## ArevaEPRDCPEm Resource

| | |
|---|---|
| **From:** | WELLS Russell D (AREVA NP INC) [Russell.Wells@areva.com] |
| **Sent:** | Friday, March 27, 2009 5:32 PM |
| **To:** | Getachew Tesfaye |
| **Cc:** | Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC) |
| **Subject:** | Response to U.S. EPR Design Certification Application RAI No. 119, FSAR Ch 9, Supplement 1 |
| **Attachments:** | RAI 119 Supplement 1 Response US EPR DC.pdf |

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to 2 of the 24 questions of RAI No. 119 on December 15, 2008. The attached file, "RAI 119 Supplement 1 Response US EPR DC.pdf" provides technically correct and complete responses to 15 of the remaining 22 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 119 Questions 09.02.01-1, 09.02.01-2, 09.02.01-3, 09.02.01-4, 09.02.01-7, 09.02.01-9, 09.02.01-11, 09.02.01-19, 09.02.01-21 and 09.02.01-22.

Since responses to the remaining 7 questions cannot be provided as committed, a revised schedule is provided in this email.

The following table indicates the respective pages in the response document, "RAI 119 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 119 — 09.02.01-1 | 2 | 3 |
| RAI 119 — 09.02.01-2 | 4 | 5 |
| RAI 119 — 09.02.01-3 | 6 | 6 |
| RAI 119 — 09.02.01-4 (Parts a through h, j and k) | 7 | 11 |
| RAI 119 — 09.02.01-5 | 12 | 12 |
| RAI 119 — 09.02.01-6 | 13 | 15 |
| RAI 119 — 09.02.01-7 | 16 | 16 |
| RAI 119 — 09.02.01-9 | 17 | 18 |
| RAI 119 — 09.02.01-11 | 19 | 20 |
| RAI 119 — 09.02.01-12 | 21 | 21 |
| RAI 119 — 09.02.01-14 | 22 | 22 |
| RAI 119 — 09.02.01-16 | 23 | 24 |
| RAI 119 — 09.02.01-18 | 25 | 25 |
| RAI 119 — 09.02.01-19 | 26 | 26 |
| RAI 119 — 09.02.01-20 | 27 | 27 |
| RAI 119 — 09.02.01-21 (Parts 2, 3, 11, 13, 18 and 19) | 28 | 30 |
| RAI 119 — 09.02.01-22 | 31 | 33 |

The schedule for technically correct and complete responses to the remaining 7 questions has been changed as provided below:

| Question # | Response Date |
|---|---|
| RAI 119 — 09.02.01-4 (Part i) | April 27, 2009 |
| RAI 119 — 09.02.01-8 | April 27, 2009 |
| RAI 119 — 09.02.01-10 | April 27, 2009 |
| RAI 119 — 09.02.01-17 | April 27, 2009 |
| RAI 119 — 09.02.01-21 (Parts 1, 4 through 10, 12 and 14 through 17) | April 27, 2009 |
| RAI 119 — 09.02.01-23 | April 27, 2009 |
| RAI 119 — 09.02.01-24 | April 27, 2009 |

Sincerely,

(Russ Wells on behalf of)

*Ronda Pederson*
ronda.pederson@areva.com
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**From:** WELLS Russell D (AREVA US)
**Sent:** Monday, December 15, 2008 4:36 PM
**To:** 'Getachew Tesfaye'
**Cc:** 'John Rycyna'; Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 119, FSAR Ch 9

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 119 Response US EPR DC.pdf" provides technically correct and complete responses to 2 of the 24 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 119 Questions 09.02.01-13 and 09.02.01-15.

The following table indicates the respective pages in the response document, "RAI 119 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 119 — 09.02.01-1 | 2 | 2 |
| RAI 119 — 09.02.01-2 | 3 | 3 |
| RAI 119 — 09.02.01-3 | 4 | 4 |
| RAI 119 — 09.02.01-4 | 5 | 6 |
| RAI 119 — 09.02.01-5 | 7 | 7 |
| RAI 119 — 09.02.01-6 | 8 | 8 |
| RAI 119 — 09.02.01-7 | 9 | 9 |

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|---|---|---|
| RAI 119 — 09.02.01-8 | 10 | 10 |
| RAI 119 — 09.02.01-9 | 11 | 11 |
| RAI 119 — 09.02.01-10 | 12 | 12 |
| RAI 119 — 09.02.01-11 | 13 | 13 |
| RAI 119 — 09.02.01-12 | 14 | 14 |
| RAI 119 — 09.02.01-13 | 15 | 15 |
| RAI 119 — 09.02.01-14 | 16 | 16 |
| RAI 119 — 09.02.01-15 | 17 | 17 |
| RAI 119 — 09.02.01-16 | 18 | 18 |
| RAI 119 — 09.02.01-17 | 19 | 19 |
| RAI 119 — 09.02.01-18 | 20 | 20 |
| RAI 119 — 09.02.01-19 | 21 | 21 |
| RAI 119 — 09.02.01-20 | 22 | 22 |
| RAI 119 — 09.02.01-21 | 23 | 24 |
| RAI 119 — 09.02.01-22 | 25 | 25 |
| RAI 119 — 09.02.01-23 | 26 | 26 |
| RAI 119 — 09.02.01-24 | 27 | 27 |

A complete answer is not provided for 22 of the 24 questions. The schedule for a technically correct and complete response to these questions is provided below.

| **Question #** | **Response Date** |
|---|---|
| RAI 119 — 09.02.01-1 | March 27, 2009 |
| RAI 119 — 09.02.01-2 | March 27, 2009 |
| RAI 119 — 09.02.01-3 | March 27, 2009 |
| RAI 119 — 09.02.01-4 | March 27, 2009 |
| RAI 119 — 09.02.01-5 | March 27, 2009 |
| RAI 119 — 09.02.01-6 | March 27, 2009 |
| RAI 119 — 09.02.01-7 | March 27, 2009 |
| RAI 119 — 09.02.01-8 | March 27, 2009 |
| RAI 119 — 09.02.01-9 | March 27, 2009 |
| RAI 119 — 09.02.01-10 | March 27, 2009 |
| RAI 119 — 09.02.01-11 | March 27, 2009 |
| RAI 119 — 09.02.01-12 | March 27, 2009 |
| RAI 119 — 09.02.01-14 | March 27, 2009 |
| RAI 119 — 09.02.01-16 | March 27, 2009 |
| RAI 119 — 09.02.01-17 | March 27, 2009 |
| RAI 119 — 09.02.01-18 | March 27, 2009 |
| RAI 119 — 09.02.01-19 | March 27, 2009 |
| RAI 119 — 09.02.01-20 | March 27, 2009 |
| RAI 119 — 09.02.01-21 | March 27, 2009 |
| RAI 119 — 09.02.01-22 | March 27, 2009 |
| RAI 119 — 09.02.01-23 | March 27, 2009 |
| RAI 119 — 09.02.01-24 | March 27, 2009 |

Sincerely,

(Russ Wells on behalf of)
*Ronda Pederson*
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**From:** Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
**Sent:** Friday, November 14, 2008 10:22 AM
**To:** ZZ-DL-A-USEPR-DL
**Cc:** James Tatum; John Segala; Peter Hearn; Joseph Colaccino; John Rycyna
**Subject:** U.S. EPR Design Certification Application RAI No. 119 (1410), FSARCh. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 23, 2008, and on November 13, 2008, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

**Hearing Identifier:** AREVA_EPR_DC_RAIs
**Email Number:** 347

**Mail Envelope Properties** (1F1CC1BBDC66B842A46CAC03D6B1CD410149B068)

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**Sent Date:** 3/27/2009 5:32:16 PM
**Received Date:** 3/27/2009 5:32:24 PM
**From:** WELLS Russell D (AREVA NP INC)

**Created By:** Russell.Wells@areva.com

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| MESSAGE | 7010 | 3/27/2009 5:32:24 PM |
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**Response to**

**Request for Additional Information No. 119, Supplement 1**

**11/14/2008**

**U. S. EPR Standard Design Certification**
**AREVA NP Inc.**
**Docket No. 52-020**
**SRP Section: 09.02.01 - Station Service Water System**
**Application Section: FSAR 9.2.1**

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

**Question 09.02.01-1:**

The emergency service water system (ESWS) must be able to withstand natural phenomena without the loss of function in accordance with 10 CFR 50, Appendix A, General Design Criterion (GDC) 2 requirements. The criteria that are specified in Tier 2 of the Final Safety Analysis Report (FSAR), Section 3.2, indicate that non-safety-related parts of the ESWS should be designated as Seismic Category II if a failure under seismic loading conditions could prevent or reduce the functional capability of a safety-related structure, system, or component (SSC). The staff found that insufficient information was provided to determine if the seismic designation for non-safety-related parts of the ESWS is appropriate. Also, the staff noted that the information on Tier 2 Figure 9.2.1-1, “Essential Service Water System Piping & Instrumentation Diagram,” (P&ID) was inconsistent with the information in Tier 2 FSAR Table 3.2.2-1, “Classification Summary,” in that the table (Sheet 94) shows that the dedicated ESWS pump is classified as non-safety-related supplemental grade (NS-AQ), Seismic Category II and the P&ID shows the dedicated ESWS pump as simply non-safety-related. The applicant needs to provide additional information in Tier 2 FSAR Section 9.2.1 to fully explain why the non-safety-related parts of the ESWS are not classified as Seismic Category II (i.e., why the assumed simultaneous failure of all non-safety-related ESWS piping will not adversely affect safety-related parts of the ESWS or any other safety-related SSCs that are in the same general area as the non-safety-related ESWS piping), and to explain the inconsistency noted above with respect to the Seismic Category II designation for the dedicated ESWS pump, and why other parts of the dedicated ESWS are not similarly designated as NS-AQ, Seismic Category II in Table 3.2.2-1 and on the P&ID.

**Response to Question 09.02.01-1:**

The seismic design classification of the essential service water system (ESWS) components is provided in U.S. EPR FSAR Tier 2, Table 3.2.2-1—Classification Summary and is consistent with the guidance provided in SRP 3.2.1 (refer to the Response to RAI 71, Question 03.02.01-1 for further details of the methodology for classifying SSC). Designation of a particular non-safety-related component as Seismic Category II (as stated in RG 1.29, Regulatory Position C.2) is dependent on the potential failure modes and consequences of that component, the proximity of Seismic Category I/safety-related components, and the vulnerability of those components to the consequences of the failure mode of the particular non-safety-related component in question. Failure of the non-safety-related non-seismic portions of the ESWS does not prevent or degrade the safety function of any safety-related Seismic Category I component of the ESWS.

Non-seismic lines and associated equipment are routed, to the extent possible, outside of safety-related structures and areas to avoid potentially adverse interactions. In the event that this routing is not possible and non-seismic lines must be routed in safety-related areas, the non-seismic items are evaluated for seismic interactions (refer to U.S. EPR FSAR Tier 2, Section 3.7.3.8).

U.S. EPR FSAR Tier 2, Table 3.2.2-1 will be revised to show the following changes for the dedicated ESW pump: safety classification changed from supplemented grade (NS-AQ) to non-safety related (NS), quality group classification changed from quality group D to quality group E, and seismic classification changed from Seismic Category II to non-seismic (NSC). These changes will make the classification of the dedicated ESW pump consistent with the other non-safety-related portions of the dedicated ESW subsystem.

Because the entries in U.S. EPR FSAR Tier 2, Table 3.2.2-1 are alphabetized within a given system by SSC description, the SSC description of all dedicated ESW components will begin with “Dedicated ESW” to provide clarity by maintaining contiguity of these non-safety-related components within the larger context of the ESWS.

To enhance U.S. EPR FSAR Tier 2, Table 3.2.2-1 clarity with respect to the ESWS (both safety-related and “dedicated ESW” portions) as depicted in U.S. EPR FSAR Tier 2, Figure 9.2.1, additional line items will be added to the table.

To provide additional clarity in differentiating between the safety-related portions of the ESWS and the non-safety-related dedicated ESW subsystem, several editorial changes to material in U.S. EPR FSAR Tier 2, Section 9.2.1 will be made.

U.S. EPR FSAR Tier 1, Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design will be revised to delete the non-safety-related dedicated ESW pump from the table.

U.S. EPR FSAR Tier 1, Table 2.7.11-3—Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria will be revised to reflect the deletion of the non-safety-related dedicated ESW pump from U.S. EPR FSAR Tier 1, Table 2.7.11-1.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Table 3.2.2-1 and Section 9.2.1 will be revised as described in the response and indicated on the enclosed markup.

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

**Question 09.02.01-2:**

The ESWS must be able to withstand natural phenomena without the loss of function in accordance with GDC 2 requirements. The system description does not explain the functioning and maximum allowed combined seat leakage of safety-related boundary isolation valves to ensure ESWS integrity and operability during seismic events and other natural phenomena. Consequently, the applicant needs to include additional information in Tier 2 Section 9.2.1 of the FSAR to fully describe: (a) how ESWS integrity and operability is assured by the safety-related boundary isolation valves so that common-cause simultaneous failure of all non-safety-related ESWS piping will not compromise the ESWS safety functions during seismic events, (b) what the maximum allowed combined seat leakage is for the safety-related ESWS boundary isolation valves (including check valve for the non-safety-related dedicated ESWS cooling water supply for the Division 4 ESWS room cooler) 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 that are necessary to assure the capability of the ESWS to perform its safety functions during natural phenomena.

**Response to Question 09.02.01-2:**

Part (a):

Non-safety-related ESW piping, components, and associated pipe supports located near or forming an extension of safety-related system piping and components are classified and designed as Seismic Category II or non-seismic depending on pipe routing. As a minimum, the non-safety-related system piping is seismically analyzed up to the boundary anchor. A Seismic Category II classification establishes that loss of physical integrity of non-safety-related structures, systems and components (SSC) as a result of natural phenomena will not result in an adverse interaction with a safety-related SSC that potentially compromises the capability of the safety-related SSC to perform its safety function. The safety-related essential service water system (ESWS) boundary isolation valves are classified and designed as Seismic Category I.

Non-seismic lines and associated equipment are routed, to the extent possible, outside of safety-related structures and areas to avoid potentially adverse interactions. In the event that this routing is not possible and non-seismic lines must be routed in safety-related areas, the non-seismic items are evaluated for seismic interactions (refer to U.S. EPR FSAR Tier 2, Section 3.7.3.8).

For additional information related to the seismic classification of ESW components, refer to the Response to RAI 119, Question 09.02.01-1.

Part (b):

The ultimate heat sink (UHS) tower basin volume is calculated considering the loss of inventory through valve seat leakage for 72 hours. The valves considered are those whose leakage will cause a loss of inventory in the UHS tower basin. After 72 hours and up to 30 days, the UHS emergency makeup system will provide sufficient water to the cooling tower basin including compensation for the valve leakage inventory loss. The following methodology is used to determine the valve seat leakage.

ASME OM Code, subparagraph ISTC-3630 (e) states that leakage rate measurements shall be compared with the permissible leakage rates specified by the Owner for a specific valve or valve combination. If leakage rates are not specified by the Owner, the following rates shall be permissible:

(1) For water, 0.5D gal/min (12.4d ml/s) or 5 gal/min (315 ml/s), whichever is less, at function pressure differential

where,

D = nominal valve size, inches
d = nominal valve size, centimeters.

In-service testing shall be performed as described in U.S. EPR FSAR Tier 2, Section 3.9.6.3, which establishes that the specified limit will not be exceeded.

U.S. EPR FSAR Tier 2, Section 9.2.1.3.5 will be revised to include the following information:

> "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 2004 Edition, Subsection ISTC."

**Part (c):**

The ESWS performs its safety function under design basis accident (DBA) conditions. As mentioned in U.S. EPR FSAR Tier 2, Section 9.2.1.1, the ESWS components are designed to withstand the effects of natural phenomena. The above ground piping and components are protected by the structures. The buried piping and components are inherently protected against natural phenomena, by providing adequate depth to confirm the integrity to perform the intended safety function.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 9.2.1.3.5 will be revised as described in the response and indicated on the enclosed markup.

**Question 09.02.01-3:**

The ESWS must be able to withstand natural phenomena without the loss of function in accordance with GDC 2 requirements. Tier 2 FSAR Table 3.2.2-1 (Sheet 96) indicates that some of the safety-related parts of the ESWS are located in outside areas. The applicant needs to provide additional information in Tier 2 of the FSAR to describe more specifically the location of these parts of the ESWS, identify the other SSCs located in the same general area, and describe the protection of safety-related parts of the ESWS that are located outside including the protection from adverse interactions with these other SSCs during an earthquake and other natural phenomena.

**Response to Question 09.02.01-3:**

The following safety-related portions of the essential service water system (ESWS) are located underground in outside areas:

- ESWS supply and return piping between the Safeguards Buildings (SB) and ESW Pump Buildings (ESWPB).
- ESWS supply and return piping between the Emergency Power Generating Buildings (EPGB) and ESWPBs.
- Safety-related duct banks and associated control and power cables between the Switchgear Building and ESWPBs.

The safety-related ESW trains are physically separated from one another, as well as from structures and components in other systems, to preclude any adverse interactions.

Other SSC are not located in close proximity to the buried ESW piping.

The safety-related ESWS duct banks and supply and return piping between the ESWPBs and SBs and EPGBs are indicated with the location designation UZT, which is the KKS designator for outdoor areas (refer to list of KKS identifiers in U.S. EPR FSAR Tier 2, Table 3.2.2-1, Notes). These SSC are buried at a sufficient depth to protect the piping from freezing as well as to shield the piping and duct banks from the effects of natural phenomena. This protection is described in U.S. EPR FSAR, Tier 2 Section 9.2.1.1, first and second bullets. Pipe routing in the yard will be consistent with these design bases.

U.S. EPR FSAR Tier 2, Table 3.2.2-1—Classification Summary will be revised to add a note to the List of Notes, and also, after the UZT designator corresponding to the ESW Piping/Components (Trains PEB10/20/30/40). Note 22 will specify:

> “ESW piping in trains PEB10/20/30/40 located in UZT are situated underground.”

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Table 3.2.2-1 will be revised as described in the response and indicated on the enclosed markup.

**Question 09.02.01-4:**

The ESWS must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with GDC 44 requirements. The ESWS description and P&ID were reviewed to assess the design adequacy of the ESWS for performing its heat removal functions. While the P&ID shows the ESWS components and identifies the boundaries between safety-related and non-safety-related parts of the system, some of the information is incomplete, inaccurate, or inconsistent. Consequently, the applicant needs to revise the FSAR to address the following considerations in this regard:

a. Pipe sizes are not shown on the P&ID, and the system description does not explain the criteria that were used in establishing the appropriate pipe sizes (such as limiting flow velocities).

b. The system description does not provide design details such as system operating temperatures, pressures, and flow rates for all operating modes and alignments.

c. The P&ID does not show where indications are displayed (e.g., local, remote panel, control room), and what instruments provide input to a process computer and/or have alarm and automatic actuation functions.

d. The P&ID does not show what the normal valve positions are, what valves are locked in position, and what valves have automatic functions; and these design features are not described.

e. The P&ID shows ESWS pump recirculation, emergency blowdown, and normal blowdown flow paths, but the functions and uses of these flow paths are not described and the flow rates are not provided.

f. The P&ID does not show a flow indicator for the ESWS pump room coolers and additional discussion is needed to explain how the ESWS flow rate through the pump room coolers will be periodically verified and confirmed to be adequate.

g. The ESWS filter high differential pressure alarm is not included in the summary of ESWS alarms provided in Tier 2 FSAR Table 9.2.1-3.

h. The P&ID does not show specific set point for alarms, relief valves, vacuum breakers, air release valves, automatic functions such as filter backwash, etc., and the bases for these set points are not explained in the system description.

i. The P&ID shows the cooling tower basin (sheet 1), makeup, blowdown and chemical treatment as part of the ESWS when they are referred to in the system description and more appropriately designated as part of the ultimate heat sink (UHS).

j. Confirm that the ESWS backwash filter motor and power supply are classified as safety-related, Class1E.

k. The system description (Tier 2 FSAR Section 9.2.1.3) indicates that each of the four safety-related ESWS divisions contains one 50 percent capacity pump. The staff noted that this characterization was only applied to the ESWS pumps and not to the pumps for interfacing systems that are cooled by ESWS (e.g. component cooling water system (CCWS) and residual heat removal/safety injection), and is inconsistent with the description provided in Tier 2 FSAR Section 1.2.3.1.1, “Overview,” which states:

> "Redundant safety systems (one in each Safeguard Building) are physically separated into four divisions, which protect the individual integrity of the electrical and mechanical safety systems. The four divisions of safety systems are consistent with an N+2 safety concept. With four safety divisions, one division can be out of service for maintenance, and one division can fail to operate, while the remaining two divisions are available to perform the necessary safety functions even if one of the two remaining becomes inoperable due to the initiating event."

Clarification is needed for what the 50 percent ESWS pump capacity designation means and how this relates to the interfacing systems that are cooled by ESWS and the description provided in Tier 2 FSAR Section 1.2.3.1.1.

**Response to Question 09.02.01-4:**

a. Specific emergency service water system (ESWS) line sizing details will be identified later in the design process. Pipe sizing is based on maintaining fluid velocities within 4 to 10 feet per second. Pipe sizes will be determined to optimize fluid velocities during all operating scenarios.

   The following factors are affected by velocity and will be considered:

   - Allowable line pressure drop.
   - Piping layout and configuration.
   - Economic evaluation that considers piping material costs and pumping energy costs.
   - Quality of fluid handled.
   - System operation (e.g., continuous, intermittent).
   - Effects of flashing, noise, vibration, water hammer, and erosion with high velocities at continuous service.

b. System operating temperatures, pressures, and flow rates for all modes and alignments that are not already provided in U.S. EPR FSAR Tier 2, Section 9.2.1 will be identified later in the design process.

c. Locations where indications are displayed (e.g., local, remote panel, control room), and what instruments provide input to a process computer and/or have alarm and automatic actuation functions will be developed later in the design process.

d. The level of detail required to show the normal valve positions (i.e., what valves are locked in position, what valves have automatic functions, and what valves have manually operated controls with restricted access) will be identified later in the design process. Normal operation is described by the following:

- 30PEB10/20/30/40 AA005, the ESWS pump discharge isolation valve, is open during normal operation. Prior to train startup, the valve is closed. After pump start, the valve automatically opens.

- 30PEB10/20/30/40 AA002 and 30PEB80 AA015, the pump minimum flow recirculation valve, is normally closed during normal operation. Prior to train startup, the valve is closed. In the event the ESW pump discharge isolation valve 30PEB10/20/30/40 AA005 fails to open after pump start, the minimum flow recirculation valve opens to establish a flow path for water from the pump back to the cooling tower basin, thereby protecting the pump from damage due to overheating.

- 30PEB10/20/30/40 AA016, the ESWS normal blowdown isolation valve, is throttled as necessary during normal operation to maintain ESW water chemistry within established limits.

- 30PEB80 AA016, the dedicated ESW blowdown isolation valve, is throttled as necessary during normal operations to maintain ESW water chemistry within established limits.

- 30PEB10/20/30/40 AA003, cooling tower emergency blowdown system isolation valves are motor-operated valves capable of being throttled, as necessary, to obtain the desired blowdown flow rate, based on water chemistry analysis results.

- 30PEB10/20/30/40 AA015 and 30PEB80 AA009, the debris filter blowdown isolation valve, is cycled open and automatically closed as necessary during normal operations to provide a flow path for debris removal from the debris filter during the automatic backwash cycle.

- 30PED10/20/30/40 AA010, the ESWS return header isolation valve, is open during normal operations. The valve automatically closes when the ESW pump for that train is de-energized.

- 30PED10/20/30/40 AA011, the ESWS cooling tower bypass isolation valve, is shut during normal operations. The valve will be repositioned automatically under low heat load/low ambient conditions to help maintain ESW basin water temperature above established limits.

- 30PED10/20/30/40 AA019, the ESWS normal makeup water isolation valve, is cycled open and closed as necessary during normal operations to maintain cooling tower basin water level within the established operating band. Upon receipt of a safety injection (SI) signal, the valve automatically closes, isolating the non-safety-related normal makeup water system from the safety-related emergency makeup system.

- 30PED10/20/30/40 AA021, the ESWS emergency makeup water isolation valve, is closed during normal operations. Upon receipt of an SI signal, the valve automatically opens to establish the flow path from the ESW emergency makeup system to the tower basin.

e. The minimum flow recirculation line extends from the pump discharge line and runs to the tower basin. The flow path is established if the ESW pump minimum flow recirculation isolation valve is opened due to failure of the ESW pump discharge isolation valve to open. The recirculation line will be sized to provide adequate flow based on the final pump selection.

   The normal blowdown flow path extends from the ESW supply header just downstream of the debris filter to the plant waste water retention basin. Flow from the ESWS to the retention basin is established when the ESW normal blowdown isolation valve opens. The debris removal line joins the normal blowdown flow path downstream of a check valve in the blowdown line. The blowdown flow rate and line size will be based on evaporation loss from the associated cooling tower and maintaining the number of cycles of concentration in the tower basin.

   The emergency blowdown line extends from the normal blowdown line to its terminal end outside the ESW pump building. The flow path is established when the ESW emergency blowdown isolation valve is opened by the operator. This flow path is used only in the event of a failure of the normal blowdown flow path. This line will be sized based on evaporation loss from the associated cooling tower and maintaining the number of cycles of concentration in the tower basin.

f. Temporary flow instrumentation will be installed for the performance of periodic cooler surveillance testing and testing after repairs. The purpose of the cooler is to maintain pump room temperature within established limits. Performance curves for the cooler will (with consideration for the pump room geometry) establish expected room temperatures over the range of expected outside ambient conditions. Maintenance of suitable temperatures in the pump room of an operating train, with consideration to the outside ambient conditions, confirms indirectly that the room cooler is operating adequately.

g. The ESWS filter high differential pressure alarm and cooling tower basin level alarms will be added to U.S. EPR FSAR Tier 2, Table 9.2.1-3—Alarm Summary.

h. Setpoints and bases for alarms, relief valves, vacuum breakers, air release valves, debris filter backwash cycle initiation, and automatic opening of the minimum flow recirculation valves will be developed later in the design process.

j. The ESWS backwash filter motor and power supply are classified as safety-related, Class1E.

k. The 50 percent ESW pump capacity designation means each train supplies 50 percent of plant capacity or 100 percent of train capacity. Each ESW train contains one 100 percent capacity pump for that division. Two 50 percent divisions are available to meet 100 percent of the plant requirements. With each ESW division supplying 100 percent of train capacity requirements; this is no different than the other systems that interface with the ESWS.

The CCWS uses one pump per train to supply the associated train related users, independent of the operation of other CCWS trains and their pumps. For accident mitigation, two of four CCWS trains are required to be available for heat removal (refer to U.S. EPR FSAR Tier 2, Section 9.2.2.2).

U.S. EPR FSAR Tier 2, Section 9.2.1.3.1 will be revised to reflect this clarification.

**FSAR Impact:**

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

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

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

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

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

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

g. U.S. EPR FSAR Tier 2, Table 9.2.1-3 will be revised as described in the response and indicated on the enclosed markup.

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

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

k. U.S. EPR FSAR Tier 2, Section 9.2.1.3.1 will be revised as described in the response and indicated on the enclosed markup.

**Question 09.02.01-5:**

The ESWS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with GDC 44 requirements. In order for the staff to confirm that the ESWS has been adequately sized, the applicant needs to include additional information in Tier 2 of the FSAR, Section 9.2.1, to fully describe and explain what the minimum system heat transfer and flow requirements are for normal operating, refueling, and accident conditions, the bases for these requirements including limiting assumptions that apply (such as temperature considerations, recirculation flow, and blowdown flows), the degree of excess margin available and the method used to determine it, and the limiting system temperatures and pressures that are assumed with supporting basis.

**Response to Question 09.02.01-5:**

Essential service water system (ESWS) flow rates are specified to remove heat from the component cooling water (CCW) heat exchanger, emergency diesel generator (EDG) coolers, and essential service water (ESW) room cooler. Specific heat loads, mass flow requirements, and temperatures for normal operating, spring/fall outage, design basis accident (DBA) and severe accident are provided in U.S. EPR FSAR Tier 2, Table 9.2.5-1—Ultimate Heat Sink System Interface with no recirculation or blowdown. Individual ESW flow rates to the CCW heat exchanger, EDG coolers, and ESW pump room cooler are addressed in the Response to Question 09.02.01-7. Final margin and limiting system temperatures and pressures will be determined later in the design process incorporating vendor information.

**FSAR Impact:**

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

**Question 09.02.01-6:**

The ESWS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with GDC 44 requirements. The system description (Section 9.2.1.3.1) indicates that the ESWS pumps are sized to accommodate head losses in the cooling water inlet piping based on full power flow conditions, fluctuations in the supplied electrical frequency, increased pipe roughness due to aging and fouling, fouled debris filters, and maximum pressure drop through the system heat exchangers. In order for the staff to confirm that the ESWS has been adequately sized, the applicant needs to include additional information in Tier 2 FSAR Section 9.2.1 to fully describe the actual amount of excess margin that is provided by the design and the basis for this determination needs to be explained.

**Response to Question 09.02.01-6:**

NUREG-0800, Section 9.2.1 indicates that essential service water system (ESWS) and component design margins are not required to be documented in the U.S. EPR FSAR. The essential service water (ESW) pump overall design margin will be determined later in the design process.

The ESWS consists of four safety-related cooling trains and one non-safety-related cooling train. For the four safety-related trains, the ESW pump total developed head (TDH) is based, in part, on the pressure losses incurred in the limiting ESW train. The principal ESW pump TDH considerations are as follows:

- Flow to main ESW circuit – 17,000 gpm.
- Flow to emergency diesel generator (EDG) coolers – 2,200 gpm.
- Flow to ESW pump room cooler – 137.6 gpm.
- Maximum cold water ESW fluid temperature – 95°F.
- Minimum cold water ESW fluid temperature – 40°F.
- Pipe material absolute roughness – 0.0018 in.
- Pressure drop across component cooling water (CCW) coolers – 15 psi.
- Pressure drop across emergency diesel generator (EDG) coolers – 30 psi.
- Pressure drop across debris filter – 5 psi.
- Pressure drop across cooling tower spray nozzle – 7 psi.
- Pressure drop through pipes and fitting – 9.44 psi (maximum pressure drop of the four trains).

- Minimum water level in the UHS tower basin – 95 inches from vertical turbine pump bell bottom.

For the non-safety-related cooling train, the dedicated ESW pump TDH is based on the following:

- Maximum cold water dedicated ESW fluid temperature – 95°F.
- Pressure drop across dedicated CCW heat exchanger – 15 psi.
- Pressure drop across debris filter – 5 psi.
- Pressure drop across cooling tower spray nozzle – 7 psi.
- Pressure drop through pipes and fitting – 6.32 psi.
- Minimum water level in the UHS tower basin – 46 inches from vertical turbine pump bell bottom.

Piping lengths and fitting types, sizes, and numbers are taken from isometrics for the ESW trains.

The differences between actual values and design input values translate into additional design margin.

Adding water treatment chemicals to the ESWS increases the water vapor pressure resulting in a net positive suction head (NPSH) available reduction of as much as 6 ft, according to ANSI/HI 9.6.1-1998, Section 9.6.1.5.4, part c. The actual range of increase in water vapor pressure is dependent on actual water chemistry. The pump design sizing assumes maximum available reduction in NPSH of 6 ft, so margin (between design NPSH available reduction and actual NPSH available reduction experienced) exists.

A 10 percent margin is added to the ESW pump TDH obtained in the pump sizing calculation. This is to account for uncertainty in pipe routing as well as the number of valves and fittings that may be used (e.g., in the final system design, pump performance degradation, increased piping roughness due to pipe aging and fouling, variation in electrical frequency). The result is rounded upward.

A 15 percent margin is added to the dedicated ESW pump TDH obtained in the pump sizing. This is to account for uncertainty in pipe routing as well as the number of valves and fittings that may be used (e.g., in the final system design, pump performance degradation, increased piping roughness due to pipe aging and fouling, variation in electrical frequency). The result is rounded upward to the next 10 ft increment.

Round off in calculated submergence imparts additional conservatism.

Finally, the ESW pump model selection is based on the worst case ESW train (highest TDH requirement) of the four safety-related trains.

Motor specifications developed for the ESW and dedicated ESW pump drive motors require that the motors deliver required driver output horsepower while accommodating variations in plant electrical supply frequency. Motor specification includes at least 5 percent margin, between the load brake hp and motor rated hp at 1.0 service factor, under any operating condition. Where such a requirement would result in using the next larger size motor, an allowable option will be to provide a 1.15 service factor motor.

**FSAR Impact:**

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

**Question 09.02.01-7:**

The ESWS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with GDC 44 requirements. With respect to ESWS flow requirements, Tier 2 FSAR Table 9.2.1-1 states that the safety related ESWS pump normal flow rate is 73.2 $m^3$/min (19,340 gpm) at 0.55 MPa (185 feet) of water. Each ESWS train includes parallel connected flow paths to one CCWS heat exchanger (HX), one emergency diesel generator (EDG) and an ESWS pump room cooler. ESWS flow appears to be continuously supplied to all components for both normal and accident conditions. Tier 2 FSAR Table 9.2.5-1 indicates that nominal CCWS HX flow is $4.31\times10^6$ Kg/hr ($9.504\times10^6$ lbm/hr) and EDG flow is $0.48\times10^6$ Kg/hr ($1.06\times10^6$ lbm/hr). No flow rate information (or heat load) is provided for the pump room cooler. However, the total ESWS flow rate for the EDG plus the CCW HX at ≤32.2 ˚C (90 ˚F) converts roughly to 80.25 $m^3$/min (21,200 gpm), which exceeds the normal pump flow of 73.2 $m^3$/min (19,340 gpm). In order for the staff to confirm that the ESWS has been adequately sized, the applicant needs to provide additional information in the FSAR to address this apparent inconsistency.

**Response to Question 09.02.01-7:**

Each essential service water (ESW) train includes parallel connected flow paths to one component cooling water system (CCWS) heat exchanger (HX), one EDG, and essential service water (ESW) pump room cooler. The ESWS flow is continuously supplied to all components for both normal and accident conditions.

The ESWS flow rate to the CCWS HX is incorrectly described in U.S. EPR FSAR Tier 2, Table 9.2.5-1—Ultimate Heat Sink System Interface. The minimum flow rate of 8.64E+6-lbm/hr represents the combined minimum flow rate requirement to the CCWS HX and the EDG coolers. The minimum flow rate requirement to the CCWS HX is 7.54E+6-lbm/hr and the minimum flow rate requirement to the EDG coolers is 1.06E+6-lbm/hr. U.S. EPR FSAR Tier 2, Table 9.2.5-1—Ultimate Heat Sink System Interface will be revised to reflect this distinction.

Also, for clarification, only the minimum flow requirements for the CCWS HX will remain in this table. The minimum flow rate (and heat load) for the pump room cooler is 137.6-gpm (0.619 MBTU/hr) during normal operations, shutdown/cooldown, and a design basis accident. The minimum flow rate (and heat load) for the pump room cooler is 69.8-gpm (0.314 MBTU/hr) during a severe accident. The minimum flow rate (and heat load) requirements for the pump room cooler will also be added to U.S. EPR FSAR Tier 2, Table 9.2.5-1—Ultimate Heat Sink System Interface.

**FSAR Impact:**

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

**Question 09.02.01-9:**

The ESWS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with GDC 44 requirements. System design features, operating procedures, and surveillance testing must provide adequate assurance that the ESWS safety functions will not be compromised due to damaging waterhammer events. Two of the four safety-related trains are normally in operation with the remaining two trains in standby. All valves in the main flow path of each train, including the two trains in standby, are kept open (Tier 2 FSAR Section 9.2.1.4). Since the cooling tower spray nozzles are located at an elevation that is well above the cooling tower basin water level, there is a potential for the standby loops to drain to their respective cooling tower basins and create a large air void in the piping of the ESWS standby trains. If this occurs, an automatic actuation of the standby ESWS trains could result in a waterhammer. Any loop seals in the ESWS that are caused by component design or piping configuration would tend to result in a much more severe waterhammer event. The ESWS description does not adequately consider and address waterhammer vulnerabilities (such as this) in the FSAR and does not explain how system design features, operating procedures, and periodic surveillance testing provide adequate assurance that the ESWS safety functions will not be compromised by waterhammer events. Accordingly, the applicant needs to provide additional information in Tier 2 FSAR Section 9.2.1 to address waterhammer considerations. If system valves are relied upon to prevent excessive back-leakage, the ESWS description in the FSAR needs to fully explain and justify the maximum amount of back-leakage that is allowed, and specify the leakage acceptance criteria that will be established in the in-service testing program for these valves along with the basis for this determination.

**Response to Question 09.02.01-9:**

The check valve located downstream of the pump will close immediately after a pump trip (or normal shutdown), in response to a flow reversal. Therefore, in an idle essential service water system (ESWS) division, the piping downstream of the check valve remains full up to the elevation of the cooling tower riser at the spray nozzles. In addition, the isolation valve located downstream of the check valve closes automatically following a pump trip (or normal shutdown). This mitigates the water leakage through the seat of the check valve. However, to minimize the leakage, a maximum valve leakage criterion is specified for the check valve, consistent with API-598. This valve leakage is approximately 0.18 cubic inch per minute per inch of check valve size. For a 30-in check valve, this results in a maximum allowable leakage rate of 0.023 gallon per minute (gpm) or 470 gallons every two weeks. Each ESWS division has two cooling towers cells, each with 24-in diameter riser pipes. This results in a reduction of water column in the risers to a maximum of 11 ft. The volume lost to leakage for the standby division is replenished by rotating the idle division bi-weekly so that the water level does not drop more than 11 ft below the spray header elevation. This minimum water level inside the riser pipe maintains the remaining ESW piping and equipment flooded/primed, and minimizes the potential air volume to be vented upon division restart. Should the valves be manufactured to a more stringent leakage criterion and be proven by monitoring to allow less back-leakage than the 0.023 gpm criterion noted above based on API-598, the filling (pump rotation) frequency can be reduced as low as (but not less than) monthly.

A vent pipe will be installed atop each of the cooling tower riser pipes. Should water level in the cooling tower riser pipe drop lower than the top of the riser, the vent pipe evacuates the air as water level inside the riser pipe rises following a startup of the standby ESWS division. This prevents compression of air pockets, and therefore, no adverse impact of water hammer is expected. The vent pipe will have enough area suitable for permanent surge control and will be installed vertically with a gooseneck of sufficient height to prevent spillage during operation and pump startup. Alternatively, the vent pipe can be replaced with a pipe with air/vacuum valves that perform the same function as the vent pipe.

Finally, a hydraulic transient analysis of the ESWS will be performed later in the design process to identify the system behavior during normal startup, normal shutdown, and abnormal conditions to determine the system maximum and minimum pressures for various system mechanical and piping components. Sizing of the permanent surge control devices, such as the vent pipe (or vent valve) atop the cooling tower riser and type of check valve to be used will also be confirmed. This analysis will consider pump and cooling tower details, as well as the pipe sizes and piping physical arrangement determined in the detailed design phase. The analysis will confirm that: (a) the dynamic pulse loadings for piping and equipment, as a result of various transient events, will be fully accounted for and designed against transient events for all segments of the piping system, and (b) the component and piping system will be properly designed and be within the maximum internal transient pressure allowable.

U.S. EPR FSAR Tier 2, Section 9.2.1.3.5 will be revised to reflect the information on the acceptable leakage rate against established acceptance criteria. With this arrangement, during standby, the divisions not in operation are aligned for normal operation (with pump discharge isolation valve and check valve initially closed) and available for immediate startup. Because the system piping and equipment are primed and the riser pipes are full or mostly full, immediate startup of the standby ESW pump is not expected to result in a transient pressure beyond design.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 9.2.1.3.5 will be revised as described in the response and indicated on the enclosed markup.

**Question 09.02.01-11:**

The ESWS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with GDC 44 requirements. Also, 10 CFR 52.47(a)(22) requires that information demonstrating the incorporation of operating experience insights into the plant design be included in the FSAR. During a recent review of industry operating experience, the staff found that some licensees were experiencing significant wall thinning of pipe downstream of butterfly valves that were being used to throttle service water flow. In order to assure that this will not occur in the ESWS for the EPR design, the applicant needs to provide additional information in Tier 2 FSAR Section 9.2.1 to describe the extent to which the butterfly valves will be used to throttle ESWS flow and the design provisions that will be implemented to prevent consequential pipe wall thinning from occurring.

**Response to Question 09.02.01-11:**

Essential service water system (ESWS) users have a fixed flow resistance during operating conditions (flow rates are constant in various operating conditions). Flow rates through ESWS users are adjusted during plant start-up in the most limiting configuration (i.e., system flow balancing), using globe valves, or a combination of a fixed orifice plate upstream and a butterfly valve. In the latter configuration, the fixed orifice plate provides the majority of the flow resistance, and the butterfly valve is used for minor adjustment. When the system is balanced, the minimum required user flow rate is maintained for any plant operating condition. The system flow balance is re-affirmed throughout the life of the plant during periodic surveillances. Use of a fixed orifice plate upstream of a butterfly valve to establish a fixed flow resistance greatly reduces the probability of pipe erosion, which can occur immediately downstream of butterfly valves when valve throttling is severe and for protracted periods.

The following ESW manual butterfly valves will be subject to continuous, but limited, throttling service to maintain the required fixed flow resistance to ESWS users:

- Component cooling water system (CCWS) heat exchanger isolation valves 30PEB10/20/30/40 AA009 may be subject to continuous, limited throttling service, as the flow resistance in individual lines and users change, and the system is re-balanced over time.

- Emergency diesel generator (EDG) heat exchanger isolation valves 30PEB21/22/23/24 AA002 may be subject to limited, continuous throttling service, as the flow resistance in individual lines and users change, and the system is re-balanced over time.

The following ESW motor-operated butterfly valves will be subject to short term (abnormal condition) throttling service:

- Cooling tower blowdown system isolation valves 30PEB10/20/30/40 AA003 are motor operated valves capable of being throttled, as necessary, to obtain the desired blowdown flow rate, based on water chemistry analysis results. The valves are used in the event of failure of the normal blowdown flow path.

Due to the limited degree of throttling service or the short term nature of throttling service for the above ESW butterfly valves, no special design considerations relative to flow induced erosion in downstream piping are required.

The following ESW motor-operated butterfly valves will be subject to substantial throttling service for extended periods of time during cold weather:

- Cooling tower return isolation and bypass valves 30PED10/20/30/40 AA010 and AA011 will be positioned by the operator from the main control room (MCR), as necessary, to maintain the desired ESWS cold water temperature during low load, low ambient temperature conditions.

U.S. EPR FSAR Tier 2, Section 9.2.1.3.5 will be revised to include the following information:

> "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."

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 9.2.1.3.5 will be revised as described in the response and indicated on the enclosed markup.

**Question 09.02.01-12:**

The ESWS must 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 in accordance with GDC 45 requirements. The staff finds the design to be acceptable if the FSAR describes inspection program requirements that will be implemented and are considered to be adequate for this purpose. While Tier 2 FSAR Section 9.2.1.6 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 ESWS is adequately maintained over time were not described. Furthermore, the accessibility and periodic inspection of buried ESWS piping is of particular interest and needs to be addressed. Consequently, the applicant needs to provide additional information 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.

**Response to Question 09.02.01-12:**

Safety-related piping, valves, and fittings in the essential service water system (ESWS) are designed in accordance with ASME III, Class 3 (refer to U.S. EPR FSAR Tier 2, Section 9.2.1.3.5). The pre-service and in-service inspection programs for ASME III, Class 3 components are described in U.S. EPR FSAR Tier 2, Section 6.6. Implementing procedures will be developed later in the design process. Welds, or portions thereof, that are inaccessible due to being buried underground are exempt from the visual examination requirements of ASME XI, Article IWD-2500, in accordance with Article IWD-1220(e).

**FSAR Impact:**

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

**Question 09.02.01-14:**

Means must be provided for monitoring effluent discharge paths and the plant environs for radioactivity that may be released in accordance with GDC 64 requirements. Also, 10 CFR 52.47(a)(6) and 10 CFR 20.1406 require applicants for standard plant design certifications to describe facility design and procedures for operation that will minimize contamination of the facility and the environment. The staff's review criteria (SRP Section 9.2.1, Paragraph III.3.D) specify that provisions should be provided to detect and control leakage of radioactive contamination into and out of the ESWS. The design is considered to be acceptable by the staff if the ESWS P&IDs show that radiation monitors are located on the ESWS discharge and at components that are susceptible to leakage, and if the components that are susceptible to leakage can be isolated. However, the staff noted that Tier 2 FSAR Section 9.2.1 and the ESWS P&ID do not include radiation monitors in the system design and the NRC regulations in this regard have not been addressed. Therefore, the applicant needs to provide additional information in Tier 2 FSAR Section 9.2.1 to address the NRC requirements referred to above.

**Response to Question 09.02.01-14:**

The essential service water system (ESWS) is free of radioactivity resulting from plant operation. The ESWS design is consistent with the U.S. EPR contaminant management philosophy to comply with the requirements of 10 CFR 20.1406, as described in U.S. EPR FSAR Tier 2, Section 12.3.6. Migration of radioactive material from potentially radioactive systems is prevented with a minimum of two barriers. The ESWS supplies water to the component cooling water system (CCWS) heat exchangers (HX) and returns the water to the ultimate heat sink (UHS) cooling tower basins. The CCWS is between the ESWS and residual heat removal system (RHRS).

In addition to the CCWS/ESWS HX, there is a second HX barrier between the CCWS and RHRS. In addition, radiation monitors are present in the CCWS to detect contamination migrating in or out of the system. With two barriers between the ESWS and RHRS, as well as provisions provided in the CCWS, additional radiation monitors in the ESWS design are not required.

U.S. EPR FSAR Tier 2, Section 9.2.1.2 currently states:

> "The CCWS is monitored to detect radioactive contamination into and out of the system."

**FSAR Impact:**

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

**Question 09.02.01-16:**

Criteria are specified in 10 CFR 50.36 for establishing Technical Specification (TS) requirements. Proposed TS requirements are evaluated in part to confirm consistency with the STS. LCO 3.7.8, Action A, allows one ESWS train to be inoperable for up to 120 days. The staff notes that the description provided in Tier 2 FSAR Chapters 1 and 3 are not entirely clear and are rather inconsistent in places with respect to how the ESWS is protected from internal and external hazards. To the extent that anything other than physical protection is credited, the proposed 120 day allowed outage time may not be appropriate. For instance, if one train is out of service and one train is rendered inoperable due to a pipe break, flooding, or some other hazard, no margin is available for a single active failure on one of the other trains and a 72 hour action allowed outage time should be specified consistent with STS requirements. Likewise, two trains out of service could render the ESWS unable to perform its safety function if one of the operable trains is rendered inoperable due to a pipe break, flooding, or some other hazard. The applicant needs to provide additional information to justify the proposed allowed outage times and Tier 2 FSAR Chapters 1 and 3 need to be revised accordingly to specify physical protection for the ESWS consistent with the allowed outage times that are proposed.

**Response to Question 09.02.01-16:**

The scope of the U.S. EPR Technical Specifications satisfies the four criteria of 10 CFR 50.36 "Technical Specifications." The essential service water system (ESWS), Technical Specifications satisfy Criteria 2 and 3. As stated in 10 CFR 50.36 and the NRC's Final Policy Statement on Technical Specification improvements:

> "Criterion 2 - A process variable, design feature, or operating restriction that is an initial condition of a Design Basis Accident or Transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.
>
> Discussion of Criterion 2: Another basic concept in the adequate protection of the public health and safety is that the plant shall be operated within the bounds of the initial conditions assumed in the existing Design Basis Accident and Transient analyses and that the plant will be operated to preclude unanalyzed transients and accidents. These analyses consist of postulated events, analyzed in the FSAR, for which a structure, system, or component must meet specified functional goals.
>
> Criterion 3 - A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a Design Basis Accident or Transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.
>
> Discussion of Criterion 3: A third concept in the adequate protection of the public health and safety is that in the event that a postulated Design Basis Accident or Transient should occur, structures, systems, and components are available to function or to actuate in order to mitigate the consequence of the Design Basis Accident or Transient. Safety sequence analyses or their equivalent have been performed in recent years and provide a method of presenting the plant response to an accident. These can be used to define the primary success paths."

As required in the above regulations and regulatory policy, the Technical Specifications for the ESWS address the design basis events included in Chapter 15 of the Standard Review Plan.

The Technical Specifications do not consider "pipe break, flooding, or some other hazard" that are not design basis events or anticipated operational occurrences. A design basis event or anticipated operational occurrence would not result in the inoperability of one train of the ESWS.

With regard to risk insights, the 120 day allowed outage time is not a risk-informed value. The U.S. EPR safety analysis assumptions are satisfied with two operable ESWS trains, therefore, an indefinite allowed outage time (AOT) is justifiable from a deterministic standpoint. The proposed AOT does not constitute a temporary relaxation of the requirement for a postulated single failure concurrent with a postulated design basis accident or anticipated operational occurrence. Therefore, the proposed 120 day AOT does not constitute a deviation from the Standard Technical Specifications. Rather, it is an additional conservative restriction that maximizes the availability of the ESWS. In general, as addressed in RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," a licensee would not be expected to submit risk information in support of a position that is consistent with currently approved staff positions. These licensee positions are normally evaluated by the staff using traditional engineering analyses. Physical protection of the system is addressed in U.S. EPR FSAR Tier 2, Section 9.2.1.1. The design of the ESWS satisfies the relevant requirements of GDC 2, GDC 4, GDC 5, GDC 44, GDC 45 and GDC 46. This is consistent with the acceptance criteria in SRP 9.2.1.

**FSAR Impact:**

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

**Question 09.02.01-18:**

Surveillance requirements are established in accordance with 10 CFR 50.36 requirements to assure that the necessary quality of systems and components is maintained, that operation will be within safety limits, and that the LCOs will be met. Also, GDC 46 requires periodic pressure and functional testing of components 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 ESWS safety functions. SR 3.7.8.6 establishes a requirement to verify that each ESWS pump and cooling tower fan starts automatically on an actual or simulated actuation signal every 24 months. This test does not adequately demonstrate ESWS operability, especially with respect to waterhammer considerations and the proper functioning of vacuum breakers during loss of power and ESWS drain down scenarios, and demonstrating that the ESWS flow balance is properly set. Furthermore, the staff noted that surveillance requirements are also not proposed for demonstrating proper functioning of the ESWS vacuum breakers. Therefore, the proposed surveillance requirement does not satisfy GDC 46 requirements and the applicant needs to provide additional information in the FSAR to resolve this issue.

**Response to Question 09.02.01-18:**

10CFR50.36(c)(3) requires that Technical Specifications include surveillance requirements. Specifically:

> "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met."

The surveillance requirements proposed in U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section 3.7.8 are consistent with the Improved Standard Technical Specifications approved in NUREG-1431, Rev. 3.1, which is the stated basis of the U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications.

As addressed in U.S. EPR FSAR Tier 2, Chapter 9, Section 9.2.1.1, the essential service water system (ESWS) is designed to permit appropriate periodic pressure and functional testing in accordance with GDC 46. Preoperational testing will be performed on the ESWS as described in U.S. EPR FSAR Tier 2, Section 14.2, Test #048 to demonstrate the proper operation of the ESWS in all operational configurations, including flow balancing and the absence of waterhammer.

The valves that confirm proper operation of the ESWS are periodically tested in accordance with the ASME OM Code as described in U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Section 5.5.7.

**FSAR Impact:**

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

**Question 09.02.01-19:**

The Bases for TS 3.7.8 (Page B 3.7.8-1) states that for an accident: “The pumps aligned to the critical loops are automatically started upon receipt of a safety injection signal, and all essential valves are aligned to their post accident position.” However, no description of what the critical loops are or what valves must be realigned is provided in Tier 2 FSAR Section 9.2.1 or in the TS Bases. Therefore, the applicant needs to provide additional information in Tier 2 FSAR Section 9.2.1 to fully describe these design features and operating considerations.

**Response to Question 09.02.01-19:**

As described in U.S. EPR FSAR Tier 2, Section 9.2.1.2, the essential service water system (ESWS) consists of four separate, redundant safety-related divisions. U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications, Bases 3.7.8 will be revised to reflect the deletion of the phrase “aligned to the critical loops.”

**FSAR Impact:**

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

**Question 09.02.01-20:**

Applications for standard plant design approval must contain proposed inspections, tests, analyses, and acceptance criteria (ITAAC) in accordance with 10 CFR 52.47(b)(1) requirements. Tier 1 FSAR Section 2.7.11, “Essential Service Water System,” provides EPR design certification information and ITAAC for the ESWS and UHS. The staff noted that the title for Tier 1 FSAR Section 2.7.11 is misleading in that it includes requirements for the UHS along with those that are specified for the ESWS. However, the ESWS and the UHS each involve significant safety considerations that are described separately in Tier 2 of the FSAR and are reviewed separately by the staff in this report. Therefore, consistent with the approach that is used in Tier 2 of the FSAR, the applicant needs to provide the required Tier 1 information for the ESWS and the UHS in their own respective sections.

**Response to Question 09.02.01-20:**

The arrangement of U.S. EPR FSAR Tier 1, Chapter 2 is based on the structures, systems, and components (SSC) defined for the U.S. EPR, which are listed in U.S. EPR FSAR Tier 1, Table 14.3-8—ITAAC Screening Summary. The ultimate heat sink (UHS) is part of the essential service water system (ESWS), so the UHS is listed in U.S. EPR FSAR Tier 1, Section 2.7.11. Also, because the arrangement of information in U.S. EPR FSAR Tier 1, Chapter 2 follows the list of SSC in U.S. EPR FSAR Tier 2, Table 14.3-8, the ITAAC in U.S. EPR FSAR Tier 1 may be derived from numerous sections of U.S. EPR FSAR Tier 2. For example, the nuclear island structures in U.S. EPR FSAR Tier 1, Section 2.1.1 cover requirements from fire protection, flooding protection, high energy line breaks, radiation protection, severe accident mitigation, external events (including rain, snow, flood, tornado, tornado-generated missiles, earthquake, aircraft hazard, explosion pressure wave).

The UHS information required to be in Tier 1 is in Tier 1. Arranging U.S. EPR FSAR Tier 1 to match the arrangement of U.S. EPR FSAR Tier 2 is not practical or desired. Therefore, a separate section within U.S. EPR FSAR Tier 1 will not be created for the UHS.

**FSAR Impact:**

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

**Question 09.02.01-21:**

Applications for standard plant design approval must contain proposed ITAAC in accordance with 10 CFR 52.47(b)(1) requirements. Proposed ITAAC for the ESWS are provided in Tier 1 FSAR Section 2.7.11. The staff reviewed the descriptive information, arrangement, design features, environmental qualification, performance requirements, and interface information provided in Tier 1 FSAR Section 2.7.11 to confirm completeness and consistency with the plant design basis as described in Tier 2 Section 9.2.1. The staff found that the Tier 1 information is incomplete, inconsistent, inaccurate, or that clarification is needed and the applicant needs to revise the Tier 1 information to address the following considerations in this regard:

- 1. 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 9.2.1 (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).
- 2. In the listing of safety-related functions, the first bullet does not include the capability to remove heat from the ESWS pump room cooler. This is not consistent with the ESWS design basis.
- 3. In the listing of non-safety-related functions, the second bullet includes the capability to maintain temperatures in the component cooling water system within their specified limits as a non-safety-related function. First, this is not stated as a function and needs to be corrected accordingly. Second, this is not entirely true in that temperature limits for safety-related SSCs must be maintained in accordance with accident analysis and operability considerations and equipment qualification requirements.
- 4. The specifications do not stipulate that the ESWS is accessible for performing periodic inspections as required by GDC 45.
- 5. The specification that stipulates that the ESWS design provide for flow testing of the pumps during operation is incomplete in that it does not specify provisions for flow testing the individual component flow paths to verify flow balance requirements are satisfied.
- 6. Specifications to assure that the filters satisfy design and performance requirements, and to confirm alarm functions, are not provided.
- 10. Specifications to assure that the vacuum breakers satisfy design and performance requirements are not provided.
- 11. Specifications to assure that the blowdown piping satisfy design and performance requirements are not provided.
- 12. Specifications to assure that ESWS outdoor piping is adequately protected from the elements and postulated hazards are not provided.
- 13. Figure 2.7.11-1, “Essential Service Water System Functional Arrangement,” does not show nominal pipe sizes, which are necessary for design certification.
- 14. Figure 2.7.11-1 does not show vacuum breaker and air release valve locations and these components are not listed in the applicable tables.

- 15. Figure 2.7.11-1 does not show flow control valves for the individual flow paths of the components being cooled and these components are not listed in the applicable tables, which is necessary for design certification.
- 16. Table 2.7.11-2, "Essential Service Water System Equipment I&C and Electrical Design," does not include information pertaining to the ESWS filter motors and corresponding power supplies.
- 17. Tables 2.7.11-1 and -2, do not describe the ESWS pump downstream filters, 30PEB10/20/30/40 AT002.
- 18. Table 2.7.11-1 conflicts with Figure 2.7.11-1 related to the blowndown check valves, 30PEB10/20/30/40 AA205. The Figure shows the check valves as non-safety, non-seismic while the Table shows the check valves as ASME III and Seismic Category I.
- 19. The point of Note 2 for 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.
- 20. The discussion under Item 6 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.

**Response to Question 09.02.01-21:**

2. In the listing of safety-related functions, the first bullet in U.S. EPR FSAR Tier 1, Section 2.7.11, 1.0 Description, will be revised to include the capability to remove heat from the ESW pump room cooler.

3. Accident analyses, operability considerations, and equipment qualification requirements are taken into consideration in the safety-related designs of the component cooling water system (CCWS), essential service water system (ESWS) and ultimate heat sink (UHS). The UHS capability is designed so that the basin water temperature is maintained below that required to support all scenarios. Therefore, the water supply temperature from the basin to the CCWS during an accident scenario remains below or equal to the minimum required ESW supply temperature for a design basis accident (DBA) (refer to U.S. EPR FSAR Tier 2, Table 9.2.5-1—Ultimate Heat Sink System Interface). For the non-safety-related functions of the system, the ESWS functions that provide the minimum required ESW flow to the system users during normal plant operating conditions. Therefore, the ESWS provides water at the required temperature and flow rate to system users during normal plant operating conditions.

   In the listing of non-safety-related functions, the second bullet in U.S. EPR FSAR Tier 1, Section 2.7.11, 1.0 Description, will be deleted because its original intent was to support the function in the first bullet, and the main function of the ESWS is to provide flow to system users.

11. Specifications to establish that the blowdown piping satisfy design and performance requirements are not provided because there is no design commitment for which numeric performance values for this structure, system and component could be specified as ITAAC acceptance criteria. Additionally, only key numbers or physical

parameters that support safety analyses are included in the design description. Pipe sizes will be determined to optimize fluid velocities during operating scenarios.

13. Specific ESWS line sizing details will be identified later in the design process. Final pipe sizes will be determined based on ESWS user loads and flow requirements. Pipe sizes will be determined to optimize fluid velocities during operating scenarios.

18. Portions of the blowdown system piping inside the ESW pump buildings and downstream of isolation valves 30PEB10/20/30/40 AA003, AA015, and AA016 are non-safety-related and are seismically analyzed up to the boundary anchor. The blowdown check valves are located within this non-safety-related portion of the blowdown system. Portions of the blowdown system routed outside the ESW pump buildings and running to the site-specific retention basin are non-safety-related (NS) and non-seismic (NSC).

    U.S. EPR FSAR Tier 1, Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design will be revised to reflect the NS, NSC classification for blowdown check valves 30PEB10/20/30/40 AA205.

19. U.S. EPR FSAR Tier 1, Table 2.7.11-2—Essential Service Water System Equipment I&C and Electrical Design, Note 2, will be deleted.

**FSAR Impact:**

2. U.S. EPR FSAR Tier 1, Section 2.7.11, 1.0 Description will be revised as described in the response and indicated on the enclosed markup.

3. U.S. EPR FSAR Tier 1, Section 2.7.11, 1.0 Description will be revised as described in the response and indicated on the enclosed markup.

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

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

18. 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.

19. U.S. EPR FSAR Tier 1, Table 2.7.11-2 will be revised as described in the response and indicated on the enclosed markup.

**Question 09.02.01-22:**

Applications for standard plant design approval must contain proposed ITAAC in accordance with 10 CFR 52.47(b)(1) requirements. Proposed ITAAC for the ESWS are provided in Tier 1 FSAR Section 2.7.11. The staff reviewed the information provided in Table 2.7.11-3, "Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria," to confirm that the proposed ITAAC are adequate for EPR design certification. In addition to the items referred to in **RAI 9.2.1-1 through -9 and RAI 9.2.1-21**, some of which involve ITAAC considerations, the staff found that the proposed ITAAC are incomplete, inconsistent, inaccurate, or that clarification is needed and the applicant needs to revise the Tier 1 information to address the following considerations in this regard:

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.
2. Item 2.3 is incomplete in that it does not address physical separation criteria for outdoor piping.
3. Item 7.2 needs to specify that ESWS pump testing to demonstrate adequate net positive suction head will be completed at the maximum ESWS flow rate conditions, with the inventory in the cooling tower basin at the lowest allowable level (as corrected to account for actual temperature and atmospheric pressure conditions). The maximum ESWS flow rate and minimum allowable cooling tower basin water level, along with the corresponding design basis water temperature and atmospheric pressure that apply need to be listed to assure that test conditions are properly established. The acceptance criteria for an acceptable test need to be specified.
4. Quantitative acceptance criteria need to be established for all ITAAC as applicable (flow rates, heat transfer rates, completion times, etc.).
5. No test item is provided to demonstrate that water hammer will not occur in the as built system upon manual or automatic start of a previously idle train, and during loss-of-power scenarios.
6. Some items for the dedicated ESWS train from the text of Tier 1 FSAR Section 2.7.11 are converted into ITAAC (e.g. Item 7.5), whereas many are not (e.g. 3.5, 3.6. 3.7, 4.6, 4.7, 5.3.). An explanation is needed for this apparent inconsistency.
7. Item 3.2 commitment wording should reference Table 2.7.11-1 not 2.7.8-1.
8. Items 4.5 and 4.6 (automatic train switch-over on spurious valve closure) appear to be the same.

**Response to Question 09.02.01-22:**

1. Specific ESWS line sizing details will be identified later in the design process. Final pipe sizes will be determined based on ESWS user loads and flow requirements. Pipe sizes will be determined to optimize fluid velocities during all operating scenarios.

2. For the ESWS, all piping indicated as being located in outdoor areas is buried. The above ground piping and components are protected by the structures. The buried piping and components are inherently protected against natural phenomena by providing adequate depth to confirm the integrity needed to perform the intended safety function. For additional

information related to physical separation of outdoor piping refer to the Response to Question 09.02.01-3.

3. U.S. EPR FSAR Tier 1, Table 2.7.11-3—Essential Service Water System ITAAC, Item 7.2, will be revised to specify ESW pump testing to demonstrate adequate net positive suction head (available NPSH must be greater than required NPSH). The testing will be completed at the maximum ESWS flow rate conditions, with consideration for the inventory in the cooling tower basin at the lowest allowable level (as corrected to account for actual temperature and atmospheric pressure conditions).

4. U.S. EPR FSAR Tier 1, Table 2.7.11-3—Essential Service Water System ITAAC, Item 7.1, will be revised to include quantitative acceptance criteria for applicable ESW UHS ITAAC.

5. A hydraulic transient analysis of the ESWS will be performed later in the design process to identify the system behavior during normal startup, normal shutdown, and abnormal conditions to determine the system maximum and minimum pressures for various system mechanical and piping components. Sizing of the permanent surge control devices such as the vent pipe (or vent valve) and vacuum breakers will also be confirmed. This analysis will consider pump and cooling tower details, as well as the pipe sizes and piping physical arrangement determined in the detailed design phase. The analysis will establish that (a) the dynamic pulse loadings for all piping and equipment as a result of various transient events will be fully accounted for and designed against for all segments of the piping system, and (b) the component and piping system will be properly designed and within the maximum internal transient pressure allowable. For additional information related to pre-operational testing and surveillance requirements in consideration of water hammer, refer to the Response to Question 09.02.01-18.

6. U.S. EPR FSAR Tier 1, Section 2.7.11 will be revised to delete the items for the dedicated ESW train that are not converted into ITAAC; this includes Items 3.5, 3.6, 3.7, 4.6, 4.7, and 5.3.

7. U.S. EPR FSAR Tier 1, Table 2.7.11-3—Essential Service Water System ITAAC, Item 2.3 and Item 3.2, will be revised to refer to Table 2.7.11-1 rather than Table 2.7.8-1.

8. U.S. EPR FSAR Tier 1, Table 2.7.11-3—Essential Service Water System ITAAC, Item 4.6, has been deleted.

**FSAR Impact:**

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

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

3. 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.

4. 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.

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

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

7. 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.

8. U.S. EPR FSAR Tier 1, Table 2.7.11-3 will not require an additional change as a result of this question.

# U.S. EPR Final Safety Analysis Report Markups

Table 3.2.2-1—Classification Summary
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| KKS System or Component Code | System or Component SSC Description | Safety Classification (Note 15) | Quality Group Classification | Seismic Category (Note 16) | 10 CFR 50 Appendix B Program | Location (Note 17) | Comments/ Commercial Code |
|---|---|---|---|---|---|---|---|
| PEB80 | Dedicated ESW Blowdown Piping inside 4UQBBlowdown System Piping from Dedicated ESW train inside 4UQB | NS | E | NSC | No | 4UQB | ANSI/ASME B31.1(6) |
| PEB80 | Dedicated ESW Blowdown Piping outside 4UQB Blowdown System Piping from Dedicated ESW train outside 4UQB | NS | E | NSC | No | UZT | ANSI/ASME B31.1(6) |
| 30PEB80 AT001 | Dedicated ESW Debris Filter | NS | E | NSC | No | 4UQB | ANSI/ASME B31.1(6), ANSI/ ASME B16.34(7) |
| PEB80 | Dedicated ESW Piping/Components (Includes Components Listed Below, excluding Dedicated ESW Pump) | NS | E | NSC | No | 4UQB, UZT, 4UJH | ANSI/ASME B31.1(6), ANSI/ ASME B16.34(7), Manufacturer Standards |
| 30PEB80 AP001 | Dedicated ESW Pump | NS-AQNS | DC | INSC | YesNo | 4UQB | Manufacturer Standards |

09.02.01-1

Table 3.2.2-1—Classification Summary
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| KKS System or Component Code | ~~System or Component~~ SSC Description | Safety Classification (Note 15) | Quality Group Classification | Seismic Category (Note 16) | 10 CFR 50 Appendix B Program | Location (Note 17) | Comments/ Commercial Code |
|---|---|---|---|---|---|---|---|
| 30PEB80 AA004 | Dedicated ESW return isolation valve | S | C | I | Yes | 4UJH | ASME Class 3(3) |
| PEB81 | Dedicated ESW to/ from UQB Ventilation System Room Cooler | NS | E | NSC | No | 4UQB | Manual Initiation ico Severe Accident ONLY; ANSI/ASME B31.1(6) |
| PEB80 | Dedicated ESW Valves ~~(Dedicated Train)~~ | 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 ~~System~~ Isolation Valve | S | C | I | Yes | UQB | ASME Class 3(3) |
| 30PEB10/20/30/40 AA015-016 | ESW Blowdown ~~System~~ Isolation Valve | S | C | I | Yes | UQB | ASME Class 3(3) |
| PEB10/20/30/40 | ESW Blowdown ~~System~~ 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) |

09.02.01-1

Table 3.2.2-1—Classification Summary
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| KKS System or Component Code | ~~System or Component~~ SSC Description | Safety Classification (Note 15) | Quality Group Classification | Seismic Category (Note 16) | 10 CFR 50 Appendix B Program | Location (Note 17) | Comments/ Commercial Code |
|---|---|---|---|---|---|---|---|
| PEB10/20/30/40 09.02.01-1 | ESW Blowdown ~~System~~ 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) |
| PED10/20/30/40 | ESW Chemical Treatment System Piping | NS | E | NSC | No | UQB | ANSI/ASME B31.1(6) |
| 30PEB10/20/30/ 40 AT002 | ESW Debris Filters | S | C | I | Yes | UQB | ASME Class 3(3) |
| 30PED10/20/30/ 40 AA021 | ESW Emergency Makeup Water ~~System~~ Isolation Valves | S | C | I | Yes | UQB | ASME Class 3(3) |
| PED10/20/30/40 | ESW Emergency Makeup Water ~~System~~ Piping | S | C | I | Yes | UQB | ASME Class 3(3) |
| 30PED10/20/30/ 40 AA019 | ESW Normal Makeup Water ~~System~~ Isolation Valves | S | C | I | Yes | UQB | ASME Class 3(3) |

**Table 3.2.2-1—Classification Summary**
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| KKS System or Component Code | ~~System or Component~~ SSC Description | Safety Classification (Note 15) | Quality Group Classification | Seismic Category (Note 16) | 10 CFR 50 Appendix B Program | Location (Note 17) | Comments/ Commercial Code |
|---|---|---|---|---|---|---|---|
| PED10/20/30/40 | ESW Normal Makeup Water ~~System~~ Piping downstream of Isolation Valves 30PED10/20/30/40 AA019 | S | C | I | Yes | UQB | ASME Class 3(3) |
| PED10/20/30/40 | ESW Normal Makeup Water ~~System~~ Piping upstream of Isolation Valves 30PED10/20/30/40 AA019 | NS | E | NSC | No | UQB | ANSI/ASME B31.1(6) |
| 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 | |

09.02.01-1

09.02.01-3

- The ESWS is designed to permit appropriate periodic inspection of important components necessary to maintain the integrity and capability of the system (GDC 45).
- The ESWS is designed to permit appropriate periodic pressure and functional testing necessary to maintain structural and leak-tight integrity of its components, the operability and performance of the active components of the system, and the operability of the system as a whole. The ESWS is also designed to make sure the performance of the full operational sequence necessary to bring the system into operation for reactor shutdown is satisfactory. For loss of coolant accident (LOCA) conditions, operation of applicable portions of the protection system (PS) and the transfer between normal and emergency power sources is also provided (GDC 46).

The ESWS provides sufficient cooling water for removing heat from essential plant equipment and transferring the heat to the cooling towers over the full range of normal reactor operation. The ESWS flow capacity and supply capability are designed so that the temperatures in essential plant equipment remain within their specified limits.

The ESWS operates in conjunction with the 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. The safety-related ESWS divisions provide continued heat transfer from the fuel pool cooling system (FPCS) via the CCWS as long as any spent fuel assemblies are in the spent fuel storage pool located outside containment.

### 9.2.1.2 System Description

The ESWS consists of four separate, redundant, safety-related divisions, and one dedicated, non-safety-related division.

09.02.01-1 The ESWS cools the CCWS HX which acts as an intermediate loop isolating the ESWS from the RCS. The CCWS is monitored to detect radioactive contamination into and out of the system.

The ESWS takes suction from the UHS cooling tower basin and provides cooling water to the CCWS HX, EDG HXs, and the ESW pump room coolers. The heated water is then returned to the UHS cooling tower. The system is shown in Figure 9.2.1-1—Essential Service Water System Piping & Instrumentation Diagram. Safety and seismic design classification of the components is provided in Section 3.2.

Each safety-related ESWS division consists of one ESWS pump, a debris filter, piping, valves, controls and instrumentation.

Provisions are made to make sure there is a continuous flow of cooling water under normal and accident operating conditions. The four safety-related divisions of the

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

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

09.02.01-1 → ~~The ESWS cools the CCWS HX which acts as an intermediate loop isolating the ESWS from the RCS. The CCWS is monitored to detect radioactive contamination into and out of the system.~~

### 9.2.1.3 Component Description

#### 9.2.1.3.1 Safety-Related Essential Service Water Pumps

09.02.01-4 (Part k) → Each of the four safety-related cooling divisions contains one ~~50~~100 percent capacity pump. During normal operating conditions, two of the four ~~pumps~~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.

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.

09.02.01-1

This non-safety-related pump is manually started only in reponse 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.

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.

09.02.01-11

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 (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.

Four ESWS divisions are normally running to achieve cold shutdown in the minimum time. Only two divisions are required to achieve cold shutdown.

During refueling, when the core is almost discharged to the Fuel Building (FB), two or three ESWS divisions are in operation. During this phase, maintenance can be performed on one division. When the core is totally offloaded and in the FB, only two ESWS divisions are required to be in operation.

**Non-Safety-Related Division**

09.02.01-1

The dedicated ESW division is not in use during normal plant operation. The ESW side of the dedicated CCWS HX is separated from the rest of the system. The ESW inlet and outlet isolation valves are closed and this section is filled with demineralized water to prevent corrosion. The rest of the system is filled with site specific ESW fluid.

09.02.01-1

The dedicated ESW cooling chain is activated in case of an SA. This requires closing the ESW isolation valve downstream of CCW HX #4, manually opening the dedicated ESW isolation valves upstream and downstream of the dedicated CCW HX, and manually starting the dedicated ESW pump.~~closing of the isolation valve downstream of the train 4 HX, and the activation of the dedicated pump.~~

### 9.2.1.4.2 Abnormal Operating Conditions

#### Non-LOCA Design Basis Event During Power Operation

The ESWS operates as described for normal operating conditions, supplying the operating CCWS divisions as required.

#### Loss of Offsite Power

In case of loss of offsite power (LOOP), at least three of the safety-related ESWS divisions are available assuming one division is not available due to preventive maintenance. The four ESWS pumps belonging to the four safety-related divisions have power supplied by the EDGs.

In case of LOOP, the dedicated ESWS division is available but in standby condition. Power is supplied by the EDG. The dedicated ESWS division is also capable of being powered by the SBODGs so that the function is available even in case of LOOP with simultaneous loss of all EDGs.

If one safety-related ESWS pump fails during normal operation, a switchover to the other ESWS division is carried out. This switchover is done automatically for the entire cooling chain.

A spurious closure of the isolation valve in a safety-related ESWS division has the same consequences as the failure of the respective pump for that division.

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.

**Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design (9 Sheets)**

| Equipment Description | Equipment Tag Number [(1)] | Equipment Location | ASME Code Section III | Function | Seismic Category |
|---|---|---|---|---|---|
| AC001 | | Division Safeguards Building 4 | | | |
| DEDICATED ESW PUMP | 30PEB80 AP001 | Essential Service Water Pump Structure Division 4 | No | Run | ~~II~~N/A |

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

09.02.01-1

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).

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. One-out-of-two logic from two nuclear island drain and vent system (NIDVS) sump level instruments in the non-controlled areas of the SBs provide a MAX alarm in the MCR and isolate the affected ESWS train. No operator action is required to isolate the ESWS in a large flooding event.~~In case of pipe failure in one Safeguard Building above elevation +0.00 feet, the water is directly led to the lower levels via sufficient openings in the floor.~~

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.

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.

09.02.01-2 →

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, 2004 Edition, Subsection ISTC.

09.02.01-9 →

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.

| | |
|---|---|
| UTG | Central gas supply building |
| UYA | Office and staff amenities building |
| UYF | Security access facility |
| UYH | Simulator building (training facilities) |
| UZE | Track system (rails if necessary) |
| UZJ | Fencing and gates |
| UZT | Outdoor area |

(18) NFPA 90A refers to "Standard for Installation of Air Conditioning and Ventilation Systems," 2002 Edition.

(19) NFPA 92A refers to "Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences," 2006 Edition.

(20) NFPA 80 refers to "Standard for Fire Doors and Other Opening Protectives," 2007 Edition.

09.02.01-3

(21) HEI refers to "Standards for Power Plant Heat Exchangers," Fourth Edition, 2004.

(22) ESW piping in trains PEB10/20/30/40 located in UZT are situated underground.

Next File

09.02.01-4 (Part g)

**Table 9.2.1-3—Alarm Summary**

| Alarm Name | Division | Setpoint Name |
|---|---|---|
| CCW Hx differential pressure Hi | 1/2/3/4 | Max 1 |
| CCW Hx Lo flow | 1/2/3/4 | Min 1 |
| EDG coolers Lo flow | 1/2/3/4 | Min 1 |
| SAQ room cooler differential pressure ESW side | 1/2/3/4 | Max 1 |
| ESW temperature Hi | 1/2/3/4 | Max 1 |
| ESW temperature Hi – Hi | 1/2/3/4 | Max 2 |
| ESW temperature Low | 1/2/3/4 | Min 1 |
| ESW debris filter differential pressure Hi | 1/2/3/4 | Max 1 |
| ESW debris filter differential pressure Hi - Hi | 1/2/3/4 | Max 2 |
| ESW pump abnormal | 1/2/3/4 | Min1 / Max 1 |
| Dedicated CCW Hx differential pressure Hi | Dedicated | Max 1 |
| Dedicated CCW Hx Lo flow | Dedicated | Min 1 |
| Dedicated ESW temperature Hi | Dedicated | Max 1 |
| Dedicated ESW temperature Hi - Hi | Dedicated | Max 2 |
| Dedicated ESW pump abnormal | Dedicated | Min 1 / Max 1 |
| Cooling tower basin water level Hi - Hi | 1/2/3/4 | Max 2 |
| Cooling tower basin water level Hi | 1/2/3/4 | Max 1 |
| Cooling tower basin water level Lo | 1/2/3/4 | Min 1 |
| Cooling tower basin water level Lo - Lo | 1/2/3/4 | Min 2 |

Next File

**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 | 7.5408.640 min 9.504 nominal | ≤92°F | Normal Operation |
| | 120.1 | 7.5408.640 min 9.504 nominal | ≤90°F | Spring/Fall Outage Cooldown |
| | 291.3 | 7.5408.640 min 9.504 nominal | ≤95°F | DBA |
| Dedicated CCWS heat exchanger | 48.64 | 1.205 min 1.326 nominal | ≤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 | ≤ 95°F | Normal Operations Shutdown/ Cooldown and DBA |
| ESW pump room cooler for 34 UQB | 0.314 | 69.8 gpm | ≤ 95°F | Severe Accident - ESW flow supplied by dedicated ESW pump |

09.02.01-7

# B 3.7 PLANT SYSTEMS

## B 3.7.8 Essential Service Water (ESW)/Ultimate Heat Sink (UHS) Systems

BASES

BACKGROUND

The ESW/UHS Systems provides a heat sink for the removal of process and operating heat from safety related components during an anticipated operational occurrence (AOO) or postulated accident. During normal operation, and a normal shutdown, the ESW/UHS Systems also provides this function for the associated safety related and nonsafety related systems. The safety related function is covered by this LCO.

The ESW/UHS Systems consists of four separate safety related, cooling water trains. Each train consists of aone mechanical draft cooling tower, associated basin, pump, piping, valving, instrumentation, and mechanical filtration. Each safety related 2-cell seismic Category I mechanical draft cooling tower rejects energy from the ESW fluid to the ambient and returns the cooled fluid to the ESW UHS cooling tower basin, from which the ESW pumps take suction. Each ESW UHS cooling tower basin is sized for 3 days of post loss of coolant accident (LOCA) operation and ensures adequate volume for the required net positive suction head (NPSH) for the associated ESW pump. Post LOCA evaporative losses are replenished by a safety related seismic Category I source of makeup water. The train associated safety related make-up source delivers water to each basin at ≥ 300 gpm to maintain the NPSH for the ESW pump for up to 30 days following a LOCA. The system pumps and valves are remote and manually aligned, except in the unlikely event of a LOCA or loss of offsite power. The pumps aligned to the critical loops are automatically started upon receipt of a safety injection signal, and all essential valves are aligned to their post accident positions.

09.02.01-19

The mechanical draft cooling towers and basins are safety related, seismic Category I structures sized to provide heat dissipation for safe shutdown following an accident. The cooling tower is protected from tornado missiles.

[The seismic Category 1 makeup necessary to support 30 days of post accident mitigation is site specific and details are to be provided by the Combined License applicant].

Additional information about the design and operation of the ESW/UHS Systems, along with a list of the components served, is presented in FSAR Section 9.2.1 (Ref. 1) and FSAR Section 9.2.5 (Ref. 5). The principal safety related functions of the ESW/UHS Systems is -the removal of decay heat from the reactor and reactor coolant pump thermal barrier cooling via the Component Cooling Water (CCW) System and removal of operational heat from the emergency diesel generator (EDG).

## 2.7.11 Essential Service Water System

### 1.0 Description

The essential service water system (ESWS) is a safety-related system that provides cooling water to the component cooling water system (CCWS) heat exchangers, the emergency diesel generator (EDG) heat exchangers, and the essential service water pump building ventilation system (ESWPBVS) room coolers under normal operating, shutdown/cooldown, design basis events. The Ultimate Heat Sink (UHS) dissipates heat rejected from the ESW during normal operation and post accident shutdown.

The ESWS provides the following safety related functions:

09.02.01-21 (Part 2)

- The ESWS provides the capability to transfer heat from CCWS, ~~and~~ EDG and ESWPBVS room cooler to the environment following an anticipated operational occurrence (AOO) or postulated accident.

- The ESWS provides continued heat transfer from the fuel pool cooling system (FPCPS) via the CCWS as long as any fuel assemblies are in the spent fuel storage pool located outside containment.

- The ESW normal and emergency makeup water systems and blowdown system piping from pump discharge piping up to and including the isolation valves provided for isolation of the tower basins to prevent loss of tower water inventory.

- Pursuant to NRC Regulatory Guide 1.27 requirements, each UHS cooling tower basin is sized to contain sufficient water to allow for 72 hours of ESW train operation under DBE conditions without addition of makeup water. The water level in the basin at the end of the 72 hour period is sufficient to meet pump minimum suction head (NPSH) requirements.

- After 72 hours have elapsed since the initiation of design basis event, the ESW emergency makeup water system provides water to the ESW system to replenish cooling water lost to evaporation, drift, blowdown and other losses in order to ensure cooling tower basin water levels remain within established limits under DBE conditions.

- The site specific ESW emergency makeup water system will provide this makeup water for at least 27 days following the initial 72 hour post-accident period (balance of 30 day scenario).

The ESWS provides the following non-safety-related functions:

- The ESWS provides the cooling of the system users during all normal plant operating conditions.

09.02.01-21 (Part 3)

- ~~The ESWS capability is designed so that the temperatures in the CCWS remain within their specified limits.~~

- The ESW normal makeup water system provides makeup water to the ESW system to replenish cooling water lost to evaporation, drift, and other losses in order to

| Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design (9 Sheets) | | | | | |
|---|---|---|---|---|---|
| **Equipment Description** | **Equipment Tag Number [(1)]** | **Equipment Location** | **ASME Code Section III** | **Function** | **Seismic Category** |
| DIVISION 1 | | | | | |
| BLOWDOWN CHECK VALVE DIVISION 1 | 30PEB10 AA205 | Essential Service Water Pump Structure Division 1 | ~~Yes~~No | Close | ~~I~~NSC |
| TOWER ISOLATION VALVE DIVISION 1 | 30PED10 AA010 | Essential Service Water Pump Structure Division 1 | Yes | Open | I |
| TOWER BYPASS ISOLATION VALVE DIVISION 1 | 30PED10 AA011 | Essential Service Water Pump Structure Division 1 | Yes | Close | I |
| MAKEUP WATER ISOLATION VALVE DIVISION 1 | 30PED10 AA019 | Essential Service Water Pump Structure Division 1 | Yes | Close | I |
| EMER. MAKEUP WATER ISOLATION VALVE DIVISION 1 | 30PED10 AA021 | Essential Service Water Pump Structure Division 1 | Yes | Open | I |
| MAKEUP WATER CHECK VALVE DIVISION 1 | 30PED10 AA220 | Essential Service Water Pump Structure Division 1 | Yes | Close | I |
| ESWS PUMP | 30PEB20 AP001 | Essential Service Water Pump Structure | Yes | Run | I |

09.02.01-21 (Part 18)

**Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design (9 Sheets)**

| Equipment Description | Equipment Tag Number [(1)] | Equipment Location | ASME Code Section III | Function | Seismic Category |
|---|---|---|---|---|---|
| BLOWDOWN CHECK VALVE DIVISION 2 | 30PEB20 AA205 | Essential Service Water Pump Structure Division 2 | ~~Yes~~No | Close | ~~I~~NSC |
| TOWER ISOLATION VALVE DIVISION 2 | 30PED20 AA010 | Essential Service Water Pump Structure Division 2 | Yes | Open | I |
| TOWER BYPASS ISOLATION VALVE DIVISION 2 | 30PED20 AA011 | Essential Service Water Pump Structure Division 2 | Yes | Close | I |
| MAKEUP WATER ISOLATION VALVE DIVISION 2 | 30PED20 AA019 | Essential Service Water Pump Structure Division 2 | Yes | Close | I |
| EMER. MAKEUP WATER ISOLATION VALVE DIVISION 2 | 30PED20 AA021 | Essential Service Water Pump Structure Division 2 | Yes | Open | I |
| MAKEUP WATER CHECK VALVE DIVISION 2 | 30PED20 AA220 | Essential Service Water Pump Structure Division 2 | Yes | Close | I |
| ESWS PUMP DIVISION 3 | 30PEB30 AP001 | Essential Service Water Pump Structure Division 3 | Yes | Run | I |

09.02.01-21 (Part 18)

**Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design (9 Sheets)**

| Equipment Description | Equipment Tag Number (1) | Equipment Location | ASME Code Section III | Function | Seismic Category |
|---|---|---|---|---|---|
| RECIRC ISOLATION VALVE DIVISION 3 | 30PEB30 AA002 | Essential Service Water Pump Structure Division 3 | Yes | Close | I |
| EMER. BLOWDOWN ISOLATION VALVE DIVISION 3 | 30PEB30 AA003 | Essential Service Water Pump Structure Division 3 | Yes | Close | I |
| PUMP DISCHARGE ISOLATION VALVE DIVISION 3 | 30PEB30 AA005 | Essential Service Water Pump Structure Division 3 | Yes | Open | I |
| FILTER BLOWDOWN ISOLATION VALVE DIVISION 3 | 30PEB30 AA015 | Essential Service Water Pump Structure Division 3 | Yes | Close | I |
| BLOWDOWN ISOLATION VALVE DIVISION 3 | 30PEB30 AA016 | Essential Service Water Pump Structure Division 3 | Yes | Close | I |
| PUMP DISCHARGE CHECK VALVE DIVISION 3 | 30PEB30 AA204 | Essential Service Water Pump Structure Division 3 | Yes | Open | I |
| BLOWDOWN CHECK VALVE DIVISION 3 | 30PEB30 AA205 | Essential Service Water Pump Structure Division 3 | ~~Yes~~No | Close | ~~I~~NSC |

09.02.01-21 (Part 18)

**Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design (9 Sheets)**

| Equipment Description | Equipment Tag Number (1) | Equipment Location | ASME Code Section III | Function | Seismic Category |
|---|---|---|---|---|---|
| EMER. BLOWDOWN ISOLATION VALVE DIVISION 4 | 30PEB40 AA003 | Essential Service Water Pump Structure Division 4 | Yes | Close | I |
| PUMP DISCHARGE ISOLATION VALVE DIVISION 4 | 30PEB40 AA005 | Essential Service Water Pump Structure Division 4 | Yes | Open | I |
| FILTER BLOWDOWN ISOLATION VALVE DIVISION 4 | 30PEB40 AA015 | Essential Service Water Pump Structure Division 4 | Yes | Close | I |
| BLOWDOWN ISOLATION VALVE DIVISION 4 | 30PEB40 AA016 | Essential Service Water Pump Structure Division 4 | Yes | Close | I |
| PUMP DISCHARGE CHECK VALVE DIVISION 4 | 30PEB40 AA204 | Essential Service Water Pump Structure Division 4 | Yes | Open | I |
| BLOWDOWN CHECK VALVE DIVISION 4 | 30PEB40 AA205 | Essential Service Water Pump Structure Division 4 | ~~Yes~~No | Close | ~~I~~NSC |
| DEDICATED SYSTEM CHECK | 30PEB41 AA011 | Essential Service Water Pump Structure | Yes | Open | I |

09.02.01-21 (Part 18)

**Table 2.7.11-2—Essential Service Water System Equipment I&C and Electrical Design (78 Sheets)**

09.02.01-21 (Part 18)

| Equipment Description | Equipment Tag Number (1) | Equipment Location | IEEE Class 1E (2) | EQ – Harsh Env. | PACS | MCR/RSS Displays | MCR/RSS Controls |
|---|---|---|---|---|---|---|---|
| DEDICATED RECIRC ISOLATION VALVE | 30PEB80 AA015 | Essential Service Water Pump Structure Division 4 | Division 4 | No | No | Pos/N/A | Open-Close/N/A |

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

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

09.02.01-21 (Part 19)

**Table 2.7.11-3—Essential Service Water System Inspections, Tests, Analyses, and Acceptance CriteriaITAAC (6 8 Sheets)**

| | Commitment Wording | Inspections, Tests, or AnalysisAnalyses | Acceptance Criteria |
|---|---|---|---|
| 6.1 | Components listed as Class 1E in Table 2.7.11-2 that are designated as harsh environment will perform the function listed in Table 2.7.11-1 in the environments that exist before and during the time required to perform their safety function. | a. Type tests, tests, analyses or a combination of tests and analyses will be performed to demonstrate the ability of the equipment listed for harsh environment in Table 2.7.11-2 to perform the function listed in Table 2.7.11-1 for the environmental conditions that could occur before and during a design basis accident.<br>b. For equipment listed for harsh environment in Table 2.7.11-2, an inspection will be performed of the as-installed Class 1E equipment and the associated wiring, cables and terminations. | a. A report exists and concludes that the Class 1E equipment listed for harsh environment in Table 2.7.11-2 can perform the function listed in Table 2.7.11-1 before and during design basis accidents for the time required to perform the listed function.<br>b. Inspection concludes the as-installed Class 1E equipment and associated wiring, cables, and terminations as listed in Table 2.7.11-2 for harsh environment conform to the design. |
| 7.1 | The ESW UHS system as listed in Table 2.7.11-1 has the capacity to transfer remove the design heat load from the CCWS and EDG heat exchangers, and the ESWPBVS room coolers. | Tests and analyses will be performed to demonstrate the capability of the ESWS UHS as listed in Table 2.7.11-1 to remove transfer the design heat load from CCWS and EDG heat exchangers, and the ESWPBVS room coolers.<br>09.02.01-22 (Part 4) | A report exists and concludes that tThe ESWS UHS has the capacity to remove the design heat load from the CCWS and EDG heat exchangers, and the ESWPBVS room coolers with:<br>a. Design CCWS heat exchanger heat load of 2.913 E+08 BTU/hr.<br>b. EDG heat exchanger heat load of 2.20 E+07 BTU/hr.<br>c. ESWPBVS room cooler load of 619,400 BTU/hr. |

**Table 2.7.11-3—Essential Service Water System Inspections, Tests, Analyses, and Acceptance CriteriaITAAC (6 8 Sheets)**

| | Commitment Wording | Inspections, Tests, or AnalysisAnalyses | Acceptance Criteria |
|---|---|---|---|
| 7.2 | The pumps listed in Table 2.7.11-1 have sufficient NPSHA. | Testing and analyses will be performed to verify adequate NPSHA for pumps listed in Table 2.7.11-1. 09.02.01-22 (Part 3) | A report exists and concludes that the pumps listed in Table 2.7.11-1 have sufficient NPSHA that is greater than net positive suction head required (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 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 design conditions. | The as-installed valve changes position as listed Table 2.7.11-1 under system design 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 allows ESWS pump flow back to the ESW cooling tower basin. |
| 7.5 | The non-safety related dedicated ESWS as listed in Table 2.7.11-1 has the capacity to transfer remove the design heat load from the non-safety related dedicated CCWS heat exchanger and ESWPBVS division 4 room cooler. | 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 transfer heat has the capacity to remove transfer the design heat load from the non-safety related dedicated CCWS heat exchanger and ESWPBVS division 4 room cooler. | A report exists and concludes that tThe 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. 09.02.01-1 |

ensure cooling tower basin water levels remain within established limits.

- The ESW system provides the means of transferring heat loads from the dedicated CCW heat exchanger under severe accident conditions to ensure containment integrity.
- Freeze protection is provided by diverting ESW return flow directly to the tower basin and controlling fan operation under low load/low ambient temperature conditions.

The non-safety-related dedicated ESWS train provides water as a cooling medium to the non-safety-related dedicated CCWS train heat exchanger and to the division 4 ESWS ESWPBVS room cooler for the removal of reject heat under severe accident conditions.

## 2.0 Arrangement

2.1 The functional arrangement of the ESWS is as shown in Figure 2.7.11-1—Essential Service Water System Functional Arrangement.

2.2 The location of the ESWS equipment is as listed in Table 2.7.11-1—Essential Service Water System Equipment Mechanical Design.

2.3 Physical separation exists between divisions of the ESWS.

2.4 ~~The non-safety-related dedicated ESWS train functional arrangement is as shown in Figure 2.7.11-1~~Deleted.

2.5 ~~The location of non-safety-related dedicated ESWS equipment is in the division 4 essential service water pump structure (ESWPS) and division 4 Safeguard Building (SB)~~Deleted.

## 3.0 Mechanical Design Features

3.1 Equipment listed in Table 2.7.11-1 as ASME Code Section III is designed, welded, and hydrostatically tested ~~to~~ in accordance with ASME Code Section III.

3.2 Check valves listed in Table 2.7.11-1 will function as listed in Table 2.7.11-1.

3.3 Piping indicated in Figure 2.7.11-1 as ASME Code Section III is designed, welded, and tested in accordance with ASME Code Section III.

3.4 Equipment identified as Seismic Category I in Table 2.7.11-1 can withstand ~~a~~ seismic design basis ~~seismic~~ loads without loss of safety function as listed in Table 2.7.11-1.

3.5 ~~Non-safety-related ASME classification boundaries for dedicated ESWS are as indicated in Figure 2.7.11-1~~Deleted.

3.6 ~~Non-safety related equipment in the dedicated ESWS as indicated in Figure 2.7.11-1 is designed and tested to ASME B31.1, Power Piping Code and ASME Section VIII, Pressure Vessel Code~~Deleted.

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3.7 ~~Non-safety-related piping in the dedicated ESWS as indicated in Figure 2.7.11-1 is designed and tested in accordance with ASME B31.1 Section Code~~Deleted.

3.8 Supports for piping shown as ASME Section III in Figure 2.7.11-1 will be designed per ASME Section III.

3.9 ~~Specifications exist for components listed as ASME Section III in Table 2.7.11-1~~Deleted.

3.10 ~~Specifications exist for piping shown as ASME Section III in Figure 2.7.11-1~~Deleted.

3.11 Specifications exist for supports for piping shown as ASME Section III in Figure 2.7.11-1.

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

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) ~~has the same consequences as the failure of the ESW pump (30PEB10/20/30/40 AP001),~~ results in a switchover to the other ESWS train ~~is carried out~~ automatically for the entire cooling train and is initiated by the CCWS Switchover sequence.

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4.6 ~~The non-safety-related dedicated ESWS is provided with displays retrievable in the MCR and the RSS~~Deleted.

4.7 ~~The non-safety-related dedicated ESWS is provided with controls in the MCR and the RSS~~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.

09.02.01-22 (Part 6)

5.3 ~~The non-safety related dedicated ESWS is powered from Class 1E division power. In the case of LOOP, the dedicated ESWS is powered from the station blackout diesel generator~~Deleted.

**Table 2.7.11-3—Essential Service Water System ~~Inspections, Tests, Analyses, and Acceptance Criteria~~ITAAC (~~6~~ 8 Sheets)**

09.02.01-22 (Part 7)

| | Commitment Wording | Inspections, Tests, or ~~Analysis~~Analyses | Acceptance Criteria |
|---|---|---|---|
| 2.1 | The functional arrangement of the ESWS is as shown on Figure 2.7.11-1. | Inspections of the as-built system as shown on Figure 2.7.11-1 will be conducted | The as-built ESWS conforms to the functional arrangement as shown in Figure 2.7.11-1. |
| 2.2 | The location of the ESWS equipment is as listed in Table 2.7.11-1. | An inspection will be performed of the location of the equipment listed in Table 2.7.11-1. | The equipment listed in Table 2.7.11~~8~~-1 is located as listed in Table 2.7.11-1. |
| 2.3 | Physical separation exists between divisions of the ESWS. | An inspection will be performed to verify that the divisions of the ESWS are located in separate ESW and SB buildings. | The divisions of the ESWS system are located in separate ESW and SB buildings. |
| 2.4 | Deleted. | Deleted. | Deleted. |
| 2.5 | Deleted. | Deleted. | Deleted. |

**Table 2.7.11-3—Essential Service Water System Inspections, Tests, Analyses, and Acceptance CriteriaITAAC (6 8 Sheets)**

| | Commitment Wording | Inspections, Tests, or AnalysisAnalyses | Acceptance Criteria |
|---|---|---|---|
| 3.1 | The components designatedEquipment listed in Table 2.7.11-1 as ASME Code Section III in Table 2.7.11-1 areis designed, welded, and hydrostatically tested to in accordance with ASME Code Section III requirements. | a. Analysis of the equipment identified in Table 2.7.11-1 as ASME Code Section III will be performed per ASME Code Section III design requirements. | a. ASME Code Section III Design Reports (NCA-3550)A report exists and concludes that the components equipment identified in Table 2.7.11-1 listed as ASME Code Section III in Table 2.7.11-1 have been designed and hydrostatically tested in accordancemeets ASME Code Section III design requirements. |
| | | b. Inspections will be conducted of ASME design, NDE and hydrostatic test reports for the components listedon the equipment identified in Table 2.7.11-1 as ASME Code Section III in Table 2.7.11-1 to verify welding has been performed per ASME Code Section III welding requirements. | b. Equipment identified in Table 2.7.11-1 as ASME Code Section III has been welded per ASME Code Section III welding requirements. |
| | | c. Hydrostatic testing of the equipment identified in Table 2.7.11-1 as ASME Code Section III will be performed per ASME Code Section III hydrostatic testing requirements. | c. Equipment identified in Table 2.7.11-1 as ASME Code Section III has been hydrostatically tested per ASME Code Section III hydrostatic testing requirements. |
| 3.2 | Check valves listed in Table 2.7.811-1 will function as listed in Table 2.7.11-1. | Tests will be performed for the operation of the check valves listed in Table 2.7.11-1. | The check valves listed in Table 2.7.11-1 perform the functions listed in Table 2.7.11-1. |

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