9.0
AUXILIARY SYSTEMS

The U.S. Nuclear Regulatory Commission (NRC or the Commission) staff's safety evaluation (SE) for Chapter 9, "Auxiliary Systems," of the Comanche Peak Nuclear Power Plant, Units 3 and 4 (CPNPP3&4) Combined License (COL) Application (COLA), Part 2, Final Safety Analysis Report (FSAR), Revision 3 provides the results of the staff's review for the following sections: Section 9.1, "Fuel Storage and Handling," Section 9.1.2 "New and Spent Fuel Storage," Section 9.1.3, "Spent Fuel Pool Cooling and Cleanup System," Section 9.1.4, "Light Load Handling System (Related to Refueling)," Section 9.1.5, "Overhead Heavy Load Handling Systems," Section 9.2.1, "Station Service Water System," Section 9.2.2, "Reactor Auxiliary Cooling Water Systems," Section 9.2.3, "Demineralized Water Makeup System," Section 9.2.4, "Potable and Sanitary Water Systems," Section 9.2.5, "Ultimate Heat Sink," Section 9.2.6, "Condensate Storage Facilities," Section 9.3.1, "Compressed Air System," Section 9.3.2, "Process and Post-accident Sampling Systems," Section 9.3.3, "Equipment and Floor Drainage System," Section 9.3.4, "Chemical and Volume Control System (PWR) (Including Boron Recovery System)," Section 9.4.1, "Control Room Area Ventilation System," Section 9.4.2, "Spent Fuel Pool Area Ventilation System," Section 9.4.3, "Auxiliary and Radwaste Area Ventilation System," Section 9.4.4, "Turbine Area Ventilation System," Section 9.4.5, "Engineered Safety Feature Ventilation System," Section 9.5.1.1, "Fire Protection Program," Section 9.5.2, "Communications Systems," Section 9.5.3, "Lighting Systems," Section 9.5.4, "Emergency Diesel Engine Fuel Oil Storage and Transfer System," Section 9.5.5, "Emergency Diesel Engine Cooling Water System," Section 9.5.6, "Emergency Diesel Engine Starting System," Section 9.5.7, Emergency Diesel Engine Lubrication System," and Section 9.5.8, "Emergency Diesel Engine Combustion Air Intake and Exhaust System." The COLA, Part 2 FSAR was submitted by Luminant Generation Company, LLC and Comanche Peak Nuclear Power Company, LLC (hereinafter referred to as the applicant).

9.1 Fuel Storage and Handling

This section of the CPNPP3&4 Reference Combined License (RCOL) Safety Evaluation Report (SER) summarizes the results of the review and evaluation of Section 9.1, "Fuel Storage and Handling," of the applicant's CPNPP3&4 RCOL FSAR, Revision 3, by the NRC staff (the staff).

9.1.1 Criticality Safety of New and Spent Fuel Storage (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage and Handling")

Section 9.1.1, "Criticality Safety of New and Spent Fuel Storage," of the CPNPP3&4 FSAR describes the design features of the fuel handling and storage facilities to prevent inadvertent criticality of both new and spent fuel.

The COLA FSAR, Revision 3 Section 9.1.1 incorporates by reference, with no departures or supplements, Section 9.1.1, of the U.S. Advanced Pressurized-Water Reactor (US-APWR) Design Control Document (DCD), Revision 3. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.[1] The staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.1.1 on Docket Number 52-021. The results of the staff's technical evaluation of the DCD information related to the design features of the fuel handling and storage facilities to prevent inadvertent criticality, incorporated by reference in the FSAR, will be documented in the staff's final safety evaluation report (FSER) on the design certification (DC) application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.1.1 of this SER to reflect the final disposition of the DC application.

9.1.2 New and Spent Fuel Storage

9.1.2.1 Introduction

The CPNPP3&4 will have facilities for the storage of new and spent fuel. The new fuel storage pit includes the fuel assembly storage racks, the concrete storage facility that contains the storage racks, and the auxiliary components. The spent fuel storage pit (SFP) includes the spent fuel storage racks, the spent fuel storage pool that contains the storage racks, and the associated equipment storage pits.

9.1.2.2 Summary of Application

Section 9.1.2, "New and Spent Fuel Storage," of the CPNPP3&4 COL FSAR, Revision 3 incorporates by reference Section 9.1.2 of the US-APWR DCD.

[1] See Section 1.x for a discussion on the staff's review related to verification of the scope of information, to be included within a COLA that references a DC.

In addition, in CPNPP3&4 COL FSAR Section 9.1.2.1, the applicant, in addressing Standard (STD) COL 9.1(9), replaced the last sentence of the last paragraph of the incorporated text with the following:

US-APWR COL Information Items

- STD COL 9.1(9)

  A procedure that will instruct the operator to perform formal inspection of the integrity of the spent fuel racks will be established prior to first fuel load.

Interface Requirements

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.1.2 of the DCD.

9.1.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission's regulations for new and spent fuel storage, and the associated acceptance criteria, are given in Section 9.1.2 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR *[light-water reactor]* Edition)," (SRP).

The applicable regulatory requirements for the COL information item described above are as follows:

1. Section 50.68 of Part 50 of Title10 of the *Code of Federal Regulations* (10 CFR) as it relates to criticality monitoring or design to preclude criticality accidents. Section 50.68 allows the applicant to follow the guidelines of 10 CFR 70.24 for criticality monitors or the guidance described therein for significant margins of sub-criticality.

2. General Design Criterion (GDC) 63, of Appendix A to 10 CFR Part 50, "Monitoring Fuel and Waste Storage," as it relates to monitoring systems for detecting conditions that could result in the loss of residual heat removal capabilities and excessive radiation levels, and initiating appropriate safety actions.

9.1.2.4 Technical Evaluation

The NRC staff reviewed Section 9.1.2 of the CPNPP3&4 COL FSAR, and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[2] The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the new and spent fuel storage. Section 9.1.2 of

[2] See Section 1.x for a discussion on the staff's review related to verification of the scope of information to be included within a COLA that references a DC.

the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information incorporated by reference related to the new and spent fuel storage will be documented in the staff SER on the DC application for the US-APWR design.

The staff reviewed the following information contained in the CPNPP3&4 COL FSAR:

US-APWR COL Information Items

- STD COL 9.1(9)

The NRC staff reviewed STD COL 9.1(9) related to COL Information Item 9.1(9) included under Section 9.1.2 of the FSAR. The applicant committed, in the FSAR, to establishing a procedure, prior to first fuel load, which will instruct the operator to perform formal inspection of the integrity of the spent fuel racks.

The NRC staff determined that developing a formal inspection procedure for the inspection of the spent fuel pool racks is in accordance with the recommendations of SRP Section 9.1.2, Section II, and with the requirements of 10 CFR Part 50, Appendix A, GDC 63. The procedure can be credited with detecting conditions that could cause the loss of decay heat removal capabilities for spent fuel assemblies, detecting excessive radiation levels, and initiating appropriate safety actions in a timely fashion. The applicant has committed to have this procedure in place prior to fuel loading. The staff finds the proposed license commitment acceptable, because the procedure will be completed prior to having fuel in the pools. In addition, the staff finds that the applicant has adequately addressed STD COL 9.1(9).

9.1.2.5 Post-Combined License Activities

The following items were identified as the responsibility of the COL holder:

- Comanche Peak (CP) COL 9.1(9) involving the development of a procedure for the formal inspection of the integrity of the spent fuel racks.

9.1.2.6 Conclusions

The staff is reviewing the information in Section 9.1.2 of the US-APWR DCD on Docket Number 52-021. The results of the staff's technical evaluation of the information related to the new and spent fuel storage incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.1.2 of this SER to reflect the final disposition of the DC application.

In addition, the staff concludes that the relevant information presented within the CPNPP3&4 COL FSAR is acceptable and meets the requirements of 10 CFR 50.68 and GDC 63 of Appendix A to 10 CFR Part 50. The staff based its conclusion on the following:

- CP COL 9.1(9), related to developing of a procedure for the formal inspection of the of the integrity of the spent fuel racks, prior to fuel load, is acceptable because formal procedure would detect in a timely fashion, conditions that could cause the loss of decay heat removal capabilities for spent fuel assemblies, or detect excessive radiation levels.

9.1.3 Spent Fuel Pit Cooling and Purification System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.1.3, "Spent Fuel Pool Cooling and Cleanup System")

This section of the CPNPP3&4 COL FSAR, Revision 3 describes the functions of the spent fuel pit cooling and purification system to cool and purify the spent fuel pool water.

Section 9.1.3, "Spent Fuel Pool Cooling and Cleanup System," of the CPNPP3&4 COL FSAR, Revision 3 incorporates by reference, with no departures or supplements, Section 9.1.3, of the US-APWR DCD, Revision 3. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.1.3 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the spent fuel pit cooling and purification system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff's FSER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.1.3 of this SER to reflect the final disposition of the DC application design.

9.1.4 Light Load Handling System (Related to Refueling)

This section of the CPNPP3&4 COL FSAR, Revision 3 describes the light load handling system, which consists of mechanical and electrical equipment and building structural features related to refueling operations.

Section 9.1.4, "Light Load Handling System (Related to Refueling)," of the CPNPP3&4 COL FSAR, Revision 3 incorporates by reference, with no departures or supplements, Section 9.1.4, of the US-APWR DCD, Revision 3. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.1.4 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the light load handling system related to refueling operations, incorporated by reference in the CPNPP3&4 COL FSAR, will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.1.4 of this SER to reflect the final disposition of the DC application design.

9.1.5 Overhead Heavy Load Handling System

This section of the CPNPP3&4 COL FSAR, Revision 3 describes the overhead heavy load handling system, which consists of devices used for critical load handling evolutions.

9.1.5.1 Introduction

The overhead heavy load handling system (OHLHS) consists of devices used for critical load handling evolutions. A critical load handling evolution is defined as the handling of a heavy load where inadvertent operations or equipment malfunctions, separately or in combination, could cause a release of radioactivity, a criticality accident, inability to cool fuel within the reactor vessel or spent fuel pool, or could prevent safe shutdown of the reactor. Heavy loads are defined as a load weighing more than one fuel assembly and its handling device.

9.1.5.2 Summary of Application

FSAR Section 9.1, "Fuel Storage and Handling," Revision 3 incorporates by reference DCD Section 9.1, "Fuel Storage and Handling," Revision 3. Additionally, in FSAR Section 9.1.5, the applicant provided the following information to address STD COL 9.1(6).

<u>*US-APWR COL Information Items*</u>

- CP COL 9.1(6)

The applicant provided additional information in CP COL 9.1(6) to address COL Information Item 9.1(6), which requested the applicant to provide site-specific information for the heavy-load handling program. In response to this COL information item, the applicant provided details of procedures related to this subject, discussion relating to an inspection and testing program, a training and qualification program, and quality assurance (QA) measures to satisfy the requirements.

Interface Requirements

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.1.5 of the DCD.

9.1.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

The acceptance criteria associated with the relevant requirements of the Commission's regulations are given in Section 9.1.5, "Overhead Heavy Load Handling Systems," of NUREG-0800.

In addition, the relevant requirements of the Commission's regulations applying to the overhead heavy load handling system, Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Section C.I.9.1.5, "Overhead Heavy Load Handling System."

9.1.5.4 Technical Evaluation

The staff reviewed Section 9.1.5 of FSAR Revision 3, in which the applicant incorporated by reference Section 9.1.5 of DCD Revision 3, with no departures or supplements, and addressed COL Information Item 9.1(6), as STD COL 9.1(6) in FSAR Section 9.1.5. The staff reviewed the acceptability of the applicant's response to the COL information item against the acceptance criteria in SRP Section 9.1.5, "Overhead Heavy Load Handling System" and Section C.I.9.1.5 of RG 1.206.

The guidelines of SRP Section 9.1.5, RG 1.206, Section C.I.9.1.5, and NUREG-0612, "Control of Heavy Load at Nuclear Power Plants," describe the acceptance criteria for the heavy load handling program.

In accordance with Section C.I.9.1.5 of RG 1.206, "Combined License Applications for Nuclear Power Plants," the COL applicant should describe the program and schedule for implementation of the program governing heavy load handling including the following:

- A listing of all heavy loads and heavy load handling equipment outside the scope of loads described in the referenced certified design and the associated heavy load attributes (load weight and typical load path);
- Heavy load handling safe load paths and routing plans including descriptions of automatic and manual interlocks and safety devices and procedures to assure safe load path compliance;
- Heavy load handling equipment maintenance manuals and procedures;
- Heavy load handling equipment inspection and test plans;

- Heavy load handling personnel qualifications, training, and control programs; and
- QA programs to monitor, implement, and ensure compliance with the heavy load handling program.

During the review of the application, the staff was unable to locate the details of the heavy load handling program. The staff requested the applicant, in Request for Additional Information (**RAI) 3294, Question 09.01.05 -01,** to provide the key elements of the heavy loads handling program at a level of detail similar to that of Section 5.1.1 of NUREG-0612, SRP Section 9.1.5, and RG 1.206. The staff also requested the applicant to provide a schedule as to when the program will be completed.

In its response to **RAI 3294, Question 09.01.05-01**, dated October 21, 2009 (Agencywide Document Access and Management System (ADAMS) accession number ML092990303), the applicant proposed to address COL item 9.1(6) by indicating that a heavy load handling program, including associated procedural and administrative controls, will be established prior to fuel load and will address the attributes consistent with the standards and regulatory guidance identified in DCD Section 9.1.5. The staff found the RAI response provided a reasonable description of the heavy load handling program, but the proposed FSAR changes was inconsistent with the RG 1.206 guidance.

In a supplemental response to **RAI 3294, Question 09.01.05-01**, dated June 13, 2012 (ADAMS accession number ML12167A291), the applicant expanded its RAI response for clarification of certain aspects of the heavy load handling program. The program as described in the expanded response was in accordance with RG 1.206, NUREG-0612, and SRP Section 9.1.5. The applicant proposed to revise the COLA to include a detailed description of the heavy load handling program. In the proposed revision to Section 9.1.5, the applicant also committed to establish the heavy load program (procedural and administrative controls) prior to fuel load. The staff finds this acceptable as it complies with the guidance described in RG 1.206, and considers **RAI 3294, Question 09.01.05-01,** to be resolved. The staff will confirm that the proposed revision to CPNPP3&4 FSAR Section 9.1.5 is incorporated into the next revision of the CPNPP3&4 FSAR. This is being tracked as **Confirmatory Item 9.1.5-01.**

In addition to the program described above, there are additional items requested in COL Item 9.1(6) in DCD Section 9.1.5, which the applicant has incorporated by reference.

Based on the above, the staff finds that the description and commitment to the heavy load handling program is adequate and will reduce the probability and mitigate the consequences of an accidental load drop. Therefore, COL item 9.1(6) is satisfactorily addressed.

9.1.5.5 Post-Combined License Activities

To address COL Information Item 9.1(6), the FSAR will contain a commitment to establish the heavy load handling program, including procedural and administrative controls, prior to first fuel load.

9.1.5.6 Conclusions

The staff is reviewing the information in DCD Section 9.1.5 on Docket No. 52-021. The results of the staff's technical evaluation of the information related to the heavy load handling system incorporated by reference in the FSAR will be documented in the staff SER on the design certification application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.1.5 of this SER to reflect the final disposition of the design certification application.

The staff has evaluated FSAR Section 9.1.5 provided by the applicant in response to COL Information Item 9.1(6). The staff evaluated STD COL 9.1(6) against the relevant NRC regulations, guidance, and acceptance criteria defined in SRP Section 9.1.5 and RG 1.206. Based on the results of this evaluation, and the applicant's responses to the staff's RAIs, which is being tracked as Confirmatory Item **RAI 3294, Question 9.1.5-01**, the staff concludes that the overhead heavy load handling system portion of the FSAR is acceptable.

9.2 Water Systems

9.2.1 Essential Service Water System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.2.1, "Station Service Water System (Open, Raw Water Cooling Systems)")

9.2.1.1 Introduction

The FSAR Section 9.2.1, "Essential Service Water System," describes the essential service water system (ESWS) for CPNPP3&4. The ESWS transfers heat from the component cooling water system (CCWS) and essential chilled water system (ECWS) essential chiller units to the ultimate heat sink (UHS). The ESWS pumps are located in the UHS-related structure (UHSRS), taking suction from the UHS basin. The CPNPP3&4 ESWS design also serves as a backup source of water for the fire protection water supply system (FSS) in the reactor building (R/B) and in the ESW pump (ESWP) house. ESWS water is pumped through underground piping, located within the ESWS pipe tunnel (ESWPT) to the R/B to cool the CCWS and to the power source building (PS/B) to cool the essential chiller loads. The ESWS is required to operate with the reactor at power, shutdown, in hot standby, and after a postulated loss-of-coolant accident (LOCA). Under each of these conditions the ESWS is required to function both with and without preferred AC power available and with a single active failure.

The ESWS is arranged into four independent trains (A, B, C, and D). Each train consists of one ESWP, two 100 percent strainers in the pump discharge line, one CCW HX, one essential chiller unit, and associated piping, valves, instrumentation and controls. Four 50 percent capacity ESWPs, one per train, supply cooling water to remove heat from the recipient components, and then discharge the heated water to the UHS.

Four 100 percent-capacity UHS transfer pumps, one located in each UHS ESWP house, are provided to transfer cooling water from a non-operating UHS basin to the operating UHS basins when required during accident conditions. The UHS and UHS transfer pumps are further described in Section 9.2.5, "Ultimate Heat Sink," of this report.

9.2.1.2 Summary of Application

Section 9.2.1, "Essential Service Water System," of FSAR Revision 3 incorporates by reference Section 9.2.1, of the US-APWR DCD, Revision 3, with no departures.

In addition, in FSAR Section 9.2.1, the applicant provided supplemental information to better describe site-specific design features and address COL information items. Conceptual design information (CDI) in the DCD is also addressed. These items are shown below.

US-APWR COL Information Items

- STD and CP COL 9.2(1)

The applicant provided additional information in CP COL 9.2(1) to address COL Information Item 9.2(1), which states:

> The COL Applicant is to provide the evaluation of the ESWP at the lowest probable water level of the UHS. The COL Applicant is to develop recovery procedures in the event of approaching low water level of UHS.

- CP COL 9.2(2)

The applicant provided additional information in CP COL 9.2(2) to address COL Information Item 9.2(2), which states:

> The COL Applicant is to provide protection of the site-specific portions of the ESWS against adverse environmental, operating, and accident conditions that can occur, such as countermeasures to freezing by safety-related heat tracing, low temperature operation, and thermal overpressurization.

- STD and CP COL 9.2(6)

The applicant provided additional information in CP COL 9.2(6) to address COL Information Item 9.2(6), which states:

> The COL Applicant is to provide ESWP design details – required total dynamic head with adequate margin and net positive suction head (NPSH) available, and the mode of cooling the ESWP motor. The COL Applicant is to assure that the sum of the shut-off head of the selected ESW pumps and the static head will not result in system pressure that exceeds the ESWS design pressure at any location within the system. The COL Applicant is responsible for the testing of the potential for vortex formation based on the most limiting assumptions that apply.

- STD and CP COL 9.2(7)

The applicant provided additional information in CP COL 9.2(7) to address COL Information Item 9.2(7), which states:

> The COL Applicant is to address the piping, valves, lining material specifications for piping and fittings as applicable, including those at the boundary between the safety-related and nonsafety-related portions with clarifications for their connections locations, and other design of the ESWS related to the site-specific conditions. The COL Applicant is also to design the pipes entering and exiting the pipe tunnel based on the location of the UHSRS.

- STD COL 9.2(8)

The applicant provided additional information in CP COL 9.2(8) to address COL Information Item 9.2(8), which states:

> The COL Applicant is to specify the following ESW chemistry requirements
>
> - A chemical injection system to provide non-corrosive, non-scale forming conditions to limit biological film formation.
> - Type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant based on the site conditions.

- STD COL 9.2(25)

The applicant provided additional information in CP COL 9.2(25) to address COL Information Item 9.2(25), which states:

> The COL Applicant is to develop system filling, venting, keeping full and operational procedures to minimize the potential for water hammer; to analyze the system for water hammer impacts; to design the piping system to withstand potential water hammer forces; and to analyze water hammer events in accordance with NUREG-0927.

- STD COL 9.2(26)

The applicant provided additional information in CP COL 9.2(26) to address COL Information Item 9.2(26), which states:

> The COL Applicant is to specify appropriate sizes of piping and pipe fittings such as restriction orifices to prevent potential plugging due to debris buildup, and develop maintenance and test procedures to monitor debris build up and flush out debris.

- CP COL 9.2(29)

The applicant provided additional information in CP COL 9.2(29) to address COL Information Item 9.2(29), which states:

> The COL Applicant is to provide the safety evaluation of the capability of the ESWS to: (1) isolate its site-specific, nonsafety-related portions; and (2) provide measures to prevent long-term corrosion and organic fouling that may degrade its performance, per Generic Letter (GL) 89-13, "Service Water System Problems Affecting Safety-related Equipment."

- CP COL 9.2(30)

The applicant provided additional information in CP COL 9.2(30) to address COL Information Item 9.2(30), which states:

> The COL Applicant shall conduct periodic inspection, monitoring, maintenance, performance and functional testing of the ESWS and UHS piping and components, including the heat transfer capability of the CCW heat exchangers and essential chiller units, consistent with GL 89-13 and GL 89-13 Supplement 1. The COL Applicant is to develop operating procedures to periodically alternate the operation of the trains to ensure performance of all trains is regularly monitored.

- STD COL 9.2(31)

The applicant provided additional information in CP COL 9.2(31) to address COL Information Item 9.2(31), which states:

> The COL Applicant is to verify the system layout of the ESWS and UHS and is to develop operating procedures to assure that the ESWS and UHS are above saturation conditions for all operating modes.

- STD and CP COL 9.2(32)

The applicant provided additional information in CP COL 9.2(32) to address COL Information Item 9.2(32), which states:

> The COL Applicant is to provide a void detection system with alarms to detect system voiding.

- STD COL 9.2(33)

The applicant provided additional information in CP COL 9.2(33) to address COL Information Item 9.2(33), which states:

> The COL Applicant is to provide the design details of the strainer backwash line, vent line, and their discharge locations.

- CP COL 9.5(2)

The applicant provided additional information in CP COL 9.5(2) to address COL Information Item 9.5(2), which states:

> The COL Applicant addresses the design and fire protection aspects of the facilities, buildings and equipments, such as cooling towers and a fire protection water supply system, which are site-specific and/or are not a standard feature of the US-APWR.

FSAR: Section 9.2, “Water Systems,” Table 9.2.1-1R, Essential Service Water System Component Design Data,” and Table 9.2.1-2R, “Essential Service Water System Failure Modes and Effects Analysis,” set forth the design basis and a detailed description of the ESWS.

US-APWR DCD CDI

The CDI as part of the US-APWR DCD which is outside the scope of the specific ESWS and UHS COL items (see SER 9.2.5), is not specifically described in the COL FSAR. However, the staff has evaluated the CDI as described in the following subsections.

- DCD Section 9.2.1.2.1 – ESW sampling of blowdown
- DCD Section 9.2.1.2.2 – strainer mesh
- DCD Section 9.2.1.2.3.1 – spray header draining

FSAR Section 14.2.12.1.113, “Ultimate Heat Sink (UHS) System Preoperational Test,” describe the UHS and ESWS preoperational testing.

The CPNPP3&4 Reference COL Application (RCOLA), Part 4, Technical Specifications *[TS]* and Bases: TS for the ESWS are provided in TS Section 3.7.8, “Essential Service Water System (ESWS).”

The RCOLA Part 10, "Inspection, Tests, Analysis, and Acceptance Criteria (ITAAC)"

US-APWR DCD INTERFACE REQUIREMENTS

Interface requirements addressed in DCD Tier 1, Section 3.2.3," Essential Service Water System," are to be addressed by the COL. These items are as follows:

a. The ESWS piping in the ESWPT that connects to the UHS system is designed, constructed and inspected in accordance with ASME Code Section III.
b. System layout of the ESWS and UHS system is verified to assure that the pressures in the ESWS and UHS system are above saturation conditions during all plant operating conditions including normal plant operations, abnormal and accident conditions.
c. The sum of the ESW pump shutoff head and static head is such that the ESW system design pressure is not exceeded.
d. The ESWS is designed to prevent water hammer.
e. The ESWS can provide cooling water required for the component cooling water (CCW) heat exchangers and the essential chiller units of the essential chilled water system (ECWS) during all plant operating conditions, including normal plant operations, abnormal and accident conditions.

The RCOLA, Part 10, Revision 3, ITAAC, Appendix A.1, "Ultimate Heat Sink System (UHSS) and Essential Service Water system (ESWS) (Portions Outside the Scope of the Certified Design)," describe the site-specific ITAAC for the ESWS and UHS.

The RCOLA, Part 10, ITAAC, Figure A.1-1, "Ultimate Heat Sink System and Essential Service Water system (Portions outside the Scope of the Certified)," provides the ESWS and UHS functional arrangement.

Figure 9.2.1-1R, "Essential Service Water System Piping and Instrumentation Diagram," which was part of Revision 2 of the FSAR, has been removed from FSAR Revision 3. The ESWS diagram of record is the US-APWR DCD, Tier 2, Figure 9.2.1-1, "Essential Service Water System Piping and Instrumentation Diagram," which is incorporated by reference.

9.2.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission's regulations for this area of review, i.e., pertaining to site-specific information on the ESWS, and the associated acceptance criteria, are specified for the most part in NUREG-0800, Section 9.2.1, "Essential Service Water," Revision 5, and are summarized below. Review interfaces with other SRP sections also can be found in SRP Section 9.2.1. The applicable regulatory requirements for the ESWS are as follow:

1. 10 CFR Part 50, Appendix A, GDC 2, "Design Basis for Protection against Natural Phenomena," as it relates to the capabilities of structures housing the system and the

system itself having the capability to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of safety-related functions.

2. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to effects of missiles inside and outside containment, effects of pipe whip, jets, environmental conditions from high- and moderate-energy line-breaks, and dynamic effects of flow instabilities and attendant loads (e.g., water hammer) during normal plant operation, as well as upset or accident conditions.

3. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of Structures, Systems, and Components," insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be shown that sharing will not significantly impair their ability to perform their safety functions.

4. 10 CFR Part 50, Appendix A, GDC 44, "Cooling Water," as it relates to the capability to transfer of heat from systems, structures, systems, and components important to safety to an ultimate heat sink during both normal and accident conditions, with suitable redundancy, assuming a single active component failure coincident with either the loss of offsite power or loss of onsite power.

5. 10 CFR Part 50, Appendix A, GDC 45, "Inspection of Cooling Water System," as it relates to design provisions for in-service inspection of safety-related components and equipment.

6. 10 CFR Part 50, Appendix A, GDC 46, "Testing of Cooling Water System," as it relates to design provisions for pressure and operational functional testing of cooling water systems and components in regard to:
    a. Structural integrity and system leak-tightness of its components;
    b. Operability and performance of active system components; and
    c. Capability of the integrated system to perform credited functions during normal, shutdown, and accident conditions.

7. 10 CFR 52.80(a), "Contents of applications; additional technical information," which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

The 10 CFR 20.1406(a), "Minimization of Contamination," which requires an applicant to describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Acceptance criteria adequate to meet the above requirements include:

1. RG 1.29, "Seismic Design Classification," March 2007, (Seismic Design Criteria), Regulatory Position C.1 for safety-related and Regulatory Position C.2 for non-safety-related portions of the ESWS.

2. The information will be considered acceptable if the design provisions presented in Generic Letter (GL) 96-06 and GL 96-06, Supplement 1, are appropriately addressed.

3. The information will be considered acceptable if the provisions of GL 89-13 and GL 91-13 are appropriately addressed.

4. NUREG-0927, "Evaluation of Water Hammer Occurrence in Nuclear Power Plants," Revision 1, which provides guidance for designing systems to withstand potential water hammer forces.

9.2.1.4 Technical Evaluation

The NRC staff reviewed Section 9.2.1 of FSAR, Revision 3 and considered the referenced DCD. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the ESWS. DCD Section 9.2.1 is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information incorporated by reference related to the ESWS will be documented in the corresponding SER.

As discussed in the Introduction Section, the ESWS consists of four separate safety-related trains each with the capability to cool fifty percent of the design basis heat load. The ESWS functions to transfer heat from CCWS and ECWS essential chiller units to the UHS during normal operating, accident, and shutdown conditions.

- STD COL Item 9.2(1): ESWP water level and recovery procedures.

This COL item is related to GDC 44.

The COL FSAR Section 9.2.1.3, "Regulatory Basis," states that the design of the basin provides adequate submergence of the pumps to assure the net positive suction head (NPSH) for the pumps.

The basin is divided into two levels as shown in Figure 3.8-30, "Typical Section Looking West at UHS Basin and Pumps House Interface with ESWPT." The basin lower section is the suction point of the ESWS pump with is approximately 12 feet lower than the other section.

The ESWP is designed to operate with the lowest expected water level (after 30 days of accident mitigation). The basins have sufficient water inventory to assure adequate cooling and NPSH for 30 days without makeup. The applicant also stated that this item is discussed further in Subsection 9.2.5.2, "System Description," which provides more detail of the UHS basin measurements and level requirements. Recovery procedures contained in the Operating and Maintenance Procedures (see FSAR Section 13.5.2.1, "Operating and Emergency Operating Procedures") are implemented if the UHS approaches low water level.

The COL FSAR Section 9.2.1.2.2.1, "General Description," states that available NPSH with the lowest expected water level (after 30 days of accident mitigation) in the basin is approximately

40 feet. Available NPSH is based on the lowest expected water level in the ESWP intake basin of approximately 12 feet and at 95 degrees Fahrenheit (°F) water temperature.

The COL FSAR Section 9.2.5.2.1, “General Description,” states that the ESW intake basin located underneath the ESW pump house occupies the southwest corner of the UHS basin. The ESW intake basin is 12 feet deeper than the UHS basin. Water volume occupying this 12 feet depth in the ESW intake basin is not included in the UHS basin inventory. This is to assure adequate NPSH to the ESW pump. The UHS basin floor elevation (791 feet) is the reference point for measuring the basin water level.

In **RAI 3698, Question 09.02.01-01,** the applicant was requested to discuss the pump vortex formation as part of the NPSH evaluation, provide drawings that showed the elevation of the ESWS pump impellers, and provide a basis for the ESWS pump total dynamic head.

The applicant, in its response to **RAI 3698, Question 09.02.01-01,** dated November 2, 2009, stated that the procurement of ESW pumps will assure that the pump NPSH required has adequate NPSH margin at the design water temperature of 95 °F and the pump operability is not affected. Available NPSH is approximately 71 feet during normal plant operation.

Additionally, on December 20, 2011, the applicant submitted an Updated Tracking Report, Revision 0, FSAR. This Updated Tracking Report incorporated changes to FSAR Chapter 9 that were made as a result of changes to the US-APWR DCD, and changes to US-APWR DCD RAI responses.

The staff reviewed this supplemental information related to COL 9.2(1) and determined that the ESWP NPSH is adequately addressed since the ESWS pump will be purchased with adequate NPSH margin versus the calculated available NPSH available of 41.2 feet; worst-case condition. Calculations provided by the applicant indicate a worst-case water level above the impeller eye of the ESWP of 10 feet is accounted for in the NPSH available. In addition, the ESWP available NPSH is verified to be greater than required NPSH as described in ITAAC Table A.1-1, Item 14. However, the staff did not see any specific preoperational testing to confirm the adequacy of NPSH without vortex for the entire 30-day accident period. Only an ITAAC was noted in the application. Thus, the staff issued **RAI 6348, Question 09.02.01-06,** in which the applicant was requested to provide specific testing for the ESWS NPSH and pump vortex.

In its response to **RAI 6348, Question 09.02.01-06**, on May 31, 2012, the applicant stated that FSAR Subsection 14.2.12.1.113 was revised to include the requested information. The new text states:

> To demonstrate that the ESW pumps and the UHS transfer pumps have adequate NPSH and maintain design flow rates without vortex formation with the basin at minimum level (end of the 30-day emergency period).

The staff finds that the applicant’s response to **RAI 6348, Question 09.02.01-06**, and its proposed FSAR changes are acceptable. The testing of the ESWS pumps will include NPSH verification. Testing will verify that vortex formation will not occur at the end of the 30-day emergency period. Therefore **RAI 3698, Question 09.02.01-1** is resolved and closed and **RAI 6348, Question 09.02.01-06,** is resolved. Confirmation that the approved change to the FSAR is properly incorporated in the next FSAR revision is being tracked as **Confirmatory Item 09.02.01-6.**

In addition, recovery procedures are adequately addressed in COL FSAR Section 13.5.2.1, which addresses procedures for conditions of UHS low water level. The UHS water level is further discussed in Section 9.2.5 of this report.

In summary, the staff has determined that the applicant has adequately addressed COL Item 9.2(1) and the applicant's response complies with GDC 44. This COL item ensures that the ESWP can perform at the designed low water levels to perform their intended function to transfer heat to the UHS. In addition, recovery procedures are implemented if the UHS approaches low water level.

- CP COL Item 9.2(2): Adverse environmental, freezing, and thermal over-pressurization.

This COL item is related to GDC 2 and GDC 4.

The COL FSAR Section 9.2.1.3 (Revision 3) states that based on the anticipated lowest ambient temperature, the following countermeasures are provided to prevent the ESW from freezing in the basins or piping:

1. The basins are located below grade and thus ground temperature prevents water from freezing.

2. In the operating trains, water is continuously circulated which helps to prevent freezing. Ultimate heat sink (UHS) transfer pumps can be used to circulate water from the idle basins. Plant procedures are developed to operate the pumps in this mode based on the basin water and ambient temperatures.

3. UHS ESW pump house ventilation system maintains pre-determined minimum temperature in the pump house areas. This is further described in FSAR Section 9.4.

4. Temperature in the R/B is maintained through ventilation and therefore heat tracing is not required.

5. Exposed safety-related ESW piping that may be filled with water while the pump is not operating is heat traced. The safety-related heat tracing is activated when the thermostat senses a pre-set low ambient temperature.

The COL FSAR, Section 9.2.1.3, states for the thermal overpressure protection of the component cooling water heat exchanger ESW side, the valves located at the component cooling water heat exchanger ESW side inlet and outlet lines are administratively locked open valves. These locked open valves assure protection from the thermal overpressurization due to the erroneous valve operation coincident with the heat input from the component cooling water (CCW) side to ESW side. During backflush operation of the heat exchanger, essential service water flows from the discharge side of the heat exchanger and then exits from the inlet side to the discharge header. Cooling operation is continued and there is no overpressurization.

Based on the staff's review the ESWS/UHS heat tracing needed to be further addressed by the applicant. Therefore, the staff issued **RAI 6403, Question 14.03.07-38, Part 2**, to request that the applicant provide an ITAAC that describes testing of the ESWS/UHS heat tracing. Due to overlap between the ESWS and the UHS, the balance of **RAI 6403** and testing is further discussed in Section 9.2.5 of this report and only the ESW/UHS heat tracing is described below.

In its response to **RAI 6403, Question 14.03.07-38**, dated September 24, 2012, as supplemented by responses dated November 12, 2012, and November 26, 2012, the applicant stated:

> FSAR Subsections 9.2.1 and 9.4.5 have been revised to address freeze protection for the ESW piping and UHS transfer piping that pass through the piping rooms that are between the pump house and the essential service water pipe tunnel (ESWPT). These piping rooms are heated by unit heaters in the UHS ESW pump house ventilation system, which prevents freezing of the ESW and UHS piping contained therein. Therefore, heat tracing is not applied for freeze protection.
>
> FSAR Figure 9.2.5-1R has been revised to include a drain valve (UHS-VLV-521A/B/C/D) to drain water in the exposed portion of the ESW return line in the cooling tower. For freeze protection of the ESW return piping in the cooling tower, the water in the spray header is drained to the basin though the spray nozzles and the water in the vertical piping is drained to the basin through the drain line. Prior to the onset of temperatures which could cause freezing, a plant operator opens the locked closed manual valve in the ESW pump room on the cooling tower drain line to drain the water in the exposed portion to the basin. After draining, the operator closes and locks the drain valve. The water in the spray header is drained to the basin through the spray nozzles.

The staff finds the applicant's response to **RAI 6403, Question 14.03.07-38, Part 2,** and the proposed FSAR change acceptable since freeze protection for the ESWS was adequately described. The freeze protection design features described in the response include UHS/ESW pump house safety related heating units. There is a total of eight safety-related heaters between the four UHS/ESW pump houses, which maintain the pump rooms and piping rooms within the required temperature range ($\geq$40 °F); thus providing freeze protection. Therefore, **RAI 6403, Question 14.03.07-38,** is resolved**.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 14.03.07-38.**

The staff found the COL supplemental information to be acceptable since the applicant had adequately described the freeze protection for the ESWS. The freeze protection design features provided include the UHS basins which are located below grade, pump circulation, and UHS ESW pump house safety-related heating units. In addition, the R/B temperature is maintained through ventilation and therefore heat tracing is not required. These design features provide adequate freeze protection of the ESWS; therefore, the ESWS is not expected to freeze.

Details of the safety-related heaters for the ESW pump room and UHS transfer piping room are further described in Section 9.4.5 of this SER

Related to CCWS heat exchanger (HX) over-pressurization, during back flush operation for a typical train, HX inlet and outlet isolation valves VLV-514A/B/C/D and VLV-517A/B/C/D are closed, and bypass valves VLV-531A/B/C/D and VLV-532A/B/C/D are opened. Water upstream from the inlet of the HX inlet isolation valves VLV-514A/B/C/D flows through bypass valves VLV-531A/B/C/D and in the HX from the discharge side. The water flows out of the HX from the inlet side to bypass valves VLV-532A/B/C/D and then to the downstream side of valves VLV-517A/B/C/D. Thus, the HX is not isolated during back flushing operation; cooling operation is continued, and there will be no over-pressurization.

Based on this description from the applicant's response to **RAI 3698, Question 09.02.01-02**, dated November 20, 2009, once valves VLV-514A/B/C/D and VLV-517A/B/C/D are closed and before VLV-531A/B/C/D and VLV-532A/B/C/D are opened, there is a small amount of time during which there could be a possible ESWS isolation event and the cooling operation is stopped. In addition, it was unclear, from the applicant's RAI response, if during the flushing operation, the ESWS/CCWS train remains operable. Thus, the staff issued **RAI 6348, Question 09.02.01-07**, as a follow-up to **RAI 3698 Question 09.02.01-2**. In **RAI 6348, Question 09.02.01-07**, the applicant was requested to clarify whether the ESWS and CCWS remain operable during back flushing.
In its response to **RAI 6348, Question 09.02.01-07,** dated May 31, 2012, the applicant stated:

> There is a small amount of time for a possible ESWS isolation event with the CCWS cooling operation stopped if VLV-514A/B/C/D and VLV-517A/B/C/D are closed before VLV-531A/B/C/D and VLV-532A/B/C/D are opened. For this reason, the back flushing procedure requires opening bypass valves VLV-531A/B/C/D and VLV-532A/B/C/D before closing isolation valves VLV-514A/B/C/D and VLV-517A/B/C/D: The train being backwashed is identified as a maintenance outage train prior to commencing the procedure; thus making an ESWS train unavailable to perform maintenance is allowed by Technical Specification 3.7.8 as the LCO requires three of the four trains to be OPERABLE.
>
> Therefore, complete isolation of the ESWS train in backflush is not expected to occur based upon procedural controls, but such isolation would not impact the required cooling because the three other trains remain OPERABLE.
>
> FSAR Section 9.2.1.3 markup states that the backflush procedure requires opening the bypass valves before closing the isolation valves. The train to be backflushed is identified as a maintenance outage train before backflush commences.

The staff finds the applicant's response to **RAI 6348, Question 09.02.01-07,** and the FSAR change acceptable. The backflush procedures will ensure that there is no heat exchanger isolation since valves will be opened (VLV-531A/B/C/D and VLV-532A/B/C/D) before others are fully closed (VLV-514A/B/C/D and VLV-517A/B/C/D). In addition, the ESWS/CCWS train will be out of service for the maintenance activity to backflush the ESWS side of the CCWS heat exchanger. Therefore, **RAI 3698, Question 09.02.01-02** is resolved and closed, and **RAI 6348, Question 09.02.01-07** is resolved. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.01-7.**

In summary, the staff found the applicant's response to COL Item 9.2(2) to be acceptable and the applicant's response complies with GDC 2 and 4. This COL item ensures that environmental conditions such as low ambient temperatures and possible freezing will not negatively impact the design and performance of the ESW. In addition, the over-pressurization of the CCWS HX is not feasible with locked open valves which provide continuous water flow provided by the ESWS and procedural controls in place to prevent over-pressurization during heat exchanger flushing.

- STD and CP COL Item 9.2(6): ESWP details (Pump NPSH, Pump Head, and Testing for Pump Vortex)

This COL item is related to GDC 44.

FSAR Section 9.2.1.2.1 states that the UHS delivers the design water flow rate to the ESWS and does not exceed the maximum design temperature of 95 °F under all operating conditions. Design of the basin provides adequate submergence for the pumps and assures adequate NPSH for the pumps. The ESWP is designed to operate with the lowest expected water level (after 30 days of accident mitigation). The basins have sufficient water inventory to ensure adequate cooling and NPSH for 30 days without makeup. This is discussed further in subsection 9.2.5.2.

The COL FSAR 9.2.1.2.2 states that the total dynamic head (TDH) of the ESWP is 220 feet. Total calculated system head losses including static lift are approximately 190 feet. This provides ample margin. Available NPSH with the lowest expected water level (after 30 days of accident mitigation) in the basin is approximately 40 feet. Available NPSH is based on the lowest expected water level in the ESWP intake basin of approximately 12 feet at 95 °F water temperature.

The ESW pump design will assure that the pressure in the ESWS and UHS system, with the pump operating at shut-off head, is below the ESWS design pressure of 150 pounds per square inch gage (psig).

The lowest expected water level, which is the same as that being used for pump available NPSH evaluation, provides adequate submergence at the pump suction to preclude vortex formation, which is tested according to the procedure indicated DCD Subsection 14.2.12.1.113.

In **RAI 3698, Question 09.02.01-01,** the applicant was requested to clarify the differences in the UHS basin level. FSAR Section 9.2.1.2.2.1 describes the available NPSH with the lowest expected water level in the basin to be about 40 feet, while FSAR Section 9.2.5.3 shows the UHS basin level to be 29 feet deep.

Further discussion was provided by the applicant related to ESWP vortex formation in its response to **RAI 3698, Question 09.02.01-01,** dated November 20, 2009, which stated that a normal water level of approximately 31 feet above the cooling tower basin floor (822-ft elevation) is maintained during plant operation. This provides a water level of 43 feet in the pump intake basin. Following a design-basis accident, water level in the pump intake basin after 30 days without makeup will be approximately 12 feet. The ESWP is located approximately 10 feet from the basin wall. The UHS transfer pump and the ESWP from the same basin do not operate simultaneously. Thus the pump submergence, location, and operating restrictions preclude any vortex formation.

In **RAI 6358, Question 09.02.05-20,** the applicant was requested to state what controls are in place to prevent the ESWS pumps from operating simultaneously with the UHS transfer pump.

The applicant in its response to **RAI 6358, Question 09.02.05-20,** dated June 7, 2012, and supplemented November 12, 2012, stated that the UHS transfer pump and the ESWP from the same basin do not typically operate simultaneously. Section 9.2.5 of this SER provide further discussion related to the UHS transfer pump and the ESWP operating simultaneously.

The staff reviewed the applicant’s supplemental information and proposed FSAR changes, and found that the ESWS pumps have adequate NPSH margin, as previously stated under the staff’s evaluation under COL Item 9.2(1). Testing will demonstrate that the ESW pumps have adequate NPSH and maintain design flow rates without vortex formation with the basin at minimum water level. Related to ESWP vortexing, the applicant has adequately addressed vortex formation since the UHS transfer pumps and ESWP do not normally operate at the same time, and submergence height and pump locations prevent air from being pulled into the intake of the ESWP. ESWP head has been properly addressed since the pumps design total dynamic head is 220 feet, versus the calculated ESWS system head losses of 190 feet. Based on engineering judgment and industry experience, with a head margin of 15 percent, the ESWP head margin is reasonable and acceptable. As such, the NRC staff finds that **RAI 6358, Question 09.02.05-20** is resolved and **RAI 3698, Question 09.02.01-01 is** resolved and closed. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-20.**

In summary, the staff finds that the applicant has adequately addressed COL Item 9.2(6), and the applicant's response complies with GDC 44. This COL item ensures that the ESWPs can perform at the designed low water levels and have adequate margin in pump head to perform their intended function to transfer heat to the UHS.

- STD and CP COL Item 9.2(7): ESWS design related to UHS (material, boundary locations, and interface with pipe tunnel), CP COL 9.2(29): Safety Evaluation (system isolation and GL 89-13), and COL 9.5(2): Fire Protection (site-specific fire protection aspects).

These COL items are related to GDC 44.

The FSAR, Section 9.2.1.2.2.5, states that the lining of the inner surfaces of piping, fittings, and flanges of the ESWS is polyethylene.

The FSAR, Section 9.2.1.2.3.1, states that the in-service testing (IST) program with detailed criteria, including valve leak rates committed to in the implementation milestones, is identified in Table 13.4-201, "Operational Programs Required by NRC Regulation and Program Implementation."

The FSAR, Section 9.2.1.3, states that the non-safety-related portions of the ESWS connected to the circulating water system blowdown header are automatically isolated by the ESWS blowdown main header isolation valve to the CWS blowdown header, which closes with an emergency core cooling system (ECCS) actuation signal, under-voltage signal, ESWP stop signal, or low UHS basin level. The supply line to the FSS is isolated by normally closed manual valves. The position of these valves is controlled by the Operating and Maintenance Procedures mentioned in Subsection 13.5.2.1 in order to maintain water-tight conditions and prevent inadvertent draining of the ESWS.

The blowdown header to the CWS blowdown header, to which the strainer blowdown line for normal power operation use and the UHS basin blowdown line for maintaining acceptable water chemistry are connected, has an isolation valve powered from a Class 1E direct current (DC) bus. The blowdown header isolation valve is interlocked to close on a loss-of-offsite-power (LOOP) signal and an ECCS actuation signal to isolate non-safety-related portions. The blowdown header isolation valve is a redundant valve to the UHS basin blowdown isolation valves and the strainer backwash line isolation valves. The backup line from the FSS has administratively locked closed valves in each of the fire protection water supply taps, which assures water inventory loss control. The counter measures to prevent long-term corrosion and organic fouling per GL 89-13 are reflected in the system operating procedures described in FSAR Section 13.5.2.1.

The ESWS serves as a backup source of water for the FSS in the R/B and in the ESWP house. This is in conformance with the requirement for an alternate fire protection water supply from a Seismic Category I water system in the event of a safe-shutdown earthquake (SSE), in accordance with RG 1.189. Two hose stations at approximately 150 gallons per minute (gpm) total take water from the ESWS for a maximum of two hours. Approximately 18,000 gallons are consumed by the FSS. The ESWS is not required to supply water to the FSS during any other design-basis event including LOCA. This water volume has minimal impact on the UHS water inventory, and does not jeopardize the 30-day capacity requirement. Administratively locked closed valves in each of the fire protection water supply taps assure that water inventory loss is controlled.

The FSAR, Section 9.5.1.2.4, states that the FSS standpipe can be isolated from the normal fire protection water source after a SSE and the standpipe can be aligned to the ESWS for water supply of at least two hose streams of 75 gpm each. To support two hours operation of these hose streams, the ESWS is designed to supply at least 18,000 gallons for this need.

The staff reviewed this supplemental information related to the ESWS piping materials, including fittings, flanges, and internal polyethylene coating. It was unclear based on the replacement of the fourth sentence in DCD Tier 2, Section 9.2.1.2.2.5, whether the rest of the piping is carbon steel and has cathodic protection. In addition, it was not clear how periodic inspections of portions of piping in the ESWPT will be conducted and how inspections of the internal coatings will be possible, e.g., by means of access manholes. In **RAI 6348, Question 09.02.01-08**, the staff requested the applicant provide information in the FSAR on how the internal polyethylene coatings will be inspected, to clarify which portions of the system are not internally coated and to state where cathodic protection is being utilized. In addition, the staff requested the applicant identify any piping material differences that may exist between ESWS piping in tunnels, trenches, and above ground.

In its response to **RAI 6348, Question 09.02.01-08,** dated May 31, 2012, the applicant stated:

> The general arrangements of the ESWPTs are provided in FSAR Figures 3.8-201 through 3.8-205 and show that the ESWPTs have adequate space for maintenance and inspection. The ESWS pipes are connected by flanges and are easy to disassemble if necessary for maintenance. Also, as stated in FSAR Subsections 3.1.4.16.1 and 3.8.4.1.3.1, manholes and hand holes in the ESW piping are provided for inspection.
>
> Periodic visual inspections of the lining will be conducted to detect cracking, peeling, lining separation, abnormal color, or extraneous incrustation. The inspection will utilize the manholes and hand holes, and the pipe end flanges can be removed if necessary.
>
> If damage is found during the inspection, lining repair in a shop or pipe replacement will be performed depending on the extent of damage. If the extent of damage is unclear, a non-destructive test with a pinhole detector may be used to confirm the extent of damage.
>
> All safety-related portions of the ESWS piping are carbon steel coated internally with polyethylene. All ESWS piping is installed in pipe chases inside the buildings or in

> concrete pipe tunnels outside the buildings. There is no buried ESWS piping, no ESWS piping located in trenches, and no above-ground ESWS piping outside the buildings. There is no buried ESWS piping, so cathodic protection of piping is not needed and is not provided.
>
> FSAR Subsection 9.2.1.2.2.5 has been revised to reflect the above information. The FSAR markup states that the rest of the ESWS piping, fittings, and flanges are carbon steel internally lined with polyethylene. Periodic visual inspections of the lining will be conducted to detect cracking, peeling, lining separation, abnormal color, or extraneous incrustation. The inspection will utilize the manholes and hand holes, and the pipe end flanges can be removed if necessary.

The staff reviewed the applicant's response to **RAI 6348, Question 09.02.01-08,** and finds the responses and the proposed FSAR changes acceptable. The ESWPTs have adequate space for maintenance and inspection and the ESWS pipes are connected by flanges and are easy to disassemble if necessary for maintenance. Also manholes and hand holes in the ESW piping are provided for inspection. Periodic visual inspections of the lining will be conducted to detect piping defects such as cracking, peeling, and liner separation. If damage is found during the inspection, lining repairs or piping replacement will be performed depending on the extent of damage. The staff has confirmed that FSAR Revision 3, Section 9.2.1.2.2.5 states that ESWS piping is lined with polyethylene. Therefore, **RAI 6348, Question 09.02.01-08,** is resolved. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP3&4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.01-8.**

The US-APWR DCD Figure 9.2.1-1 describes the ESWS/UHS blowdown and ESW strainer blowdown design. A header from the ESW strainer blowdown connects to the ESWS/UHS blowdown header and is discharged to the CWS blowdown header. ESW/UHS blowdown to CWS is controlled by valves HCV-010, 011, 012, and 013. ESW strainer blowdown to CWS is controlled by valves ESW-AOV-576 A/B/C/D with ESW strainer blowdown being controlled to the UHS basin with valves ESW-MOV-573A/B/C/D and ESW-MOV-574A/B/C/D.

The FSAR, Section 9.2.1.2.1, stated that the isolation valve in the backwash line to the CWS blowdown main header (EWS-AOV-577) is interlocked to close upon receipt of an under-voltage signal, ECCS actuation signal, ESW pump stop signal, or low UHS basin level signal. This action isolates the UHS basin blowdown line to the CWS blowdown main header to preclude system inventory drain-down, which could result in water hammer at pump restart. In addition, FSAR Table 9.2.1-2R describes the failure modes and effects analysis (FMEA) for the ESWS/UHS blowdown safety-related-to-non-safety-related interface valve (ESW-AOV-577). Regarding this valve, the staff asked the US-APWR DC applicant to provide additional design description in **RAI 6344, Question 09.02.01-60**. The DC applicant provided the following clarification in a letter dated July 9, 2012:

> ESW-AOV-577 has 4 pilot valves that are supplied electric power from different trains. A, B, C and D Class 1 E DC-buses power ESW-AOV-577, and when power is lost to any of the buses, ESW-AOV-577 closes. ESW-AOV-577 is a fail-closed valve, and closes automatically on a low basin water level signal, ECCS actuation signal, UV signal or ESW pump stop signal. Closure isolates non-safety-related portions to maintain the required UHS basin inventory for a minimum of 30 days without makeup water. Valve closure also precludes system inventory drain down which may lead to water hammer at pump restart. The valve position is indicated in the main control room (MCR).

> The safety function of ESW-AOV-577 is to isolate the UHS blowdown line to ensure that the UHS basin inventory required for cooling the unit for a minimum of 30 days without makeup water is maintained. Either ESW-AOV-577 and ESW-HCV-010,011,012,013, or ESW-AOV-576A/B/C/D can perform the safety function to isolate the UHS blowdown line. Conversely, opening ESW-AOV-577 is not a safety function. If ESW-AOV-577 fails closed, the UHS basin water chemistry wouldn't be controlled; however, controlling basin water chemistry is not required during an accident and ESW-AOV-577 is designed to close during an accident. The function of ESW-AOV-577 for water hammer prevention is also not a safety function because it is not related to accident mitigation.
>
> The postulated failure resulting in a blowdown bypass could be terminated by operator action. The effect of uncontrolled blowdown for 30 minutes on basin inventory is insignificant. For example, Comanche Peak Nuclear Power Plant, Units 3 & 4 COLA Rev. 3, Part 3, "Environmental Report," Table 3.3-1, describes that the maximum blowdown flow rate is 515 gpm per unit. Blowdown water volume for 30 minutes is 15,450 gallons, which is less than 1% of the total required basin water volume of approximately 8.40 million gallons per unit. When EWS-HCV-010, 011, 012, 013 or ESW-VLV-544A/B/C/D (blowdown bypass valve) is open with a single failure of ESW-AOV- 577 not fully closing, an operator has sufficient time to close the appropriate valve(s) to terminate an uncontrolled blowdown.
>
> In general, components within the scope of the standard design are described in the DCD and those within the scope of the site-specific design are described in the COLA. For example, ESW-AOV-577 was not described in DCD Revision 3 as it is within the scope of site-specific design. However, it will be included in the next revision of the DCD in Figure 9.2.1-1 as conceptual design information. As stated above, ESW-AOV-577 is not included in the DCD because it is conceptual design information.

The staff has reviewed the DC applicant's response to **DCD RAI 6344, Question 09.02.01-60** and finds the additional information to be adequate (this RAI was evaluated in US-APWR DC SER Section 9.2.1). The conceptual design information provided by the DC applicant and additional information in the FSAR are sufficient for the staff to fully understand the safety function of ESW-AOV-577.

This safety-related-to-non-safety-related boundary isolation valve, ESW-AOV-577, which is a fail-closed valve (FC), will close on either a low basin water level signal, an ECCS actuation signal, an under-voltage (UV) signal, or an ESW pump stop signal, thus maintaining ESW system volume to support 30 days of ESW operation without water makeup. ESW-AOV-577 has four different pilot valves powered from four separate Class 1E DC buses (A/B/C/D). ESW-AOV-577 is a FC valve and valve closure is needed to prevent system drain-down, which prevents water hammer upon an ESW pump start. Opening ESW-AOV-577 is not a safety function. MCR operator actions will be required to reopen ESW-AOV-577 to support the continuation of ESW system blowdown (as required) and ESW strainer backwash (as required) if EWS-AOV-577 automatically closes on an isolation signal. The ESW strainer backwash can be drained back to the UHS basin during abnormal conditions such as when ESW-AOV-577 is closed. ESW blowdown is used to maintain acceptable water chemistry composition. In the event that EWS-AOV-577 fails to fully close, the MCR operator will be required to isolate the blowdown line by closing safety-related, hydraulically controlled valves ESW-HCV-010,011,012,013 or air-operated valves ESW-AOV-576 A/B/C/D, which are all upstream of EWS-AOV-577. If the manual bypass valves (ESW-VLV-544A/B/C/D) around

HCV-010,011,012,013 are open, then field operator would have to close these manual valves. The effects of an uncontrolled blowdown for 30 minutes on basin inventory are insignificant due the UHS water basin volume that is initially maintained at approximate 8.4 million gallons per unit.

In addition, the staff finds that the blowdown piping from each of the ESWS loops has individual FC valves (ESW-HCV-010, HCV-011, HCV-012 and HCV-013), and each receives logic signals to close on a sensed safety injection signal, station blackout signal, UHS basin low level signal, or ESWS pump stop signal. The ESWS strainer backwash from each of the ESWS loops has individual FC valves (ESW-AOV-576 A/B/C/D) and each receive logic signals to close on a sensed safety injection signal, station blackout signal, UHS basin low level or ESWS pump stop. In the event that ESW strainer backwash is needed, motor-operated valves ESW-MOV-573 A/B/C/D and ESW-MOV-574 A/B/C/D (powered from a Class 1E DC bus) can be opened to direct flow to the UHS basin.

In addition, the associated valves for the ESW/UHS blowdown and ESW strainer blowdown are found acceptable since other valves can be either closed manually or from the MCR in the event of a valve failure to close which is shown in the below table.

Valve number	Description	Failure	Valves that perform backup isolation functions to preserve UHS basin volume
AOV-577 (DC)	Boundary isolation (SR to NSR) to CWS	to close	• AOV-576A/B/C/D (strainer side) • HCV-010,011,012,013 (UHS blowdown side)
AOV-576 A/B/C/D	ESW strainers blowdown to CWS	to close	• AOV-577 • SST-001 A/B/C/D and SST-002 A/B/C/D
SST-001 A/B/C/D SST-002 A/B/C/D	ESW strainer blowdown	to close	• AOV-576 A/B/C/D (strainer side) • MOV-573 A/B/C/D (UHS basin) • MOV-574 A/B/C/D (UHS basin)
MOV-573 A/B/C/D (DC) MOV-574 A/B/C/D (DC)	ESW strainer blowdown to UHS basin	to close	• SST-001 A/B/C/D and SST-002 A/B/C/D
HCV-010,011,012,013	ESW/UHS blowdown	to close	• Manual valves VLV-541 A/B/C/D • Manual valves VLV-543 A/B/C/D • AOV-577
Manual VLV-544 A/B/C/D	ESW/UHS blowdown to CWS, HCV bypass	N/A manual	• AOV-577

Valve number	Description	Failure	Valves that perform backup isolation functions to preserve UHS basin volume
	Valves are normally locked closed and only open to bypass HCV 010,011,012,013	valves remains open	

The staff reviewed the counter measures to prevent long-term corrosion and organic fouling as discussed in NRC Generic Letter 89-13, and found that they are adequately reflected in the system operating procedures in FSAR Section 13.5.2.1. System operating procedures will include procedures and instructions for energizing, filling, venting, draining, starting up, shutting down, changing modes of operation, returning to service following testing or maintenance, and other instructions appropriate for operation of systems important to safety.

The staff reviewed the supplemental information related to the ESWS water supply for the FSS (up to 18,000 gallons) and finds the UHS inventory is adequate to support 30 days post-accident operation, given the water volume margins within the UHS basins, without makeup to the UHS basins. Administrative controls were sufficient for the FSS connections, which ensure that undesirable ESWS leak paths are isolated and will not prevent the ESWS from performing its intended function.

In summary, the staff found that the applicant has adequately addressed COL Item 9.2(7), and COL Item 9.2(29), and the applicant’s supplemental information complies with GDC 44. The ESWS materials, boundary locations and fire protection aspects have been adequately addressed. These COL items ensure that the ESWS can perform its intended function since adequate design and controls are in place related to water cleanliness to support heat removal to the UHS.

- STD COL Item 9.2(8): Chemistry

This COL item is related to GDC 44.

The FSAR, Section 9.2.1.2.1, states that chemicals are added to the basin to control corrosion, scaling, and biological growth. The water chemistry is managed through a Chemistry Control Program such as following a standard Langelier Saturation Index. The chemical injection system is described in FSAR Section 10.4.5.2.2.8, which states that chemical injection is also provided for the makeup water, blowdown systems, and ultimate heat sink basin.

Blowdown is used to maintain acceptable water chemistry composition. This is accomplished by tapping each ESWP discharge header. Additional description of blowdown is provided in FSAR Section 9.2.5.2.

The FSAR, Section 9.2.5.2.1, states that a chemical injection system is designed to provide non-corrosive, non-scale forming conditions in the UHS basin and ESWS piping to limit biological film formation. The type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant is determined by the Lake Granbury water quality.

The staff reviewed this supplemental information and finds it acceptable since blowdown rate is controlled manually during normal operations. The blowdown control valves (HCV-010, HCV-011, HCV-012, and HCV-013) close automatically upon receipt of a low UHS basin water level signal or ECCS actuation signal. The valves are designed to fail in the close position. The blowdown valves, once closed due to an automatic signal, are not reopened since this will reduce the UHS basin water inventory. Chemicals are added to the basin to control corrosion, scaling, and biological growth, as required.

In summary, the staff finds that the applicant has adequately addressed COL Item 9.2(8) and the applicant's response complies with GDC 44. The COL item ensures that the ESW can perform its intended function since adequate design and controls are in place related to water cleanliness to support heat removal to the UHS.

- STD COL Item 9.2(26): Potential plugging

This COL item is related to GDC 44.

The FSAR, Section 9.2.1.2.1, states that maintenance and test procedures (see Operating and Maintenance Procedures in Subsection 13.5.2.1) are followed to monitor and flush debris accumulated in the system.

The FSAR, Section 9.2.1.3, states that the size of the strainer backwash line is considered to provide adequate velocity to preclude debris buildup without challenging the integrity of the lining. The diameter of the orifices installed in the backwash lines is also considered to be adequate to preclude debris buildup. If necessary, the hole diameter should be sufficient; however, the differential pressure will be lower, so the number of orifices will be increased.

The staff reviewed this supplemental information and found it adequate since the applicant has stated operating and maintenance procedures will address the monitoring and debris flushing of the ESWS. In addition, the hole sizes in the strainer backwash lines has been addressed with respect to system velocities to preclude debris buildup. The number of orifices in the backwash lines will be evaluated by the COL applicant and may be increased as necessary.

In summary, the staff finds that the applicant has adequately addressed COL Item 9.2(26) and the applicant's response complies with GDC 44. This COL item ensures that the ESWS can perform its intended function and system debris will not negatively affect the performance of the ESWS.

- COL Item 9.2(30): Inspection, monitoring, operating procedures, and ensure performance.

This COL item is related to, GDC 45 and 46.

The FSAR, Section 9.2.1.4, states that periodic inspection, monitoring, maintenance, performance and functional testing are performed according to the in-service inspection program and IST program that are described in FSAR Section 13.4. Periodic inspections and testing of the CCW heat exchangers and essential chiller units, consistent with GL 89-13 and GL 89-13, Supplement 1, are performed. The inspections and testing above are subject to programmatic requirements and procedural controls as described in FSAR Section 13.5. The operating procedures to periodically alternate the operating trains for monitoring performance of all ESWS trains are included in the system operating procedures described in FSAR Section 13.5.2.1.

The US-APWR DCD Tier 2, Section 3.1.4.16, “Criterion 45 – Inspection of Cooling Water System,” states that the CCWS and portions of the ESWS are capable of being monitored during normal operation. The important components of these systems are located in accessible areas. These components will have suitable inspection capability as noted in Section 9.2. FSAR 3.1.4.16 adds to the above paragraph and states that these components have suitable inspection capability enhanced with appropriate layout features, as discussed in Section 9.2. The ESWS and CCWS piping is arranged to permit access for inspection. Manholes, handholes, or inspection ports are provided for periodic inspection of system components. The integrity of underground piping is demonstrated by pressure and functional tests.

US-APWR DCD Tier 2, Section 3.1.4.17, “Criterion 46 – Testing of Cooling Water System,” states that the CCWS and the ESWS operate continuously during normal plant operation and shutdown, under flow and pressure conditions that approximate accident conditions. These operations demonstrate the operability, performance, and structural and leak-tight integrity of all cooling water system components. These cooling water systems are designed to include the capability for testing through the full operational sequence that brings the system into operation for reactor shutdown and for LOCAs, including operation of applicable portions of the protection system and the transfer between normal and emergency power sources. The CCWS and the ESWS are capable of being tested during normal operation by alternating operation of the systems between the redundant trains. The FSAR accepts this paragraph and incorporates it by reference (IBR).

The staff reviewed this supplemental information and finds it acceptable since the applicant does describe how periodic inspection, monitoring, maintenance, performance and functional testing are performed. ESWS piping is contained within buildings or the ESWPT. In addition, manholes and inspection ports are provided, and the integrity of the underground piping is confirmed utilizing pressure and functional tests.

In summary, the staff finds that the applicant has adequately addressed COL Item 9.2(30) and the applicant’s response complies with GDCs 45 and 46. This COL item ensures that the ESWS is adequately designed for inspections and testing. Design provisions for pressure and operational functional testing of the ESWS are provided.

- STD COL Item 9.2(25): Water hammer, STD COL Item 9.2(31): Above saturation conditions, and STD and CP COL Item 9.2(32): Void detection

These COL items are related to GDC 4.

The FSAR, Section 9.2.1.2.1, states that the piping layout of the UHS maintains the ESWS/UHS systems pressure downstream of the pump discharge check valve above their saturation pressure at 140 °F design temperature by ensuring that no piping high points are above the cooling tower spray header.

Filling and operating venting procedures are implemented to minimize the occurrence of water hammer and mitigate its effects. These are included in the Operating and Maintenance Procedures described in FSAR Section 13.5.2.1. The system is analyzed for water hammer impact and the system piping is designed to withstand potential water hammer forces in accordance with NUREG-0927, “Evaluation of Water Hammer Occurrence in Nuclear Power Plants,” Revision 1.

The isolation valve in the backwash line to the CWS blowdown main header (EWS-AOV-577) is interlocked to close upon receipt of an under-voltage signal, ECCS actuation signal, ESW pump stop signal, or low UHS basin level signal. This action isolates the UHS basin blowdown line to the CWS blowdown main header to preclude system inventory drain-down, which could result in water hammer upon pump restart.

Layout of the ESW and UHS piping and equipment, and system operating procedures, ensure that the water pressure remains above saturation conditions for all operating modes.

The DCD, Tier 2, Section 14.2.12.1.34, “Essential Service Water System (ESWS) Preoperational Testing,” directs the operator to verify the absence of indications of water hammer by re-activating the ESW pump after a simulated LOOP as specified in Section 14.2.12.1.45, “Class 1E Bus Load Sequence Preoperational Test”.

The RCOLA Part 10, Appendix A.1, ITAAC #16, states that a report exists and concludes that the as-built UHSS is fabricated and installed to prevent water hammer. This means that to satisfy this ITAAC, the as-built UHSS must have been evaluated and found to prevent water hammer and that this evaluation and determination has been documented in a report.

FSAR Section 9.2.5.2.2 states that the system layout assures water pressure remains above saturation conditions throughout the system. The ESW discharge pipe from the pump house passes to the pipe tunnel located at an elevation below grade. The ESWS flows to the CCW heat exchanger and the essential chiller unit located at an elevation below grade in the R/B. The discharge pipe is connected to the cooling tower riser and spray nozzles located above grade. The ESW pump is designed to provide positive pressure at the spray nozzle headers. This together with the high-point vents minimizes system drain-down in the idle trains or upon loss of offsite power and subsequent pump trip.

The following features preclude or minimize water hammer forces:

- On LOOP, the discharge motor-operated valve (MOV) of the operating train is closed by DC power. This, together with the discharge check valve, prevents drain-down to the basin.
- The ESW pump start logic interlocks the discharge MOV operation with the pump operation. The re-start of the tripped pump or start of the stand-by pump, opens the discharge valve slowly after a pre-determined time delay, sweeping out voids from the discharge piping and CT riser and distribution piping.
- The system valve lineup and periodic in-service testing of the idle trains, including testing of the high-point vents, help minimize potential voids and water hammer forces.

The FSAR Revision 3, Section 9.2.1.2.3.1, states that level switches are installed in the vertical piping before the cooling tower spray header to annunciate if system inventory reduction occurs. The detail of the detector is described in FSAR Section 9.2.5.5.

The FSAR Revision 3, Section 9.2.5.5, also states that level switches are installed in the vertical piping upstream of the cooling tower spray header to annunciate if system inventory reduction occurs. The factors considered for detector position are the allowable leakage rate for the ESW pump discharge check valve and motor-operated butterfly valve, allowable voiding volume and maintenance durations.

The FSAR Figure 9.2.5-1R (sheets 1 and 2) shows the level switches with low-water alarms in the vertical piping upstream of the cooling tower spray header.

The staff reviewed this supplemental information and Figure 9.2.5-1R, and determined it to be unacceptable since information related to the system inventory instrumentation related to ESWS void protection at the cooling tower is missing or incomplete. Therefore, the staff issued **RAI 6348, Question 09.02.01-09,** which requested the applicant to:

1. Specify the safety grade of the void protection instruments and power supplies, as described in FSAR Sections 9.2.1 and 9.2.5;
2. Specify and describe FSAR Chapter 14 preoperational testing or site-specific ITAAC for these ESWS voiding instruments; and
3. Consider FMEA related to failures of these instruments to detect voiding.

In its response to **RAI 6348, Question 09.02.01-09,** dated September 10, 2012, and December 5, 2012, the applicant stated:

> The level switches are unnecessary as a void detection system for water hammer prevention because water hammer will not occur in Units 3 and 4 as described below.
>
> According to EPRI Report TR-106438, "Water Hammer Handbook for Nuclear Plant Engineers and Operators," the causes of water hammer are the following:
>
> 1. Water Cannon
> 2. Steam/water Counterflow
> 3. Steam Pocket Collapse
> 4. Low Pressure Discharge
> 5. Water Slug
> 6. Valve Slam
> 7. Column Rejoining
>
> Except for item 7, water hammer at the spray nozzles is not applicable to the items above.
>
> The phenomenon at the spray nozzles is only that water enters into an air space and the air is vented from the nozzles. Hence, the phenomenon is different from item 7 as well. In addition, the ESW pump outlet valves, MOV-503A/B/C/D, open slowly, taking approximately 30 seconds from startup of the ESW pump to fully open. This is to sweep air from the cooling tower spray riser and distribution piping so there is no rapid increase in spray riser water level. Water hammer is prevented by this design. Therefore, the level switches which were installed in the spray headers as an additional precaution and defense-in-depth have been deleted. Failure of the safety-related outlet MOV to open slowly is considered to be a single failure. The

descriptions of the level switches have been deleted from the FSAR and the switches are not included in ITAAC or the FMEA.

Markup[s] of FSAR Sections 9.2.1, 9.2.5 and 14.2 have been provided to delete this information related to the level switches.

The staff reviewed the applicant's response to **RAI 6348, Question 09.02.01-09**, and found it acceptable. The applicant has determined that there is no need for a void detection system since the discharge MOV to the ESWS pump opens slow enough to prevent water hammer and the air in the ESWS is self-vented from the cooling tower spray nozzles during ESWS pump starts. In addition, operational procedures are in place to minimize the potential for water hammer, an analysis has been completed for the ESWS for water hammer impact with no adverse effect identified, and the piping system has been designed to withstand potential water hammer forces. As previously addressed under COL Item 9.2(2), the ESW/UHS cooling tower vertical riser is drained during cold weather to prevent water freezing in the piping system; therefore, during cold weather the vertical riser is emptied of water and voided.

In addition, related to pipe voiding and water hammer, FSAR Section 14.2.12.1.113, D.6, "Acceptance Criteria," verifies the absence of significant water hammer during ESW pump starts and stops with voids in the spray headers or nozzles. This was added based on the response to **RAI 6457, Question 14.02-21**, which is further discussed in Section 9.2.5 of this SER.

The proposed FSAR change was reviewed and found acceptable since the change removed all the references to the UHS level switches. Therefore, RAI 6348, **Question 09.02.01-09,** is resolved**.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.01-9.**

As previously stated, testing for water hammer is addressed in the US-APWR DCD Tier 2, Section 14.2.12.1.34, and RCOLA Part 10, Appendix A.1, ITAAC #16, which states that a report exists and concludes that the as-built UHSS is fabricated and installed to prevent water hammer.

The staff reviewed this supplemental information related to 'above saturation conditions' and finds it acceptable since the applicant does demonstrate that the piping layout of the UHS maintains the ESWS/UHS systems pressures above their saturation pressure (at 140 °F). This system pressure prevents potential void formation during pump stoppage. During pump operation, due to the addition of the dynamic head to the static head, the ESWS/UHS system pressure will be above saturation pressure. This along with the control of valves and other design features of the system minimizes the potential for transient water hammer. The system layout and other design features assure that the fluid pressure remains above saturation conditions at all locations during all modes of operation.

The staff reviewed this supplemental information related to water hammer and found it adequate since the applicant has analyzed for water hammer impact and the system piping is designed to withstand potential water hammer forces in accordance with NUREG-0927. ESW-AOV-577 is designed to close on emergency signals, thus system drain-down is prevented and water hammer should not occur on subsequent ESWS pump restarts.

In summary, the staff finds that the applicant has adequately addressed COL Items 9.2(25), 9.2(31), and 9.2(32), and finds the applicant's supplemental information complies with GDC 4, as it related to water hammer. These COL items ensure that the ESWS can perform its intended function and water hammer has been adequately addressed with design features and analysis to withstand potential water hammer forces. In addition, preoperational testing and ITAAC for the ESWS and UHS adequately describe the necessary testing related to water hammer.

- COL Item 9.2(33): Design details of strainer (backwash, vent and discharge)

This COL item is related to GDC 44.

FSAR Section 9.2.1.2.2.2 states that the strainer backwash lines are installed downstream of the strainer backwash and discharge to the CWS blowdown main header and UHS basin.

The blowdown line to the CWS blowdown main header from each strainer is used during normal power operation. The normally open Class 1E DC-powered isolation valve in the backwash line to the CWS blowdown main header is interlocked to close at a low UHS basin water level signal, ESW pump stop signal, under-voltage signal, or ECCS actuation signal to maintain UHS basin inventory required for cooling the unit for a minimum of 30 days without makeup water. Also, in the absence of the above signals, the isolation valve in the backwash line to the CWS is interlocked to close only when the ESW pump is stopped to preclude the system inventory drain-down, which can lead to water hammer upon pump restart. Table 9.2.1-2R shows the redundancy for the above functions.

The strainer backwash drains back to the UHS basin during an accident or abnormal conditions. This is to maintain the basin inventory when normal makeup water is not available. The normally closed Class 1E DC powered, motor-operated isolation valve in the backwash line to the basin is interlocked to open upon an under-voltage signal or ECCS actuation signal to provide flow to the basin. Also, in the absence of the above signals, the isolation valve in the backwash line to the basin is interlocked to close when ESW pump is stopped to preclude system inventory drain-down which can lead to water hammer at pump restart. Table 9.2.1-2R shows the redundancy for above functions.

An automatic vent valve is also installed to sweep out air introduced into the piping system by the vacuum breakers that are installed to prevent water hammer. The drainage is discharged via a floor drain of the UHSRS.

The staff reviewed this supplemental information and finds it acceptable since the applicant does adequately describe how the strainer backwash lines are designed and functions. Adequate design features exists in addressing single failure which are described in Table 9.2.1-2R which have been previously addressed in this report under COL Item 9.2(7), boundary locations.

For the ESWS strainer blowdown configuration, AOV-576A/B/C/D which are normal opened, fail close, and are powered by Class 1E DC power. AOV-573A/B/C/D and AOV-574A/B/C/D provide a backup flow path for the strainer backwash to the UHS basin. These valves are normally closed and are also Class 1E DC power and received automatic open signal during accident conditions.

In summary, the staff finds that the applicant has adequately addressed COL Item 9.2(33), and finds the applicant's supplemental information complies with GDC 44. This COL item ensures that the ESWS is adequately designed to maintain UHS water quality and water inventory to support long term emergency operations while prevent water hammer with installed automatic vent.

CDI which is outside the scope of COL items:

The CDI as part of the US-APWR DCD which is outside the scope of the specific ESWS and UHS COL items (see SER 9.2.5), is not specifically described in the FSAR. However, the staff has evaluated the CDI as described below:

US-APWR DCD Tier 2, Section 9.2.1.2.1 – ESW sampling of blowdown

[For discharge to cooling towers, the ESW is sampled prior to blowdown releases.]

The COL applicant has adopted this DCD statement without comments and without changes to FSAR Section 9.2.1.2.1.

The staff finds this DCD statement acceptable for the COL. Prior to any radiation leakage being detected in the ESWS radiation alarms in the CCWS side would have already alerted the operators of contamination in the CCWS. The affected CCWS train is immediately isolated followed by the isolation of the aligned ESWS to prevent possible contamination of the UHS and the environment. A local grab sampling line is installed downstream of the CCW heat exchanger to determine any trace amounts of radioactivity prior to release to the UHS. ESW discharge sampling is performed periodically. Since ESWS blowdown is a discharge path to the environment, sampling is performed prior to blowdown release.

Radiation protection and Regulatory Guide 4.21, is further described in Section 12.3 of this SER.

US-APWR DCD Tier 2, Section 9.2.1.2.2 – strainer mesh

[The 3-mm mesh of the strainer element also assures that potential clogging of the cooling tower nozzles is avoided.]

The COL applicant has adopted this DCD statement without comments and without changes to FSAR Section 9.2.1.2.2.

The staff finds this DCD statement acceptable for the COL. Detailed design of the cooling tower spray nozzles is still under development; however, the COL applicant has taken the necessary steps to ensure that the blockage will not occur in the ESWS, specifically in the ESW to the CCWS plate-type heat exchangers and UHS spray nozzles.

The clearances for plate-type heat exchangers is more limiting, and industry practice has indicated the UHS spray nozzles have orifices much larger than 3mm. If during the detailed design of the UHS spray nozzles, the required orifice is determined to be smaller, the FSAR would need to be revised to reflect the new required mesh size.

US-APWR DCD Tier 2, Section 9.2.1.2.3.1 – spray header draining

The DCD Section 9.2.1.2.3.1 states that voiding upstream of the pump discharge check valve in any train may occur during LOOP and subsequent pump trip, particularly at a low UHS water level. To maintain the pressure at this portion above the saturation pressure to preclude steam void formation which leads to water hammer, vacuum breakers shall be installed between the pump discharge and its check valve. Air entering the piping cushions any abrupt water flow filling the voids and water hammer will not take place at pump actuation. The entering air then discharges through the automatic vent valve installed in the strainer. The motor-operated pump discharge valve, being powered by a safety DC power source, is unaffected by the loss of offsite power and will close when the pump stops. [[Water in the cooling tower spray header will drain to the UHS.]]

The COL applicant has adopted this DCD statement without comments and without changes to FSAR Section 9.2.1.2.3.1.

The staff found this DCD statement and bracketed text needed to be clarified by the COL applicant. This statement appears to be out of place since the paragraph is addressing voiding of the piping system at the ESWS pumps and draining of the cooling tower spray header may be in error in this section. Therefore the staff issued **RAI 6348, Question 09.02.01-11,** to address this issue**.**

The applicant responded to **RAI 6348, Question 09.02.01-11,** on May 31, 2012, and September 10, 2012, and provided the following response:

> The bracketed statement in DCD Section 9.2.1.2.3.1 is related to the subsequent description regarding the prevention of water hammer. In addition, the above description in DCD Section 9.2.1.2.3.1 is incorporated by reference in the FSAR. The potential for water hammer is minimized by opening the pump discharge MOV gradually and by testing of the high point vents to minimize voids as described in FSAR Subsection 9.2.5.2.2. In addition, a report is prepared based on inspection and analysis, which concludes that the as-built UHS system is fabricated and installed to prevent water hammer (see COLA Part 10, Appendix A.1, table A.1-1 item 16). In general, when a large capacity pump such as the ESW pump stops, water in the piping near an outlet drains. At CPNPP Unit 3 and 4, when an ESW pump stops, water in the UHS cooling tower spray header and the short segment of vertical piping between the header and the spray nozzles will drain to the basins through the nozzles. The bracketed statement in the DCD generally describes this phenomenon. Since the cooling tower spray header is site-specific scope, the description is bracketed in the DCD as CDI.

The staff reviewed the applicant's responses to **RAI 6348, Question 09.02.01-11,** and finds the response acceptable. The bracket text is incorporated by reference and is related to the prevention of water hammer. Water hammer is minimized by opening the pump discharge MOV gradually which sweeps out voids from the discharge piping and cooling tower riser and distribution piping. In addition, testing of the highpoint vents helps to minimize void and water hammer forces. A report is prepared based on inspection and analysis, which concludes that the as-built UHSS and ESWS is fabricated and installed to prevent water hammer (see COLA Part 10, Appendix A.1, Table A.1-1 Item 16). Therefore, **RAI 6348, Question 09.02.01-11, is resolved and closed**.

Initial Plant Testing:

The US-APWR DCD Tier 2, Section 14.2.12.1.34, “Essential Service Water System, (ESWS) Preoperational Test,” includes ESWP performance and pump flow rates, automatic system controls and interlocks, alarms, and verification of the absence of water hammer during load sequences. FSAR Section 14.2 states that DCD Section 14.2 is incorporated by reference.

The FSAR Section 14.2.12.1.113,” Ultimate Heat Sink (UHS) System Preoperational Test,” includes preoperational testing which includes the ESWS. Included in the acceptable testing related to ESWS are ESW pump flow rates and basin-low-water-level, blowdown equipment operations, and required flows and pressure when the FSS is aligned.

Section 14.2 of this SER addresses the staff’s evaluation of the initial test program for CPNPP3&4 as described in the FSAR.

ITAAC:

The RCOLA Part 10, Appendix A.1, addresses the DCD Tier 1 ESWS Interface Requirements.

Item a, ESWS piping in the ESWPT must be designed, constructed and inspected in accordance with ASME Code Section III. This item is addressed in Appendix A.1, ITAAC 2, 3 and 4.

Item b, the ESWS is above saturation conditions during all plant operating conditions including normal plant operations, abnormal and accident conditions. This item is not specifically addressed in Appendix A.1 ITAAC.

Item c, sum of the ESW pump shutoff head and static head is such that the ESW system design pressure is not exceeded. This item is addressed in Appendix A.1, ITAAC 17.

Item d, the ESWS is designed to prevent water hammer. This item is addressed in Appendix A.1 ITAAC 16 – but no defined testing is indicated.

Item e, the ESWS can provide cooling water required for the CCW heat exchangers and the essential chiller units of the ECWS during all plant operating conditions, including normal plant operations, abnormal and accident conditions. This item is not specifically addressed in Appendix A.1 ITAAC.

The staff finds that the applicant has not fully addressed Interface Items b, d, and e and issued **RAI 6348, Question 09.02.01-10,** in which the staff requested the applicant to provide the following information:

Item b; System layout of the ESWS/UHS is verified above saturation conditions during all plant operating conditions including normal plant operations, abnormal and accident conditions; however the staff was unable to locate this item in the RCOLA Part 10, Appendix A.1 ITAAC.

Item d; ESWS is designed to prevent water hammer, and is addressed in Appendix A.1, ITAAC 16, with the statement that a ‘test report exists’; however, there is no defined water hammer testing indicated.

Item e; ESWS can provide cooling water required for the component cooling water (CCW) heat exchangers and the essential chiller units of the essential chilled water system (ECWS) during all plant operating conditions, including normal plant operations, abnormal and accident conditions, however the staff was unable to locate this item in the RCOLA Part 10, Appendix A.1, ITAAC.

The applicant responded to **RAI 6348, Question 09.02.01-10 (part b)**, on May 31, 2012, and provided the following response:

> Item b: FSAR Subsection 9.2.1.2.1 states:
>
> The piping layout of the UHS maintains the ESWS/UHS system pressure downstream of the pump discharge check valve above their saturation pressure at 140 °F design temperature by ensuring that no piping high points are above the cooling tower spray header.
>
> Voids could be generated and potentially cause water hammer if the ESWS/UHS is not maintained above saturation pressure. Testing for the preclusion of void generation and water hammer is necessary and the ITAAC regarding the occurrence of water hammer is described in COLA Part 10 Appendix A.1 Item #16.

The staff reviewed the applicant's response to **RAI 6348, Question 09.02.01-10 (part b),** and finds the response acceptable related to maintaining the ESWS above saturated pressure. RCOLA Part 10, Appendix A.1, Item #16, adequately addressed water hammer prevention including as-built verification with the acceptance criterion of a "report exists…" described above. Therefore, **RAI 6348, Question 09.02.01-10 (part b),** is resolved and closed.

The applicant responded to **RAI 6348, Question 09.02.01-10 (part d),** on May 31, 2012, and provided the following response:

> Item d: Test of the as-built UHS system and ESWS will be performed to ensure prevention of a water hammer. A description of ITAAC regarding water hammer in the UHSS and the ESWS has been added in COLA Part 10 Appendix A.1 Item #16.

The staff reviewed the applicant's response to **RAI 6348, Question 09.02.01-10 (part d),** and finds the responses and the proposed FSAR change acceptable. COLA Part 10, Appendix A.1, Item #16, adequately addressed water hammer prevention including as-built verification with the acceptance criterion of a "report exists". The applicant added the ESWS to this ITAAC which the staff finds as acceptable. Therefore **RAI 6348, Question 09.02.01-10 (part d),** is resolved. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP3&4 COL FSAR. This is being tracked as
Confirmatory Item 09.02.01-10.

The applicant responded to **RAI 6348, Question 09.02.01-10 (part e),** on May 31, 2012, and provided the following response:

> Item e: The ITAAC described in "Item e" has been described in DCD Tier 1 Revision 3 Table 2.7.3.1-5 Item #7. This standard plant ITAAC item requires tests of the system, which include both the standard plant and site-specific portions of the system. As such, the site-specific interface is being adequately addressed by the

US-APWR ITAAC and no additional description is required in COLA Part 10 Appendix A.1 ITAAC.

The staff reviewed the applicant's response to **RAI 6348, Question 09.02.01-10 (part e),** and finds the response acceptable. The staff confirmed that the ITAAC related to providing flow to the CCWS and ECWS is part of the DCD and not site-specific. The COL applicant does not need to provide a site-specific ITAAC for this item. **RAI 6348, Question 09.02.01-10 (part e) is resolved and closed.**

The staff reviewed the associated RCOLA Part 10 ITAAC and the five DCD interface requirements associated with the ESWS and determined that the ITAAC are adequately addressed. This includes the ASME Code, saturation conditions (water hammer preventions), ESW pressures, prevention of water hammer, and cooling water flow to essential components and systems. In addition, the ESWS relevant automatic system controls, interlocks, alarms, and ESWS pump performance are adequately addressed in ITAAC to insure the ESWS can perform its intended function.

Regarding COLA ITAAC related to the ESWS, the staff finds that if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations per 10 CFR 52.80(a).

Technical Specifications:

The staff reviewed US-APWR DCD Tier 2, Chapter 16, and FSAR Chapter 16, and determined that the FSAR had added no supplemental TS information in this area of review. The staff issued its Comanche Peak Nuclear Power Plant, Units 3 and 4, Safety Evaluation with Open Items for Chapter 16 on January 29, 2013.

9.2.1.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.2.1.6 Conclusions

The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the ESWS, and there is no outstanding information expected to be addressed in the FSAR related to this section.

The staff is reviewing the information in DCD Section 9.2.1 on Docket Number 52-021. The results of the staff's technical evaluation of the information related to the ESWS incorporated by reference in the FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.1 of this SER to reflect the final disposition of the DC application.

The staff evaluated the information in FSAR Revision 3, Section 9.2.1, ESWS, in accordance with the guidance in Section 9.2.1.3, "Regulatory Basis." On the basis of its review and evaluation, the staff concludes that the proposed ESWS as described in FSAR Section 9.2.1 will be in compliance with GDCs 2, 4, 5, 44, 45, and 46, 10 CFR 20.1406,10 CFR 52.80(a), and the guidance established in SRP Section 9.2.1. Therefore, based on the applicant's responses to the staff's RAIs, which is being tracked as Confirmatory Items **RAI 6348 Questions 09.02.01-6, 7, 8, 9, and 10, RAI 6358 Question 09.02.01-20, and RAI 6403 Question 14.03.07-38** the staff concludes that the information in FSAR Section 9.2.1 is acceptable.

As stated above, the US-APWR DCD is still undergoing NRC staff review and has not been approved. Therefore, there is not an approved regulatory basis for the US-APWR at this time. Acceptability of the specific review considerations that pertain to the CPNPP3&4 RCOLA is judged based upon conformance with the specified review criteria (or equivalent) and the current revision of the US-APWR DCD, as appropriate. The final acceptance of the RCOLA cannot be accomplished until the design certification process for the US-APWR is completed and the RCOLA has been determined to be fully consistent with the approved regulatory basis.

9.2.2 Component Cooling Water System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.2.2, "Cooling System for Reactor Auxiliaries (Closed Cooling Water Systems)")

9.2.2.1 Introduction

The FSAR Section 9.2.2, “Component Cooling Water System,” describes the CCWS for CPNPP3&4. The CCWS is a closed-loop cooling water system that removes heat from safety-related and non-safety-related components during normal operating, accident, and shutdown conditions. The heat transferred from these components to the CCWS is rejected to the ESWS via the CCWS HXs.

The CCWS consists of two independent subsystems with each subsystem providing 100 percent of the cooling capacity required for its safety function. Each of the two subsystems contains two 50 percent trains for a total of four safety-related 50 percent trains with the principal equipment of each train located in its own separate area in the reactor building.

Each of the two trains in each subsystem (trains A & B, trains C & D) consists of two CCWS pumps, two plate-type CCWS heat exchangers, a surge tank, and three sampling lines with a continuous radiation monitor. The CCWS includes supply headers A, B, C, D, A-1, A-2, C-1 and C-2 for providing cooling water to both safety-related and non-safety-related loads.

The following are served by the CCWS supply headers A, B, C and D:

- containment spray/residual heat exchangers;
- containment spray/residual heat removal pump motors;
- safety injection pump (oil coolers and motors); and
- component cooling water pump motors.

The CCWS provides cooling water for other major loads via headers A-1, A-2, C-1 or C-2 which include:

- spent fuel pit heat exchangers;
- charging pumps;
- blowdown and atmosphere gas sample coolers;
- sample heat exchangers;
- reactor coolant pumps (bearing coolers, air coolers, and thermal barriers);
- instrumental air systems;
- excess letdown and letdown heat exchangers;
- waste gas dryers;
- chemical drain tank pumps;
- boric acid evaporators; and
- auxiliary stream drain monitor heat exchangers.

Each safety-related CCWS train is powered by a Class 1E electric bus with emergency power from its associated gas turbine generator (GTG).

9.2.2.2 Summary of Application

The COLA FSAR, Revision 3, Section 9.2.2 incorporates by reference Section 9.2.2, "Component Cooling Water System," of the US-APWR DCD, Revision 3.

In addition, FSAR Revision 3, Section 9.2, "Water Systems," provides supplemental information.

US-APWR COL Information Items

- CP COL 9.2(27)

The applicant provided additional information in CP COL 9.2(27) to address COL Information Item 9.2(27), which states:

> The COL Applicant is to develop a milestone schedule for implementation of the operating and maintenance procedures for water hammer prevention.

Interface Requirements

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.2.2 of the DCD.

9.2.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission's regulations for this area of review, i.e., pertaining to site-specific information on the CCWS, and the associated acceptance criteria, are specified for the most part in SRP Section 9.2.2, "Reactor Auxiliary Cooling Water System," Revision 4 – March 2007, and are summarized below. Review interfaces with other SRP sections also can be found in SRP Section 9.2.2.

The applicable regulatory requirements for the CCWS are as follows:

1. 10 CFR Part 50, Appendix A, GDC 2, "Design Basis for Protection against Natural Phenomena," as it relates to the capabilities of structures housing the system and the system itself having the capability to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of safety-related functions.

2. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to effects of missiles inside and outside containment, effects of pipe whip, jets, environmental conditions from high- and moderate-energy line-breaks, and dynamic effects of flow instabilities and attendant loads (e.g., water hammer) during normal plant operation, as well as upset or accident conditions.

3. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of Structures, Systems, and Components," insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be shown that sharing will not significantly impair their ability to perform their safety functions.

4. 10 CFR Part 50, Appendix A, GDC 44, "Cooling Water," as it relates to the capability to transfer of heat from systems, structures, systems, and components important to safety to an ultimate heat sink during both normal and accident conditions, with suitable redundancy, assuming a single active component failure coincident with either the loss of offsite power or loss of onsite power.

5. 10 CFR Part 50, Appendix A, GDC 45, "Inspection of Cooling Water System," as it relates to design provisions for in-service inspection of safety-related components and equipment.

6. 10 CFR Part 50, Appendix A, GDC 46, "Testing of Cooling Water System," as it relates to design provisions for pressure and operational functional testing of cooling water systems and components in regard to;
    a. Structural integrity and system leak-tightness of its components
    b. Operability and adequate performance of active system components
    c. Capability of the integrated system to perform credited functions during normal, shutdown, and accident conditions

7. 10 CFR 20.1406(a), which requires an applicant to describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

8. 10 CFR 52.80(a), which requires that the COL application must contain the proposed inspections, tests, analyses and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will be operated in conformity with the combined license, the provisions of the Act, and the Commission's rules and regulations.

9.2.2.4 Technical Evaluation

The NRC staff reviewed Section 9.2.2 of the CP Unit 3 and 4, Revision 3, COL FSAR and considered the referenced US-APWR DCD (Revision 3). The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the CCWS. Section 9.2.2 of the US-APWR DCD is being reviewed by the staff under docket number 52-021. The NRC staff's technical evaluation of the information incorporated by reference related to the CCWS (including associated ITAAC) will be documented in the corresponding SER for the US-APWR.

The staff reviewed the COL application to determine the acceptability of the information supplied by the applicant to address each COL item. The staff's review for the COL information item is provided below.

<u>US-APWR COL Information Items</u>

- CP COL 9.2 (27)

In CP COL 9.2(27), which addresses DCD COL 9.2(27), in FSAR Section 9.2.2.2.2, the COL applicant replaced the last paragraph in DCD Section 9.2.2.2.2.6 with the following:

> *The operating and maintenance procedures regarding water hammer are included in system operating procedures in Section 13.5.2.1. A milestone schedule for implementation of the procedures is also included in Subsection 13.5.2.1.*

The reference to FSAR Section 13.5.2.1, "Operating and Emergency Operating Procedures," stated that for system operating procedures, these procedures include instructions for energizing, filling, venting, draining, starting up, shutting down, changing modes of operation, returning to service following testing or maintenance, and other instructions appropriate for operation of systems important to safety.

The staff determined that COL 9.2(27), as stated above, with the reference to FSAR Section 13.5.2.1, adequately addresses the development of procedures to address the prevention of water hammer due to a voided line condition in the CCWS.

9.2.2.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.2.2.6 Conclusions

The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the CCWS, and there is no outstanding information expected to be addressed in the FSAR related to this section.

The staff is reviewing the information in DCD Section 9.2.2 on Docket Number 52-021. The results of the staff's technical evaluation of the information related to the ESWS incorporated by reference in the FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.2 of this SER to reflect the final disposition of the DC application.

The staff evaluated the information in FSAR Revision 3, Section 9.2.2, CCWS, in accordance with the guidance in Section 9.2.2.3, "Regulatory Basis." On the basis of its review and evaluation, the staff concludes that the proposed CCWS as described in FSAR Section 9.2.2 will be in compliance with GDCs 2, 4, 5, 44, 45, and 46, 10 CFR 20.1406,10 CFR 52.80(a), and the guidance established in SRP Section 9.2.2. Therefore, the staff concludes that the information in FSAR Section 9.2.2 is acceptable.

As stated above, the US-APWR DCD is still undergoing NRC staff review and has not been approved. Therefore, there is not an approved regulatory basis for the US-APWR at this time. Acceptability of the specific review considerations that pertain to the CPNPP3&4 RCOLA is judged based upon conformance with the specified review criteria (or equivalent) and the current revision of the US-APWR DCD, as appropriate. The final acceptance of the RCOLA cannot be accomplished until the design certification process for the US-APWR is completed and the RCOLA has been determined to be fully consistent with the approved regulatory basis.

9.2.3 Not Used

9.2.4 Potable and Sanitary Water Systems

9.2.4.1 Introduction

The potable and sanitary water system (PSWS) is a non-safety-related system that provides clean and potable water for domestic use and human consumption and other process purposes. The PSWS serves all the areas in the nuclear island (NI) (reactor and auxiliary buildings) and the conventional island (CI), including the turbine building, access building, firehouse and future facilities. The sanitary waste water system collects site sanitary waste for treatment, dilution and discharge during normal operation.

9.2.4.2 Summary of Application

The FSAR Section 9.2, “Water Systems,” incorporates by reference Section 9.2 of the US-APWR DCD, Revision 3. Section 9.2 of the DCD includes Subsection 9.2.4, “Potable and Sanitary Water Systems.”

In addition, in FSAR Section 9.2.4, the applicant provided the following:

US-APWR DCD Site-Specific Interface

DCD Tier 2, Table 1.8-1, “Significant Site Specific Interfaces with the Standard US-APWR Design,” states that the design and configuration of the potable and sanitary water systems (PSWS) is conceptual design information (CDI). The potable water system provides water supply and distribution fit for human consumption, and the sanitary water system provides collection of sanitary wastewater, with standard plant design features to prevent the potential for contamination from radioactive sources.

US-APWR COL Information Items

- STD and CP COL 9.2(9)

The applicant provided additional information in CP COL 9.2(9) to address COL Information Item 9.2(9), which states:

> The COL applicant is to confirm the storage capacity and usage of potable water.

- CP COL 9.2(10)

The applicant provided additional information in CP COL 9.2(10) to address COL Information Item 9.2(10), which states:

> The COL applicant is to confirm that all state and local department of health, natural resources/environmental protection standards are applied and followed

- CP COL 9.2(11)

The applicant provided additional information in CP COL 9.2(11) to address COL Information Item 9.2(11), which states:

> The COL applicant is to confirm the source of potable water to the site and the necessary required treatment.

- CP COL 9.2(12)

The applicant provided additional information in CP COL 9.2(12) to address COL Information Item 9.2(12), which states:

> The COL applicant is to confirm that the sanitary waste is sent to the onsite plant treatment area or they will use the city sewage system.

- CP COL 9.2(14)

The applicant provided additional information in CP COL 9.2(14) to address COL Information Item 9.2(14), which states:

> The COL applicant is to confirm Table 9.2.4-1 for required components and their values.

- STD and CP COL 9.2(15)

The applicant provided additional information in CP COL 9.2(15) to address COL Information Item 9.2(15), which states:

> The COL applicant is to determine the total number of people at the site and identify the usage capacity. Based on these numbers the COL applicant is to size the potable water tank and associated pumps.

- CP COL 9.2(17)

The applicant provided additional information in CP COL 9.2(17) to address COL Information Item 9.2(17), which states:

> The COL applicant is to determine the total number of sanitary lift stations and is to size the appropriate interfaces.

The applicant included Figure 9.2.4-1R, “Potable and Sanitary Water System Flow Diagram,” and Table 9.2.4-1R, “Potable and Sanitary Water System Component Data,” to reflect the COL information that was provided.

9.2.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in the FSER related to the DCD.

In addition, the relevant requirements of the Commission's regulations applicable to the PSWS site-specific information and the associated acceptance criteria are given in SRP Section 9.2.4 and are as follow:

1. 10 CFR Part 50, Appendix A, GDC 60, as it relates to design provisions provided to control the release of liquid effluents containing radioactive material from contaminating the PSWS.

Acceptance criteria adequate to meet the above requirements are:

1. Information that addresses the requirements of GDC 60 is considered acceptable if the following are met:
    a. There are no interconnections between the PSWS and systems having the potential for containing radioactive material.
    b. The potable water system is protected by an air gap, where necessary.
    c. An evaluation of potential radiological contamination, including accidental, and safety implications of sharing (for multi-unit facilities) indicates that the system will not result in contamination beyond acceptable limits.

9.2.4.4 Technical Evaluation

The NRC staff reviewed FSAR Section 9.2.4 and checked the referenced DCD to ensure that the combined information represents the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the regulatory considerations and required information that pertain to the PSWS. Section 9.2.4 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information incorporated by reference for the PSWS will be documented in the corresponding section of the FSER that is issued for the US-APWR DC application

The staff reviewed the information contained in the CPNPP3&4 COL FSAR:

<u>*Interface Requirements*</u>:

US-APWR DCD Tier 1 Section 2.7.6.12.1, "Design Description" under the paragraph titled, "Interface Requirements," states that the PSWS are interface systems. In accordance with 10 CFR 52.47(a)(26) and 10 CFR 52.80(a) requirements, site-specific ITAAC must be established In order to demonstrate that the specified Tier 1 interface requirements are met. Consequently, in **RAI 3909, Question 9.2.4-01,** the staff requested that the COL applicant provide site-specific ITAAC for the PSWS to address the interface requirement that is specified in DCD Section 2.7.6.12.1 in accordance with 10 CFR Part 52 requirements.

In its letter dated February 18, 2010, in response to **RAI 3909, Question 9.2.4-01**, the applicant stated that Mitsubishi Heavy Industries (MHI), the US-APWR DC applicant, proposed to revise US-APWR DCD, Tier 1, Subsection 2.7.6.12.1 (see MHI letter UAP-HF-10046 dated February 19, 2010), in order to clarify that the PSWS does not have any safety-related interfaces with systems outside of the certified design, and therefore no site-specific ITAAC in the RCOLA is required. The staff agreed that this DCD change eliminated the requirement for site-specific

ITAAC related to the PSWS in RCOLA. Therefore **RAI 9.2.4-01** is considered resolved and closed**.**

US-APWR COL Information Items

- STD and CP COL 9.2(9)

The NRC staff reviewed CP COL 9.2(9) related to COL Information Item 9.2(9) included under Section 9.2.4 of the CPNPP3&4 COL FSAR. The applicant provided information on the capacity and usage of the potable water in CPNPP3&4 COL FSAR Sections 9.2.4.1, 9.2.4.2.2.1, 9.2.4.2.2.2, and 9.2.4.2.2.3.

- CP COL 9.2(10)

The NRC staff reviewed CP COL 9.2(10) related to COL Information Item 9.2(10) included under Section 9.2.4 of the CPNPP3&4 COL FSAR. The applicant provided information regarding State and Local Department of Health and Natural Resources Environmental Protection Standards in CPNPP3&4 COL FSAR Section 9.2.4.1.

- CP COL 9.2(11)

The NRC staff reviewed CP COL 9.2(11) related to COL Information Item 9.2(11) included under Section 9.2.4 of the CPNPP3&4 COL FSAR. The applicant provided information on the site-specific source of potable water, the hydrostatic testing and system inspection of the potable water system, operation of the pressure controllers, the use of hot water heaters, and the required water treatment in CPNPP3&4 COL FSAR Sections 9.2.4.1, 9.2.4.2, 9.2.4.2.1, 9.2.4.2.2.4, 9.2.4.2.3, 9.2.4.4, and 9.2.4.5, and Figure 9.2.4-1R, and Table 9.2.4-1R.

- CP COL 9.2(12)

The NRC staff reviewed CP COL 9.2(12) related to COL Information Item 9.2(12) included under Section 9.2.4 of the CPNPP3&4 COL FSAR. The applicant provided site-specific characteristics on the disposition of the sanitary waste in CPNPP3&4 COL FSAR Sections 9.2.4.1 and 9.2.4.2.1.

- CP COL 9.2(14)

The NRC staff reviewed CP COL 9.2(14) related to COL Information Item 9.2(14) included under Section 9.2.4.2.1 of the CPNPP3&4 COL FSAR. The applicant provided site-specific data on major components in CPNPP3&4 COL FSAR Table 9.2.4-1R.

- STD and CP COL 9.2(15)

The NRC staff reviewed CP COL 9.2(15) related to COL Information Item 9.2(15) included under Section 9.2.4 of the CPNPP3&4 COL FSAR. The applicant provided information on the usage capacity and the sizing of the potable water system in CPNPP3&4 COL FSAR Sections 9.2.4.1, 9.2.4.2.2.1, 9.2.4.2.2.2, and 9.2.4.2.2.3.

- CP COL 9.2(17)

The NRC staff reviewed CP COL 9.2(17) related to COL Information Item 9.2(17) included under Section 9.2.4 of the CPNPP3&4 COL FSAR. The applicant provided the characteristics of the site-specific sanitary drainage system in CPNPP3&4 COL FSAR Sections 9.2.4.1 and 9.2.4.2.3.

On the basis of its review of the COL information items for the PSWS referred to above, the staff determined that the information that is called for by the US-APWR DCD does not pertain to or otherwise involve design provisions that are specified for preventing radioactive material from contaminating the PSWS. Therefore, the COL information items do not affect compliance with GDC 60 requirements and the PSWS will continue to be acceptable in this regard. However, the staff noted that in some cases, the information that was provided to address the COL information items was not limited to the information that was called for by the DCD, but included changes to the PSWS design as described in Tier 1 and Tier 2 of the DCD. These changes were not properly identified and evaluated, and they are not listed in the Departures Report that is included as Part 7 of the COL application. For example, the information that was provided to address COL 9.2(11) eliminates the design provision in DCD Tier 2 Section 9.2.4.1, "Design Bases," that specifies that "the potable water system layout is designed with no interconnection and/or sharing between systems or between units." This is also contrary to the certified design information that is specified in DCD Tier 1, Section 2.7.6.12.1, "Design Description." Consequently, in **RAI 3909, Question 9.2.4-02,** the staff requested that the COL applicant properly identify and evaluate all departures from Tier 1 and Tier 2 of the DCD as required by 10 CFR Part 52.

In a letter dated February 18, 2010, in its response to **RAI 3909, Question 9.2.4-02**, the applicant stated that the DCD and FSAR have been updated to eliminate any potential departures from the DCD. The applicant also proposed a revision to FSAR Sections 9.2.4.1, "Design Bases," and 9.2.4.2, "System Description," to specify that the PSWS will not be shared with radiologically controlled systems and to clarify the source of potable water supply. The staff has reviewed the proposed US-APWR DCD and FSAR changes and agrees that the potential departures have been adequately addressed, and these departures no longer exist. Subsequently, the staff confirmed that FSAR, Revision 2 included the changes to FSAR Sections 9.2.4.1 and 9.2.4.2, which were proposed in the applicant's response to RAI 3909, Question 9.2.4-02. The changes in response to the staff's RAI increase the clarity of the description, but they do not fulfill a specific regulatory requirement. Accordingly, **RAI 3909, Question 9.2.4-02, is resolved and closed.**

The FSAR Section 9.2.4.2.2.4 "Hot Water Heaters," incorporates by reference DCD Section 9.2.4.2.2.4, which states that the potable water tank supplies water to the hot water heater. However, the potable water tank is not described in the FSAR and in **RAI 3909 Question 9.2.4-03**, staff requested that the applicant provide design details of the potable water tank that will supply hot water heaters.

In a letter dated February 18, 2010, the applicant provided a response to **RAI 3909, Question 9.2.4-03**. In its response the applicant proposed a revision to the FSAR to include specific information regarding hot water heating to address the previously identified inconsistency. The applicant stated that the hot water heaters will be supplied directly from the potable water source, and that a potable water tank is not applicable to the site-specific PWSW configuration. The applicant's response also indicated that as stated in a letter from MHI, dated February 13, 2010, the DCD would be revised to make the site-specific use of a potable water tank optional based on site conditions. The DCD changes submitted in the February 13, 2010, letter from MHI have been incorporated into the US-APWR DCD. The staff reviewed the applicant's RAI response and finds that the applicant provided sufficient details to adequately address COL information item 9.2(11), and therefore **RAI 3909, Question 9.2.4-03 is resolved and closed**.

The PSWS does not contain interconnections to any other system with the potential to carry radiological material, and design features are provided to prevent backflow. The staff finds that General Design Criteria (GDC) 60, "Control of Releases of Radioactive Materials to the Environment," is satisfied with respect to preventing contamination by radioactive water.

9.2.4.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.2.4.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the PSWS, and there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in Section 9.2.4 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the PSWS incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.4 of this SER to reflect the final disposition of the DC application.

On the basis of its review and evaluation of FSAR Section 9.2.4, the staff concludes that the information presented within the CPNPP3&4 COL FSAR, Section 9.2.4 is acceptable and meets the applicable requirements of GDC 60 and 10 CFR 52.80(a).

9.2.5 Ultimate Heat Sink

9.2.5.1 Introduction

The COLA FSAR, Section 9.2.5, "Ultimate Heat Sink," describes the ultimate heat sink (UHS) for CPNPP3&4. The UHS consists of an assured source of water with associated safety-related structures designed to dissipate the heat rejected from the ESWS during normal, accident, and shutdown conditions. The UHS system is safety-related and designed to meet the requirements of Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants," and the type of UHS employed and other design details are based on specific site conditions and meteorological data. Each unit is provided with its own independent UHS, with no sharing between the two units. The UHS for each unit consists of four 50-percent-capacity mechanical draft cooling towers (MDCT), one for each ESWS train, and four 33-1/3-percent-capacity basins to satisfy the 30-day cooling water supply criterion of RG 1.27. The UHS utilizes four 100-percent-capacity

UHS transfer pumps which allows water inventory to be pumped between any of the four independent UHS cooling towers to support the 30 day cooling water criterion.

9.2.5.2 Summary of Application

Section 9.2.5 of FSAR Revision 3 incorporates by reference Section 9.2.5, “Ultimate Heat Sink,” of DCD, Revision 3.

In addition, in FSAR Section 9.2.5, the applicant provided additional information to better describe site-specific design features and address COL information items. CDI in the DCD that relates to the UHS is also addressed. These items are shown below.

US-APWR COL Information Items

- CP COL 9.2(1)

The applicant provided additional information in CP COL 9.2(1) to address COL Information Item 9.2(1), which states:

> The COL Applicant is to provide the evaluation of the ESWP at the lowest probable water level of the UHS. The COL Applicant is to develop recovery procedures in the event of approaching low water level of UHS.

- CP COL 9.2(2)

The applicant provided additional information in CP COL 9.2(2) to address COL Information Item 9.2(2), which states:

> The COL Applicant is to provide protection of the site-specific portions of the ESWS against adverse environmental, operating, and accident conditions that can occur, such as freezing, low temperature operation, and thermal overpressurization.

- CP COL 9.2(3)

The applicant provided additional information in CP COL 9.2(3) to address COL Information Item 9.2(3), which states:

> The COL Applicant is to determine source and location of the UHS.

- CP COL 9.2(4)

The applicant provided additional information in CP COL 9.2(4) to address COL Information Item 9.2(4), which states:

> The COL Applicant is to determine location and design of the ESW intake structure.

- CP COL 9.2(5)

The applicant provided additional information in CP COL 9.2(5) to address COL Information Item 9.2(5), which states:

> The COL Applicant is to determine location and design of the ESW discharge structure.

- CP COL 9.2(7)

The applicant provided additional information in CP COL 9.2(7) to address COL Information Item 9.2(7), which states:

> The COL Applicant is to address the piping, valves, lining material specifications for piping and fittings as applicable, including those at the boundary between the safety-related and nonsafety-related portions with clarifications for their connections locations, and other design of the ESWS related to the site-specific conditions. The COL Applicant is also to design the pipes entering and exiting the pipe tunnel based on the location of the ultimate heat sink related structure (UHSRS).

- CP COL 9.2(8)

The applicant provided additional information in CP COL 9.2(8) to address COL Information Item 9.2(8), which states:

> The COL Applicant is to specify the following ESW chemistry requirements:
>
> - A chemical injection system to provide non-corrosive, non-scale forming conditions to limit biological film formation.
> - Type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant based on the site conditions.

- CP COL 9.2(18)

The applicant provided additional information in CP COL 9.2(18) to address COL Information Item 9.2(18), which states:

> The COL Applicant is to determine the type of the UHS based on specific site conditions and meteorological data.

- CP COL 9.2(19)

The applicant provided additional information in CP COL 9.2(19) to address COL Information Item 9.2(19), which states:

> The COL Applicant is to design the UHS to receive its electrical power supply, if required by the UHS design, from safety busses so that the safety functions are maintained during LOOP *[loss of offsite power]*. The UHS also receives its standby electrical power from the onsite emergency power supplies during a LOOP.

- CP COL 9.2(20)

The applicant provided additional information in CP COL 9.2(20) to address COL Information Item 9.2(20), which states:

> The COL Applicant is to provide a detailed description and drawings of the UHS, including water inventory, temperature limits, heat rejection capabilities, instrumentation, and alarms.

- CP COL 9.2(21)

The applicant provided additional information in CP COL 9.2(21) to address COL Information Item 9.2(21), which states:

> The COL Applicant is to determine the source of make-up water to the UHS inventory and the blowdown discharge location based on specific site conditions.

- CP COL 9.2(22)

The applicant provided additional information in CP COL 9.2(22) to address COL Information Item 9.2(22), which states:

> The COL Applicant is to provide results of UHS capability and safety evaluation of the UHS based on specific site conditions and meteorological data. The COL Applicant is to use at least 30 years site-specific meteorological data for UHS performance analysis.

- CP COL 9.2(23)

The applicant provided additional information in CP COL 9.2(23) to address COL Information Item 9.2(23), which states:

> The COL Applicant is to provide test and inspection requirements of the UHS. These is *[sic]* to include inspection and testing requirements necessary to demonstrate that fouling and degradation mechanisms are adequately managed to maintain adequate UHS performance and integrity.

- CP COL 9.2(24)

The applicant provided additional information in CP COL 9.2(24) to address COL Information Item 9.2(24), which states:

> The COL Applicant is to provide the required alarms, instrumentation and controls details based on the type of UHS to be provided.

- CP COL 9.2(28)

The applicant provided additional information in CP COL 9.2(28) to address COL Information Item 9.2(28), which states:

> The COL Applicant is to provide the piping, valves, materials specifications, and other design details related to the site-specific UHS.

- CP COL 9.2(30)

The applicant provided additional information in CP COL 9.2(30) to address COL Information Item 9.2(30), which states:

> The COL Applicant shall conduct periodic inspection, monitoring, maintenance, performance and functional testing of the ESWS and UHS piping and components, including the heat transfer capability of the CCW heat exchangers and essential chiller units, consistent with GL 89-13 and GL 89-13 Supplement 1. The COL Applicant is to develop operating procedures to periodically alternate the operation of the trains to ensure performance of all trains is regularly monitored.

- CP COL 9.2(31)

The applicant provided additional information in CP COL 9.2(31) to address COL Information Item 9.2(31), which states:

> The COL Applicant is to verify the system layout of the ESWS and UHS and is to develop operating procedures to assure that the ESWS and UHS are above saturation conditions for all operating modes.

- CP COL 9.2(32)

The applicant provided additional information in CP COL 9.2(32) to address COL Information Item 9.2(32), which states:

> The COL Applicant is to provide a void detection system with alarms to detect system voiding.

The CPNPP 3&4, Part 2 – FSAR: Section 9.2, “Water Systems,” Table 9.2.5-3R, “Ultimate Heat Sink System Design Data,” Table 9.2.5-4R, “Ultimate Heat Sink Failure Modes and Effects Analysis,” and Figure 9.2.5-1R, “Ultimate Heat Sink Piping and Instrumentation Diagram,” set forth the design basis and a detailed description of the UHS.

The CDI as part of the US-APWR DCD which is outside the scope of the specific ESWS and UHS COL items are not specifically described in the COL FSAR. However, the staff has evaluated the CDI as described in the following subsections.

- DCD 9.2.1.2.2 – strainer mesh
- DCD 9.2.1.2.3.1 – spray header draining
- DCD 9.2.5.5 – instrumentation requirements

The FSAR Section 14.2.12.1.113, “Ultimate Heat Sink (UHS) System Preoperational Test,” describe the UHS and ESWS preoperational testing.

The CPNPP 3&4, Part 4 – TS and Bases: Technical specifications for the UHS are provided in TS Section 3.7.9, “Ultimate Heat Sink (UHS).”

The CPNPP 3&4, Part 10, Inspection, Tests, Analysis, and Acceptance Criteria (ITAAC):

Interface requirements addressed in Tier 1, DCD Section 3.2.1," Ultimate Heat Sink," are to be addressed by the COL. These items are as follow:

a. The UHS system design meets the divisional separation requirements of the essential service water system (ESWS) and the UHS is capable of performing its safety functions under design basis event conditions and coincident single failure with or without offsite power available.
b. The safety related, pressure retaining components, and their supports, are designed, constructed and inspected in accordance with ASME Code Section III, if applicable to the site-specific design.
c. The maximum supply water temperature is 95 °F under the peak heat loads condition to provide sufficient cooling capacity to ESWS.
d. The UHS water level is maintained such that available net positive suction head (NPSH) is greater than the ESW pump's required NPSH during all plant operating conditions including normal plant operations, abnormal and accident conditions. The ESW pump operation does not cause vortex formation at minimum allowed UHS water level.
e. The UHS system has main control room (MCR) and remote shutdown console (RSC) alarms and displays for UHS water level and water temperature.
f. The UHS system has MCR and RSC controls for UHS components' active safety functions if applicable to the site-specific design.
g. UHS components that have protection and safety monitoring system (PSMS) control (if applicable to the site-specific design) perform an active safety function after receiving a signal from PSMS.
h. The UHS can provide the required cooling for a minimum of 30 days without make-up during accident conditions.
i. The UHS system is designed to prevent water hammer.

The CPNPP 3&4, Revision 2, Part 10 - ITAAC, Appendix A.1, "Ultimate Heat Sink System (UHSS) and Essential Service Water system (ESWS) (Portions Outside the Scope of the Certified Design)," describe the site-specific ITAAC for the ESWS and UHS.

The CPNPP 3&4, Part 10 – ITAAC, Figure A.1-1, "Ultimate Heat Sink System and Essential Service Water system (Portions Outside the Scope of the Certified)," provides the ESWS and UHS functional arrangement.

9.2.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission's regulations for the information on the UHS, and the associated acceptance criteria are given in SRP Section 9.2.5, Revision 3, March 2007.

The applicable regulatory requirements for the UHS are as follows:

1. 10 CFR Part 50, Appendix A, GDC 2, "Design Basis for Protection Against Natural Phenomena," as it relates to the capabilities of structures housing the system and the system itself having the capability to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of safety-related functions.

2. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to effects of missiles inside and outside containment, effects of pipe whip, jets, environmental conditions from high- and moderate-energy line-breaks, and dynamic effects of flow instabilities and attendant loads (e.g., water hammer) during normal plant operation, as well as upset or accident conditions.

   SRP 9.2.5 does not specifically address GDC 4 requirements; however, the UHS transfer system is added to comply with the 30 day UHS water system and volume requirements and shall meet the requirements of GDC 4 which is described in SRP 9.2.1.

3. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of Structures, Systems, and Components," insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be shown that sharing will not significantly impair their ability to perform their safety functions.

4. 10 CFR Part 50, Appendix A, GDC 44, "Cooling Water," as it relates to the capability to transfer of heat from systems, structures, and components important to safety to an ultimate heat sink during both normal and accident conditions, with suitable redundancy, assuming a single active component failure coincident with either the loss of offsite power or loss of onsite power.

5. 10 CFR Part 50, Appendix A, GDC 45, "Inspection of Cooling Water System," as it relates to design provisions for in-service inspection of safety-related components and equipment.

6. 10 CFR Part 50, Appendix A, GDC 46, "Testing of Cooling Water System," as it relates to design provisions for pressure and operational functional testing of cooling water systems and components in regard to;
   a. Structural integrity and system leak-tightness of its components
   b. Operability and adequate performance of active system components
   c. Capability of the integrated system to perform credited functions during normal, shutdown, and accident conditions

7. 10 CFR 52.80(a), "Contents of applications; technical information," which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

8. 10 CFR 20.1406(a), which requires an applicant to describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Acceptance criteria adequate to meet the above requirements are:

1. Information that addresses the requirements of GDC 2 will be considered acceptable if the guidance of RG 1.27, "Ultimate Heat Sink for Nuclear Power Plant," Revision 2, January 1976, Positions C.2 and C.3, are appropriately addressed.

2. Information that addresses the requirements of GDC 5 will be considered acceptable if the use of the UHS in multi-unit plants during an accident in one unit does not significantly affect the capability to conduct a safe and orderly shutdown and cooldown in the other unaffected unit(s).

3. Information that addresses the requirements of GDC 44 will be considered acceptable if guidance of RG 1.27, Positions C.2 and C.3; RG 1.72, "Spray Pond Piping Made from Fiberglass-Reinforced Thermosetting Resin," Positions C.1, C.4, C.5, C.6, and C.7; and ANSI/ANS Standard 5.1-2005, "Decay Heat Power in Light Water Reactor," are applied appropriately.

4. Information that addresses the requirements of GDC 45 will be considered acceptable if the design of the UHS permits in-service inspection of safety-related components and equipment.

5. Information that addresses the requirements of GDC 46 will be considered acceptable if the UHS is designed for testing of safety-related systems or components for structural integrity and leak-tightness, operability, performance of active components, and the capability of the system to function as intended under accident conditions.

6. RG 1.29, "Seismic Design Classification," March 2007, (Seismic Design Criteria), Regulatory Position C.1 for safety-related portions of the UHS and Regulatory Position C.2 for non-safety-related portions of the UHS

9.2.5.4 Technical Evaluation

The NRC staff reviewed Section 9.2.5 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[3] The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the UHS. Section 9.2.5 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information, incorporated by reference, related to the UHS will be documented in the staff SER on the DC application for the US-APWR design.

[3] See Section 1.x for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

As discussed in the Introduction Section, the UHS consists of four separate safety-related trains each with the capability to cool 50 percent of the design basis heat load. The UHS functions to dissipate the heat rejected from the ESWS during normal operating, accident, and shutdown conditions.

There is no impact on cooling tower design or the required UHS basin volume. However, the "governing" UHS heat load for UHS basin cooling water capacity determination is changed from Safe Shutdown with LOOP (2-train) mode to LOCA (2-train) mode. The change in the governing heat load scenario is expected to impact the second to last paragraph of DCD Subsection 9.2.5.2.3, "System Performance," and specific values for heat load and cooling water capacity are expected to change slightly in DCD Subsections 9.2.5.2.3 and 9.2.5.3 to reflect the final calculations**. This is P2 Open Item 09.02.05-01, which is expected to be resolved at P4.**

The staff reviewed the COL information contained in the FSAR relating to the UHS:

<u>*US-APWR COL Information Items*</u>

- COL Item 9.2(1): ESWP water level and recovery procedures.

This COL item is related to NRC Regulatory Bases, GDC 44.

The ESWS and the UHS has various overlap areas between Sections 9.2.1 and 9.2.5 of the DCD and CPNPP COL. COL Item 9.2(1) is reviewed under Section 9.2.1 of this report; therefore, this item is considered resolved and no further evaluation is required.

- COL Item 9.2(2): Adverse environmental, freezing, and thermal over-pressurization.

This COL item is related to NRC Regulatory Bases, GDC 2 and 4.

The ESWS and the UHS has various overlap areas between Sections 9.2.1 and 9.2.5 of the DCD and CP COL. COL Item 9.2(2) is reviewed under Section 9.2.1 of this report; therefore, this item is considered resolved and no further evaluation is required.

- COL Item 9.2(3): Source/location of the UHS.
- COL Item 9.2(28): Piping, valves, materials specifications, and other design details related to the site-specific UHS.

These COL items are related to NRC Regulatory Bases, GDC 44.

The COL FSAR Section 9.2.5.2.1 states each unit is provided with its own independent UHS, with no sharing between the two units. The UHS for each unit consists of four 50 percent capacity mechanical draft cooling towers, one for each ESWS train, and four 33 one-third percent capacity basins to satisfy the thirty day cooling water supply criteria of RG 1.27.

Each cooling tower consists of two cells with fans and motors, drift eliminators, film fills, risers, and water distribution system all enclosed and supported by a Seismic Category I reinforced concrete structure. Cooling tower components are designed per equipment Class 3 and quality group C requirements. Each basin includes an ESWP intake structure that contains one 50 percent capacity ESWP and one 100 percent capacity UHS transfer pump, and associated piping and components. Tornado missile protection for the cooling tower components, ESWPs and piping is provided by the UHS safety-related Seismic Category I structures and ESW pipe tunnel as discussed in Subsection 3.8.4, "Other Seismic Category 1 Structures. The UHS structural design, including pertinent dimensions, is also discussed in Subsection 3.8.4.

Each cooling tower consists of two cells, each with a motor driven fan driven with a right-angle gear reducer. The fan motors are powered from the Class 1E normal ac power system. On a LOOP, the motors are automatically powered from their respective division emergency power source.

The cooling towers are designed for the following conditions: water flow of 12,000 gpm, hot (inlet) water temperature of 128° F, cold (outlet) water temperature of 95° F, ambient wet bulb temperature of 80° F, and DBA design heat load of 196 x 10^6 Btu/hr.

The COL FSAR Figure 3.8-201, "General Arrangement of the essential service water pipe tunnel (ESWPT), UHSRS, and power source fuel storage vault (PSFSV)," shows the locations of the UHS which are directly south of the nuclear island.

The COL Section 3.8.4.1.3.2, "UHSRS," states that the UHS fans, motors and associated equipment are designed with consideration given to the effects of design basis tornado differential pressure.

The COL Figure 3.8-209, "Typical Section Looking West at UHS Basin and Cooling Tower Interface with ESWPT," graphically shows a typical UHS transfer pump with a vaned basket which is used to prevent debris from entering the pump from the UHS basin.

In **RAI 6342, Question 03.03.02-09,** the staff requested that the applicant consider design-basis hurricane and hurricane missiles for the CPNPP3&4 site and their impact on the safety of the site-specific Seismic Category I SSCs.

The applicant responded to **RAI 6342, Question 03.03.02-09,** in letter dated September 14, 2012, and stated that the COLA has been revised to incorporate RG 1.221, Revision 0, guidance to consider the effects of design-basis hurricane winds and hurricane-generated missiles on the analysis and design of CPNPP3&4 site-specific Seismic Category I SSCs.

The staff reviewed the applicant's response to **RAI 6342, Question 03.03.02-09,** and finds the response and the proposed FSAR change acceptable related to the addition of hurricane missile protections to Sections 3.8 and 9.2.5 of the FSAR. Therefore, **RAI 6342**, **Question 03.03.02-09, is resolved.** Confirmation of proper incorporation of the approved change in the next FSAR revision is being tracked as **Confirmatory Item 03.03.02-09.** Protection against wind forces and missiles is further described in Section 3.3 of this SER.

The staff reviewed the supplemental information related to COL Item 9.2(3) and 9.2(28) and finds it unacceptable because the applicant did not provide an evaluation or discussion in the FSAR regarding possible tower interference and recirculation effects with other safety-related air intakes and other cooling towers in the vicinity. Therefore, the staff issued **RAI 6358, Question 09.02.05-18,** in which the staff requested the applicant to address the following:

- UHS cooling tower interference (tower effluent being drawn into the air inlet of a downwind tower) - This should include interference between all cooling towers at the site related to the design performance of the UHS cooling towers.

- Recirculation effects with other safety related air intakes at the site.

The applicant responded to **RAI 6358, Question 09.02.05-18,** by letters dated June 7, 2012, September 10, 2012, and November 12, 2012, with the following responses:

> Cooling tower plume interference and recirculation effects could adversely affect HVAC systems and other cooling tower operation due to potential increased humidity and air temperature. The UHS cooling towers are designed and located to withstand the expected effects without significant compromise of the functions of the other UHS cooling towers of the same unit and the UHS cooling towers of the other unit, the gas turbine generator (GTG) safety-related air intakes for both units, and air intakes for safety-related HVAC systems for both units. The cooling tower shape combined with the cooling tower height is .designed to achieve an air discharge velocity and height that ensures proper dissipation of the plume, which minimizes plume interference and recirculation on the other UHS cooling towers and nearby safety-related air intakes. The temperature of plume exhausted from the cooling tower is higher than the local ambient air temperature, so buoyancy causes the thermal plume to rise under low wind conditions. However, high wind conditions that could direct a plume toward the intakes would result in rapid air dispersion and mixing that cools the plume.
>
> A 2°F recirculation allowance was added to the wet bulb temperature used for cooling tower design to account for possible recirculation of the plume into the cooling tower air intake. These design features reduce the adverse effects of the cooling tower plume's interference and recirculation to itself, to the other UHS cooling towers, and to nearby safety-related 'supply air intakes. The cooling tower discharge elevation is approximately 887'-0," or 65 feet above the grade elevation of 822'-0," and approximately 45 feet above the UHS cooling tower air intakes. In addition, the temperature of the plume is higher than the ambient air temperature. This induces natural buoyancy causing the thermal plume to climb higher under low wind conditions. Higher wind conditions would cause rapid air dispersion and mixing, which would effectively cool the plume. Therefore, both the low and the high wind conditions aid in minimizing the interference and recirculation effects.
>
> The following safety-related systems with supply air intakes have been evaluated for potential adverse impact from the UHS cooling tower plume for both units:
>
> - Combustion air intakes for the safety-related gas turbine generators (GTGs).
> - Supply air intakes for the following safety-related HVAC systems:
>   - UHS/ESW pump house ventilation
>   - GTG rooms safety-related ventilation
>   - Main control room HVAC
>   - Class 1 E electrical room HVAC
>   - Trains A & D emergency feedwater pump room HVAC
>
> All these intakes except the UHS/ESW pump house are separated from the UHS cooling tower discharge by approximately 360 - 450 ft horizontally and 19-35 ft vertically. This large spacial separation will allow the plume to dissipate, precluding

its entry into the external air intakes. Also the prevailing wind direction at CPNPP is from the south-south-east (SSE) which will assist in preventing the plume from reaching the air intakes.

The UHS/ESW pump houses are adjacent to their associated cooling towers, but their ventilation air intakes are 47 feet below the top and 22 feet horizontally from the cooling tower outlet. This exceeds the typical separation criteria between a ventilation exhaust and a ventilation air intake. The International Mechanical Code-2009, Section 401.4 identifies a minimum distance of 10 feet from any hazardous source for air intakes and Section 501.2.1 identifies that exhausts are to be 10 feet from air intakes. In addition, the intakes for the pump house are on the south side of the houses which takes advantage of the prevailing wind from the south direction to minimize the potential of a UHS cooling tower plume to adversely affect the pump house ventilation intakes.

In addition, CPNPP Units 3 and 4 each have two circulating water system (CWS) mechanical draft cooling towers in addition to the UHS cooling towers. The plume from the closest CWS cooling tower to the UHS cooling tower intake and the UHS/ESW pump house ventilation intake is approximately 600 feet. The Unit 3 and 4 safety-related air intakes identified above are even further away from the closest CWS cooling tower. Therefore, the CWS cooling tower plumes will not adversely affect Unit 3 and 4 safety-related systems with external air intakes.

COL FSAR Subsection 9.2.5.2.1, “General Description,” has been revised to clarify that the cooling tower design minimizes plume interference and recirculation.

The staff reviewed the applicant’s response to **RAI 6358, Question 09.02.05-18,** and finds the response and the proposed changes to the FSAR to be acceptable. The MDCT shape combined with the MDCT height is designed to achieve an air discharge velocity and height that ensures proper dissipation of the plume, which minimizes plume interference and recirculation on the other UHS cooling towers and nearby safety-related air intakes. The UHS MDCT are designed and located to withstand the expected effects without significant compromise of the functions of the other UHS MDCT of the same unit and the UHS cooling towers of the other unit.

Plume interaction have no adverse impacts based on the prevailing SSE wind directions and buildings separation (360 - 450 ft horizontally and 36 ft vertically) related to the combustion air intakes for the safety-related gas turbine generators, GTG rooms safety-related ventilation, main control room HVAC, Class 1 E electrical room HVAC, and trains A & D emergency feedwater pump room HVAC. Plume interaction have no adverse impacts based on the prevailing SSE wind directions and HVAC opening location on the south wall of the pump house and open distance being 47 feet below the top of the cooling tower and 22 feet horizontally related to the UHS/ESW pump house ventilation. In addition, CWS cooling tower plume interaction have no adverse impacts based SSE wind directions and buildings separation (600 feet horizontally) related to the UHS cooling tower and UHS/ESW pump house ventilation.

The proposed FSAR change also adds a discussion of the cooling tower interference and recirculation effects. Therefore, **RAI 6358, Question 09.02.05-18,** is resolved. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-18.**

The staff reviewed the supplemental information related to COL Item 9.2(3) and 9.2(28) and found it unacceptable because the UHS piping materials (including the UHS transfer piping material), piping internal lining, and cathodic protection are not identified or described, similarly to FSAR Section 9.2.1.2.2.5, "Piping." Thus, the staff issued **RAI 6358, Q09.02.05-19,** in which the staff requested the applicant, for the UHS piping system outside the scope of the ESWS, to describe the materials to be utilized (carbon or alloy), ASME Code class, and state if the system has internal lining and/or has cathodic protection. This FSAR description should be similarly to US-APWR DCD and COL FSAR Sections 9.2.1.2.2.5, "Piping."

The applicant responded to **RAI 6358 Question 09.02.05-19** by letter dated June 7, 2012, with the following response.

> The UHS piping material, including the UHS transfer piping, is carbon steel with an internal polyethylene lining. The piping is not buried, so cathodic protection is not provided. The UHS piping material description has been added to COL FSAR Subsection 9.2.5.2.1.
>
> The ASME Code class piping is described in Figure 9.2.5-1 R. The equipment class of piping of the ESW return line and the UHS transfer line is EC3 (ASME Code Section III, Class 3), and the equipment class of the piping of the CWS makeup water main header line is EC5 (Codes and standards as defines in design bases).

The staff reviewed the applicant's response to **RAI 6358, Question 09.02.05-19,** and finds the response and the proposed changes to the FSAR to be acceptable. The UHS transfer piping is carbon steel with an internal polyethylene lining which is an acceptable material for long-term corrosion prevention. In addition, ASME Code Section III, Class 3, has been correctly specified for the UHS. Since the UHS piping is not buried, special protection for soil interactions is not required. The proposed changes to the FSAR adds a discussion on the UHS piping material and states the UHS piping is not buried, thus cathodic protection is not utilized. Therefore, RAI 6358, **Question 09.02.05-19** is resolved**.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09-02-05-19**.

In summary, the staff finds that the applicant has adequately addressed COL Items 9.2(3) and 9.2(28) and the applicant's supplemental information complies with GDC 44. These COL items ensure that the UHS and associated structures support the necessary safety functions to remove heat and reject it to the UHS under all operating and accident conditions. In addition, the locations of the UHS and the cooling tower discharge plume has no negative interactions related other safety related functions such as outside air intake into SSCs important to safety.

- COL Item 9.2(4) and COL Item 9.2(5): Location and design of the ESW intake structure and discharge structure.

These COL items are related to GDC 44.

The COL FSAR Figure 1.2-1R, "Comanche Peak Units 3 & 4 Site Plan," describes the location of the UHS related to the ESWS pipe tunnels and Unit 3 and 4 reactor buildings.

The COL FSAR Figure 3.8-201, "General Arrangement of ESWPT, UHSRS and PSFSV," and FSAR Figure 3.8-206, "General Arrangement of the UHS Basin," describes the UHS.

The COL FSAR Section 9.2.5.2.1 states that each basin includes an ESWP intake structure that contains one 50 percent capacity ESWP and one 100 percent capacity UHS transfer pump, and associated piping and components. Tornado missile protection for the cooling tower components, ESWPs and piping is provided by the UHS safety-related Seismic Category I structures and ESW pipe tunnel as discussed in Subsection 3.8.4. The UHS structural design, including pertinent dimensions, is also discussed in Subsection 3.8.4.

The ESW intake basin located underneath the ESW pump house occupies the southwest corner of the UHS basin. The ESW intake basin is 12 feet deeper than the UHS basin. Water volume occupying this 12 feet depth in the ESW intake basin is not included in the UHS basin inventory. This is to assure adequate NPSH to the ESW pump. The UHS basin floor elevation (791 feet) is the reference point for measuring the basin water level.

The mechanical draft cooling towers are the UHS. Hence, no discharge structure is necessary.

The staff reviewed the applicant's supplemental information and finds it acceptable since this information related to the ESWS intake and discharge was adequately described. These COL items were identified at the DCD for various UHS designs and in the case of this CPNPP3&4 application which is utilizing UHS cooling towers, the discharge structure does not exist.

Related to the ESWS intake structure, the applicant adequately describes the UHS structure which includes an intake structure that houses the ESWS pump, UHS transfer pump, and associated components. This ESWS intake structure is also referred to as the pump house. The UHS is a safety related, Seismic Category I structure.

As previously stated, the staff requested, in **RAI 6342, Question 03.03.02-09,** that the applicant consider design-basis hurricane and hurricane missiles for the CPNPP3&4 site and their impact on the safety of the site-specific Seismic Category I SSCs.

The applicant responded to **RAI 6342, Question 03.03.02-09,** in letter dated September 14, 2012, and stated that the COLA has been revised to incorporate RG 1.221 Revision 0 guidance to consider the effects of design-basis hurricane winds and hurricane-generated missiles on the analysis and design of CPNPP3&4 site-specific Seismic Category I SSCs.

The staff reviewed the applicant's response to RAI 6342 Question 03.03.02-9 and finds the applicant's response and proposed changes to the FSAR acceptable related to the addition of hurricane missile protections to Section 9.2.5.2.1 of the COL FSAR. **RAI 6342, Question 03.03.02-09, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 03.03.02.09**. Protection against wind forces and missiles is further described in Section 3.3 of this safety evaluation report.

In summary, the applicant's responses to COL Items 9.2(4) and 9.2(5) are found acceptable and these responses comply with GDC 44. These COL items ensure that the UHS and associated structures support the necessary safety functions to remove heat and reject it to the UHS under all operating and accident conditions. Specifics of the UHS structural design details are described in Section 3.8 of this safety evaluation report.

- COL Item 9.2(7): ESWS design related to UHS (material, boundary locations, and interface with pipe tunnel)

The ESWS and the UHS has various overlap areas between Sections 9.2.1 and 9.2.5 of the DCD and CPNPP COL. Therefore, COL Item 9.2(7) is reviewed under Section 9.2.1 of this report and this item is considered resolved and no further evaluation is required.

- COL Item 9.2(8): Chemistry

The ESWS and the UHS has various overlap areas between Sections 9.2.1 and 9.2.5 of the US-APWR DCD and CP COL. Therefore, COL Item 9.2(8) is reviewed under Section 9.2.1 of this report this item is considered resolved and no further evaluation is required.

- CP COL 9.2(18)

The NRC staff reviewed CP COL 9.2(18) related to COL Information Item 9.2(18) included under Section 9.2.5 of the CPNPP3&4 COL FSAR. The applicant provided information on the type of UHS based on site conditions and meteorological data in CPNPP3&4 COL FSAR Sections 9.2.5.1 and 9.2.5.2.

- CP COL 9.2(19)

The NRC staff reviewed CP COL 9.2(19) related to COL Information Item 9.2(19) included under Section 9.2.5 of the CPNPP3&4 COL FSAR. The applicant provided information regarding UHS electrical power supplies in CPNPP3&4 COL FSAR Section 9.2.5.2.

- CP COL 9.2(20)

The NRC staff reviewed CP COL 9.2(20) related to COL Information Item 9.2(20) included under Section 9.2.5 of the CPNPP3&4 COL FSAR. The applicant provided a description and drawings of the UHS in CPNPP3&4 COL FSAR Section 9.2.5.2, Table 9.2.5-201, and Figure 9.2.5-201.

- CP COL 9.2(21)

The NRC staff reviewed CP COL 9.2(21) related to COL Information Item 9.2(21) included under Section 9.2.5 of the CPNPP3&4 COL FSAR. The applicant provided information on the source of makeup water for the UHS in CPNPP3&4 COL FSAR Section 9.2.5.2.

- CP COL 9.2(22)

The NRC staff reviewed CP COL 9.2(22) related to COL Information Item 9.2(22) included under Section 9.2.5 of the CPNPP3&4 COL FSAR. The applicant provided information on the UHS performance and safety evaluation in CPNPP3&4 COL FSAR Sections 9.2.5.2, 9.2.5.3, and Table 9.2.5-202.

- CP COL 9.2(23)

The NRC staff reviewed CP COL 9.2(23) related to COL Information Item 9.2(23) included under Section 9.2.5 of the CPNPP3&4 COL FSAR. The applicant provided information on test and inspection requirements of the UHS in CPNPP3&4 COL FSAR Section 9.2.5.4.

- CP COL 9.2(24)

The NRC staff reviewed CP COL 9.2(24) related to COL Information Item 9.2(24) included under Section 9.2.5 of the CPNPP3&4 COL FSAR. The applicant provided information on alarms and instrumentation and controls details of the UHS in CPNPP3&4 COL FSAR Section 9.2.5.5.

- COL Item 9.2(18): Type of the UHS based on a specific site conditions and meteorological data.

This COL item is related to NRC Regulatory Bases, GDC 44.

The COL Table 3.2-201, “Classification of Site-Specific Mechanical and Fluid System, Components, and Equipment,” states that the UHS transfer pumps, cooling tower fans, basin, and associated piping and valves are Equipment Class 3, Quality Group C and Seismic Category I. The exception to this is the UHS basin makeup piping and valves are Equipment Class 9 and Non-seismic (NS).

The COL FSAR Section 9.2.5.1 states that the UHS is designed in accordance with Regulatory Guide 1.27 with inventory sufficient to provide cooling for at least 30 days following an accident, with no makeup water. The performance of the UHS is based upon 30 years of site-specific historical wet bulb temperature conditions (refer to Section 2.3.1.2.10, “Ultimate Heat Sink”).

The structures and components of the UHS are designed and constructed as safety-related structures to the requirements of Seismic Category I as defined in RG 1.29, “Seismic Design Classification,” and equipment Class 3.

The COL FSAR Section 9.2.5.2.1 states that the UHS cooling towers are designed for the following conditions: water flow of 12,000 gpm, hot (inlet) water temperature of 128° F, cold (outlet) water temperature of 95° F, ambient wet bulb temperature of 80° F, and DBA design heat load of $196x10^6$ Btu/hr.

The COL FSAR Section 9.2.5.2.2 states that the ESWPs take suction from the basin as described in FSAR Subsection 9.2.1. The water flows through the CCW heat exchangers and essential chiller units and then is cooled by the cooling tower before being returned to the basin.

Heat rejection to the environment is effected by direct contact with the cooling tower forced airflow, which provides evaporative cooling of the ESW return flow. During normal operation, evaporation, drift and blowdown losses are replaced with the makeup from Lake Granbury. Water level controllers provided in each basin automatically open and close the makeup control valves. Low and high water level annunciation in the MCR indicates a malfunction of the makeup control valve or the blowdown control valve. Adequate NPSH is maintained under all operating modes, including LOCA and LOOP, with one train out of service for maintenance, when the source of makeup water is assumed lost for a period of thirty days after the accident. During such conditions, the combined inventory of three basins provides a thirty-day cooling water supply assuming the worst combination of meteorological conditions and accident heat loads.

Four 100 percent capacity UHS transfer pumps, one located in each UHS ESW pump house, are provided to transfer cooling water from a non-operating UHS basin to the operating UHS basins when required during accident conditions. All transfer pumps discharge into a common header which in turn discharges to individual UHS basins. All discharge piping is located in missile protected and tornado protected areas. The common discharge header and other UHS system piping are designed to Seismic Category I requirements. The piping is located in Seismic Category I structures. There is no non-seismic piping in the vicinity of this header, and there are no seismically induced failures. Pipes are protected from tornado missiles. The UHS transfer pump(s) operate during accident conditions, during IST in accordance with plant Technical Specifications, during maintenance, and for brief periods during cold weather conditions for recirculation. As the header is normally not in service, deterioration due to flow-accelerated corrosion is insignificant. Transfer of water inventory is required assuming one train/basin of ESW/UHS is out of service (e.g., for maintenance), and a second train is lost due to a single failure. When a transfer pump is in operation, fluid velocity in the header is approximately 5.1 feet per second. Operating conditions are approximately 20 psig and 95° F. Therefore, header failures are not considered credible.

The UHS transfer pump is designed to supply 800 gpm flows at a total dynamic head (TDH) of 40 feet. Transfer pump capacity is more than adequate to replenish the maximum water inventory losses from two operating ESWS trains. Minimum available net positive suction head (NPSHA) is approximately 40 feet. This is based on the lowest expected water level of approximately 12 feet in the UHS ESW intake basin and 95° F water temperature. Transfer pump location and submergence level precludes vortex formation. In addition, the transfer pump and the ESW pump from the same basin do not operate simultaneously.

A water line from the transfer pump discharge to the ESWP discharge is installed in each UHS train for recovering ESWS/UHS inventory after drainage for maintenance. The line provides water at a low flow rate to preclude water hammer that could be caused by the full flow operation of the ESWP for water inventory restoration. Normally-closed double isolation valves with administrative control provide isolation between the ESWS and UHS.

The COL FSAR Section 9.2.5.2.3, “System Performance,” states that the wet bulb design temperature was selected to be 80°F based on 30 years (1977-2006) of climatological data obtained from National Climatic Data Center /National Oceanic & Atmospheric Administrator for Dallas/ Fort Worth International Airport Station in accordance with RG 1.27. The worst 30 day period based on the above climatological data was between June 1, 1998, and June 30, 1998, with an average wet bulb temperature of 78.0°F. A 2°F recirculation penalty was added to the maximum average wet bulb temperature.

The 83° F wet bulb temperature as shown in the FSAR Table 2.0-1R, “Key Site Parameters,” corresponds to the 0 percent annual exceedance value (two consecutive hourly peak temperatures on July 12, 1995, at 1500 hours and 1600 hours) in accordance with SRP 2.3.1, “Regional Climatology.” The 0 percent exceedance criterion means that the wet bulb temperature does not exceed the 0 percent exceedance value for more than two consecutive data occurrences, namely two consecutive hours on data recorded hourly. The 83° F wet bulb temperature is used to establish the cooling tower basin water temperature surveillance requirements.

The UHS is analyzed using the heat loads provided in Table 9.2.5-2 for LOCA and safe shutdown conditions with LOOP and a maximum ESW supply temperature of 95°F. Per Subsection 9.2.1.2, each ESWP is designed to provide 13,000 gpm flow. Since cooling water flow is inversely proportional to the cooling tower temperature range, for conservatism, a lower ESW flow of 12,000 gpm to each cooling tower is used in the analysis.

The required total water usage (due to cooling tower drift and evaporation) over the postulated 30 day period is determined using industry standard methodology. Total Evaporation (E) and Drift (D) rates were calculated using the ESW flow rate (GPM) of 12,000 gpm times the temperature rise (CR) and a conservative cooling tower factor of 0.0009, E (total) = GPM x CR x 0.0009.

Based on the above analyses, the governing case for the maximum required 30 days cooling water capacity is two-train operation during safe shutdown with LOOP condition, with a total required cooling water of approximately 8.40 million gallons. The total required 30 days cooling water capacity with two-train operation during LOCA condition is approximately 8.20 million gallons. The safe shutdown conditions with LOOP for two-train operation, requires a peak heat load of 196 million British thermal unit per hour(Btu/hr) to be dissipated. The LOCA case with two train operation peak heat load is 158 million Btu/hr. Therefore safe shutdown with two train operation peak heat loads are used for cooling tower design.

The staff reviewed the applicant's COL FSAR supplemental information related to COL Item 9.2(18) and determined it to be unacceptable. As a result, the staff issued **RAI 6358, Question-09.02.05-20,** for the following reasons:

- Part 1: The applicant stated in several places (for example FSAR 9.2.5.2.1 and 9.2.5.2.3), that the cooling towers are designed for 12,000 gpm when Table 9.2.5-3R states the design flow rate of the ESWS pumps is 13,000 gpm. This discrepancy needs to be clarified.
- Part 2: COL FSAR Section 9.2.5.2.2 describes that the UHS transfer pump and the ESW pump from the same basin do not operate simultaneously. Describe if during quarterly UHS transfer pump testing (COL FSAR Table 3.9-202, "Site-Specific Pump IST Requirements,") what controls are in place, such as interlocks, that prevent the ESWS pumps from operating simultaneously with the UHS transfer pump, say from an automatic start signal of the ESWS pumps during a ECCS actuation signal, as described in DCD Section 9.2.1.2.3.2, "Emergency Operations."
- Part 3: Also describe in the FSAR if the UHS transfer system remains full of water or placed in 'layup' after UHS transfer pump testing and what chemical controls (to prevent pipe wall thinning) are used if extended wet layup conditions is utilized.

The applicant responded to **RAI 6358, Question 09.02.05-20, part 1,** by letter dated June 7, 2012, with the following response.

> Each ESW pump is designed to provide 13,000 gpm. In general, the efficiency of removing heat from the cooling tower improves if the supply flow rate to the cooling tower is large. Therefore, the supply flow rate to the cooling tower was assumed to be less than the actual flow rate. A flow rate of 12,000 gpm was used to calculate the required capacity of the cooling tower and the ESW pump

design flow rate was conservatively specified as 13,000 gpm. This clarification has been added to FSAR Subsection 9.2.5.2.1.

The staff reviewed the applicant's response to **RAI 6358 Question 09.02.05-20, part 1,** and finds the response and the proposed changes to the FSAR acceptable. The applicant clarified that the ESW pump design flow rate is 12,000 gpm but the actual flow rate of the ESW pump is 13,000 gpm. This lower designed flow rate of 12,000 gpm is below actual flow rates of 13,000 gpm which is conservative and provides margin to the design requirements. The change to the COL FSAR clarifies the design flow rate and actual flow rate of the ESWP. **RAI 6358 Question 09.02.05-20, part 1, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-20, part 1**.

The applicant responded to **RAI 6358, Question 09.02.05-20, part 2,** by letters dated June 7, 2012, and November 12, 2012, with the following response:

COL FSAR Subsection 9.2.5.2.2 states:

> The UHS transfer pump(s) operate during accident conditions, during IST in accordance with plant Technical Specifications, during maintenance, and for brief periods during cold weather conditions for recirculation.
>
> Although it is not a normal operating condition, the UHS transfer pump and the ESW pump in the same basin may operate simultaneously. Under these conditions the UHS transfer pump and ESW pumps will be able to perform their safety functions. The current distance between the ESW pump and the UHS transfer pump is 13 ft. In general, in the assumed case of a pump that suctions water from the horizontal direction, the distance between the center of the vortex that would be generated and the suction of the pump is obtained by multiplying the suction diameter by 1.5 according to swirling flow problems at intakes. The inner diameter of the ESW pump suction is about 23 inches (-2 ft), hence the distance from the suction to the center of vortex becomes 3 ft (=2 ft x 1.5). The distance from the suction to the center of vortex generated at the UHS transfer pump is even shorter (-1 ft). The distance between the two pumps is 13 ft, so vortices generated if the two pumps are operated simultaneously would not interfere with each other and the existing calculations for pump vortexing remain valid. Additionally, regarding the case of operating each pump independently, the pumps are designed such that air suction from the water surface would not occur even when the water level of the basin is at the lowest allowable level.
>
> In addition, the UHS transfer pump and ESW pumps will be able to perform their safety functions because the basin water inventory is sufficient even at the minimum allowable basin water level for both pumps to operate simultaneously until the UHS transfer pump is stopped by operators. The water inventory of the basin will decrease if the operator does not realize that both the ESW pump and the UHS transfer pump of the same basin are operating. An alarm will annunciate in the main control room when the basin water level reaches the low water set point and the operator will stop the UHS transfer pump. There is no adverse impact on the safety function in this case because water can be supplied by starting the UHS transfer pump in an idle basin if necessary.

FSAR Subsection 14.2.12.1.113 requires pump operation to be verified during preoperational testing. Testing the operation of both pumps simultaneously has been added to FSAR Subsection 14.2.12.1.113.

The staff reviewed the applicant's response to **RAI 6358, Question 09.02.05-20, part 2** and finds the response and the proposed changes to the FSAR acceptable. The running of both the ESW pumps and the UHS transfer pump simultaneously from the same UHS basin is an infrequent operation; however, if operated together, there is no adverse impact. The distance between the two pumps is 13 feet, so vortices generated if the two pumps are operated simultaneously would not interfere with each operating pump.

During dual pump operations, and if basin water inventory decreases to unacceptable water levels, plant operators are notified by a MCR alarm that will annunciate when the basin water level reaches the low water set point. Operators would stop the UHS transfer pump as required. The change to the COL FSAR clarifies the simultaneous operations of the ESW pump with the UHS transfer pump and no adverse impact. In addition, preoperational testing (FSAR 14.2.12.1.113) will demonstrate that simultaneous operation of ESW pumps and UHS transfer pumps will not result in vortices that would interfere with each other. Significant vibration or cavitation is not expected to occur during two pump operations. **RAI 6358, Question 09.02.05-20, part 2,** is considered **resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-20, part 2**.

The applicant responded to **RAI 6358, Q09.02.05-20, part 3,** by letter dated June 7, 2012, with the following response:

FSAR Subsection 9.2.5.2.1 states:

> A chemical injection system is designed to provide non-corrosive, non-scale forming conditions in the UHS basin and ESWS piping to limit biological film formation. The type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant is determined by the Lake Granbury water quality.

The description below has been added to FSAR Subsection 9.2.5.2.2.

> The chemical condition and quality of the ESW is controlled. The UHS transfer system piping is carbon steel with an internal polyethylene lining to reduce corrosion and water does not flow in the transfer piping except during periodic operation of the UHS transfer pump. The UHS transfer system is designed such that pipe wall thinning will not occur. After UHS transfer pump testing, the UHS transfer system remains full of chemically treated ESW except for the discharge piping from the basin inlet valve, which is drained.

The staff reviewed the applicant's response to **RAI 6358, Question 09.02.05-20, part 3** and finds the response and proposed changes to the FSAR acceptable. The UHS transfer system piping is carbon steel with an internal polyethylene lining to reduce corrosion and water does not flow in the transfer piping except during periodic operation of the UHS transfer pump. The UHS transfer system is designed such that pipe wall thinning will not occur. After UHS transfer pump testing, the UHS transfer system remains full of chemically treated ESW. The proposed change to the COL FSAR clarifies the UHS transfer piping material and chemical controls provided. **RAI 6358, Question 09.02.05-20, part 3, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-20, part 3**.

As previously stated, the staff asked **in RAI 6342, Question 03.03.02-9** that the applicant consider design-basis hurricane and hurricane missiles for the CPNPP3&4 site and their impact on the safety of the site-specific Seismic Category I SSCs.

The applicant responded to **RAI 6342, Question 03.03.02-9** in letter dated September 14, 2012, and stated that the COLA has been revised to incorporate RG 1.221 Revision 0 guidance to consider the effects of design-basis hurricane winds and hurricane-generated missiles on the analysis and design of CPNPP3&4 site-specific Seismic Category I SSCs.

The staff reviewed the applicant's response to **RAI 6342 Question 03.03.02-9,** and finds the response and the applicant's proposed FSAR changes acceptable related to the addition of hurricane missile protections to Section 9.2.5.2.2 of the COL FSAR. **Question 03.03.02-9** is considered a **Confirmatory Item** for COL FSAR Revision 4. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. Protection against wind forces and missiles is further described in Section 3.3 of this safety evaluation report.

In summary, the applicant's response to COL Item 9.2(18) is found acceptable and this response complies with GDC 44. UHS transfer pumps are not expected to be placed into service until after a few days into the accident since each UHS basin will be at normal water levels at the initiation of the accident which was stated in the applicant's response to **RAI 3762, Question 09.02.05-6** response. Margin for NPSH, vortex formation and consideration for the transfer pumps has been adequately addressed. The UHS transfer pump flow rate of 800 gpm exceeds the required water makeup requirements due to cooling tower evaporative losses expected post-design-basis accident (DBA) out to 30 days. Based on calculations reviewed by the staff, starting at day 2 of a DBA, the cooling tower evaporative losses expected are in the range of less than 100 gpm per tower. Simultaneously operation of the ESW pump with the associated UHS transfer pump from the same UHS basin has no adverse impact. This COL item ensures that the UHS and associated structures support the necessary safety functions to remove heat and reject it to the UHS under all operating and accident conditions.

In addition, site meteorological conditions have been adequately addressed related to ambient wet bulb conditions. The worst 30 day period based on the above climatological data was between June 1, 1998, and June 30, 1998, with an average wet bulb temperature of 78.0 °F. A 2 °F recirculation penalty was added to the maximum average wet bulb temperature. Also, an additional 3 °F wet bulb margin (83 °F) corresponds to the 0 percent annual exceedance value. The 0 percent exceedance criterion means that the wet bulb temperature does not exceed the 0 percent exceedance value for more than two consecutive data occurrences, namely two consecutive hours on data recorded hourly. The 83° F wet bulb temperature is used to establish the cooling tower basin water temperature surveillance requirements.

- COL Item 9.2(19): Electrical and onsite emergency power supplies during a LOOP

This COL item is related to NRC Regulatory Bases, GDC 44.

The COL FSAR Table 8.3.1-4R, "Electrical Load Distribution - Class 1E GTG Loading," describes the electrical and GTG loading sequence related to the ESWS and UHS.

The COL FSAR Section 9.2.5.2 states that the UHS receives its electrical power from the safety buses so that the safety functions are maintained during LOOP. The UHS receives its standby electrical power from the onsite emergency power supplies during a LOOP.

The COL FSAR Section 9.2.5.2.1 states that each cooling tower consists of two cells, each with a motor driven fan driven with a right-angle gear reducer. The fan motors are powered from the Class 1E normal ac power system. On a LOOP, the motors are automatically powered from their respective division emergency power source.

COL FSAR Section 9.2.5.2.2 states that the UHS transfer pumps and the ESWPs located in each basin are powered by the different Class 1E buses, e.g., for basin A, the ESWP is powered from bus A, and the UHS transfer pump is powered from bus C or D, depending on manual breaker alignment. The power operated valve at each transfer pump discharge and instrumentation associated with each individual transfer pump are powered from the same buses as the transfer pump. The power operated valves at the transfer lines discharging into the UHS basins are powered from different buses than the transfer pumps in their respective basins. The cooling tower fans are automatically activated by the emergency core cooling system (ECCS) actuation signal, the LOOP sequence actuation signal, or the remote manual actuation signal in case of automatic actuation failure. The ECCS actuation signal ensures continuous cooling to the reactor during accidents to allow the reactor to be brought to safe shutdown conditions. The LOOP sequence actuation signal automatically starts the Class 1E gas turbine generators (GTG) to resume power to the active components in each UHS train during LOOP events.

During DBA conditions or loss of makeup water, the Class 1E DC powered UHS basin blowdown control valves are interlocked to close at a low UHS basin water level, LOOP signal and ECCS actuation signal to maintain the UHS basin inventory required for cooling the unit for a minimum of 30 days without makeup water. The blowdown valves are also interlocked to close during the ESW pump stoppage to preclude the system inventory drain down which leads to water hammer at pump restart. Table 9.2.5-4R shows the redundancy for the above functions.

The staff reviewed this supplemental information and finds it unacceptable because it does not clearly states what the power supplies for the UHS transfer pumps, associated discharge valves, and associated inlet valves are based on since there were no reference drawings, figures, or tables. In addition, it is not clear how electrical separation will be maintained in the ESW pump house considering there may be multiple train safety related power in the same room susceptible to flooding or fire. Thus, the staff issued **RAI 252 - 6358, Question 09.02.05-21,** to address this concern.

Specifically, the applicant was requested to address:

- Part 1: COL FSAR Section 9.2.5 or Section 8.3, “Onsite Power Systems,” does not clearly state what the power supplies for the UHS transfer pumps, associated pump discharge MOVs, and associated basin inlet MOVs are based on since no reference drawings, figures, or tables could be found in the COL FSAR.

- Part 2: It is not clear how electrical separation will be maintained in the ESW pump house considering you may have multiple trains of safety-related power in the same room susceptible to flooding or fire.

- Part 3: Chapter 14, “Verification Programs,” testing and ITAAC should clearly describe testing of the UHS transfer pumps and associated MOVs from their various safety-related power supplies.

The applicant responded to **RAI 6358, Question 09.02.05-21, part 1,** by letter dated June 7, 2012, with the following response.

> The power supplies are based on each of the four basins having a 33.33 % capacity of the 30-day cooling requirement. The power supply for the UHS transfer pumps, associated pump discharge MOVs, and associated basin inlet MOVs is based on moving water from a non-operating basin to the other two operating basins.
>
> The power supplies for the UHS transfer pumps and associated pump MOVs are shown in Table 1. These pumps and MOVs are safety-related components powered by safety-related power sources. Class 1 E electrical trains are different for each ESW pump. The UHS transfer pumps and the ESW pumps located in each basin are powered by different Class 1 E buses. The MOV at each transfer pump discharge is powered from the same bus as the transfer pump. The MOVs at the transfer lines discharging into the UHS basins are powered from the same buses as the ESW pump in their respective basins. FSAR Subsection 9.2.5.2.2 currently provides this discussion.

Table 1: Power supply train for ESWP/UHS related component.

Component Power Supply Train	**Power Supply Train**
A-ESW Pump (EWS-MPP-001A)	A Train
B-ESW Pump (EWS-MPP-001B)	B Train
C-ESW Pump (EWS-MPP-001C)	C Train
D-ESW Pump (EWS-MPP-001D)	D Train
A-UHS Transfer Pump (UHS-MPP-001A)-	480V, D1 Train (supplied by C or D Class 1E buses) - See Figure 8.1-1R.
B-UHS Transfer Pump (UHS-MPP-001B)-	480V, D1 Train (supplied by C or D Class 1E buses) - See Figure 8.1-1R.
C-UHS Transfer Pump (UHS-MPP-001C)-	480V, A1 Train (supplied by A or B Class 1E buses) - See Figure 8.1-1R.
D-UHS Transfer Pump (UHS-MPP-001D)-	480V, A1 Train (supplied by A or B Class 1E buses) - See Figure 8.1-1R.
A-UHS Transfer Pump outlet MOV (UHS-MOV-503A)	480V, D1 Train (supplied by C or D Class 1E buses) - See Figure 8.1-1R.
B-UHS Transfer Pump outlet MOV(UHS-MOV-503B)	480V, D1 Train (supplied by C or D Class 1E buses) - See Figure 8.1-1R.
C-UHS Transfer Pump outlet MOV(UHS-MOV-503C)	480V, A1 Train (supplied by A or B Class 1E buses) - See Figure 8.1-1R.
D-UHS Transfer Pump outlet	480 V, A1 Train (supplied by A or B Class

Component Power Supply Train	Power Supply Train
MOV(UHS-MOV-503D)	1E buses) - See Figure 8.1-1R.
A-Basin inlet MOV (UHS-MOV-506A)	A Train
B-Basin inlet MOV (UHS-MOV-506B)	B Train
C-Basin inlet MOV (UHS-MOV-506C)	C Train
D-Basin inlet MOV (UHS-MOV-506D)	D Train

The staff reviewed the applicant's response to **RAI 6358, Question 09.02.05-21, part 1** and finds the response acceptable. Each of the four trains of the UHS transfer system can be powered from either the A or B 1E safety-related bus or the C or D 1E safety-related bus, as shown above in Table 1. Figure 8.1-1R shows how the D1 or A1 safety-related 480V can be powered from two 1E safety-related busses. **RAI 6358, Question 09.02.05-21, part 1, is resolved and closed;** however, the applicant has added Table 9.2.5-201, "Electrical Power Division of UHS Transfer Pumps and Associated Motor-operated Valves," under the response to **RAI 6403 Question 14.03.07-38 (see ITAAC).**

The applicant responded to **RAI 6358, Question 09.02.05-21, part 2,** by letter dated June 7, 2012, with the following response.

> Electrical separation between the UHS transfer pump, associated basin inlet MOVs and instrumentation, the ESW pump, and associated basin outlet valves and instrumentation is maintained by routing cables within the respective fire area.

The staff reviewed the applicant's response to **RAI 6358, Question 09.02.05-21, part 2** and finds the response acceptable. Electrical separation between the UHS transfer pump is maintained by routing cables within the respective fire area. **RAI 6358, Question 09.02.05-21, part 2,** is resolved and closed.

The applicant responded to **RAI 6358, Question 09.02.05-21, part 3,** by letter dated June 7, 2012, with the following response:

> The requirement regarding safety-related power supply for the UHS transfer pumps and associated MOVs has been added to FSAR Subsection 14.2.12.1.113. COLA Part 10 Appendix A.1 Table A.1-1. Items 6, 8, and 9 provide site-specific ITAAC for the UHS transfer pumps and associated MOVs.

The staff reviewed the applicant's response and proposed FSAR change to Question 09.02.05-21, part 3 and finds the response and FSAR change acceptable. FSAR Section 14.2.12.1.113 was modified to add testing of the UHS transfer pumps and associated MOVs from their associated Class 1E buses. No ITAAC revision is required since the existing ITAAC includes testing of the Class 1E components. **RAI 6358, Question 09.02.05-21, part 3, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP3&4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-21, part 3**.

In summary, the applicant's response to COL Item 9.2(19) was found acceptable and this response complies with GDC 44. This COL item ensures that the UHS and associated structures support the necessary safety functions to remove heat and reject it to the UHS under all operating and accident conditions. The electrical power requirements have been adequately addressed since UHS receives its electrical power from the safety buses so that the safety functions are maintained during LOOP. The UHS also receives its standby electrical power from the onsite emergency power supplies during a LOOP. In addition, power for the UHS transfer pumps can be supplies from two of the four safety-related Class 1E buses.

- COL Item 9.2(20): Detailed description and drawings
- COL Item 9.2(22): UHS capability and safety evaluation
- COL Item 9.2(24): Required alarms, instrumentation and controls
- COL Item 9.2(32): Void detection system

These four COL items are related to NRC Regulatory Bases, GDC 44.

The COL FSAR Section 3.6.1.3, "Postulated Failure Associates with Site-Specific Piping," states that there is no site-specific high-energy piping within the protective walls of the ESWPT and UHSRSs and therefore, high-energy pipe breaks are not postulated for site-specific piping within these protective walls. The site-specific moderate-energy piping systems are the ESWS and the FSS.

The staff determined that that UHS transfer system is not specifically described in FSAR Section 3.6.1.3, "Postulated Failure Associates with Site-Specific Piping," therefore, the staff issued **RAI 6358, Question 09.02.05-25,** to address this issue. Specifically,

- Part 1: Describe in the FSAR the 'energy' of the UHS transfer system; reference US-APWR DCD Section 3.6.1.1, "Design Basis," and Table 3.6-1, "High and Moderate Energy Fluid Systems."
- Part 2: Describe in the FSAR how the UHS transfer system is designed against postulated piping leak paths in the UHS transfer portions. Also describe the bounding conditions related to piping leak size and locations.
- Part 3: Describe in the FSAR the consequences of such a piping leak path in the common UHS, looking at the UHS water transfer between UHS basins, post-DBA.
- Part 4: Describe in FSAR Table 9.2.5-4R, "UHS Failure Modes and Effects Analysis," this failure mode and the effects on the UHS system safety function.

The applicant responded to **RAI 6358, Question 09.02.05-25, part 1,** by letter dated June 7, 2012, and September 10, 2012, with the following responses:

> The UHS system is classified as a moderate-energy system. This description has been added to FSAR Subsections 3.6.1.3 and 9.2.5.2.1. Also Table 3.6-201, "High and Moderate Energy Fluid Systems," was added to the COL FSAR.

The staff reviewed the applicant's response and proposed change to FSAR to **RAI 6358, Question 09.02.05-25, part 1** and finds the response and the change to the FSAR acceptable. The applicant has adequately addressed the energy classification of the UHS and has provided a change to the FSAR stating that the UHS is classified as a moderate-energy system. This classification is appropriate for this system since the UHS does not normally operate above 200

°F or exceeds 275 psig which is the definition of high energy fluid systems in DCD 3.6.1.1, "Design Basis." The UHS does satisfy the definition of moderate-energy system which operates at less than 200 °F and less than 275 psig. **RAI 6358, Question 09.02.05-25, part 1, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP3&4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-25, part 1**.

The applicant responded to **RAI 6358, Question 09.02.05-25, part 2,** by letter dated June 7, 2012, with the following response.

> Branch Technical Position (BTP) 3-4 referred to in BTP 3-3 defines an exception from postulating leakage cracks as follows:
>
> B. Moderate-Energy Fluid System Piping
>
> (iii) Fluid Systems in Areas Other Than Containment Penetration.
>
> (1) Leakage cracks should be postulated in piping located adjacent to structures, systems, or components important to safety, except:
>
> (c) For ASME Code, Section III, Class 2 or 3 and non-safety-class piping, where the stresses calculated [2] by the sum of Equations (9) and (10) in NC/HD- 3653 are less than 0.4 times the sum of the stress limits given in NC/ND-3653.
>
> [2] For those loads and conditions for which Level A and Level B stress limits have been specified in the design specification (including the operating basis earthquake).
>
> US-APWR DCD Section 3.6.2.1.2.2 states that the moderate-energy fluid system piping in areas other than PCCV penetrations is designed to comply with BTP 3-4 B(iii)(1)(c) as follows: Leakage cracks are postulated in the following piping systems located adjacent to SSCs important to safety.
>
> * For ASME Code, Section III (Reference 3.6-9), Class 2 and 3 and non-safety-class piping, at axial locations where calculated stress by the sum of Equations 9 and 10 in NC/ND-3653 exceed 0.4 times the sum of the stress limits given in NC/ND-3653.
>
> In the US-APWR, BTP 3-4 is applicable to the safety-related portions of the UHS and the postulation of cracks is not required for the following reasons:
>
> The safety-related portions of the UHS are designed in accordance with ASME Code, Section III, Class 3, which is described as an applicable condition in BTP 3-4 for moderate-energy piping systems. Additionally, the stress levels in the US-APWR UHS safety-related piping will be designed to be less than the stress levels stated in BTP 3-4.
>
> A description stating that the postulation of cracks for safety-related UHS piping is not required has been added to FSAR Subsection 9.2.5.3.

The staff reviewed the applicant's response and FSAR change for **RAI 6358, Question 09.02.05-25, part 2,** and finds the response and the proposed change to the FSAR acceptable. The stress levels in the US-APWR UHS safety-related piping will be designed to be less than the stress levels stated in BTP 3-4; therefore, postulation of cracks for safety-related UHS piping is not required. The proposed FSAR change is acceptable since the applicant added a statement to COL FSAR Section 9.2.5 indicating that leakage cracks and other type of pipe ruptures are not postulated in the safety-related UHS since the UHS is a moderate energy fluid system and the piping is designed to comply with BTP 3.4. **RAI 6358, Question 09.02.05-25, part 2, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-25, part 2**.

The applicant responded to **RAI 6358, Question 09.02.05-25, part 3,** by letter dated June 7, 2012, with the following response.

> As stated above, cracks are not required to be postulated in UHS transfer system piping.

The staff reviewed the applicant's response to **RAI 6358, Question 09.02.05-25, part 3** and finds the response acceptable. As previously stated under the staff evaluation of **RAI 6358, Question 09.02.05-25, part 2,** cracks are not required to be postulated in the UHS. **Question 09.02.05-25, part 3,** is resolved and closed.

The applicant responded to **RAI 6358, Question 09.02.05-25, part 4,** by letter dated June 7, 2012, with the following response:

> A description stating that the postulation of cracks of the UHS transfer system piping is not required has been added to the FSAR. Because of this addition, Table 9.2.5-4R is not affected.

The staff reviewed the applicant's response to **RAI 6358, Question 09.02.05-25, part 4** and finds the response acceptable. As previously stated under the staff evaluation of **RAI 6358, Question 09.02.05-25, part 2,** cracks are not required to be postulated in the UHS, therefore, no corrections or additions are required FSAR Table 9.2.5-4R, "UHS Failure Modes and Effects Analysis." **Question 09.02.05-25, part 4 is resolved and closed.**

Related to COL Items 9.2(20) and 9.2(22), the applicant provided supplemental information. COL FSAR Section 9.2.5.2.1 states that with ESW water temperature of 95° F, the RHRS is capable of reducing the reactor coolant temperature from 350° F to 200° F within 36 hours after shutdown. As the Technical Specifications surveillance ensures that the UHS basin water temperature is limited to 93° F or less, the evaluation provided in DCD Section 5.4.7 is bounding.

Inside dimensions of each basin are approximately 123 feet by 123 feet and 31 feet deep at normal water level. The cooling towers utilize the basins for structural foundation.

The normal maintained water level in the UHS basin is elevation 822 feet. Grade elevation in the vicinity of the basin is 822 feet. A four feet thick basin wall extends four feet above grade level to elevation 826 feet providing a curb around the basin. The basin is not expected to overflow. In the unlikely event of water level reaching the top of the curb wall, it will spill over and flow to site drainage. No special design for the spillway or drain pipe is deemed necessary.

The COL FSAR Section 9.2.5.3 states that the combined volume of water in the three basins is sufficient to provide at least 30 days required cooling capacity.

The total required 30 days cooling water capacity is approximately 8.40 million gallons, or approximately 2.80 million gallons per cooling tower (CT) basin. This is the minimum volume required in each basin to satisfy the thirty day cooling water supply criteria of RG 1.27.

Each basin dimension, not including any column or wall sections, is 120 feet by 120 feet. Normal water level is maintained at 31 feet above the basin floor. A water level decrease to 30 feet above the basin floor is alarmed. Allowing 1 foot for sedimentation accumulation at the floor, with a water depth of 29 feet, a usable water volume of approximately 3.12 million gallons is available for each basin before the operator is alerted of abnormal conditions. The CT basin volume of 2.80 million gallons does not include the water volume located in the ESWP intake basin below the CT basin. The ESWP pump intake basin water level maintains adequate pump NPSH under design basis conditions.

During normal power operation, the UHS basin water temperature is expected to be below 93° F under the worst-case ambient condition (i.e. wet bulb temperature of 83° F based on the 0 percent annual exceedance value). At the initiation of the LOOP event, each basin contains approximately 3.12 million gallons of water (minimum required is 2.80 million gallons per Technical Specification 3.7.9). The heat load peaks (196 million Btu/hr/train) four hours into the accident and then decreases continuously. The heat load is approximately 81 million Btu/hr/train at 24 hours into the accident. Cooling tower water discharge at 95° F and at a flow rate of 12,000 gpm mixing with the large quantity of basin water increases the basin water temperature (initially below 93° F). The basin water temperature increases until equilibrium is reached. However, since the cooling tower is designed for 95° F discharge water at a peak heat load of 196 million Btu/hr, the basin water temperature will not exceed 95° F. LOCA peak heat loads are less than the safe shutdown peak heat loads. Thus, the safe shutdown analysis bounds the LOCA case.

During accident conditions, including LOCA and LOOP, makeup to the basin is presumed lost. During such conditions, the UHS transfer pump operates to permit the use of three of the four basin water volumes. The power supply for each transfer pump is from a different division than the ESWP and cooling tower in that basin. Therefore, loss of one electrical train does not compromise the ability to satisfy the short-term accident requirements.

The COL FSAR Table 9.2.5-3R, “Ultimate Heat Sink System Design Data,” provides a comprehensive list of physical date and process parameters for the UHS and cooling towers. Also, the design data for the UHS transfer pump are provided.

The COL FSAR Table 9.2.5-4R, “UHS Failure Modes and Effects Analysis,” provides the failure effects of the UHS cooling tower fans, UHS transfer pumps, and associated valves.

The COL FSAR Figure 9.2.5-1R (Sheets 1 and 2), “UHS Piping and Instrumentation Diagram,” provides the drawing of the UHS, normal water makeup configuration, UHS transfer system, cooling towers, and cooling tower basins.

The COL FSAR 9.2.5.2.2 states that a portion of the basin water is discharged through the blowdown via the ESWS when the makeup water is available. The blowdown rate is determined using a conductivity cell located at ESW pump discharge and is based on the total dissolved solids in the water and the makeup water source.

The COL FSAR Section 9.2.5.5 describes the instrumentation requirements of the UHS. Water level in each of the basins is controlled by level instrumentation that opens or closes the automatic valves in the makeup lines.

Two level transmitters and associated signal processors are provided for each basin to indicate water level in the basin and annunciate in the MCR for both the high and low water levels in the basin.

A water level signal at six inches below the normal water level causes the makeup water control valve to open. A signal at normal water level then causes the makeup control valve to close. A low level alarm annunciates in the MCR whenever the water level falls one foot below the normal water level.

During accident conditions, level indications from the operating basins are used to alert the MCR operator to start the UHS transfer pump to transfer water from the idle basin to the operating basins.

Blowdown rate is controlled manually. The blowdown control valves close automatically upon receipt of a low water level signal or emergency core cooling system actuation signal. The valve is designed to fail in the close position. Failure of the valve to close is indicated in the MCR. The conductivity cells are provided at the ESW pump discharge line and conductivity are indicated in the MCR.

Temperature elements are provided in each basin and temperatures are indicated in the MCR.

Local flow rate and pressure indicators located in each UHS transfer pump discharge header are used for pump performance testing.

The cooling tower fan is equipped with vibration sensors that alarm in the control room in the event of high vibration.

Level switches are installed in the vertical piping upstream of the cooling tower spray header to annunciate if system inventory reduction occurs. The factors considered for detector position are the allowable leakage rate for the ESW pump discharge check valve and motor-operated butterfly valve, allowable voiding volume and maintenance durations.

The staff reviewed this supplemental information and found it unacceptable for the following reasons. The applicant stated two different dimensions for the UHS basin (123 by 123 versus 120 by 120 feet); this needs to be clarified. Also, it was unclear what instrumentation has safety-related power since there are no FSAR sections describing this information. Thus, the staff issued **RAI 6358, Question 09.02.05-22,** to address this concern. Note: Part 10 of the COLA only has the UHS basin level and water temp as SR Seismic Category I.

The staff reviewed this COLA FSAR supplemental information related to COL Item 9.2(19, 20, and 22) and finds that additional information is required to determined compliance with GDC 44, “Cooling Water.”

Specifically, the applicant was requested to address in the FSAR:

- Part 1: The applicant states two different dimensions for the UHS Basin (approximately 123 ft x 123 ft) in FSAR Section 9.2.5.2.1 versus 120 ft X 120 ft in FSAR Section 9.2.5.3. This needs to be clarified.
- Part 2: FSAR Section 9.2.5 is unclear what UHS instrumentations are safety related and what has safety grade electrical power. Instrumentation of concern includes; basin water level, basin water temperature, conductivity, flow/pressure, cooling tower fan vibration, and spray header level switches. Note: Part 10 (ITAAC - Table A.1-2) of the COL only has the UHS basin level and water temp as safety Class 1E and Seismic Category I.
- Part 3: Figure 9.2.5-1R describes that each UHS basin has two level instruments with high and low alarms. Since the UHS transfer pumps have a different power supplies than the ESWS pump in the same pump house, describes the redundant UHS basin water level and their respected power supplies. Since the ESWS A pump is supplied by bus A and the UHS transfer pump A is powered from bus C or D, describe in the FSAR that in the event of loss of a single power supply (say A), basin level indication is still available for level determination to operated the UHS transfer pump powered from bus C or D.
- Part 4: Table 9.2.5-4R, "UHS Failure Modes and Effects Analysis," (FMEA) does not adequately describe the 'safety function' related to the effects on system safety function capability related to the loss of the UHS transfer pumps and discharge/inlet valves.
- Part 5: Table 9.2.5-4R, "UHS Failure Modes and Effects Analysis," has a valve mark number error, AOV-560; in three places (should be AOV-577).

The applicant responded to **RAI 6358, Question 09.02.05-22, part 1,** by letters dated June 7, 2012, and November 12, 2012, with the following response.

> The dimension of 123 ft x 123 ft is the physical inside dimensions of each UHS basin for the basin footprint. The dimension of 120 ft x 120 ft is the calculated useable area of each UHS basin, excluding areas which do not contribute to the basin water volume (e.g., any column or wall sections). This clarification has been added to FSAR Subsection 9.2.5.2.1.

The staff reviewed the applicant's response and FSAR change to **Question 09.02.05-22, part 1,** and finds the response and the change to the FSAR acceptable. Clarification was added to the FSAR related to the calculated area versus the inside basin footprint. **Question 09.02.05-22, part 1, is resolved**. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-22, part 1**.

The applicant responded to **RAI 6358, Question 09.02.05-22, part 2,** by letter dated June 7, 2012, and September 10, 2012, with the following responses.

The description of safety-related or non-safety-related for each instrument has been added in FSAR Subsection 9.2.5.5. The safety-related basin water level and the basin water temperature instruments are powered by safety-related power supplies.

Technical Specifications Surveillance Requirement 3.7.9.3 requires each cooling tower fan to be operated periodically in accordance with the Surveillance Frequency Program. This ensures that all fans are operable and that all associated controls are functioning properly. It also ensures that fan or motor failure or excessive vibration can be detected for corrective action. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk. This is briefly described in FSAR Subsection 9.2.5.4.

The UHS fan vibration is monitored by permanently installed vibration monitoring instrumentation such that early detection of increased vibration allows preventive maintenance to be completed prior to failure. Vibration levels tend to increase slowly over a period of time, which can typically be addressed by planned maintenance. The instrumentation is not safety-related, and is provided only for diagnostics and reliability monitoring. The instrumentation will be procured to operate in the expected ambient environment.

Non-safety related vibration instrumentation would not be expected to function during an accident. Therefore, the fan is assumed to fail in the event of high vibration during an accident as addressed in Table 9.2.5-4R. Additionally, a thrown fan blade adversely impacting another UHS cooling tower train fan is prevented by the concrete walls and ceiling superstructure installed between each train of UHS cooling tower fans.

The staff reviewed the applicant's response and proposed change to the FSAR to **Question 09.02.05-22, part 2**, and finds the response and FSAR change acceptable. Clarification was added to the FSAR related to non-safety-related and safety-related instrumentation. The applicant stated that for the UHS, the conductivity cells, local flow rate and pressure indicator for the UHS transfer system, and the UHS fan vibration sensors are non-safety related. The safety-related instruments for the UHS include the UHS basin water level and water temperature, with Class 1E power. The staff finds that the described instruments are correctly classified, since both the UHS basin water level and water temperature are instruments utilized to meet TS 3.7.9 Surveillance Requirements (SR 3.7.9.1 and 3.7.9.2). The balance of the associated instruments for the UHS, which include conductivity cells, local flow rate and pressure indicator for the UHS transfer system, and UHS fan vibration sensors, are used for diagnostics and reliability monitoring. As previously described in Section 9.2.1 of this report, the ESW/UHS vertical riser has been deleted and the description of the instrumentation associated with this ESW/UHS vertical riser was removed based on **RAI 6348, Question 09.02.01-9**. **Question 09.02.05-22, part 2, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-22, part 2**.

The applicant responded to **RAI 6358, Question 09.02.05-22, part 3,** by letter dated June 7, 2012, with the following response:

> FSAR Subsection 9.2.5.5 describes the two basin water level instruments. Since the redundant instruments are powered by different Class 1 E power trains, a basin water level instrument is available to operate the UHS transfer pump in the event of a power supply failure in one of the two trains servicing the basin. The description of the power supplies for the level instruments has been added to FSAR Subsection 9.2.5.5.

The staff reviewed the applicant's response and FSAR change to **RAI 6358 Question 09.02.05-22, part 3**, and finds the response and FSAR change acceptable. Clarification was added to the FSAR related to the loss of one safety-related UHS water level. The loss of one electrical train still leaves at least one instrument functional since the level transmitters and associated signal processors are powered by different Class 1E trains. **RAI 6358 Question 09.02.05-22, part 3, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-22, part 3**.

The applicant responded to **RAI 6358, Question 09.02.05-22, part 4,** by letter dated June 7, 2012, with the following response:

> Descriptions regarding the failure effects on system safety function capability related to the loss of the UHS transfer pumps and discharge/inlet valves have been added in Table 9.2.5-4R.

The staff reviewed the applicant's response and proposed FSAR change to Question 09.02.05-22, part 4 and finds the response and FSAR change acceptable. The FMEA has been revised to add failure modes of 'closed for any reason' for the UHS transfer pump discharge MOVs and UHS transfer inlet MOVs. In addition, the FMEA has been revised to add failure modes of 'trip for any reason' for the UHS transfer pumps. If single failure is postulated for any of the valves or pump, three other 33.33 percent capacity cooling tower remain available. In addition, the cooling tower located at the same basin as the inoperable transfer pump or MOV can use its own basin water; thus, it is not necessary to transfer this basin water to another basin. **Question 09.02.05-22, part 4, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-22, part 4**.

The applicant responded to **RAI 6358, Question 09.02.05-22, part 5,** by letter dated June 7, 2012, with the following response.

> The correct valve number for the ESWS Blowdown Main Header Isolation Valve to the CWS blowdown main header is AOV-577. This correction is shown in Luminant's submittal, TXNB-11090, "Update Tracking Report," (ADAMS Numbers ML12012A101, ML12012A140) dated December 20, 2011.

The staff reviewed the applicant's response and proposed FSAR change to Question 09.02.05-22, part 5 and finds the response and FSAR change associated with TXNB-11090 (ML12012A140) acceptable. Valve number ESW-AOV-560 was revised to ESW-AOV-577 in the FMEA, Table 9.2.1-2R. **Question 09.02.05-22, part 5,** is **resolved and closed** since Revision 3 of the FSAR has corrected this valve number.

In summary, the staff finds that the applicant has adequately addressed COL Items 9.2(20), 9.2(22), 9.2(24), 9.2(32), and the applicant's supplemental information complies with GDC 44. As previously addressed for COL Item 9.2(32) the void detection instrumentation was deleted by the responses to **RAI 6348 Question 09.02.01-9** and is addressed in Section 9.2.1 of this report. These COL items ensure that the UHS and associated structures support the necessary safety functions to remove heat and reject it to the UHS under all operating and accident conditions. As stated above, detailed description and drawings, UHS capability and safety evaluation, and alarms and controls of the UHS have been adequately addressed in the FSAR.

- COL Item 9.2(21): Source of makeup water and blowdown.

This COL item is related to NRC Regulatory Bases, GDC 2 and 44.

The COL FSAR Section 9.2.5.2.1 states that the normal makeup water to the UHS inventory is from Lake Granbury via the circulating water system (CWS) described in Subsection 10.4.5. A control valve with instrumentation located in each makeup line maintains basin water level during normal operation. The blowdown water is discharged to Lake Granbury via the circulating water system.

A chemical injection system is designed to provide non-corrosive, non-scale forming conditions in the UHS basin and ESWS piping to limit biological film formation. The type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant is determined by the Lake Granbury water quality.

The makeup water intake structure design and location at Lake Granbury minimize debris, algae, and grass into the makeup water and prevent the impingement and entrainment of fish and other aquatic life. The long makeup water pipe run diminishes the carryover of debris and other fouling agents to the UHS basin.

The COL Figure 9.2.5-1R shows the UHS makeup piping system from the CWS into the basin with a control station with manual bypass valves.

The COL FSAR 10.4.5.2.2.8 states that chemical injection is also provided for in the makeup water and blowdown systems and ultimate heat sink basin.

The staff found this supplemental information unacceptable because it did not show these above noted important connections and safety-related/non safety-related connections on the Figure 9.2.5-1R. From that figure, it was unclear how normal make-up is isolated during accident conditions to preclude flooding the UHS basins. In addition, it was not clear that the interconnection from the nonsafety-related CWS cannot fail and possibly drain the UHS basin (GDC 2). That is, is it possible for a seismic event in the nonsafety-related line to siphon the water out of the UHS basin. Therefore, the staff generated **RAI 6358 Question 09.02.05-23** to address this issue.

Specifically, the applicant was requested to address the following information:

- Part 1: It is not clear that the interconnection from the nonsafety-related normal water basin, makeup from circulating water system (CWS) (Figure 9.2.5-1R) cannot fail and possibly drain the UHS basin. Given a possible seismic event in the nonsafety-related line, describe if a UHS basin siphon event is possible (drain-down event).
- Part 2: Describe how normal make-up from CWS is isolated during accident conditions to preclude flooding the UHS basins.
- Part 3: It is not clear to the exact location of the makeup control valves located on Figure 9.2.5-1R, since it appears to be between the two cooling towers.

The applicant responded to **RAI 6358, Question 09.02.05-23, part 1,** by letter dated June 7, 2012, with the following response:

> The makeup water discharge piping outlet of the CWS piping is installed above the normal water level of the UHS basin. Thus, a UHS basin siphon event will not occur during normal power operation. During a seismic event, coincident with a failure to close the AOV on the CWS makeup water piping, a UHS basin siphon event may occur for only short periods due to sloshing of water in a UHS basin. However, since only a small amount of water would flow out due to the

> makeup water discharge piping outlet level, there is minimal impact on the amount of water available to perform the UHS/ESWS function.

The staff reviewed the applicant's response to Question 09.02.05-23, part 1 and finds the response acceptable. Since the makeup water discharge piping outlet of the CWS piping is installed above the normal water level of the UHS basin, a UHS basin siphon event is unlikely during normal power operation. However, it is possible that during a seismic event, coincident with a failure to close the AOV on the CWS makeup water piping, a UHS basin siphon event may occur for only short periods due to sloshing of water in a UHS basin. The total required 30 days cooling water capacity is approximately 8.40 million gallons or approximately 2.80 million gallons per cooling tower (CT) basin and there is an usable water volume of approximately 3.12 million gallons per CT basin. It is expected that only a small amount of water would flow out due to the makeup water discharge piping outlet level; therefore, there is minimal impact on the loss of water to perform the UHS/ESWS function. The small amount of water loss is expected to be less than the 320,000 gallons of extra usable water in each CT. **Question 09.02.05-23, part 1 is resolved and closed.**

The applicant responded to **RAI 6358, Question 09.02.05-23, part 2,** by letter dated June 7, 2012, with the following response:

> Since the normal make-up water line from CWS is non-safety related, it is not likely to be isolated during accident conditions. However, this is not a concern for the following reason. FSAR Subsection 9.2.5.2.1 states:
>
> The normal maintained water level in the UHS basin is elevation 822 feet. Grade elevation in the vicinity of the basin is 822 feet. A four feet thick basin wall extends four feet above grade level to elevation 826 feet providing a curb around the basin. The basin is not expected to overflow. In the unlikely event of water level reaching the top of the curb wall, it will spill over and flow to site drainage. No special design for the spillway or drain pipe is deemed necessary.

The staff reviewed the applicant's response to Question 09.02.05-23, part 2 and finds the response acceptable. Figure 3.8-209, "Typical Section Looking West at UHS Basin and Pump Houses Interface with ESWPT," shows the normal UHS water level at Elevation 822feet and the top of wall at Elevation 826feet. With the four feet curb design, the basin is not expected to overflow. If water reaches the top of the curb, it will spill and flow to site drainage. In addition, the note on Figure 3.8-209 stated that floor drains are provided in the ESW and transfer pump rooms to allow internal flood waters to drain to the basin below. In addition, two level transmitters and associated signal processors are provided for each basin to indicate water level in the basin and annunciate in the MCR for both the high and low water levels in the basin. This will alert MCR operators to take appropriate actions related to high water levels. **Question 09.02.05-23, part 2 is resolved and closed.**

The applicant responded to **RAI 6358, Question 09.02.05-23, part 3,** by letter dated June 7, 2012, with the following response:

> Figure 9.2.5-1R is a simplified piping and instrumentation drawing (P&ID). The UHS makeup water control valves, the UHS makeup control isolation valves, and the makeup control bypass are located in the UHSRS as shown in FSAR Table 3.2-201 (Sheet 2 of 3) to avoid potential plume and heat effects from the cooling tower. The makeup control isolation valves and the makeup control bypass valves are locally operated and are

located in the UHSRS. Requirements for the location of these valves have been added in FSAR Subsection 9.2.5.2.1.

The staff reviewed the applicant's response and proposed FSAR changes to **RAI 6358, Question 09.02.05-23, part 3**, and finds the response and FSAR change acceptable. The UHS makeup water control valves, the UHS makeup control isolation valves, and the makeup control bypass are located in the ultimate heat sink related structure (UHSRS) and are outside the plume effected area of the ultimate heat sink related structure UHSRS. The FSAR change adds the locations of the valves associated with the UHS basin makeup. **Question 09.02.05-23, part 3, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-23, part 3**.

In summary, the staff finds that the applicant has adequately addressed COL Item 9.2(21), and the applicant's supplemental information complies with GDCs 2 and 44. This COL item ensures that the UHS and associated structures support the necessary safety functions to remove heat and reject it to the UHS under all operating and accident conditions. Makeup water from Lake Granbury is chemically treated in the UHS basin and ESWS piping to limit biologically film formation and maintain proper water cleanliness. Chemically injection is further described in Section 9.2.1 of this report (COL 9.2(8)). Water from the Lake Granbury via the CWS is further described in Section 10.4.5 of this report.

- COL Item 9.2(23): Test and inspection requirements of the UHS
- COL Item 9.2(30): Conduct of periodic inspection, monitoring, maintenance, performance and functional testing of the UHS and development of operating procedures to periodically alternate operation of the trains for regular monitoring.

These COL items are related to NRC Regulatory Bases, GDC 45 and 46.

The COL FSAR Section 9.2.5.4 states that in-service inspection of piping is performed in accordance with the requirements of ASME Section XI, and is included in Section 6.6. Inservice testing of pumps and valves is performed to ensure operational readiness and is included in Subsection 3.9.6. Periodic inspections and testing of the mechanical cooling tower components, including fan, motors, and reducing gears, are performed in accordance with cooling tower manufacturer's recommendations, industry operating experience, and as a part of the monitoring required in Generic Letter 89-13, to maintain acceptable system performance.

Periodic cooling tower fan testing in accordance with Technical Specifications provides a means of detecting and correcting motor failure or excessive vibration.

A test program is developed to verify and monitor heat exchanger performance. Baseline performance and acceptance criteria for heat transfer capability for all heat exchangers are established. CCW heat exchangers, essential chiller cooling units and cooling towers are included in the program. Tests are performed during normal plant operation per an established schedule. Heat transfer capability at operating conditions is calculated and then prorated to accident mitigation heat transfer capability. Performance of each heat exchanger is trended to determine degradation.

An inspection program and test procedures are developed to monitor fouling and degradation of the ESW and UHS and to maintain acceptable system performance. The inspection program includes the following:

- Inspect piping for corrosion, erosion and bio-fouling on a regular basis.
- Perform visual inspection of ESWS and UHS piping for leakage.
- Perform visual inspection of the ESW intake basin and the UHS basin for microscopic biological fouling organism, sedimentation and corrosion once every refueling cycle.
- Analyze water samples on a regular basis.

A preventive maintenance program is developed to remove excessive bio-fouling agents, corrosion products, silt etc. This program will address visual as well as hands-on inspection of fill material and supports, drift eliminators, panels, riser piping, spray nozzles, fans, motors, and associated components.

Two ESWS and UHS trains are operating during normal plant operations. Operation of the standby trains is alternated per operating procedures. Thus, the performance of all trains is monitored. The system operation, established inspection, testing and maintenance program assure the integrity and capability of the system over time complies with the requirements of GDC 45. Continuous system operation at pressures and flows near accident conditions, periodic heat exchanger performance tests, surveillance tests and monitoring of various parameters assure that the ESWS and UHS perform their safety functions in accordance with the requirements of GDC 46. The inspection and testing provisions described above are subject to programmatic requirements and procedural controls as described in FSAR Section 13.5. Manholes, handholes, inspection ports, ladder, and platforms are provided, as required, for periodic inspection of system components. Maintenance and test procedures to monitor debris build up and flush out debris in the UHS are discussed in Subsection 9.2.1.2.1.

The COL Item 9.2(30) discussion appears to be missing from the COL FSAR, thus, the staff issued **RAI 6358 Question 09.02.05-26** to address this concern.

The applicant responded to **RAI 6358, Question 09.02.05-26** by letter dated June 7, 2012, with the following response:

> FSAR Subsection 9.2.5.4 has been revised to include the left margin notation for COL Item 9.2(30).

The staff reviewed the applicant’s response and FSAR change to **RAI 6358, Question 09.02.05-26**, and finds the response and FSAR change acceptable. The left margin notation for COL Item 9.2(30) was correctly added to the FSAR and FSAR Section 9.2.5.4 was added to the COL 9.2(30) reference list. **Question 09.02.05-26 is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 09.02.05-26**.

In summary, the staff finds that the applicant has adequately addressed COL Items 9.2(23) and 9.2(30) and the applicant’s supplemental information complies with GDCs 45 and 46. These COL items ensure that testing is performed for the UHS and associated components and support the necessary safety functions to remove heat and reject it to the UHS under all operating and accident conditions. In addition, operation of the standby UHS trains is alternated per operating procedures.

- COL Item 9.2(31): System layout, develop procedures to assure that the ESWS and UHS are above saturation conditions.

This COL item is related to NRC Regulatory Bases, GDC 4.

The ESWS and the UHS has various overlap areas between Sections 9.2.1 and 9.2.5 of the DCD and CP COL. Since COL Item 9.2(31) is reviewed under Section 9.2.1 of this safety evaluation, this item is considered resolved and no further evaluation is required.

<u>CDI which is outside the scope of COL items:</u>

The CDI as part of the US-APWR DCD which is outside the scope of the specific ESWS and UHS COL items (see safety evaluation section 9.2.1), are not specifically described in the COL FSAR. However, the staff has evaluated the CDI as described below:

<u>US-APWR Tier 2, DCD 9.2.1.2.2 – strainer mesh</u>

[The 3 mm mesh of the strainer element also assures that potential clogging of the cooling tower nozzles is avoided.]

The COL applicant has adopted this DCD statement without comments and without changes to COL FSAR 9.2.1.2.2.

The staff's evaluation is found in Section 9.2.1 of this safety evaluation report.

<u>US-APWR Tier 2, DCD FSAR 9.2.1.2.3.1 – spray header draining</u>

[Water in the cooling tower spray header will drain to the UHS.]

The COL applicant has adopted this DCD statement without comments and without changes to COL FSAR 9.2.1.2.3.1.

The staff's evaluation is found in Section 9.2.1 of this safety evaluation report

<u>US-APWR Tier 2, DCD 9.2.5.5 – Instrumentation Requirements</u>

[UHS transfer pump discharge pressure – local and MCR/RSC display]
[UHS transfer pump discharge flow rate – local and MCR/RSC display]

The COL applicant has adopted this DCD statement without comments but has incorporated these instruments in to COL FSAR Figure 9.2.5-1R.

The staff finds this DCD statement acceptable for the COL. Both pressure and flow rate instruments are shown graphically in the FSAR.

<u>Initial Plant Testing</u>

Tier 2 DCD Section 14.2.12.1.34, "Essential Service Water System, (ESWS) Preoperational Test," includes ESW pump performance and pump flow rates, automatic system controls and interlocks, alarms, and verification of the absence of water hammer during load sequences. COL FSAR Section 14.2 states that DCD Section 14.2 is incorporated by reference.

COL FSAR Section 14.2.12.1.113," Ultimate Heat Sink (UHS) System Preoperational Test," includes preoperational testing which includes the ESWS. Included in the acceptable testing related to ESWS is; ESW pump flow rates and basin low water level, blowdown equipment operations, and required flows and pressure when the FSS is aligned.

Section 14.2 of this safety evaluation report addresses the staff's evaluation of the initial test program for CPNPP Units 3 and 4 FSAR.

ITAAC

The COL Part 10, Appendix A.1 addresses the Tier 1 DCD ESWS/UHS Interface Requirements.

Item a, UHS design with divisional separation and is capable of performing its safety functions under design basis event conditions and coincident single failure with or without offsite power available is addressed in Appendix A.1 ITAAC 1b, 6b, and 18.

Item b, UHS is designed, constructed and inspected in accordance with ASME Code Section III, is addressed in Appendix A.1 ITAAC 2, 3 and 4.

Item c, the maximum supply water temperature is 95 °F under the peak heat loads is addressed in Appendix A.1 ITAAC 7.

Item d, the UHS water level is maintained such that available net positive suction head (NPSH) is greater than the ESW pump's required NPSH during all plant operating and the ESW pump operation does not cause vortex formation at minimum allowed UHS water level are addressed in Appendix A.1 ITAAC 14 and 15.

Item e, the UHS system has MCR and remote shutdown console (RSC) alarms and displays for UHS water level and water temperature is addressed in Appendix A.1 ITAAC 11 and 12.

Item f, the UHS system has MCR and RSC controls for UHS components' active safety functions if applicable to the site-specific design is addressed in Appendix A.1 ITAAC 10.

Item g, the UHS components that have protection and safety monitoring system (PSMS) control (if applicable to the site-specific design) perform an active safety function after receiving a signal from PSMS is addressed in Appendix A.1 ITAAC 9 and 10.

Item h, the UHS can provide the required cooling for a minimum of 30 days without make-up during accident conditions is addressed in Appendix A.1 ITAAC 13.

Item i, the UHS system is designed to prevent water hammer is addressed in Appendix A.1 ITAAC 16.

The COL Part 10, Appendix A.3.1.3, "UHSRS," Items 2.a and 7, addresses flood and fire barrier separation between the UHS transfer pumps and the ESWS since these pumps are supplied by different safety related power and are in the same general area of the UHSPH.

Based on the staff's review of CPNPP Units 3 and 4, Revision 3, Part 10 - ITAAC, Appendix A.1, "Ultimate Heat Sink System (UHSS) and Essential Service Water system (ESWS) (Portions

Outside the Scope of the Certified Design)," several items needed to be further addressed by the applicant. Therefore, the staff generated **RAI 6403, Question 14.03.07-38** to request that the applicant address these issues.

- Part 1: Site-specific ITAAC should clearly describe testing of the UHS transfer pumps and associated MOVs from their various safety-related power supplies**.**

- Part 2: Site-specific ITAAC should clearly describe testing of the ESWS/UHS heat tracing.
- Part 3: Site-specific ITAAC should clearly describe testing of the ESWS/UHS freeze protection features, including fans in reverse speed.
- Part 4: Site-specific ITAAC should clearly describe and conclude that the UHS fans are designed to withstand the effects of design basis tornado differential pressure.
- Part 5: Site-specific ITAAC (see ITAAC #18) should clearly describe the UHS is capable of performing its safety function without exceeding the maximum temperature limit of the water in the UHS basin.

- Part 6: Site-specific ITAAC should clearly describe that the UHS spray nozzles and orifices are adequate design with consideration for blockage. Note, DCD 9.2.1.2.2 states that the ESWS strainer mess is 3 mm to assure that potential clogging of the cooling tower nozzles is avoided.

The applicant responded to **RAI 6403, Question 14.03.07-38, part 1,** by letter dated June 21, 2012, and September 24, 2012, with the following responses:

> Site-specific inspection and testing of the UHS transfer pumps and associated MOVs are described in COLA Part 10 Table A.1-1. ITAAC #6.a and #6.b are provided to verify through testing and inspection that Class I E equipment are powered from their respective Class I E division and that the divisions are physically separated and electrically isolated. ITAAC #9.a.i and #9.a.ii confirm that MOVs and AOVs for the UHS and the site-specific portions of the ESWS operate under design and pre-operational test conditions. ITAAC #10.a and #12.b test the operation of the UHS transfer pumps from the main control room and the remote shutdown console.

The COL FSAR Table 9.2.5-201, "Electrical Power Division of UHS Transfer Pumps and Associated Motor-operated Valves," has been added to show the electrical power configuration for the UHS transfer pumps and associated MOVs.

The staff reviewed the applicant's response to **RAI 6403 Question 14.03.07-38, part 1** and finds the response and the proposed changes to the FSAR acceptable. As previously stated under the staff evaluation for **RAI 6358, Question 09.02.05-21, part 1,** each of the four trains of the UHS transfer system can be powered from either the A or B 1E safety-related bus or the C or D 1E safety-related bus, as shown above in Table 1. Figure 8.1-1R shows how the D1 or A1 safety-related 480V can be powered from two 1E safety-related busses. COLA Part 10 Table A.1-1, ITAAC items 6.a, 6.b, 9.a.i and 9.a.ii correctly describes that Class 1E components will have separation between redundant divisions, will have Class 1E components powered from their respective Class 1E division, and will have testing of active safety function for remotely operated valves.

The COLA Part 10 Table A.1-1, ITAAC items 10.a and 12.b. correctly describes testing of MCR controls for the associated UHS pumps and fans and will have testing at the remote shutdown console (RSC) for associated UHS valves, pumps and fans. In addition, the proposed change to FSAR Table 9.2.5-201 correctly indicates the electrical power divisions for the UHS transfer pumps and MOVs. **RAI 6403 Question 14.03.07-38, part 1 is a Confirmatory Item and RAI 6403 Question 14.03.07-38, part 1, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 14.03.07-38, part 1**.

The applicant responded to **RAI 6403, Question14.03.07-38, part 2,** by letters dated September 24, 2012, and November 26, 2012, with the following response.

> FSAR Subsections 9.2.1 and 9.4.5 have been revised to address freeze protection for the ESW piping and UHS transfer piping that pass through the piping rooms that are between the pump house and the essential service water pipe tunnel (ESWPT). These piping rooms are heated by unit heaters in the UHS ESW pump house ventilation system, which prevents freezing of the ESW and UHS piping contained therein. Therefore, heat tracing is not applied for freeze protection. Furthermore, to ensure that heating is available, it is necessary to separate the rooms where UHS transfer piping is installed from the rooms where ESW piping is installed because the unit heaters in each room are powered by a different Class 1 E power supply. Therefore, the piping room now includes a wall for separation of the ESW piping and the UHS piping.
>
> The layout of the ESW pump house was changed as shown in Attachment 2 of the supplemental response to **RAI 6124** (**RAI Letter Number 243**) (ADAMS Number ML12243A456). A portion of the UHS transfer piping passes through the ESW pump room in the revised layout. It is necessary to provide separation for the UHS transfer piping in the ESW pump house consistent with the separation provided for the piping in the piping rooms. Therefore, the ESW pump house layout is revised so the UHS transfer piping does not pass through the ESW pump room.
>
> Site-specific inspection and testing for UHS ESW pump house ventilation system is already described in COLA Part 10 Table A.2-1 Item #4. This inspection and testing confirms that the ambient temperature in the piping rooms can be maintained above 40°F by the UHS ESW pump house ventilation system so that ESW and UHS transfer piping within each piping room will not freeze.

The staff reviewed the applicant's response to **RAI 6403 Question 14.03.07-38, part 2** and finds the response acceptable. Heat tracing was removed correctly from FSAR Sections 9.2.1 and 9.2.5; therefore, a specific ITAAC for heat tracing is no longer required. There are eight safety-related heaters in the ESW pump room (two per pump room), four safety-related unit heaters in the UHS pump transfer rooms, four safety-related unit heaters in the ESW piping rooms, and four safety-related unit heaters in the UHS transfer piping room which maintain the pump rooms and piping rooms within the required temperature range (>40 °F) thus providing freeze protection. Further description and testing of the space heaters is addressed in Section 9.4.5 of this report. **RAI 6403 Question 14.03.07-38, part 2 is considered closed and resolved.**

The applicant responded to **RAI 6403, Question 14.03.07-38, part 3,** by letters dated September 24, 2012, and November 12, 2012, with the following response:

> FSAR Subsections 9.2.1 and 9.4.5 have been revised to address ESWS/UHS freeze protection. COLA Part 10 ITAAC Appendix A.1 Figure A.1-1 has also been revised to include a drain valve to drain water in the exposed portion of the ESW return line in the cooling tower. The drain valve is tested in accordance with ITAAC Appendix A.1 Table A.1-1 Item #1.a.
>
> For freeze protection of the ESW return piping in the cooling tower, the water in the spray header is drained to the basin though the spray nozzles and the water in the vertical piping is drained to the basin through the drain line.
>
> Prior to the onset of temperatures which could cause freezing, a plant operator opens the locked closed manual valve in the ESW pump room on the cooling tower drain line to drain the water in the exposed portion to the basin. After draining, the operator closes and locks the drain valve. The water in the spray header is drained to the basin through the spray nozzles.
>
> Additionally, operation of the UHS fans in reverse speed for freeze protection is not applied.
>
> Freezing in the ESW pipe tunnel (ESWPT) and the ESW pipe chase (ESWPC) will not occur because they are buried below grade as shown in FSAR Chapters 1 and 3. The ambient temperature in the ESWPT and the ESWPC will not fall below freezing, but will remain at or above ground temperature. The tunnel is not a closed area, so air can pass through it. The tunnel openings are connected to heated areas in the R/B, PS/B, and UHSRS, and only warm air passes into the tunnel area. Therefore, the water in the tunnel piping will not freeze.

The staff reviewed the applicant's response and the COL Part 10 change to **RAI 6403 Question 14.03.07-38, part 3** and finds the response and COL change acceptable. The new drain lines (VLV-521A/B/C/D) have been added to Part 10 ITAAC Figure A.1-1 and will be inspected under ITAAC Table A.1-1, Item 1.a; functional arrangement. Freezing in the ESWPT and the ESWPC will not occur because they are buried below grade and the ambient temperature will not fall below freezing. The tunnel and chase will remain at or above ambient ground temperature. The tunnel is not a closed area so therefore air can pass through it. The tunnel openings are connected to heated areas in the R/B. Power source building (PS/B) and UHSRS and only warm air passes into the tunnel area. Therefore, the water in the piping in the tunnel is not frozen. In addition, an ITAAC is not required for the UHS fans related to freeze protections since the fans do not operate in reverse. **RAI 6403 Question 14.03.07-38, part 3, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 14.03.07-38, part 3**.

The applicant responded to **RAI 6403, Question 14.03.07-38, part 4,** by letter dated June 21, 2012, with the following response.

> COL FSAR Subsection 3.8.4.1.3.2 has been revised to state that the UHS fans, motors, and associated equipment are designed to withstand the effects of design basis tornado differential pressure. FSAR Subsection 9.2.5.3 has been

> revised to describe tornado qualification of the UHS basins, cooling towers, fans, motors, and associated equipment. During design and fabrication, the UHS fans (including motors and associated equipment) will be qualified to withstand the effects of tornado loading. ITAAC #19 has been added in COLA Part 10 Table A.1-1 to include qualification of the UHS fans to withstand tornado loads, and as-built inspection and analysis.

As previously stated, the staff asked **in RAI 6342, Question 03.03.02-09,** that the applicant consider design-basis hurricane and hurricane missiles for the CPNPP3&4 site and their impact on the safety of the site-specific Seismic Category I SSCs.

The applicant responded to **RAI 6342, Question 03.03.02-09,** in letter dated September 14, 2012, and stated that the COLA has been revised to incorporate RG 1.221 Revision 0 guidance to consider the effects of design-basis hurricane winds and hurricane-generated missiles on the analysis and design of CPNPP3&4 site-specific Seismic Category I SSCs.

The staff reviewed the applicant's response to **RAI 6342, Question 03.03.02-09,** and finds the response and the proposed changes to the COL acceptable related to the addition of hurricane missile protections to COLA Part 10, ITAA C, Table A.1-1, Item 19. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. RAI 6342, Question 03.03.02-09, is considered a Confirmatory Item for COL FSAR Revision 4.

The staff reviewed the applicant's response and the proposed changes to the COL FSAR/Part 10 for RAI 6403 Question 14.03.07-38, part 4 and finds the response and the proposed changes to the COL FSAR/Part 10 acceptable. The UHS fans, motors, and associated equipment are designed to withstand the effects of design basis tornado differential pressure. In addition, ITAAC has been established to include qualification of the UHS fans to withstand tornado loads, including differential pressures from a tornado, and as-built inspection and analysis. The changes to the FSAR/ITAAC correctly added the new ITAAC and made corrections to FSAR Section 3.8.4.1.3.2 and 9.2.5.3. **Question 14.03.07-38, part 4, is resolved.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 14.03.07-38, part 4**.

The applicant responded to **RAI 6403, Question 14.03.07-38, part 5,** by letter dated June 21, 2012, with the following response:

> COLA Part 10 Table A.1-1 ITAAC #7 describes tests and analyses of the UHSS to remove sufficient heat to maintain the ESWS supply water within the maximum temperature limit of 95°F under peak heat load conditions, as well as under normal, abnormal, or accident conditions. ITAAC #18 describes inspections and analyses which conclude that the UHSS is capable of removing heat during a LOOP and coincident single failure, as described by the standard plant interface requirements in DCD Tier 1 Subsection 3.2.1 .a. The "safety function" in ITAAC #18 is described in COLA Part 10 Appendix A.1 Section A.1.1 and further details are provided in DCD Subsection 9.2.5.1. The design basis heat load and the maximum ESW supply temperature are described in these sections.
>
> For clarification, ITAAC #18 ensures through inspection and analysis that sufficient redundancy exists within the UHSS to account for LOOP and coincident

> single failure, and ITAAC #7 ensures through testing and analysis that the heat removal capacity of the UHSS is sufficient for peak heat load conditions, which includes normal, abnormal, and accident conditions. The condition under which ITAAC #7 is satisfied is for combinations of two operating trains of the UHS cooling towers and three basins. This is under the assumption that one division is out of service for maintenance coincident with the postulated LOOP and any single failure within the UHSS.

The staff reviewed the applicant's response **RAI 6403 Question 14.03.07-38, part 5**, and finds the response acceptable. Both ITAAC #7 and #18 address the UHS design and safety function. ITAAC #7 focused on normal, abnormal, and accident conditions while maintaining the ESWS basin below 95 °F. ITAAC #18 focused on single failure with or without offsite power. Together these two ITAACs are sufficient to demonstrate the UHS can perform its intended function during normal, abnormal, and accident conditions. **RAI 6403 Question 14.03.07-38, part 5 is resolved and closed.**

The applicant responded to **RAI 6403, Question 14.03.07-38, part 6,** by letter dated June 21, 2012, with the following response:

> The cooling tower spray nozzles are sized sufficiently greater than 3 mm to prevent blockage by debris. This sizing prevents blockage from debris that passes through the 3 mm mesh strainer. The orifices which are installed in 24-inch, 8-inch, and 6-inch ESW piping are also sized sufficiently greater than 3 mm to prevent blockage by debris. FSAR Subsection 9.2.5.2.1 has been revised to clarify that the spray nozzles are sized to prevent blockage by debris. ITAAC #20 has been added in COLA Part 10 Table A.1-1 to include inspection of the as-built spray nozzles and orifices.

The staff reviewed the applicant's response and the proposed changes to COL FSAR/Part 10 for **RAI 6403, Question 14.03.07-38, part 6** and finds the response and the proposed changes to the FSAR/ITAAC acceptable. DCD Table 9.2.1-1, "Essential Service Water System Component Design Data," states that the ESWS outlet strainer has a mesh size of 3 mm; therefore, debris 3 mm and larger is blocked from entering downstream of the ESWS strainers. The cooling tower spray nozzles are sized sufficiently greater than 3 mm to prevent blockage. ITAAC #20 verifies that the UHS cooling tower spray nozzles have an orifice size greater than 3 mm. The FSAR/ITAAC change was found acceptable with the above noted changes to FSAR Section 9.2.5.2.1 and ITAAC #20. **RAI 6403 Question 14.03.07-38, part 6, is resolved**. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. This is being tracked as **Confirmatory Item 14.03.07-38, part 6**.

The staff reviewed FSAR, Tier 1, ITAAC Appendix A.1 for UHS testing. The staff finds that the DCD interface requirements, Tier 1, Section 3.2.1, "Ultimate Heat Sink," related to the UHS have been adequately described in the COL and found acceptable. The requirements of 10 CFR 52.80, ITAAC have been met and that the proposed ITAAC provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in accordance with the design certification, the provisions of the Atomic Energy Act, and NRC regulations.

<u>Technical Specifications</u>

The staff reviewed FSAR, Tier 2, Chapter 16, Technical Specification (TS) 3.7.9 "Ultimate Heat Sink," and its associated TS basis. DCD CDI and COL supplemental information was added to TS 3.7.9 Limited Conditions of Operations (LCO) associated with three UHS cooling towers, three transfer pumps, and water basin temperature. DCD CDI and COL supplemental information was also added for Surveillance Requirements (SR) for total basin inventory, basin water temperature, fans, fans automatic starts, UHS transfer manual pump starts, valves positions, and valve automatic features.

The staff has determined that the COL TS 3.7.9 to be unacceptable since the applicant stated that the 83° F wet bulb temperature is used to establish the cooling tower basin water temperature surveillance requirements, but the staff could not find technical specification surveillance requirements for wet bulb. In addition, it is not clear whether the 93 °F technical specification limit is assumed as the starting temperature during the 30-day accident analysis to ensure no ESWS intake temperatures are greater than 95 °F. Therefore, the staff issued **RAI 6173, Question 09.02.05-17** to address these concerns.

The applicant provided a response to **RAI 6173, Question 09.02.05-17** on January 24, 2012, and stated the following:

> The wet bulb temperature of 80 °F and the 0% exceedance wet bulb temperature of 83 °F are appropriately calculated in accordance with RG 1.27 and the Advanced Light Water Utility Requirements Document (URD) EPRI TR-016780. These are the meteorological parameters used to confirm that the UHS system as designed is capable of performing its required function. Using these parameters, the UHS has design margin to accommodate postulated future changes in local meteorology. As described in FSAR Subsection 9.2.5, the UHS is designed in accordance with RG 1.27. The design for the MDCT and the UHS is confirmed using an ambient wet bulb temperature of 80 °F. As stated in Subsection 9.2.5.2.3, the UHS wet bulb temperature used to confirm the design was 80 °F based on 30 years (1977-2006) of climatological data obtained from the National Climatic Data Center/National Oceanic & Atmospheric Administration for the Dallas/Fort Worth International Airport Station. From this data, the worst 30-day period relative to wet bulb temperature occurred between June 1, 1998 and June 30, 1998, with an average wet bulb temperature of 78.0°F. A recirculation penalty of 2 °F was added as margin to give an 80 °F UHS design basis wet bulb temperature.
>
> The UHS cooling tower basin water temperature surveillance requirement (SR 3.7.9.2) that the UHS water temperature is < 93 °F provides margin for the plant operating staff to monitor and verify the UHS temperature is < 95 °F averaged over the previous 24-hour period. This operability limit for the UHS was confirmed by analyses using the 0% exceedance non-coincident wet bulb temperature (83 °F) as given in FSAR Table 2.0-1R, which is the more conservative temperature and provides additional margin. The operator needs only to check the UHS basin temperature to assure UHS heat removal performance. The UHS heat removal capacity depends on the UHS basin temperature and directly affects the CCW heat exchanger, which dominates the plant cooling performance. The period of functionality is based upon the volume of water available, which is verified by basin water level. As such, UHS basin temperature and water level alone provide assurance, in accordance with RG

> 1.27, that the UHS is capable of performing its intended heat removal functions. In accordance with the regulatory guide, an appropriate worst case combination of controlling meteorological parameters were used to confirm the adequacy of the design and neither the design or the Technical Specifications need to address the potential or consequences of exceeding those worst case meteorological parameters. Thus, the impact of exceeding the worst case wet bulb temperature has not been calculated (and the RG does not require that it be calculated) although it is known that increasing wet bulb temperature will decrease the performance of the system. RG 1.27 was confirmed to be implemented in this manner in the Standard Technical Specifications and in the technical specifications for numerous operating plants.
>
> In summary, while 78 °F wet bulb temperature would satisfy the regulatory guide, Luminant added margin and used 80 °F for the 30-day safety analysis of the system and used 83 °F (the 0% exceedance noncoincident wet bulb value) to confirm performance of the system. The conservatism used by Luminant shows that the UHS design has sufficient margin to accommodate postulated future changes in local meteorology.

The staff finds this RAI response acceptable since it adequately describes the relationship between the wet bulb temperature and the design of the UHS basin water temperature to support the indented heat removal functions (DBA). Specifically, the wet bulb of 78 °F (collected meteorological data), wet bulb of 80 °F (+2 °F accounting penalty for recirculation) and 0 percent exceedance of wet bulb 83 °F (a total of 5 °F wet bulb margin), as calculated input to the cooling tower basin maximum water temperate of < 95 °F. TS addresses the UHS basin temperature under SR 3.7.9.2 ($\leq$ 93 °F) and the LCO Action B ($\leq$ 95 °F – averaged over the previous 24 hour period). This operability limit for the UHS is based on analyses using the 0 percent exceedance non-coincident wet bulb temperature (83 °F). Plant operator's need to only check the UHS basin temperature to assure the UHS can support the DBA heat loads. In addition, the applicant has a continuing obligation to ensure that their plants stay within their licensing basis, if in the future the site wet bulb of 83 °F is exceeded. 10 CFR Part 50, Appendix B, Criterion XVI (Corrective Actions), requires licensees to promptly identify and correct conditions adverse to quality. Operation of the plant outside the FSAR specifications constitutes a nonconforming condition and a condition adverse to quality. In summary, based on the above, the staff has determined a specific TS addressing wet bulb temperature is unnecessary and the applicant is within the guidance of RG 1.27. **RAI 6173, Question 09.02.05-17**, **is resolved and closed**.

Related to UHS basin water temperature and the applicant's response to **RAI 3762, Question 09.02.05-14,** the staff found the Bases associated with Action B.1 confusing and in need of clarification. Specifically, TS Actions B.1 which describes the actions required for exceeding 95 °F should describe the reason for the B.1 Action which is due to the UHS basin water temperature exceeding 93 °F, which is addressed under SR 3.7.9.2 and the LCO Bases. For this reason, the staff generated **RAI 6358 Question 09.02.05-24** to address this item.

The applicant responded to **RAI 6358, Question 09.02.05-24** by letter dated June 7, 2012, with the following response.

> A temperature instrument with indication, control, and alarm functions is installed in each UHS basin. The basin water temperature is kept below 93 °F to ensure

that the maximum allowable ESWS and UHS basin temperature of 95 °F is not exceeded during accident conditions.

Technical Specifications LCO and Bases 3.7.9 for Action B.1 were revised to change the 95 °F water temperature of the UHS basin to 93 °F to be consistent with DCD Chapter 16. This change was submitted in letter TXNB-12015 (ADAMS Number ML12159A235 and ML12159A326, "Part 4 Technical Specifications Revision 2") on May 31, 2012.

The staff reviewed the applicant's response to **RAI 6358 Question 09.02.05-23, part 2** and finds the response acceptable. Clarification was provides in TS 3.7.9 which addresses keeping the basin water temperature below 93 °F. The FSAR change provided in ML12159A326 (May 22, 2012) was found acceptable since the 95 °F UHS basin temperature for LCO "B" and "B1 Bases" was replaced with the UHS basin 93 °F temperature. **Question 09.02.05-24, is resolved and closed** since this temperature change to 93 °F has been incorporated into Revision 3 (June 28, 2012) of the COL FSAR.

The staff concludes that the COL applicant has adequately addressed the UHS TS and TS Bases. 10 CFR 50.36(c)(2)(ii) states that a technical specification (TS) limiting condition for operation (LCO) of a nuclear reactor must be established for each item meeting one or more of four listed criteria.

A) *Criterion 1*. Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.

(B) *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.

(C) *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.

(D) *Criterion 4*. A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.

The staff finds that the DCD CDI and COL supplemental information was correctly incorporated, addressing the four part criterion above, into TS 3.7.9 Limited Conditions of Operations (LCO) associated with requiring three UHS cooling towers, three transfer pumps, with adequate water basin temperature and UHS volume, MODES 1,2,3 and 4). DCD CDI and COL supplemental information was also added for Surveillance Requirements (SR) for total basin inventory, basin water temperature, fans, fans automatic starts, UHS transfer manual pump starts, valves positions, and valve automatic features.

Chapter 16 of this SER further addressed the CPNPP3&4 TS and TS Bases.

9.2.5.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.2.5.6 Conclusions

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the site-specific UHS, and there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in Section 9.2.5 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the UHS incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.5 of this SER to reflect the final disposition of the DC application.

The staff evaluated the information pertaining to the UHS provided in FSAR Revision 3 in accordance with the guidance cited in the Section 9.2.5.3, "Regulatory Basis," of this SER. With the exception to **Open Item 09.02.05**-01, the information showed that the UHS as described in FSAR Section 9.2.5 is in compliance with GDCs 2, 4, 5, 44, 45, and 46 and with 10 CFR 20.1406, 10 CFR 52.80, and the guidance referenced in SRP Section 9.2.5. Therefore, based on the applicant's responses to the staff's RAIs, which is being tracked as Confirmatory Items **RAI 6342 Question 03.03.02-09, RAI 6358 Questions 09.02.05-18, 19, 20, 21, 22, 23, 25, and 26, and RAI 6403, Question 14.03.07-38** the staff concludes that the UHS as described in FSAR Section 9.2.5 is acceptable.

9.2.6 Condensate Storage Facilities (Demineralized Water, Condensate Storage, and Primary Makeup Water)

This section of the CPNPP3&4 COL FSAR describes the condensate storage facilities system, which consists primarily of the demineralized water system, the condensate storage and transfer system, and the primary makeup water system.

Section 9.2.6 of the CPNPP3&4 COL FSAR, Revision 3 incorporates by reference, Section 9.2.6, "Condensate Storage Facilities (Demineralized Water, Condensate Storage, and Primary Makeup Water)," of the US-APWR DCD, Revision 3. This section contains supplemental information to a CDI item on the site-specific design of waste water system (WWS). The site-specific design information of WWS included in this section is evaluated in Chapter 12, Sections 12.3 and 12.4 of this SER. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.2.6 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the condensate storage facilities system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.6 of this SER to reflect the final disposition of the DC application design.

9.2.7 Chilled Water System

9.2.7.1 Introduction

This section of the CPNPP3&4 RCOL SER presents the results of the NRC staff's review of FSAR Section 9.2.7, "Chilled Water System." The CWS encompasses two independent closed loop systems; the ECWS and the non-essential chilled water system (non-ECWS).

The ECWS provides, during all plant operating conditions, a heat sink for various safety related air handling units, which are located in the power source building (east and west) and the reactor building. Air handling units that are cooled by the ECWS include those in the penetration area, annulus emergency exhaust filtration unit area, main control room, safeguard component area, Class 1E electrical room, emergency feedwater pump area, CCW pump area, charging pump area, and essential chiller unit area. The ECWS rejects the heat from these air handling units to the essential chiller units. Heat from the essential chiller units is rejected to the ESW system. Each chiller operates on environmentally safe refrigerants with each chiller containing a condenser, evaporator, compression tank, and associated piping and controls.

The non-ECWS provides, during plant normal operation and LOOP, a heat sink for various non-safety-related air handling units. These air handling units include those in the Technical Support Center, Auxiliary Building, and non-Class IE electrical rooms. While the non-ECWS is a non-safety-related system, the non-ECWS containment penetrations, penetration isolation valves and interconnecting piping are safety-related and designed to Seismic Category I specifications.

9.2.7.2 Summary of Application

Section 9.2.7 of the CPNPP3&4 COL FSAR, Revision 3, incorporates by reference, Section 9.2.7, "Chilled Water System," of the US-APWR DCD, Revision 3, with additional supplementary information in FSAR Section 9.2, "Water Systems."

<u>US-APWR COL Information Items</u>

- STD COL 9.2(27)

The applicant provided additional information in CP COL 9.2(27) to address COL Information Item 9.2(27), which states:

> The COL Applicant is to develop a milestone schedule for implementation of the operating and maintenance procedures for water hammer prevention.

<u>Interface Requirements</u>

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, “Significant Site-Specific Interfaces with the Standard US-APWR Design,” identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.2.7 of the DCD.

9.2.7.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission’s regulations for this area of review, i.e., pertaining to site-specific information on the CWS, and the associated acceptance criteria, are specified for the most part in SRP Section 9.2.2, “Reactor Auxiliary Cooling Water System,” Revision 4 – March 2007, and are summarized below. Review interfaces with other SRP sections also can be found in SRP Section 9.2.2.

The applicable regulatory requirements for the CWS are as follows:

1. 10 CFR Part 50, Appendix A, GDC 2, “Design Basis for Protection against Natural Phenomena,” as it relates to the capabilities of structures housing the system and the system itself having the capability to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of safety-related functions.

2. 10 CFR Part 50, Appendix A, GDC 4, “Environmental and Dynamic Effects Design Bases,” as it relates to effects of missiles inside and outside containment, effects of pipe whip, jets, environmental conditions from high- and moderate-energy line-breaks, and dynamic effects of flow instabilities and attendant loads (e.g., water hammer) during normal plant operation, as well as upset or accident conditions.

3. 10 CFR Part 50, Appendix A, GDC 5, “Sharing of Structures, Systems, and Components,” insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be shown that sharing will not significantly impair their ability to perform their safety functions.

4. 10 CFR Part 50, Appendix A, GDC 44, “Cooling Water,” as it relates to the capability to transfer of heat from systems, structures, systems, and components important to safety to an ultimate heat sink during both normal and accident conditions, with suitable redundancy, assuming a single active component failure coincident with either the loss of offsite power or loss of onsite power.

5. 10 CFR Part 50, Appendix A, GDC 45, “Inspection of Cooling Water System,” as it relates to design provisions for in-service inspection of safety-related components and equipment.

6. 10 CFR Part 50, Appendix A, GDC 46, "Testing of Cooling Water System," as it relates to design provisions for pressure and operational functional testing of cooling water systems and components in regard to;
    a. Structural integrity and system leak-tightness of its components
    b. Operability and adequate performance of active system components
    c. Capability of the integrated system to perform credited functions during normal, shutdown, and accident conditions

7. 10 CFR 20.1406(a), which requires an applicant to describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

9.2.7.4 Technical Evaluation

The NRC staff reviewed FSAR, Revision 3, Section 9.2.7, and considered Revision 3 of the referenced DCD. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the CWS.

The staff reviewed the following additional related information in the FSAR:

US-APWR COL Information Items

- STD COL 9.2(27)

The NRC staff reviewed STD COL 9.2(27) in FSAR Section 9.2.7, related to COL Information Item 9.2(27). The applicant replaced the thirteenth (13th) paragraph in DCD Section 9.2.7.2.1 incorporated by reference in FSAR Section 9.2.7.2.1 with the following:

> *The operating and maintenance procedures regarding water hammer are included in system operating procedures in Section 13.5.2.1. A milestone schedule for implementation of the procedures is also included in Subsection 13.5.2.1.*

The reference to FSAR Section 13.5.2.1, "Operating and Emergency Operating Procedures," stated that for system operating procedures, these procedures include instructions for energizing, filling, venting, draining, starting up, shutting down, changing modes of operation, returning to service following testing or maintenance, and other instructions appropriate for operation of systems important to safety.

The staff has determined that the applicant has adequately addressed STD COL 9.2 (27), with the reference to FSAR Section 13.5.2.1, and has adequately addressed the development of procedures to address the prevention of water hammer due to a voided line condition in the CWS for CPNPP3&4. The applicant's supplemental information complies with GDCs 2, 4, 5, 44, 45, and 46, 10 CFR 20.1406, and 10 CFR 52.80.

9.2.7.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.2.7.6 Conclusions

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the CWS, and there is no outstanding information expected to be addressed in the FSAR related to this section.

The staff is reviewing the information in Section 9.2.7 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the CWS incorporated by reference in the FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.7 of this SER to reflect the final disposition of the DC application.

The staff evaluated the information pertaining to the CWS provided in FSAR Revision 3 in accordance with the guidance cited in the Section 9.2.7.3, "Regulatory Basis," of this SER. The information showed that the CWS as described in FSAR Section 9.2.7 is in compliance with GDCs 2, 4, 5, 44, 45, and 46 and with 10 CFR 20.1406 and 10 CFR 52.80, as cited in SRP Section 9.2.7. Therefore, the staff concludes that the CWS as described in FSAR Section 9.2.7 is acceptable.

9.2.8 Turbine Component Cooling Water System

This section of the CPNPP3&4 COL FSAR describes the turbine component cooling water system, which provides chemically treated, demineralized cooling water for the removal of heat from various turbine building heat loads and rejects the heat to the non-essential service water system.

Section 9.2.8 of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.2.8, "Turbine Component Cooling Water System," of the US-APWR DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.2.8 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the turbine component cooling water system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.8 of this SER to reflect the final disposition of the DC application design.

9.2.9 Non-Essential Service Water System

This section of the CPNPP3&4 COL FSAR describes the non-essential service water system, which provides cooling water to remove heat from the turbine component cooling water system.

Section 9.2.9 of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.2.9, "Non-Essential Service Water System," of the US-APWR DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.2.9 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the non-essential service water system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.2.9 of this SER to reflect the final disposition of the DC application design.

9.3 Process Auxiliaries

9.3.1 Compressed Air and Gas Systems

9.3.1.1 Introduction

The purpose of the compressed air and gas systems (CAGS) is to supply compressed air and gas to various plant components. The only system safety function is to support containment isolation. The portions of the CAGS that serve that function are safety-related; other portions of the system are not safety-related. The compressed air system delivers instrument air, service air, and high-pressure air. The instrument air subsystem provides high quality instrument air for plant use. The service air subsystem supplies plant breathing air. The high-pressure air subsystem produces air for high pressure applications.

9.3.1.2 Summary of Application

The FSAR Section 9.3.1 incorporates by reference Section 9.3.1 of DCD Revision 1 without any departures. Section 9.3 of the US-APWR DCD includes subsection 9.3.1, "Compressed Air and Gas Systems."

In addition, in CPNPP3&4 COL FSAR Section 9.3.1, the applicant provided the following:

US-APWR COL Information Item

- STD and CP COL 9.3(1)

The applicant provided additional information in STD and CP COL 9.3(1) to address COL Information Item 9.3(1), which states that the COL Applicant is to provide high- and low-pressure nitrogen gas, hydrogen gas, carbon dioxide, and oxygen supply systems.

9.3.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition the relevant requirements of the Commission's regulations for the information on the CAGS, and the associated acceptance criteria are given in Section 9.3.1 of NUREG-0800.

The applicable regulatory requirements for the site-specific portions of the CAGS are as follows:

1. 10 CFR 50.63, "Loss of all alternating power," as to the ability of the plant to withstand for a specified duration and recover from a station blackout.

2. 10 CFR 52.80(a), which requires that a COL application include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC's regulations.

3. 10 CFR Part 50, Appendix A, GDC 1, as it relates to safety-related SSCs designed, fabricated, and tested to quality standards commensurate with the importance of the safety functions to be performed.

4. 10 CFR Part 50, Appendix A, GDC 2, as it relates to safety-related component cooling systems capability to withstand the effects of earthquakes.

5. 10 CFR Part 50, Appendix A, GDC 5, "as it relates to the sharing of SSCs.

Acceptance criteria adequate to meet the above requirements are:

1. Acceptance for meeting the relevant requirements of 10 CFR 50.63, as it relates to the system design and the ability of the plant to withstand for a specified duration and recover from a station blackout is based on Regulatory Guide (RG) 1.155.

9.3.1.4 Technical Evaluation

The NRC staff reviewed Section 9.3.1 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[4] The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the CAGS. Section 9.3.1 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information, incorporated by reference, related to the CAGS will be documented in the staff safety evaluation report (SER) on the design certification (DC) application for the US-APWR design.

The staff reviewed the information contained in the CPNPP3&4 COL FSAR:

[4] See Section 1.x for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

US-APWR COL Information Items

- STD and CP COL 9.3(1)

The NRC staff reviewed STD and CP COL 9.3(1) related to COL Information Item 9.3(1), included under Section 9.3.1 of the CPNPP3&4 COL FSAR. The applicant provided information on the site-specific gas sources in CPNPP3&4 COL FSAR Sections 9.3.1.2.1.3, 9.3.1.2.2.3, and Figure 9.3.1-201.

The applicant responded to COL 9.3(1) by providing a description of the high pressure nitrogen gas, low pressure nitrogen gas, the hydrogen gas, carbon dioxide, and oxygen supply systems. These systems are described in the DCD as performing no safety related functions, except for their containment isolation function. The containment isolation function is evaluated in Chapter 6, Section 6.2 of this SER. These are equipped with pressure regulation and over pressure protection.

The staff evaluated the system descriptions provided in the response to the COL 9.3(1) and determined that these systems are not safety-related and the failure of these systems will not impact the function of other safety-related components or systems. Based on the discussion above, the staff finds that the design of the high pressure nitrogen gas, low pressure nitrogen gas, the hydrogen gas, carbon dioxide, and oxygen supply systems meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, "Quality Standards and Records," as it relates to safety-related SSCs designed, fabricated, and tested to quality standards commensurate with the importance of the safety functions to be performed, GDC 2, "Design Bases for Protection Against Natural Phenomena," as it relates to safety-related SSCs capability to withstand the effects of Earthquakes, and GDC 5, "Sharing of Structures, Systems, and Components," as to the sharing of safety-related SSCs. Therefore, the staff has determined that the applicant has adequately addressed COL Information Item 9.3(1).

9.3.1.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.3.1.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the site-specific CAGS, and there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in Section 9.3.1 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the CAGS incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.3.1 of this SER to reflect the final disposition of the DC application.

On the basis of its review, the staff concludes that the relevant information presented within Section 9.3.1 of the FSAR is acceptable and meets the requirements of 10 CFR 50.63 and 10 CFR 52.80(a). The staff based its conclusion on the following:

The CP COL 9.3(1), as related to the site-specific source of the various gases used in the CAGS, is acceptable because the information pertaining to the FSAR Section 9.3 is within the scope of the design certification and adequately incorporates by reference Section 9.3.1 of the US-APWR DCD.

9.3.2 Process and Post-Accident Sampling Systems

This section of the CPNPP3&4 COL FSAR describes the process and post-accident sampling systems, which contain equipment to collect representative samples of the various process fluids in a safe and convenient manner.

Section 9.3.2 of the CPNPP3&4 COL FSAR incorporates by reference, Section 9.3.2, “Process and Post-Accident Sampling Systems,” of the US-APWR DCD. This section contains a CDI change on the site-specific design of the waste water system (WWS). This change is evaluated in Section 9.3.3.4 of this SER. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff’s review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.3.2 on Docket Number 52-021. The results of the NRC staff’s technical evaluation of the information related to the process and post-accident sampling systems incorporated by reference in the FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.3.2 of this SER to reflect the final disposition of the DC application design.

9.3.3 Equipment and Floor Drainage Systems

The FSAR Section 9.3.3 describes the equipment and floor drainage systems, which collect liquid waste from equipment and floor drains during all modes of operation and separate the contaminated effluents and transfer them to the processing and disposal systems.

Section 9.3.3 of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.3.3, “Equipment and Floor Drainage Systems,” of the US-APWR DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff’s review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.3.3 on Docket Number 52-021. The results of the NRC staff’s technical evaluation of the information related to the equipment and floor drainage systems incorporated by reference in the CPNPP3&4 FSAR will be documented in the staff SER on the DCD application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.3.3 of this SER to reflect the final disposition of the DCD application design.

9.3.3.1 Introduction

The equipment and floor drainage system collects liquid waste from equipment and floor drains during all modes of operation. The liquid waste is classified and segregated by the type of waste generated. The equipment and floor drainage systems collect liquid waste from equipment and floor drains in the containment vessel (C/V), the auxiliary building (A/B), the reactor building (R/B), the power source building (PS/B), the turbine building (T/B), and the access building (AC/B).

9.3.3.2 Summary of Application

COLA, Revision 3, FSAR Section 9.3.3, “Equipment and Floor Drainage Systems,” incorporates by reference Section 9.3.3, “Equipment and Floor Drainage Systems,” of the US-APWR DCD, Revision 3. In addition, in Section 9.3.3, “Equipment and Floor Drainage Systems,” the applicant provided the following:

US-APWR DCD Site-Specific Interface

The applicant provided additional information to address the site-specific interface from DCD Section 9.3.3, “Equipment and Floor Drainage System.” Table 1.8-1R, “Significant Site-Specific Interfaces with the Standard US-APWR Design,” of the FSAR states that the portions of equipment and floor drainage systems that are outside the US-APWR standard plant design buildings are conceptual design information (CDI). This includes the discharge path to the waste water system. The waste water system used for processing effluent from the systems is a site-specific design and is not part of the standard design.

9.3.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD. In addition, the relevant requirements of the Commission's regulations for the drainage system, and the associated acceptance criteria, are given in Section 9.3.3, "Equipment and Floor Drainage System," of NUREG-0800.

The applicable regulatory requirements for the FSAR-specific items described above are as follows:

- GDC 60, "Control of Releases of Radioactive Material to the Environment," as to suitable control of the release of radioactive materials in liquid effluent during normal operation, including anticipated operational occurrences. This criterion applies as the equipment and floor drainage system usually consists of two subsystems, radioactive and nonradioactive.

9.3.3.4 Technical Evaluation

Section 9.3.3 of the US-APWR DCD, Revision 3, provides information regarding the design of the drainage system within the various buildings and contains CDI requesting the COL applicant to provide the site-specific design of the waste water system (WWS). The CPNPP3&4 site-specific portions includes the discharge path to the waste water system. The waste water system used for processing effluent from the systems is a site-specific design and is not part of the standard design. The staff's technical evaluation below is limited to a review of this site-specific supplemental information.

The WWS is used to collect non-radioactive liquid waste from the T/B drain system prior to discharge to the environment. To address the CDI, the applicant has provided a site-specific design where the non-radioactive T/B drain system discharges into an existing waste water management Pond C, prior to discharge to the Squaw Creek Reservoir (SCR). The WWS portion of the drainage system has no safety-related function and, therefore, no nuclear safety design basis.

In order to meet GDC 60, the equipment and floor drains must be designed to control the release of radioactive material in liquid effluent by preventing the inadvertent transfer of contaminated fluids to a non-contaminated drainage system for disposal. As indicated in DCD Section 9.3.3, the T/B drain system discharges into either the Liquid Waste Management System (LWMS) or the WWS. The T/B drain sump collects drainage from all equipment and floor drains in the T/B and non-radioactive drain sump. In the COL applicant design, this sump normally discharges to the existing waste water management Pond C. In the unlikely event that the fluid becomes radioactive, waste is sent to the LWMS. Based on the non-radioactive liquid waste being sent to the existing waste water management Pond C and the proper monitoring and control of the discharge of radioactive fluid, the staff finds that GDC 60 is met.

Section 11.2, "Liquid Waste Management System," of the FSAR provides additional details on the flow path and treatment of the drainage from the various sumps discharging into SCR via the CPNPP exiting waste water management Pond C.

9.3.3.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.3.3.6 Conclusions

The staff is reviewing the information in DCD Section 9.3.3 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the equipment and floor drainage system incorporated by reference in the Comanche Peak COL FSAR will be documented in the staff safety evaluation report on the design certification application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.3.3 of this SER to reflect the final disposition of the design certification application.

The staff finds that the site-specific WWS design meets GDC 60, based on the non-radioactive liquid waste being sent to the existing waste water management Pond C and having proper monitoring and control of the potential for radioactive fluid discharge.

9.3.4 Chemical and Volume Control System

This section of the CPNPP3&4 COL FSAR describes the chemical and volume control system (CVCS), which performs a number of functions, including maintaining the coolant inventory in the reactor coolant system (RCS) for all modes of operation, regulating the boron concentration in the reactor coolant during normal operation, and providing makeup capability for small RCS leaks.

9.3.4.1 Summary of Application

The COLA Revision 3, FSAR Section 9.3.4, "Chemical and Volume and Control System," incorporates by reference Section 9.3.4, "Chemical and Volume and Control System," of the US-APWR DCD, Revision 3. In addition, in Section 9.3.3, "Equipment and Floor Drainage Systems," the applicant provided the following supplemental information:

US-APWR COL Supplemental Information

- CP SUP 9.3(1)

The applicant provided supplemental information that described the Zinc injection system.

Interface Requirements

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.3.4 of the DCD.

9.3.4.2 Technical Evaluation

The NRC staff reviewed Section 9.3.4 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic. The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the CVS. Section 9.3.4 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information, incorporated by reference, will be documented in the staff SER on the DC application for the US-APWR design.

The staff reviewed the information contained in the CPNPP3&4 COL FSAR:

US-APWR COL Supplemental Information Item

- CP SUP COL 9.3(1)

The applicant responded to COL SUP 9.3(1) by providing a description of the injection of Zinc compound into the primary system. The zinc compound is injected into the primary system in order to reduce operational radiation exposure within the primary system. This injection system consists of a tank, pumps, piping, a check valve, and a manual isolation valve. This system maintains a target zinc concentration of 5 parts per billion (ppb) with a limiting value of 10 ppb.

The applicant's zinc injection system is evaluated in Chapter 12, Section 12.3 of this SER. In addition, the staff found that the applicant's zinc injection system does not affect the staff's technical evaluation of the CVS.

9.3.4.3 Post-Combined License Activities

There are no post-COL activities related to this section.

9.3.4.4 Conclusions

The staff is reviewing the information in DCD Section 9.3.4 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the CVCS incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.3.4 of this SER to reflect the final disposition of the DC application design.

9.4 Air Conditioning, Heating, Cooling, and Ventilation Systems

Section 9.4 of this SER presents the results of the NRC staff's evaluation of the heating, ventilation, and air conditioning (HVAC) systems serving the plant during normal and emergency conditions including station blackout (SBO). These HVAC systems are designed to provide a suitable environment for plant equipment and personnel. Ventilation zones, air distribution, and airflow migration are configured and arranged so that the ventilation air is drawn from the clean areas to areas of potentially greater radioactive contamination to a final filtration and exhaust systems discharging to the plant vent stack. These systems include the following:

- Main Control Room HVAC system;
- Spent Fuel Pool Area Ventilation system;

- Auxiliary Building Ventilation system;
- Turbine Building Area Ventilation system;
- Engineered Safety Feature Ventilation system; and
- Containment Ventilation system.

9.4.1 Main Control Room Heating, Ventilation, and Air Conditioning System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.4.1, "Control Room Area Ventilation System")

9.4.1.1 Introduction

The US-APWR Main Control Room HVAC System design provides the proper environment in the MCR and other areas within the MCR envelope (MCRE). The MCRE consists of the MCR, operator area, shift supervisor office, clerk room, tagging room, toilet, and kitchen. This MCR HVAC system enables control room operators to remain safely inside the MCRE and take actions necessary to manage and control the plant under normal and abnormal plant conditions, including a LOCA and SBO.

The system consists of two redundant 100-percent-capacity emergency filtration units and four 50-percent-capacity air handling units, two 100-percent-capacity toilet/kitchen exhaust fans, one 100-percent-capacity smoke purge fan, ductwork, associated dampers and instrumentation and control. The air handling units connect to a common overhead air distribution ductwork system. The MCR HVAC system is capable of operating in the normal, emergency pressurization, emergency isolation, and emergency smoke purge operation modes.

9.4.1.2 Summary of Application

The FSAR Section 9.4, Revision 3, which includes Section 9.4.1, incorporates by reference Section 9.4.1 of the US-APWR DCD, Revision 3.

In addition, in CPNPP3&4 COL FSAR Section 9.4.1, the applicant provided the following:

<u>US-APWR COL Information Item</u>

- CP COL 9.4(4)/STD COL 9.4(4)

The applicant provided additional information in CP COL 9.4(4) to address COL Information Item 9.4(4), which states:

> The COL Applicant is to determine the capacity of cooling and heating coils that are affected by site-specific conditions.

For DCD Section 9.4.1.2, the COL applicant provided additional information with CP COL 9.4(4) / STD COL 9.4(4). For FSAR Section, 9.4.1.2 the sentence "*The capacity of heating coils that* *are affected by site-specific conditions is shown in Table 9.4-201."* will replace the relevant sentence in DCD Section 9.4.1.2 that assigns this responsibility to the COL applicant. The COL applicant included the heating coil capacity of 40kW for the MCR air handling unit in FSAR Table 9.4-201, "Equipment Design Data."

Interface Requirements

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.4.1 of the DCD.

9.4.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission regulations for the information on the MCR HVAC, and the associated acceptance criteria are given in Section 9.4.1 of NUREG-0800.

The applicable regulatory requirements for the site-specific information of the MCR HVAC system are as follows:

1. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to the control room area ventilation system (CRAVS) being appropriately protected against dynamic effects and being designed to accommodate the effects of, and to be compatible with, the environmental conditions of normal operation, maintenance, testing, and postulated accidents. The GDC 4 evaluation includes the adequacy of environmental support for safety-related SSCs within areas served by the CRAVS.

2. 10 CFR 50.63, as it relates to necessary support systems providing sufficient capacity and capability to ensure the capability for coping with an SBO event. An analysis to determine capability for withstanding (if an acceptable alternate alternating current [ac] source is provided) or coping with an SBO event is required. The analysis should address, as appropriate, the potential failures of equipment/systems during the event (e.g., loss or degraded operability of HVAC systems, including the CRAVS, as appropriate), the expected environmental conditions associated with the event, the operability and reliability of equipment necessary to cope with the event under the expected environmental conditions, and the habitability of plant areas requiring operator access during the event and associated recovery period.

3. 10 CFR 52.80(a), which requires that a COL application include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC regulations.

Acceptance criteria adequate to meet the above requirements are:

1. Information addressing the requirements of 10 CFR 50.63 will be considered acceptable if the guidance of Regulatory Guide (RG) 1.155; including Position C.3.2.4 is applied appropriately.

2. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007

3. The safety-related portions of the system are reviewed with respect to the following:
   a. The functional performance requirements to maintain the habitability of the control room area and other safety-related areas served by the CRAVS during adverse environmental occurrences, normal operation, anticipated operational occurrences, and subsequent to postulated accidents. The review includes the effects of radiation, combustion, other toxic products and the coincidental LOOP.
   b. The ability of the MCR HVAC subsystems to maintain a suitable ambient temperature for MCR personnel and equipment.
   c. The expected environmental conditions in areas served by the CRAVS and the extent, if any, to which the CRAVS is relied upon to function for a SBO event.

9.4.1.4 Technical Evaluation

The NRC staff reviewed Section 9.4.1 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[5] The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the MCR HVAC system. Section 9.4.1 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information, incorporated by reference, related to the MCR HVAC system will be documented in the staff SER on the DC application for the US-APWR design.

The staff reviewed the information contained in the CPNPP3&4 COL FSAR:

US-APWR COL Information Items

- CP COL 9.4(4)

The NRC staff reviewed CP COL 9.4(4) related to COL Information Item 9.4(4), included under Section 9.4.1 of the FSAR. The applicant provided information regarding the site-specific capacities of heating and cooling coils of the system in FSAR Section 9.4.1.2 and FSAR Table 9.4-201.

The staff noted that COL Information Item 9.4(4) reads, "*The COL Applicant is to determine the capacity of cooling and heating coils provided in the air handling units that are affected by site-specific conditions.*" In contrast, the relevant sentence (i.e., second sentence of the first paragraph) in DCD Section 9.4.1.2 reads, "*The COL Applicant is to determine the capacity of*

[5] See Chapter 1 for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

heating coils that are affected by site-specific conditions." As a point of record, the staff notes that the sentence in DCD subsection 9.4.1.2 is accurate in that DCD Table 9.4.1-1, "Equipment Design Data," already contains the requisite cooling capacity in Btu/hr for the four MCR air handling units. Therefore, the COL applicant is correct in providing only a heating coil capacity for the MCR air handling units in FSAR Table 9.4-201 "Equipment Design Data."

The staff reviewed FSAR Sections 9.4.1.2, "System Description," and 9.4.7, "Combined License Information," and FSAR Table 9.4-201 against the relevant passages of SRP Section 9.4.1. From its review, the staff determined the heaters are to be procured as and installed in CPNPP3&4, per the criteria of DCD Table 3.2-2, "Classification of Mechanical and Fluid Systems, Components, and Equipment." More specifically, the heaters are Equipment Class 3, Seismic Category I, and are subject to the requirements of 10 CFR Part 50, Appendix B.

The DCD Table 8.3.1-7, "Electrical Load Distribution - Class 1E MCC Loads," shows that the rated output of the motor control centers (MCCs) is 46 kilowatts (kW). FSAR Table 9.4-201 specifies a heating element capacity of 40 kW (ML103060043) for all four trains (i.e., A, B, C, and D). Class 1E divisional power supplies will be evaluated in Section 8.3 of this SER.

The staff noted during its review that the COL applicant did not include a new reference for FSAR Section 9.4.8 that would provide the bases and calculation for the sizing of the heaters (i.e., 40 kW) for the MCR air handling units.

The SRP 9.4.1, Section IV, "Evaluation Findings," creates the expectation that the staff will perform confirmatory calculations on a select basis to provide reasonable assurance of the plant's overall integrity with respect to safety-related component design. Specifically, Section IV.1.C reads:

> "Using calculational methods for [what was evaluated] that have been previously reviewed by the staff and found acceptable; the staff has reviewed the impact parameters in this case and found them suitably conservative or has performed independent calculations to verify acceptability of their analysis."

The staff notes that the "Technical Rationale" section of SRP 9.4.1 provides the reasoning behind the acceptance criteria contained in the SRP.

Based on the referenced technical rationale, in **RAI 3219, Question No. 09.04.01-01**, the staff requested that the applicant provide the basis for the sizing of the heaters and the design-basis MCR temperature that the heaters are designed to maintain. The staff requested that the applicant include these design bases in the FSAR. To facilitate confirmatory calculations, the staff requested that the applicant provide the inputs to the design calculations used in the derivation of the heating coil capacity value for the heater of the four MCR air handling units (AHU).

In its response dated October 30, 2009 (ML093090163), the applicant responded with the basic equation it used and the parameters used to derive the kilowatt sizing of each AHU heater. The applicant based this calculation on an outside air temperature of -0.5ºF based on the historical limit excluding 2 hour peaks from FSAR Table 2.0-1R. The applicant amended this response (ML103060043) with a recalculated heater size based on outside air temperature of -5ºF based on the more conservative "100-year return period." This revision of FSAR Table 2.0-1R data was driven by the applicant's response to **RAI 4606, Question 02.03.01-06** (ML102780284). The applicant agreed to revise FSAR Table 9.4-201 to list the heating coil [element] capacity of the MCR AHUs as 40kW each. The staff verified that Table 9.4-201 of Revision 2 of the RCOLA FSAR reflected a 40 kW heating coil capacity for each MCR AHU.

The staff evaluated the information presented in the RAI responses and concluded that the methodology used to derive the kilowatt sizing of each AHU heater was reasonable.

However, it was not obvious or verifiable from the data presented in the RAI responses, that the resultant temperature from mixing the two air streams of 18,000 cubic feet per minute (cfm) returning from the control room with 1800 cfm of fresh outside air was accurate. The derivation of this parameter is a key factor in determining the integrity of the heater sizing calculations. The staff also noted that the applicant failed in its response to **RAI 3219 Question 09.04.01-1** to amend FSAR section 9.4.1.2 to reflect the design basis of the heaters (i.e., a change of the outside air temperature from -0.5ºF to -5.0ºF). Based on these residual concerns the staff issued **RAI 5598, Question 09.04.01-03**. In its response dated April 13, 2011 (ML11104A053), the applicant provided sufficient supplemental information to allow the staff to determine the integrity of the support calculation. Also in Revision 2 of the FSAR, the applicant changed FSAR Section 9.4.1.2 to reflect the more conservative outside air temperature value of -5.0ºF. Based on the applicant's response to **RAI 5598, Question 09.04.01-3**, and based on the existence of ITAAC Item 4 in DCD Tier 1, Table 2.7.5.1-3, which ensures the MCR HVAC system will satisfy its safety-related design basis with respect to maintaining MCRE temperatures, the staff did not believe that a formal audit of the applicant's calculation 4CS-CP34-20110004 was warranted. The staff found the applicant's response to **RAI 5598, Question 09.04.01-3** acceptable. Therefore, **RAI 3219, Question 09.04.01-01, and RAI 5598, Question 09.04.01-03 are resolved and closed.**

Item 2.C of SRP Section 9.4.1, Section III, "Review Procedures," pertains to the subject of functional testing of system components important to safety. The staff found that neither FSAR Section 9.4 nor DCD Section 9.4.1.4, "Inspection and Testing Requirements," contained any type of testing or inspections of the MCR AHU heaters for demonstrating/maintaining their operability.

Stating in **RAI 3219, Question 09.04.01-02,** that each AHU heater is safety-related; is of significant size (i.e., 40kW) and performs a significant safety-related function, the staff requested that the applicant include a site-specific ITAAC in Tier 1, Section 2.7.5.1, "Main Control Room HVAC System," to demonstrate adequate sizing of the AHU heaters. In its response dated October 30, 2009 (ML093090163), the applicant stated that in the response to DCD **RAI 184, Question 14.03.07-26**, (ML091040177), MHI, the US-APWR DC applicant, pointed out that ITAAC Item 4.a in DCD Tier 1, Table 2.7.5.1-3, requires tests and analyses to verify the as-built MCR HVAC system is capable of maintaining the control room envelope (CRE) within design limits for temperature and relative humidity during all plant operating conditions, including normal plant operations, abnormal and accident conditions. The applicant concluded and the staff concurred that this amendment of ITAAC Item 4a would include demonstrating heater performance as well.

Also in **RAI Question No. 09.04.01-02**, the staff requested that the applicant provide an update of Preoperational Test 14.2.12.1.101, "MCR HVAC System Preoperational Test (including MCR Habitability)," to reflect the addition of these AHU heaters to the US-APWR plant. **In its response to RAI Question No. 09.04.01-02**, dated October 30, 2009, the applicant responded that Preoperational Test 14.2.12.1.101 had been significantly modified per MHI's response to DCD **RAI 33, Question 14.02-82**, (ML082520230). The modified preoperational test abstract verifies performance of heater coils in Test Method Item C.12. The staff notes that the heaters referred to in Test Method Item C.12 and tested per RG 1.52 are those heaters contained in the ESF filter train and not the heaters for the MCR air handling units. However, since the operational integrity of the AHU heaters will be demonstrated with ITAAC Item 4a, there is no need to further enhance Preoperational Test 14.2.12.101.

The staff found acceptable both parts of the applicant's response in that the applicant has satisfied the guidance of Item 2.C of SRP Section 9.4.1, Section III, "Review Procedures." Based on this**, RAI 3219, Question No. 09.04.01-02 is resolved and closed.**

9.4.1.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.4.1.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the MCR HVAC system, and there is no outstanding information expected to be addressed in the FSAR related to this section.

The staff is reviewing the information in Section 9.4.1 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the MCR HVAC system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.4.1 of this SER to reflect the final disposition of the DC application.

In addition, the staff concludes that the relevant information presented within FSAR Section 9.4.1 is acceptable and meets the applicable requirements of 10 CFR 50.63 and 10 CFR 52.80(a). The staff based its conclusion on the following:

The applicant's response to CP COL 9.4(4), as related to information on the capacities of cooling and heating coils affected by site-specific conditions is acceptable because the FSAR changes as described in Section 9.4.1, of this SER satisfy: (1) CP COL 9.4(4) and US-APWR COL 9.4(4); (2) RG 1.206, Section C.I.9.4.1, "Control Room Ventilation System;" and (3) SRP Section 9.4.1

9.4.2 SPENT FUEL POOL AREA VENTILATION SYSTEM (Related to RG 1.206, Section C.I.9.4.2, Spent Fuel Pool Area Ventilation System)

Section 9.4 of the FSAR, Revision 3 incorporates by reference, with no departures or supplements, subsection 9.4.2, "Spent Fuel Pool Area Ventilation System," of Revision 3 of the US-APWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The staff's review confirmed that there is no outstanding issue related to this subsection.

The staff is reviewing the information in DCD Section 9.4 on Docket Number 52-021. The results of the staff's technical evaluation of the information related to the "Spent Fuel Pool Area Ventilation System," incorporated by reference in the FSAR, will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.4 of this SER to reflect the final disposition of the design certification application.

9.4.3 Auxiliary Building Ventilation System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.4.3, "Auxiliary and Radwaste Area Ventilation System")

9.4.3.1 Introduction

The A/B ventilation system (ABVS) provides proper environmental conditions during normal plant operation throughout all areas of the A/B, R/B, PS/B, and AC/B, except for the main control room envelope (MCRE) discussed in Section 9.4.1, and Class 1E electrical rooms discussed in Section 9.4.5, "Engineered Safety Feature Ventilation System." With the exception of the isolation dampers, the ABVS is a non-safety-related system. The ABVS includes the following:

- Auxiliary building HVAC system;
- Non-Class 1E electrical room HVAC system;
- Main steam/feed water piping area HVAC system; and
- Technical support center (TSC) HVAC system.

The ABVS is classified as a non-safety-related, non-Seismic Category I system, with the exception of isolation damper assemblies. The safety-related, Seismic Category I isolation dampers close during a design-basis accident. Also, the design of the system's duct work supports will prevent adverse interaction with other safety-related systems during seismic events.

9.4.3.2 Summary of Application

FSAR Section 9.4, Revision 3 incorporates by reference subsection 9.4.3, "Auxiliary Building Ventilation System," of Revision 3 of the US-APWR DCD.

In FSAR Section 9.4, the COL applicant provided the following:

US-APWR COL Information Items

- STD COL 9.4(4)

The applicant provided additional information in STD COL 9.4(4) to address COL Information Item 9.4(4), which states:

> The COL Applicant is to determine the capacity of cooling and heating coils that are affected by site-specific conditions.

For the following subsections:

- 9.4.3.2.1 Auxiliary Building HVAC system;
- 9.4.3.2.2 Non-Class 1E Electrical Room HVAC system;
- 9.4.3.2.3 Main Steam / Feed water Piping Area HVAC system; and
- 9.4.3.2.4 Technical Support Center HVAC system.

The applicant provided additional information with STD COL 9.4(4). For subsections 9.4.3.2.1, 9.4.3.2.2 9.4.3.2.3 and 9.4.3.2.4 in the application, the sentence "*The capacity of cooling and heating coils that are affected by site-specific conditions is shown in Table 9.4-201.*" will replace relevant sentence in the DCD subsection that assigns this responsibility to the COL applicant.

The applicant included in Table 9.4-201 "Equipment Design Data" the cooling coil capacity of 9,200,000 Btu/hr and the heating coil capacity of 4,750,000 Btu/hr (Steam) for the Auxiliary Building Air Handling Unit.

The applicant included in Table 9.4-201 "Equipment Design Data," the cooling coil capacity of 1,330,000 Btu/hr for the Non-Class 1E Electrical Room Air Handling Unit.

The applicant included in Table 9.4-201 "Equipment Design Data," the cooling coil capacity of 450,000 Btu/hr and the heating coil capacity of 9 kW for the Main Steam/Feedwater Piping Area Air Handling Unit.

The applicant included in Table 9.4-201 "Equipment Design Data," the cooling coil capacity of 550,000 Btu/hr and the heating coil capacity of 30 kW for the Technical Support Center Air Handling Unit.

Interface Requirements

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.4.3 of the DCD.

9.4.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission regulations for the information on the A/B ventilation system, and the associated acceptance criteria are given in Section 9.4.3 of NUREG-0800.

The applicable regulatory requirements for the site-specific information on the A/B ventilation system are as follows:

1. 10 CFR 52.80(a), which requires that a COL application include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that

the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC regulations.

9.4.3.4 Technical Evaluation

The NRC staff reviewed Section 9.4.3 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[6] The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the A/B ventilation system. Section 9.4.3 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information, incorporated by reference, related to the A/B ventilation system will be documented in the staff SER on the DC application for the US-APWR design.

The staff reviewed the COL information relating to FSAR Section 9.4.3:

US-APWR COL Information Items

- STD COL 9.4(4)

The NRC staff reviewed STD COL 9.4(4) related to COL Information Item 9.4(4), included under Section 9.4.3 of the CPNPP3&4 COL FSAR. The applicant provided information regarding the site-specific capacities of heating and cooling coils of the air handling units (AHUs) of the A/B ventilation subsystems in CPNPP3&4 COL FSAR Sections 9.4.3.2.1, 9.4.3.2.2, 9.4.3.2.3, and 9.4.3.2.4 and Table 9.4-201.

The staff has determined from their review that the function of the auxiliary building ventilation system's heating and cooling coils is non-safety-related.

To satisfy the requirements of STD COL 9.4(4), the FSAR amends DCD Subsections 9.4.3.2.1, 9.4.3.2.2, 9.4.3.2.3, 9.4.3.2.4, and 9.4.7 and adds Table 9.4-201 to accommodate the site-specific needs of CPNPP3&4.

The staff notes that the heating coils and cooling coils of the A/B ventilation system air handling units as defined in DCD Table 3.2-2 are classified as "NS" (i.e. non-Seismic). The sizing of the coils by the COL applicant per the requirements of CP COL 9.4(4) does not affect this classification.

The DCD Table 9.4-1, "Area Design Temperature and Relative Humidity," defines the minimum and maximum temperatures and the minimum and maximum humidity (if applicable) of the areas served by the auxiliary building ventilation system. The function of the heating coils and the cooling coils of the auxiliary building ventilation system is to maintain the temperature and the humidity in these areas within these minimum and maximum values. Neither the heating function nor the cooling function is safety related.

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[6] See Section 1.x for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

To satisfy the requirements of 10 CFR Part 20 and to preclude unmonitored plant releases, the COL FSAR via STD COL 9.4(7) amends DCD subsection 9.4.3.4.1 for CPNPP 3&4.

In addition, for subsection 9.4.3.2.2 "Non-Class 1E Electrical Room HVAC System," in the application the second sentence of the second paragraph will be replaced with the words "Each air handling unit consists of, in the direction of airflow, a low efficiency pre-filter, a high efficiency filter, a chilled water cooling coil, a supply fan, and associated controls."

The staff notes that FSAR subsection 9.4.3.2.2 has been given the tag "STD COL 9.4.4." The staff notes that the changes to the second sentence of the second paragraph, as captured in the paragraph above, would be site-specific since subsequent COLAs may have the need for heating coils to be installed in the air handling units of the Non-Class 1E Electrical Room HVAC System. More specifically, FSAR subsection 9.4.3.2.2, should be tagged CP COL 9.4(4). To correct this error the staff, in **RAI 6898, Question 09.04.05-27,** requested that Luminant confirm whether the response to the COL information item should be standard or site specific. In its letter (ML12355A029) dated December 18, 2012, the applicant responded and agreed that the second part of subsection 9.4.3.2.2, should be labeled CP COL 9.4.4. The applicant provided a change to the FSAR as part of the response that resolved the staff's concern. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP3&4 COL FSAR. The status of **RAI 6898, Question 09.04.05-27** is now listed as a **Confirmatory Item.**

In **RAI 3225, Question 09.04.03-01**, the staff requested, consistent with the requirement of STD COL 9.4(4) that the applicant provide the size of the in-duct heaters and provide a basis for determining the sizing. The applicant responded on October 19, 2009 (ML093370112), COL Item 9.4(4) requires the capacity of cooling and heating coils that are major components, which include the heating coils installed in air handling units and locally-installed safety-related heating coils. The applicant concluded that the in-duct heaters are neither major components nor safety related and therefore it was not necessary to provide in the FSAR the size of the in-duct heaters and the basis for determining the sizing. The staff found the applicant's answer as acceptable because of the non-safety status of the in-duct heaters. Furthermore, the DCD applicant has agreed to add an ITAAC Item 9 (Reference **RAI 483-3885, Question No. 09.04.03-8**, ML100480086) to DCD Tier 1, Table 2.7.5.4-3 that will ensure the installed auxiliary building ventilation system will maintain design temperature limits for areas housing safety related components during normal operations. The staff verified that Revision 3 of DCD Tier 1, Table 2.7.5.4-3 contained ITAAC Item 9. Based on this, **RAI 3225, Question 09.04.03-01, is resolved and closed.**

The staff has determined from their review of the FSAR changes described in subsection 9.4.3.2 "Summary of Application" of this SER, that the applicant's supplemental information has adequately addressed STD COL 9.4(4) and US-APWR COL 9.4(4).

- CP and STD COL Information Item 9.4(7) (Nonexistent in US-APWR DCD, Revision 3)

The staff notes that there is no US-APWR COL 9.4(7) in Revision 3 of the US-APWR DCD; however, MHI's response in part (1) of **DCD RAI 831-6030, Question 09.04.03-19,** (ML12031A245) indicates that the following will be added to the DCD:

US-APWR COL 9.4(7) states: *"The COL Applicant is to determine the frequency of performance of periodic auxiliary building HVAC system ventilation flow balancing"*

In support of this requirement, the COL FSAR, Revision 3, Section 9.4.3.4.1 states:

STD COL 9.4(7) *"Frequency of performance of periodic auxiliary building HVAC system ventilation flow balancing."*

The staff reviewed STD COL 9.4(7) related to the frequency of performance of periodic system ventilation flow balancing included under FSAR Section 9.4.3.4.1., which replaces the last sentence of DCD Subsection 9.4.3.4.1, with the following:

> *"The operating and maintenance procedures regarding the frequency of performance of periodic auxiliary building HVAC system ventilation flow balancing are included in system operating procedures in Subsection 13.5.2.1. A milestone schedule for implementation of procedures is also included in Subsection 13.5.2.1."*

Upon review of the substitute sentences and FSAR subsection 13.5.2.1, the staff determined that the COL applicant has provided the information necessary for fulfilling the requirements of STD COL 9.4.(7) and US-APWR COL 9.4(7).

9.4.3.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.4.3.6 Conclusions

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the A/B ventilation system, including: (a) the sizing of the auxiliary building ventilation system's heating and cooling coils and (b) periodic flow balancing of the auxiliary building HVAC ventilation system to preclude an unmonitored release. The staff further confirmed that there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in Section 9.4.3 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the A/B ventilation system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.4.3 of this SER to reflect the final disposition of the DC application.

In addition, the staff concludes that the relevant information presented in FSAR Section 9.4.3 is acceptable and satisfies the guidance of RG 1.206, C.I.9.4.3.1 "Auxiliary and Radwaste Area Ventilation System." From their review the staff has determined, with the exception discussed below, that the FSAR changes as described in Subsection 9.4.3.2 "Summary of Application" of this SER satisfy: (a) / STD COL 9.4(4) and US-APWR COL 9.4(4); (b) STD COL 9.4.(7) and US-APWR COL 9.4(7); (c) RG 1.206, Section C.I.9.4.3, Auxiliary and Radwaste Area Ventilation System; and (d) SRP 9.4.3.

This exception mentioned above is being tracked as a Confirmatory Item and pertains to the inappropriate use of STD COL 9.4.4 against FSAR Section 9.4.3.2.2.

The Confirmatory Item is as follows:

- **CONFIRMATORY ITEM – RAI 6898, Question 09.04.05-27**.

As a result of Confirmatory Item 09.04.05-27 in Subsection 9.4.3.4 of this SER, the staff is unable to finalize its conclusions on CP COL 9.4(4) / STD 9.4(4) *"Information of UHS ESW pump house ventilation system,"* in accordance with the requirements of NRC associated acceptance criteria as given in Section 9.4.3 of NUREG-0800 and 10 CFR 52.80(a).

The staff concludes that additions to the FSAR as described in subsection 9.4.3.2 "Summary of Application," of this SER affect non-safety related SSCs.

9.4.4 Turbine Building Area Ventilation System (Related to RG 1.206, Section C.I.9.4.4, Turbine Building Area Ventilation System)

This section of the CPNPP3&4 COL FSAR describes the turbine building area ventilation system, which maintains a suitable environment for the operation of equipment in the turbine building.

Section 9.4.4 of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.4.4, "Turbine Building Area Ventilation System," of the US-APWR DCD, Revision 3. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.4.4 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the turbine building area ventilation system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.4.4 of this SER to reflect the final disposition of the DC application design.

9.4.5 Engineered Safety Feature Ventilation System

9.4.5.1 Introduction

The design of the engineered safety feature (ESF) ventilation system will provide the proper environmental conditions within plant areas that house engineered safety feature equipment. The system function is to support and assure the safe and continuous operation of the ESF equipment during normal and emergency operating conditions. .

The ESF ventilation system includes:

- Annulus Emergency Exhaust system ;
- Class 1E Electrical Room HVAC system;
- Safeguard Component Area HVAC system;
- Emergency Feedwater Pump Area HVAC system;
- Safety Related Component Area HVAC system; and
- UHS ESW Pump House Ventilation system.

The design of the ESF ventilation system satisfies the following design bases:

- The ESF ventilation system is classified as a safety-related and Seismic Category I system.
- Separate safety related buses power the redundant ventilation systems such that a failure of a single active component cannot result in loss of cooling for the served areas.
- The system is capable of performing the intended design functions assuming a single active component failure coincident with a loss of offsite power (LOOP).
- The system can withstand the effects of adverse environmental conditions.
- The system can withstand the effects of tornado depressurization and tornado-generated missiles.

9.4.5.2 Summary of Application

Section 9.4.5 of the CPNPP3&4 COL FSAR, Revision 3, incorporates by reference Section 9.4.5 of the US-APWR DCD, Revision 3.

In addition, in CPNPP3&4 COL FSAR Section 9.4.5, the applicant provided the following:

US-APWR COL Information Items

- STD and CP COL 9.4(4)

The applicant provided additional information in STD/CP COL 9.4(4) to address COL Information Item 9.4(4), which states:

> The COL Applicant is to determine the capacity of cooling and heating coils that are affected by site-specific conditions.

- STD and CP COL 9.4(6)

The applicant provided additional information in STD/CP COL 9.4(6) to address COL Information Item 9.4(6), which states:

> The COL Applicant is to provide a system information and flow diagram on ESW pump area ventilation system if the ESW pump area requires the heating, ventilating, and air conditioning.

For the following subsections:

- 9.4.5.2.2 Class 1E Electrical Room HVAC system;

- 9.4.5.2.3 Safeguard Component Area HVAC system;
- 9.4.5.2.4 Emergency Feedwater Pump Area HVAC system; and
- 9.4.5.2.5 Safety Related Component Area HVAC system.

The COL applicant provided additional information with CP COL 9.4(4) / STD COL 9.4(4). For subsections 9.4.5.2.2, 9.4.5.2.3, 9.4.5.2.4 and 9.4.5.2.5 in the application, the sentence: "*The capacity of heating coils that are affected by site-specific conditions is shown in Table 9.4-201."* will replace relevant sentence in the DCD subsection that assigns this responsibility to the COL applicant. For the four Class 1E Electrical Room Air Handling Units, the COL applicant listed in Table 9.4-201 "Equipment Design Data," the heating coil capacities of 45 kW for the A and B Trains and of 65 kW for the C and D Trains**.** These air handling unit (AHU) heaters are supplemented with the following in-duct heaters of capacities specified below and as displayed in Table 9.4-201 "Equipment Design Data":

- For the Class 1E I&C Room In-duct Heaters (2 total), Train A, D – 18kW;
- For the Class 1E I&C Room In-duct Heaters (2 total), Train B, C – 16.3kW;
- For the MCR/Class 1E Electrical HVAC Equipment Room In-duct Heaters (2 total), Train B & Train C – 2.2kW;
- Remote Shutdown Console Room In-duct Heaters (2 total), one from Train A,B and one from Train C,D – 10.9kW; and
- Class 1E Battery Room In-duct Heaters (4 total) – 3.2 kW.

The COL applicant added after DCD subsection 9.4.5.1.1.5 the safety design bases of the ESF Ventilation System, subsection 9.4.5.1.1.6 "UHS ESW Pump House Ventilation System," which reads:

> The UHS ESW pump house ventilation system provides and maintains the proper environmental conditions within the required temperature range of 40°F – 120°F to support the operation of the instrumentation and control equipment and components in the individual UHS ESW pump houses during normal operations, a design basis accident and LOOP. The ventilation system is designed based on the outside ambient design temperature conditions (-5°F – 115°F) using 100-year return period temperature values.
>
> The ESWP is installed at a location in the pump house where cooling air is adequately being circulated for cooling the ESWP motor.

The COL applicant added a new subsection after DCD Subsection 9.4.5.2.5, subsection 9.4.5.2.6 "UHS ESW Pump House Ventilation System," as part of the DCD "System Description." In this subsection, the COL applicant noted that there are four separate and independent UHS ESW pump houses.

Each pump house consists of two rooms, the ESW pump room and the UHS transfer pump room, with each room having its own 100 percent capacity ventilation subsystem. Each ESW pump room contains two unit heaters and each UHS transfer pump room contains one unit heater, to maintain a minimum room temperature to prevent the freezing of instrument lines, the wet pipe sprinkler system, and the standpipe hose station. The applicant provided a comprehensive discussion of: (a) Class 1E power supplies and divisional separation; (b) the absence of sources of airborne radioactive contamination within four the pump houses; (c) equipment seismic category and equipment safety class; (d) GDC 17 compliance; (e) unit heater sizing, room temperature controls and MCR alarms; and (f) fire protection.

The COL applicant added new subsection after DCD Subsection 9.4.5.3.5, Subsection 9.4.5.3.6, “UHS ESW Pump House Ventilation System,” as part of the DCD “Safety Evaluation.” This new subsection described the safety related attributes of the UHS ESW Pump House Ventilation System as follows:

- The ESW pump room ventilation system and the UHS transfer pump room ventilation system located in each UHS ESW pump house are each powered by a different Class 1E bus.

- The UHS transfer pump and the ESW pump in a single UHS ESW pump house are powered from different Class 1E power supplies and are located in different fire areas separated by three-hour fire barriers. The two Class 1E power supply trains in a UHS ESW pump house are physically separated by a three-hour fire barrier.

- The safety function of the UHS ESW pump house ventilation system is assured by the physical separation provided by the four separate and independent UHS ESW pump houses. All ventilation system components are classified as equipment class 3, Seismic Category I.

- The ESW pump room ventilation system and the UHS transfer pump room ventilation system are capable of performing their safety function under all associated design basis accidents coincident with LOOP.

- The ESW pump room exhaust fans and UHS transfer pump room exhaust fans are capable of performing required safety functions under all postulated internal flooding events

- Failure of a single active component in one of the UHS ESW pump house ventilation system does not result in a loss of the system’s safety function.

- The UHS ESW pump house ventilation system components are protected from tornado generated missiles by their location inside a Seismic Category I structure.

- Backdraft dampers are capable of withstanding the affects of tornado wind and atmospheric differential pressure loading.

In the COL FSAR, the applicant amends DCD subsection 9.4.5.4 entitled “Inspection and Testing Requirements,” with site-specific information by adding a new subsection 9.4.5.4.6 “UHS ESW Pump House Ventilation System.” The applicant indicated that in addition to the applicable general requirements of DCD subsection 9.4.5.4 that “…*the backdraft dampers are factory tested to demonstrate their capability to withstand the tornado wind effects and atmospheric differential pressure loading.*”

In the COL FSAR, the applicant amends DCD subsection 9.4.5.5 entitled “Instrumentation Requirements,” with site-specific instrumentation and alarm information by adding a new subsection 9.4.5.5.6 “UHS ESW Pump House Ventilation System”. The COL applicant indicates that the instrumentation for the UHS ESW Pump House Ventilation System will include high and low temperature alarms for both rooms of the four separate and independent UHS ESW pump houses. The design will also include status indication for all eight exhaust fans and low airflow alarms for both the ESW pump room and the UHS transfer pump room.

Interface Requirements

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, “Significant Site-Specific Interfaces with the Standard US-APWR Design,” identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.4.5 of the DCD.

9.4.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission regulations for the ESF ventilation system, and the associated acceptance criteria are given in Section 9.4.5 of NUREG-0800.

The applicable regulatory requirements for the site-specific information on the ESF ventilation system are as follows:

1. 10 CFR Part 50, Appendix A, GDC 2, “Design Basis for Protection against Natural Phenomena,” as it relates to the capabilities of structures housing the system and the system itself having the capability to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of safety-related functions.

2. 10 CFR Part 50, Appendix A, GDC 4, “Environmental and Dynamic Effects Design Bases,” as it relates to effects of missiles inside and outside containment, effects of pipe whip, jets, environmental conditions from high- and moderate-energy line-breaks, and dynamic effects of flow instabilities and attendant loads (e.g., water hammer) during normal plant operation, as well as upset or accident conditions.

3. 10 CFR Part 50, Appendix A, GDC 5, “Sharing of Structures, Systems, and Components,” insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be shown that sharing will not significantly impair their ability to perform their safety functions.

4. 10 CFR Part 50, Appendix A, GDC 17 as related to ensuring proper functioning of the essential electric power system. Compliance requires the provision of onsite and offsite electrical power to permit functioning of structures, systems, and components important to safety. Each electric power system must provide sufficient capacity to ensure that specified fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences. For GDC 17, acceptance is based on the guidance of Item 2 under Subsection A and Item 1 under Subsection C of the NUREG-CR/0660 section "Recommendations" for protection of essential electrical components from failure due to the accumulation of dust and particulate materials

5. 10 CFR Part 50, Appendix A, GDC 60, as related to the capability of the system to suitably control release of gaseous radioactive effluents to the environment.

6. For 10 CFR 50.63, acceptance is based on the applicable guidance of RG 1.155, including Position C.3.2.4. Compliance with 10 CFR 50.63 requires a demonstration that the plant has the capability to withstand and recover from a station blackout (i.e., loss of offsite electric power system concurrent with reactor trip and unavailability of the onsite emergency ac electric power system). A station blackout analysis covering a minimum acceptable duration (either to "withstand" the event until an alternate ac source and shutdown systems are lined up for operation or to "cope" with it for its duration, including the associated recovery period) is required.

7. 10 CFR 52.80(a), which requires that a COL application include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC regulations.

The design of safety-related portions of the ESFVS is acceptable if the integrated design of the systems is in accordance with the following criteria:

1. 10 CFR Part 50, Appendix A, GDC 2 bases its acceptance criteria on the guidance of RG 1.29, Position C.1, for safety-related portions and Position C.2 for non-safety-related portions. Compliance with GDC 2, as related to the system being capable of withstanding the effects of earthquakes, requires that structures, systems, and components important to safety be designed to withstand the effects of a design basis earthquake without loss of capability to perform their safety functions.

   The function of the Engineered Safety Feature Ventilation System (ESFVS) is to provide a suitable and controlled operating environment for engineered safety feature components during normal operation, during adverse environmental occurrences, and during and subsequent to postulated accidents, including loss of offsite power. GDC 2 ensures that engineered safety features will remain functional during and after a design basis earthquake.

2. 10 CFR Part 50, Appendix A, GDC 4 as related to ensuring that the ESFVS is appropriately protected against dynamic effects and being designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. This evaluation also includes evaluation of the adequacy of environmental support provided to structures, systems, and components important to safety located within areas served by the ESFVS. The function of the ESFVS is to provide a suitable and controlled operating environment for engineered safety feature components during normal operation, during adverse environmental occurrences, and during and subsequent to postulated accidents, including loss of offsite power. This requirement is imposed to ensure that engineered safety features function through the course of operating and accident events.

3. 10 CFR Part 50, Appendix A, GDC 5, as related to shared systems important to safety.

4. 10 CFR Part 50, Appendix A, GDC 17 as related to ensuring proper functioning of the essential electric power system. Compliance requires the provision of onsite and offsite electrical power to permit functioning of structures, systems, and components important to safety. Each electric power system must provide sufficient capacity to ensure that specified fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences. For GDC 17, acceptance is based on the guidance of Item 2 under Subsection A and Item 1 under Subsection C of the NUREG-CR/0660 section "Recommendations" for protection of essential electrical components from failure due to the accumulation of dust and particulate materials

5. 10 CFR Part 50, Appendix A, GDC 60, as related to the capability of the system to suitably control release of gaseous radioactive effluents to the environment.

6. For 10 CFR 50.63, acceptance is based on the applicable guidance of RG 1.155, including Position C.3.2.4. Compliance with 10 CFR 50.63 requires a demonstration that the plant has the capability to withstand and recover from a station blackout (i.e., loss of offsite electric power system concurrent with reactor trip and unavailability of the onsite emergency ac electric power system). A station blackout analysis covering a minimum acceptable duration (either to “withstand” the event until an alternate ac source and shutdown systems are lined up for operation or to “cope” with it for its duration, including the associated recovery period) is required.

   Regardless of the extent to which the ESFVS is expected to function to maintain suitable environmental conditions during a station blackout event, equipment that is necessary to accomplish core cooling, maintenance of appropriate containment integrity, and other functions that constitute “withstanding” and/or “coping” during the event should be capable of functioning under the expected environmental conditions associated with the event.

7. 10 CFR 52.80(a), which requires that a COL application include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC regulations.

9.4.5.4 Technical Evaluation

The NRC staff reviewed Section 9.4.5 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[7] The NRC staff’s review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the ESF ventilation system. Section 9.4.5 of the

[7] See Chapter 1 for a discussion on the staff’s review related to verification of the scope of information to be included within a COL application that references a design certification.

US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information, incorporated by reference, related to the ESF ventilation system will be documented in the staff SER on the DC application for the US-APWR design.

9.4.5.4.1 ESF Air Handling Units – Heating Coil Capacity Specifications

US-APWR COL Information Items

- STD and CP COL 9.4(4)

The NRC staff reviewed STD and CP COL 9.4(4) related to COL Information Item 9.4(4), included under Section 9.4.5 of the CPNPP3&4 COL FSAR. The applicant provided information regarding the site-specific capacities of heating and cooling coils of the ESF ventilation subsystems in CPNPP3&4 COL FSAR Sections 9.4.5.2.2, 9.4.5.2.3, 9.4.5.2.4, 9.4.5.2.5, and Table 9.4-201.

During performance of their review of the COL application the staff noted that US-APWR combined license Information Item COL *9.4(4)* reads:

> "The COL Applicant is to determine the capacity of cooling and heating coils provided in the air handling units that are affected by site-specific conditions."

In contrast, the relevant sentence contained in each of DCD subsections 9.4.5.2.2, 9.4.5.2.3, 9.4.5.2.4, and 9.4.5.2.5 reads:

> "The COL Applicant is to determine the capacity of heating coil that are affected by site-specific conditions."

As a point of record, the staff notes that the relevant sentences in DCD subsections 9.4.5.2.2, 9.4.5.2.3, 9.4.5.2.4, and 9.4.5.2.5 are accurate in that DCD Table 9.4.5-1, "Equipment Design Data," already contains the requisite cooling capacity in Btu/hr for the air handling units of the ESF Ventilation System. Therefore, the COL applicant is correct in providing only a heating coil capacity for the ESF Ventilation System Air Handling Units of FSAR Table 9.4-201. More specifically, the COL applicant is correct in providing only a heating coil capacity for:

- the four Class 1E Electrical Air Handling Units (subsection 9.4.5.2.2);
- the twelve Class 1E Electrical Room HVAC System in-duct heaters (subsection 9.4.5.2.2);
- the four Safeguard Component Area Air Handling Units (subsection 9.4.5.2.3) ;
- the two Emergency Feedwater Pump (M/D) Area Air Handling Units (subsection 9.4.5.2.4);
- the two Emergency Feedwater Pump (T/D) Area Air Handling Units(subsection 9.4.5.2.4) ; and
- the eighteen air handling units of the Safety Related Component Areas (subsection 9.4.5.2.5).

The staff reviewed the relevant passages of NUREG-800 SRP 9.4.5 against the information provided by the COL applicant in FSAR subsections 9.4.5.2.2, 9.4.5.2.3, 9.4.5.2.4 and 9.4.5.2.5 and 9.4.7 and FSAR Table 9.4-201. From its review, the staff determined that the heaters are to be procured as and installed in Comanche Peak Units 3 and 4, per the criteria of US-APWR DCD Table 3.2-2, "Classification of Mechanical and Fluid Systems, Components, and

Equipment." More specifically, the heaters are equipment Class 3, Seismic Category I and fall under the auspices of the 10 CFR Part 50 Appendix B.

The Class 1E divisional power supplies are addressed in FSAR Section 8.3 and are reviewed by the "Division of Engineering," while the components of the ESF Air Handling Units are described in FSAR Section 9.4.5

The staff noted that FSAR Revision 3 Table 9.4-201 indicates in-duct heaters to the MCR/Class 1E Electrical HVAC Equipment Room for only Trains B and C. This configuration was represented in Figure 9.4-202 "Class 1E Electrical Room HVAC System Flow Diagram," of FSAR Revision 2. FSAR Revision 3 deleted Figure 9.4-202 from the RCOLA. DCD Revision 3 Figure 9.4.5-2 has been incorporated by reference in RCOLA FSAR Revision 3. DCD Revision 3 Figure 9.4.5-2 indicates that all four MCR/Class 1E Electrical HVAC Equipment Rooms (i.e. Trains A, B, C and D) have
in-duct heaters which conflicts with FSAR Revision 3 Table 9.4-201. Based on a configuration that is indeterminate, the staff issued **RAI 6898, Question 09.04.05-26**. The applicant responded in a letter (ML12355A029) dated December 18, 2012. The applicant agreed to amend Table 9.4-201 to indicate that for the line item of MCR/Class 1E Electrical HVAC Equipment Room In-Duct Heater Capacity that no heating via in-duct heaters is required for Trains A and D. This solution is acceptable to the staff since it establishes a clear licensing basis for the subject safety related equipment. The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. The status of **RAI 6898, Question 09.04.05-26** is now listed as a **Confirmatory Item.**

The COL applicant listed in Table 9.4-201 "Equipment Design Data" a heating coil capacity of 27 kW for each of the four Safeguard Component Area Air Handling Units.

The COL applicant listed in Table 9.4-201 "Equipment Design Data," a heating coil capacity of 2 kW for each of the two Emergency Feedwater Pump (M/D) Area Air Handling Units and a heating coil capacity of 6 kW for each of the two Emergency Feedwater Pump (T/D) Area Air Handling Units.

For the air handling units of the Safety Related Component Areas, the COL applicant listed in Table 9.4-201 "Equipment Design Data," the following heating coil capacities:

- For each of the four Penetration Area Air Handling Units -- 35 kW;
- For each of the two Annulus Emergency Filtration Unit Area Air Handling Units -- 12 kW;
- For each of the two Charging Pump Area Air Handling Units -- 6 kW;
- For each of the four CCW Pump Area Air Handling Units -- 3 kW;
- For each of the four Essential Chiller Unit Area Air Handling Units -- 5 kW; and
- For each of the two SFP Pump Area Air Handling Units – 5 KW.

US-APWR COL 9.4(6):

> "*The COL Applicant is to provide a system information and flow diagram of ESW pump area ventilation system if the ESW pump area requires the heating, ventilating and air conditioning.*"

The COL applicant provided the requisite information with CP COL 9.4(6) / STD COL 9.4(6). COL Application subsections 9.4.5, 9.4.5.1.1.6, 9.4.5.2.6, 9.4.5.3.6, 9.4.5.4.6, 9.4.5.5.6, Table 9.4-202, Table 9.4-203 and Figure 9.4-201 address this COL Item. For DCD subsection 9.4.5, the COL applicant added the UHS ESW Pump House Ventilation System to the bulleted list of subsystems that comprise the ESF Ventilation System and erroneously deleted the third paragraph which reads, "*The ESF ventilation system complies with 10 CFR Part 50, Appendix A, GDC 2, 4 and 60*." The staff issued **RAI 6124, Question 09.04.05-20,** to request that the error be corrected. The applicant responded on February 27, 2012 (ML12060A378), by concurring with the staff's observation and provided an FSAR markup to correct the error. The staff verified that FSAR Revision 3 contained this correction. Therefore, **RAI 6124, Question 09.04.05-20, is resolved and closed.**

The staff notes that Item 2 of SRP 9.4.5 Section I reads:

> "Safety-related portions of the ESFVS are also reviewed with respect to the following:
>
> A. The ability of the heating and cooling systems to maintain a suitable ambient temperature range in the areas serviced, assuming proper performance of equipment contained in these areas; and
>
> B. The ability of the safety features equipment in the areas being serviced by the ventilation system to function under the worst anticipated degraded ESFVS system performance."

As noted in SER Section 9.4.5.3 of this SER, evaluation against the requirements of GDC 4 also includes evaluation of the adequacy of environmental support provided to structures, systems, and components important to safety located within areas served by the ESFVS. The function of the ESFVS is to provide a suitable and controlled operating environment for engineered safety feature components during normal operation, during adverse environmental occurrences, and during and subsequent to postulated accidents, including loss of offsite power. This requirement is imposed to ensure that engineered safety features function through the course of operating occurrences and accidents.

Class 1E power supplies provides the staff assurance of the ability of the ESF air handling unit heaters to provide this safety function during and subsequent to postulated accidents, including loss of offsite power. The staff did question the ability of these heaters to provide their intended safety function during adverse environmental occurrences in **RAI 3230, Question 09.04.05-01**. The staff requested that the applicant provide the basis for the sizing of the heaters and the design basis temperature that the heaters are designed to maintain. The staff also requested that the applicant include these design bases in the FSAR. To facilitate confirmatory calculations the staff requested that the applicant provide the inputs to the design calculations used in the derivation of the heating coil capacity value for the heater of the ESF air handling units.

The applicant responded in a letter dated November 13, 2009 (ML093230704), with a basic equation that derives heater size based on the air flow through the heater and a differential temperature rise across the heater. In addition, the applicant provided a table that captured the input values of differential temperatures, air flows and the calculated size in kilowatts for each heater. The applicant subsequently revised their response to **RAI 3230 Question No. 09.04.05-01** (ML103060043) due to revising the 0-percent exceedance dry-bulb temperature value from -0.5 ºF to -5.0 ºF per their disposition of **RAI No. 4606, Question No.**

02.03.01-6 (ML102780284). The staff evaluated the adequacy of the applicant's response "as acceptable" since Items 4.b, 4.d, 4.e, and 4.f of DCD ITAAC Table 2.7.5.2-3 "Engineered Safety Features Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria," will provide acceptance criteria that will ensure the adequate sizing of the heaters. In particular, Items 4.b, 4.d, 4.e, and 4.f will provide the staff assurance of the ability of the ESF air handling unit heaters to fulfill their safety function during and subsequent to postulated accidents, including loss of offsite power. Based on this, **RAI 3230, Question 09.04.05-1, is resolved and closed.**

The staff issued **RAI 3230, Question 09.04.05-02**, informing Luminant that each AHU heater is safety related and performs a significant safety related function. The staff noted that the COL applicant did not provide in the application an ITAAC update to include the ESF Ventilation System (ESFVS) air handling unit heaters in Tier 1, DCD subsection 2.7.5.2 "Engineered Safety Features Ventilation System." Similarly, the COL applicant did not provide in the application an update of the following preoperational tests to reflect the addition of these AHU heaters to the US-APWR plant:

- 14.2.12.1.96 "Safeguard Component Area HVAC System Preoperational Test";
- 14.2.12.1.97 "Emergency Feedwater Pump Area HVAC System Preoperational Test";
- 14.2.12.1.98 "Class 1E Electrical Room HVAC System Preoperational Test"; and
- 14.2.12.1.106 "Safety-Related Component Area HVAC System Preoperational Test."

In this RAI, Luminant was requested to provide a justification as to why the heater capacity need not be verified through site specific ITAAC or startup testing.

The applicant, in its response to **RAI 3230, Question 09.04.05-02**, dated November 13, 2009 (ADAMS No. ML093230704) cited DCD **RAI 184 Question 14.3.07-26** (ML091040177) which established ITAAC for the all four subsystems of the ESF system and subsequently with **RAI 474-3811, Question 09.04.05-10** (ML093210470). The staff concludes, based on the RAI responses, that DCD Table 2.7.5.2-3 Items 4.b, 4.d, 4.e, and 4.f, will demonstrate the safety function of the ESF air handling heaters. Accordingly, **RAI 3230, Question 09.04.05-02 is resolved and closed.**

9.4.5.4.2 UHS ESW Pump House Ventilation System

- CP COL 9.4(6)

The NRC staff reviewed CP COL 9.4(6) related to COL Information Item 9.4(6), included under Section 9.4.5 of the CPNPP3&4 COL FSAR. The applicant provided design basis, design description, and safety evaluation of the site-specific ultimate heat sink (UHS) essential service water (ESW) pump house ventilation system in CPNPP3&4 COL FSAR Sections 9.4.5, 9.4.5.1.1.6, 9.4.5.2.6, 9.4.5.3.5, 9.4.5.4.6, 9.4.5.5.6, Figure 9.4-201, and Table 9.4-202.

The US-APWR combined license Information Item COL *9.4(6)* reads:

> "The COL Applicant is to provide a system information and flow diagram of ESW pump area ventilation system if the ESW pump area requires the heating, ventilating and air conditioning."

The staff reviewed NUREG-800 SRP 9.4.5 against the information provided by the COL applicant in FSAR subsections 9.4.5., 9.4.5.1.1.6, 9.4.5.2.6, 9.4.5.3.6, 9.4.5.4.6, 9.4.5.5.6, 9.4.7, FSAR Table 9.4-202, Table 9.4-203, and FSAR Figure 9.4-201 against other relevant sections of the COL FSAR and US-APWR DCD.

The staff noted that Revision 2 FSAR Figure 9.4-203 "UHS ESW Pump House Ventilation Systems Flow Diagram," was tagged with a "STD COL 9.2(6)" identifier. In Revision 1 of the RCOLA FSAR Figure 9.4-201 (changed to Figure 9.4-203 with Revision 2) was tagged with a "CP COL 9.4(6)" identifier. The staff believed this to be a typographical error that warranted correction and initiated **RAI 6124 Question 09.04.05-21**. which requested that Luminant correct the COL information number. The applicant, in its response to **RAI Question No. 09.04.01-02**, dated February 27, 2012 (ML12060A378), indicated the error would be corrected with Revision 3 of the RCOLA. The staff verified that Revision 3 of the RCOLA appropriately tagged the "UHS ESW Pump House Ventilation Systems Flow Diagram" with "STD COL 9.4(6)." Based on this, **RAI 6124 Question 09.04.05-21 is resolved and closed.**

The staff structured the order of its technical evaluation based on the numerical order of 10 CFR Part 50 Appendix A General Design Criteria.

<u>Seismic I and Seismic II/I – GDC 2</u>

In **RAI 3232, Question 09.04.05-03**, based on Technical Rational 1 of SRP 9.4.5, the staff requested that the applicant revise Figure 9.4-201 "UHS ESW Pump House Ventilation System Flow Diagram," to designate the seismic classifications of components and demarcate division between classifications.

The applicant responded to **RAI 3232, Question 09.04.05-03**, on December 16, 2009 (ML093520667), that all ventilation system equipment and components are classified as equipment class 3, Seismic Category I. There is no seismic classification break needed. The applicant agreed to revise FSAR Figure 9.4-201 stating that all UHS ESW Pump House Ventilation System equipment and components (fans, heaters, dampers) are Seismic Category I.

The staff also observed from their review of Figure 9.4-201 that HVAC duct work appears on both sides of the back draft dampers of the air outlets and on the upstream side of the back draft dampers of the air intakes of each room's ventilation system. In contrast, the staff found that Table 3.2-201 "Classification of Site-Specific Mechanical and Fluid Systems, Components, and Equipment," does not list "ducts" or "ducting" as a system component for UHS ESW Pump House Ventilation System. The staff requested that the applicant provide clarification. The applicant responded that the UHS ESW Pump House Ventilation System contains no ductwork. The damper is mounted in the Seismic Category I wall opening and the fan is mounted on the Seismic Category I wall of each independent UHS ESW pump house. The applicant agreed to revise Figure 9.4-201 to indicate that no system ductwork is installed.

The staff also requested that the applicant clarify as to whether there was any other non-safety or non-seismic systems or components located within the Seismic Category I UHS ESW Pump Houses. To this part of the RAI, the applicant responded that:

> "…the UHS ESW Pump Houses each contain a wet-pipe sprinkler system, hose station and smoke detection system. These fire protection components are classified as non-safety-related. With the exception of standpipes supplying manual hose stations,

> these fire protection components are seismically supported such that their failure during a design basis seismic event will not damage any of the safety-related equipment in the areas. … the standpipe systems supplying hose stations are designed to remain functional under safe shutdown earthquake loadings for manual fire suppression in areas containing equipment required for safe shutdown."

The applicant agreed to amend FSAR Section 9.4.5.2.6 with words similar to the above. The applicant also noted that ITAAC to verify the as-built plant is designed and constructed to avoid adverse seismic interactions is appropriately addressed as part of ITAAC Item 2 for as-built verification of the SSCs as described in FSAR Part 10 Appendix A.2 Table A.2-1.

The staff found that the applicant provided adequate answers to all the technical issues raised in Question No. 09.04.05-3 and had agreed to amend the relevant sections of the FSAR with this clarifying information. Based on this, the staff found the applicant's response acceptable pending FSAR incorporation of these changes. The staff reviewed Revision 2 of the FSAR to confirm the presence of all three intended changes from the applicant's response. The staff found issues still lacking sufficient resolution from this review.
In follow up **RAI 6124, Question 09.04.05-22,** the staff noted that Note 1 of FSAR Figure 9.4-203 (i.e. changed to 9.4-203 with Revision 2 of FSAR from 9.4-201) did not address the seismic category of instrumentation (e.g. flow switches, temperature switches) attached to the unit heaters and exhaust fans. Nor did the Note address the seismic classification of the detached temperature switches and temperature controllers contained within the pump rooms. The staff noted that FSAR Table 3.2-201 also failed to address the seismic classification of the UHS ESW Pump House Ventilation System's instrumentation.

In its response dated February 27, 2012 (ML12060A378), the applicant amended Notes 1 and 5 of FSAR Revision 3 Figure 9.4-201 (i.e. changed back to 9.4-201 with Revision 3 of FSAR from 9.4-203) to indicate that all safety related instrumentation was Seismic Category I and that all non-safety related instrumentation was Seismic Category II. The applicant replied in particular that: "FSAR Table 3.2-201 provides a list of mechanical and fluid systems, components, and equipment and their designated seismic category along with the equipment class, and design codes and standards as stated in DCD Subsection 3.2.1.2. In addition, the quantity and types of process instrumentation provided assure the safe and orderly operation of all systems over the full design range of the plant and these systems are described in their respective sections of Chapters 6, 7, 8, 9, 10, 11, and 12, as described in DCD Subsection 3.1.2.4.1. The FSAR incorporates this subsection of the DCD by reference. As such, the instrumentation associated with safety-related systems, components, and equipment is not within the scope of FSAR Table 3.2-201 and is generally not listed therein."

The staff acknowledges this explanation and notes that the safety related temperature switches for the UHS ESW Pump House Ventilation System are listed in FSAR, Table 9.4-203 "UHS ESW Pump House Ventilation System Failure Modes, Effects Analysis," FSAR Table 3D-201 "Site-Specific Environmental Qualification Equipment List," and in Tier 1, ITAAC Table A.2-2 "UHS ESW Pump House Ventilation System Equipment Characteristics." Given this and the fact that FSAR Revision 3 Figure 9.4-201 has been amended with Notes 1 and 5 to provide a seismic classification for both safety related and non-safety related instrumentation the staff found the applicant's response to Question 09.04.05-22 acceptable. For further discussion of the safety versus non-safety classification of the UHS ESW Pump House Ventilation System's instrumentation, refer to **RAI No. 3232, Question 09.04.05-10**, and **RAI No. 5585, Question No. 09.04.05-18**, at the end of this SER section (i.e. before 9.4.5.5). The staff verified that

Revision 3 of FSAR Figure 9.4-201 contained the amended notes. Based on this, **RAI 3232, Question 09.04.05-03, and RAI 6124, Question 09.04.05-22, are resolved and closed.**

Externally Generated Missiles – GDC 4

In **RAI 3232, Question 09.04.05-04**, the staff observed that it was not clear from their review of the applicant's FSAR Chapters 3 and 9 how the air intakes and air outlets of the UHS ESW Pump Houses are protected from tornado generated missiles. As such, in this RAI, Luminant was requested to explain how the air intakes and air outlets of the UHS ESW Pump Houses are protected from tornado generated missiles.

The applicant responded on December 16, 2009 (ML093520667), that back-draft dampers are mounted in the wall opening on the outside air intakes and the exhaust outlets perform a function similar to tornado dampers. The safety-related design basis from FSAR Section 9.4.5.3.6 reads, "*Backdraft dampers are capable of withstanding the affects of tornado wind and atmospheric differential pressure loading*." Therefore, separate tornado dampers are not required. The design basis for the air intakes and outlets for the ESW and transfer pump rooms is that these openings are protected against tornado generated missiles with reinforced concrete missile shields which overhang the ventilation openings. The applicant agreed to revise FSAR Subsection 3.8.4.1.3.2 to reflect the design basis.

The staff verified that Revision 2 of FSAR subsection 3.8.4.1.3.2 contained the requisite changes. The applicant noted that the locations of the missile shields for the UHS ESW pump house are shown in the plan view of the UHSRS in FSAR Figure 3.8-206 at the northwest and southeast corners of each UHS ESW pump house. The applicant went on to note that for purposes of structural design, the external walls of the ESW pump rooms and transfer pump rooms are conservatively designed as unvented and the full tornado atmospheric pressure differential is included in the structural design. The internal walls and slabs of these rooms are also conservatively designed for the full tornado atmospheric pressure differential.

The staff requested additional information about the design of the missile shields in **RAI 5585, Question 09.04.05-16**. In its response dated May 6, 2011 (ML111300166), the applicant agreed to amend Figure 3.8-206 with a note clarifying the existence of the missile shields on the ventilation openings for the ESW pump room and UHS transfer pump room. The applicant went on to note that, "*The reinforced concrete walls and roof slabs surround all the ventilation openings and are arranged to provide protection so there is no straight pathway for incoming missiles to enter through the ventilation opening*." The staff verified that Revision 2 FSAR Figure 3.8-206 drawing contains the note describing the existence of the missile shields. Based on the implemented changes to both FSAR subsection 3.8.4.1.3.2 and Figure 3.8-206, the staff found the applicant's response acceptable since the applicant had clarified the issue of how the air intakes and air outlets of the UHS ESW Pump Houses are protected from tornado generated missiles. Based on this, **RAI 3232, Question 09.04.05-4, and RAI 5585, Question 09.04.05-16, are resolved and closed.**

Internal Flooding – GDC 4

In **RAI No. 5585, Question No. 09.04.05-13**, the staff noted that FSAR subsections 9.4.5.2.6 and 9.4.5.3.6 were in conflict. In particular, subsection 9.4.5.2.6 read, "The four UHS ESW pump houses are physically separate and independent structures and are each supplied by independent Class 1E power supplies with Emergency Gas Turbine Generators backup." The NRC staff interpreted this statement to read that all Class 1E equipment contained within one ultimate heat sink (UHS) essential service water (ESW) pump house is powered by the same divisional power supply (i.e. redundant divisional trains A, B, C, or D). In contrast subsection 9.4.5.2.6 read "The ESW pump room exhaust fan and the UHS transfer pump room exhaust fan are separated by a three-hour fire rated barrier. Therefore, each fan powered by different Class 1E power supplies is protected and remains functional in the event of a fire in either room." The staff requested Luminant provide further clarification with respect to the issue of ESW Pump House divisional power supplies.

The applicant responded on May 6, 2011 (ML111300166), and explained that the description contained in subsection 9.4.5.2.6 was accurate for the ESW Pump House Class 1E power supply configuration, and agreed to amend FSAR subsections 9.4.5.2.6 and 9.4.5.3.6 to remove the conflict. The staff verified that this amendment was captured in Revision 3 of the FSAR. Based on this, **RAI No. 5585, Question 09.04.05-13, is resolved and closed.**

In **RAI 3232, Question No. 09.04.05-05**, the staff cited two of the "Review Interfaces" of SRP 9.4.5, specifically SRP section 3.4.1 "Internal Flood Protection for Onsite Equipment Failures" and SRP section 3.6.1 "Plant Design For Protection Against Postulated Piping Failures In Fluid Systems Outside Containment." The staff noted that FSAR subsection 9.4.5.3.6 reads:

> "The ESW pump room exhaust fan and the UHS transfer pump room exhaust fan are separated by a three-hour fire rated barrier. Therefore, each fan powered by different Class 1E power supplies is protected and remains functional in the event of a fire in either room."

With respect to the issue of internal flooding, the staff could find no information contained in the COL applicant's FSAR subsection 3.4. In **RAI 3232, Question 09.04.05-5,** the staff requested additional information about the flood and fire barriers between the ESW pump room and the UHS transfer pump room that ensure Class 1E divisional separation in each of the four ESW pump houses. The staff issued **RAI No. 5585, Question 09.04.05-17,** requesting that Luminant provide the final evaluation of the flooding event along with a detailed design of the floor drains and door sill. Luminant provided its response to **RAI No. 5585, Question 09.04.05-17** on May 6, 2011 (ML111300166).

In its response to **RAI No. 5585 Question No. 09.04.05-17,** the applicant indicated that the transfer pump motor drive is located within a room separated from the ESW pump motor drive by a 12-inch-thick concrete wall which has a 3-hour fire rated access door.
In **RAI 6124 Question 09.04.05-23**, the staff noted that within the FSAR there was neither a discussion of the structural design of the access door nor of the door sill height between the ESW pump room and the UHS transfer pump room. Nor was there a discussion in the applicant's response to **RAI 5585, Question No. 09.04.05-17,** of the internal flood protection evaluation findings with respect to the required floor drain sizing and the maximum internal flood water height, that prevent other design details from being a factor in the response's conclusions. In particular, the staff's focus was on the door that separated the two pump rooms of each ESW pump house and the capability of the floor drains to mitigate the effects of an internal flood in either room.

In its response, dated August 29, 2012 (ML122430550), to **RAI 6124 Question 09.04.05-23**, the applicant provided a major ESW Pump House design change that eliminates the internal door between the pump rooms of each ESW pump house and provides a modified drain system that precludes fire transferring between the two pump rooms through the common pump bay. The applicant provided a supplement, to its response for **RAI 6124, Question 09.05.05-23,** with a letter dated March 4, 2013 (reference Luminant Log #TXNB-13006). By letter dated March 4, 2013, Luminant provided a supplemental response to **RAI 6124, Question 09.05.05-23.** In its response, Luminant provided additional information with respect to: (a) the non-safety related liquid detection system to be installed in each pump room (b) the independent drain lines from each pump room of the ESW pump house to the basin below. The supplemental information resolved all residual staff concerns about the enhanced design of the ESW pump house.

Therefore, the issue is resolved and listed as a **Confirmatory Item - RAI 6124, Question 09.04.05-23.** The staff will confirm that the proposed revision to the FSAR is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR

<u>Internally Generated Missiles – GDC 4</u>

In **RAI 3232, Question 09.04.05-06**, the staff documented that the COL applicant failed to address in either COL FSAR subsection 9.4.5 “Engineered Safety Function Ventilation System” or COL FSAR subsection 3.5 “Missile Protection,” the potential threat of any and all internally generated missiles to safety related SSCs contained in the ESW pump room and the UHS transfer pump room. More specifically, the COL applicant had not addressed the threats from internally generated missiles created by:

- the fan blades of the unit heaters;
- the fan blades of the exhaust fans; or
- any and all sources of internally generated missiles within the UHS ESW Pump Houses.

The staff requested that the applicant address the issue of internally generated missiles and update the FSAR, as appropriate.

The applicant provided a comprehensive response on December 16, 2009 (ML093520667) that included discussion of:

- the rotating elements contained within the pump/motor casing ;
- the fan blades of the unit heaters and of the exhaust fans ; and
- the rotating blades of the cooling tower exhaust fans.

With respect to the issue of missiles originating from piping under high pressure or in the pressurized portion of the valves in high energy piping during normal operation, the applicant concluded that such missiles are not considered credible due to ASME Code, Section III and Section XI design and inspection criteria. Furthermore, the applicant noted that there is no site-specific high energy piping at CPNPP 3&4 as discussed in FSAR Subsection 3.6.1.3. For moderate energy fluid systems the applicant concluded that the systems have insufficient stored energy to generate a missile as indicated in DCD Subsection 3.5.1.1. In addition, any SSCs with the potential to cause damage to safety-related SSCs following an earthquake are analyzed and designed using the same methods and stress limits specified for Seismic Category I SSCs.

The applicant added a new FSAR subsection 3.5.1.1.2 “High Speed Rotating Equipment,” after the fifth paragraph of DCD Revision 3 Subsection 3.5.1.1.2. This amendment resulted in applicant’s above-mentioned conclusions being included in the DCD. The staff found the applicant’s discussion to be thorough and the conclusions reached to be substantiated. Based on this, the staff finds that the pump house design satisfies GDC4 requirements with respect to internally generated missiles. Therefore, **RAI 3232 Question 09.04.05-06 is resolved and closed.**

Maintaining Design Basis Temperatures – GDC 4

The staff notes that RG 1.206 Section C.I.9.4.5.1 "Design Bases," reads in part:

> "The design bases for the air handling and treatment system for areas that house ESF equipment should include the criteria and/or features to ensure the system's performance (i.e., flow rates, temperature limits, humidity limits, filtration) and reliability (i.e., single failure, redundancy, seismic design, environmental qualification) for all modes of operation, including normal, abnormal, and SBO conditions. …"

In **RAI 3232, Question 09.04.05-07,** the staff requested that the applicant provide the inputs to the design calculations used in the derivation of the sizing of the ventilation system.

The applicant responded on December 16, 2009, and October 29, 2010 (ML093520667 as amended by ML103060043), by stating that the UHS ESW pump house ventilation system provides and maintains the proper environmental conditions within the required temperature range of 40 ºF - 120 ºF to support the operation of the instrumentation and control equipment and components in the individual UHS ESW pump houses during a design basis accident and LOOP. The ventilation system designed is based on the outside ambient design temperature conditions (-5 °F - 115 °F) using 0 percent temperature exceedance values. The applicant did provide the fundamental equations used to derive the required flow rates for the exhaust fans and the required heater capacity values of both the ESW Pump Room and the UHS Transfer Pump Room.

The staff determined the applicant's response as acceptable since RCOLA Revision 2 Item 4 of ITAAC Table A.2-1 provides acceptance criteria (as discussed in **RAI No. 5585, Question No. 09.04.05-15**) that demonstrates the adequate sizing of the ventilation system. In particular, Item 4 provides the staff assurance of the ability of the UHS ESW pump house ventilation system to fulfill its safety function during normal operation and subsequent to postulated accidents, including loss of offsite power. Based on this, the staff considers this aspect of **RAI No.3232 Question 09.04.05-07** closed. In addition, the staff noted that each of the room heaters has an attendant fan displayed in COL FSAR Figure 9.4.201 "UHS ESW Pump House Ventilation System Flow Diagram." However, FSAR Table 9.4-202 did not list a design specification air flow rate for these unit heater fans. In **RAI No. 5585, Question 09.04.05-15,** the staff asked Luminant to provide additional information about this absence of design information. The applicant replied that the unit heaters are supplied by a vendor in compliance with a procurement specification. This specification requires a maximum allowable watt density for a specific coil design. The airflow is provided by the vendor who is responsible for the design of the heaters. The vendor ensures that a minimum air velocity is provided so that the specified allowable watt density of the unit heater coils is not exceeded. The applicant included this information in Revision 2 FSAR subsection 9.4.5.2.6.

The staff also requested information about the impact on the UHS ESW Pump House room temperature when the effect of a 140ºF UHS Basin temperature (COL FSAR Table 7.5-201) is combined with the effects of the most severe summertime ambient conditions for the plant site and the heat load from the ESW pump motor.

To these questions, the applicant responded that FSAR Table 7.5-201 provides the indication range for the instruments (32-140 ºF) that serve the Cooling Water System. The UHS basin temperature monitor has the maximum range temperature of 140 ºF. In contrast, the maximum water temperature in the basin is 95 ºF as stated in Table 9.2.5-201. The UHS ESW pump house ventilation is designed as described above to maintain the room temperature within a range of 40 ºF- 120 ºF.

The staff notes that FSAR Revision 1 Table 9.2.5-201 was re-labeled as Table 9.2.5-3R in FSAR Revision 2 and that the "Cooling Water Temperature," has a Cold (Outlet) temperature of 95 ºF listed. Based on this fact and the existence of RCOLA Revision 2 Item 4 of ITAAC Table A.2-1 as discussed above, the staff found the applicant's response to acceptable. Therefore, **RAI 3232, Question 09.04.05-07, is resolved and closed.**

In **RAI 3232, Question 09.04.05-08**, the staff noted that the "System Description," of COL FSAR subsection 9.4.5.2.6 lacked significant detail when compared to the prescriptive guidance of RG 1.206 Section C.I.9.4.5.1 "Design Bases" and Section C.I.9.4.5.2 "Systems Description." In particular for normal plant operations, the staff requested Luminant provide information about their intent with respect to maintaining the operability of this safety related equipment and to maintain the integrity of the pump houses' instrument lines, wet pipe sprinkler station and the standpipe hose station during the most severe design basis winter conditions.

In their response to **RAI 3232, Question 09.04.05-08,** dated December 16, 2009 (ML093520667), the applicant agreed to amend FSAR subsection 9.4.5.2.6, with a more thorough system description that provides assurance of maintaining ESW pump house equipment operability during normal plant operations and concurrent design basis winter conditions. The staff found the applicant's response acceptable and verified that Revision 2 of FSAR contained these changes. Based on this, **RAI 3232, Question 09.04.05-08, is resolved and closed.**

Based on the outstanding internal flooding issues pertaining to the ESW pump house as captured by Confirmatory Item **RAI 6124, Question 09.04.05-23**, the staff could not find that the applicant's FSAR, Revision 3 satisfied the requirements of GDC 4.

<u>Sharing of Systems and Components Important to Safety Between Units 3 and 4 – GDC 5</u>

From this review, the staff determined that
CPNPP3&4 will each have their own set of four divisional ESW Pump Houses with independent Essential Service Water Systems and attendant UHS ESW Pump House Ventilation Systems. More specifically, there will be no sharing of system components or potential dependencies between the two Units' UHS ESW Pump House Ventilation Systems. Therefore, the staff concludes that the acceptance criteria for GDC 5 are satisfied for each UHS ESW Pump House Ventilation System of CPNPP3&4.

<u>Proper Functioning of the Essential Electric Power System – GDC 17</u>

The first paragraph from Section II "Acceptance Criteria" of SRP section 9.4.5 "Technical Rationale" reads:

> "Compliance with GDC 17 requires that onsite and offsite electrical power be provided to permit functioning of structures, systems, and components important to safety. Each electric power system must provide sufficient capacity to ensure that specified fuel

design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences. In addition, core cooling, containment integrity, and other vital functions must be maintained in the event of postulated accidents."

The Class 1E divisional power supplies are addressed in FSAR Section 8.3 and are reviewed by the "Division of Engineering" while the components of the ESF Air Handling Units are described in FSAR Section 9.4.5

In **RAI No. 3232, Question No. 09.04.05-09**, the staff documented the absence of information in the FSAR about the spatial positioning of the fresh air intake dampers for the UHS ESW Pump House. More specifically, the staff noted that Section II "Acceptance Criteria" of SRP Section 9.4.5 "Technical Rationale" recommends that the bottom of the fresh air intakes are to be positioned 20 feet above grade elevation to limit the flow of air borne particulate (dust) into the two rooms of the UHS ESW Pump House. The staff went on to note that electrical and instrumentation cabinets can be provided with suitable seals or gaskets to prevent dust from entering the cabinets as an alternate way of satisfying the "Acceptance Criteria." Accordingly, the staff requested Luminant explain how the design of the UHS ESW pump House satisfied the requirements of 10 CFR Part 50 GDC 17.

Luminant responded to **RAI No. 3232, Question No. 09.04.05-09**, on December 16, 2009 (ML093520667). In its response, Luminant stated that the bottoms of the fresh air intakes are positioned as high as physically possible above the ground level. The height of the UHS ESW pump house is 16 feet above grade and the air is not filtered. In addition, electrical and instrument enclosures are NEMA type 12 (dust tight and drip tight - for indoor use) and any louvered vents on the enclosure are provided with filters to minimize the intake of dust, dirt, and grit.

The staff verified that the applicant amended Revision 3 FSAR subsection 9.4.5.2.6 with this design description. Based on this FSAR amendment, the staff found that compliance with GDC17 is assured with respect to the installed Class 1E electrical and instrumentation panels in the UHS ESW Pump House. Accordingly, **RAI 3232, Question 09.04.05-09, is resolved and closed.**

The staff concluded that the divisional power supplies associated with the four UHS ESW Pump Houses satisfy the requirements of 10 CFR Part 50 Appendix A, Criterion 17.

The GDC 17 is satisfied in part for the essential electrical components of the ESF Ventilation System, such as contacts and relays. This is accomplished by protecting the components from accumulated dust and particulate materials by enclosing the components in dust-tight cabinets.

<u>Coping with a Station Blackout Event – 10 CFR 50.63</u>

In **RAI 3232, Question 09.04.05-11,** the staff requested additional information about the electrical loading of MCCs listed in DCD Table 8.3.1-6 in support of the station blackout coping scenario. The staff noted that the Table reads that one Essential Service Water Pump (i.e. ESW pump) will be required to be in operation for the duration of the 8 hour coping event. The staff noted that Phase "3" (i.e. "After AAC GTG has restored power to the Class 1E power system within 60 minutes of the start of the event) of DCD subsection 8.4.2.1.2, "Station Blackout Coping Analysis," indicates that the supporting systems will include I&C, cooling system, and HVAC. The staff asked in particular whether the applicant had determined that the electrical sizing of the MCCs relative to all miscellaneous CPNPP, Unit 3 (or 4) SBO loads is bounded by the electrical capacity of the MCCs listed in Table 8.3.1-6.

The applicant responded on December 16, 2009, and October 29, 2010 (ML093520667 and ML103060043), that the total capacity of these miscellaneous loads, including the UHS ESW Pump House HVAC System components is approximately 214 kW. Since DCD Table 8.3.1-6 indicates that the MCC capacity equals 400 kW, the MCCs can easily supply the required loads and the miscellaneous loads.

Also in **Question 09.04.05-11,** the staff inquired as to whether there would be any Class 1E instrumentation or electrical panels housed within the UHS ESW Pump House whose operation could be impacted by extreme ambient conditions of central Texas.

The applicant responded that the Class 1E electrical and I&C cabinets described in DCD Subsection 8.4.2.1.2 are located within the Class 1E electrical room and I&C room (Reference DCD **RAI 11, Question No 08.04-7**, ML082040270) and are not located within the UHS ESW pump house. The applicant went on to state that "… non-Class IE electrical and I&C cabinets are located within UHS ESW pump house and are typically designed to maintain their integrity at the maximum allowable room temperatures, including cabinet internal heating effects. Also, the failure of the non-Class 1E electrical and I&C cabinets will not impact any of the UHS/ESW safety-related functions."

The staff found the applicant's response to all parts of **RAI 3232, Question 09.04.05-11** as acceptable as the applicant provided sufficient technical detail with respect to the locations of the Class 1E and non-Class 1E electrical and I&C cabinets. Furthermore, the staff found no need to request that the applicant amend the FSAR, since the relevant information is already captured in the DCD. Based on this, **RAI 3232, Question 09.04.05-11,** is resolved and closed.

Inspection and Testing Requirements (including Preoperational Testing and ITACC)

In **RAI 3232, Question 09.04.05-12,** the staff requested additional information about: (a) the location of the fresh air intakes of the four UHS ESW Pump Houses with respect to the closest external sources of flammable or explosive gas, fuel-vapor mixtures or exhaust fumes; and (b) whether the four UHS ESW Pump Houses will internally harbor any potential sources of explosive gas or fuel-vapor mixtures

The applicant responded on December 16, 2009 (ML093520667), that the UHS ESW pump houses will not be located near any gas storage facility. Furthermore, that based on the location of the UHS ESW pump houses' fresh air intakes; there is no source of hazardous contaminant that could enter through the outside air openings. The UHS ESW pump houses do not harbor any potential sources of explosive gas or fuel-vapor mixtures on a continuous basis.

The staff verified that Revision 2 FSAR subsection 9.4.5.2.6 reflected the above response. The applicant also referenced FSAR, subsections 9.5.1.6.4.2.4 and 9.5.1.6.4.2.5, and indicated that the potential presence of explosive hazards internal to the pump houses is addressed by the CPNPP Fire Protection Program, which includes general housekeeping practices, control of transient combustibles, and procedures for the control of flammable and combustible gases. Also, in **RAI 3232, Question No. 09.04.05-12** the staff noted that one of the safety related design bases of FSAR subsection 9.4.5.3.6 reads … "Backdraft dampers are capable of withstanding the effects of tornado wind and atmospheric differential pressure loading." The staff could not find any mention of demonstrating this capability in either the Part 10 ITAAC of the COLA; the Preoperational Test 14.2.12.1.114; or the "Inspection and Testing Requirements" of FSAR subsection 9.4.5.4.6.

The staff requested that the COL applicant amend FSAR subsection 9.4.5.4.6 to include required factory testing of these dampers to demonstrate this capability and also amend the ITAAC to include verification of the operational integrity of the installed safety related backdraft dampers.

The applicant responded that **RAI No. 3532, Question 14.03.07-21**, dated November 13, 2009 (ML093210468) revised COLA Part 10, Table A.2-2 to add the UHS ESW pump house supply and exhaust backdraft dampers.

As a follow up, the staff subsequently issued **RAI 5585, Question 09.04.05-14,** to address the applicant's contention that the ESW Pump House pump rooms' backdraft dampers "do not perform an active safety function." The staff noted that these dampers must change position (i.e., full open or full closed) as "driven" by concurrent exhaust fan operation during all seasons to maintain pump room temperatures within design basis limits.

The applicant's response to **RAI 3232, Question 09.04.05-12** left the staff with two unresolved issues. More specifically in **RAI 5585, Question 09.04.05-14**, the staff requested that the applicant: (1) amend FSAR subsection 9.4.5.4.6 to include required factory testing of these dampers to demonstrate the dampers capability of withstanding the effects of tornadic winds and atmospheric differential pressure loading; and (2) amend the ITAAC to include verification of the operational capability of the installed safety related backdraft dampers to open fully upon exhaust fan induced flow and to fully close after exhaust fan shut down.

The applicant's response dated May 6, 2011 (ML111300166), resulted in FSAR subsection 9.4.5.4.6 documenting the requisite factory testing of the dampers. In response to Part (2), the applicant amended ITAAC Table A.2-2 with a note that indicates that the backdraft dampers are passive components that have the safety function to open in the direction of airflow and to close by counterbalance when no air flow is present. The staff found both of these FSAR changes acceptable and verified that Revision 2 of the FSAR included both changes.

However, the applicant did not amend ITAAC Table A.2-1 to include verification of this safety function. That is, the staff believes demonstrating the operational capability of the installed safety related backdraft dampers to open fully upon exhaust fan induced flow and to fully close after exhaust fan shut down is essential to maintaining the ESW Pump House room within design basis limits. The staff issued **RAI 6124, Question 09.04.05-19,** requesting that Luminant amend ITAAC Table A2-1 to demonstrate the operational capability of the safety related backdraft dampers.

Luminant responded on February 27, 2012 (ML12060A378), with proposed revisions to FSAR, Section 14.2.12.1.114, "UHS ESW Pump House Ventilation System Preoperational Test" and COLA Part 10 ITAAC Table A.2-1 "UHS ESW Pump House Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria." ITAAC Item "5.c" was created in Table A.2-1 to demonstrate the safety functions of the UHS ESW Pump House Ventilation System backdraft dampers. These changes fully resolve the staff's concern pertaining to maintaining the ESW Pump House rooms within design basis temperature limits per GDC 4 requirements.

The staff verified that the Tier 1 ITAAC and the Tier 2 FSAR of RCOLA Revision 3 contained the changes of the applicant's response to Question 09.04.05-19. Based on this, **RAI 3232, Question 09.04.05-12; RAI 5585, Question 09.04.05-14 and RAI 6124, Question 09.04.05-19, are resolved and closed.**

The staff also noted in **RAI 3232, Question 09.04.05-12,** that Preoperational Test 14.2.12.1.114, "UHS ESW Pump House Ventilation System Preoperational Test," lacked sufficient detail to clearly demonstrate the capability of the UHS ESW Pump House Ventilation to meet its safety related design basis. This design basis is stated in FSAR subsection 9.4.5.1.1.6 as:

> "The UHS ESW pump house ventilation system provides and maintains the proper environmental conditions within the required temperature range (40 °F – 120 °F) to support the operation of the instrumentation and control equipment and components in the individual UHS ESW pump houses during a design basis accident and LOOP with outside ambient design temperature condition of 0-percent temperature exceedance values."

Accordingly, in this RAI, Luminant was requested to revise FSAR subsection 14.2.12.1.114 to add verification that the heaters are capable of meeting their name plate heating capacities. Provide verification of preoperational testing of heater controls and alarms, and provide acceptance criteria for heater and exhaust fan flow rates. .

The applicant responded on December 16, 2009 (ML093520667) that **RAI 3366 Question 14.03.07-15** (ML093210468), revised ITAAC Table A.2-1 Item 4 the Design Commitment (DC) and Acceptance Criteria (AC) to show that the UHS ESW pump house ventilation system maintains the area design temperature limits in the respective rooms. The applicant went on to note that the DC and AC will verify the capability of the system unit heaters to perform their intended safety related function.

The staff concluded that upon review of the ITAAC Table A.2-1 Item 4 that the words of the AC lacked precise definition when compared to the words contained in FSAR subsection 9.4.5.1.1.6. To resolve this lack of consistency, the staff issued **RAI No. 5585, Question No. 09.04.05-15**.

The applicant response (ML111300166) to **Question 09.04.05-15** included the enhancements to ITAAC Table A.2-1 Item 4.

The staff verified that RCOLA Revision 2 ITAAC Table A.2-1 Item 4 contained these enhancements. However, the staff noted two areas in FSAR subsection 9.4.5.1.1.6 and ITAAC Table A.2-1 Item 4 that warranted a follow-up RAI 6124, Question 09.04.05-24. In particular, the staff requested that Luminant modify ITAAC Table A.2-1 of Item 4 to place equal emphasis on the ventilation "cooling" function of the exhaust fans and the heating function of the unit heaters. In this RAI, the staff also requested that Luminant amend FSAR subsection 9.4.5.1.1.6 to make it clear that the UHS ESW pump house ventilation system provides ventilation during normal plant operations and is not a standby system that only runs during accident scenarios.

The RCOLA applicant responded on February 27, 2012 (ML12060A378), with proposed changes to the Tier 2 FSAR and to the Tier 1 ITAAC. In particular, the applicant indicated that FSAR Subsection 9.4.5.1.1.6 would be revised to include normal operations and that ITAAC

Table A.2-1 Item 4 would be revised to specify the cooling function of the exhaust fans and heating function of the unit heater. The staff found the applicant's response acceptable since both the relevant ITAAC and FSAR subsection changes are consistent with the intent of satisfying GDC 4 requirements. The staff verified that Revision 3 of the RCOLA FSAR contained the changes proposed in the applicant's response to Question 09.04.05-24. Based on this, **RAI 3232, Question 09.04.05-12; RAI 5585, Question 09.04.05-15 and RAI 6124, Question 09.04.05-24, are resolved and closed.**

<u>SRP 9.4.5 – Section III "Review Procedures" – Miscellaneous Guidance</u>

In **RAI 3232, Question 09.04.05-10**, the staff did not find in its review of the COL applicant's FSAR the results of a Failure Modes and Effects Analysis (FMEA) specific to the UHS ESW Pump House Ventilation System as recommended by Item 3.D of SRP section 9.4.5**.** The staff requested that the applicant provide a summary of the FMEA for the ventilation system.

In response to this part of the question, the applicant in a response dated December 16, 2009 (ML093520667), agreed to add to the FSAR, Table 9.4-203 "UHS ESW Pump House Ventilation System Failure Modes and Effects Analysis." The staff verified that FSAR Section 9.4 Revision 2 contained Table 9.4-203. In this FMEA Table, the applicant included the pump house intake and exhaust back draft dampers. The applicant also stated "that the backdraft dampers are Seismic Category I and do not perform an active safety function as shown in revised ITAAC Table A.2-2" *(R*eference: **RAI No. 3532, Question 14.03.07-21** ML093130124)). The applicant went on to note that "…The backdraft dampers are a gravity balance type which open in the direction of air flow, and close due to the counterbalance when no air flow is present. Therefore, the backdraft dampers are not included as active safety mechanical components and are not required to be listed in FSAR Table 3D-201."

The staff disagreed with this statement. The resolution of this issue was addressed under **RAI 5585, Question 09.04.05-14,** as previously discussed in this SER section.

In addition in **RAI 3232, Question 09.04.05-10**, the staff deduced from FSAR subsection 9.4.5.3.6, that all the instrumentation (e.g. TS, TC, FE) and alarms displayed on Figure 9.4-201 "UHS ESW Pump House Ventilation System Flow Diagram" is equipment Class 3 and Seismic Category I. The staff found the following inconsistencies for this grouping of instrumentation:

- COL FSAR subsection 9.4.5.5.6 does not list TS and TCA instruments/alarms for the unit heaters contained in the ESW Pump Room or the UHS Transfer Pump Room;
- Not all the instrumentation displayed on Figure 9.4-201 appears in Table 3D-201 "Site-Specific Environmental Qualification Equipment List." FSAR subsection 3.11.1.1 reads "This table (i.e. Table 3D-201) lists information on site-specific safety-related or important to safety equipment." In addition, Table 3D-201 does not list the tornado resistant back draft dampers for the ESW Pump Rooms and UHS Transfer Pump Rooms (e.g. VRS-BDD-603A, VRS-BDD-601A); and
- COL FSAR Chapter 7 "Instrumentation and Controls" does not include any reference to the instruments displayed on Figure 9.4-201. Most of these instruments, if not all, are safety related.

The staff requested that the applicant provide additional information about these instrumentation inconsistencies and augment the FSAR as appropriate to provide clarification.

In the response the applicant indicated that FSAR Table 3D-201 “Site-Specific Environmental Qualification Equipment List” lists the safety related temperature switches. The safety function of these switches is to initiate the ESW and UHS transfer pump room exhaust fans and heaters. The description in FSAR Subsection 9.4.5.5.6 has been revised to be consistent with FSAR Table 3D-201. The applicant concluded that the remaining alarms, displays, and controls shown on FSAR Figure 9.4-201 are not relied upon for safety-related operation of the UHS ESW Pump House Ventilation System. To justify this conclusion, the applicant cited guidance from Revision 5 of SRP Section 7.1.I.1.I and referred to the response of **RAI No. 3532, Question 14.03.07-27** (ML093210468). The applicant stated that “The instrumentation described in DCD Subsection 9.4.5.5 and shown in FSAR Figure 9.4-201 supports safety-related HVAC system operation and is therefore, described in Chapter 9. FSAR Table 7.4-201 includes the ESW pump room and UHS transfer pump room exhaust fans and heaters among the site-specific components required for safe shutdown.”

The staff notes that there exists RAI No. 5755, Question No. 14.03.07-36 documented in the ITAAC SER for SRP section 14.3.7, that further challenged the applicant to justify the non-safety related classification of the whole population of instrumentation displayed in FSAR Figure 9.4-201. In concluding their response to **RAI 3232 Question No. 09.04.05-10,** the applicant in summary agreed to amend FSAR Revision I pages 9.4-5, 9.4-6, 9.4-7, 9.4-12, 9.4-13, 9.4-14, 9.4-15 and 9.4-16. The staff verified that FSAR Section 9.4 Revision 2 contained these changes. Based on the outstanding existence of **RAI No. 5755, Question 14.03.07-36**, the staff found “as acceptable” the applicant’s response to this part of **RAI 3232, Question 09.04.05-10.**

In **RAI 5585, Question 09.04.05-18**, the staff noted that COLA Part 10 ITAAC Table A.2-2 listed the safety related temperature switches (e.g. VRS-TS-2610C,D,E,F) for the “ESW Pump Room Temperature” and “UHS ESW pump Room Temperature “but not there in series Temperature Controllers (e.g. VRS-TC-2610C,D,E,F). The staff requested additional information about this series safety related/non-safety arrangement and the Class 1E and non-Class 1E control circuits.

The applicant responded on May 6, 2011 (ML111300166), that the temperature controllers located in series with their respective temperature switches, are part of a plant control system that starts/stops the associated heaters or exhaust fans. The plant control system used with safety-related components is the Protection and Safety Monitoring System (PSMS), which is a basic software program described in DCD Chapter 7 and incorporated by reference in the RCOLA. The signals from the temperature switches are transmitted to the PSMS, which provides the start or stop signal to the associated heaters and exhaust fans. The applicant concluded that Part 10 ITAAC Table A.2-2 was correct (i.e. no changes required). However, the applicant did commit to amend Figure 9.4-201(Figure 9.4-203 in FSAR Revision 2) to indicate that the temperature controllers are part of the plant control system. This change did not occur in RCOLA Revision 2 FSAR Figure 9.4-203. Also in **RAI 5585 Question No. 09.04.05-18**, the staff noted that safety related temperature switches (e.g. VRS-TS-2610C,D,E,F) did not appear in FMEA Table 9.4-203 as part of the applicant’s resolution to **RAI No. 3232, Question 09.04.05-10.** The applicant responded to this part of Question No. 09.04.05-18, by including renamed temperature switches [VRS-TS-803-S, 804-S, 805-S, 806-S (i.e., VRS-TS-2610C, D, E and F in COLA Revision 1)] in COLA Revision 2 FSAR Table 9.4-203. The staff found the applicant’s overall response acceptable but incomplete in that Revision 2 FSAR

Figure 9.4-203 failed to include a note that the temperature controllers are part of the plant control system. The staff addressed this residual issue in **RAI 6124, Question 09.04.05-25.** The applicant responded (ML12060A378) on February 12, 2012, that Figure 9.4-201 (i.e. formerly Revision 2 Figure 9.4-203) warranted no system interface designation with the PCMS or PSMS since the instrumentation symbol implicitly captures this interface. The staff found the applicant's composite RAI responses acceptable since the staff's original concern pertaining to the potential electrical interface of a Class 1E/non-Class 1E system was adequately justified. Based on this, **RAI 3232, Question 09.04.05-10; RAI 5585, Question 09.04.05-18; and RAI 243-6124, Question 09.04.05-25, are resolved and closed.**

9.4.5.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.4.5.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the ESF ventilation system, and there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in Section 9.4.5 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the ESF ventilation system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.4.5 of this SER to reflect the final disposition of the DC application.

- In addition, the staff concludes that the relevant information presented within FSAR Section 9.4.5 is acceptable and meets the requirements of GDC 2, GDC 4, GDC 5, GDC 17, and GDC 60; 10 CFR 50.63; and 10 CFR 52.80(a), with the exception of the two confirmatory items noted herein.

The confirmatory items are as follows:

- **CONFIRMATORY ITEM – RAI 6898, Question 09.04.05-26**
- **CONFIRMATORY ITEM – RAI 6124, Question 09.04.05-23**

The staff has determined that the applicant's supplemental information complies with the requirements of NRC regulations 10CFR50 Appendix A GDC 2, GDC 4, GDC 5 and GDC 17, GDC 60, 10CFR50.63 and 10 CRF 52.80(a).

Based on the review documented above, and the applicant's responses to the staff's RAIs, which is being tracked as Confirmatory Items **RAI 6898 Question 9.4.5-26 and RAI 6124, Question 09.04.05-23,** the staff concludes that the applicant has adequately addressed COL Information Item STD 9.4(6).

9.4.6 Containment Ventilation System

9.4.6.1 Introduction

The Containment Ventilation System (CVS) controls and maintains the environmental temperature and radioactivity concentration within the containment at a level suitable for the plant equipment operation. CVS also allows safe access to operating personnel for inspection and maintenance activities. The CVS includes safety-related and non-safety related systems.

The safety-related system serving the CVS consists of the containment penetration isolation assemblies.

The CVS includes:

- Containment fan cooler system;
- Control rod drive mechanism (CRDM) cooling ;
- Reactor cavity cooling system; and
- Containment low volume and high volume purge system.

The CVS is classified as a non-safety-related, non-Seismic Category I system. However, ductwork is supported, as required, to prevent adverse interaction with safety-related systems during a seismic event.

The staff reviews the CVS to ensure it satisfies the following safety design bases:

- The containment purge system has the capability to close the safety-related, Seismic Category I, containment isolation valves during a design-basis accident.
- The safety-related containment isolation valves isolating the containment are connected to separate electrical safety buses that satisfy the single active failure criterion.
- The containment isolation valve assemblies are designed to withstand the effect of adverse environment conditions.
- The CVS meets GDC 2 by being located within Seismic Category I and II structures and by meeting the acceptance criteria of RG 1.29, Position C.1 for safety-related portions of the system and Position C.2 for non-safety-related portions. The containment and the reactor building contain the safety-related portions of the CVS and are protected from the effects of natural phenomena such as earthquakes (DCD Section 3.7), wind and tornados (DCD Section 3.3), floods (DCD Section 3.4), and external missiles (DCD Section 3.5).

9.4.6.2 Summary of Application

Section 9.4 of the CPNPP3&4 COL FSAR incorporates by reference Section 9.4.6, “Containment Ventilation System,” of the US-APWR DCD, Revision 3.

In addition, in CPNPP3&4 COL FSAR Section 9.4.6, the applicant provided the following:

<u>US-APWR COL Information Item</u>

- STD COL 9.4(4)

The applicant provided additional information to address COL Information Item 9.4(4), which states:

> The COL Applicant is to determine the capacity of cooling and heating coils that are affected by site-specific conditions.

For the following FSAR subsections:

- 9.4.6.2.4.1 Containment Low-Volume Purge System; and
- 9.4.6.2.4.2 Containment High-Volume Purge System.

The COL applicant provided additional information with STD COL 9.4(4). For each of these subsections in the FSAR, the sentence "*The capacity of cooling and heating coils that are affected by site-specific conditions is shown in Table 9.4-201.",* will replace relevant sentence in DCD Subsections 9.4.6.2.4.1 and 9.4.6.2.4.2 that assigns this responsibility to the COL applicant.

The COL applicant included in FSAR Table 9.4-201, "Equipment Design Data," the cooling coil capacity of 190,000 Btu/hr and the heating coil capacity of 30 kW for each of the two Containment Low-Volume Purge Air Handling Units.

The COL applicant included in FSAR Table 9.4-201, "Equipment Design Data," the cooling coil capacity of 2,820,000 Btu/hr and the heating coil capacity of 440 kW for the single Containment High-Volume Purge Air Handling Unit.

<u>Interface Requirements</u>

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.4.6 of the DCD.

9.4.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

The staff determined it to be appropriate to review DCD Section 9.4.6, "Containment Ventilation System," against the regulatory requirements and acceptance criteria given in SRP Section 6.5.1, "ESF Atmosphere Cleanup Systems." Similarly, the staff chose to review FSAR subsection 9.4.6, "Containment Ventilation System," against the regulatory requirements and acceptance criteria given in SRP Section 6.5.1. Accordingly, the relevant requirements of the Commission's regulations for CP COL 9.4(4) / STD COL 9.4(4), and the associated acceptance criteria, are given in SRP Section 6.5.1.

In addition, the relevant requirements of the Commission regulations for the site-specific information on the containment ventilation system are also as follows:

1. 10 CFR 52.80(a), which requires that a COL application include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that

the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC regulations.

9.4.6.4 Technical Evaluation

The NRC staff reviewed Section 9.4.6 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[8] The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the containment ventilation system. Section 9.4.6 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information, incorporated by reference, related to the containment building ventilation system will be documented in the staff SER on the DC application for the US-APWR design.

The staff reviewed the COL information contained in the FSAR:

US-APWR COL Information Item

- STD COL 9.4(4): *Capacity of heating coils in safety-related HVAC system and capacity of cooling and heating coils in non-safety related HVAC system air handling units that are affected by site-specific conditions.*

The NRC staff reviewed STD COL 9.4(4) related to COL Information Item 9.4(4), included under Section 9.4.6 of the CPNPP3&4 COL FSAR. The applicant provided information regarding the site-specific capacities of heating and cooling coils of the low-volume and high-volume containment purge subsystems in FSAR Sections 9.4.6.2.4.1, 9.4.6.2.4.2, and Table 9.4-201.

The staff determined that the function of the containment purge system's heating and cooling coils is non-safety-related. The staff also determined that the FSAR changes as described in Subsection 9.4.6.2, "Summary of Application," of this SER satisfy STD COL 9.4(4) and US-APWR COL 9.4(4).

The DCD specifies the four subsystems and integral components that comprise the CVS as non-safety-related with one exception. This one exception pertains to the containment purge subsystem's four sets of containment isolation valves. These valves are listed against containment penetration numbers P451, P452, P410, and P401 in DCD Table 6.2.4-3. DCD Section 9.4.6.1.1 specifies these isolation valves as Seismic Category I and safety-related. To satisfy the requirements of STD COL 9.4(4) for the CVS, the FSAR amends DCD Subsections 9.4.6.2.4.1, 9.4.6.2.4.2 and 9.4.7 and adds Table 9.4-201 to accommodate the site-specific needs of CPNPP 3&4.

The staff notes that the heating coils and cooling coils of the Containment Purge System air handling units as defined in DCD Table 3.2-2 are classified as "NS" (i.e., non-Seismic). The

[8] See Chapter 1 for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

sizing of these coils by the COL applicant per the requirements of STD COL 9.4(4) does not affect this classification.

DCD Table 9.4-1, "Area Design Temperature and Relative Humidity," defines the minimum and maximum temperatures of the areas served by the Containment Ventilation System. The function of the heating coils and the cooling coils of the Containment High Volume Purge System is to maintain the temperature in these areas within these minimum and maximum values during refueling operations. Neither the heating function nor the cooling function is safety-related. Neither the heating coils nor the cooling coils support any regulatory requirements.

The Containment Low Volume Purge System is not meant to be used for containment cooling and heating. This is indicated in Note 4 to DCD Table 9.4-1. DCD section 9.4.6.2.4.1 indicates that the supply air to the containment is dehumidified and tempered to minimize the condensation within containment ventilation system components. The design capacity of the heating and cooling coils is determined by the ambient design outside dry- and wet-bulb temperature conditions.

9.4.6.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.4.6.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the containment building ventilation system, and there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in Section 9.4.6 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the containment building ventilation system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.4.6 of this SER to reflect the final disposition of the DC application.

In addition, the staff concludes that the relevant information presented within FSAR Section 9.4.6 is acceptable and meets the requirements of 10 CFR 52.80(a). The staff based its conclusion on the following:

- STD COL 9.4(4), as related to information on the capacities of cooling and heating coils of the containment purge system as they are affected by site-specific conditions, is acceptable to the staff because from its review, the staff has determined that that the applicant has adequately addressed STD COL 9.4(4) and US APWR COL 9.4(4).

- The staff concludes that FSAR changes as described in subsection 9.4.6.2 "Summary of Application" of this SER affect non safety related SSCs.

9.5 Other Auxiliary Systems

9.5.1 Fire Protection Program

9.5.1.1 Introduction

The primary objectives of the fire protection program (FPP) are: to minimize the potential for fire and explosions to occur; to rapidly detect, control, and extinguish any fire that may occur; and to assure that any fire that may occur will not prevent the performance of necessary safe-shutdown functions and will not significantly increase the risk of radioactive releases to the environment. In addition, the fire protection systems are designed such that any system failure or inadvertent operation does not adversely impact the ability of the SSCs important to safety to perform their safety function.

Section 9.5 describes the staff's evaluation of the applicant's fire protection program for both 10 CFR Part 52, Subpart C, "Combined Licenses," and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

9.5.1.2 Summary of Application

Section 9.5.1 of the CPNPP3&4 COL FSAR, Revision 3 incorporates by reference Section 9.5.1 and associated Appendix 9A of the US-APWR DCD, Revision 3.

In addition, in CPNPP3&4 COL FSAR Section 9.5.1, the applicant provided the following supplemental information:

COL Information Items

- STD and CP COL 9.5(1)

The applicant provided additional information in STD and CP COL 9.5(1) to address COL Information Item 9.5(1), which states:

> The COL Applicant establishes a fire protection program, including organization, training and qualification of personnel, administrative controls of combustibles and ignition sources, firefighting procedures, and quality assurance.

- STD and CP COL 9.5(2)

The applicant provided additional information in STD and CP COL 9.5(2) to address COL Information Item 9.5(2), which states:

> The COL Applicant addresses the design and fire protection aspects of the facilities, buildings, and equipments, such as cooling towers and a fire protection water supply system, which are site-specific and/or are not a standard feature of the US-APWR.

- CP COL 9.5(3)

The applicant provided additional information in CP COL 9.5(3) to address COL Information Item 9.5(3), which states:

> The COL Applicant provides apparatus for plant personnel and fire brigades such as portable fire extinguishers, and self contained breathing apparatus.

Initial Test program

Additional preoperational test for the fire protection system outside the scope of the US-APWR certified design is described in CPNPP3&4 COL FSAR Section 14.2.12.1 as follows:

> Verify that local offsite fire departments utilize hose threads or adapters capable of connecting with onsite hydrants, hose couplings, and standpipe risers.

ITAAC

Additional fire protection system ITAAC (portions outside the scope of the US-APWR certified design) is described in CPNPP3&4 COL Part 10, Appendix A.6, as follows:

1. The seismic standpipe system can be supplied from a seismic Category I water source (ESWS) with a capacity of at least 18,000 gallons.

2. The fire protection system water supply is from two separate, reliable freshwater sources (the two fire water storage tanks).

The CPNPP3&4 COL Part 10, Appendix A.3, also contains ITAAC related to the fire protection program as follows:

1. Redundant safe shutdown components and associated electrical divisions of the UHSRS, ESWPT, and PSFSV are separated by 3-hour rated fire barriers to preserve the capability to safely shutdown the plant following a fire.

2. Penetrations and openings through the fire barriers of the UHSRS, ESWPT, and PSFSV are protected against fire.

9.5.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.
The applicable regulatory requirements and guidance for the site-specific information on the FPP are as follows:

1. 10 CFR 50.48, “Fire Protection,” which requires that operating nuclear power plants have a fire protection plan that satisfies GDC 3 and also provides general requirements regarding the content of the fire protection plan.

2. 10 CFR Part 50, Appendix A, GDC 3, “Fire Protection,” establishes the criteria for the fire and explosion protection of SSCs important to safety. GDC 3 also establishes the criteria for fire detection and firefighting systems and for the use of noncombustible and heat-resistant materials throughout the unit.

3. 10 CFR Part 50, Appendix A, GDC 5, “Sharing of Structures, Systems, and Components,” as it applies to shared fire protection systems and potential fire impacts on shared SSCs important to safety.

4. 10 CFR Part 50, Appendix A, GDC 19, “Control Room,” as it applies to providing the capability both inside and outside the control room to operate plant systems necessary to achieve and maintain safe-shutdown conditions.

5. 10 CFR Part 50, Appendix A, GDC 23, ”Protection System Failure Modes,” as it applies to safe-failure states of the protection system when exposed to adverse conditions associated with fire events or inadvertent operation of the fire protection systems.

6. 10 CFR 52.80(a), which requires that a COL application include the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC regulations.

7. 10 CFR 70.23(a)(3), which requires the applicant’s proposed equipment and facilities to be adequate to protect health and minimize danger to life or property.

8. 10 CFR 70.23(a)(4), which requires the applicant’s proposed procedures to protect health and to minimize danger to life or property are adequate.

9. NUREG-0800, Standard Review Plan, Section 9.5.1, ‘Fire Protection Program,’ Revision 5

10. Regulatory Guide 1.189, “Fire Protection for Nuclear Power Plants,” Revision 1, March 2007

11. NUREG-1520, “Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility,” March 2002

9.5.1.4 Technical Evaluation for 10 CFR Part 52 COLA

The NRC staff reviewed Section 9.5.1 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic. The NRC staff’s review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the FPP. Section 9.5.1 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff’s technical evaluation of the information incorporated by reference related to the FPP will be documented in the staff SER on the DC application for the US-APWR design.

The staff reviewed the additional information contained in the CPNPP3&4 COL FSAR:

COL Information Items

- STD and CP COL 9.5(1)

The NRC staff reviewed STD and CP COL 9.5(1) related to COL Information Item 9.5(1), included under Section 9.5.1 of the CPNPP3&4 COL FSAR. The applicant provided information regarding site-specific elements of the FPP such as organization, training and qualification of personnel, administrative procedures, and quality assurance in CPNPP3&4 COL FSAR Sections 9.5.1, 9.5.1.2, 9.5.1.6, and Tables 9.5.1-1R and 9.5.1-2R.

The NRC staff determined that the above sections and tables provided adequate details to ensure conformance with the regulatory positions contained in RG 1.189 regarding the implementation of the CPNPP3&4 FPP. However, there were several areas where clarifications to the fire protection program descriptions are required. Therefore, the staff issued **RAI 2328, Question 09.05.01-08**, in which it requested the applicant to clarify whether storage of unused ion exchange resins or hazardous chemicals and combustible materials will be permitted in safety related areas and describe what administrative controls exist for such storage.

In its response dated August 11, 2009, (ML092430784), and in its supplemental letter dated February 19, 2010, (ML100550214), the applicant revised FSAR 9.5.1.6.4.2.4, to clarify that the use of hazardous chemicals and combustibles in safety related areas will be administratively controlled through the combustibles control program and the site hazardous material control program. In addition, the fire protection supervisor review and approval will be implemented for the use of combustibles in safety related areas. The applicant's response meets the guidance described in RG 1.189. The proposed CPNPP3&4 FSAR revisions as prescribed in the above letters have been incorporated in the CPNPP3&4 COLA, Revision 2. Therefore, **RAI 2328, Question 09.05.01-08, is resolved and closed** and the applicant has adequately addressed STD and CP COL 9.5(1)**.**

- STD and CP COL 9.5(2)

The NRC staff reviewed STD and CP COL 9.5(2) related to COL Information Item 9.5(2), included under Section 9.5.1 of the CPNPP3&4 COL FSAR. The applicant addressed the design and fire protection aspects of facilities, buildings, and equipment which are site-specific and not standard features in the US-APWR design of the FPP in CPNPP3&4 COL FSAR Sections 9.5.1.2.1, 9.5.1.2.2, 9.5.1.2.3, 9.5.1.2.4, Tables 9.5.1-1R and 9.5.1-2R, and Figures 9.5-201 and 9.5-202. Interface information concerning essential service water as a source for fire protection water, as required under certain conditions, was provided in CPNPP3&4 COL FSAR Section 9.2.1.2.1.

In addition, the applicant provided fire hazard analysis (FHA) for site-specific plant structures and associated fire areas and/or fire zones in CPNPP3&4 COL FSAR Sections 9A.3.101 through 9A.3.114; Tables 9A-201, 9A-202, and 9A-203; and Figures 9A-201 and 9A-202.

The NRC staff determined that adequate details have been provided by the applicant to ensure conformance with the regulatory positions contained in RG 1.189. In its response to **RAI 2328**, **Question 09.05.01-15,** dated August 11, 2009, (ML092240406), the applicant revised FSAR pages 9.5-2 and 9.5-22 to clarify that the fire protection water storage tank will be designed in accordance with NFPA 22. These proposed FSAR changes were incorporated in the CPNPP3&4 COL FSAR updates found in the CPNPP3&4 COLA, Revision 2.

The CPNPP3&4 cooling towers are of noncombustible construction in accordance with RG 1.189 and are separated from adjacent cooling towers by a 3-hour fire rated wall of reinforced concrete; therefore, it is anticipated that a postulated fire would be confined to one cooling tower and will not affect the other redundant trains.

Based on the above, it is concluded that the applicant adequately addressed COL Information Item 9.5(2) and the staff considers **RAI 2328**, **Question 09.05.01-15 to be closed and resolved.**

- CP COL 9.5(3)

The NRC staff reviewed CP COL 9.5(3) related to COL Information Item 9.5(3), included under Section 9.5.1 of the CPNPP3&4 COL FSAR. The applicant provided information regarding site-specific apparatus for plant personnel and fire brigades such as portable fire extinguishers and self-contained breathing apparatus in CPNPP3&4 COL FSAR Section 9.5.1.6.1.8 and Table 9.5.1-2R.

The NRC staff determined that adequate details were provided by the applicant to ensure conformance with the regulatory positions contained in RG 1.189. In its response to **RAI 2328**, **09.05.01-15,** dated August 11, 2009 (ML092240406), the applicant clarified that at least 10 self-contained breathing apparatus are available for fire brigade use and each unit will be provided with an additional 1-hour supply of breathing air in extra bottles. In addition, in its response dated May 1, 2009 (ML091250488), to **RAI 2332**, **Question 14.3-1** the applicant provided that the CPNPP3&4 Fire Protection System Preoperational Test Program will be revised to add a new item to ensure verification that local offsite fire departments utilize hose threads or adapters capable of connecting with onsite hydrants, hose couplings and standpipe risers. These changes were incorporated inCPNPP3&4 COL FSAR, Revision 2. Based on the above, it is concluded that the applicant has adequately addressed COL 9.5(3) and the applicant's response complies with the guidance described in RG 1.189. **RAI 2332, Question 14.3-1 is resolved and closed**.

Initial Test Program

In addition to fire protection system preoperational testing as part of the certified design, the CPNPP3&4 COL FSAR, Revision 2 included a provision to verify that local offsite fire departments utilize hose threads or adapters capable of connecting with onsite hydrants, hose couplings, and standpipe risers in the initial test program. This will ensure equipment compatibility between plant and outside fire brigade in accordance with RG 1.189. Therefore, it is concluded that the initial test program related to the fire protection system is acceptable.

ITAAC

Plant-specific ITAAC's related to the fire protection system (portions outside the scope of the US-APWR certified design) is described in CPNPP3&4 COL Part 10, Appendix A.3 and A.6. The ITAAC's in Appendix A.3 ensures that redundant safe-shutdown components and cables of the UHSRS, ESWPT, and PSFSV are separated by 3-hour rated fire barriers to maintain post-fire safe shutdown capability. The ITAAC's in Appendix A.6 ensures that the fire protection system is supplied from two separate, reliable freshwater sources. In addition, an alternate 18,000 gallons safety-related water source (ESWS) can be aligned to the seismic standpipe system for fire-fighting activities during safe-shutdown earthquake events. The above design features are implemented in accordance with RG 1.189; therefore, the NRC staff concluded that the plant-specific ITAAC's as described are acceptable.

9.5.1.5 Technical Evaluation 10 CFR Part 70 Special Nuclear Material

The fire protection review was performed relative to the guidance provided in NUREG-1520. The information to support this review was obtained from Revision 3 of the COLA submitted by Luminant for construction and operation of a nuclear power generating plant designated as Comanche Peak 3 and 4, dated June 2012 (COLA).

Building Construction and Facility Design

The facility and its original fire protection systems are designed and will be constructed to industrial standards currently in effect. The applicant commits to meeting the prevailing codes whenever facilities are expanded or modified. Facilities are generally noncombustible masonry or metal construction. Lightning protection is incorporated into the facility design. Facility exit routes are posted throughout and are unimpeded by physical security requirements. In addition, workers are trained in evacuation, and periodic drills are conducted to verify the adequacy of egress.

Process Fire Safety

Within the Fuel Building, which is a Seismic Category I structure, new fuel bundles are brought in through the rail car bay, uncrated, raised to the fuel handling area, and transferred for storage on dry racks in the new fuel storage pit within the Reactor Building, also a Seismic Category I structure. The process itself utilizes methods and materials that have no fire safety concerns.

Fire Protection and Emergency Response

The fire protection equipment in the fuel handling area of the Fuel Building includes fire detection, portable fire extinguishers, and hose stations for manual firefighting. Additionally, wet pipe sprinklers are provided in the rail car bay. Site procedures for the maintenance and surveillance testing of the above-listed equipment; including fire pump, fire mains, standpipes, and hoses have been developed and will be performed as described in the FPP. In addition, the compensatory actions described in the FPP will be used should any of the listed fire equipment becomes unavailable.

Effective handling of fire emergencies is accomplished by trained and qualified emergency response personnel. The fire response organization is staffed and equipped for firefighting activities. The fire brigade is composed of a fire brigade leader and four fire brigade members. The fire brigade does not include the Shift Manager or other members of the minimum shift crew necessary for safe shutdown of the unit, nor any personnel required for other essential functions during a fire emergency. Additional support is available when needed through an agreement with a local fire department.

Training ensures that the capability of the fire brigades capability to combat fires is established and maintained. The training program consists of initial (classroom and practical) training, and recurrent training, which includes periodic instruction, fire drills, and annual fire brigade training.

Firefighting equipment is provided throughout the plant. Fire emergency procedures and Pre fire Plans specify actions taken by the individual discovering the fire and by the emergency response organization. A specific pre-fire plan has been prepared for the fuel receipt area and the fuel storage area. Discussion of this pre-fire plan is included in the periodic classroom instruction's training program provided for the Emergency Response Team.

Fire Safety Management

Combustibles are controlled to reduce the severity of a fire which might occur in a given area and to minimize the amount and type of material available for combustion. The use and application of combustible materials at CPNPP3&4 are controlled utilizing the following methods:

- instructions/guidelines provided during general employee training/orientation programs;

- the chemical control program;

- periodic plant housekeeping inspections/tours by management and/or the plant fire protection organization;

- design/modification review and installation process; and

- administrative procedures (e.g., Transient Combustible Control Program).

The use of ignition sources such as welding, flame cutting, thermite welding, brazing, grinding, arc gouging, torch applied roofing, and open flame soldering within safety-related areas are controlled through the approval and issuance of an ignition source permit. Permits are reviewed and approved by appropriate plant personnel. The ignition source permit is valid for one job. Job area inspection will be performed and documented at the start of each shift that ignition source activities are being performed.

Fire Hazards Analysis

The Fire Hazards Analysis (FHA) is part of the FPP. The FHA results are documented on a fire area basis, broken down into separate discussions of classical fire protection features and safe shutdown analysis for each fire area. The FHA is required to be updated, prior to receipt of the new fuel and is as part of the License Condition previously mentioned in Section 7.3.3. The FHA includes the following:

- A summary of the evaluation performed to determine the adequacy of the fire protection features for each fire area; and

- A discussion of the ability to achieve safe shutdown in case of a fire in each fire area. The fire hazards and safe shutdown evaluation were performed by qualified nuclear, mechanical, electrical, and fire protection engineers.

The FHA and Pre-Fire Plans conform to the applicable guidance provided in the National Fire Protection Association (NFPA) 801, “Standard for Fire Protection for Facilities Handling Radioactive Materials” (NFPA, 2008).

Evaluation Findings

The staff concluded that the applicant's capabilities meet the criteria in Chapter 7 of NUREG-1520 (NRC, March 2002). The staff determined that the applicant's equipment, facilities, and procedures provide reasonable assurance that adequate fire protection will be provided and maintained to meet the criteria of 10 CFR 70.23(a)(3) and 10 CFR 70.23(a)(4).

<u>REFERENCES</u>

1. (NRC, 2002) U.S. Nuclear Regulatory Commission (NRC). NUREG-1520, A Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility, March 2002.

2. (NFPA, 2008) National Fire Protection Association (NFPA). NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials," 2008.

9.5.1.6 10 CFR Part 52 and 70 License Conditions

By letter dated January 14, 2011, the NRC staff issued RAI Number 198. In its RAI, the staff requested the applicant to implement applicable portions of the Fire Protection Program prior to initial receipt of byproduct, source, or special nuclear materials onsite (excluding Exempt Quantities as described in 10 CFR 30.18). In its response dated May 6, 2011, the applicant added the following implementation milestone in FSAR Table 13.4-201, "Operational Programs Required by NRC Regulation and program Implementation," item 8 titled 'Fire Protection Program' to the two license conditions provided in COL FSAR, Revision 3, Table 13.4-201.

The COLA, FSAR Revision 3 Table 13.4-201, Item 8, 'Fire Protection Program,' provides the following license conditions and program milestone below:

- The licensee shall implement the Fire Protection Program on or before the associated milestones identified below.

    1. The Construction Fire Protection Program will be in place prior to initial receipt of byproduct, source, or special nuclear materials (excluding Exempt Quantities as described in 10 CFR 30.18);

    2. Prior to fuel receipt for elements of the Fire Protection Program necessary to support receipt and storage of fuel on site; and

    3. Prior to initial fuel load for elements or the Fire Protection Program necessary to support fuel load and plant operation.

Pursuant to the requirements of RG1.189, the staff has revised the license conditions and milestone as follows:

- License Condition (9-1) - The licensee shall implement the Fire Protection Program on or before the associated milestones identified below.

    1. The Fire Protection measures in accordance with Regulatory Guide 1.189 for designated storage building areas (including adjacent fire areas that could affect the storage area) implemented before initial receipt of

byproduct or special nuclear materials that are not fuel (excluding exempt quantities as described in 10 CFR 30.18);

2. The fire protection measures in accordance with Regulatory Guide 1.189 for areas containing new fuel (including adjacent areas where a fire could affect the new fuel) implemented before receipt of fuel onsite; and

3. All Fire Protection Program features implemented before the initial fuel load.

The NRC staff finds the modified license conditions and milestone as modified acceptable because it ensures the applicant implements the fire protection program that complies with the guidance described in RG 1.189.

9.5.1.7 Post-Combined License Activities

The following post-COL activity is identified as the responsibility of the NRC staff:

Verify the adequacy of CPNPP3&4's final fire hazards and safe shutdown analyses based on as-built information prior to fuel load.

- License Condition (9-1) - The licensee shall implement the Fire Protection Program on or before the associated milestones identified below:

    1. The Fire Protection measures in accordance with Regulatory Guide 1.189 for designated storage building areas (including adjacent fire areas that could affect the storage area) implemented before initial receipt of byproduct or special nuclear materials that are not fuel (excluding exempt quantities as described in 10 CFR 30.18);

    2. The fire protection measures in accordance with Regulatory Guide 1.189 for areas containing new fuel (including adjacent areas where a fire could affect the new fuel) implemented before receipt of fuel onsite; and

    3. All Fire Protection Program features implemented before the initial fuel load.

9.5.1.8 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the FPP, and there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in Section 9.5.1 of the US-APWR DCD on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the FPP incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.5.1 of this SER to reflect the final disposition of the DC application.

The staff concluded that the applicant's capabilities meet the criteria in Chapter 7 of NUREG-1520 (NRC, March 2002). The staff determined that the applicant's equipment, facilities, and procedures provide reasonable assurance that adequate fire protection will be provided and maintained to meet the criteria of 10 CFR 70.23(a)(3) and 10 CFR 70.23(a)(4).

In addition, the staff concludes that the relevant information presented within the CPNPP3&4 COL FSAR is acceptable and meets the requirements of 10 CFR 50.48; GDC 3, GDC 5, GDC 19, and GDC 23; 10 CFR Part 72; and 10 CFR 52.80(a). The staff based its conclusion on the following:

- CP COL 9.5(1), as related to site-specific elements of the FPP such as organization, training and qualification of personnel, administrative procedures, and quality assurance, is acceptable because these CPNPP3&4 site-specific FPP aspects are in conformance with the applicable regulatory positions of RG 1.189, Fire Protection for Nuclear Power Plants, which ensure compliance with the requirements of 10 CFR 50.48, Fire Protection.
- CP COL 9.5(2), as related to the design and fire protection aspects of facilities, buildings, and equipment, which are site-specific and not standard features in the US-APWR, is acceptable because the design of these site-specific fire protection systems and features are in accordance with the regulatory positions of RG 1.189, Fire Protection for Nuclear Power Plants, which ensure compliance with the requirements of 10 CFR 50.48, Fire Protection.
- CP COL 9.5(3), as related to site-specific apparatus for plant personnel and fire brigades such as portable fire extinguishers and self-contained breathing apparatus, is acceptable because these CPNPP3&4 site-specific FPP aspects are in conformance with the applicable regulatory positions of RG 1.189, Fire Protection for Nuclear Power Plants, which ensure compliance with the requirements of 10 CFR 50.48, Fire Protection.
- The additional fire protection system preoperational testing to verify that local offsite fire departments utilize hose threads or adapters capable of connecting with onsite hydrants, hose couplings, and standpipe risers in the initial test program is acceptable because it will ensure equipment compatibility between plant and outside fire brigade in accordance with RG 1.189.
- The implementation of additional plant-specific ITAAC's related to the fire protection system (portions outside the scope of the US-APWR certified design) to ensure redundancy of the UHSRS, ESWPT and PSFSV, and to ensure availability and reliability of the fire water system during normal as well as seismic conditions, is acceptable because these design features are implemented in accordance with RG 1.189.

9.5.2 Communication System

9.5.2.1 Introduction

The staff review of the CPNPP3&4 communications system includes that portion of the system used in intra-plant and plant-to-offsite communications during normal operation, transients, fire, accidents, off-normal phenomena, including LOOP, and security-related events. Examples of normal operation intra-plant communication are during IST, inspection, and maintenance. An example of normal plant-to-offsite communication is for plant operators to communicate with offsite electric power grid transmission organization staff regarding the nuclear power plant offsite power status. Other examples of plant-to-offsite communication are between plant operators and the NRC Incident Response Center and local authorities when the plant is operating during natural phenomena such as a tornado, hurricane, flood, tsunami, lightning strike, and earthquake. The staff's review of security communications is presented in Section 13.6, "Security."

9.5.2.2 Summary of Application

Section 9.5 of the CPNPP3&4 COL FSAR, Revision 3 incorporates by reference Section 9.5 of the US-APWR DCD, Revision 3, which includes Section 9.5.2, "Communications Systems," with supplements as described below.

The DCD Section 9.5.2, "Communication Systems," lists systems that are provided for communication between various parts of the nuclear power plant and with offsite organizations such as the utility company, government agencies, support agencies, and other locations during normal operations, testing and drills, maintenance, transient, fire, emergency, and accident conditions under maximum potential noise levels. The listed systems are:

- Public address system/page (2 way communications, PA/PL);
- Telephone system (onsite and offsite communications, PABX);
- Sound powered telephone system (SPTS);
- Plant radio system;
- Offsite communication systems, including emergency communication systems; and
- Plant security communication systems.

In addition, in CPNPP3&4 COL FSAR Section 9.5.2, the applicant provided the following:

US-APWR COL Information Items

- CP COL 9.5(4)

The applicant provided additional information in Comanche Peak (CP) COL 9.5(4) to provide site-specific design information for communication system interfaces external to the plant (offsite locations). This COL item is addressed in Sections 9.5.2, 9.5.2.2.2, 9.5.2.2.2.2, and 9.5.2.2.5.1. CP COL 9.5(4) states:

> The COL Applicant addresses all communication system interfaces external to the plant (offsite locations). These include interfaces to utility private networks, commercial carriers and the federal telephone system. The configuration of these connections will include consideration of the concerns raised in IE Bulletin 80-15.

- CP COL 9.5(5)

The applicant provided additional information in CP COL 9.5(5) to provide site-specific design information for emergency offsite communications. This COL item is addressed in Sections 9.5.2.2.2, 9.5.2.2.2.2 and 9.5.2.2.5.2. CP COL 9.5(5) states:

> The COL Applicant addresses the emergency offsite communications including the crisis management radio system.

- CP COL 9.5(6)

The applicant provided additional information in CP COL 9.5(6) to provide site-specific design information for connections to the technical support center. This COL item is addressed in Section 9.5.2.2.5.2. CP COL 9.5(6) states:

> The COL Applicant addresses connections to the Technical Support Center from where communication networks are provided to transmit information pursuant to the requirements delineated in 10 CFR *[Part]* 50 Appendix E, Part IV.E.9.

- CP COL 9.5(8)

The applicant provided additional information in CP COL 9.5(8) to provide site-specific design information for the offsite communications for the onsite operations support center. This COL item is addressed in Section 9.5.2.2.5.2. CP COL 9.5(8) states:

> The COL Applicant addresses offsite communications for the onsite operations support center.

9.5.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the relevant requirements of the Commission regulations for the communications system, and the associated acceptance criteria, are given in Section 9.5.2 of NUREG-0800

The applicable regulatory requirements for the communications system are as follows:

1. Part IV.E(9) of Appendix E to 10 CFR Part 50, “Emergency Planning and Preparedness for Production and Utilization,” as it relates to the provision of at least one onsite and one offsite communications system, each with a backup power source.

2. Part IV.D(1) of Appendix E to 10 CFR Part 50, which requires a description of the administrative and physical means for notifying local, state, and federal officials and agencies.

3. 10 CFR 50.34(f)(2)(xxv), “Emergency Response Facilities,” (TMI Action Plan Item III A.1.2), which requires an onsite TSC.

4. 10 CFR 50.47(a)(8), “Equipment and Facilities to Support Emergency Response.”

5. 10 CFR 50.47(b)(6), which requires that provisions exist for prompt communications among response organizations to emergency personnel and to the public.

6. 10 CFR 50.47(b)(8), which requires adequate emergency facilities and equipment such as an offsite communication system.

The related acceptance criteria are as follows:

1. RG 1.206, as it relates to COL treatment of communications systems.

2. NUREG-0654, as it relates to communication devices in respiratory protective devices.

3. NUREG-0696, as it relates to the criteria for emergency response facilities (ERFs) and calls for at least one dial telephone capable of reaching onsite and offsite locations.

4. NRC Bulletin 80-15, as it relates to the Emergency Notification System (ENS) states, in part, "… all extensions of the ENS located at your facility(ies) would remain fully operable from the facility(ies) to the NRC Operations Center in the event of a loss of offsite power to your facility(ies)."

9.5.2.4 Technical Evaluation

The NRC staff reviewed Section 9.5.2 of the CPNPP3&4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic. The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the communications system. Section 9.5.2 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information incorporated by reference related to the communications system will be documented in the staff SER on the DC application for the US-APWR design.

The staff reviewed FSAR Section 9.5.2 against the guidance in RG 1.206, Section C.III.1, Chapter 9, C.I.9.5.2, "Communication Systems." The staff finds that the applicant appropriately incorporated by reference Section 9.5.2 of the US-APWR DCD, Revision 3.

On June 30, 2011, the NRC staff held a public meeting with the DC and COL applicants to discuss COL Items 9.5(7) and 9.5(9). These COL items made reference to out-of-date regulations and were repetitive of the information contained in Chapter 13 of the COL FSAR. During this meeting, the COL and DC applicants proposed deleting these items from the DCD and the COL application. On July 26, 2011, the DC applicant submitted a supplemental response to US-APWR DCD RAI No. 139-1533, Revision 1. This response deleted COL Items 9.5(7) and 9.5(9) from the DCD. On August 4, 2011, the COL applicant submitted a supplemental response to CPNPP3&4 **RAI 5369**. This response deleted items 9.5(7) and 9.5(9) from the COL application. The staff finds this acceptable and confirmed that in Section 9.5.9, "Combined License Information," in FSAR Revision 3, COL Items 9.5(7), 9.5(9), and 9.5(10) are indicated as having been deleted from the DCD.

The staff reviewed the following additional related information in the FSAR:

US-APWR COL Information Items

- CP COL 9.5(4)/STD COL 9.5(4)

The NRC staff reviewed COL 9.5(4) in FSAR Revision 3, Section 9.5.2, related to COL Information Item 9.5(4). To address the COL item, FSAR Revision 3, Section 9.5.2, the applicant replaced the first sentence of the second paragraph in DCD Section 9.5.2 with the following:

> *The intra-plant communications systems consist of a public address/page party line system, intra-plant telephone system, intra-plant sound powered telephone system, plant radio transmitter and receiver system, broadband (internet) communications, and offsite radio systems. The offsite communications systems include telephone, radio frequency system, privately-owned microwave and fiber optic systems, broadband (internet), and personal cell phone.*

This CP and STD COL item, as indicated in FSAR Revision 3, Section 9.5.2.2.5.1, also replaces the first and second sentence of the first paragraph in DCD Section 9.5.2.2.5.1 with the following:

> *Plant specific redundant external communication links include.*
>
> - *Copper and fiber optic telephone circuits*
> - *Microwave telephone links*
> - *Fiber optic data links*
> - *Emergency radio communication links*
> - *Direct telephone links to utility operations centers, the NRC, and State and Local Emergency Operations facilities*
> - *Personal cell phone links (no credit is taken but these links provide alternate links which allow for additional communication paths)*

The staff reviewed the resolution of COL Information Item 9.5(4) involving offsite interfaces included under FSAR Section 9.5.2 against the regulations and NRC guidance cited in Section 9.5.2.3 of this SER.

The applicant provided sufficient information on the external system interfaces specific to CPNPP3&4 to allow the staff to make a determination. Redundant and diverse communication routes described include copper and fiber optic telephone circuits, microwave telephone links, fiber-optic data links, emergency radio communication links, direct telephone links to utility operations centers, and the NRC, state and local emergency operations facilities (EOFs). Personal cell phone links are also listed, but no credit is taken.

The applicant demonstrated compliance with the above mentioned sections of 10 CFR 50.47 and 10 CFR Part 50, Appendix E, by describing communication systems such as the Private Automatic Branch Telephone Exchange (PABX) and crisis management radio system, which are designed to be used for offsite emergency communications and to continue to operate during a LOOP event. The applicant demonstrated compliance with 10 CFR Part 50.47(b)(8), because the offsite communication system is a component of adequate emergency facilities and equipment.

The applicant demonstrated compliance with 10 CFR 50.47(b)(6) because the offsite communication systems allow for prompt communications among response organizations, with emergency personnel and with the public. The applicant demonstrated compliance with 10 CFR

Part 50, Appendix E, Part IV.D(1), by describing physical means for notifying local, state, and federal officials and agencies.

The applicant demonstrated compliance with 10 CFR Part 50, Appendix E, Part IV.E(9), by describing at least one offsite communication system with a backup power source. The applicant committed to ensure that the ENS will be in conformance with the recommendations of BL 80-15, which states that a safeguards instrumentation bus backed up by automatic transfer to batteries and an inverter, or equally reliable power supply, is needed to power the ENS, and that the capability of the ENS to operate during LOOP conditions is to be testable. The communication systems are independent of each other and will operate through a LOOP because they either have a built-in battery or are powered by an uninterruptible power supply (UPS). Tests to ensure the capability to operate through a LOOP are conducted. For emergency communications, the ENS is powered by a UPS. Details regarding ENS conformance with BL-80-15 are provided in US-APWR DCD Subsections 9.5.2.1.1, 9.5.2.2.2.2, and 9.5.2.4.

In **RAI 5369, Question 09.05.02-03**, the staff requested the applicant to clarify the discussion of the emergency offsite communication system in the FSAR by adding information provided in the response to **RAI 4957, Question 09.05.02-02**, dated October 11, 2010 (ML102861203). In response, the applicant proposed the following FSAR modifications in its letter “Comanche Peak Nuclear Power Plant, Units 3 and 4 Docket Nos. 52-034 and 52-035, Response to Request for Additional Information No. 5369 (Section 9.5.2),” dated February 18, 2011 (ML110530429). Subsequently, the staff confirmed that the applicant has incorporated the following proposed language, i.e., the following paragraphs, to the end of DCD Subsection 9.5.2.2.2.2:

> *Direct communications links (direct telephone) are provided to the NRC Operations Center, the State Emergency Operations Center, and the Central Emergency Operations Center. A crisis management radio system is provided which meets the intent of NUREG 0654 is discussed in Subsection 9.5.2.2.5.2.*
>
> *The Emergency Notification System (ENS) capability is part of the Federal Telecommunication System (FTS) independent phone link, with extensions in the Main Control Room (MCR), Technical Support Center (TSC) and Emergency Operations Facility (EOF). The FTS extensions in the MCR, TSC and EOF are all part of the emergency communications capability of the Private Automatic Branch Telephone Exchange (PABX).*
>
> *The ENS is connected through a local telephone company system through a switch that is located and maintained at the site. Power is provided from a non-safety related uninterruptible power supply (UPS) system capable of operating in the event of a LOOP. The design provides for the ENS to remain functional from the site to the NRC Operations Center in the event of a LOOP at the site and complies with the requirements of IE Bulletin 80-15.*

Accordingly, the information provided in FSAR Section 9.5.2 and DCD Section 9.5.2 is sufficient for the NRC staff to find that the communication system interfaces external to the plant are adequately addressed. The NRC staff finds that the applicant adequately addressed COL Information Item 9.5(4) and demonstrated compliance with the applicable requirements of 10 CFR 50.34, 10 CFR 50.47, and 10 CFR Part 50, Appendix E, and met the acceptance criteria of BL 80-15. The NRC staff has confirmed that the applicant’s proposed changes to the FSAR were implemented into COLA, FSAR, Revision 3. Accordingly, **RAI 5369, Question 09.05.02-03, is resolved and closed**.

- CP COL 9.5(5)

The NRC staff reviewed STD COL 9.5(5) related to COL Information Item 9.5(5), included under Section 9.5.2 of the FSAR. The applicant replaced the third sentence in DCD Section 9.5.2.2.2 with the following:

> Access to commercial facilities such as central office trunk, utility's private network, and other offsite connections are provided though redundant and diverse routes as discussed in Subsection 9.5.2.2.2.2 and 9.5.2.2.5.1.

- The staff reviewed the resolution to the COL Information Item 9.5(5) involving emergency offsite communications including the crisis management radio system included under FSAR Section 9.5.2.2.2.

The staff finds that the applicant provided sufficient information regarding the emergency communication systems, including the crisis management radio system specific to CPNPP3&4, to allow the staff to make a safety determination. Redundant and diverse emergency communication systems are described and include the emergency telephones which utilize the PABX system and the crisis management radio system. Direct telephone links are provided to the NRC Operations Center and state and local Emergency Operations Centers (EOCs). Telephone service, including an onsite switch, is identified in the application.

The details of multiple communication links provided by the applicant for CPNPP3&4 give sufficient information to confirm compliance with the above mentioned sections of 10 CFR 50.47 and 10 CFR Part 50, Appendix E, by describing communication systems such as the PABX and crisis management radio system which are designed to be used for offsite emergency communications and to continue to operate during a LOOP.

The applicant demonstrated compliance with 10 CFR Part 50.47(b)(8) because the offsite communication system is a component of adequate emergency facilities and equipment. The applicant demonstrated compliance with 10 CFR 50.47(b)(6) because the offsite communication systems allow for prompt communications among response organizations, with emergency personnel, and with the public. The applicant demonstrated compliance with 10 CFR Part 50, Appendix E, Part IV.E(9), by describing at least one offsite communication system with a backup power source. The applicant demonstrated compliance with 10 CFR Part 50, Appendix E, Part IV.D(1), by describing physical means for notifying local, state, and federal officials and agencies.

The applicant committed to ensure that the crisis radio management system will meet the acceptance criteria in NUREG-0654 as discussed in Subsection 9.5.2.2.5.2. NUREG-0654 lists specific criteria necessary for emergency communications. These criteria include, as a minimum, a telephone link and alternate means for initiating and coordinating emergency response actions, as well as provisions for communications between all organizations and entities involved in emergency response.

Accordingly, based on the description provided in FSAR Section 9.5.2 and incorporated by reference to DCD Section 9.5.2, the NRC staff finds that the applicant adequately addressed COL Information Item 9.5(5) and demonstrated compliance with the applicable requirements of

10 CFR 50.47, 10 CFR Part 50, Appendix E, and met the acceptance criteria of NRC IE Bulletin 80-15.

- STD COL 9.5(6) and,STD COL 9.5(8),

The NRC staff reviewed STDP COL 9.5(6) and STD 9.5(8) included under FSAR Section 9.5.2. In FSAR Revision 3, Section 9.5.2.2.5.2, the applicant replaced the second and third sentence of the second paragraph in DCD Section 9.5.2.2.5.2 with the following:

The effectiveness of the overall emergency response plan is in conformance with the requirements of 10 CFR 50.47 (b)(8). Adequate communications equipment are provided and maintained to allow the control room to communicate with offsite personnel and organizations. Pursuant to the emergency response plan, the following equipment is tested.

- *An inspection and test is performed of the [Technical Support Center] TSC voice communication equipment.*
- *An inspection and test is performed of the operation support center voice communication equipment.*
- *An inspection and test is performed of the [emergency operations facility] EOF voice communication equipment.*
- *A test is performed of the means for warning or advising onsite individuals of an emergency.*

The offsite communications systems within the onsite Technical Support Center and operations support center provide for emergency response following a design basis accident. During emergencies, the TSC is the primary onsite communication center for the communications to the control room, the operations support center and the NRC.

The Operations Support Center (OSC) is equipped with a PABX system similar to that provided for the TSC and the EOF. This PABX telephone system is connected to the offsite commercial telephone system and provides voice and facsimile communications capability for normal and emergency communications between the MCR, TSC, EOF, OSC, Corporate Offices, NRC, State agencies and county Sheriff's offices. In addition to the PABX system, the plant communication systems for the OSC also include the public address system / plant page – party system, the plant radio system and the sound powered telephone system.

In addition, provisions for communication with state and local operations centers are provided in the onsite TSC to initiate early notification and recommendations to offsite authorities prior to activation of the EOF. This is in accordance with the requirements of 10 CFR 50 Appendix E, Part IV.E.9.

In addition, to address STD COL 9.5(5) and STD COL 9.5(6), Section 9.5.2.2.5.2 of FSAR Revision 3 replaces the sixth paragraph in DCD Subsection 9.5.2.2.5.2 with the following:

The emergency offsite communication system serves as an alternate means of communication to notify local authorities of an emergency at the nuclear plant.

Radios are provided for communications with the main control room, TSC, EOF, and local authorities.

This emergency radio communications system connects onsite and offsite monitoring teams with the operation support center and EOF respectively.

Data Communications is discussed in Section 7.9. Fire brigade communications is covered in Subsection 9.5.1.

The emergency plan and security plan are described in Sections 13.3 and 13.6, respectively. These plans require testing of offsite communications links.

The NRC staff reviewed the resolution to the COL Information Item 9.5(6) involving communication connections to the Technical Support Center (TSC) included under Section 9.5.2.2.5.2 of the CPNPP COLA.

The details of multiple communication links provided by the applicant for CPNPP3&4 give sufficient information to confirm compliance with the above mentioned sections of 10 CFR Part 50, by describing communication systems provided in the TSC which are designed to be used for onsite and offsite emergency communications. The communication paths provided from the TSC include the public address system, the telephone system, the sound-powered telephone system, the plant radio system, and plant security communication systems. Backup power systems are discussed for required systems to maintain TSC communication capabilities. The backup power systems are described in US-APWR DCD Sections 9.5.2.1.1, 9.5.2.2.2.3, 9.5.2.2.3 and 9.5.2.2.4.3. The staff confirmed that the proposed additions to FSAR Section 9.5.2.2.5.2 to address STD COL 9.5(6) and STD COL 9.5(8) were incorporated in that section in FSAR Revision 3.

The applicant demonstrated compliance with 50.34(f)(2)(xxv) by describing provisions for an onsite TSC. The applicant demonstrated compliance with the applicable requirements in 10 CFR Part 50, Appendix E, by describing TSC communication systems that have backup power supplies and that can be relied upon to support emergency response.

Accordingly, based on the provided description and Section 9.5.2 of the US-APWR DCD, the NRC staff finds that the applicant adequately addressed COL Information Item 9.5(6) and demonstrated compliance with the applicable requirements of 10 CFR 50.34 and 10 CFR Part 50, Appendix E.

- CP COL 9.5(8)

- The NRC staff reviewed the resolution to the COL Information Item 9.5(8) involving offsite communications for the onsite operations support center included under FSAR Section 9.5.2.2.5.2.

In **RAI 5369, Question 09.05.02-03**, the staff requested the applicant to clarify the discussion of the offsite communications for the onsite operations support center (OSC) in the FSAR by adding information provided in the response to **RAI 4957, Question 09.05.02-02**, dated October 11, 2010 (Adams Accession No. ML102861203). In its response letter, “Comanche Peak Nuclear Power Plant, Units 3 and 4 Docket Nos. 52-034 and 52-035 Response to Request for Additional Information No. 5369 (Section 9.5.2),” dated February 18, 2011 (ADAMS Accession No. ML110530429), the applicant proposed the following modification to be added to FSAR Section 9.5.2.2.5.2:

> *The Operations Support Center (OSC) is equipped with a PABX system similar to that provided for the TSC and the EOF. This PABX telephone system is connected to the offsite commercial telephone system and provides voice and facsimile communications capability for normal and emergency communications between the MCR, TSC, EOF, OSC, Corporate Offices, NRC, State agencies and county Sheriff's offices. In addition to the PABX system, the plant communication systems for the OSC also include the public address system / plant page – party system, the plant radio system and the sound powered telephone system.*

The applicant demonstrated compliance with the above mentioned sections of 10 CFR 50.34, 10 CFR 50.47, and 10 CFR Part 50, Appendix E, by stating that the onsite operations support center is equipped with a PABX system connected to the offsite telephone system, is capable of being used for normal and emergency communications, and is provided with a backup power supply. Accordingly, the information provided in the COL application description and Section 9.5.2 of the US-APWR DCD is sufficient for the NRC staff to find that the communication system interfaces external to the plant are adequately addressed. The NRC staff finds that the applicant adequately addressed COL Information Item 9.5(8) and demonstrated compliance with 10 CFR 50.34, 10 CFR 50.47, and 10 CFR Part 50, Appendix E. The staff confirmed that the proposed modification above was added to FSAR Section 9.5.2.2.5.2 in FSAR Revision 3. Accordingly, **RAI 5369, Question 09.05.02-03 is resolved and closed.**

9.5.2.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.5.2.6 Conclusions

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the communications system, and there is no outstanding information expected to be addressed in the CPNPP3&4 COL FSAR related to this section.

The staff is reviewing the information in DCD Section 9.5.2 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the communications system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR design. The SER on the US-APWR is not yet complete, and this is being tracked as part of **Open Item [1-1]**. The staff will update Section 9.5.2 of this SER to reflect the final disposition of the DC application.

The staff compared the COL information within the application to the relevant NRC regulations, acceptance criteria defined in NUREG-0800 Section 9.5.2, and other NRC regulatory guidance, and concludes that the applicant is in compliance with the NRC regulations; particularly 10 CFR 50.34(f)(2)(xxv), 10 CFR 50.47(b)(6), 10 CFR 50.47(b)(8), 10 CFR 73.45(g)(4)(i), and Parts IV.D(1) and IV.E(9) of Appendix E to 10 CFR Part 50. The applicant described the availability of backup power sources for the ENS in case of LOOP to address BL 80-15 as required by 10 CFR 50.54(f).

The staff's review for compliance to 10 CFR 73.46(e)(5), 10 CFR 73.46(f), 10 CFR 73.45(g)(4)(ii), and 10 CFR 73.45(e)(2)(iii)is discussed in Section 13.6 of this SER.

As a result of the open and confirmatory items discussed above in Section 9.5.2.4 of this SER, the staff is unable to finalize its conclusions on the acceptability of the CPNPP3&4 communications systems as described in FSAR Section 9.5.2 in accordance with the requirements cited above in Section 9.5.2.3 of this SER.

9.5.3 Lighting Systems

This section of the CPNPP3&4 COL FSAR describes the lighting systems, which provide for adequate lighting during normal, transient, fire, accidents, and off-normal events.

Section 9.5.3, "Lighting Systems," of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.5.3, of the US-APWR DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.5.3 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the lighting systems incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.5.3 of this SER to reflect the final disposition of the DC application design.

9.5.4 Gas Turbine Generator Fuel Oil Storage and Transfer System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.5.4, "Diesel Generator Fuel Oil Storage and Transfer System")

This section of the CPNPP3&4 COL FSAR describes the fuel oil storage and transfer system, which provides storage for and continuous supply of fuel oil to each of the four Class 1E emergency GTGs.

9.5.4.1 Introduction

The fuel oil storage and transfer system (FOS) provides storage for and continuous supply of fuel oil to each of the four Class 1E emergency GTGs.

9.5.4.2 Summary of Application

FSAR Section 9.5.4, "Gas Turbine Generator Fuel Oil Storage and Transfer System," Revision 3 incorporates by reference DCD Section 9.5.4, "Gas Turbine Generator Fuel Oil Storage and Transfer System," Revision 3. Additionally, in FSAR Section 9.5.4, the applicant provided the following information to address the following COL information items.

<u>US-APWR COL Information Items</u>

- CP COL 9.5(11)

The applicant provided additional information in CP COL 9.5(11) to address COL Information Item 9.5(11), which requested the applicant specify that adequate and acceptable sources of fuel oil are available, including the means of transporting and recharging the fuel storage tank, following a design basis accident.

- CP COL 9.5(12)

The applicant provided additional information in CP COL 9.5(12) to address COL Information Item 9.5(12), which requested the applicant to address the need for installing unit heaters in the Power Source Fuel Storage Vault during the winter for site locations where extreme cold temperature conditions exist.

<u>Interface Requirements</u>

The US-APWR DCD Tier 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 9.5.4 of the DCD.

9.5.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

The acceptance criteria associated with the relevant requirements of the Commission's regulations are given in Section 9.5.4, "Emergency Diesel Engine Fuel Oil Storage and Transfer System," of NUREG-0800.

9.5.4.4 Technical Evaluation

The NRC staff reviewed Section 9.5.4 of FSAR, Revision 3 and considered the referenced DCD. DCD Section 9.5.4 is being reviewed by the staff under docket number 52-021. The NRC staff's technical evaluation of the information incorporated by reference will be documented in the corresponding SER.

The staff reviewed the following COL information items in the FSAR:

<u>US-APWR COL Information Items</u>

- CP COL 9.5(11)

The NRC staff reviewed COL 9.5(11) in FSAR Revision 3, Section 9.5.4.3, related to COL Information Item 9.5(11). To address this COL item, the applicant replaced the second sentence of the seventh paragraph in DCD Subsection 9.5.4.3 with the following:

> Fuel oil is normally brought by tank truck for recharging the storage tank. Additionally, if circumstances require, railroad tank cars can be brought in on the site railroad spur. The CPNPP Units 3 and 4 are located approximately 90 miles southwest of the Dallas-Ft. Worth area. Dallas-Ft. Worth is a major commercial area which has distributors of diesel fuel that represent the majority of the major oil companies. The cities, such as Houston, Beaumont etc., within 300 miles from site are capable of supplying diesel oil within seven days.

The guidance contained in SRP 9.5.4 states that the application will be reviewed to ensure adequate sources of fuel are available, including the means of transporting and recharging the fuel storage tanks, following a design basis accident to enable each generator to supply uninterrupted emergency power for as long as required. The applicant's response to CP COL 9.5(11) meets the guidance described in SRP 9.5.4. As such, the applicant has adequately addressed COL Information Item COL 9.5(11).

- CP COL 9.5(12)

The NRC staff reviewed COL 9.5(12) in FSAR Revision 3, Section 9.5.4.2.2.1, related to COL Information Item 9.5(12). To address this COL item, the applicant replaced the tenth paragraph in DCD Subsection 9.5.4.2.2.1 with the following, in part:

> Insulation and heat tracing on the fuel oil piping in the concrete pipe chase and on a portion of the piping running down into the power source fuel storage vault area are provided to maintain fuel oil temperature within specification during winter. The concrete pipe chases between each fuel oil tank room and each power source building are the areas through which the fuel oil piping through. Within each concrete pipe chase is a 3-hour fire rated wall that separates each power source building from the associated power source fuel storage vault area. The door and penetrations through each wall are all 3-hour fire rated. One side of each concrete pipe chase is part of a power source building, which is a normally heated building.

The guidance contained in SRP 9.5.4 states, in part, that the application will be reviewed to ensure each emergency generator has an independent and reliable fuel oil storage and transfer system. The applicant's response to CP COL 9.5(12) meets the guidance described in SRP 9.5.4 as it describes a heating system to maintain a reliable fuel system. As such, the applicant has adequately addressed COL Information Item COL 9.5(12).

9.5.4.5 Post-Combined License Activities

There are no post-COL activities related to this section.

9.5.4.6 Conclusions

The staff evaluated the information in FSAR Revision 3, Section 9.5.4, in accordance with the guidance in Section 9.5.4.3, "Regulatory Basis." On the basis of its review and evaluation, the staff concludes that the proposed fuel oil storage and transfer system as described in FSAR Section 9.5.4 meets the guidance described in SRP Section 9.5.4. Therefore, the staff concludes that the information in FSAR Section 9.5.4 is acceptable.

The staff is reviewing the information in DCD Section 9.5.4 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the GTG fuel oil storage and transfer system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.5.4 of this SER to reflect the final disposition of the DC application design.

9.5.5 Not Used

9.5.6 Gas Turbine Generator Starting System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.5.6, "Diesel Generator Starting System")

This section of the CPNPP3&4 COL FSAR describes the GTG starting system, which provides for a reliable GTG start following a loss-of-offsite power.

Section 9.5.6, "Gas Turbine Generator Starting System," of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.5.6, of the US-APWR DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.5.6 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the GTG starting system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.5.6 of this SER to reflect the final disposition of the DC application design.

9.5.7 Gas Turbine Lubrication System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.5.7, "Diesel Generator Lubrication System")

This section of the CPNPP3&4 COL FSAR describes the GTG lubrication system, which provides essential lubrication to the components for each of the four GTGs.

Section 9.5.7, Gas Turbine Lubrication System," of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.5.7, of the US-APWR DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.5.7 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the GTG lubrication system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff

SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.5.7 of this SER to reflect the final disposition of the DC application design.

9.5.8 GTG Combustion Air Intake and Exhaust System (Related to RG 1.206, Section C.III.1, Chapter 9, C.I.9.5.8, "Diesel Generator Combustion Air Intake and Exhaust System")

This section of the CPNPP3&4 COL FSAR describes the GTG combustion air intake and exhaust system, which supply combustion air of reliable quality to the gas turbines and exhausts combustion products from the gas turbines to the atmosphere.

Section 9.5.8, "GTG Combustion Air Intake and Exhaust System," of the CPNPP3&4 COL FSAR incorporates by reference, with no departures or supplements, Section 9.5.8, of the US-APWR DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review. The NRC staff's review confirmed that there is no outstanding issue related to this section.

The staff is reviewing the information in DCD Section 9.5.8 on Docket Number 52-021. The results of the NRC staff's technical evaluation of the information related to the GTG combustion air intake and exhaust system incorporated by reference in the CPNPP3&4 COL FSAR will be documented in the staff SER on the DC application for the US-APWR. The SER on the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 9.5.8 of this SER to reflect the final disposition of the DC application design.