure in the Essential Service Water System (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 of the U.S. EPR FSAR, 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.

The non-safety-related dedicated ESW system would not be operating during a DBA; therefore, it is not a source of flooding.

As indicated in U.S. EPR FSAR Tier 2, Section 9.2.5.3, the UHS blowdown is automatically secured by safety-related valves during the initial 72-hour post accident period. The non-safety-related ESW blowdown piping and debris removal piping inside Essential Service Water Pump Buildings (UQB) and downstream of isolation valves 30PEB 10/20/30/40 AA015, AA016 are shut-off from the ESW pump discharge which is the pressure source that could cause flooding. Therefore, the non-safety-related ESW blowdown piping and debris removal piping inside Essential Service Water Pump Buildings (UQB) is not a source of flooding.

As indicated in U.S. EPR FSAR Tier 2, Section 9.2.5.5, “the cooling towers must 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.” The normal makeup water system would not be operating during a DBA. Any required make-up would be provided by the safety-related emergency makeup system. Also the water from a break of normal makeup water system would overflow into the UHS basin where it would be maintained by UHS water level control features so as not to render the associated train of UHS inoperable. Therefore, the non-safety-related ESW normal makeup water piping upstream of isolation valves 30PED10/20/30/40 AA019 and the chemical treatment piping are not a flooding concern.

In the event of torrential rains and hurricanes, water can enter the UHS tower basin only through the air inlet opening (air intake) and air outlet opening (fans) area of the cooling tower portions of the ESW buildings. Refer to Figure 3.8-95 through Figure 3.8-102 of the U.S. EPR FSAR for details of the ESW building layout.

The makeup water flow to the cooling tower basin automatically stops once the water level in the cooling tower basin rises to the pre-set high limit in either an operating or standby division. If the water level in the cooling tower basin continues to rise, an alarm will alert the operator at the high level. Operator action will be performed to remove water from the cooling tower basin through the use of the safety related emergency blowdown to maintain normal water level. Additionally based on Figure 3.8-101, there is approximately four feet of height available from the high water level alarm setpoint to the bottom of door that forms the first point of entry into the ESW pump room.

As shown in the revised FSAR Figure 9.2.1-1 the complete emergency blowdown flow path is classified as safety related to assure its functional availability during any design basis event. The emergency blowdown discharges outside of the building and is located above the flood level. The emergency blowdown pipe exiting the building is protected from tornado generated missiles by the building structure.

Based on the above, 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.

To ensure the function of the safety related filter, an alternate safety related filter blowdown path is provided as shown in the FSAR Figure 9.2.1-1 being revised. The new line includes valve 30PEB10/20/30/40AA004, Filter Emergency Blowdown Isolation Valve.

FSAR Impact:

The following parts of the U.S. EPR FSAR will be revised as described in the response and indicated in the attached markup.

Tier 1, Table 2.7.11-1

Tier 1, Table 2.7.11-2

Tier 1, Figure 2.7.11-1, Sheets 1-4

Tier 2, Table 3.2.2-1

Tier 2, Table 3.9.6-2

Tier 2, Figure 3.8-101

Tier 2, Table 3.10-1

Tier 2, Table 3.11-1

Tier 2, Section 9.2.1.3.3

Tier 2, Section 9.2.1.7

Tier 2, Figure 9.2.1-1, Sheet 1

Tier 2, Section 9.2.5.3.1

Tier 2, Section 9.2.5.5

Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design (8 Sheets)

~~Equipment~~ Description	~~Equipment~~ Tag Number [1]	~~Equipment~~ Location	ASME Code Section III	Function	Seismic Category
ESWS Pump Division 1	30PEB10AP001	ESW Pump Structure Division 1	Yes	Run	I
Recirc Isolation Valve Division 1	30PEB10AA002	ESW Pump Structure Division 1	Yes	Close	I
Emer. Blowdown Isolation Valve Division 1	30PEB10AA003	ESW Pump Structure Division 1	Yes	Close	I INSERT /
Pump Discharge Isolation Valve Division 1	30PEB10AA005	ESW Pump Structure Division 1	Yes	Open	I
Filter Blowdown Isolation Valve Division 1	30PEB10AA015	ESW Pump Structure Division 1	Yes	Close	I
Blowdown Isolation Valve Division 1	30PEB10AA016	ESW Pump Structure Division 1	Yes	Close	I
Pump Discharge Check Valve Division 1	30PEB10AA204	ESW Pump Structure Division 1	Yes	Open	I
Tower Isolation Valve Division 1	30PED10AA010	ESW Pump Structure Division 1	Yes	Open	I
Tower Bypass Isolation Valve Division 1	30PED10AA011	ESW Pump Structure Division 1	Yes	Close	I
Makeup Water Isolation Valve Division 1	30PED10AA019	ESW Pump Structure Division 1	Yes	Close	I

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INSERT for RAI 351 Q 09.02.05-22

INSERT 1 -- Table 2.7.11-1

Description	Tag Number	Location	ASME Code Section III	Function	Seismic Category
Filter Emergency Blowdown Isolation Valve Division 1	30 PEB10 AA004	ESW Pump Structure Division 1	Yes	Open	I
Filter Emergency Blowdown Isolation Valve Division 2	30 PEB20 AA004	ESW Pump Structure Division 2	Yes	Open	I
Filter Emergency Blowdown Isolation Valve Division 3	30 PEB30 AA004	ESW Pump Structure Division 3	Yes	Open	I
Filter Emergency Blowdown Isolation Valve Division 4	30 PEB40 AA004	ESW Pump Structure Division 4	Yes	Open	I

Table 2.7.11-2—Essential Service Water System Equipment I&C and Electrical Design (6 Sheets)

~~Equipment~~ Description	~~Equipment~~ Tag Number (1)	~~Equipment~~ Location	IEEE Class 1E (2)	PACS	MCR/RSS Displays	MCR/RSS Controls
ESWS Pump Division 1	30PEB10AP001	ESW Pump Structure Division 1	Division 1	Yes	On-Off/ On-Off	Start-Stop/ Start-Stop
Recirc Isolation Valve Division 1	30PEB10AA002	ESW Pump Structure Division 1	Division 1	Yes~~No~~	Pos/N/A	Open-Close/N/A
Emer. Blowdown Isolation Valve Division 1	30PEB10AA003	ESW Pump Structure Division 1	Division 1	Yes~~No~~	Pos/N/A	Open-Close/N/A INSERT 2
Pump Discharge Isolation Valve Division 1	30PEB10AA005	ESW Pump Structure Division 1	Division 1	Yes	Pos/Pos	Open-Close/Open-Close
Filter Blowdown Isolation Valve Division 1	30PEB10AA015	ESW Pump Structure Division 1	Division 1	Yes~~No~~	Pos/N/A	Open-Close/N/A
Blowdown Isolation Valve Division 1	30PEB10AA016	ESW Pump Structure Division 1	Division 1	Yes~~No~~	Pos/N/A	Open-Close/N/A
Tower Isolation Valve Division 1	30PED10AA010	ESW Pump Structure Division 1	Division 1	Yes~~No~~	Pos/N/A	Open-Close/N/A
Tower Bypass Isolation Valve Division 1	30PED10AA011	ESW Pump Structure Division 1	Division 1	Yes~~No~~	Pos/N/A	Open-Close/N/A
Makeup Water Isolation Valve Division 1	30PED10AA019	ESW Pump Structure Division 1	Division 1	Yes~~No~~	Pos/N/A	Open-Close/N/A

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INSERT for RAI 351 Q 09.02.05-22

INSERT 2 -- Table 2.7.11-2

Description	Tag Number	Location	IEEE Class 1E	PACS	MCR/RSS Displays	MCR/RSS Controls
Filter Emergency Blowdown Isolation Valve Division 1	30 PEB10 AA004	ESW Pump Structure Division 1	Division 1	Yes	Pos/NA	Open-Close/N/A
Filter Emergency Blowdown Isolation Valve Division 2	30 PEB20 AA004	ESW Pump Structure Division 2	Division 2	Yes	Pos/NA	Open-Close/N/A
Filter Emergency Blowdown Isolation Valve Division 3	30 PEB30 AA004	ESW Pump Structure Division 3	Division 3	Yes	Pos/NA	Open-Close/N/A
Filter Emergency Blowdown Isolation Valve Division 4	30 PEB40 AA004	ESW Pump Structure Division 4	Division 4	Yes	Pos/NA	Open-Close/N/A

Figure 2.7.11-1—Essential Service Water System Functional Arrangement
Sheet 1 of 9

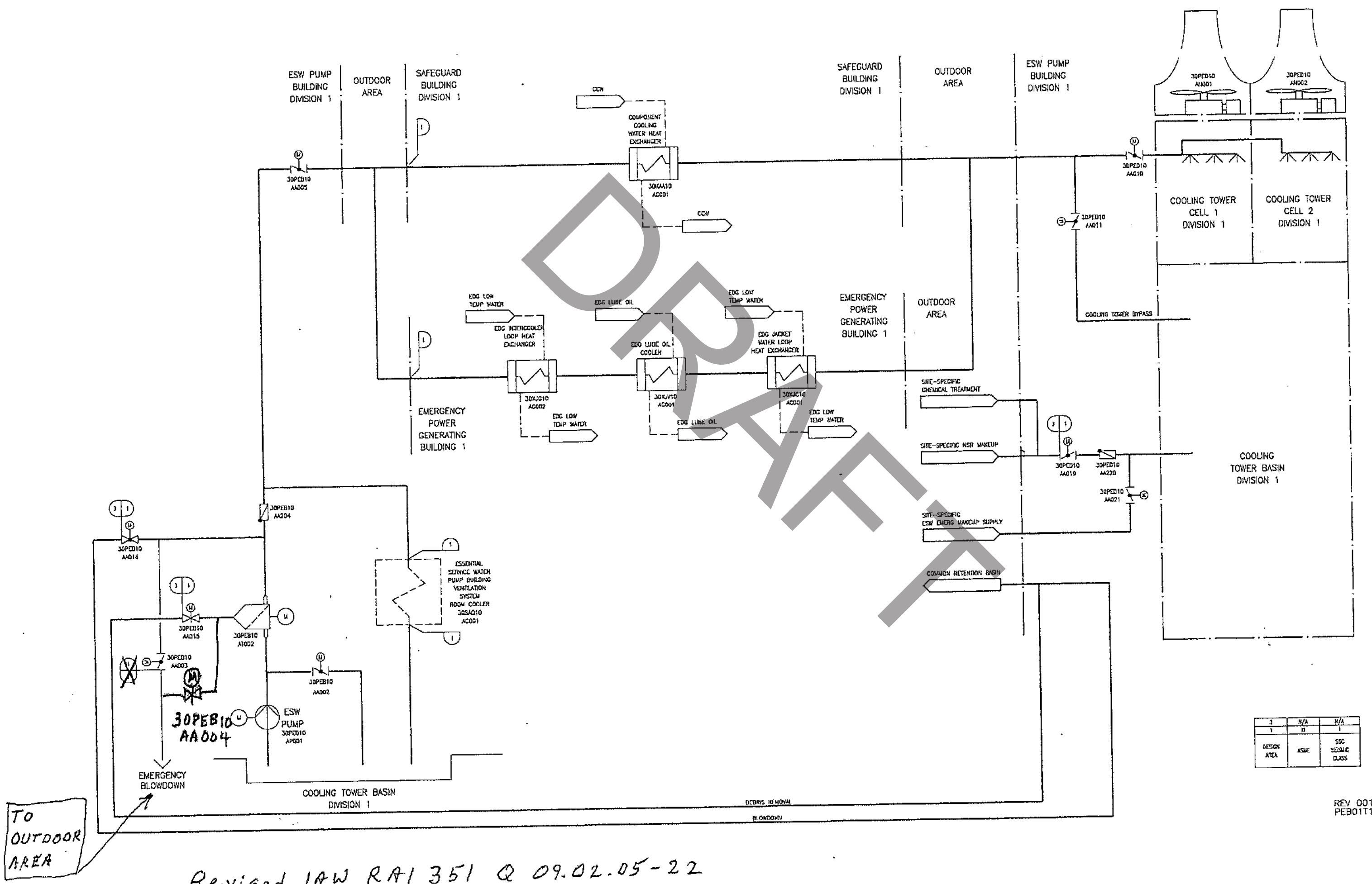

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Figure 2.7.11-1—Essential Service Water System Functional Arrangement
Sheet 2 of 9

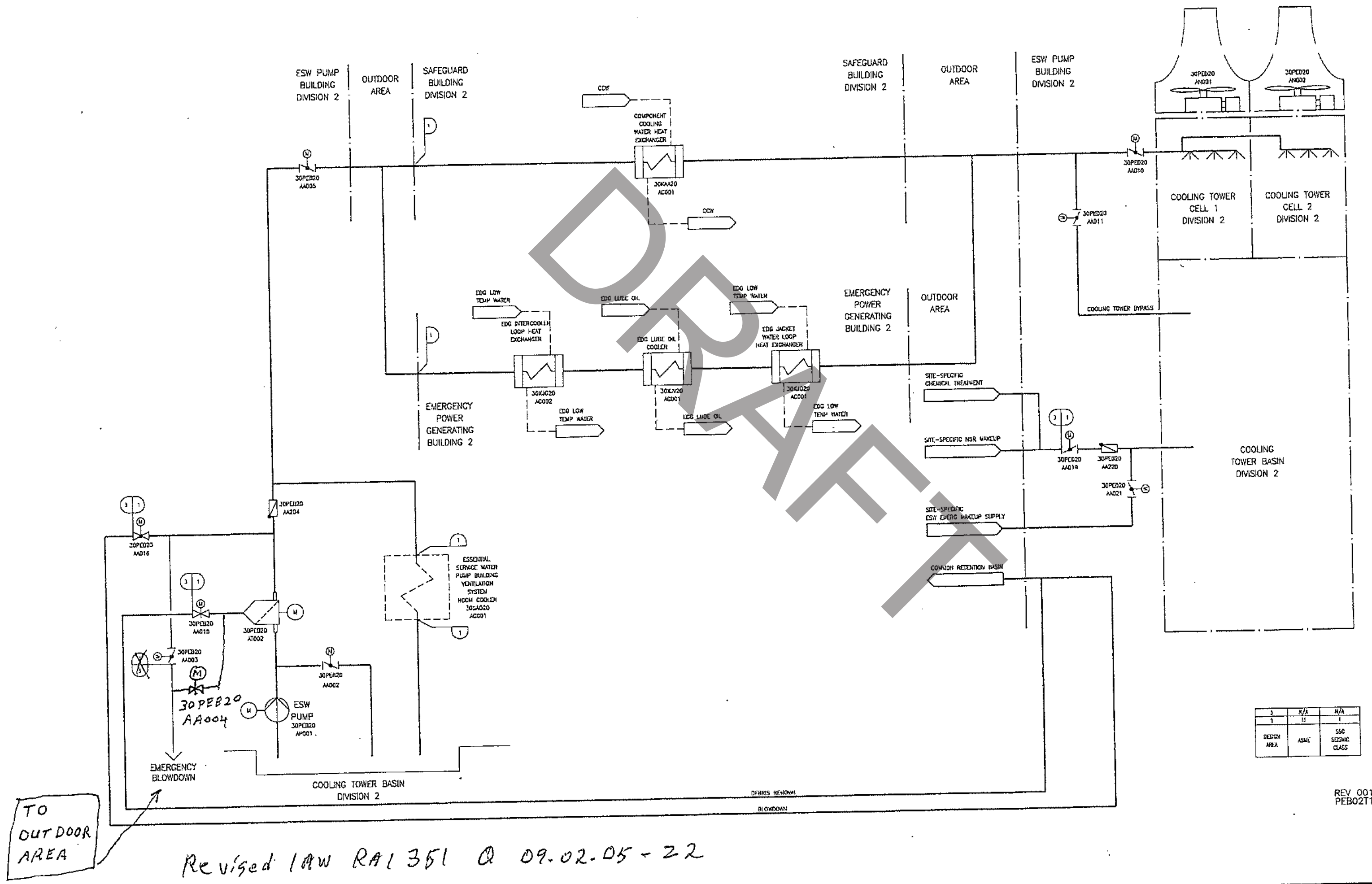

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Figure 2.7.11-1—Essential Service Water System Functional Arrangement
Sheet 3 of 9

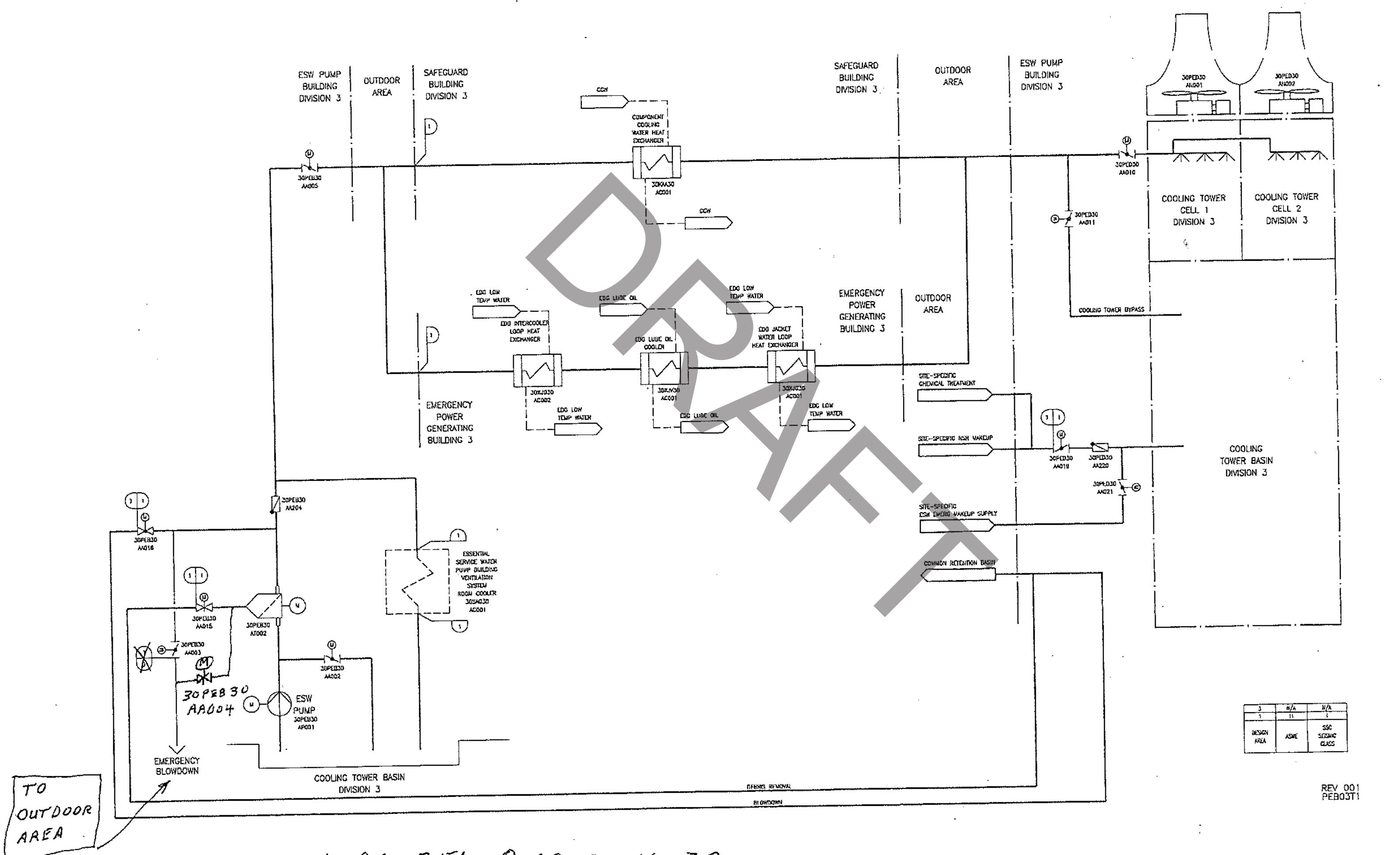

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Figure 2.7.11-1—Essential Service Water System Functional Arrangement
Sheet 4 of 9

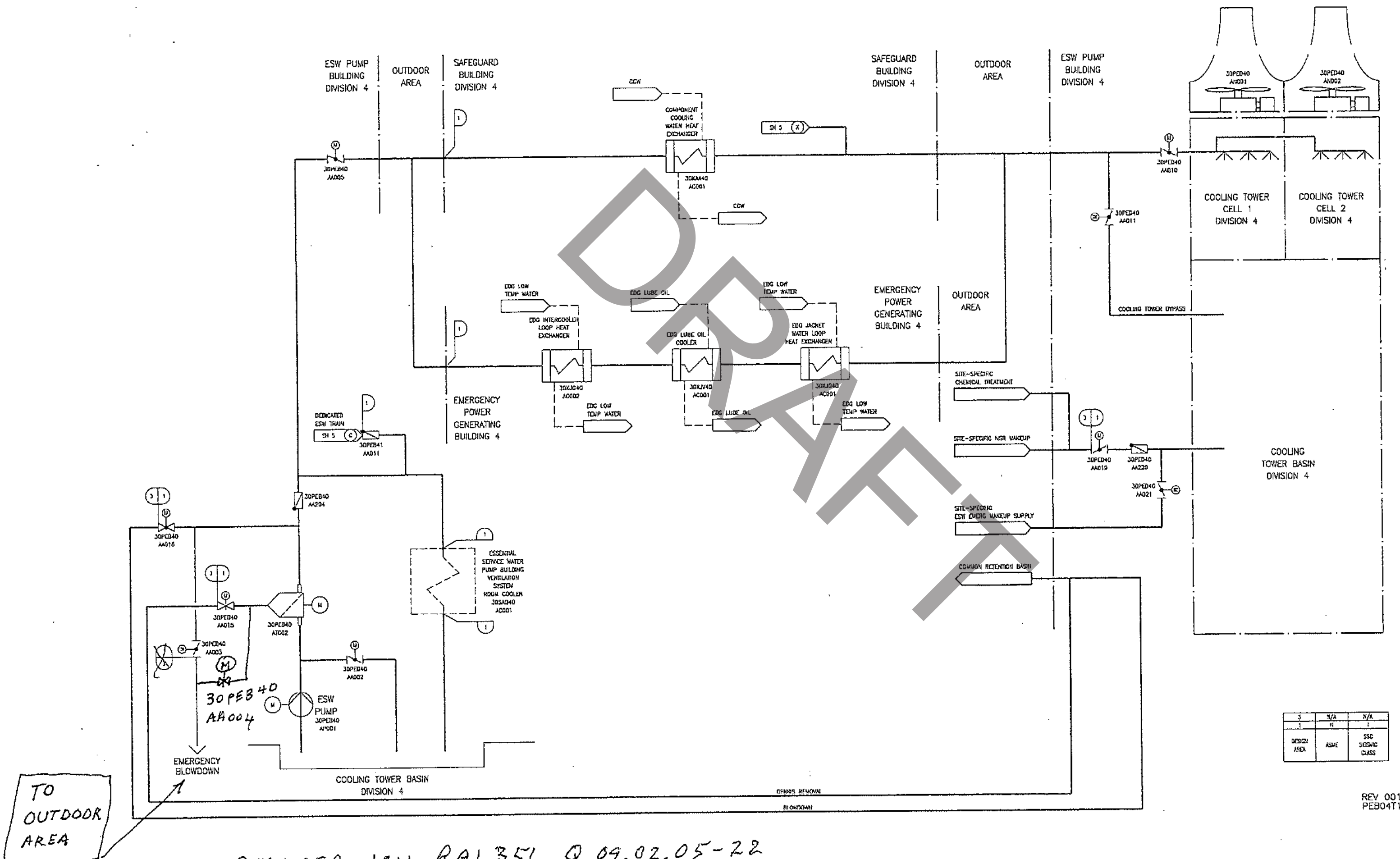

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Table 3.2.2-1—Classification Summary
Sheet 94 of 182

KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
PEB80	Dedicated ESW Valves	NS	E	NSC	No	4UQB, UJH	ANSI/ASME B31.1[6]
PEB10/20/30/40	ESW Blowdown Piping Outside UQB	NS	E	NSC	No	UZT	ANSI/ASME B31.1[6]
30PEB10/20/30/40 AA003	ESW Blowdown Isolation Valve	S	C	I	Yes	UQB	ASME Class 3[3]
30PEB10/20/30/40 AA015/016	ESW Blowdown Isolation Valve	S	C	I	Yes	UQB	ASME Class 3[3]
PEB10/20/30/40	ESW Blowdown Piping inside UQBs and downstream of Isolation Valves 30PEB 10/20/30/40 ~~AA003~~, AA015, AA016	NS	E	NSC	No	UQB	ANSI/ASME B31.1[6]
PEB10/20/30/40	ESW Blowdown Piping upstream of Isolation Valves 30PEB 10/20/30/40 ~~AA003,~~ AA015, AA016	S	C	I	Yes	UQB	ASME Class 3[3]
30PED10/20/30/40 AA022	ESW Chemical Treatment System Isolation Valves	NS	E	NSC	No	UQB	ANSI/ASME B31.1[6]

INSERT 3

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Table 3.9.6-2—Inservice Valve Testing Program Requirements
Sheet 78 of 102

Valve Identification Number[1]	Description/ Valve Function	Valve Type[2]	Valve Actuator[3]	ASME Code Class[4]	ASME OM Code Category[5]	Active / Passive[6]	Safety Position[7]	Test Required[8,10]	Test Frequency[9]	Comments
30LBA43AA101	Main Steam Relief Control Valve	GB	MO	2	A	A	O/C	ET ST LT PI	Q Q 2Y 2Y	
30LBA11AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30LBA21AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30LBA31AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30LBA41AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30LBA12AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30LBA22AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30LBA32AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30LBA42AA191	Main Steam Safety Valve	RV	SA	2	A/C	A	O/C	ET LT	5Y 5Y	
30PEB10AA002	Recirc Isolation PEB10 AP001	BF	MO	3	B	A	C	ET PI	Q 2Y	
30PEB10AA003	Emergency Blowdown Isolation PEB10	BF	MO	3	~~B~~A	A	C	ET PI LT	Q 2Y 2Y	

INSERT 4

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INSERT 3 -- Table 3.2.2-1

30PEB10/20/30/40AA004	ESW Filter Emergency Blowdown Isolation Valve	S	C	I	Yes	UQB	ASME Class 3[3]
PEB10/20/30/40	Emergency Blowdown and Emergency Debris Filter Blowdown Piping to its terminal end outside of wall of UQB.	S	C	I	Yes	UQB	ASME Class 3[3]

INSERT 4 -- Table 3.9.6-2

30PEB10AA004	Filter Emergency Blowdown Isolation Valve	GT	MO	3	A	C	ET PI LT	Q 2Y 2Y	
30PEB20AA004	Filter Emergency Blowdown Isolation Valve	GT	MO	3	A	C	ET PI LT	Q 2Y 2Y	
30PEB30AA004	Filter Emergency Blowdown Isolation Valve	GT	MO	3	A	C	ET PI LT	Q 2Y 2Y	
30PEB40AA004	Filter Emergency Blowdown Isolation Valve	GT	MO	3	A	C	ET PI LT	Q 2Y 2Y	

Figure 3.8-101—Essential Service Water Building Section A-A

Table 3.10-1—List of Seismically and Dynamically Qualified Mechanical and Electrical Equipment
Sheet 88 of 204

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID (Room Location)	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)	Safety Class (Note 4)	EQ Program Designation (Note 5)
T Dnstr CVCS HP Cl2	30KAB70CT082	30UJA11016	H	H	SI	S C/NM	Y (4) Y (5)
V 1 Upstr *QN* Users	30KAB80AA015	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V 2 Upstr *QN* Users	30KAB80AA016	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V Dnstr *QN* Users	30KAB80AA019	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
CK-V Rten Com 1B NC	30KAB80AA020	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V F KAB80 CF060	30KAB80AA314	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V F KAB80 CF060	30KAB80AA315	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V F KAB80 CF061	30KAB80AA316	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V F KAB80 CF061	30KAB80AA317	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
D-V Sup Com1B NC	30KAB80AA403	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
D-V Retn Com1B NC	30KAB80AA406	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
D-V Retn Com1B NC	30KAB80AA407	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V-V Sup Com1B NC	30KAB80AA501	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
V-V Retn Com1B NC	30KAB80AA504	31UJH10004	M	H	ES SI	S C/NM	Y (3) Y (5)
F Upstr QNA21 AC002	30KAB80CF060	31UJH10004	M	H	SI	S C/NM	Y (3) Y (5)
F Dnstr KAB80 Chil	30KAB80CF061	31UJH10004	M	H	SI	S C/NM	Y (3) Y (5)
Essential Service Water System (ESWS)							
CCW HX Inlet Isolation Vlv	30PEB10AA007	31UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Outlet Isolation Vlv	30PEB10AA009	31UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Tube Side Thermal Relief Vlv	30PEB10AA192	31UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Inlet Side DP Root Vlv	30PEB10AA306	31UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Outlet Side DP Root Vlv	30PEB10AA307	31UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB10AA401	31UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB10AA402	31UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB10AA403	31UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB10AA405	31UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB10AA407	31UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB10AA408	31UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Tube Side Vent Vlv	30PEB10AA508	31UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Tube Side Vent Vlv	30PEB10AA509	31UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
Orifice Plate	30PEB10BP002	31UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX DP Measurement	30PEB10CP004	31UJH05026	M	H	SI	S	Y (5)
CCW HX Outlet Temp Measurement	30PEB10CT002	31UJH05026	M	H	SI	S	Y (5)

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INSERT 5

Revised IAW RAI 351 Q 09.02.05-22

Table 3.11-1—List of Environmentally Qualified Electrical/I&C Equipment
Sheet 54 of 150

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID (Room Location)	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)			Safety Class (Note 4)			EQ Program Designation (Note 5)		
SW Pump Bldg Cooler Pressure Indicator	30PEB31CP501	33UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
SAQ HX Outlet Temp Measurement	30PEB31CT001	33UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AA002 Valve Motor Actuator	30PEB40AA002	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AA003 Valve Motor Actuator	30PEB40AA003	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AA005 Valve Motor Actuator	30PEB40AA005	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AA015 Valve Motor Actuator	30PEB40AA015	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AA016 Valve Motor Actuator	30PEB40AA016	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Motor Heater, Train 4	30PEB40AH500	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Motor, Train 4	30PEB40AP001	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AT002 Filter Motor Actuator	30PEB40AT002	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Discharge Flow Indicator	30PEB40CF001	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
CCW HX Outlet Flow Measurement	30PEB40CF002	34UJH05026	M	H	ES	~~PAM~~	SI	S	1E		Y (2)	Y (5)	
UHS Tower Basin Level Indicator	30PEB40CL001	34URB01003	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Discharge Pressure Indicator	30PEB40CP002	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Filter Diff Pressure Indicator	30PEB40CP003	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Discharge Thermocouple	30PEB40CT001	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
SAQ HX DP Measurement	30PEB41CP001	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
SW Pump Bldg Cooler Pressure Indicator	30PEB41CP501	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
SAQ HX Outlet Temp Measurement	30PEB41CT001	34UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
~~ESW Pump Motor, Dedicated Train~~	~~30PEB80AP001~~	~~34UQB02001~~	~~M~~	~~M~~			~~SII~~	~~NS-AQ~~		~~EMC~~		~~Y (5)~~	~~Y (6)~~
30PED10 AA010 Valve Motor Actuator	30PED10AA010	31UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AA011 Valve Motor Actuator	30PED10AA011	31UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AA019 Valve Motor Actuator	30PED10AA019	31UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AA021 Valve Motor Actuator	30PED10AA021	31UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AN001 Fan Motor	30PED10AN001	31URB03001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AN002 Fan Motor	30PED10AN002	31URB03002	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA010 Valve Motor Actuator	30PED20AA010	32UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA011 Valve Motor Actuator	30PED20AA011	32UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA019 Valve Motor Actuator	30PED20AA019	32UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA021 Valve Motor Actuator	30PED20AA021	32UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AN001 Fan Motor	30PED20AN001	32URB03001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AN002 Fan Motor	30PED20AN002	32URB03002	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)
30PED30 AA010 Valve Motor Actuator	30PED30AA010	33UQB02001	M	M	ES		SI	S	1E	EMC		Y (5)	Y (6)

DRAFT

INSERT 6

Revised IAW RAI 351, Q 09.02.05-22

RAI 351, Q 09.02.05-22, Insert 5, FSAR Table 3.10-1

Filter Emergency Blowdown Isolation Valve	30PEB10AA004	31UQB2001	M	M	ES SI	S SI C/NM	Y(5)
Filter Emergency Blowdown Isolation Valve	30PEB20AA004	32UQB2001	M	M	ES SI	S SI C/NM	Y(5)
Filter Emergency Blowdown Isolation Valve	30PEB30AA004	33UQB2001	M	M	ES SI	S SI C/NM	Y(5)
Filter Emergency Blowdown Isolation Valve	30PEB40AA004	34UQB2001	M	M	ES SI	S SI C/NM	Y(5)

RAI 351, Q 09.02.05-22, Insert 6, FSAR Table 3.11-1

30PEB10AA004 Valve Motor Actuator	30PEB10AA004	31UQB2001	M	M	ES SI	S 1E EMC	Y(5) Y(6)
30PEB20AA004 Valve Motor Actuator	30PEB20AA004	32UQB2001	M	M	ES SI	S 1E EMC	Y(5) Y(6)
30PEB30AA004 Valve Motor Actuator	30PEB30AA004	33UQB2001	M	M	ES SI	S 1E EMC	Y(5) Y(6)
30PEB40AA004 Valve Motor Actuator	30PEB40AA004	34UQB2001	M	M	ES SI	S 1E EMC	Y(5) Y(6)

The pump motors are air cooled. To remove heat losses, an air recirculation system is installed for each division. In addition, anti-condensation heaters on the motors are switched on as soon as the pumps cease operation.

9.2.1.3.2 Dedicated Essential Service Water Pump

The 100 percent capacity dedicated ESW pump is normally in standby mode.

This non-safety-related pump is manually started only in response to certain postulated SA conditions; it is not credited for response to any DBA.

The required flow rate of the dedicated ESWS pump is defined by the heat to be removed from the dedicated CCWS HX. Design parameters are listed in Table 9.2.1-2. The pump is designed to fulfill the corresponding minimal required design mass flow rate under the following conditions:

- Minimal water level.
- Fluctuations in the supplied electrical frequency.
- Increased pipe roughness due to aging and fouling.
- Fouled debris filter.
- Minimum water level in cooling tower basin considers minimum submergence requirements to prevent vortex effects, and net positive suction head to prevent cavitation of the dedicated ESWS pump.

The pump motor is air cooled. In addition, an anti-condensation heater on the motor is switched on as soon as the pump ceases operation.

9.2.1.3.3 Debris Filters -Safety Divisions

The debris filters remove all debris particles from the cooling water that would obstruct the system user HXs.

The debris filters are designed as an automatic backwash type. With increasing fouling, the differential pressure across the filter segments increases until reaching a preset operational point. The pressure relief backwash process of the filter is initiated by either the signal of the differential pressure measuring system, a timer after the start of the ESW pump or via a manual operator initiation.

The discharge and disposal of the collected debris must be treated in accordance with federal and state regulations relevant to site location.

INSERT 7

Revised IAW RAI 351 Q 09.02.05-22

RAI 351 Q 09.02.05-22

INSERT 7 -- U.S. EPR FSAR 9.2.1.3.3:

To ensure the function of the safety related filter, an alternate safety-related filter blowdown path is provided. The line includes valve 30PEB10/20/30/40AA004, Filter Emergency Blowdown Isolation Valve.

U.S. EPR FSAR Tier 2, Section 3.9 and Section 6.6 outline the inservice testing and inspection requirements. Refer to U.S. EPR FSAR Tier 2, Section 16.0, Surveillance Requirement (SR) 3.7.8 for surveillance requirements that verify continued operability of the ESWS.

Pursuant to the recommendations included in Generic Letter 89-13 (Reference 2), the design of safety-related portions of the ESWS considers the potential for capability and performance degradation and subsequent system failure due to siltation, erosion, corrosion, protective coating failure, and the presence of organisms that subject the system to microbiological influenced corrosion, as well as macro-fouling. A combination of design means, such as chemical treatment to reduce biological challenges; provisions to permit regular, periodic inspections, preventative maintenance, testing and performance trending; the use of best design practices for piping material selection and layout to minimize erosion and corrosion; and administrative controls in the form of operating, maintenance and emergency procedures, provide a level of assurance that the ESWS is able to perform its safety function when required.

Consistent with GL 89-13, design provisions of the ESWS accommodate performing the following:

- Identify and reduce the incidence of flow blockage problems caused from biofouling.
- Verify the heat transfer capability of safety-related heat exchangers connected to or cooled by the ESWS.
- Conduct routine inspection and maintenance activities of ESWS piping and components to provide assurance that corrosion, erosion, protective coating failure, silting, and biofouling cannot degrade the performance of safety-related systems supplied by ESW.

9.2.1.7 Instrumentation Requirements

Instrumentation is provided in order to control, monitor and maintain the safety-related and non-safety-related functions of the ESWS.

Upon receipt of a safety injection signal, the following valves will receive a signal to automatically align to their post accident position as indicated:

- ESWS normal blowdown isolation valves 30PEB10/20130/40 AA016 (closed).
- ESWS debris filter emergency blowdown isolation valve, 30PEB10/20/30/40 AA004 (closed)
- Cooling tower emergency blowdown system isolation valves 30PEB10/20/30/40 AA003 (closed).
- Debris filter blowdown isolation valves 30PEB10/20130/40 AA015 (closed).

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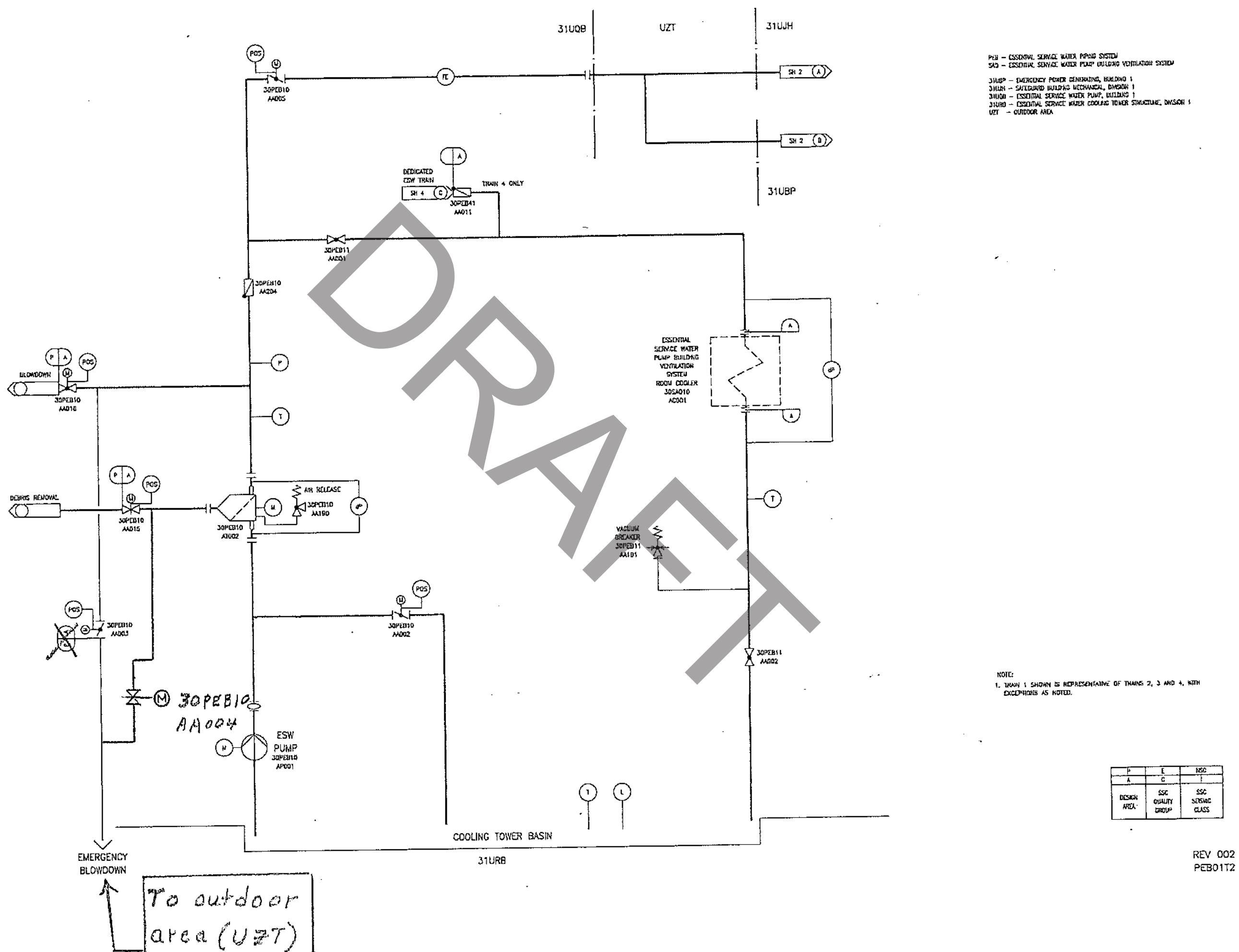
Figure 9.2.1-1—Essential Service Water System Piping & Instrumentation Diagram
Sheet 1 of 4



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(9.2.5.3.1 contin)

UHS cooling tower fill is constructed of ceramic tile, supported on reinforced concrete beams. Spray piping and nozzles are fabricated of corrosion resistant materials (e.g., stainless steel, bronze). UHS cooling tower internals are seismically designed and supported to withstand a safe shutdown earthquake (SSE). Passive failures of the cooling tower spray or fill systems are considered extremely unlikely due to their materials of construction, supporting systems and Seismic Category I design.

To prevent the entrainment of debris from the UHS cooling tower, each cell of the UHS cooling tower includes a debris screen located between the cooling tower internals and the ESW pump.

To account for potential interference effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific conditions of orientation (with respect to wind direction), location, wind velocity, and direction to determine a wet bulb correction factor to account for interference effects.

To account for potential recirculation effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific location to determine a wet bulb correlation factor to account for recirculation effects.

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.

INSERT 8

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).

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

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Based on the increase in heat removal during a DBA, a temperature of less than or equal to 90°F is maintained in the UHS basin during normal operation, so that the cooling tower basin temperature does not exceed 95°F.

9.2.5.5 Safety Evaluation

The UHS pump buildings and cooling towers are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the basis for the adequacy of the structural design of these structures. The aboveground piping and components are protected by the structures.

The UHS is designed to remain functional after a safe shutdown earthquake (SSE). Section 3.7 and Section 3.9 provide the design loading conditions that are considered. Section 3.5, Section 3.6 and Section 9.5.1 provide the hazards analyses to verify that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

The four division design of the UHS provides complete redundancy; therefore a single failure will not compromise the UHS system safety-related functions. Each division of UHS is independent of any other division and does not share components with other divisions or with other nuclear power plant units.

Considering preventative maintenance and a single failure, two UHS divisions may be lost, but the ability to achieve the safe shutdown state under DBA conditions can be reached by the remaining two UHS divisions. In case of LOOP the four UHS cooling towers have power supplied by their respective division EDGs. Isolation valves can isolate non-safety-related portions of the system if necessary without compromising the safety-related function of the system.

The cooling towers must 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. After the initial 72 hours, the site specific makeup water system will provide sufficient flow rates of makeup water to compensate for system volume losses for the remaining 27 days. ~~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. INSERT 10

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

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(9.2.5.5 Contin)

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. INSERT 9

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 under normal and emergency conditions. The UHS is tested as described in Chapter 14.2, Test # 49.

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

The installation and design of the UHS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leaktight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

Section 3.9 and Section 6.6 outline the inservice testing and inspection requirements. Refer to Section 16.0, Surveillance Requirements (SR) 3.7.19 for surveillance requirements that verify continued operability of the UHS.

9.2.5.7 Instrumentation Applications

Instrumentation is provided in order to control, monitor and maintain the safety-related functions of the UHS. Indications of the process variables measured by the instrumentation are provided to the operator in the main control room.

9.2.5.7.1 System Monitoring

- Cooling tower basin water level.
- Cooling tower water temperature.

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RAI 351 Question 09.02.05-22 FSAR Markup Inserts

INSERT 8 FOR U.S. EPR FSAR 9.2.5.3.1:

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 of the U.S. EPR FSAR 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.

INSERT 9 FOR U.S. EPR FSAR 9.2.5.5:

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.

INSERT 10 FOR U.S. EPR FSAR 9.2.5.5:

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 ESW Pump Building at an elevation above the flood level. The emergency blowdown pipe exiting the building is protected from tornado generated missiles by the building structure.

Question 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.

Response to Question 09.02.05-23:

Concerning items d and g, references will be added to U.S. EPR FSAR, Tier 2, Section 9.2.5 to Section 9.2.1 where information on UHS valves and instrumentation is located.

The following U.S. EPR FSAR Tier 2 figures are revised for clarification.

Figure 9.2.1.1, Sheets 1, 3 and 4.

Figure 9.2.5-1

Figure 9.2.5-2

a. See response above concerning the dedicated and emergency ESWS blowdown system. The emergency ESWS blowdown system is shown on U.S. EPR FSAR Tier 2, Figure 9.2.1-1, Sheet 1, Essential Service Water System Piping & Instrumentation Diagram. The dedicated ESWS blowdown system is shown on U.S. EPR FSAR Tier 2, Figure 9.2.1-1, Sheet 4. A conceptual design for the emergency ESWS blowdown system is indicated in the response to RAI 175 Supplement 2, Question 09.02.05-20, Figure 9.2.5-2 [[Conceptual Site-Specific UHS Systems]]. Figure 9.2.5-2 will be revised to show the dedicated blowdown system and the change in classification of emergency ESWS blowdown piping indicated in the response to RAI 351 Question 09.02.05-22.

b. Refer to response to RAI 351, Question 09.02.05-22, markup of U.S. EPR FSAR, Figure 9.2.1-1, Sheet 1 for additional information concerning the emergency ESWS blowdown system. U.S. EPR FSAR Tier 2, Figure 9.2.1-1 Sheet 4 will be revised to show the off-page connection for the ESWS dedicated blowdown system to Tier 2 Figure 9.2.5-1 and the site-specific interface.

c. This is not in error. The chemical treatment system is non-safety site specific system that provides water treatment chemicals to the normal make up water system. The chemical treatment system is not needed during emergency operation. Details related to chemical treatment for the safety-related emergency makeup system are the responsibility of the COL applicant as indicated in Tier 2 Figure 9.2.5-2.

Concerning item d, refer to response to RAI 345, Question 09.02.01-42a, which includes information on UHS valves functions and valve positions.

Concerning item e, UHS bypass flow rates for low load/low ambient temperature conditions to maintain essential service water (ESW) cold water temperature within established limits, the U.S. EPR FSAR will be revised to indicate that the bypass has the capability of diverting the full flow to the basin as indicated in the response to RAI 175 Supplement 1, Question 09.02.05-5e.

Item a

For criteria for pipe line sizing for UHS refer to response to RAI 351 Question 09.02.05-30 Item (f) (1).

Item b

Refer to the response to RAI 351 Question 09.02.05-31 e and f and the markup of U.S EPR FSAR Tier 1, Table 2.7.11-3 that includes ITAAC 7.7 and 7.8. ITAAC 7.7 and 7.8 will include or envelope the UHS design details such as system operating temperatures, pressures, fan speeds, and flow rates for all operating modes and alignments.

Item c

References will be added to U.S. EPR FSAR, Tier 2, Section 9.2.5.7 to Section 9.2.1 where information on UHS instrumentation is located.

Item f

U.S EPR FSAR Tier 2, Section 9.2.5.7 will be revised to indicate that UHS fan status including fan speed selection (low speed, high speed, etc.) and forward or reverse direction are provided to the control room operator.

FSAR Impact:

The following parts of the U.S. EPR FSAR will be revised as described in the response and indicated in the attached markup.

Tier 2, Figure 9.2.1-1, Sheets 1, 3 and 4

Tier 2, Section 9.2.5

Tier 2, Section 9.2.5.2

Tier 2, Section 9.2.5.3.2

Tier 2, Section 9.2.5.4

Tier 2, Section 9.2.5.7

Tier 2, Figure 9.2.5-1

Tier 2, Figure 9.2.5-2

Figure 9.2.1-1—Essential Service Water System Piping & Instrumentation Diagram
Sheet 1 of 4

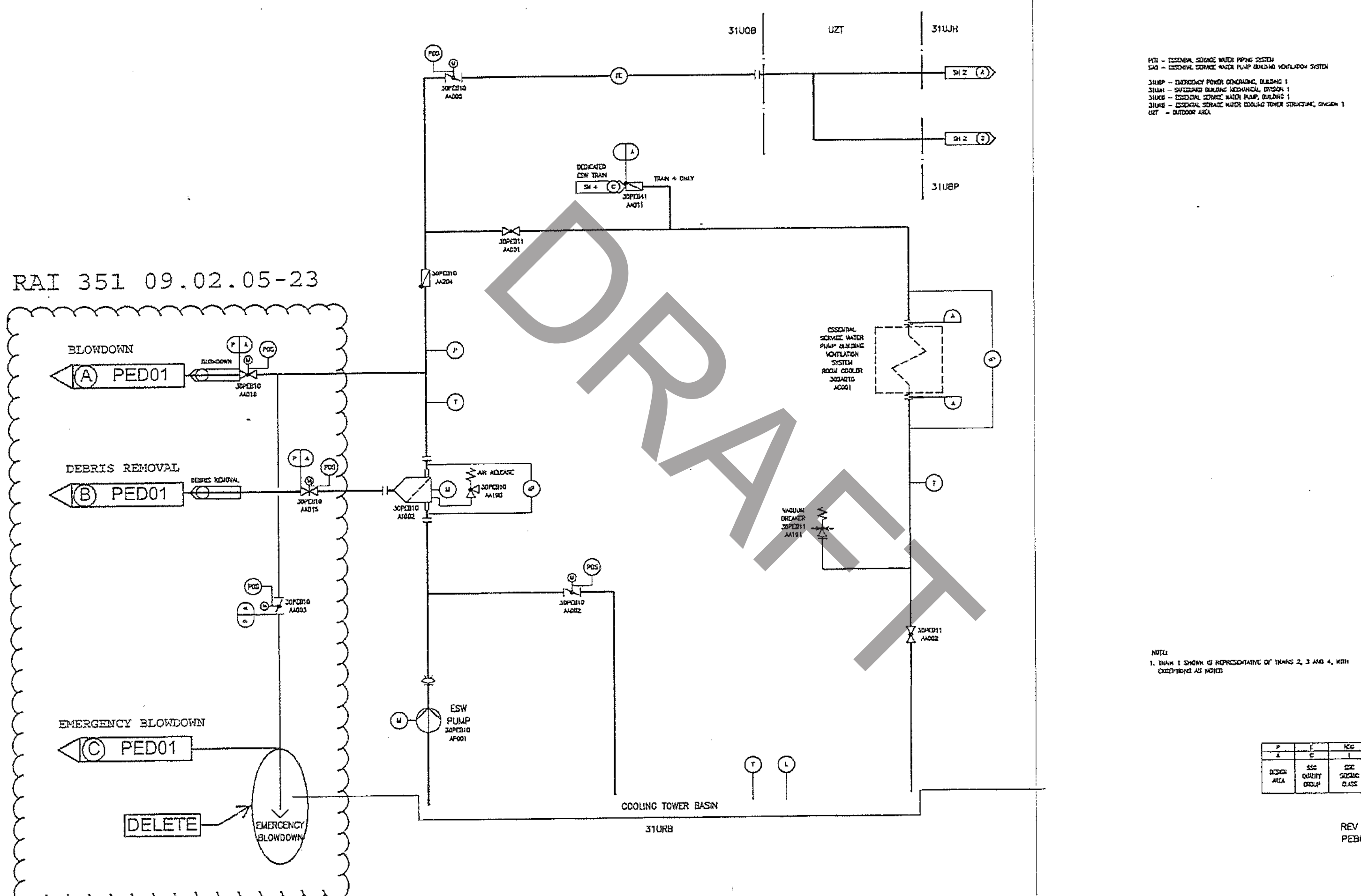


Figure 9.2.1-1—Essential Service Water System Piping & Instrumentation Diagram
Sheet 3 of 4

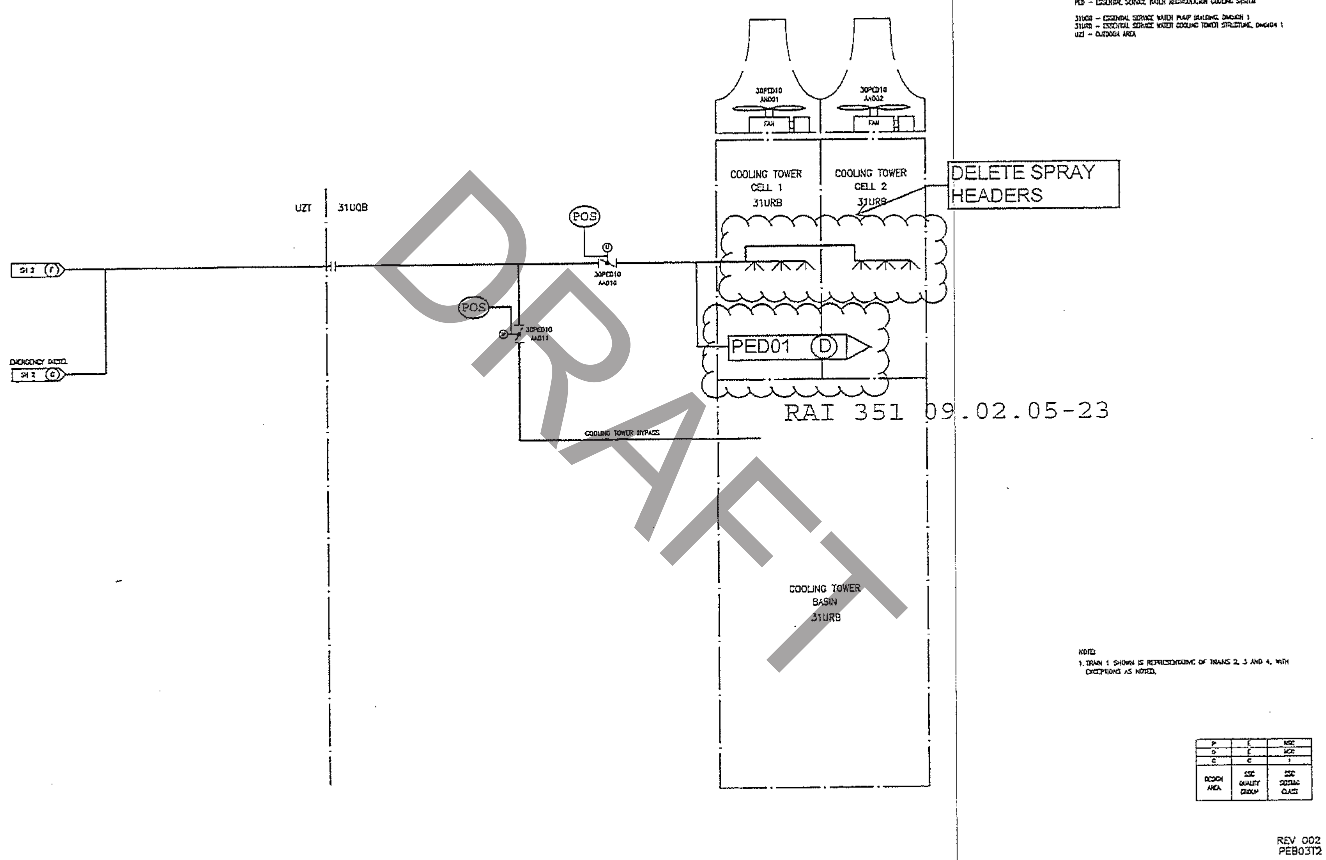
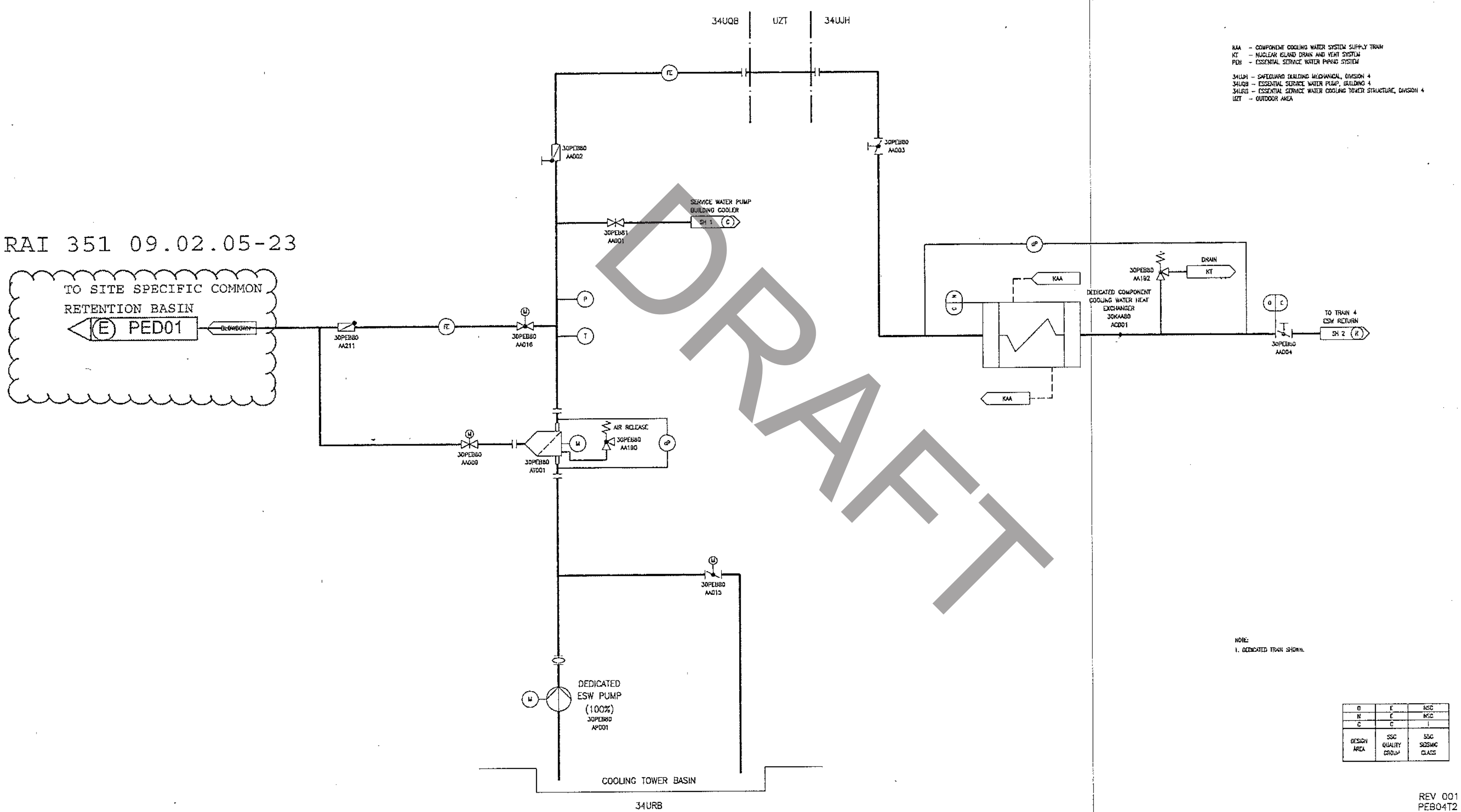


Figure 9.2.1-1—Essential Service Water System Piping & Instrumentation Diagram Sheet 4 of 4



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9.2.5 Ultimate Heat Sink

The function of the ultimate heat sink (UHS) is to dissipate heat rejected from the essential service water system (ESWS) during normal operations and post accident shutdown conditions. System interface heat loads are listed on Table 9.2.5-1. The UHS for the U.S. EPR is sized to provide adequate cooling capacity as required by RG 1.27.

INSERT 1

9.2.5.1 Design Basis

UHS structures, systems and components which provide cooling for safety-related equipment are designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, and external missiles without loss of capability to perform their safety-related functions (GDC 2). Structures housing the system as well as the system components are capable of withstanding the effects of earthquakes. The seismic design of this system meets the guidance of RG 1.29 (Position C.1 for the safety-related portion, and Position C.2 for the non-safety-related portion). Refer to Section 3.2 for quality group classifications.

The UHS is designed to accommodate the effects of, and to be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. These shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from external events (GDC 4).

The UHS does not share structures, systems or components important to safety with other nuclear power plant units unless it has been shown that such sharing does not significantly impair the ability to perform their safety-related functions; including, the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units (GDC 5).

The UHS functions to provide heat removal from the ESWS during normal operation and accident conditions, and transfers that energy to the environment (GDC 44).

The UHS is designed to permit appropriate periodic inspection of important components necessary to maintain the integrity and capability of the system (GDC 45).

The UHS is designed to permit operational functional testing of safety-related components to ensure system operability (GDC 46).

The UHS operates in conjunction with the ESWS and component cooling water system (CCWS) and other reactor auxiliary components to provide a means to cool the reactor core and reactor coolant system (RCS) to achieve a safe shutdown.

Revised IAW RAI 351, Q 09.02.05-23

The UHS operates for a nominal 30 days following a loss of coolant accident (LOCA) without requiring any makeup water to the source or demonstrates that replenishment or use of an alternate or additional water supply can be effected to ensure continuous capability of the sink to perform its safety-related functions.

9.2.5.2 System Description

The UHS consists of four separate, redundant, safety-related divisions. Also included is one dedicated non-safety-related division which is located in division 4. Each safety-related UHS division consists of one mechanical draft cooling tower with two fans, piping, valves, controls and instrumentation. System design parameters are listed on Table 9.2.5-2. The system is shown in Figure 9.2.5-1—Ultimate Heat Sink Piping and Instrumentation Diagram. ← INSERT 2

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).

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.

The UHS contains isolation valves at the cooling towers to isolate the safety related portions of the system from the non-safety-related basin support systems provided by the COL applicant. The site-specific UHS systems are shown in Figure 9.2.5-2—[[Conceptual Site-Specific UHS Systems]].

9.2.5.3 Component Description

9.2.5.3.1 Mechanical Draft Cooling Towers

The cooling towers are rectangular mechanical-induced draft-type towers. Each tower consists of two cells in a back-to-back arrangement. The two cells of the cooling tower in a particular division share a single cooling tower basin and each cell is capable of transferring fifty percent of the design basis heat loads for one division from the ESWS to the environment under worst-case ambient conditions. The division four cooling tower shares use with the dedicated ESW train and can transfer severe accident (SA) heat loads to the environment under worst-case ambient conditions.

The cooling tower fill design and arrangement maximize contact time between water droplets and air inside the tower. The tower fill spacing is chosen to minimize the buildup of biofilm and provide for ease of cleaning, maintenance, and inspection.

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UHS cooling tower fill is constructed of ceramic tile, supported on reinforced concrete beams. Spray piping and nozzles are fabricated of corrosion resistant materials (e.g., stainless steel, bronze). UHS cooling tower internals are seismically designed and supported to withstand a safe shutdown earthquake (SSE). Passive failures of the cooling tower spray or fill systems are considered extremely unlikely due to their materials of construction, supporting systems and Seismic Category I design.

To prevent the entrainment of debris from the UHS cooling tower, each cell of the UHS cooling tower includes a debris screen located between the cooling tower internals and the ESW pump.

To account for potential interference effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific conditions of orientation (with respect to wind direction), location, wind velocity, and direction to determine a wet bulb correction factor to account for interference effects.

To account for potential recirculation effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific location to determine a wet bulb correlation factor to account for recirculation effects.

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.

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).

INSERT 3

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

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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. Cooling tower fans operating in the reverse direction during normal operation are considered operable at the onset of a design basis accident (DBA). Upon receipt of a safety injection (SI) signal, any fans operating in the reverse direction are secured and brought to a complete stop before re-energizing to operate at full speed in the forward direction. Upon receipt of an SI signal, fans in the operating and standby trains are automatically set to full fan speed to dissipate the maximum heat load to the environment. The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within established limits and to protect against freezing. ← INSERT 4

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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.

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 under normal and emergency conditions. The UHS is tested as described in Chapter 14.2, Test # 49.

The installation and design of the UHS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leaktight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

Section 3.9 and Section 6.6 outline the inservice testing and inspection requirements. Refer to Section 16.0, Surveillance Requirements (SR) 3.7.19 for surveillance requirements that verify continued operability of the UHS.

9.2.5.7 Instrumentation Applications

Instrumentation is provided in order to control, monitor and maintain the safety-related functions of the UHS. Indications of the process variables measured by the instrumentation are provided to the operator in the main control room.

INSERT 5

9.2.5.7.1 System Monitoring

- Cooling tower basin water level.
- Cooling tower water temperature.

9.2.5.7.2 System Alarms

- Cooling tower water temperature low.
- Cooling tower basin water level low.
- Cooling tower basin water level high.

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RAI 351 Q 09.02.05-23, Markup Inserts

Insert 1 (U.S. EPR FSAR Tier 2, Section 9.2.5)

Essential service water system (ESWS) and dedicated essential service water system components including some UHS valves and some UHS instrumentation are addressed in Section 9.2.1.

Insert 2 (U.S. EPR FSAR Tier 2, Section 9.2.5.2)

Also parts of the blowdown system, emergency blowdown system and dedicated essential service water system are shown in Figure 9.2.1-1.

Insert 3 (U.S. EPR FSAR Tier 2, Section 9.2.5.3.2)

UHS valve functions are addressed in Section 9.2.1.3.5.

Insert 4 (FSAR Tier 2 Section 9.2.5.4)

The bypass has the capability of diverting the full flow to the basin by paired operation of the bypass valve and return header valve.

Insert 5 (U.S. EPR FSAR Tier 2, Section 9.2.5.7)

UHS fan status including fan speed selection (low speed, high speed, etc.) and forward or reverse direction are provided to the control room operator.

UHS valve positions are addressed in Section 9.2.1.7.
UHS basin level sensors and temperature sensors are shown on Figure 9.2.1-1, Sheet 1.
UHS basin level alarm summary is addressed in Table 9.2.1-3.

Figure 9.2.5-1—Ultimate Heat Sink Piping and Instrumentation Diagram

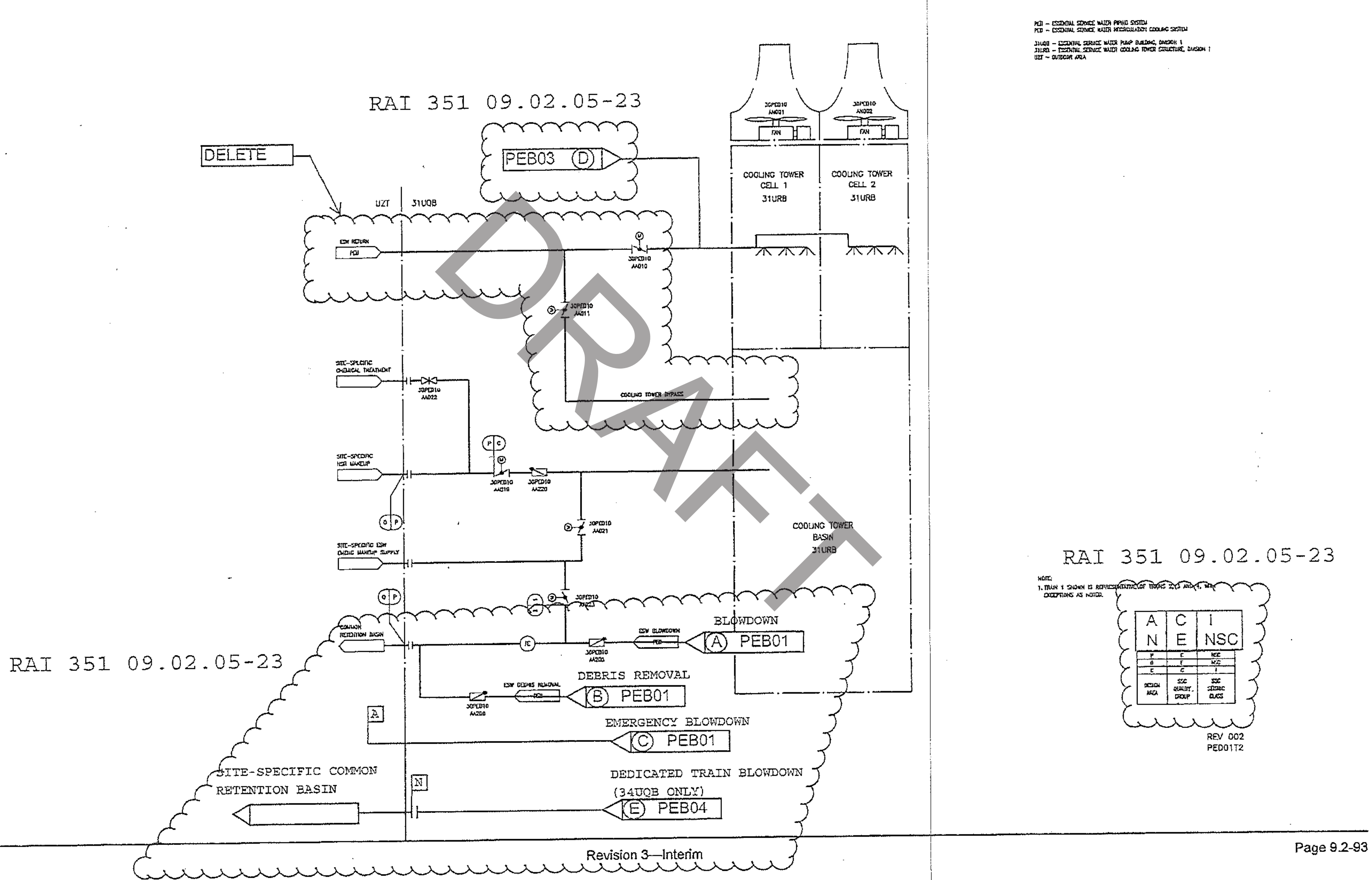
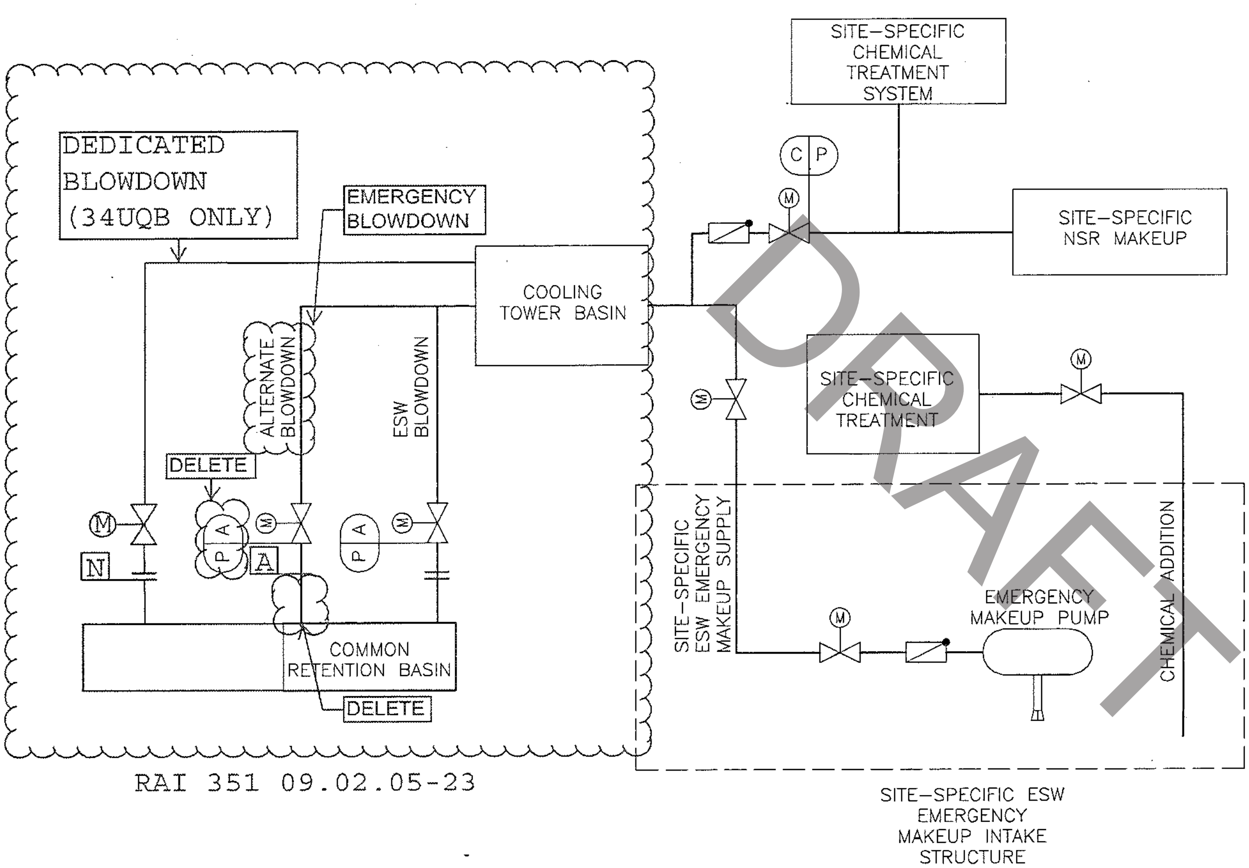


Figure 9.2.5-2—[[Conceptual Site-Specific UHS Systems]]



RAI 351 09.02.05-23

NOTE:
CONFIGURATION SHOWN
IS REPRESENTATIVE
FOR TRAINS 1, 2, 3, & 4

N	E	NSC
P	E	NSC
C	C	I
A	C	I
DESIGN AREA	SSC QUALITY GROUP	SSC SEISMIC CLASS

PED02T2

Next File

Question 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 determination 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.

Response to Question 09.02.05-24:

Item 1

(a) The following are the key assumptions and inputs (including justification) used to demonstrate the heat rejection capability to meet the predicted heat loads during the first 3 days of a DBA. These assumptions are reasonable and very conservative. Response to RAI 345, Q32 provides the margins assumed for flow rate and pump head, as well as for other equipment, such as fans in the UHS System. Examples of these items (more details are provided below) are: maximizing evaporation rates, assuming very high solids content at the start of a DBA and worst case meteorological data and consideration of all pump loads as additional heat loads.

For the DBA, two ESW divisions are assumed to remain running for 3 days. Both cells of the cooling tower in each division are assumed to run at 100 percent fan speed for the 3 day duration.

The initial water inventory of one basin is modeled as 12,000,000 lbm.

The 3-day seepage loss is assumed to be 40,000 lbm. This is based on experience other cooling towers with similar characteristics.

The drift loss is assumed to be 0.01% of the water flowrate. Since vendors will guarantee 0.005%, this assumption is conservative.

For the case determining the basin inventory, the water in the basin is assumed to be pure water. The effect of impurities (solids) is to reduce the mass lost through evaporation.

For the case to determine the maximum water temperature rise, the water in the basin is assumed to have an initial solids content of 67 parts per thousand (ppt). This is 67,000 ppm solids content, which is very conservative. Sensitivity cases were run to confirm that zero initial solids is conservative for maximizing basin evaporation, but using the initial solids of 67 ppt is conservative for maximizing basin water temperature.

(b) The generic US EPR plant will operate the UHS cooling tower within normal operating limits. After the start of a DBA, there would be no make-up, blowdown or chemical treatment at the cooling tower basin for three days. After three days, make-up water flow would commence. For an operating cooling tower, the chemistry is controlled to minimize corrosion and scaling thus preserving the long-term integrity of the equipment. Below is a table of chemistry controls that are specified for UHS cooling towers, to be maintained during normal operation. The table below is generic to all US EPR plants and is based on EPRI guidelines.

Constituent	Limits	
	Without Scale Inhibitors	With Scale Inhibitors
pH (pH units)	6.8-7.2	7.8-8.4
Total Alkalinity (mg/l as $CaCO_3$)	30-50	200-250
Calcium Sulfate (mg/l of Ca as $CaCO_3$)	Maintain Ca <900	Maintain Ca <900
Silica (mg/l as SiO_2)	<150	<150
Magnesium Silicate (mg/l of Mg as $CaCO_3$ and mg/l of silica as SiO_2)	Mg x SiO_2 <35,000	Mg x SiO_2 <75,000
Suspended Solids (mg/l)	<150	<150
Total Dissolved Solids (mg/l)	<5,000 (1)	<5,000 (1)
Calcium Phosphate (mg/l as PO_4)	< 5 orthophosphate	As required on an individual basis per supplier's recommendation (2)
Scale Inhibitor (mg/l)	Zero	As required on an individual basis per supplier's recommendation (3)

(1) EPRI Guidelines list a TDS limit of <60,000 mg/l. However, for UHS design for the US EPR, based on a fresh water make-up supply, a TDS of < 5,000 mg/l is recommended, with the other limiting constituents as listed above. This is a conservative approach and still allows a plant running on a fresh water supply 500 mg/l TDS make-up source to allow 10 cycles of concentration.

(2) Assume 5 mg/l orthophosphate for calculation purposes.

(3) For evaluation purposes, this item was not considered, as it is site-specific and not important to heat removal effectiveness.

These chemical parameters are controlled by a combination of blowdown, chemical treatment (acid for alkalinity control, corrosion inhibitors, scaling inhibitors, dispersants, biofouling control etc.) and make-up and/or blowdown treatment. Note that the above table does not provide for biofouling control, as this is site-specific. Individual plants may be subjected to limits on oil and grease (O&G), iron and other parameters, based on site-specific chemistry and type of cooling tower selected. For the purpose of this evaluation 10 mg/l of O&G were assumed to present in the cooling water, which is a conservative assumption.

If the above parameters are maintained, corrosion, scaling and biofouling will be controlled effectively. The above limits will insure that corrosion and scaling will be kept at a minimum during normal operation. Experience with cooling tower vendors indicates that the most important parameter to heat transfer is Total Dissolved Solids (TDS). In general, a higher TDS will result in some reduction in heat removal effectiveness. However, this fact is balanced by the reduced heat loads the further the plant is into the DBA scenario.

Based on the design of the UHS cooling tower basin and the heat loads during the first 3 days of the DBA, the chemical concentrations of the cooling water will almost double after 3 days of the DBA. The UHS cooling tower will adequately dissipate the required heat load, with essentially negligible change in cooling water temperature, considering that heat loads are reduced with time.

A COLA item is assigned to each US EPR plant to insure that the proper heat dissipation can be accomplished with the site-specific UHS water chemistry (see FSAR mark-up for the COLA item).

(c) Based on the response to RAI 351, Q22, operator action can be performed to use the emergency blowdown to perform blowdown function as necessary. In addition as described in the response to RAI 351, Q31, an ITAAC will verify the ability of the UHS Cooling tower to perform its intended function for 30 days. Also it has been established by analysis with conservative assumption inputs, that the cooling tower can dissipate the heat for the first three days.

Item 3 -- Performance curves for the cooling towers would not be available until later in the design process

Item 4 -- Monitoring of UHS heat rejection capability to ensure adequate performance over time will be as indicated in the markup of U.S. EPR FSAR Tier 2, Section 9.2.1.6 concerning GL-89-13 in response to RAI 119, Supplement 4, Question 09.02.01-10. U.S. EPR FSAR Tier 2, Section 9.2.5.6 will be revised to reference the aforementioned Section 9.2.1.6. Also The inspections will include periodic inspections of the UHS cooling tower basins to identify macroscopic biological fouling organisms (e.g., blue mussels, American oysters, Asiatic clams), sediment and corrosion, biocide treatment of the system, flushing and flow testing of redundant and infrequently used cooling loops and equipment, and periodic sampling to identify the presence of Asiatic clams. Chemical treatment with the appropriate biocide(s) will be performed in response to positive biological fouling test results, and the frequency of treatment will be adjusted as appropriate. Biocide treatment will be in accordance with applicable Federal, State and local environmental regulations.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 9.2.5 and Chapter 16, Section 3.7 will be revised as described in the response and indicated on the enclosed markup.

The UHS operates for a nominal 30 days following a loss of coolant accident (LOCA) without requiring any makeup water to the source or demonstrates that replenishment or use of an alternate or additional water supply can be effected to ensure continuous capability of the sink to perform its safety-related functions.

9.2.5.2 System Description

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Q 09.02.05-24

The UHS consists of four separate, redundant, safety-related divisions. Also included is one dedicated non-safety-related division which is located in division 4. Each safety-related UHS division consists of one mechanical draft cooling tower with two fans, piping, valves, controls and instrumentation. System design parameters are listed on Table 9.2.5-2. The system is shown in Figure 9.2.5-1—Ultimate Heat Sink Piping and Instrumentation Diagram.

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).

INSERT 1

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.

The UHS contains isolation valves at the cooling towers to isolate the safety related portions of the system from the non-safety-related basin support systems provided by the COL applicant. The site-specific UHS systems are shown in Figure 9.2.5-2—[[Conceptual Site-Specific UHS Systems]].

9.2.5.3 Component Description

9.2.5.3.1 Mechanical Draft Cooling Towers

The cooling towers are rectangular mechanical-induced draft-type towers. Each tower consists of two cells in a back-to-back arrangement. The two cells of the cooling tower in a particular division share a single cooling tower basin and each cell is capable of transferring fifty percent of the design basis heat loads for one division from the ESWS to the environment under worst-case ambient conditions. The division four cooling tower shares use with the dedicated ESW train and can transfer severe accident (SA) heat loads to the environment under worst-case ambient conditions.

The cooling tower fill design and arrangement maximize contact time between water droplets and air inside the tower. The tower fill spacing is chosen to minimize the buildup of biofilm and provide for ease of cleaning, maintenance, and inspection.

Table 9.2.5-4—Design Values for Minimum Water Cooling in the UHS

Time (hr)	Wet Bulb Temp (°F)	Dry Bulb Temp (°F)
1	75.8	82
2	76.1	83
3	76.1	83
4	77.3	85
5	79.7	89
6	80.8	91
7	82.0	93
8	84.6	99
9	85.3	99
10	85.3	99
11	84.2	100
12	84.2	100
13	84.6	99
14	83.9	99
15	83.9	99
16	82.6	96
17	82.6	93
18	82.1	91
19	82.1	91
20	81.9	90
21	80.7	88
22	80.7	88
23	79.5	86
24	79.5	86

SEE INSERT 2 OF NEW TABLE 9.2.5-5

Next File

EXTRACTED from FSAR Chapter 16, Section 3.7

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.19.1	Verify water level of each UHS cooling tower basin is ≥ 23.75 feet.	24 hours
SR 3.7.19.2	Verify water temperature of each UHS cooling tower basin is ≤ 90°F.	24 hours
SR 3.7.19.3	Operate each UHS cooling tower fan for ≥ 15 minutes in each speed setting and direction, including reverse.	31 days
SR 3.7.19.4	Verify each UHS cooling tower fan starts automatically on an actual or simulated actuation signal.	24 months
SR 3.7.19.5	Verify the ability to supply makeup water to each UHS cooling tower basin at ≥ 300 gpm.	24 months
SR 3.7.19.6	Verify each UHS automatic valve in the flow path that is not locked, sealed, or otherwise secured in position, actuates to the correct position on an actual or simulated actuation signal.	24 months

INSERT 3 FOR SR 3.7.19.7

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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.

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 under normal and emergency conditions. The UHS is tested as described in Chapter 14.2, Test # 49.

The installation and design of the UHS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leaktight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

Section 3.9 and Section 6.6 outline the inservice testing and inspection requirements. Refer to Section 16.0, Surveillance Requirements (SR) 3.7.19 for surveillance requirements that verify continued operability of the UHS.

INSERT 4

9.2.5.7 Instrumentation Applications

Instrumentation is provided in order to control, monitor and maintain the safety-related functions of the UHS. Indications of the process variables measured by the instrumentation are provided to the operator in the main control room.

9.2.5.7.1 System Monitoring

- Cooling tower basin water level.
- Cooling tower water temperature.

9.2.5.7.2 System Alarms

- Cooling tower water temperature low.
- Cooling tower basin water level low.
- Cooling tower basin water level high.

RAI 351
09.02.05-24

Insert 1 5

A COL applicant that references the U.S. EPR design certification will compare site-specific chemistry data to the parameters in Table 9.2-5-3. If the specific data for the site falls within the assumed design parameters in Table 9.2-5-3, then the U.S. EPR standard design is bounding for the site.

For site-specific design parameter data or characteristics that are outside the bounds of the assumptions presented in Table 9.2-5-3, the COL applicant will confirm that the U.S. EPR design acceptably meets any additional requirements that may be imposed by the more limiting site-specific design parameter data or characteristics, and that the design maintains conformance to the design commitments and acceptance criteria described in this FSAR.

Additionally, a COL applicant that references the U.S. EPR design certification will provide information concerning site-specific evaluations to determine the cooling tower heat transfer capability using the site-specific makeup water, for 27 days after the initial 72 hours post DBA period.

Insert 2 5

Table 9.2.5-3–Ultimate Heat Sink – Initial Chemistry to be Maintained at the Start of a DBA

Constituent	Limits	
	Without Scale Inhibitors	With Scale Inhibitors
pH (pH units)	6.8-7.2	7.8-8.4
Total Alkalinity (mg/l as $CaCO_3$)	30-50	200-250
Calcium Sulfate (mg/l of Ca as $CaCO_3$)	Maintain Ca <900	Maintain Ca <900
Silica (mg/l as SiO_2)	$\leq$150	$\leq$150
Magnesium Silicate (mg/l of Mg as $CaCO_3$ and mg/l of silica as SiO_2)	Mg x SiO_2 <35,000	Mg x SiO_2 <75,000
Suspended Solids (mg/l)	$\leq$150	$\leq$150
Total Dissolved Solids (mg/l)	$\leq$5,000	$\leq$5,000
Calcium Phosphate (mg/l as PO_4)	$\leq$ 5 orthophosphate	As required on an individual basis per supplier's recommendation

Insert 3 7

Surveillance	Frequency
SR 3.7.19.6 Verify that the UHS Cooling Tower Basin chemistry is within specification limits.	31 days

Insert 4

~~Item 4~~ Insert to U.S. EPR FSAR Tier 2, Section 9.2.5.6

Monitoring of UHS heat rejection capability to ensure adequate performance over time will be as indicated in Section 9.2.1.6 concerning GL-89-13. The inspections will include periodic inspections of the UHS cooling tower basins to identify macroscopic biological fouling organisms (e.g., blue mussels, American oysters, Asiatic clams), sediment and corrosion, biocide treatment of the system, flushing and flow testing of redundant and infrequently used cooling loops and equipment, and periodic sampling to identify the presence of Asiatic clams. Chemical treatment with the appropriate biocide(s) will be performed in response to positive biological fouling test results, and the frequency of treatment will be adjusted as appropriate. Biocide treatment will be in accordance with applicable Federal, State and local environmental regulations.

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Question 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 scenario 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.

Response to Question 09.02.05-25:

Item 1

UHS fan classification is covered as follows in the U.S. EPR FSAR;

Tier 1, Table 2.7.11-1 – refer to response to RAI 345 Question 09.02.01-44b

Tier 1, Table 2.7.11-2 – refer to response to RAI 175 S3 Question 09.05.02-17

Tier 2, Table 3.2.2-1

Tier 2, Table 3.11-1

UHS fans will be added to Tier 2, Table 3.10-1 as indicated in attached markup.

Item 2

Refer to the response to RAI 351 Question 09.02.05-31 e and f and the markup of U.S EPR FSAR Tier 1, Table 2.7.11-3 that includes ITAAC 7.7 and 7.8. ITAAC 7.7 and 7.8 will include UHS cooling tower fan data (e.g., capacity, speeds).

Item 3

As indicated in the response to RAI 175 S2 Question 09.02.05-7 and in the response to Item 4 of this RAI question, the associated essential service water system (ESWS) train is considered operable during reverse operation of the fans.

As indicated in the response to RAI 175, Supplement 1, Question 09.02.05-5e, the UHS has the capability of bypassing return water flow to the basin during low ambient temperature conditions to protect against freezing. As indicated in the response to RAI 175, Supplement 2, Question 09.02.05-7, the UHS has multiple fan speed and reverse fan operation capability. Low fan speed operation can be used during low load and/or low ambient temperature conditions. Reverse fan operation can be used to retard ice formation. Operating guidance and procedures to reduce or eliminate ice are within the scope of operating procedures, which is the responsibility of the COL applicant as indicated in U.S. EPR FSAR Tier 2, Section 13.5 and listed in Tier 2 Table 1.8-2, Item No. 13.5-1.

Item 8

Concerning the indications and controls for the cooling tower fans provided to the operator in the MCR, refer to the response to RAI 351 Question 09.02.05-23f.

FSAR Impact:

Item 1

U.S. EPR FSAR, Tier 2, Table 3.10-1 will be revised as described in the response and indicated on the enclosed markup.

Items 2, 3 and 8

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

Table 3.10-1—List of Seismically and Dynamically Qualified Mechanical and Electrical Equipment
Sheet 93 of 195

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID (Room Location)	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)		Safety Class (Note 4)		EQ Program Designation (Note 5)	
CCW HX Tube Side Thermal Relief Vlv	30PEB40AA192	34UJH05026	M	H		SI	S	C/NM	Y (3)	Y (5)
CCW HX Inlet Side DP Root Vlv	30PEB40AA306	34UJH10026	M	H		SI	S	C/NM	Y (3)	Y (5)
CCW HX Outlet Side DP Root Vlv	30PEB40AA307	34UJH10026	M	H		SI	S	C/NM	Y (3)	Y (5)
ESW Drain Isolation Vlv	30PEB40AA401	34UJH01026	M	H		SI	S	C/NM	Y (3)	Y (5)
ESW Drain Isolation Vlv	30PEB40AA402	34UJH10026	M	H		SI	S	C/NM	Y (3)	Y (5)
ESW Drain Isolation Vlv	30PEB40AA403	34UJH05026	M	H		SI	S	C/NM	Y (3)	Y (5)
ESW Drain Isolation Vlv	30PEB40AA405	34UJH05026	M	H		SI	S	C/NM	Y (3)	Y (5)
ESW Drain Isolation Vlv	30PEB40AA407	34UJH01026	M	H		SI	S	C/NM	Y (3)	Y (5)
ESW Drain Isolation Vlv	30PEB40AA408	34UJH01026	M	H		SI	S	C/NM	Y (3)	Y (5)
CCW HX Tube Side Vent Vlv	30PEB40AA508	34UJH10026	M	H		SI	S	C/NM	Y (3)	Y (5)
CCW HX Tube Side Vent Vlv	30PEB40AA509	34UJH10026	M	H		SI	S	C/NM	Y (3)	Y (5)
Orifice Plate	30PEB40BP002	34UJH05026	M	H		SI	S			Y (5)
CCW HX DP Measurement	30PEB40CP004	34UJH05026	M	H		SI	S			Y (5)
CCW HX Outlet Temp Measurement	30PEB40CT002	34UJH05026	M	H		SI	S			Y (5)
SAQ HX DP Measurement	30PEB41CP001	34UQB02001	M	M		SI	S			Y (5)
SAQ HX Outlet Temp Measurement	30PEB41CT001	34UQB02001	M	M		SI	S			Y (5)
CCW HX Outlet Isolation Vlv	30PEB80AA004	34UJH05026	M	H		SI	S	C/NM	Y (3)	Y (5)
ESW Drain Isolation Vlv	30PEB80AA405	34UJH01026	M	H		SI	S	C/NM	Y (3)	Y (5)
Safety Chilled Water System (SCWS)										
QKA Cross-Tie Valve, Div 1	30QKA10AA102	31UJK22028	M	M		SI	S	C/NM		Y(5)
QKA Cross-Tie Valve, Div 1	30QKA10AA103	31UJK22028	M	M		SI	S	C/NM		Y(5)
QK Tank Isol Valve, Div 1	30QKA10AA001	31UJK26029	M	M		SI	S	C/NM		Y (5)
QK Pmp #1 Suct Isol Valve, Div 1	30QKA10AA002	31UJK22028	M	M		SI	S	C/NM		Y (5)
QK Pmp #1 Disch Check Valve, Div 1	30QKA10AA003	31UJK22028	M	M		SI	S			Y (5)
QK Pmp #1 Disch Isol Valve, Div 1	30QKA10AA004	31UJK22028	M	M		SI	S	C/NM		Y (5)
QK Chiller Dnstrm Flow Reg Valve, Div 1	30QKA10AA005	31UJK22028	M	M		SI	S	C/NM		Y (5)
QK Chiller Dnstrm Isol Valve, Div 1	30QKA10AA006	31UJK22028	M	M		SI	S	C/NM		Y (5)
QKA10AT001 Upstrm Isol Valve, Div 1	30QKA10AA007	31UJK26029	M	M		SI	S	C/NM		Y (5)
QKA10AT001 Dnstrm Flow Reg Valve, Div 1	30QKA10AA008	31UJK26029	M	M		SI	S	C/NM		Y (5)
QKA10AT001 Dnstrm Isol Valve, Div 1	30QKA10AA009	31UJK26029	M	M		SI	S	C/NM		Y (5)
QK QCB Isol Valve, Div 1	30QKA10AA010	31UJK22028	M	M		SI	S			Y (5)
QK QCB Check Valve, Div 1	30QKA10AA011	31UJK22028	M	M		SI	S			Y (5)
QK Bypass Control Valve-MOV, Div 1	30QKA10AA101	31UJK26029	M	M	ES	SI	S	C/NM		Y (5)

INSERT

Revised IAW RAI 351 Question 09.02.05-25

RAI 351, Q 09.02.05-25, Insert _, FSAR Table 3.10-1

UHS Cooling Tower Fan	30PED10AN001	31URB03001	M	M	ES SI	S SI C/NM	Y(5)
UHS Cooling Tower Fan	30PED10AN002	31URB03002	M	M	ES SI	S SI C/NM	Y(5)
UHS Cooling Tower Fan	30PED20AN001	32URB03001	M	M	ES SI	S SI C/NM	Y(5)
UHS Cooling Tower Fan	30PED20AN002	32URB03002	M	M	ES SI	S SI C/NM	Y(5)
UHS Cooling Tower Fan	30PED30AN001	33URB03001	M	M	ES SI	S SI C/NM	Y(5)
UHS Cooling Tower Fan	30PED30AN002	33URB03002	M	M	ES SI	S SI C/NM	Y(5)
UHS Cooling Tower Fan	30PED40AN001	34URB03001	M	M	ES SI	S SI C/NM	Y(5)
UHS Cooling Tower Fan	30PED40AN002	34URB03002	M	M	ES SI	S SI C/NM	Y(5)

NRC Question 09.02.05-25

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.

Response to NRC Question 09.02.05-25:

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 onsite of a DBA, they will be switched automatically to full speed upon receipt of an SI signal, to dissipate the maximum heat to the environment. All of the above actions are automatic following the receipt of an SI signal, and do not require operator action.

onset

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. <u>All fans start automatically and accelerate to full speed in response to an SI signal.</u> 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. <u>Thus, cooling tower fan start time, as well as the time required for fan coast-down, re-start and acceleration to full speed of fan(s)</u>

operating in reverse, have no impact on the ability of the UHS cooling tower to mitigate the consequences of a DBA.

FSAR Impact: Section 9.2.5.4 and Section 14.2.12.5.8 (Test 049)

U.S. EPR FSAR Tier 2, ~~Table 9.2.5-4~~, will be revised as described in the response and indicated on the enclosed markup.

INSERT 1

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. Cooling tower fans operating in the reverse direction during normal operation are considered operable at the onset of a design basis accident (DBA). Upon receipt of a safety injection (SI) signal, any fans operating in the reverse direction are secured and brought to a complete stop before re-energizing to operate at full speed in the forward direction. Upon receipt of an SI signal, fans in the operating and standby trains are automatically set to full fan speed to dissipate the maximum heat load to the environment. The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within established limits and to protect against freezing.

DELETE

Based on the increase in heat removal during a DBA, a temperature of less than or equal to 90°F is maintained in the UHS basin during normal operation, so that the cooling tower basin temperature does not exceed 95°F.

9.2.5.5 Safety Evaluation

The UHS pump buildings and cooling towers are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the basis for the adequacy of the structural design of these structures. The aboveground piping and components are protected by the structures.

RAI 345
09.02.05-25

The UHS is designed to remain functional after a safe shutdown earthquake (SSE). Section 3.7 and Section 3.9 provide the design loading conditions that are considered. Section 3.5, Section 3.6 and Section 9.5.1 provide the hazards analyses to verify that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

The four division design of the UHS provides complete redundancy; therefore a single failure will not compromise the UHS system safety-related functions. Each division of UHS is independent of any other division and does not share components with other divisions or with other nuclear power plant units.

Considering preventative maintenance and a single failure, two UHS divisions may be lost, but the ability to achieve the safe shutdown state under DBA conditions can be reached by the remaining two UHS divisions. In case of LOOP the four UHS cooling towers have power supplied by their respective division EDGs. Isolation valves can isolate non-safety-related portions of the system if necessary without compromising the safety-related function of the system.

The cooling towers must operate for a nominal 30 days following a LOCA without requiring any makeup water to the source or it must be demonstrated that

Insert 1 for FSAR Section 9.2.5.4

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 onsite of a DBA, they will be switched automatically to full speed upon receipt of an SI signal, to dissipate the maximum heat to the environment. All of the above 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. <u>All fans start automatically and accelerate to full speed in response to an SI signal.</u> 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.

2.5 Test instrumentation available and calibrated per applicable procedures.

2.6 Appropriate AC and DC power sources are available.

2.7 UHS basin support systems required for operation of the UHS and ESWS are available, as required.

2.8 The UHS basin is filled to normal operating levels.

3.0 TEST METHOD

3.1 Demonstrate operation of the UHS tower over the design range of operation.

RAI 351 Q09.02.05-32(2)

3.1.1 Simulate a UHS operating temperature that corresponds to the lower range of operation.

each speed setting and direction, including reverse.

3.1.2 Demonstrate that fans operate in ~~the reverse direction.~~

3.1.3 Demonstrate that tower bypass paths realign to mitigate ice formation.

3.1.4 Simulate a gradual increase in ambient UHS temperature and terminate the ambient temperature increase at the upper end of the design operation band.

RAI 351 Q09.02.05-25(4) Insert

3.1.5 Record changes to tower fans and critical component operation during temperature increase.

3.2 Perform valve performance tests (e.g., valve position response of valves to loss of motive power, thrust, stroke time).

3.3 Demonstrate that UHS makeup flow rate meets design flow requirements.

3.3.1 During normal operation.

3.3.2 During emergency operation.

3.4 Demonstrate that UHS blowdown flow rate meets design flow requirements.

3.4.1 During normal operation.

3.4.2 During emergency operation.

3.5 Demonstrate the operation of UHS level and temperature instruments and alarms.

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

3.7 Demonstrate that the chemical treatment system functions as designed.

3.7.1 Injection flow rate to UHS.

3.7.2 Interlocks with UHS blowdown.

RAI 351 Question 09.02.05-25(4), Insert to FSAR 14.2.12.5.8 (Test 049)

3.1.6 **Verify that the UHS tower is operating with cooling load.**

3.1.7 **Verify that each UHS fan is operating in high speed (forward direction) and record performance data in the following sequence:**

- **Corresponding UHS inlet and outlet temperatures (°F).**
- **Essential service water flow rates (gpm).**
- **UHS air flow rates (cfm).**
- **Duration of described event (seconds).**

3.1.7.1 **Record data from initiation of deicing sequence till fan coasts to stop.**

3.1.7.2 **Record data from fan coasting to stop till fan starts moving in reverse direction.**

3.1.7.3 **Record data from fan starting in reverse direction till fan is operating at normal speed in reverse direction.**

3.1.7.4 **Record data from fan speed stabilizing in reverse direction until fan can be returned to normal forward direction. Observe all applicable starting duty restrictions before returning fan to forward direction.**

3.1.7.5 **Record data from terminating deicing sequence till fan coasts to stop.**

3.1.7.6 **Record data from fan stop till fan starts moving in forward direction.**

3.1.7.7 **Record data from fan starting in forward direction till fan is operating at high speed in the forward direction.**

Question 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.

Response to Question 09.02.05-26:

Refer to the response to RAI 345, Question 09.02.01-43 that indicates the valves that receive a signal to automatically align upon receipt of a safety injection signal.

Refer to the response to RAI 351 Question 09.02.05-22, concerning the addition of valves 30PEB10/20/30/40AA004, Filter Emergency Blowdown Isolation Valve.

Concerning the need for additional ITAAC, the valves that receive a signal to automatically align upon receipt of a safety injection signal are identified in U.S. EPR FSAR Tier 1, Tables 2.7.11-1 and 2.7.11-2. As indicated in Item 7.3 of U.S. EPR Tier 1, Table 2.7.11-3, these valves can perform the function listed in U.S. EPR Tier 1, Table 2.7.11-1 under system operating conditions, which includes safety injection.

ESWS valves operation is verified through Tier 2 Section 14.2 Test 048.

U.S. EPR FSAR Tier 2, Section 14.2.12.5.8, Ultimate Heat Sink (Test #049) will be revised to add Test Method 3.8 – "Demonstrate that the UHS starts automatically in response to a protection signal and applicable realignments are performed in a satisfactory manner".

Surveillance 3.7.8.2 for ESWS and Surveillance 3.7.19.5 for UHS verifies proper automatic operation of each valve in the flow path that is not locked, sealed, or otherwise secured in position, actuates to the correct position on an actual or simulated actuation signal. Thus, each ESWS valve and each UHS valve response to actuation signal is verified through ITAAC and periodically through a surveillance requirement.

Concerning unclear terminology, refer to the response to RAI 397, Question 09.02.05-36 that describes the emergency makeup water system.

FSAR Impact:

The U.S. EPR FSAR Tier 2, Section 14.2.12.5.8, Ultimate Heat Sink (Test #049) will be revised as described in the response and indicated in the attached markup.

3.3.1 During normal operation.

3.3.2 During emergency operation.

3.4 Demonstrate that UHS blowdown flow rate meets design flow requirements.

3.4.1 During normal operation.

3.4.2 During emergency operation.

3.5 Demonstrate the operation of UHS level and temperature instruments and alarms.

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

3.7 Demonstrate that the chemical treatment system functions as designed.

3.7.1 Injection flow rate to UHS.

3.7.2 Interlocks with UHS blowdown.

4.0 DATA REQUIRED

4.1 UHS makeup and blowdown flow rates.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Temperature and relative humidity trend data.

4.5 Setpoints at which alarms and interlocks occur.

4.6 Cooling fan air flow rates.

5.0 ACCEPTANCE CRITERIA

5.1 The UHS meets design requirements (refer to Section 9.2.5):

5.1.1 Verify that control logic starts forced draft fans and aligns critical components for UHS operation for the entire design range.

5.1.2 Verify that valve performance tests (e.g., valve position response of valves to loss of motive power, thrust, stroke time) meet design requirements.

5.1.3 Verify that UHS makeup flow rate meets design flow requirements.

5.1.4 Verify that UHS blowdown flow rate meets design flow requirements.

5.1.5 Verify that the operation of UHS level and temperature instruments and alarms meet design requirements.

5.1.6 Verify that the UHS tower bypass function meets design requirements.

Question 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.

Response to Question 09.02.05-27:

Item 1

Analytical results confirm that the minimum submergence level for the essential service water pump to prevent vortex effects is the limiting condition for determining the minimum water level in the cooling tower basin.

The 72 hour basin water volume is the minimum water volume that must be present in the basin to accommodate system water inventory losses experienced due to UHS Cooling tower operation during a Design Basis Accident (DBA). The required volume is determined based on water losses under the worst case environmental conditions and with the essential service water (ESW) heat load during a DBA for a 72-hour period, without incurring pump vortexing during this period.

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

Meteorological conditions resulting in the maximum evaporative loss of water for the UHS over a 72-hour period are represented in U.S. EPR FSAR, Tier 2, Table 2.1-3, Design Values for Maximum Evaporation and Drift Losses of Water from the UHS (this table will be moved to Tier 2, Table 9.2.5-3 in Revision 2 of the U.S. EPR FSAR).

Response to RAI 119 Question 09.02.01-17 provides a figure that details the various UHS Tower basin water levels and respective margins. This figure was added to U.S. EPR FSAR Tier 2, Section 9.2.5 per RAI 345, Question 09.02.01-41. A margin of 6" was applied for the minimum pump submergence and a 10" margin for the 72-hour water volume. Drift loss from the UHS tower is 0.005%; however, a conservative 0.10% was used in the analysis. The valve leakage is calculated assuming all isolated valves leak simultaneously at a maintained rate of 0.5 D (inch) gpm. The 30 day seepage loss is 360,000 lbm and a 3-day seepage loss of 40,000 lbm was chosen for this analysis. This analysis also assumes that ESW pumps operate at design flow for the 72-hour duration. A water height of 21" is provided above the technical specification height required to account for the operating band and other instrument margins. Also 6" is provided for freeboard.

The maximum temperature increase during the first 72 hours assumes each ESW train consists of a two-cell cooling tower, where both cells share a common water storage basin. One ESW pump serves each ESW train, and the flow is assumed to be evenly split between the two cells of the cooling tower. Two of the four ESW trains are assumed to operate following the DBA. The fans in both cells of the cooling tower are assumed to operate at full speed for the 72-hour duration.

The cooling tower basin water volume required for the most limiting 72 hour period is currently provided in FSAR Tier 2, Table 9.2.5-2. Additionally, the minimum required cooling tower basin water level for pump operation is provided in Table 9.2.5-2.

Item 2

The mechanical work done by the UHS Cooling Tower Basin Pump during normal, cooldown, and DBA operations is 2.80 MBtu/hr (820 kW). This value will be added to FSAR Tier 2 Table 9.2.5-1. Table 9.2.5-1 heat load values are revised as indicated in the response to RAI 406 Question 09.02.02-110. U.S. EPR FSAR Tier 1, Table 2.7.11-3, Item 7.1 will be revised in accordance with the revised CCWS heat load value and include the ESW pump mechanical work. The corresponding insert supersedes the markup and acceptance criteria stated in the response to RAI 345, Question 09.02.01-45. The pump motor ambient heat is included in the ESWS pump room cooler heat load in FSAR Tier 2 Table 9.2.5-1. These numbers assume that the pump is operating at the maximum horsepower.

Item 3, Part 1

The RAI 175 Supplement 2, Question 09.02.05-9 markup of FSAR Tier 2 Section 9.2.5.4 will be expanded to indicate that 95 °F is the maximum design basis UHS basin temperature for the duration of a DBA. Also it will be expanded to indicate that normal UHS basin temperature of less than or equal to 90 °F and DBA UHS basin temperature of less than or equal to 95 °F are the bases for ESWS temperatures listed in FSAR Table 9.2.5-1. As indicated in the response to RAI 406 Question 09.02.02-110, a value of 92 °F normal ESWS temperature is used for sizing the CCWS heat exchanger.

Item 3, Part 2

The maximum basin temperature is based on an 81°F Wet Bulb temperature with a zero percent exceedance which is the most conservative design for this application and is consistent with FSAR Tier 2, Table 2.1-4, Design Values for Minimum Water Cooling of the UHS (this table will be moved to Tier 2, Table 9.2.5-4 in Revision 2 of the U.S. EPR FSAR). The previous response incorrectly listed the 81°F WBT is with a 1 percent exceedance.

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 2.7.11-3 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Sections 9.2.5.3.3, 9.2.5.4 and Table 9.2.5-1 will be revised as described in the response and indicated on the enclosed markup.

Table 2.7.11-3—Essential Service Water System ITAAC
(6 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
5.1	The components designated as Class 1E in Table 2.7.11-2 are powered from the Class 1E division as listed in Table 2.7.11-2 in a normal or alternate feed condition.	a. Testing will be performed for components designated as Class 1E in Table 2.7.11-2 by providing a test signal in each normally aligned division. b. Testing will be performed for components designated as Class 1E in Table 2.7.11-2 by providing a test signal in each division with the alternate feed aligned to the divisional pair.	a. The test signal provided in the normally aligned division is present at the respective Class 1E component identified in Table 2.7.11-2. b. The test signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E component identified in Table 2.7.11-2.
5.2	Valves listed in Table 2.7.11-2 fail as-is on loss of power.	Testing will be performed for the valves listed in Table 2.7.11-2 to fail as-is on loss of power.	Following loss of power, the valves listed in Table 2.7.11-2 fail as-is.
5.3	Deleted.	Deleted.	Deleted.
5.4	Items identified in Table 2.7.11-2 as "Dedicated" ESWS motor-operated components are capable of being supplied by a SBODG.	Testing will be performed for motor-operated components designated as "Dedicated" in Table 2.7.11-2 by providing a test signal with the SBODG.	The test signal provided by the SBODG is present at the respective "Dedicated" component identified in Table 2.7.11-2.
6.1	Deleted.	Deleted.	Deleted.
7.1	The ESWS UHS as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the CCWS and EDG heat exchangers, and the ESWPBVS room cooler. ~~The ESW UHS as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the CCWS.~~	Tests of the UHS and inspection of a heat exchanger/cooler data report ~~Tests and analyses~~ will be performed to demonstrate the capability of the ESWS UHS as listed in Table 2.7.11-1 to remove the design heat load from CCWS and EDG heat exchangers and the ESWPBVS room cooler.	~~A report exists and concludes that ~~The~~ the ESWS UHS has the capacity to remove ~~at least~~ the total design heat load of 3.139+08 BTU/hr from the CCWS and EDG heat exchangers and the ESWPBVS room cooler. ~~of 2.913 E+08 BTU/hr.~~~~

A report exists and concludes that the ESWS UHS has the capacity to remove the total design heat load of 3.188+08 BTU/hr from the CCWS, EDG heat exchangers, the ESWPBVS room cooler and the ESW pump mechanical work.

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UHS cooling tower fill is constructed of ceramic tile, supported on reinforced concrete beams. Spray piping and nozzles are fabricated of corrosion resistant materials (e.g., stainless steel, bronze). UHS cooling tower internals are seismically designed and supported to withstand a safe shutdown earthquake (SSE). Passive failures of the cooling tower spray or fill systems are considered extremely unlikely due to their materials of construction, supporting systems and Seismic Category I design.

To prevent the entrainment of debris from the UHS cooling tower, each cell of the UHS cooling tower includes a debris screen located between the cooling tower internals and the ESW pump.

To account for potential interference effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific conditions of orientation (with respect to wind direction), location, wind velocity, and direction to determine a wet bulb correction factor to account for interference effects.

To account for potential recirculation effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific location to determine a wet bulb correlation factor to account for recirculation effects.

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.

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).

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~~

INSERT 1

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~~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. Cooling tower fans operating in the reverse direction during normal operation are considered operable at the onset of a design basis accident (DBA). Upon receipt of a safety injection (SI) signal, any fans operating in the reverse direction are secured and brought to a complete stop before re-energizing to operate at full speed in the forward direction. Upon receipt of an SI signal, fans in the operating and standby trains are automatically set to full fan speed to dissipate the maximum heat load to the environment. The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within established limits and to protect against freezing.

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Based on the increase in heat removal during a DBA, a temperature of less than or equal to 90°F is maintained in the UHS basin during normal operation, so that the cooling tower basin temperature does not exceed 95°F. INSERT 2

9.2.5.5 Safety Evaluation

The UHS pump buildings and cooling towers are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the basis for the adequacy of the structural design of these structures. The aboveground piping and components are protected by the structures.

The UHS is designed to remain functional after a safe shutdown earthquake (SSE). Section 3.7 and Section 3.9 provide the design loading conditions that are considered. Section 3.5, Section 3.6 and Section 9.5.1 provide the hazards analyses to verify that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

The four division design of the UHS provides complete redundancy; therefore a single failure will not compromise the UHS system safety-related functions. Each division of UHS is independent of any other division and does not share components with other divisions or with other nuclear power plant units.

Considering preventative maintenance and a single failure, two UHS divisions may be lost, but the ability to achieve the safe shutdown state under DBA conditions can be reached by the remaining two UHS divisions. In case of LOOP the four UHS cooling towers have power supplied by their respective division EDGs. Isolation valves can isolate non-safety-related portions of the system if necessary without compromising the safety-related function of the system.

The cooling towers must 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. 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 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

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RAI 406; Q 9.2.2-110

Table 9.2.5-1—Ultimate Heat Sink System Interface

Component	Max Heat Load MBTU/hr	Total Required ESW Flow (10^6 lb_m/hr)	Required ESW Temperature	Comments
CCWS heat exchanger	128.1	7,540 min	≤92°F	Normal Operation
	120.1	7,540 min	≤90°F	Spring/Fall Outage Cooldown
	293.35 (1) ~~291.3~~	7,540 min	≤95°F	DBA
Dedicated CCWS heat exchanger	~~48.64~~ 51.2 (nominal)	~~1.205~~ 1.102 min	≤95°F	Severe Accident
~~EDG heat exchanger~~	~~22.0~~	~~1.06~~	~~≤95°F~~	
ESW pump room cooler for 31/32/ 33/34 UQB	0.619	~~137.6 gpm~~0.0685	≤ 95°F	Normal Operations Shutdown/ Cooldown and DBA
ESW pump room cooler for 34 UQB	0.314	~~69.8 gpm~~0.0347	≤ 95°F	Severe Accident - ESW flow supplied by dedicated ESW pump

Notes:
1. The CCWS heat exchanger load on the UHS in DBA is equal to the LHSI DBA heat load of 241 x 10^6 Btu/hr in Table 9.2.2-2 plus the additional loads from the CCWS common users.

RAI 351 Q 09.02.05-27, INSERT 3

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RAI 351, Q 09.02.05-27, response MU Inserts

9.2.5.3.3 Cooling Tower Basin

INSERT 1 FOR U.S EPR FSAR 9.2.5.3.3:

The 72 hour basin water volume is the minimum water volume that must be present in the basin to accommodate system water inventory losses experienced in that basin due to UHS Cooling tower operation during a Design Basis Accident. The required volume is determined based on water losses under worst case environmental conditions with the highest ESW heat load during a Design Basis Accident for a 72 hour period without incurring pump vortexting during operation. Inventory losses consist of evaporation losses, tower drift losses as well as valve seat leakage and seepage.

A margin of 6" was applied for the minimum pump submergence and a 10" margin for the 72-hour water volume. Drift loss from the UHS tower is 0.005%; however, a conservative 0.10% was used in the analysis. The valve leakage is calculated assuming all isolated valves leak simultaneously at a maintained rate of 0.5 D (inch) gpm. The 30 day seepage loss is 360,000 lbm and a 3-day seepage loss of 40,000 lbm was chosen for this analysis. This analysis also assumes that ESW pumps operate at design flow for the 72-hour duration. A water height of 21" is provided above the technical specification height required to account for the operating band and other instrument margins. Also 6" is provided for freeboard.

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

INSERT 2 FOR U.S EPR FSAR Section 9.2.5.4:

95 °F is the maximum design basis UHS basin temperature for the duration of a DBA. The normal UHS basin temperature of less than or equal to 90 °F and DBA UHS basin temperature of less than or equal to 95 °F are the bases for ESWS temperatures listed in FSAR Table 9.2.5-1. A value of 92 °F normal ESWS temperature is used for sizing the CCWS heat exchanger.

INSERT 3 FOR U.S EPR FSAR Table 9.2.5-1:

ESW Pump PEB 10/20/30/40 AP001	2.80	N/A	N/A	Normal Operations/Cooldown/ and DBA

Question 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.

Response to Question 09.02.05-28:

As indicated on U.S. EPR FSAR Tier 2, Figure 3.8-101, Essential Service Water Building Section A-A and Figure 3.8-102, Essential Service Water Building Section B-B, the UHS cooling tower fans are enclosed within the Essential Service Water Building and protected by a missile shield above the fans. Figure 3.8-102 shows missile protected air intakes that cause the intake air to make multiple turns before entering the fill area of the cooling tower. In case of tornado, these building features and the cooling tower fill and drift eliminators would cause resistance to high air flow that could affect the fans.

ITAAC Item No. 3.X will be added to Tier 1 Section 2.7.11.3 and Table 2.7.11-3 to confirm that the UHS cooling tower fans are protected from the effects of tornado including differential pressure effects, overspeed, and 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). An analysis will be completed by qualified individuals with the results documented in a report. Specific methods to be used to protect the UHS fans will be identified and described in the report.

U.S. EPR FSAR Tier 2, Section 9.2.5.3.1 will be revised to indicate that the UHS cooling tower fans are designed to withstand the effects of tornado including differential pressure effects, overspeed, and 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).

FSAR Impact:

U.S. EPR FSAR Tier 1, Section 2.7.11 and Tier 2, Section 9.2.5.3.1 will be revised as described in the response and indicated in the attached markup.

3.11 Deleted.

3.12 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 is designed in accordance with ASME Code Section III requirements.

3.13 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 is installed in accordance with an ASME Code Section III Design Report.

3.14 Pressure boundary welds in ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 are in accordance with ASME Code Section III.

3.15 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 retains pressure boundary integrity at design pressure.

~~3.16 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 is installed and inspected in accordance with ASME Code Section III requirements.~~

3.17 Components listed in Table 2.7.11-1 as ASME Code Section III are installed in accordance with ASME Code Section III requirements.

Insert 1

4.0 I&C Design Features, Displays and Controls

4.1 Displays listed in Table 2.7.11-2— Essential Service Water System Equipment I&C and Electrical Design are retrievable in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.7.11-2.

4.2 The ESWS equipment controls are provided in the MCR and the RSS as listed in Table 2.7.11-2.

4.3 Equipment listed as being controlled by a priority and actuator control system (PACS) module in Table 2.7.11-2 responds to the state requested by a test signal.

4.4 If one ESWS pump (30PEB10/20/30/40 AP001) fails during normal operation, a switchover to the other ESWS train is carried out automatically for the entire cooling train and is initiated by the CCWS Switchover sequence.

4.5 A spurious closure of the ESWS pump discharge valve (30PEB10/20/30/40 AA005) results in a switchover to the other ESWS train automatically for the entire cooling train and is initiated by the CCWS Switchover sequence.

4.6 Deleted.

4.7 Deleted.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.7.11-2 are powered from the Class 1E division as listed in Table 2.7.11-2 in a normal or alternate feed condition.

5.2 Valves listed in Table 2.7.11-2 fail as-is on loss of power.

5.3 Deleted.

Revised IAW RAI 351, Q 09.02.05-28

Table 2.7.11-3—Essential Service Water System ITAAC
(6 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
3.14	Pressure boundary welds in ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 are in accordance with ASME Code Section III.	Inspections of pressure boundary welds verify that welding is performed in accordance with ASME Code Section III requirements.	ASME Code Section III Data Reports exist and conclude that pressure boundary welding for ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 has been performed in accordance with ASME Code Section III.
3.15	ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 retains pressure boundary integrity at design pressure.	Hydrostatic tests will be performed on the as-built system.	For ESWS piping shown as ASME Code Section III on Figure 2.7.11-1, ASME Code Section III Data Reports exist and conclude that hydrostatic test results comply with ASME Code Section III requirements.
3.16	ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 is installed and inspected in accordance with ASME Code Section III requirements.	An inspection of the as-built piping will be performed.	For ESWS piping shown as ASME Code Section III on Figure 2.7.11-1, N–5 Data Reports exist and conclude that installation and inspection are in accordance with ASME Code Section III requirements.
3.17	Components listed in Table 2.7.11-1 as ASME Code Section III are installed in accordance with ASME Code Section III requirements.	An inspection of ASME Code Data Reports will be performed.	ASME Code Section III N-5 Data Reports exist and conclude that components listed as ASME Code Section III in Table 2.7.11-1 have been installed in accordance with ASME Code Section III requirements.
4.1	Displays exist or can be retrieved in the MCR and the RSS as identified in Table 2.7.11-2.	Tests will be performed for the retrievability of the displays in the MCR or the RSS as listed in Table 2.7.11-2.	a. The displays listed in Table 2.7.11-2 as being retrieved in the MCR can be retrieved in the MCR. b. The displays listed in Table 2.7.11-2 as being retrieved in the RSS can be retrieved in the RSS.

Insert 2

DRAFT

Revised IAW RAI 351, Q 09.02.05-28

UHS cooling tower fill is constructed of ceramic tile, supported on reinforced concrete beams. Spray piping and nozzles are fabricated of corrosion resistant materials (e.g., stainless steel, bronze). UHS cooling tower internals are seismically designed and supported to withstand a safe shutdown earthquake (SSE). Passive failures of the cooling tower spray or fill systems are considered extremely unlikely due to their materials of construction, supporting systems and Seismic Category I design.

Insert 3

To prevent the entrainment of debris from the UHS cooling tower, each cell of the UHS cooling tower includes a debris screen located between the cooling tower internals and the ESW pump.

To account for potential interference effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific conditions of orientation (with respect to wind direction), location, wind velocity, and direction to determine a wet bulb correction factor to account for interference effects.

To account for potential recirculation effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific location to determine a wet bulb correlation factor to account for recirculation effects.

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.

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).

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

Revised IAW RAI 351, Q 09.02.05-28

RAI 351 Question 09.02.05-28 Inserts

U.S. EPR FSAR Tier 1, Section 2.7.11:

INSERT 1

3.X The UHS fans are capable of withstanding the effects of tornado including differential pressure effects, overspeed, and 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).

U.S. EPR FSAR Tier 1, Table 2.7.11-3:

INSERT 2

3.X	The UHS fans are capable of withstanding the effects of tornado including differential pressure effects, overspeed, and 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).	a. Analyses will be performed to demonstrate that the UHS fans are capable of withstanding the effects of tornado including differential pressure effects, overspeed, and 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).	a. A report exists and concludes that the UHS fans are capable of withstanding the effects of tornado including differential pressure effects, overspeed, and 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). Methods to be used to protect the UHS fans will be identified and described in the report.
		b. Inspections will be performed of the UHS fans and other equipment located within the cooling tower structure to verify that the components are installed as specified on the construction drawings and deviations have been reconciled to the tornado analysis report.	b. Inspection reports exist and conclude that the UHS fans and other equipment located within the cooling tower structure are installed as specified on the construction drawings and deviations have been reconciled to the tornado analysis report.

U.S. EPR FSAR Tier 2, Section 9.2.5.3.1:

INSERT 3

The UHS fans are designed to withstanding the effects of tornado including differential pressure effects, overspeed, and 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).

Question 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.

Response to Question 09.02.05-30:

Item (b)

The design of the UHS components includes design features as described in Tier 2 Section 6.6.2 that permit appropriate periodic inspections. Tier 2 Section 9.2.1.6 and 9.2.5.6 will be revised, including a cross reference to Tier 2 Section 6.6.2, as stated in the enclosed markup.

In addition, NUREG-0800 Section 14.3 Appendix C, Subsection I.A.xii, states that accessibility does not need to be addressed in Tier 1 but should be addressed in Tier 2. Therefore, accessibility is not addressed in Tier 1 Section 2.7.11. As stated in Tier 2 Section 9.2.1.6 and 9.2.5.6 with the revision described above, the ESWS and UHS is accessible for periodic inspection.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 9.2.1.6 and 9.2.5.6 will be revised as described in the response and indicated on the enclosed markup.

Insert 1

, as described in Tier 2 Section 6.6.2,

Insert 2

(including inservice inspection)

A failure of the cleaning function of the debris filter in a safety-related division is monitored by the elevated differential pressure or function alarm. In this case, the operator initiates a division switchover.

9.2.1.5 Safety Evaluation

The ESWS pump buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the basis for the adequacy of the structural design of these structures.

The ESWS is designed to remain functional after a safe shutdown earthquake (SSE). Section 3.7 and Section 3.9 provide the design loading conditions that are considered. Section 3.5, Section 3.6 and Section 9.5.1 provide the hazards analyses to verify that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

The four division design of the ESWS provides complete redundancy; therefore a single failure will not compromise the ESWS system safety-related functions. Each division of ESWS is independent of any other division and does not share components with other divisions or with other nuclear power plant units.

Considering a single failure and preventative maintenance, two ESW divisions may be lost, but the ability to achieve the safe shutdown state under DBA conditions can be reached by the remaining two ESWS divisions. In case of LOOP the four ESW pumps have power supplied by their respective division EDGs.

During SAs, containment heat is removed by the dedicated cooling chain consisting of the severe accident heat removal system (SAHRS), dedicated CCWS, and dedicated ESWS. This cooling chain is manually actuated. In case of loss of the dedicated ESWS division, the SAHRS cooling chain is lost. This condition is outside the DBA.

In the event of an LOCA during power operations, the engineered safety features system (ESFS) (refer to Section 7.3) initiates a safety injection and containment isolation phase 1 signal. The ESWS divisions previously not in operation are automatically started by the PS.

9.2.1.6 Inspection and Testing Requirements

The ESWS is initially tested with the program given in Section 14.2, Test # 48.

The installation and design of the ESWS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of all safety-related equipment verifies its structural and leak tight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

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.

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 under normal and emergency conditions. The UHS is tested as described in Chapter 14.2, Test # 49.

The installation and design of the UHS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leaktight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

Section 3.9 and Section 6.6 outline the inservice testing and inspection requirements. Refer to Section 16.0, Surveillance Requirements (SR) 3.7.19 for surveillance requirements that verify continued operability of the UHS.

9.2.5.7 Instrumentation Applications

Instrumentation is provided in order to control, monitor and maintain the safety-related functions of the UHS. Indications of the process variables measured by the instrumentation are provided to the operator in the main control room.

9.2.5.7.1 System Monitoring

- Cooling tower basin water level.
- Cooling tower water temperature.

9.2.5.7.2 System Alarms

- Cooling tower water temperature low.
- Cooling tower basin water level low.
- Cooling tower basin water level high.

Question 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.

Response to Question 09.02.05-30:

Item (d)

The generation of debris within the UHS cooling tower or from the emergency makeup water system is unlikely and wind blown debris entering the cooling tower basin is not expected to be significant; nonetheless, the UHS is furnished with additional screening equipment and a site-specific chemical treatment support system to remove potential debris which could be generated from cooling tower operation itself, emergency makeup water system, or due to wind blown debris entering the air inlets.

As stated in the response to RAI 175 question 9.2.5-10, the ESWS pumps are protected by screens located in the pump suction flow path. More specifically, the ESW cooling tower basin water flows to the pump intake structure through a coarse screen and a fine screen (located in series) prior to reaching the ESW pump. Both of these screens are safety related and extend across the full width of the pump bay opening and above the maximum water level to assure full control of the debris across the flow cross section.

The coarse and fine screens mesh sizes are primarily selected to protect the ESW pump operation, since the components downstream of the pump, such as the system user heat exchangers and UHS cooling tower spray nozzles, are protected by the in-line automatic backwash strainer referred to below. The coarse screen mesh is sized to prevent large debris from entering the pump intake structure and the fine screen mesh is sized to allow the debris with sizes acceptable for pump operation to pass the screen. The selected mesh openings of coarse and fine screens are 2 inches and 0.5 inch, respectively. Pump requirements based on mesh sizes will be in the specification and selection for the ESW, and ESW dedicated pumps. Both screens will be designed with include provisions for manual cleaning. Tier 1 Table 2.7.11-3 will be revised to include an ITAAC that confirms the installation and proper mesh size of the screens. Tier 2 Table 3.2.2-1 will be revised to include the debris screens.

Safety related water level indicators are installed in the UHS cooling tower basin, on the upstream side of the coarse screen, and on the downstream side of the fine screen to monitor the differential water levels across the coarse screen and the fine screen continuously through the Distributed Control System (DCS). Based on a pre-set magnitude of differential pressure between these water level indicators, operators will be alerted to inspect the screens for potential debris accumulation and cleaning. Due to the large flow area across the screens the pressure drop across these screens will be small. The maximum allowable total pressure drop across both the coarse and the fine screen is 12 inches. However, the operating procedures will include provisions for a low water level alarm responding to a differential pressure set point for the operator to initiate inspection and manual cleaning of the screens as necessary. The set pressure drop across the screens corresponds to a screen blockage that is well within the design limit of 12 inches and has no effect on the NPSH available or submergence for the pump. Such high blockage of fine screens is unlikely due to the makeup water supply to basin being free from debris and insignificant debris generated by cooling tower operation such as small concrete/ceramic particles and wear products and/or air blown debris entering the tower basin through air inlets. Tier 2 Figure 9.2.1-1 will be revised to include a level instrument in the pump bay.

As stated in Tier 2 Section 9.2.5.2, the UHS cooling tower basin is furnished with a site-specific chemical treatment support system. The purpose of the chemical treatment support system is to minimize the biofouling of heat transfer surfaces, to inhibit scale formation, to minimize the growth of legionella and other bacteria, to minimize the corrosion of internal wetted surfaces (tubing and piping internal diameters, pump and valve internals, etc.) and to minimize foaming.

As stated in Tier 2 Section 9.2.1.3, an automatic backwash debris filter is located downstream of each ESW pump and it protects the components downstream of the pump, such as the system user heat exchangers and UHS cooling tower spray nozzles.

FSAR Impact:

U.S. EPR FSAR, Tier 1, Section 2.7.11 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR, Tier 2, Section 3.2.2, 3.11, 9.2.1 and 9.2.5 will be revised as described in the response and indicated on the enclosed markup.

Insert 1 for Tier 2 Section 9.2.5.7.1

- Cooling tower basin intake structure differential water level across screens

Insert 2 for Tier 2 Section 9.2.5.7.2

- Cooling tower basin intake structure differential water level across screens high

Insert 3 for Tier 2 Section 9.2.5.2

Each safety related division also includes a cooling tower basin intake structure with removable coarse and fine screens. The screens protect the ESWS pumps and the dedicated ESWS pump against debris.

Insert 4 for Tier 2 Section 9.2.1.3.1

- Maximum allowable water level differential across the coarse and fine screens

Insert 5 for Tier 2 Section 9.2.1.3.2

- Maximum allowable water level differential across the coarse and fine screens

Insert 6 for Tier 2 Section 9.2.1.3.3

"that pass through coarse and fine screens and"

Insert 7 for Tier 2 Section 9.2.1.3.4

"that pass through coarse and fine screens and"

Insert 8 for Tier 2 Section 9.2.5.3.4(New)

9.2.5.3.4 Coarse and Fine Screens

Coarse and fine screens are provided in the ESWS cooling tower basin intake structure to protect the ESWS pumps and dedicated ESWS pump against debris. Both of these screens are safety related and extend across the full width of the pump bay opening and above the maximum water level to assure full control of the debris across the flow cross section. The screens are removable for manual maintenance and cleaning. The coarse screen mesh is sized to prevent large debris from entering the pump intake structure and the fine screen mesh is sized to allow the debris with sizes acceptable for pump operation to pass the screen. Differential water level set points across the coarse and fine screens are provided and continuously monitored. Inspection and maintenance at pre-set intervals are carried out. An inspection and cleaning of the screens is initiated anytime the water level differential reaches alarm level set point

The collected debris must be treated in accordance with federal and state regulations relevant to the site location.

Insert 9 for Tier 2 Section 9.2.1.4.1

"the differential water level across coarse and fine screens is within limit, and ”

Insert 10 for Tier 2 Section 9.2.1.4.1

"In addition, if the differential water level across coarse and fine screens reaches alarm level, inspection and clearing of screens is initiated.”

Insert 11 for Tier 2 Section 9.2.1.4.2

"A blockage of the fine screen in a safety related division is monitored by the elevated differential level or function alarm. A blockage of the coarse or fine screens will result in an operator initiated division switchover".

Insert 12 for Tier 1 Section 7.0

7.X The inlet between the cooling tower basin and pump intake structure has a coarse and a fine debris screen for each ESW pump.

Insert 13 for Tier 1 Table 2.7.11-3

Commitment Wording		Inspection, Tests, Analyses	Acceptance Criteria
7.X	The inlet between the cooling tower basin and pump intake structure has a coarse and a fine debris screen for each ESW pump.	a. An inspection will be performed for the existence of a coarse and a fine debris screen at the inlet between the cooling tower basin and pump intake structure for each ESW pump. b. An inspection will be performed to verify the maximum mesh grid opening of the debris screens.	a. A coarse and a fine debris screen exists at the inlet between the cooling tower basin and pump intake structure for each ESW pump. b. The coarse debris screen mesh is a maximum grid opening of 2 x 2 inches. The fine debris screen mesh is a maximum grid opening of 0.5 x 0.5 inches.

Insert 14 for Tier 2 Table 3.2.2-1

KKS System or Component Code	SSC Description	Safety Classification	Quality Group Classification	Seismic Category	10 CFR 50 Appendix B Program	Location	Comments/ Commercial Code
30PED10/20/30/40 AT003	Coarse Debris Screen	S	C	I	Yes	URB	Manufacturer Standards
30PED10/20/30/40 AT004	Fine Debris Screen	S	C	I	Yes	URB	Manufacturer Standards

Insert 15 for Tier 2 Table 3.11-1

Name Tag	Tag Number	Local Area	EQ Environment	Radiation Environment	EQ Designated Function	Safety Class	EQ Program Designation
UHS Tower Basin Level Indicator	30PEB10CL002	31UQB01002	M	M	ES SI	S 1E EMC	Y(5) Y(6)

Insert 16 for Tier 2 Table 3.11-1

Name Tag	Tag Number	Local Area	EQ Environment	Radiation Environment	EQ Designated Function	Safety Class	EQ Program Designation
UHS Tower Basin Level Indicator	30PEB20CL002	32UQB01002	M	M	ES SI	S 1E EMC	Y(5) Y(6)

Insert 17 for Tier 2 Table 3.11-1

Name Tag	Tag Number	Local Area	EQ Environment	Radiation Environment	EQ Designated Function	Safety Class	EQ Program Designation
UHS Tower Basin Level Indicator	30PEB30CL002	33UQB01002	M	M	ES SI	S 1E EMC	Y(5) Y(6)

Insert 18 for Tier 2 Table 3.11-1

Name Tag	Tag Number	Local Area	EQ Environment	Radiation Environment	EQ Designated Function	Safety Class	EQ Program Designation
UHS Tower Basin Level Indicator	30PEB40CL002	34UQB01002	M	M	ES SI	S 1E EMC	Y(5) Y(6)

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.

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 under normal and emergency conditions. The UHS is tested as described in Chapter 14.2, Test # 49.

The installation and design of the UHS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leaktight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

Section 3.9 and Section 6.6 outline the inservice testing and inspection requirements. Refer to Section 16.0, Surveillance Requirements (SR) 3.7.19 for surveillance requirements that verify continued operability of the UHS.

9.2.5.7 Instrumentation Applications

Instrumentation is provided in order to control, monitor and maintain the safety-related functions of the UHS. Indications of the process variables measured by the instrumentation are provided to the operator in the main control room.

9.2.5.7.1 System Monitoring

- Cooling tower basin water level.
- Cooling tower water temperature.

9.2.5.7.2 System Alarms

- Cooling tower water temperature low.
- Cooling tower basin water level low.
- Cooling tower basin water level high.

The UHS operates for a nominal 30 days following a loss of coolant accident (LOCA) without requiring any makeup water to the source or demonstrates that replenishment or use of an alternate or additional water supply can be effected to ensure continuous capability of the sink to perform its safety-related functions.

9.2.5.2 System Description

The UHS consists of four separate, redundant, safety-related divisions. Also included is one dedicated non-safety-related division which is located in division 4. Each safety-related UHS division consists of one mechanical draft cooling tower with two fans, piping, valves, controls and instrumentation. System design parameters are listed on Table 9.2.5-2. The system is shown in Figure 9.2.5-1—Ultimate Heat Sink Piping and Instrumentation Diagram.

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).

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.

The UHS contains isolation valves at the cooling towers to isolate the safety related portions of the system from the non-safety-related basin support systems provided by the COL applicant. The site-specific UHS systems are shown in Figure 9.2.5-2—[[Conceptual Site-Specific UHS Systems]].

9.2.5.3 Component Description

9.2.5.3.1 Mechanical Draft Cooling Towers

The cooling towers are rectangular mechanical-induced draft-type towers. Each tower consists of two cells in a back-to-back arrangement. The two cells of the cooling tower in a particular division share a single cooling tower basin and each cell is capable of transferring fifty percent of the design basis heat loads for one division from the ESWS to the environment under worst-case ambient conditions. The division four cooling tower shares use with the dedicated ESW train and can transfer severe accident (SA) heat loads to the environment under worst-case ambient conditions.

The cooling tower fill design and arrangement maximize contact time between water droplets and air inside the tower. The tower fill spacing is chosen to minimize the buildup of biofilm and provide for ease of cleaning, maintenance, and inspection.

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

The non-safety-related dedicated division contains a dedicated ESWS pump, debris filter, piping, valves, controls, and instrumentation. The non-safety related ESWS pumps cooling water from the division four UHS cooling tower basin to the dedicated CCWS HX and back to the division four UHS cooling tower during severe accidents (SA). The dedicated ESWS ~~pump~~train is powered by Class 1E electrical ~~buses~~Division 4 and is capable of being supplied by an EDG or a station blackout diesel generator (SBODG).

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

9.2.1.3 Component Description

9.2.1.3.1 Safety-Related Essential Service Water Pumps

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

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

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

The pump motors are air cooled. To remove heat losses, an air recirculation system is installed for each division. In addition, anti-condensation heaters on the motors are switched on as soon as the pumps cease operation.

9.2.1.3.2 Dedicated Essential Service Water Pump

The 100 percent capacity dedicated ESW pump is normally in standby mode.

This non-safety-related pump is manually started only in response to certain postulated SA conditions; it is not credited for response to any DBA.

The required flow rate of the dedicated ESWS pump is defined by the heat to be removed from the dedicated CCWS HX. Design parameters are listed in Table 9.2.1-2. The pump is designed to fulfill the corresponding minimal required design mass flow rate under the following conditions:

- Minimal water level.
- Fluctuations in the supplied electrical frequency.
- Increased pipe roughness due to aging and fouling.
- Fouled debris filter.
- Minimum water level in cooling tower basin considers minimum submergence requirements to prevent vortex effects, and net positive suction head to prevent cavitation of the dedicated ESWS pump.

The pump motor is air cooled. In addition, an anti-condensation heater on the motor is switched on as soon as the pump ceases operation.

9.2.1.3.3 Debris Filters -Safety Divisions

The debris filters remove all debris particles from the cooling water that would obstruct the system user HXs.

The debris filters are designed as an automatic backwash type. With increasing fouling, the differential pressure across the filter segments increases until reaching a preset operational point. The pressure relief backwash process of the filter is initiated by either the signal of the differential pressure measuring system, a timer after the start of the ESW pump or via a manual operator initiation.

The discharge and disposal of the collected debris must be treated in accordance with federal and state regulations relevant to site location.

9.2.1.3.4 Debris Filter -Dedicated Division

The debris filter removes all debris particles from the cooling water that would obstruct the dedicated CCWS HX.

The debris filter is designed as an automatic backwash type. With increasing fouling, the differential pressure across the filter segments increases until reaching a preset operational point. The pressure relief backwash process of the filter is initiated by either the signal of the differential pressure measuring system, a timer after the start of the dedicated ESW pump or via a manual operator initiation.

The discharge and disposal of the collected debris must be treated in accordance with federal and state regulations relevant to the site location.

9.2.1.3.5 Piping, Valves, and Fittings

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

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 the fluid properties that apply.

The general protection concept in case of pipe failures in the ESWS with regard to flooding is based on the principle of restricting the consequences to the affected division. In case of significant leakage from an ESWS train in a Safeguard Building (SB), the associated motor-driven ESWS pump discharge isolation valve is automatically closed and the ESWS pump is tripped. Another ESWS train is also put into operation. The detection and isolation signaling is done by safety-related means. The nuclear island drain and vent system (NIDVS) sump level instrument in the non-controlled areas of the SBs provides a MAX alarm in the MCR and isolates the affected ESWS train. No operator action is required to isolate the ESWS in a large flooding event.

Primary overpressure protection on the ESWS side of the CCWS HXs is provided by thermal relief valves.

Secondary overpressure protection on the ESWS side of the CCWS HXs is provided by manual opening of the valve (located upstream of the relief valve) before isolation of the particular HX.

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[1].

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. Cooling tower fans operating in the reverse direction during normal operation are considered operable at the onset of a design basis accident (DBA). Upon receipt of a safety injection (SI) signal, any fans operating in the reverse direction are secured and brought to a complete stop before re-energizing to operate at full speed in the forward direction. Upon receipt of an SI signal, fans in the operating and standby trains are automatically set to full fan speed to dissipate the maximum heat load to the environment. The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within established limits and to protect against freezing.

To make sure the performance of the safety-related functions, all manually operated valves in the main lines of the safety-related ESWS divisions are mechanically locked in the proper position.

In-service testing of valves shall 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 3).

A maximum valve leakage criterion will be specified for the safety-related check valves which will be no less stringent than the API-598 metal seated check valve criterion. A hydraulic transient analysis will be performed to confirm the integrity of ESW piping to withstand the effects of water hammer.

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

9.2.1.4 Operation

9.2.1.4.1 Normal Operating Conditions

Safety-Related Divisions

The ESWS supply is vital for all phases of plant operation and is designed to provide cooling water both during power operation and shutdown of the plant. During normal plant operation, two of four pumps are in operation with the remaining divisions in standby. The pumps are switched over periodically, thus changing the operational divisions.

The four divisions are filled and vented prior to operation. Under normal system operating conditions on a per division basis, the ESWS pump is in operation, the debris filter is functioning and all the valves in the main line are open. If the differential pressure across the debris filter reaches the predefined setpoint, automatic filter cleaning is initiated.

During standby, the divisions not in operation are aligned for normal operation (manual valves in the main line are open) and the system is filled and vented. The debris filter is in standby and ready to start. The system can be started manually from the main control room or automatically. In all cases, only the start signal needs to be actuated; preparatory measures are not necessary. The stopping of a particular division is performed manually.

A failure of the cleaning function of the debris filter in a safety-related division is monitored by the elevated differential pressure or function alarm. In this case, the operator initiates a division switchover.

9.2.1.5 Safety Evaluation

The ESWS pump buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the basis for the adequacy of the structural design of these structures.

The ESWS is designed to remain functional after a safe shutdown earthquake (SSE). Section 3.7 and Section 3.9 provide the design loading conditions that are considered. Section 3.5, Section 3.6 and Section 9.5.1 provide the hazards analyses to verify that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

The four division design of the ESWS provides complete redundancy; therefore a single failure will not compromise the ESWS system safety-related functions. Each division of ESWS is independent of any other division and does not share components with other divisions or with other nuclear power plant units.

Considering a single failure and preventative maintenance, two ESW divisions may be lost, but the ability to achieve the safe shutdown state under DBA conditions can be reached by the remaining two ESWS divisions. In case of LOOP the four ESW pumps have power supplied by their respective division EDGs.

During SAs, containment heat is removed by the dedicated cooling chain consisting of the severe accident heat removal system (SAHRS), dedicated CCWS, and dedicated ESWS. This cooling chain is manually actuated. In case of loss of the dedicated ESWS division, the SAHRS cooling chain is lost. This condition is outside the DBA.

In the event of an LOCA during power operations, the engineered safety features system (ESFS) (refer to Section 7.3) initiates a safety injection and containment isolation phase 1 signal. The ESWS divisions previously not in operation are automatically started by the PS.

9.2.1.6 Inspection and Testing Requirements

The ESWS is initially tested with the program given in Section 14.2, Test # 48.

The installation and design of the ESWS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of all safety-related equipment verifies its structural and leak tight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

6.0 Environmental Qualifications

6.1 Deleted.

7.0 Equipment and System Performance

7.1 The ESWS UHS as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the CCWS.

7.2 The pumps listed in Table 2.7.11-1 have net positive suction head available (NPSHA) that is greater than net positive suction head required (NPSHR) at system run-out flow.

7.3 Class 1E valves listed in Table 2.7.11-2 can perform the function listed in Table 2.7.11-1 under system operating conditions.

7.4 The ESWS provides for flow testing of the ESWS pumps during plant operation.

7.5 Deleted.

7.6 The ESWS delivers water to the CCWS and EDG heat exchangers and the ESWPBVS room coolers.

8.0 Interface Requirements

8.1 The site specific emergency makeup water system provides 300 gpm makeup water to each ESW cooling tower basin to maintain the minimum basin water level.

9.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.11-3 lists the ESWS ITAAC.

Table 2.7.11-3—Essential Service Water System ITAAC (6 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
7.4	The ESWS has provisions to allow flow testing of the ESWS pumps during plant operation.	Testing for flow of the ESWS pumps back to the ESW cooling tower basin will be performed.	The closed loop allows ESWS pump flow back to the ESW cooling tower basin.
7.5	Deleted.	Deleted.	Deleted.
7.6	The ESWS delivers water to the CCWS and EDG heat exchangers and the ESWPBVS room coolers.	Tests and analyses will be performed to verify the ESWS delivery rate under operating conditions.	A report exists and concludes that the ESWS system delivers a combined total flowrate of at least 19,340 gpm.

Next File

Table 3.2.2-1—Classification Summary
Sheet 96 of 182

KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
PEB10/20/30/40	ESW Piping/ Components (Trains PEB10/20/30/40)	S	C	I	Yes	UQB, UZT[22], UJH, UBP	ASME Class 3[3]
30PEB10/20/30/40 AP001	ESW Pumps	S	C	I	Yes	UQB	ASME Class 3[3]
30PEB21/22/23/24	ESW to/from EDG Coolers	S	C	I	Yes	UQB	ASME Class 3[3]
30PEB11/12/13/14	ESW to/from UQB Ventilation System Room Cooler	S	C	I	Yes	UQB	ASME Class 3[3]
30PEB10/20/30/40	ESW Valves (Trains PEB10/20/30/40)	S	C	I	Yes	UQB, UJH, UBP	ASME Class 3[3]
30PED10/20/30/40 AN001/002	UHS Cooling Tower Fans	S	C	I	Yes	URB	
QKA	**Safety Chilled Water System**						
30QKA10/20/30/40 AP107	Running Pumps	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA10/20/30/40 AP108	Standby Pumps	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA10/40 AH112	Air Cooled Chillers	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA20/30 AH112	Water Cooled Chillers	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA10/20/30/40 BB101	Expansion Tanks	S	C	I	Yes	UJK	ASME Class 3[3]

Table 3.11-1—List of Environmentally Qualified Electrical/I&C Equipment (Sheet 52 of 130)

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID (Room Location)	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)		Safety Class (Note 4)			EQ Program Designation (Note 5)			
G CLS *KAB70AA019*	30KAB70CG019B	34UJH10004	M	H	ES	SI	S	1E	EMC		Y (2)	Y (5)	Y (6)
G Meas *KAB70AA116*	30KAB70CG116	30UJA11016	H	H		SI	S	1E	EMC	Y (1)		Y (5)	
G Opng *70AA191*	30KAB70CG191A	30UJA11016	H	H		SI	S	1E	EMC	Y (1)		Y (5)	
G Acty CCWS Inlet	30KAB70CR001	30UJA11016	H	H		SI	S	1E	EMC	Y (1)		Y (5)	
G Acty CCWS Outlet	30KAB70CR002	30UJA11016	H	H		SI	S	1E	EMC	Y (1)		Y (5)	
T Dnstr CVCS HP Cl2	30KAB70CT082	30UJA11016	H	H		SI	S	1E	EMC	Y (1)		Y (5)	
F Upstr QNA21 AC002	30KAB80CF060	31UJH10004	M	H		SI	S	1E	EMC		Y (2)	Y (5)	Y (6)
F Dnstr KAB80 Chil	30KAB80CF061	31UJH10004	M	H		SI	S	1E	EMC		Y (2)	Y (5)	Y (6)
G Opng *KAB80AA015*	30KAB80CG015A	31UJH10004	M	H		SI	S	1E	EMC		Y (2)	Y (5)	Y (6)
G Cls *KAB80AA015*	30KAB80CG015B	31UJH10004	M	H		SI	S	1E	EMC		Y (2)	Y (5)	Y (6)
G Opng *KAB80AA016*	30KAB80CG016A	31UJH10004	M	H		SI	S	1E	EMC		Y (2)	Y (5)	Y (6)
G Cls *KAB80AA016*	30KAB80CG016B	31UJH10004	M	H		SI	S	1E	EMC		Y (2)	Y (5)	Y (6)
Essential Service Water System (ESWS)													
30PEB10 AA002 Valve Motor Actuator	30PEB10AA002	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB10 AA003 Valve Motor Actuator	30PEB10AA003	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB10 AA005 Valve Motor Actuator	30PEB10AA005	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB10 AA015 Valve Motor Actuator	30PEB10AA015	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB10 AA016 Valve Motor Actuator	30PEB10AA016	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
ESW Pump Motor Heater, Train 1	30PEB10AH500	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
ESW Pump Motor, Train 1	30PEB10AP001	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB10 AT002 Filter Motor Actuator	30PEB10AT002	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
ESW Pump Discharge Flow Indicator	30PEB10CF001	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
CCW HX Outlet Flow Measurement	30PEB10CF002	31UJH05026	M	H	ES	SI	S	1E			Y (2)	Y (5)	
UHS Tower Basin Level Indicator	30PEB10CL001	31URB01003	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
ESW Pump Discharge Pressure Indicator	30PEB10CP002	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
ESW Pump Filter Diff Pressure Indicator	30PEB10CP003	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
ESW Pump Discharge Thermocouple	30PEB10CT001	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
SAQ HX DP Measurement	30PEB11CP001	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
SW Pump Bldg Cooler Pressure Indicator	30PEB11CP501	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
SAQ HX Outlet Temp Measurement	30PEB11CT001	31UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB20 AA002 Valve Motor Actuator	30PEB20AA002	32UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB20 AA003 Valve Motor Actuator	30PEB20AA003	32UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)
30PEB20 AA005 Valve Motor Actuator	30PEB20AA005	32UQB02001	M	M	ES	SI	S	1E	EMC			Y (5)	Y (6)

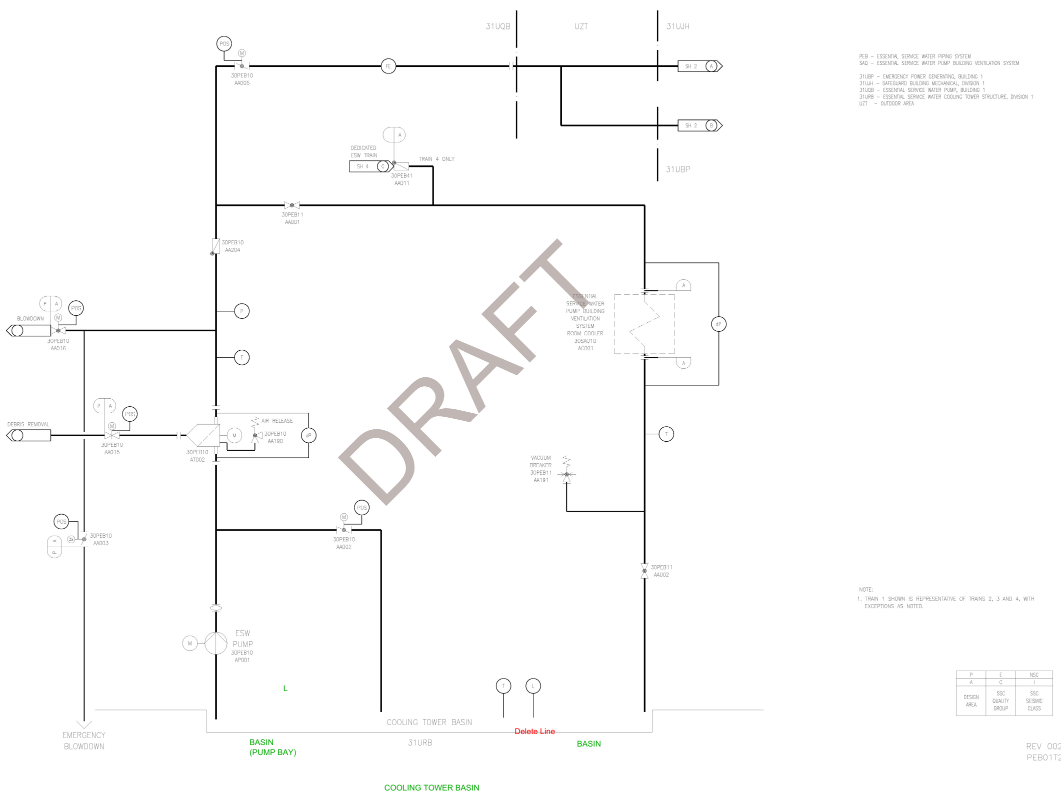
Table 3.11-1—List of Environmentally Qualified Electrical/I&C Equipment (Sheet 53 of 130)

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID (Room Location)	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)	Safety Class (Note 4)	EQ Program Designation (Note 5)
30PEB20 AA015 Valve Motor Actuator	30PEB20AA015	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB20 AA016 Valve Motor Actuator	30PEB20AA016	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Motor Heater, Train 2	30PEB20AH500	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Motor, Train 2	30PEB20AP001	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB20 AT002 Filter Motor Actuator	30PEB20AT002	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Discharge Flow Indicator	30PEB20CF001	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
CCW HX Outlet Flow Measurement	30PEB20CF002	32UJH05020	M	H	ES SI	S 1E	Y (2) Y (5)
UHS Tower Basin Level Indicator	30PEB20CL001	32URB01003	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Discharge Pressure Indicator	30PEB20CP002	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Filter Diff Pressure Indicator	30PEB20CP003	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Discharge Thermocouple	30PEB20CT001	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
SAQ HX DP Measurement	30PEB21CP001	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
SW Pump Bldg Cooler Pressure Indicator	30PEB21CP501	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
SAQ HX Outlet Temp Measurement	30PEB21CT001	32UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB30 AA002 Valve Motor Actuator	30PEB30AA002	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB30 AA003 Valve Motor Actuator	30PEB30AA003	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB30 AA005 Valve Motor Actuator	30PEB30AA005	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB30 AA015 Valve Motor Actuator	30PEB30AA015	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB30 AA016 Valve Motor Actuator	30PEB30AA016	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Motor Heater, Train 3	30PEB30AH500	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Motor, Train 3	30PEB30AP001	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB30 AT002 Filter Motor Actuator	30PEB30AT002	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Discharge Flow Indicator	30PEB30CF001	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
CCW HX Outlet Flow Measurement	30PEB30CF002	33UJH05020	M	H	ES SI	S 1E	Y (2) Y (5)
UHS Tower Basin Level Indicator	30PEB30CL001	33URB01003	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Discharge Pressure Indicator	30PEB30CP002	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Filter Diff Pressure Indicator	30PEB30CP003	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
ESW Pump Discharge Thermocouple	30PEB30CT001	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
SAQ HX DP Measurement	30PEB31CP001	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
SW Pump Bldg Cooler Pressure Indicator	30PEB31CP501	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
SAQ HX Outlet Temp Measurement	30PEB31CT001	33UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB40 AA002 Valve Motor Actuator	30PEB40AA002	34UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)
30PEB40 AA003 Valve Motor Actuator	30PEB40AA003	34UQB02001	M	M	ES SI	S 1E EMC	Y (5) Y (6)

Table 3.11-1—List of Environmentally Qualified Electrical/I&C Equipment (Sheet 54 of 130)

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID (Room Location)	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)		Safety Class (Note 4)			EQ Program Designation (Note 5)		
30PEB40 AA005 Valve Motor Actuator	30PEB40AA005	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AA015 Valve Motor Actuator	30PEB40AA015	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AA016 Valve Motor Actuator	30PEB40AA016	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Motor Heater, Train 4	30PEB40AH500	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Motor, Train 4	30PEB40AP001	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PEB40 AT002 Filter Motor Actuator	30PEB40AT002	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Discharge Flow Indicator	30PEB40CF001	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
CCW HX Outlet Flow Measurement	30PEB40CF002	34UJH05026	M	H	ES	SI	S	1E		Y (2)	Y (5)	
UHS Tower Basin Level Indicator	30PEB40CL001	34URB01003	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Discharge Pressure Indicator	30PEB40CP002	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Filter Diff Pressure Indicator	30PEB40CP003	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
ESW Pump Discharge Thermocouple	30PEB40CT001	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
SAQ HX DP Measurement	30PEB41CP001	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
SW Pump Bldg Cooler Pressure Indicator	30PEB41CP501	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
SAQ HX Outlet Temp Measurement	30PEB41CT001	34UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AA010 Valve Motor Actuator	30PED10AA010	31UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AA011 Valve Motor Actuator	30PED10AA011	31UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AA019 Valve Motor Actuator	30PED10AA019	31UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AA021 Valve Motor Actuator	30PED10AA021	31UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AN001 Fan Motor	30PED10AN001	31URB03001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED10 AN002 Fan Motor	30PED10AN002	31URB03002	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA010 Valve Motor Actuator	30PED20AA010	32UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA011 Valve Motor Actuator	30PED20AA011	32UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA019 Valve Motor Actuator	30PED20AA019	32UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AA021 Valve Motor Actuator	30PED20AA021	32UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AN001 Fan Motor	30PED20AN001	32URB03001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED20 AN002 Fan Motor	30PED20AN002	32URB03002	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED30 AA010 Valve Motor Actuator	30PED30AA010	33UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED30 AA011 Valve Motor Actuator	30PED30AA011	33UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED30 AA019 Valve Motor Actuator	30PED30AA019	33UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED30 AA021 Valve Motor Actuator	30PED30AA021	33UQB02001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED30 AN001 Fan Motor	30PED30AN001	33URB03001	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)
30PED30 AN002 Fan Motor	30PED30AN002	33URB03002	M	M	ES	SI	S	1E	EMC		Y (5)	Y (6)

Figure 9.2.1-1—Essential Service Water System Piping & Instrumentation Diagram
Sheet 1 of 4



RAI 351 09.02.05-30(d)

Question 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.

Response to Question 09.02.05-30:

Item (e)

Pumps, piping, valves and other components essential to the operation of the UHS are located within the boundary of the ESWPB, except the short section of emergency blowdown pipe exiting the building that is protected by the building structure (as stated in the response to RAI 351 9.2.5-22). As stated in Tier 2 Section 9.4.11, the ESWPB ventilation system maintains a minimum temperature. Moreover, the ESWS riser is located within the ESWPB and then branches off laterally to the spray nozzle header. The first of the self draining spray nozzles are attached to the header immediately after the header exits the ESWPB. As needed, any other piping and components subject to freezing conditions are provided with freeze protection design features, such as heat tracing. FSAR section 9.2.5.4 will be revised to include this freeze protection design feature.

ITAAC 2.1 and 2.2 in Tier 1 Table 2.7.11-3 confirm the as-built ESWS and UHS conform to the functional arrangement as shown on Tier 1 Figure 2.7.11-1 and are located as listed in Tier 1 Table 2.7.11-1. ITAAC 6.1 in Tier 1 Table 2.6.13-3 verifies the capability of the ESWPB ventilation system to maintain the ambient temperature in the ESWPB. Thus, ITAAC 2.1, 2.2 and 6.1 confirm the arrangement of the design and the capability of the ventilation system.

As stated in Tier 2 Section 9.2.5.4, “The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within the established limits and to protect against freezing.” Moreover, Tier 2 Section 2.4.7 explains that the cooling tower basin water temperature is monitored for all four ESW trains, regardless of operational status. In the event that basin water temperature drops to 40°F, an alarm alerts the operator to bring the train into bypass operation to prevent the formation of ice in the basin.

ITAAC 2.1 Tier 1 Table 2.7.11-3 confirms the as-built ESWS and UHS conforms to the functional arrangement as shown on Tier 1 Figure 2.7.11-1. Thus, ITAAC 2.1 confirms the arrangement of the cooling tower bypass.

The cooling tower fans provide freeze protection for the cooling tower air inlets as explained in the previously accepted response to RAI 351 9.2.5-25 part 4.

As stated in Tier 2 Section 14.2 Test 049 and Section 16 SR 3.7.19.3, an initial test and a periodic surveillance confirm the fan is capable of operating in the reverse direction.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 9.2.5.4 will be revised as described in the response and indicated on the enclosed markup.

Insert 1

Pumps, piping, valves and other components essential to the operation of the UHS are located within the boundary of the ESWPB, except the short section of emergency blowdown pipe exiting the building that is protected by the building structure. As stated in Tier 2 Section 9.4.11, the ESWPB ventilation system maintains a minimum temperature. Moreover, the ESWS riser is located within the ESWPB and then branches off laterally to the spray nozzle header. The first of the self draining spray nozzles are attached to the header immediately after the header exits the ESWPB. As needed, any other piping and components subject to freezing conditions are provided with freeze protection design features, such as heat tracing.

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[1].

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. Cooling tower fans operating in the reverse direction during normal operation are considered operable at the onset of a design basis accident (DBA). Upon receipt of a safety injection (SI) signal, any fans operating in the reverse direction are secured and brought to a complete stop before re-energizing to operate at full speed in the forward direction. Upon receipt of an SI signal, fans in the operating and standby trains are automatically set to full fan speed to dissipate the maximum heat load to the environment. The cooling tower bypass piping provides a means for diverting ESW return flow directly to the tower basin under low load/low ambient temperature conditions to maintain ESW cold water temperature within established limits and to protect against freezing.

Based on the increase in heat removal during a DBA, a temperature of less than or equal to 90°F is maintained in the UHS basin during normal operation, so that the cooling tower basin temperature does not exceed 95°F.

9.2.5.5 Safety Evaluation

The UHS pump buildings and cooling towers are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles and other natural phenomena. Section 3.3, Section 3.4, Section 3.5, Section 3.7 and Section 3.8 provide the basis for the adequacy of the structural design of these structures. The aboveground piping and components are protected by the structures.

The UHS is designed to remain functional after a safe shutdown earthquake (SSE). Section 3.7 and Section 3.9 provide the design loading conditions that are considered. Section 3.5, Section 3.6 and Section 9.5.1 provide the hazards analyses to verify that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

The four division design of the UHS provides complete redundancy; therefore a single failure will not compromise the UHS system safety-related functions. Each division of UHS is independent of any other division and does not share components with other divisions or with other nuclear power plant units.

Considering preventative maintenance and a single failure, two UHS divisions may be lost, but the ability to achieve the safe shutdown state under DBA conditions can be reached by the remaining two UHS divisions. In case of LOOP the four UHS cooling towers have power supplied by their respective division EDGs. Isolation valves can isolate non-safety-related portions of the system if necessary without compromising the safety-related function of the system.

The cooling towers must 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. After the initial 72 hours, the site specific makeup water system will provide sufficient flow rates of makeup water to compensate for system volume losses for the remaining 27 days. 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

Question 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.

Response to Question 09.02.05-30:

Item (f)(1)

As stated in the response to RAI 345 9.2.1-28 part a, "Pipe diameters for all branches of the ESWS are based on limiting the flow velocity to 10 ft/sec for normal modes of operation that are expected to occur frequently. This pipe diameter sizing criteria also applies to the UHS piping inside the Essential Service Water Pump Building and Cooling Tower Structure (ESWPB and ESWCT(S)). The UHS piping also has the ESWS designation (PE).

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 9.2.5.3.2 will be revised as described in the response and indicated on the enclosed markup.

Insert 1

Pipe diameters for all branches of UHS piping are based on limiting the flow velocity to 10 ft/sec for normal modes of operation that are expected to occur frequently.

UHS cooling tower fill is constructed of ceramic tile, supported on reinforced concrete beams. Spray piping and nozzles are fabricated of corrosion resistant materials (e.g., stainless steel, bronze). UHS cooling tower internals are seismically designed and supported to withstand a safe shutdown earthquake (SSE). Passive failures of the cooling tower spray or fill systems are considered extremely unlikely due to their materials of construction, supporting systems and Seismic Category I design.

To prevent the entrainment of debris from the UHS cooling tower, each cell of the UHS cooling tower includes a debris screen located between the cooling tower internals and the ESW pump.

To account for potential interference effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific conditions of orientation (with respect to wind direction), location, wind velocity, and direction to determine a wet bulb correction factor to account for interference effects.

To account for potential recirculation effects of the cooling towers, an inlet wet bulb correction factor is used. As part of addressing Item 2.0-1 of Table 1.8-2, the COL applicant that references the U.S. EPR design certification will evaluate their site-specific location to determine a wet bulb correlation factor to account for recirculation effects.

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.

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).

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

Question 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.

Response to Question 09.02.05-30:

Item (f)(2)

As stated in the response to RAI 345 9.2.1-26 part a, “U.S. EPR FSAR [Tier 1] Table 2.7.11-2 contains the IEEE Class 1E source and, as applicable for certain components, a Class 1E alternate feed source. The indications of SBO in Table 2.7.11-2 for the dedicated ESW pump and dedicated filter blowdown isolation valve have been appropriately deleted in response to RAI 334 9.2.2-76. SBO is not a Class 1E alternate feed source as indicated in Table Note 2.”

Similar to the items identified in Table 2.7.11-2 as “Dedicated” components, the division 4 cooling tower fans are capable of being supplied by a standby EDG or a SBODG that is provided as an alternate ac power source. The EDG commitment to ITAAC is already covered by Tier 1 Section 2.7.11, Subpart 5.1.

Tier 1 Section 2.7.11 Subpart 5.4, which was previously added in the response to RAI 345 9.2.1-26 part a, will be revised per insert 1:

Tier 1 Table 2.7.11-3, which was previously, added in the response to RAI 345 9.2.1-26 part a, will be revised per insert 2.

The text in insert 3 will be added to Tier 2 Section 9.2.5.3.1:

FSAR Impact:

U.S. EPR FSAR, Tier 1, Section 2.7.11 Subpart 5.4 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR, Tier 1, Table 2.7.11-3 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR, Tier 2, Section 9.2.5.3.1 will be revised as described in the response and indicated on the enclosed markup.

Insert 1

Items identified in Table 2.7.11-2 as “Dedicated” ESWS motor-operated components (including division 4 cooling tower fans) are capable of being supplied by a SBODG.

Insert 2

5.4	Items identified in Table 2.7.11-2 as “Dedicated” ESWS motor-operated components (including division 4 cooling tower fans) are capable of being supplied by a SBODG.	Testing will be performed for motor-operated components designated as “Dedicated” in Table 2.7.11-2 (including division 4 cooling tower fans) by supplying electrical power from an SBODG.	“Dedicated” components identified in Table 2.7.11-2 (including division 4 cooling tower fans) are capable of being supplied by an SBODG.

Insert 3

The division 4 cooling tower fans are capable of being supplied by a standby EDG or a station blackout diesel generator (SBODG) that is provided as an alternate ac power source.”

3.11 Deleted.

3.12 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 is designed in accordance with ASME Code Section III requirements.

3.13 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 is installed in accordance with an ASME Code Section III Design Report.

3.14 Pressure boundary welds in ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 are in accordance with ASME Code Section III.

3.15 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 retains pressure boundary integrity at design pressure.

3.16 ESWS piping shown as ASME Code Section III on Figure 2.7.11-1 is installed and inspected in accordance with ASME Code Section III requirements.

3.17 Components listed in Table 2.7.11-1 as ASME Code Section III are installed in accordance with ASME Code Section III requirements.

4.0 I&C Design Features, Displays and Controls

4.1 Displays listed in Table 2.7.11-2— Essential Service Water System Equipment I&C and Electrical Design are retrievable in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.7.11-2.

4.2 The ESWS equipment controls are provided in the MCR and the RSS as listed in Table 2.7.11-2.

4.3 Equipment listed as being controlled by a priority and actuator control system (PACS) module in Table 2.7.11-2 responds to the state requested by a test signal.

4.4 If one ESWS pump (30PEB10/20/30/40 AP001) fails during normal operation, a switchover to the other ESWS train is carried out automatically for the entire cooling train and is initiated by the CCWS Switchover sequence.

4.5 A spurious closure of the ESWS pump discharge valve (30PEB10/20/30/40 AA005) results in a switchover to the other ESWS train automatically for the entire cooling train and is initiated by the CCWS Switchover sequence.

4.6 Deleted.

4.7 Deleted.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.7.11-2 are powered from the Class 1E division as listed in Table 2.7.11-2 in a normal or alternate feed condition.

5.2 Valves listed in Table 2.7.11-2 fail as-is on loss of power.

5.3 Deleted.

Table 2.7.11-3—Essential Service Water System ITAAC (6 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
5.1	The components designated as Class 1E in Table 2.7.11-2 are powered from the Class 1E division as listed in Table 2.7.11-2 in a normal or alternate feed condition.	a. Testing will be performed for components designated as Class 1E in Table 2.7.11-2 by providing a test signal in each normally aligned division. b. Testing will be performed for components designated as Class 1E in Table 2.7.11-2 by providing a test signal in each division with the alternate feed aligned to the divisional pair.	a. The test signal provided in the normally aligned division is present at the respective Class 1E component identified in Table 2.7.11-2. b. The test signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E component identified in Table 2.7.11-2.
5.2	Valves listed in Table 2.7.11-2 fail as-is on loss of power.	Testing will be performed for the valves listed in Table 2.7.11-2 to fail as-is on loss of power.	Following loss of power, the valves listed in Table 2.7.11-2 fail as-is.
5.3	Deleted.	Deleted.	Deleted.
6.1	Deleted.	Deleted.	Deleted.
7.1	The ESW UHS as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the CCWS.	Tests and analyses will be performed to demonstrate the capability of the ESWS UHS as listed in Table 2.7.11-1 to remove the design heat load from CCWS.	The ESWS UHS has the capacity to remove at least the design heat load from the CCWS of 2.913 E+08 BTU/hr.
7.2	The pumps listed in Table 2.7.11-1 have NPSHA that is greater than NPSHR at system run-out flow.	Testing will be performed to verify NPSHA for pumps listed in Table 2.7.11-1.	The pumps listed in Table 2.7.11-1 have NPSHA that is greater than NPSHR at system run-out flow with consideration for minimum allowable cooling tower basin water level (as corrected to account for actual temperature and atmospheric conditions).
7.3	Class 1E valves listed in Table 2.7.11-2 perform the function listed in Table 2.7.11-1 under system operating conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.7.11-2 to change position as listed in Table 2.7.11-1 under system operating conditions.	The valve changes position as listed Table 2.7.11-1 under system operating conditions.

The UHS operates for a nominal 30 days following a loss of coolant accident (LOCA) without requiring any makeup water to the source or demonstrates that replenishment or use of an alternate or additional water supply can be effected to ensure continuous capability of the sink to perform its safety-related functions.

9.2.5.2 System Description

The UHS consists of four separate, redundant, safety-related divisions. Also included is one dedicated non-safety-related division which is located in division 4. Each safety-related UHS division consists of one mechanical draft cooling tower with two fans, piping, valves, controls and instrumentation. System design parameters are listed on Table 9.2.5-2. The system is shown in Figure 9.2.5-1—Ultimate Heat Sink Piping and Instrumentation Diagram.

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).

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.

The UHS contains isolation valves at the cooling towers to isolate the safety related portions of the system from the non-safety-related basin support systems provided by the COL applicant. The site-specific UHS systems are shown in Figure 9.2.5-2—[[Conceptual Site-Specific UHS Systems]].

9.2.5.3 Component Description

9.2.5.3.1 Mechanical Draft Cooling Towers

The cooling towers are rectangular mechanical-induced draft-type towers. Each tower consists of two cells in a back-to-back arrangement. The two cells of the cooling tower in a particular division share a single cooling tower basin and each cell is capable of transferring fifty percent of the design basis heat loads for one division from the ESWS to the environment under worst-case ambient conditions. The division four cooling tower shares use with the dedicated ESW train and can transfer severe accident (SA) heat loads to the environment under worst-case ambient conditions.

The cooling tower fill design and arrangement maximize contact time between water droplets and air inside the tower. The tower fill spacing is chosen to minimize the buildup of biofilm and provide for ease of cleaning, maintenance, and inspection.

Question 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.

Response to Question 09.02.05-31:

Item 3

Tier 1 Table 2.7.11-3 ITAAC 7.1 verifies the equipment as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the CCWS. As stated in the previously accepted response to RAI 345 9.2.1-44(b), the UHS cooling tower fans were added to Tier 1 Table 2.7.11-1. In addition, the cooling tower fans are verified through Tier 2 Section 14.2 Test 049 and periodically confirmed through Tier 2 Section 16 Surveillance Requirements 3.7.19.3. As stated in response to RAI 351 9.2.5-32(2)(c), the Test 049 section 3.1.2 will be revised to say "Demonstrate that fans operate in each speed setting and direction, including reverse". Surveillance 3.7.19.3 requires operating each cooling tower fan for ≥ 15 minutes in each speed setting and direction, including reverse verifies that all fans are OPERABLE and that all associated controls are functioning properly. It also ensures that fan or motor failure, or excessive vibration, can be detected for corrective action at a frequency of 31 days.

Tier 1 Table 2.7.11-3 ITAAC 4.3 verifies equipment listed as being controlled by a PACS module in Table 2.7.11-2, which includes the eight cooling tower fans, responds to the state requested by the test signal. In addition, Surveillance 3.7.19.4 verifies proper automatic operation of the UHS cooling tower fans on an actual or simulated actuation signal at a frequency of 24 months. Thus, the cooling tower fan response to actuation signal is verified through ITAAC and periodically through a surveillance requirement.

FSAR Impact:

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

Question 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.

Response to Question 09.02.05-31:

Item (a)

Each of the four mechanical draft cooling towers, which include the tower fill, wind drift eliminators, spray piping and nozzles, will be added to Tier 1 Table 2.7.11-1 for mechanical equipment as shown in Insert 1. Also, Tier 2 Section 9.2.5.3.1 will be revised to clarify that the tower fill, wind drift eliminators, spray piping and nozzles are part of the mechanical draft cooling tower.

As stated in SRP 14.3 Appendix C, Subsection I.A.iii, the internal workings of the mechanical draft cooling towers do not need to be discussed in Tier 1. Thus, the mechanical draft cooling towers are mechanical equipment included within the scope of ITAAC 3.4 in Tier 1 Table 2.7.11-3 which verifies the seismic adequacy of ESWS and UHS mechanical equipment.

In addition, the component description of the mechanical draft cooling tower (Tier 2 section 9.2.5.3.1) states "UHS cooling tower internals are seismically designed and supported to withstand a safe shutdown earthquake."

Tier 2 Table 3.2.2-1 and Tier 2 Table 3.10-1 will be revised to include the four mechanical draft cooling towers.

Item (b)

Tier 1 section 2.7.11-3 ITAAC 7.1 verifies the equipment listed in Table 2.7.11-1 has the capacity to remove the design heat load from the CCWS, EDG heat exchangers, the ESWPBVS room cooler and the ESW pump mechanical work. As stated in the previously accepted response to RAI 345 9.2.1-44(b), the UHS cooling tower fans were added to Tier 1 table 2.7.11-1. In response to Item (a), the mechanical draft cooling towers were added to Table 2.7.11-1; therefore, it is a component included in the scope of ITAAC 7.1 Tier 1 Table 2.7.11-3.

The cooling tower basin is considered a portion of the structure and ITAAC in Tier 1 Table 2.5.1-3 are used to confirm the adequacy of its design.

In response to the other items not specifically described above that were requested to be included in ITAAC, COL applicants have to address everything contained in the FSAR Tier 2 material independent of whether or not there is ITAAC on a specific feature. Inspections of ITAAC related activities are addressed by IMC 2503 while those for non-ITAAC activities are covered by IMC 2504.

The US EPR Tier 1 material and ITAAC was generated based on the guidance provided in SRP 14.3 (March 2007) using the process described in US EPR Tier 2 section 14.3. The process selected was based on the guidance provided in SRP 14.3 and consisted of two parallel paths, one based on the safety related function of the equipment and the other based on whether it is credited in a specific list of analyses. Page 14.3-19 of SRP 14.3 section 6.0 provides a summary of the guidance on selection of material from Tier 2 for inclusion in Tier 1 and defines the specific list analyses to be addressed. Additional specific topics are addressed in other sections of SRP 14.3 as discussed below.

- SRP 14.3 page 14.3-5 item 3, “If applicable, review the DCD for a certified design similar to the design for which certification is sought, specifically the Tier 1 information, for the purpose of using a similar approach, format, and language and for familiarity with the treatment of SSCs, the appropriate level of design detail, and other certification issues.”

- SRP 14.3 page 14.3-6 item 3, “Review the Tier 1 design descriptions to ensure that the key performance characteristics and safety functions of SSCs are appropriately treated at a level of detail commensurate with their safety significance.

- SRP 14.3 page 14.3-6 item 4, “Review Tier 1 for whether all information is clear and consistent with the Tier 2 information. If any new items are added to ITAAC, then ensure that they are added, including appropriate supporting analyses, to the applicable sections of Tier 2. Figures and diagrams should be reviewed to ensure that they accurately depict the functional arrangement and requirements of the systems. Reviewers should use the detailed review guidance in Appendix C to this SRP section as an aid in treating issues consistently and comprehensively.”

- SRP 14.3 (March 2007) Appendix C pages 14.3-24 through 14.3-32 provides the guidance specified for determining which Tier 2 (FSAR) material should be included in Tier 1 and have ITAAC. Examples of the guidance provided by this SRP are:

    - Unique features such as special features for flow testing.

    - Interlocks required for accomplishment of a direct safety function should be addressed; those provided for equipment protection do not need to be addressed.

    - Part B on figures specifies the use of simplified figures and diagrams and that only valves that accomplish an active safety function need to be addressed.

In the RAI question it was requested that ITAAC be provided for the following items listed in the table.

SSC	Requested ITAAC subject	Response
Cooling tower	Elevations Dimensions Materials Piping Fill Wind drift eliminators	The elevations, dimensions, and materials are not ‘unique features’ and are not credited in any of the listed safety analyses. In addition, materials are the responsibility of the COL applicant as stated in COL Items 9.2-4 and 9.2-5 in Tier 2 Table 1.8-2. Piping is covered in a level commensurate with its safety significance.

	Spray nozzles	Tower fill, wind drift eliminators, and spray nozzles are not unique features, rather they are internal parts of the mechanical draft cooling towers, and are not credited in any of the listed safety analyses.
Cooling tower basin	Elevations Dimensions Materials Screens Penetrations	See above response for elevations, dimensions, and materials. ITAAC are provided for the coarse and fine debris screens as stated in response to RAI 351 question 9.2.5-30(d). There are no specific penetration features to be verified by ITAAC.
ESWS	Elevations Materials Height of pump impeller above bottom of basin Valve and pipe sizes Pump specifications Heat exchanger specifications Filter size and specifications	See above response for elevations, dimensions, and materials. The height of the pump impeller with respect to the cooling tower basin was stated in the response to RAI 345 Question 9.2.1-34(e) regarding available NPSH. Tier 1 Table 2.7.11-3 ITAAC 7.2 verifies available NPSH. Valves and pipe sizes are not unique features. Pump performance is enveloped by confirming the necessary NPSH is available in Tier 1 Table 2.7.11-3 ITAAC 7.2 and through the system heat removal test in Tier 1 Table 2.7.11-3 ITAAC 7.6. The only heat exchanger within the scope of the ESWS-UHS is the UHS, which is enveloped by Tier 1 Table 2.7.11-3 ITAAC 7.1. ITAAC are provided for the coarse and fine debris screens as stated in response to RAI 351 question 9.2.5-30(d).

FSAR Impact:

U.S. EPR FSAR, Tier 1, Table 2.7.11-1 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR, Tier 2, Section 3.2.2, 3.10, and 9.2.5.3.1 will be revised as described in the response and indicated on the enclosed markup.

Insert 1

Description	Tag Number (1)	Location	ASME Code Section III	Function	Seismic Category
Mechanical Draft Cooling Tower Train 1 (excluding fans)	30PED10AC001	ESW Cooling Tower Structure 1	Yes	Heat Transfer Device	I
Mechanical Draft Cooling Tower Train 2 (excluding fans)	30PED20AC001	ESW Cooling Tower Structure 2	Yes	Heat Transfer Device	I
Mechanical Draft Cooling Tower Train 3 (excluding fans)	30PED30AC001	ESW Cooling Tower Structure 3	Yes	Heat Transfer Device	I
Mechanical Draft Cooling Tower Train 4 (excluding fans)	30PED40AC001	ESW Cooling Tower Structure 4	Yes	Heat Transfer Device	I

Insert 2

“spray nozzles, tower fill, wind drift eliminator”

Insert 3

KKS System or Component Code	SSC Description	Safety Classification	Quality Group Classification	Seismic Category	10 CFR 50 Appendix B Program	Location	Comments/ Commercial Code
30PED10/20/30/40 AC001	Mechanical Draft Cooling Towers (excluding fans)	S	C	I	Yes	URB	ASME Class 3[3]

Insert 4

Name Tag	Tag Number	Local Area	EQ Environment	Radiation Environment	EQ Designated Function	Safety Class	EQ Program Designation
Mechanical Draft Cooling Tower Train 1 (excluding fans)	30PED10AC001	31URB	M	M	SI	S	Y(5)
Mechanical Draft Cooling Tower Train 2 (excluding fans)	30PED20AC001	32URB	M	M	SI	S	Y(5)
Mechanical Draft Cooling Tower Train 3 (excluding fans)	30PED30AC001	33URB	M	M	SI	S	Y(5)
Mechanical Draft Cooling Tower Train 4 (excluding fans)	30PED40AC001	34URB	M	M	SI	S	Y(5)

Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design (6 Sheets)

Description	Tag Number [1]	Location	ASME Code Section III	Function	Seismic Category
Isolation Valve Dnstr KAA80AC001	30PEB80AA004	ESW Dedicated Division Safeguard Building 4	Yes	Open	I
Dedicated ESW Pump	30PEB80AP001	ESW Pump Structure Division 4	No	Run	N/A
Dedicated Blowdown Isolation Valve	30PEB80AA009	ESW Pump Structure Division 4	No	Close	N/A
Dedicated Filter Blowdown Isolation Valve	30PEB80AA016	ESW Pump Structure Division 4	No	Close	N/A
Dedicated Recirc Isolation Valve	30PEB80AA015	ESW Pump Structure Division 4	No	Close	N/A
Dedicated Filter Blowdown Isolation Check Valve	30PEB80AA211	ESW Pump Structure Division 4	No	Close	N/A
Dedicated Pump Isolation Check Valve	30PEB80AA002	ESW Pump Structure Division 4	No	Open	N/A
Dedicated Emergency Blowdown Isolation Valve	30PEB80AA003	ESW Pump Structure Division 4	No	Close	N/A

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

The UHS operates for a nominal 30 days following a loss of coolant accident (LOCA) without requiring any makeup water to the source or demonstrates that replenishment or use of an alternate or additional water supply can be effected to ensure continuous capability of the sink to perform its safety-related functions.

9.2.5.2 System Description

The UHS consists of four separate, redundant, safety-related divisions. Also included is one dedicated non-safety-related division which is located in division 4. Each safety-related UHS division consists of one mechanical draft cooling tower with two fans, piping, valves, controls and instrumentation. System design parameters are listed on Table 9.2.5-2. The system is shown in Figure 9.2.5-1—Ultimate Heat Sink Piping and Instrumentation Diagram.

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).

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.

The UHS contains isolation valves at the cooling towers to isolate the safety related portions of the system from the non-safety-related basin support systems provided by the COL applicant. The site-specific UHS systems are shown in Figure 9.2.5-2—[[Conceptual Site-Specific UHS Systems]].

9.2.5.3 Component Description

9.2.5.3.1 Mechanical Draft Cooling Towers

The cooling towers are rectangular mechanical-induced draft-type towers. Each tower consists of two cells in a back-to-back arrangement. The two cells of the cooling tower in a particular division share a single cooling tower basin and each cell is capable of transferring fifty percent of the design basis heat loads for one division from the ESWS to the environment under worst-case ambient conditions. The division four cooling tower shares use with the dedicated ESW train and can transfer severe accident (SA) heat loads to the environment under worst-case ambient conditions.

The cooling tower fill design and arrangement maximize contact time between water droplets and air inside the tower. The tower fill spacing is chosen to minimize the buildup of biofilm and provide for ease of cleaning, maintenance, and inspection.

Table 3.2.2-1—Classification Summary
Sheet 96 of 182

KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
PEB10/20/30/40	ESW Piping/ Components (Trains PEB10/20/30/40)	S	C	I	Yes	UQB, UZT[22], UJH, UBP	ASME Class 3[3]
30PEB10/20/30/40 AP001	ESW Pumps	S	C	I	Yes	UQB	ASME Class 3[3]
30PEB21/22/23/24	ESW to/from EDG Coolers	S	C	I	Yes	UQB	ASME Class 3[3]
30PEB11/12/13/14	ESW to/from UQB Ventilation System Room Cooler	S	C	I	Yes	UQB	ASME Class 3[3]
30PEB10/20/30/40	ESW Valves (Trains PEB10/20/30/40)	S	C	I	Yes	UQB, UJH, UBP	ASME Class 3[3]
30PED10/20/30/40 AN001/002	UHS Cooling Tower Fans	S	C	I	Yes	URB	
QKA	**Safety Chilled Water System**						
30QKA10/20/30/40 AP107	Running Pumps	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA10/20/30/40 AP108	Standby Pumps	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA10/40 AH112	Air Cooled Chillers	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA20/30 AH112	Water Cooled Chillers	S	C	I	Yes	UJK	ASME Class 3[3]
30QKA10/20/30/40 BB101	Expansion Tanks	S	C	I	Yes	UJK	ASME Class 3[3]

Table 3.10-1—List of Seismically and Dynamically Qualified Mechanical and Electrical Equipment (Sheet 93 of 195)

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID (Room Location)	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)	Safety Class (Note 4)	EQ Program Designation (Note 5)
CCW HX Tube Side Thermal Relief Vlv	30PEB40AA192	34UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Inlet Side DP Root Vlv	30PEB40AA306	34UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Outlet Side DP Root Vlv	30PEB40AA307	34UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB40AA401	34UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB40AA402	34UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB40AA403	34UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB40AA405	34UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB40AA407	34UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB40AA408	34UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Tube Side Vent Vlv	30PEB40AA508	34UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX Tube Side Vent Vlv	30PEB40AA509	34UJH10026	M	H	SI	S C/NM	Y (3) Y (5)
Orifice Plate	30PEB40BP002	34UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
CCW HX DP Measurement	30PEB40CP004	34UJH05026	M	H	SI	S	Y (5)
CCW HX Outlet Temp Measurement	30PEB40CT002	34UJH05026	M	H	SI	S	Y (5)
SAQ HX DP Measurement	30PEB41CP001	34UQB02001	M	M	SI	S	Y (5)
SAQ HX Outlet Temp Measurement	30PEB41CT001	34UQB02001	M	M	SI	S	Y (5)
CCW HX Outlet Isolation Vlv	30PEB80AA004	34UJH05026	M	H	SI	S C/NM	Y (3) Y (5)
ESW Drain Isolation Vlv	30PEB80AA405	34UJH01026	M	H	SI	S C/NM	Y (3) Y (5)
Safety Chilled Water System (SCWS)							
QKA Cross-Tie Valve, Div 1	30QKA10AA102	31UJK22028	M	M	SI	S C/NM	Y(5)
QKA Cross-Tie Valve, Div 1	30QKA10AA103	31UJK22028	M	M	SI	S C/NM	Y(5)
QK Tank Isol Valve, Div 1	30QKA10AA001	31UJK26029	M	M	SI	S C/NM	Y (5)
QK Pmp #1 Suct Isol Valve, Div 1	30QKA10AA002	31UJK22028	M	M	SI	S C/NM	Y (5)
QK Pmp #1 Disch Check Valve, Div 1	30QKA10AA003	31UJK22028	M	M	SI	S	Y (5)
QK Pmp #1 Disch Isol Valve, Div 1	30QKA10AA004	31UJK22028	M	M	SI	S C/NM	Y (5)
QK Chiller Dnstrm Flow Reg Valve, Div 1	30QKA10AA005	31UJK22028	M	M	SI	S C/NM	Y (5)
QK Chiller Dnstrm Isol Valve, Div 1	30QKA10AA006	31UJK22028	M	M	SI	S C/NM	Y (5)
QKA10AT001 Upstrm Isol Valve, Div 1	30QKA10AA007	31UJK26029	M	M	SI	S C/NM	Y (5)
QKA10AT001 Dnstrm Flow Reg Valve, Div 1	30QKA10AA008	31UJK26029	M	M	SI	S C/NM	Y (5)
QKA10AT001 Dnstrm Isol Valve, Div 1	30QKA10AA009	31UJK26029	M	M	SI	S C/NM	Y (5)
QK QCB Isol Valve, Div 1	30QKA10AA010	31UJK22028	M	M	SI	S C/NM	Y (5)
QK QCB Check Valve, Div 1	30QKA10AA011	31UJK22028	M	M	SI	S	Y (5)
QK Bypass Control Valve-MOV, Div 1	30QKA10AA101	31UJK26029	M	M	ES SI	S C/NM	Y (5)

Question 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.

Response to Question 09.02.05-31:

Item (c)

Tier 1 Section 2.7.11 Table 2.7.11-3 ITAAC 7.2 acceptance criteria refers to the minimum allowable cooling tower basin water level, and as stated in response to RAI 345 question 9.2.1-41(b) the required minimum water level in the cooling tower basin considers NPSH and vortex suppression. The acceptance criteria will be revised to clarify that the minimum allowable cooling tower basin water level accounts for vortexing

FSAR Impact:

U.S. EPR FSAR, Tier 1, Table 2.7.11-3 will be revised as described in the response and indicated on the enclosed markup.

Table 2.7.11-3—Essential Service Water System ITAAC (6 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
7.2	The pumps listed in Table 2.7.11-1 have sufficient NPSHA ~~that is greater than NPSHR at system run-out flow~~.	Testing and analyses will be performed to verify NPSHA for pumps listed in Table 2.7.11-1.	A report exists and concludes that ~~The~~ the pumps listed in Table 2.7.11-1 have NPSHA that is greater than NPSHR at the maximum ESWS flow rate ~~system run-out flow~~ with consideration for minimum allowable cooling tower basin water level (as corrected to account for actual temperature and atmospheric conditions).
7.3	Class 1E valves listed in Table 2.7.11-2 perform the function listed in Table 2.7.11-1 under system operating conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.7.11-2 to change position as listed in Table 2.7.11-1 under system operating conditions.	The valve changes position as listed Table 2.7.11-1 under system operating conditions.
7.4	The ESWS has provisions to allow flow testing of the ESWS pumps during plant operation.	Testing for flow of the ESWS pumps back to the ESW cooling tower basin will be performed.	The closed loop allows ESWS pump flow back to the ESW cooling tower basin.
7.5	Deleted.	Deleted.	Deleted.
7.6	The ESWS delivers water to the CCWS and EDG heat exchangers and the ESWPBVS room cooler~~s~~.	Tests and inspection of a pump data report ~~analyses~~ will be performed to verify the ESWS delivery rate to the CCWS and EDG heat exchangers and the ESWPBVS room cooler~~under operating conditions~~.	A report exists and concludes that the ESWS ~~system~~ delivers ~~a~~ the combined total flowrate of at least 19,340 gpm to the CCWS and EDG heat exchangers and the ESWPBVS room cooler.

Next File

Question 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.

Response to Question 09.02.05-31:

Item (d)

The acceptance criteria for Tier 1 Table 2.7.11-3 ITAAC 7.6 was revised to say the following in response to RAI 345 9.2.1-45: “A report exists and concludes that the ESWS delivers the combined total flow rate of at least 19,340 gpm to the CCWS and EDG heat exchangers, and the ESWPBVS room cooler”. The request to add “greater than or equal to” was met with the inclusion of “at least”.

FSAR Impact:

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

Question 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.

Response to Question 09.02.05-31:

Part (e)

ITAAC Item No. 7.7 will be added to Tier 1 Section 2.7.11.7 and Table 2.7.11-3. In addition, Tier 2 Section 9.2.5.5 will be revised to include the design bases for cooling tower performance.

For the conditions specified (i.e., minimum specified water inventory and limiting ambient conditions for heat removal) transient analyses will be completed by qualified individuals and the results will be documented in a report. The report will demonstrate that the cooling towers are capable of removing the design basis heat load without exceeding the maximum specified temperature limit for ESWS. The report will include: 1) performance curves for the cooling towers, 2) the period of record for the temperature data and the specific worst case periods used in the analysis, together with selection methods and validation techniques for the meteorological data, 3) a trend of water temperature in the cooling tower for the 30 day period, and 4) the effect of concentrated impurities in the cooling tower basin on the ESWS flow rate and the cooling tower performance.

The following assumptions are made for the report and are included in the design bases as follows:

- No makeup for the first 72 hours followed by site-specific makeup for the remaining 27 days. (U.S. EPR FSAR Tier 2 Section 9.2.5.5)
- No blowdown, no chemical treatment, and no backwash: U.S. EPR FSAR Section 9.2.5.2 states that the cooling towers contain valves to isolate the safety-related portions from the non-safety-related portions. Blowdown, chemical treatment and backwash are not safety-related; therefore, they will be isolated following an accident.

The report will show how the water temperature in the cooling tower basin will trend over time, considering the effect of concentrated impurities in the cooling tower basin on ESWS flow rate and cooling tower performance. The water quality at the end of the 30 day period will be compared with manufacturer's specifications. The report will include limiting assumptions and inputs, analytical methods, uncertainty analyses that demonstrate conservative results, and a list of references. Qualifications of the individuals performing the analysis and independent verification will also be included.

Part (f)

ITAAC Item No. 7.8 will be added to Tier 1 Section 2.7.11.7 and Table 2.7.11-3. In addition, Tier 2 Section 9.2.5.5 will be revised to include the design bases for cooling tower performance.

A similar report to the one described in (e) above will be prepared for the limiting conditions affecting water usage, as described in item (f).

FSAR Impact:

U.S. EPR FSAR Tier 2 Section 9.2.5.5 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 1 Section 2.7.11 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 1 Table 2.7.11-3 will be revised as described in the response and indicated on the enclosed markup.

INSERTS for RAI 351, Question 09.02.05-31 Part (e) and (f)

INSERT 1

During the 27 days following the 72 hour post-accident period the UHS cooling towers are capable of removing the design basis heat load without exceeding the maximum specified temperature limit for ESWS with minimum specified water inventory available and the most limiting site-specific ambient conditions that are assumed for heat removal. Analyses will demonstrate that the cooling towers are capable of removing the design basis heat load without exceeding the maximum specified temperature limit for ESWS. Transient analyses shall be completed by qualified individuals and the results will be documented in a report (Cooling Tower Design Report). The report shall include: 1) performance curves for the cooling towers, 2) the period of record for the temperature data and the specific worst case periods used in the analysis, together with selection methods and validation techniques for the meteorological data, 3) a trend of water temperature in the cooling tower for the 30 day period, and 4) the effect of concentrated impurities in the cooling tower basin on the ESWS flow rate and the cooling tower performance.

The report shall also include limiting assumptions and inputs, analytical methods, uncertainty analyses that demonstrate conservative results, and a list of references. Qualifications of the individuals performing the analysis and independent verification will also be included.

During the 27 days following the 72 hour post-accident period the UHS cooling towers are capable of removing the design basis heat load without water level dropping below the minimum required level in the cooling tower with minimum specified water inventory available and the most limiting site-specific ambient conditions that are assumed for water usage. Analyses will demonstrate that the cooling towers are capable of removing the design basis heat load without the water inventory dropping below the minimum required level in the cooling tower. Transient analyses shall be completed by qualified individuals and the results will be documented in a report (Cooling Tower Design Report). The report shall include: 1) performance curves for the cooling towers, 2) the period of record for the temperature data and the specific worst case periods used in the analysis, together with selection methods and validation techniques for the meteorological data, 3) a trend of water temperature and water level in the cooling tower for the 30 day period, and 4) the effect of concentrated impurities in the cooling tower basin on the ESWS flow rate and the cooling tower performance.

The report shall also include limiting assumptions and inputs, analytical methods, uncertainty analyses that demonstrate conservative results, and a list of references. Qualifications of the individuals performing the analysis and independent verification will also be included.

U.S. EPR FSAR Tier 1, Section 2.7.11:

INSERT 2

7.7 The ESWS and the UHS, including the site-specific emergency makeup water system, are capable of removing the design basis heat load for a minimum of 30 days following a design basis accident assuming the most limiting ambient conditions for heat removal and without exceeding the maximum specified temperature limit for ESWS.

7.8 The ESWS and the UHS, including the site-specific emergency makeup water system, are capable of removing the design basis heat load for a minimum of 30 days following a design basis accident assuming the most limiting ambient conditions for water usage and without water level dropping below the minimum required level in the cooling towers.

U.S. EPR FSAR Tier 1, Table 2.7.11-3:

INSERT 3

7.7	The UHS cooling towers are capable of removing the design basis heat load without exceeding the maximum specified temperature limit for ESWS.	Analyses will be performed to demonstrate that the UHS cooling towers, as-built, are capable of removing the design basis heat load, assuming the most limiting design conditions for heat removal (including the effects of concentrating impurities on the ESWS), without exceeding the maximum specified temperature limit for ESWS.	A report (Cooling Tower Design Report) exists and concludes that the UHS cooling towers are capable of removing the design basis heat load for a minimum of 30 days following a design basis accident without exceeding the maximum specified temperature limit for ESWS.
7.8	The UHS cooling towers are capable of removing the design basis heat load without water level dropping below the minimum required level in the cooling tower.	Analyses will be performed to demonstrate that the UHS cooling towers, as-built, are capable of removing the design basis heat load, assuming the most limiting design conditions for water usage (including the effects of concentrating impurities on the ESWS), without water level dropping below the minimum required level in the cooling tower basin.	A report (Cooling Tower Design Report) exists and concludes that the UHS cooling towers are capable of removing the design basis heat load for a minimum of 30 days following a design basis accident without water level dropping below the minimum required level in the cooling tower.

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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 makeup water system will provide sufficient flow rates of makeup water to compensate for system volume losses for the remaining 27 days. 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.

INSERT 1

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.

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 under normal and emergency conditions. The UHS is tested as described in Chapter 14.2, Test # 49.

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

The installation and design of the UHS provides accessibility for the performance of periodic inservice inspection and testing. Periodic inspection and testing of safety-related equipment verifies its structural and leaktight integrity and its availability and ability to fulfill its functions. Inservice inspection and testing requirements are in accordance with Section XI of the ASME BPV Code and the ASME OM Code.

Section 3.9 and Section 6.6 outline the inservice testing and inspection requirements. Refer to Section 16.0, Surveillance Requirements (SR) 3.7.19 for surveillance requirements that verify continued operability of the UHS.

5.0 Electrical Power Design Features

5.1 The components designated as Class 1E in Table 2.7.11-2 are powered from the Class 1E division as listed in Table 2.7.11-2 in a normal or alternate feed condition.

5.2 Valves listed in Table 2.7.11-2 fail as-is on loss of power.

5.3 Deleted.

6.0 Environmental Qualifications

6.1 Deleted.

7.0 Equipment and System Performance

7.1 The ESWS UHS as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the CCWS.

7.2 The pumps listed in Table 2.7.11-1 have sufficient net positive suction head absolute.

7.3 Class 1E valves listed in Table 2.7.11-2 can perform the function listed in Table 2.7.11-1 under system operating conditions.

7.4 The ESWS provides for flow testing of the ESWS pumps during plant operation.

7.5 Deleted.~~The non-safety-related dedicated ESWS as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the non-safety-related dedicated CCWS heat exchanger and ESWPBVS division 4 room cooler.~~

7.6 The ESWS delivers water to the CCWS and EDG heat exchangers and the ESWPBVS room coolers.

8.0 Interface Requirements~~Information~~

8.1 The site specific emergency makeup water system provides 300 gpm makeup water to each ESW cooling tower basin ~~in order~~ to maintain the minimum basin water level~~ in the ESW cooling tower basins~~.

9.0 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.11-3 lists the ESWS ITAAC.

INSERT 2

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DRAFT

Table 2.7.11-3—Essential Service Water System ITAAC (6 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
7.3	Class 1E valves listed in Table 2.7.11-2 perform the function listed in Table 2.7.11-1 under system operating conditions.	Tests and analyses or a combination of tests and analyses will be performed to demonstrate the ability of the valves listed in Table 2.7.11-2 to change position as listed in Table 2.7.11-1 under system operating conditions.	The ~~as-installed~~ valve changes position as listed Table 2.7.11-1 under system operating conditions.
7.4	The ESWS has provisions to allow flow testing of the ESWS pumps during plant operation.	Testing for flow of the ESWS pumps back to the ESW cooling tower basin will be performed.	The ~~flow test line~~closed loop allows ESWS pump flow back to the ESW cooling tower basin.
7.5	Deleted.~~The non-safety related dedicated ESWS as listed in Table 2.7.11-1 has the capacity to remove the design heat load from the non-safety-related dedicated CCWS heat exchanger and ESWPBVS division 4 room cooler.~~	Deleted.~~Tests and analyses will be performed to demonstrate the capability of the non-safety-related dedicated ESWS as listed in Table 2.7.11-1 to remove the design heat load from the non-safety related dedicated CCWS heat exchanger and ESWPBVS division 4 room cooler.~~	Deleted.~~The non-safety related dedicated ESWS has the capacity to remove the design heat load from the non-safety-related dedicated CCWS heat exchanger and ESWPBVS division 4 room cooler.~~
7.6	The ESWS delivers water at the required flow ~~and within the required time due to design basis events~~.	a. Tests and analyses will be performed to ~~determine~~ verify the ESWS delivery rate under design conditions. ~~b. An integrated system test will be performed using a simulated actuation signal to verify the startup time of the ESWS.~~	a. A report exists and concludes that the ESWS system delivers the following combined total design flowrate of at least~~:~~ 19,340 gpm. ~~b. A report exists and concludes that the ESWS starts within the following required time in response to a simulated actuation signal.~~

INSERT 3

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Next File

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 (2)(c)

Test 049 Section 3.1.2 will be revised to say “Demonstrate that fans operate in each speed setting and direction, including reverse”.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 14.2.12.5.8 (Test 049) will be revised as described in the response and indicated on the enclosed markup.

2.5 Test instrumentation available and calibrated per applicable procedures.

2.6 Appropriate AC and DC power sources are available.

2.7 UHS basin support systems required for operation of the UHS and ESWS are available, as required.

2.8 The UHS basin is filled to normal operating levels.

3.0 TEST METHOD

3.1 Demonstrate operation of the UHS tower over the design range of operation.

3.1.1 Simulate a UHS operating temperature that corresponds to the lower range of operation.

each speed setting and direction, including reverse.

3.1.2 Demonstrate that fans operate in the reverse direction.

3.1.3 Demonstrate that tower bypass paths realign to mitigate ice formation.

3.1.4 Simulate a gradual increase in ambient UHS temperature and terminate the ambient temperature increase at the upper end of the design operation band.

3.1.5 Record changes to tower fans and critical component operation during temperature increase.

3.2 Perform valve performance tests (e.g., valve position response of valves to loss of motive power, thrust, stroke time).

3.3 Demonstrate that UHS makeup flow rate meets design flow requirements.

3.3.1 During normal operation.

3.3.2 During emergency operation.

3.4 Demonstrate that UHS blowdown flow rate meets design flow requirements.

3.4.1 During normal operation.

3.4.2 During emergency operation.

3.5 Demonstrate the operation of UHS level and temperature instruments and alarms.

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

3.7 Demonstrate that the chemical treatment system functions as designed.

3.7.1 Injection flow rate to UHS.

3.7.2 Interlocks with UHS blowdown.

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:

New 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

1.1.2.1 Simulate a significant heat load on the CCW system and downstream systems (essential service water and ultimate heat sink) during hot functional testing.

Insert 2

2.5 Hot functional testing is in process for those sections that measure thermal-hydraulic performance.

2.6 Performance curves are available for the following components:

2.6.2 RHR heat exchanger.

2.6.3 CCW heat exchanger.

2.6.4 Ultimate heat sink tower.

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 RCS temperature is within the upper operating band for placing RHR into service.

3.40 Ensure that the other CCW trains are providing the minimum amount of cooling to RHR, chilled water, and other plant loads.

3.41 Ensure that CCW Train 1 is loaded with all available loads.

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

3.43 Place RHR Train 1 cooling into service.

3.44 Monitor thermal-hydraulic performance of the cooling chain including:

3.44.2 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.

3.44.3 CCW heat exchanger.

- CCW flow through the heat exchanger.
- Essential service water flow through the heat exchanger.
- Inlet and outlet CCW temperature.
- Inlet and outlet essential service water temperature on the CCW heat exchanger.

3.44.4 Essential service water.

- Essential service water flow to the UHS tower.
- Essential service water flow from the UHS basin.
- Inlet and outlet essential service water temperature at the ultimate heat sink.

3.44.5 Ultimate heat sink.

- Fan power.
- Inlet wet bulb and dry bulb air temperature for the ultimate heat sink.
- Barometric Pressure.

3.45 Determine cooling chain performance by extrapolating available data using design data.

3.46 Perform step 3.39 through 3.44 for CCWS Trains 2, 3, and 4 to measure thermal-hydraulic performance.

Insert 4

4.7 ~~Temperature~~ Thermal hydraulic performance data during cooldown.

Insert 5

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

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 versa~~CCWS 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 09.02.05-33:

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.

Response to Question 09.02.05-33:

In general, the design of the site specific UHS support systems are the responsibility of the COL applicant as stated in Tier 2 Table 1.8-2 Items 2.3-10 and 9.2-1, In addition, the following responses provide additional design information for the UHS support systems:

Refer to the response to RAI 397 09.02.05-36 for the emergency and normal makeup water systems.

Refer to the responses to RAI 351 09.02.05-22, 09.02.05-23(a)(b) and 09.02.05-24(b)(c) for the blowdown systems.

Refer to the responses to RAI 351 09.02.05-23(c) and 09.02.05-24(b) for the chemical treatment system.

Figures 9.2.5-1 and 9.2.5-2 will be revised to clarify the scope of the certified design for the UHS support systems.

FSAR Impact:

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

Figure 9.2.5-1—Ultimate Heat Sink Piping and Instrumentation Diagram

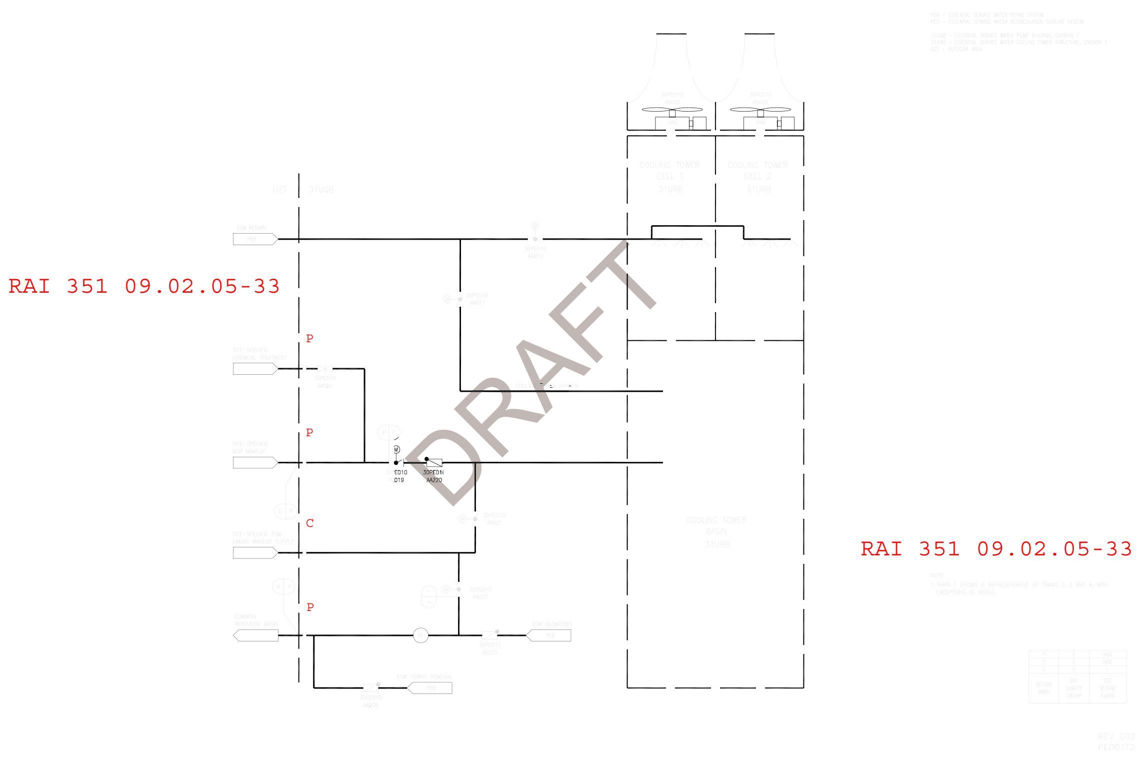
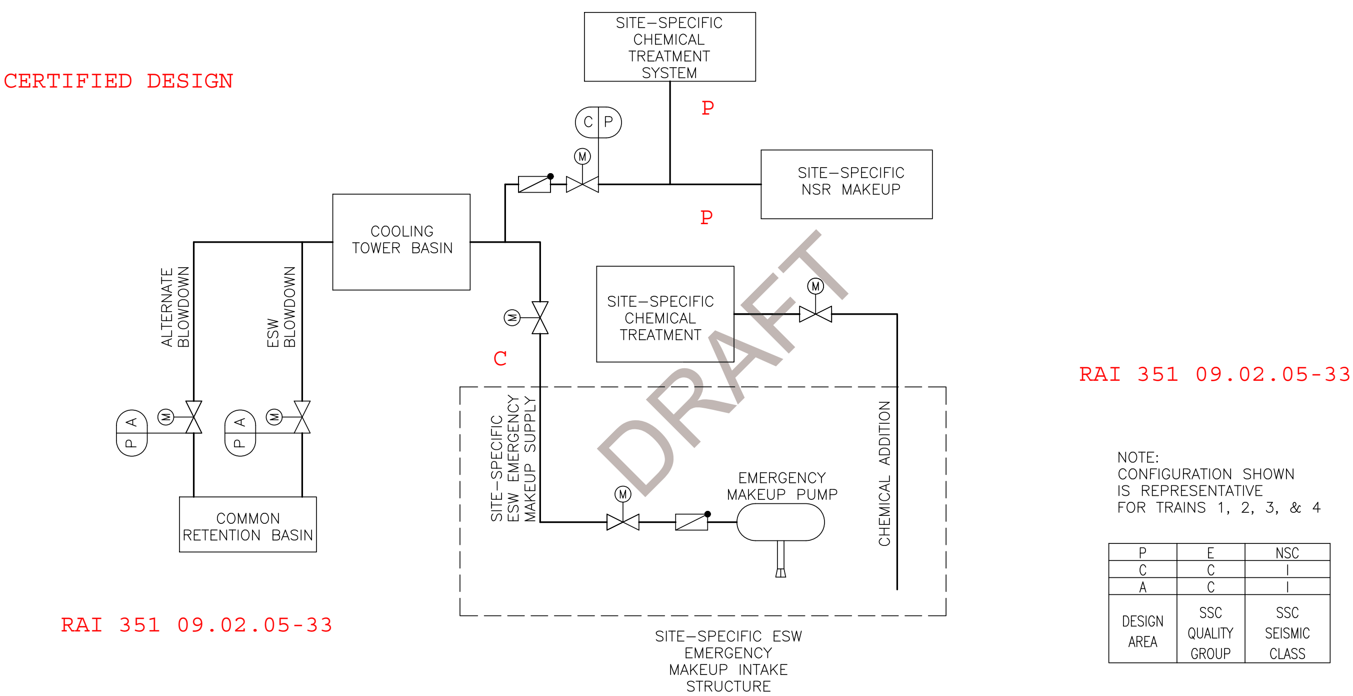


Figure 9.2.5-2—[[Conceptual Site-Specific UHS Systems]]



P	E	NSC
C	C	I
A	C	I
DESIGN AREA	SSC QUALITY GROUP	SSC SEISMIC CLASS

Next File

Question 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.

Response to Question 09.02.05-34:

The extent and nature of periodic inspections of piping and components that will be performed and the procedural controls that will be implemented is the responsibility of the COL applicant as stated in Tier 2 Section 13.5 and listed in Tier 2 Table 1.8-2 Item No. 13.5-1

FSAR Impact:

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

Question 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.

Response to Question 09.02.05-35:

As stated in the response to RAI 351 9.2.5-34, "The extent and nature of periodic inspections of piping and components that will be performed and the procedural controls that will be implemented is the responsibility of the COL applicant as stated in Tier 2 Section 13.5 and listed in Tier 2 Table 1.8-2 Item No. 13.5-1".

FSAR Impact:

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