10.0 STEAM AND POWER CONVERSION

10.1 Summary Description

10.1.1 Introduction

The steam and power conversion (S&PC) system is designed to convert heat energy from the reactor coolant system via the two main steam generators (SGs) and to convert it to electrical power in the turbine-generator (T-G). The main condenser deaerates the condensate and transfers heat that is not used in the cycle to the circulating water system (CWS). The regenerative turbine cycle heats the feedwater, and the main feedwater system returns it to the SG. This section also addresses the materials selection, fabrication, and fracture toughness of the American Society of Mechanical Engineers (ASME) Code Section III, Class 2 and Class 3 pressure boundary components of the steam and feedwater systems and also discusses material issues identified through operating experience.

10.1.2 Summary of Application

Section 10.1 of the V.C. Summer Nuclear Station (VCSNS) combined license (COL) Final Safety Analysis Report (FSAR), Revision 2, incorporates by reference Section 10.1 of the AP1000 Design Control Document (DCD), Revision 17.

In addition, in VCSNS COL FSAR Section 10.1.3, the applicant provided the following:

AP1000 COL Information Item

- Standard (STD) COL 10.1-1

The applicant provided additional information in STD COL 10.1-1 to address COL Information Item 10.1-1, providing information related to the monitoring of flow-accelerated corrosion (FAC).

License Condition

- Part 10, License Condition 6, Operational Program Readiness

The applicant proposed a license condition to provide a schedule to support the Nuclear Regulatory Commission's (NRC's) inspection of operational programs including the FAC program.

10.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793, "Final Safety Evaluation Report [FSER] Related to Certification of the AP1000 Standard Design."

In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for the FAC program are given in Section 10.1 of NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants."

The applicable regulatory guidance for STD COL 10.1-1 is as follows:

- Generic Letter (GL) 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning"

The staff notes that request for additional information (RAI) numbering was based on NUREG-0800, Section 10.3.6. The evaluation is presented in this section because the applicant provided information in Section 10.1.3 of the VCSNS COL FSAR.

10.1.4 Technical Evaluation

The NRC staff reviewed Section 10.1 of the VCSNS COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the S&PC summary description. The results of the NRC staff's evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this safety evaluation report (SER) provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the design certification (DC) and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (Vogtle Electric Generating Plant (VEGP), Units 3 and 4) were equally applicable to the VCSNS Units 2 and 3 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 2, to the VCSNS COL FSAR. In performing this comparison, the staff considered changes made to the VCSNS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the standard content to be directly applicable to the VCSNS COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) includes evaluation material from the SER for the Bellefonte Nuclear Plant (BLN), Units 3 and 4 COL application.

[1] See Section 1.2.2 for a discussion of the staff's review related to verification of the scope of information to be included in a COL application that references a design certification (DC).

The following portion of this technical evaluation section is reproduced from Section 10.1.4 of the VEGP SER:

AP1000 COL Information Item

- *STD COL 10.1-1*

The applicant also provided information (STD COL 10.1-1) in BLN COL FSAR Section 10.1.3.1 to address a COL information item as described in AP1000 DCD Section 10.1.3. BLN COL FSAR Section 10.1.3.1, "Erosion-Corrosion Monitoring," describes general attributes of the applicant's program for monitoring and managing degradation (e.g., thinning) of piping and components susceptible to FAC, sometimes called erosion-corrosion.

In AP1000 DCD Section 10.1.3, Westinghouse identified a COL information item on FAC monitoring. The COL information item identified the need for a COL applicant to address the preparation of a FAC monitoring program for carbon steel portions of the S&PC systems that contain water or wet steam in order to address the concerns identified in GL 89-08. Similarly, in the NRC staff's FSER (NUREG-1793), Section 10.3.2, the staff identified COL Action Item 10.3.2-1 for the COL applicant to develop a FAC monitoring program to address industry guidelines and the concerns identified in GL 89-08.

The staff reviewed the information provided by the applicant in Section 10.1.3.1 of the BLN COL FSAR (STD COL 10.1-1) addressing a monitoring program for FAC. The staff also reviewed additional information provided in letters dated June 27, 2008 (ML081830410) and May 26, 2009 (ML091480012). In the letters, the applicant provided additional information requested by the staff about implementation of the FAC program during the plant construction phase, pre-service thickness measurements, and the basis for determining minimum allowable thickness.

In RAI 10.3.6-1, the staff requested that the applicant discuss its implementation schedule for the detailed FAC program (i.e., the FAC program activities that will be conducted during the plant construction phase and the schedule for those activities). This information was not provided in the application and was needed by the staff to make its reasonable assurance finding that the FAC concerns discussed in GL 89-08 are adequately addressed.

In RAI 10.3.6-2, the staff asked the applicant to confirm that its program for addressing and monitoring FAC will include pre-service thickness measurements of as-built components considered susceptible to FAC, and that these measurements will use grid locations and measurement methods most likely to be used for inservice inspection (ISI) according to industry guidelines. In addition, the staff requested that the applicant describe how the pre-service testing requirement was documented in the COL application.

In RAI 10.3.6-3, the staff asked the applicant to identify the industry guidelines or established procedures for determining the minimum allowable wall thickness at which components must be repaired or replaced.

In the June 27, 2008, letter, the applicant responded that susceptibility of piping and components to FAC will be evaluated prior to fuel load as design and as-built information becomes available, and those categorized as high risk for FAC failure will be evaluated for baseline testing prior to startup. For other piping, nominal dimensions may be used until baseline wall thickness is measured, but the applicant did not state when this will occur.

The applicant also proposed revising FSAR Section 10.1.3.1 by deleting the following sentence and replacing it with a paragraph that identifies a specific industry guideline (Electric Power Research Institute (EPRI) NSAC-202L) that contains more details about the approach to FAC monitoring.

> *In addition, the FAC monitoring program considers the information of Generic Letter 89-08 and industry guidelines.*

This revision addressed the staff's concern about the basis for determining the minimum allowable thickness because it references the industry guidance (EPRI NSAC-202L) that addresses the concerns in GL 89-08. The response also addressed the staff's concern about pre-service thickness testing because it affirms the need for pre-service testing, and because the application will reference the guidance of NSAC-202L. The response confirmed that the EPRI CHECWORKS computer program will be used for wall thickness evaluations. Based on operating experience, the staff considers the EPRI guidance document and CHECWORKS program an effective approach to managing FAC. However, the staff also identified open items on this topic as discussed below. The open items are related to information that must be either clarified or added to the COL application.

The response to RAI 10.3.6-1 described how susceptibility to FAC will be evaluated as the design and as-built information becomes available, and high-risk (of FAC) components will be evaluated for baseline testing prior to startup. The staff had the following concerns:

a) The applicant stated that piping and/or components with a high risk of FAC failure will be "evaluated for baseline testing prior to startup." This statement suggests baseline testing may not be performed on high-risk components.

b) The reference to piping and/or components "deemed to have a high risk of failure due to FAC" led the staff to question the extent to which FAC prevention was included in the plant design. Given that the plant has not yet been constructed and a predictive model such as CHECWORKS can estimate FAC rates, it is the staff's understanding that materials susceptible to FAC can be avoided where FAC is a potential degradation mechanism.

c) The applicant did not add the FAC program implementation schedule and construction phase activities to the COL application.

The response to RAI 10.3.6-2 and the associated COL application revisions include the terms "Pass 1 analysis" and "Pass 2 analysis." Since these are terms defined in EPRI NSAC-202L in the context of the CHECWORKS analysis program, reference to CHECWORKS needs to be addressed in the application.

The response to RAI 10.3.6-3 refers to "Systems Not Modeled components." Based on the context of this statement, the staff understands that this statement refers to "Susceptible Not Modeled lines," as discussed in EPRI NSAC-202L.

The applicant submitted a supplemental RAI response dated May 26, 2009 (ML091480012). In the revised responses to the RAIs the applicant clarified that the plant is designed to prevent FAC, and no piping/components are expected to have a high risk of FAC failure, but the possibility of a high-risk piping/component cannot be ruled out until the as-built design is analyzed. The response also clarified that baseline testing would be performed on all high-risk piping/components, and it corrected the wording to reference "Susceptible-Not-Modeled" lines. In the response to RAI 10.3.6-2 the applicant also proposed the following revision to FSAR Section 10.1.3.1:

> *In addition, the FAC monitoring program considers the information of Generic Letter 89-08, EPRI NSAC-202L-R3, and industry operating experience. The program requires a grid layout for obtaining consistent pipe thickness measurements when using Ultrasonic Test Techniques. The FAC program obtains actual thickness measurements for highly susceptible FAC locations for new lines as defined in EPRI NSAC-202L-R3. At a minimum, a CHECWORKS type Pass 1 Analysis is used for low susceptible FAC locations and a CHECWORKS type Pass 2 Analysis for highly susceptible FAC locations will be considered. To determine wear of piping and components where operating conditions are inconsistent or unknown the guidance provided in EPRI NSAC-202L is used to determine wear rates.*

The revised response to RAIs 10.3.6-1, 10.3.6-2, and 10.3.6-3 therefore addressed all of the concerns identified above, with the exception of identifying the program implementation schedule in the application. This is ***Open Item 10.1-1****. The staff identifies the FSAR revisions proposed by the applicant in its May 26, 2009 letter as* ***Confirmatory Item 10.1-1****. Pending resolution of the open item and confirmatory item, the staff finds the COL information item on the FAC program addresses the concerns expressed in GL 89-08.*

<u>Resolution of Standard Content Open Item 10.1-1</u>

In a letter dated July 16, 2009, the VEGP applicant addressed Open Item 10.1-1 by proposing to include the FAC program as part of License Condition 6, "Operational Program Readiness." Specifically, the applicant stated that in a future application revision License Condition 6 will include the requirement to submit a FAC program implementation schedule, including the construction phase activities. The proposed license condition is consistent with SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria." The staff verified that this change was incorporated into Revision 2 of the COL application. As a result, Open Item 10.1-1 is resolved.

Resolution of Standard Content Confirmatory Item 10.1-1

In a letter dated September 9, 2009, the BLN applicant revised the May 26, 2009, response to RAI 10.3.6-2 related to preservice inspection. The letter clarified that the CHECWORKS Pass 1 analysis (corrosion rates based on the plant model) would be performed for locations with both low and high FAC susceptibility. In addition, the response stated that the Pass 2 analysis (use of inspection data for model refinement, corrosion measurement, and trending) will be performed for high-susceptibility locations if warranted by the Pass 1 analysis. The original response stated that the Pass 2 analysis "will be considered" for high-susceptibility locations. The response includes the following revised wording in FSAR Section 10.1.3.1:

> *The FAC program obtains actual thickness measurements for highly susceptible FAC locations for new lines as defined in EPRI NSAC-202L-R3 (Reference 201). At a minimum, a CHECWORKS type Pass 1 analysis is used for low and highly susceptible FAC locations and a Pass 2 analysis is used for highly susceptible FAC locations when Pass 1 results warrant.*

The staff determined that this revised FSAR text is acceptable because it clarified how the plant predictive model is used to perform FAC analysis, and the approach conforms to the EPRI NSAC-202L guidelines. The VEGP applicant has endorsed the standard RAI responses, and has incorporated the associated changes into Revision 2 of the FSAR. The staff determined that the VEGP applicant has fully addressed all RAI responses, and as a result, Confirmatory Item 10.1-1 is now resolved.

10.1.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff finds the following license condition proposed by the applicant acceptable:

- License Condition (10-1) - The licensee shall develop a schedule that supports planning for and conduct of NRC inspections of the operational programs listed in VCSNS COL FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations." This schedule must be available to the NRC staff no later than 12 months after issuance of the COL. The schedule shall be updated every 6 months until 12 months before scheduled fuel load, and every month thereafter until either the operational programs listed in VCSNS COL FSAR Table 13.4-201 have been fully implemented or the plant has been placed in commercial service, whichever comes first. This schedule shall address the flow accelerated corrosion program implementation, including the construction phase activities.

10.1.6 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 FAC, and there is no outstanding information to be addressed in the VCSNS COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

The staff concludes that the information presented in the VCSNS COL FSAR is acceptable because it meets the acceptance criteria provided in Section 10.3.6 of NUREG-0800 and the guidance in GL 89-08. The staff based its conclusion on the following:

- STD COL 10.1-1, relating to the monitoring of the FAC program, is acceptable because it conforms to the acceptance criteria and guidelines provided under Section 10.3.6 of NUREG-0800 and GL 89-08.

10.2 Turbine-Generator

10.2.1 Introduction

The T-G includes the turbine generator system (TGS), associated equipment (including moisture separation), use of extraction steam for feedwater heating, and control functions. Details of TGS component construction materials are included in the AP1000 DCD. The T-G control and overspeed system is described in detail in the DCD; including redundancy and diversity of controls, types of control utilized, overspeed setpoints, and valve actions required for each set point. Because turbine rotors have large masses and rotate at relatively high speeds during normal reactor operation, failure of a rotor may cause excessive vibration of the turbine rotor assembly and result in the generation of high energy missiles. Measures taken by the applicant to ensure turbine rotor integrity and reduce the probability of turbine rotor failure are included in this section of the application.

10.2.2 Summary of Application

Section 10.2 of the VCSNS COL FSAR, Revision 2, incorporates by reference Section 10.2 of the AP1000 DCD, Revision 17.

In addition, in VCSNS COL FSAR Section 10.2, the applicant provided the following:

Supplemental Information

- STD Supplement (SUP) 10.2-1

The applicant provided supplemental information in VCSNS COL FSAR Section 10.2.2, “System Description,” which describes the probability of generating a turbine missile.

- STD SUP 10.2-2

In Revision 0 of the VCSNS COL FSAR, the applicant provided supplemental information regarding the main steam stop and control valves. This supplemental information was deleted in a later revision of the VCSNS COL FSAR; this is discussed in Section 10.2.4 (Technical Evaluation) of this SER.

- STD SUP 10.2-3

The applicant provided supplemental information in VCSNS COL FSAR Section 10.2.3.6, “Maintenance and Inspection Program Plan,” which describes the ISI program for the turbine assembly.

- STD SUP 10.2-4

The applicant provided supplemental information in VCSNS COL FSAR Section 10.2.2, "System Description," which describes the turbine assembly preoperational and startup tests.

- STD SUP 10.2-5

The applicant provided supplemental information in VCSNS COL FSAR Section 10.2.3, "Turbine-Rotor Integrity," which describes the turbine assembly operations and maintenance procedures.

AP1000 COL Information Item

- STD COL 10.2-1

The applicant provided additional information in STD COL 10.2-1, which states that a turbine maintenance and inspection program will be submitted to the NRC for review prior to initial fuel load. This addresses the COL information item in Section 10.2.6, "Combined License Information on Turbine Maintenance and Inspection," of the AP1000 DCD (COL Action Item 10.5-2).

License Condition

- License Condition 2, Item 10.2-1, relating to the turbine maintenance and inspection program

10.2.3 Regulatory Basis

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

In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for turbine rotor integrity are given in Sections 10.2 and 10.2.3 of NUREG-0800.

10.2.4 Technical Evaluation

The NRC staff reviewed Section 10.2 of the VCSNS COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the T-G. The results of the NRC staff's evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP

Units 3 and 4) were equally applicable to the VCSNS Units 2 and 3 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 2, to the VCSNS COL FSAR. In performing this comparison, the staff considered changes made to the VCSNS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the standard content to be directly applicable to the VCSNS COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) includes evaluation material from the SER for the BLN Units 3 and 4 COL application.

The following portion of this technical evaluation section is reproduced from Section 10.2.4 of the VEGP SER:

Supplemental Information

- *STD SUP 10.2-1*

The applicant provided supplemental information as part of the BLN COL FSAR regarding the probability of generating a turbine missile. In FSAR Section 10.2.2, "System Description," the applicant stated that Section 3.5.1.3 addresses the probability of generation of a turbine missile for AP1000 plants in a side-by-side configuration. The staff's review of the acceptability of the probability of generating a turbine missile is documented in Section 3.5.1, "Missile Selection and Description," of this SER.

- *STD SUP 10.2-2*

In Revision 0 of the BLN COL FSAR, the applicant provided supplemental information regarding the frequency for exercising the main steam stop and control valves. However, the valve exercise frequency is specified in Revision 17 of the DCD, and therefore, this supplemental information is no longer necessary. In Revision 1 of BLN COL FSAR, this information is no longer provided.

- *STD SUP 10.2-3*

The applicant provided supplemental information as part of the BLN COL FSAR regarding the ISI program for the turbine assembly. The applicant added text to the end of Section 10.2.3.6 of the AP1000 DCD, Revision 17, to describe the breadth of the turbine assembly ISI program.

The NRC staff reviewed the standard supplemental information provided in STD SUP 10.2-3 regarding the text added to Section 10.2.3.6 related to the turbine assembly ISI program. The staff concludes that STD SUP 10.2-3 is acceptable because it is a statement of the scope of the turbine ISI program consistent with the acceptance criteria of Section 10.2.3 of NUREG-0800.

- *STD SUP 10.2-4*

The applicant provided supplemental information as part of the FSAR regarding the turbine assembly preoperational and startup tests. The NRC staff reviewed the standard supplemental information provided in STD SUP 10.2-4 regarding the text added to Section 10.2.2 related to the turbine assembly preoperational and startup testing. The staff determined that this additional information provides further clarity regarding the turbine system startup tests. This additional information does not affect the design aspects of the system or its regulatory basis.

- *STD SUP 10.2-5*

The applicant provided supplemental information as part of the BLN COL FSAR regarding turbine assembly operations and maintenance procedures. The applicant added text to the end of Section 10.2.3 of the AP1000 DCD, Revision 17, to note that operations and maintenance procedures mitigate potential degradation mechanisms in the turbine rotor and buckets/blades. STD SUP 10.2-5 is a general statement about the purpose of operations and maintenance procedures and does not affect those procedures that are part of the staff's review of Section 10.2.3 of the DCD application.

<u>AP1000 COL Information Item</u>

- *STD COL 10.2-1*

The applicant provided additional information (STD COL 10.2-1) in BLN COL FSAR Section 10.2.6, "Combined License Information on Turbine Maintenance and Inspection," to resolve a COL information item identified in AP1000 DCD, Section 10.2.6. STD COL 10.2-1 identifies the turbine maintenance and inspection program, plant-specific turbine rotor test data, and plant-specific calculated toughness curves as items that must be submitted by the COL holder to the NRC staff for review prior to fuel load.

The AP1000 COL information item identified in DCD Section 10.2.6 states:

> *The Combined License holder will submit to the NRC staff for review prior to fuel load and then implement a turbine maintenance and inspection program. The program will be consistent with the maintenance and inspection program plan activities and inspection intervals identified in Subsection 10.2.3.6. The Combined License holder will have available plant-specific turbine rotor test data and calculated toughness curves that*

> *support the material property assumptions in turbine rotor analysis after the fabrication of the turbine and prior to fuel load.*

BLN COL FSAR Section 10.2.6, "Combined License Information on Turbine Maintenance and Inspection," replaces Section 10.2.6 of the AP1000 DCD with the following:

> *A turbine maintenance and inspection program will be submitted to the NRC staff for review prior to fuel load. The program will be consistent with the maintenance and inspection program plan activities and inspection intervals identified in DCD Subsection 10.2.3.6. Plant-specific turbine rotor test data and calculated toughness curves that support the material property assumptions in the turbine rotor analysis will be available for review after fabrication of the turbine and prior to fuel load.*

The applicant proposed License Condition 2, Item 10.2-1 related to the above. The staff is currently reviewing Revision 17 of the DCD which contains the turbine maintenance and inspection program elements. License Condition 2 provides that the applicant will submit, prior to fuel load, its turbine maintenance and inspection program for the as-built rotor, including its material properties. The staff finds this condition acceptable because the inspection program, updated with as-built information, will be submitted to verify consistency with the maintenance and inspection program plan activities and inspection intervals identified in Section 10.2.3.6 of the DCD.

10.2.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff finds the following license condition proposed by the applicant acceptable:

- License Condition (10-2) – Prior to initial fuel load, the licensee will implement a turbine maintenance and inspection program, which will be consistent with the maintenance and inspection program plan activities and inspection intervals identified in FSAR Section 10.2.3.6.

10.2.6 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 T-G, and there is no outstanding information expected to be addressed in the VCSNS COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

In addition, the staff concludes that the relevant information presented in the VCSNS COL FSAR is acceptable and meets the acceptance criteria of Section 10.2 of NUREG-0800. The staff based its conclusions on the following:

- STD SUP 10.2-1, related to the probability of generating a turbine missile, is reviewed by the staff in Section 3.5.1, "Missile Selection and Description," of this SER.

- STD SUP 10.2-2, related to frequency for exercising the main steam stop and control valves, was deleted in Revision 1 of the VCSNS COL FSAR.

- STD SUP 10.2-3, related to the ISI program for the turbine assembly, is acceptable to the staff because the description of the ISI program is consistent with Section 10.2.3 of NUREG-0800.

- STD SUP 10.2-4, relating to the turbine assembly preoperational and startup tests, is acceptable to the staff because the proposed valve testing is consistent with the guidance in Section 10.2 of NUREG-0800.

- STD SUP 10.2-5, relating to mitigation of potential degradation mechanisms for the turbine rotor and buckets/blades, is acceptable to the staff because it is a general statement about the purpose of operations and maintenance procedures and does not affect those procedures that are part of the staff's review of Section 10.2.3 of the DCD application.

- STD COL 10.2-1, relating to the turbine maintenance and inspection program, is acceptable to the staff because the applicant proposed a license condition that appropriately addresses this information item.

10.3 Main Steam Supply System

10.3.1 Introduction

The main steam supply system (MSSS) transports the steam generated by the nuclear steam supply system to the S&PC system and various safety-related and nonsafety-related auxiliaries. Portions of the MSSS may be used as part of the heat sink that removes heat from the reactor facility during certain operations. The MSSS for the pressurized-water reactor (PWR) plant extends from the connections to the secondary sides of the SGs up to and including the turbine stop valves.

10.3.2 Summary of Application

Section 10.3 of the VCSNS COL FSAR, Revision 2, incorporates by reference Section 10.3 of the AP1000 DCD, Revision 17.

In addition, in VCSNS COL FSAR Section 10.3, the applicant provided the following:

Supplemental Information

- STD SUP 10.3-1

The applicant provided supplemental information in VCSNS COL FSAR Section 10.3.2.2.1, "Main Steam Piping," which addresses operations and maintenance procedures.

- STD SUP 10.3-2

The applicant provided supplemental information in VCSNS COL FSAR Section 10.3.5.4, "Chemical Addition," related to secondary-side water chemistry.

- STD SUP 10.3-3

The applicant provided supplemental information in VCSNS COL FSAR Section 10.3.6.2, "Material Selection and Fabrication," which addresses intergranular stress corrosion cracking (IGSCC).

10.3.3 Regulatory Basis

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

In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for the MSSS are given in Sections 10.3.1 and 10.3.6 of NUREG-0800.

The applicable regulatory requirements and guidance for STD SUP 10.3-1, STD SUP 10.3-2, and STD SUP 10.3-3 are as follows:

- General Design Criterion (GDC) 4, "Environmental and dynamic effects design bases"
- Regulatory Guide (RG) 1.37, Revision 1, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants"
- Branch Technical Position (BTP) 5-1, "Monitoring of Secondary Side Water Chemistry in PWR Steam Generators"

The regulatory basis for acceptance of the supplemental information on controls to prevent stress-corrosion cracking of stainless steels and nickel alloys is the quality assurance requirements in Appendix B of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 and the guidance in RG 1.37, as they relate to quality assurance requirements for the design, fabrication, and construction of safety-related structures, systems, and components (SSCs).

10.3.4 Technical Evaluation

The NRC staff reviewed Section 10.3 of the VCSNS COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the MSSS. The results of the NRC staff's evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP

Units 3 and 4) were equally applicable to the VCSNS Units 2 and 3 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 2, to the VCSNS COL FSAR. In performing this comparison, the staff considered changes made to the VCSNS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the standard content to be directly applicable to the VCSNS COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) includes evaluation material from the SER for the BLN Units 3 and 4 COL application.

The following portion of this technical evaluation section is reproduced from Section 10.3.4 of the VEGP SER:

Supplemental Information

- *STD SUP 10.3-1*

The applicant provided additional information as part of the BLN COL FSAR regarding operations and maintenance procedures. The applicant added text to Section 10.3.2.2.1 of the AP1000 DCD, Revision 17, to address steam hammer and relief valve discharge reaction loads.

The NRC staff reviewed the standard supplemental information provided in STD SUP 10.3-1 regarding the text added to Section 10.3.2.2.1 related to MSSS operations and maintenance procedures.

During its review of Revision 0 of the BLN COL FSAR, the staff did not find any further details regarding these procedures. Therefore, the staff raised a concern regarding the adequacy of these procedures. Also, Section 10.3 of NUREG-0800, "MAIN STEAM SUPPLY SYSTEM," Item II, related to GDC 4, describes that the main steam system should adequately consider water (steam) hammer and relief valve discharge loads to assure that system safety functions can be performed and should assure that operating and maintenance procedures include adequate precautions to prevent water (steam) hammer and relief valve loads. In order to ensure the adequacy of the MSSS and its agreement with the NUREG-0800 criteria, the staff requested the key elements of the procedures for staff's review in RAI 10.3-1.

In its response, dated July 21, 2008, concerning precluding or mitigating water hammer events, the applicant identified that good operating practice and operating experience including, but not limited to Institute of Nuclear Power

Operations (INPO) significant event reports and significant operating event reports, NRC information notices and bulletins, and other industry operating experience information are programmatically integrated into the AP1000 Operations Procedure development. The applicant also stated that specific operating experience to preclude or mitigate water hammer is included in this population of operating experience. In addition, the applicant explained that the AP1000 has been designed to prevent or minimize steam and water hammer. The applicant stated that BLN COL FSAR Section 10.3.2.2.1 will be revised to include additional precautions, when appropriate, to minimize the potential for steam and water hammer.

With respect to the relief valve discharge loads, in its response, the applicant explained that Westinghouse addressed these loads for main steam safety valves in the AP1000 DCD, Section 10.3.2.2.2, "Main Steam Safety Valves," which BLN incorporated by reference with no departures and supplements. Further, the applicant stated that as described in NUREG-0927, Revision 1, "Evaluation of Water Hammer Occurrence in Nuclear Power Plants," preventive measures for relief valve loading are addressed by design. Therefore, the applicant stated that the COL application Part 2, BLN COL FSAR Section 10.3.2.2.1 will be revised to remove the associated procedure precautions as related to the relief valve discharge reaction loading. In addition, Section 10.3.2.2.1 will be revised to state that operations and maintenance procedures include precautions, when appropriate, to minimize the potential for steam and water hammer. The applicant listed several precautionary items, such as: prevention of rapid valve motion, process for avoiding voids and flashing in water-filled lines and venting these lines, process for avoiding introduction of water into steam lines and proper warm-up and drainage of these lines, and effects of valve alignments on line conditions.

Based on its review, the staff finds the applicant's response acceptable because a detailed list of the procedural precautions (identified above) is provided and included as a proposed revision to COL application Part 2, BLN COL FSAR Section 10.3.2.2.1. The staff reviewed the precautions and compared them to the industry experience and staff guidance, and finds that they adequately address steam and water hammer. Therefore, the staff agrees that the deletion of the relief valve discharge reaction load occurrences from BLN COL FSAR Section 10.3.2.2.1 is acceptable, because its discussion was already identified in the AP1000 DCD Section 10.3.2.2.1. In BLN COL FSAR Section 10.3.2.2.1, Revision 1, the applicant revised STD SUP 10.3-1 as indicated above in its response to RAI 10.3-1. Therefore, the staff's concern in RAI 10.3-1 is resolved.

- *STD SUP 10.3-2*

The applicant provided additional information as part of the BLN COL FSAR regarding the secondary chemistry. In FSAR Section 10.3.5.4, "Chemical Addition," the applicant proposed adding the following at the end of DCD Subsection 10.3.5.4:

> *Alkaline chemistry supports maintaining iodine compounds in their nonvolatile form. When iodine is in its elemental form, it is volatile and free to react with organic compounds to create organic iodine*

> *compounds, which are not assumed to remain in solution. It is noted that no significant level of organic compounds is expected in the secondary system. The secondary water chemistry, thus, does not directly impact the radioactive iodine partition coefficients.*

The staff reviewed the secondary water chemistry under Section 10.4.6 of this SER and found it acceptable with respect to the EPRI PWR Secondary Water Chemistry Guidelines. As discussed in Section 10.4.6, the staff considers application of the guidance of the EPRI PWR Secondary Water Chemistry Guidelines, and a programmatic commitment to use these guidelines, to be an acceptable method for the applicant to ensure compliance with GDC 14 as it relates to ensuring the integrity of the reactor coolant boundary (specifically, as the secondary water chemistry program ensures the integrity of the SG tubing). As the applicant stated in STD SUP 10.3-2, the secondary water chemistry does not directly impact the iodine partition coefficients. In addition, radioactive iodine is not a consideration in the EPRI Secondary Water Chemistry Guidelines. The staff finds that STD SUP 10.3-2 is a statement of fact that does not affect the staff's review. The management of radioactive compounds, including iodine, is addressed by the staff in Chapter 11.

- *STD SUP 10.3-3*

The applicant provided additional information as part of the BLN COL FSAR regarding IGSCC. The applicant added text to the end of Section 10.3.6.2 "Material Selection and Fabrication" of the AP1000 DCD, Revision 17, to include providing the necessary controls to minimize the susceptibility of components made of stainless steel and nickel-based materials to IGSCC. The applicant proposed adding the following at the end of DCD Section 10.3.6.2:

> *Appropriate operations and maintenance procedures provide the necessary controls during operation to minimize the susceptibility of components made of stainless steel and nickel-based materials to IGSCC by controlling chemicals that are used on system components.*

The staff finds the supplemental information, addressing IGSCC concerns related to stainless steels and nickel-base alloys, acceptable because the AP1000 DCD meets the technical guidelines specified in RG 1.37. In addition, the staff notes that these materials are not proposed for use in the main steam and feedwater piping systems at BLN Units 3 and 4.

<u>Correction of Error in the Standard Content Evaluation Text</u>

The NRC staff identified an error in the text reproduced above from the BLN SER, Section 10.3.4, that requires correction. The BLN SER states that the staff reviewed the secondary water chemistry in Section 10.4.6 of the SER. Secondary water chemistry is actually reviewed in Section 10.4.7 of the SER.

10.3.5 Post Combined License Activities

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

10.3.6 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 MSSS, and there is no outstanding information expected to be addressed in the VCSNS COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

In addition, the staff concludes that the relevant information presented in the VCSNS COL FSAR is acceptable and meets the requirements of Appendix A to 10 CFR Part 50, GDC 4, 10 CFR 52.79, and the guidance in Sections 10.3 and 10.3.6 of NUREG-0800, BTP 5-1, and RG 1.37. The staff based its conclusions on the following:

- STD SUP 10.3-1, relating to operations and maintenance procedures, is acceptable because the applicant provided sufficient information to satisfy GDC 4 as related to MSSS design considering the water (steam) hammer effects on the safety-related SSCs.

- STD SUP 10.3-2, relating to secondary chemistry, is a statement of fact that does not affect the staff's review.

- STD SUP 10.3-3, relating to IGSCC, is acceptable to the staff because the AP1000 DCD meets the technical guidelines specified in RG 1.37.

10.4 Other Features of Steam and Power Conversion System

10.4.1 Main Condensers

During normal operation, the main condenser receives, condenses and deaerates exhaust steam from the main turbine and the turbine bypass system whenever the turbine bypass system is operated. The main condenser is also a collection point for other steam cycle miscellaneous drains and vents.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.1of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.2 Main Condenser Evacuation System

10.4.2.1 Introduction

Main condenser evacuation is performed by the condenser air removal system. The system removes noncondensable gases and air from the main condenser during plant startup, cooldown, and normal operation. This action is performed by liquid ring vacuum pumps.

10.4.2.2 Summary of Application

Section 10.4 of the VCSNS COL FSAR, Revision 2 incorporates by reference Section 10.4 of the AP1000 DCD, Revision 17. Section 10.4 of the DCD includes Section 10.4.2.2.

In addition, in VCSNS COL FSAR Section 10.4.2.2, the applicant provided the following:

Site-Specific Information Replacing Conceptual Design Information

- VCS CDI

The applicant provided additional information to replace conceptual design information (CDI) in VCSNS COL FSAR Section 10.4.2.2.1, "General Description," which describes the plant-specific cooling water source for the vacuum pump seal water heat exchangers.

- VCS CDI

The applicant provided additional information to replace CDI in VCSNS COL FSAR Section 10.4.2.2.2, "Component Description," which describes the plant-specific tube side water flow in the seal water heat exchangers.

10.4.2.3 Regulatory Basis

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

Additional regulatory basis is Appendix A to 10 CFR Part 50 and GDC 60, "Control of Releases of Radioactive Materials to the Environment."

Acceptance criteria associated with the relevant requirements of the Commission regulations for the main condenser evacuation system are given in Section 10.4.2 of NUREG-0800.

10.4.2.4 Technical Evaluation

The NRC staff reviewed Section 10.4.2 of the VCSNS COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the main condenser evacuation system. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

The staff's review of this application is limited to the following VCSNS plant-specific design information that replaces the CDI identified in the AP1000 DCD:

Site-Specific Information Replacing Conceptual Design Information

- VCS CDI

The VCSNS plant-specific design information was annotated as "VCS CDI" in VCSNS COL FSAR Section 10.4.2. In this section, the applicant replaced bracketed (conceptual design) text in Sections 10.4.2.2.1, "General Description," and 10.4.2.2.2, "Component Description," of the AP1000 DCD to provide specific information regarding the sources of cooling water for the vacuum pump seal water heat exchangers.

The VCS CDI in VCSNS COL FSAR Section 10.4.2.2.1 is related to the CWS and raw water system (RWS) supplying cooling water for the main condenser vacuum pump seal water heat exchangers. The VCS CDI in FSAR Section 10.4.2.2.2 clarifies that the seal water flows through the shell side of the seal water heat exchanger and CWS water flows through the tube side. Based on its review, the staff concludes that this VCSNS plant-specific design information will have no adverse affects on the capability of the main condenser evacuation system, CWS, or RWS and associated equipment. Also, the staff concludes that adding this VCSNS plant-specific design information will not affect the functions of any safety-related equipment, components, or systems of the plant. The staff accepts these revisions as stated, because the information provided in this VCS CDI meets the acceptance criteria in Section 10.4.2 of NUREG-0800, and therefore, meets GDC 60 as it relates to the main condenser evacuation system design for the control of releases of radioactive materials to the environment.

10.4.2.5 Post Combined License Activities

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

10.4.2.6 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 main condenser evacuation system, and there is no outstanding information expected to be addressed in the VCSNS COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

In addition, the staff concludes that the relevant information presented in the VCSNS COL FSAR is acceptable and meets the acceptance criteria of Section 10.4.2 of NUREG-0800 and the requirements of GDC 60. The staff based its conclusions on the following:

- VCS CDI, relating to VCSNS COL FSAR Section 10.4.2.2.1, "General Description," concerning cooling water source for the vacuum pump seal water heat exchanger, is acceptable to the staff because it meets GDC 60 for the control of releases of radioactive materials to the environment.

- VCS CDI, relating to VCSNS COL FSAR Section 10.4.2.2.2, "Component Description," concerning the tube side water flow in the seal water heat exchangers, is acceptable to the staff because it meets GDC 60 for the control of releases of radioactive materials to the environment.

10.4.3 Gland Sealing System (Related to RG 1.206, Section C.III.1, Chapter 10, C.I.10.4.3, "Turbine Gland Sealing System")

The gland seal system prevents the escape of steam from the turbine shaft, turbine casing penetrations, and valve stems. The gland seal system also prevents air in-leakage through sub-atmospheric turbine glands. The system provides a source of sealing steam to the annulus space where the turbine and large steam valve shafts penetrate the turbine casings.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.3 of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.4 Turbine Bypass System

The turbine bypass system provides the capability to discharge main steam from the reactor directly to the main condenser, which minimizes load transient effects on the nuclear steam supply system. The turbine bypass system is designed to discharge a certain percentage of rated main steam flow directly to the main condenser, bypassing the turbine. The system is also used to discharge main steam during reactor hot standby and cooldown operations.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.4 of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.5 Circulating Water System

10.4.5.1 Introduction

The CWS removes waste heat from the main condenser. This waste heat is subsequently transferred to the power cycle heat sink. The CWS provides a continuous supply of cooling water to the main condenser to remove the heat rejected by the turbine cycle and auxiliary systems.

10.4.5.2 Summary of Application

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference Section 10.4 of the AP1000 DCD, Revision 17. Section 10.4 of the DCD includes Section 10.4.5.

In addition, in VCSNS COL FSAR Section 10.4.5, the applicant provided the following:

AP1000 COL Information Item

- VCS COL 10.4-1

The applicant provided additional information related to the CWS design parameters in VCS COL 10.4-1 to resolve the COL information item in Section 10.4.12.1 of the AP1000 DCD (COL Action Item 10.5-3).

Site-Specific Information Replacing Conceptual Design Information

- VCS CDI

The applicant provided additional information to replace CDI in VCSNS COL FSAR Section 10.4.5, which describes the following various aspects of the site-specific CWS:

- Power generation design basis
- General description
- Component description
- System operation
- Tests and inspections
- Instrumentation applications

10.4.5.3 Regulatory Basis

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

In addition, the regulatory basis for acceptance of COL Information Item 10.4-1 (COL Action Item 10.5-3) is established in GDC 4, as it relates to design provisions provided to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS.

In accordance with Section 10.4.5 of NUREG-0800, the requirements of GDC 4 are met when the CWS design includes provisions to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS. Means should be provided to prevent or detect and control flooding of safety-related areas so that the intended safety function of a system or component will not be precluded due to leakage from the CWS. Malfunction or a failure of a component or piping of the CWS, including an expansion joint, should not have unacceptable adverse effects on the functional performance capabilities of safety-related systems or components.

10.4.5.4 Technical Evaluation

The NRC staff reviewed Section 10.4.5 of the VCSNS COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the CWS. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

The staff reviewed the information in the VCSNS COL FSAR:

AP1000 COL Information Items

- VCS COL 10.4-1

In VCSNS COL FSAR Section 10.4.5, the applicant provided additional information in VCS COL 10.4-1 to resolve the COL information item in Section 10.4.12.1, "Circulating Water System," of the AP1000 DCD, which states:

> The Combined License applicant will address the final configuration of the plant circulating water system including piping design pressure, the cooling tower or other site-specific heat sink.
>
> As applicable, the Combined License applicant will address the acceptable Langelier or Stability Index range, the specific chemical selected for use in the CWS water chemistry control, pH adjuster, corrosion inhibiter, scale inhibiter, dispersant, algaecide and biocide applications reflecting potential variations in site water chemistry and in micro macro biological life forms. A biocide such as sodium hypochlorite is recommended. Toxic gases such as chlorine are not recommended. The impact of toxic gases on the main control room habitability is addressed in Section 6.4. The Combined License applicant will also be responsible for the design, routing, and disposition requirements associated with the main condenser waterbox drains.

This item was also captured as COL Action Item 10.5-3 in Appendix F of NUREG-1793:

> The COL applicant is responsible for the site-specific configuration of the plant circulating water system (including piping design pressure), the cooling tower, or other site-specific heat sink.

The applicant addressed the above COL information item of the AP1000 DCD in VCSNS COL FSAR Sections 10.4.5.2.1, "General Description"; 10.4.5.2.2, "Component Description"; and 10.4.5.5, "Instrumentation Applications"; by providing additional information concerning CWS heat sink capability, design parameters, cooling towers, waterbox drains, and CWS water chemistry control. The staff reviewed the applicant's information in these FSAR sections.

In VCSNS COL FSAR Section 10.4.5.2.1, the applicant described the VCSNS site-specific CWS. The CWS and the cooling towers provide a heat sink for waste heat exhausted from the main steam turbine. Also, to address COL Information Item 10.4-1 of the AP1000 DCD, the applicant provided VCSNS-specific design parameters in VCSNS COL FSAR Table 10.4-202, "Supplemental Design Parameters for Major Circulating Water System Components."

In VCSNS COL FSAR Section 10.4.5.2.2, the applicant stated that the design pressure of the condenser portions of the piping is identified in AP1000 DCD Table 10.4.1-1, "Main Condenser Design Data," and the design pressure of the remaining piping is 100 pounds per square inch gauge (psig). The design pressure of the condenser portions of the piping (waterbox design pressure) is identified in the table as 90 psig. The staff finds the design pressure of 100 psig for the remaining piping is compatible with the 90 psig for the condenser portion and is, therefore, acceptable. The staff also reviewed the VCSNS COL FSAR Table 10.4-202 site-specific design parameters and compared them to the corresponding data in AP1000 DCD Table 10.4.5-1, "Design Parameters for Major Circulating Water Components," and finds them acceptable as the site-specific parameters are similar to those for the certified design.

Also in VCSNS COL FSAR Section 10.4.5.2.2, the applicant provided information on the chemical treatment program for the CWS. The applicant stated that specific chemicals used within the system are determined by the site water conditions. Additionally, in VCSNS COL Section 10.4.5.5, the applicant identified that circulating water chemistry is controlled by cooling tower blowdown via regulating the blowdown valve. The staff finds that the applicant adequately addressed COL Information Item 10.4-1 by specifying its site-specific chemicals and control and maintenance of CWS chemistry.

In addition, in VCSNS COL FSAR Section 10.4.5.2.2, the applicant provided information on the design, routing, and disposition requirements associated with the main condenser waterbox drains. The applicant stated that the condenser waterbox drains will drain to the cooling tower basin. Piping is routed from each waterbox to the condenser waterbox drain pump which in turn pumps the water back to the cooling tower. Each waterbox contains drain valves and vents so that a waterbox can be drained individually. Piping is sized to support an adequate drain down in the event of emergency maintenance. The staff finds that the applicant adequately addressed the site-specific design, routing, and disposition requirements associated with the main condenser waterbox drains as specified in COL Information Item 10.4-1.

The staff reviewed the information provided in the above VCSNS COL FSAR sections and finds that the applicant addressed the final configuration of the CWS as specified in the COL Information Item 10.4-1. The staff finds that the CWS design parameters of temperature and flow rates in VCSNS COL FSAR Table 10.4-202 are consistent with the design parameters in AP1000 DCD Table 10.4.5-1. The staff also finds that the design piping pressures of the VCSNS CWS are consistent with the design pressures of the conceptual (non-site-specific) design of the AP1000 CWS, and are, therefore, acceptable.

The staff's evaluation of the CWS final configuration is addressed below under the CDI discussions.

Site-Specific Information Replacing Conceptual Design Information

- VCS CDI

The applicant provided VCSNS site-specific design information as part of the FSAR to replace the CDI in the AP1000 DCD regarding the CWS. The applicant replaced bracketed text throughout Section 10.4.5 of the AP1000 DCD to provide site-specific CWS power generation design basis information, general CWS description, component description, system operation, tests and inspections, and instrumentation applications. The staff reviewed the text added in VCS CDIs throughout VCSNS COL FSAR Section 10.4.5 related to the CWS system, and the following provides the staff's evaluation of these CDIs in the application.

In VCSNS COL FSAR Sections 10.4.5.1, "Design Bases," and 10.4.5.2, "System Description," the applicant provided a description of its CWS system configuration. The CWS is a non-safety-related system. The CWS supplies cooling water to remove heat from the main condensers, the turbine building closed cooling water system heat exchangers and the condenser vacuum pump seal water heat exchangers under varying conditions of power plant loading and design weather conditions.

In VCSNS COL FSAR Section 10.4.5.2.1, "General Description," the applicant provided site-specific design information in that the VCSNS CWS consists of three 33-1/3 percent capacity circulating water pumps. In addition, each pump discharge line has a motor-operated butterfly

valve located between the pump discharge and the main header. This permits isolation of one pump for maintenance and allows two-pump operation

In VCSNS COL FSAR Section 10.4.5.2.2, "Component Description," the applicant provided VCSNS-specific design information regarding the CWS major components, such as circulating water pumps, cooling tower, cooling tower makeup and blowdown, and piping and valves, which address the final configuration of the CWS.

The two cooling towers are mechanically induced-draft, counterflow cooling towers. Each cooling tower is designed to cool the water to 90.1 °Fahrenheit (F) (32.3 °Celsius (C)) with a hot water inlet temperature of 114.8 °F (46 °C). The staff finds that the above temperature values are acceptable as they demonstrate an equally effective cooling tower design as listed in AP1000 DCD Table 10.4.5-1. The applicant states that the cooling towers are located to prevent adverse interactions with SSCs required for safe shutdown of the plant in case of collapse of the towers or failure of their basins and flumes. However, the staff could not find further details on how the cooling tower failure will have no affect on the nearby safety-related system, equipment and/or structure of the plant. As described in NUREG-0800, Section 10.4.5, Acceptance Criteria, the requirements of GDC 4 are met when the CWS design includes provisions to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS. Therefore, in order to meet this GDC 4 criteria and for the NRC staff to complete its evaluation of the site-specific CWS the staff requested, in RAI 10.4.5-1, that the applicant provide additional information to ensure that failure of the tower will not affect the safety-related systems or equipment that are located in the proximity of the cooling tower. In a letter dated February 18, 2009, the applicant responded to RAI 10.4.5-1 by stating that the mechanically induced draft cooling towers are 75 feet tall, and are more than 600 feet away from the closest safety-related building. This physical separation will prevent any interactions of a failed cooling tower and safety-related buildings. The site is graded to direct water that may result from a cooling tower failure or a circulating water yard piping failure away from the nuclear islands. The consequences of these failures are bounded by a failure of circulating water piping in the turbine building. The staff finds that the applicant has provided adequate information to satisfy GDC 4 with respect to external flooding events due to CWS failures. The staff verified that the applicant incorporated the associated changes in the VCSNS COL FSAR.

Regarding internal flooding, in VCSNS COL FSAR Section 10.4.5.2.3, "System Operation," the applicant incorporates by reference, text from the AP1000 DCD, which states "The effects of flooding due to a circulating water system failure, such as the rupture of an expansion joint, will not result in detrimental effects on safety-related equipment since there is no safety-related equipment in the turbine building and the base slab of the turbine building is located at grade elevation. Water from a system rupture will run out of the building through a relief panel in the turbine building west wall before the level could rise high enough to cause damage." Site grading will carry the water away from safety-related buildings. The staff finds that a malfunction or a failure of a component or piping of the CWS, including an expansion joint, will not have unacceptable adverse effects on the functional performance capabilities of safety-related systems or components. Therefore, the GDC 4 requirements have been satisfied since the flooding that results from failure of the CWS does not adversely impact any safety-related SSCs.

Further, the staff finds that the CWS cooling tower makeup is provided by the RWS, described in VCSNS COL FSAR Section 9.2.11, "Raw Water System." Makeup to and blowdown from the

CWS is controlled by the makeup and blowdown control valves. The evaluation of RWS capabilities is provided in Section 9.2.11 of this SER.

The underground portions of the CWS piping are constructed of prestressed concrete pressure piping. The remainder of the piping is carbon steel and is coated internally with a corrosion-resistant compound. Control valves provide regulation of cooling tower blowdown and makeup. The CWS is designed to withstand the maximum operating discharge pressure of the circulating water pumps. As discussed earlier in the staff evaluation of VCS COL 10.4-1, the staff finds the CWS piping design pressure of 100 psig to be compatible with the condenser and associated equipment design, and therefore, acceptable.

In VCSNS COL FSAR Section 10.4.5.2.3, "System Operation," the applicant stated that if the circulating water pumps, the cooling tower, or the circulating water piping malfunction and the condenser is not available to adequately support unit operation, cooldown of the reactor may be accomplished by using the power-operated atmospheric steam relief valves or safety valves rather than the turbine bypass system. The staff finds that this alternate cooldown method is acceptable, because the turbine bypass system will not function during accident conditions and the CWS is not required for safe shutdown following an accident. Further, the applicant stated that circulating water flow to the cooling towers can be diverted directly to the basins, bypassing the cooling towers' internals, by opening the bypass valves during plant startup or partial load or to maintain CWS temperatures above 40 °F (4.4 °C). The staff finds that these provisions of the site-specific CWS design meet the requirements of GDC 4, as described in NUREG-0800, Section 10.4.5.

In VCSNS COL FSAR Section 10.4.5.5, "Instrumentation Application," the applicant identifies the configuration and function of the CWS pressure, temperature and level instrumentation at the VCSNS site. Also, the motor-operated valve at each pump discharge is interlocked with the pump, so that the pump trips if the discharge valve fails to reach the full-open position shortly after starting the pump.

Based on its review of the information provided by the applicant, the staff concludes that the site-specific design of the VCSNS CWS (VCS CDI) provided in the VCSNS COL FSAR sections above adequately addresses the information that was specified in the AP1000 DCD.

10.4.5.5 Post Combined License Activities

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

10.4.5.6 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 CWS, and there is no outstanding information expected to be addressed in the VCSNS COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

In addition, VCS CDI involving the CWS is adequately addressed by the applicant. The staff concludes that the relevant information presented in the VCSNS COL FSAR is acceptable and meets the acceptance criteria of Section 10.4.5 of NUREG-0800 and the requirements of GDC 4. The staff based its conclusions on the following:

- VCS COL 10.4-1, relating to the final configuration of the circulating water, is acceptable to the staff because the applicant addressed the site-specific chemicals and control and maintenance of the CWS chemistry in order to be consistent with AP1000 DCD.

- VCS CDI, relating to various aspects of the CWS, is acceptable to the staff because failure of the site-specific CWS design does not adversely impact any safety-related SSCs.

10.4.6 Condensate Polishing System (Related to RG 1.206, Section C.III.1, Chapter 10, C.I.10.4.6, "Condensate Cleanup System")

The condensate polishing system can be used to remove corrosion products and ionic impurities from the condensate system during plant startup, hot standby, power operation with abnormal secondary cycle chemistry, safe shutdown, and cold shutdown operations.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.6 of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.7 Condensate and Feedwater System

10.4.7.1 Introduction

The condensate and feedwater system provides feedwater at the required temperature, pressure, and flow rate to the SGs. Condensate is pumped from the main condenser hot well by the condensate pumps, passes through the low-pressure feedwater heaters to the feedwater pumps, and then is pumped through the high-pressure feedwater heaters to the SGs.

10.4.7.2 Summary of Application

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference Section 10.4 of the AP1000 DCD, Revision 17. Section 10.4 of the DCD includes Section 10.4.7.

In addition, in VCSNS COL FSAR Section 10.4.7.2.1, the applicant provided the following:

AP1000 COL Information Item

- VCS COL 10.4-2

The applicant provided additional information in VCS COL 10.4-2 to address the COL information item in Section 10.4.12.2, "Condensate, Feedwater and Auxiliary Steam System Chemistry Control," of the AP1000 DCD (COL Action Item 10.5-4).

Supplemental Information

- STD SUP 10.4-1

The applicant provided supplemental information in VCSNS COL FSAR Section 10.4.7.2.1, "General Description," which addresses operations and maintenance procedures.

- STD SUP 10.4-2

The applicant provided supplemental information, which states that the EPRI Secondary Water Chemistry Guidelines will be used for guidance on selection of pH control agents and pH optimization as described in Nuclear Energy Institute (NEI) 97-06.

10.4.7.3 Regulatory Basis

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

In addition, the regulatory basis for acceptance of the COL information item and STD SUP 10.4-2 is GDC 14, as it relates to ensuring the integrity of the reactor coolant pressure boundary (specifically as the secondary water chemistry program ensures the integrity of the SG tubing). The applicable acceptance criteria for meeting GDC 14 are found in NUREG-0800 Sections 10.4.6 and 5.4.2.1, including BTP 5-1. The regulatory basis for acceptance of STD SUP 10.4-1 is established in GDC 4, insofar as it requires that the dynamic effects associated with possible fluid flow instabilities (e.g., water hammers) during normal plant operation, as well as during upset or accident conditions be considered, and that SSCs important to safety be designed to accommodate the effects of, and be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

GDC 4 can be complied with by meeting the relevant acceptance criteria specified in Section 10.4.7 of NUREG-0800, "Condensate and Feedwater System." In regard to fluid instabilities, the requirements of GDC 4, as related to protecting SSCs against the dynamic effects associated with possible fluid flow instabilities (e.g., water hammers) during normal plant operation, as well as during upset or accident conditions can be met by: (1) meeting the guidance in BTP 10-2, "Design Guidelines for Avoiding Water Hammers in Steam Generators," for reducing the potential for water hammers in SGs; and (2) meeting the guidance related to feedwater-control-induced water hammer. Guidance for water hammer prevention and mitigation is given in NUREG-0927, Revision 1, "Evaluation of Water Hammer Occurrences in Nuclear Power Plants."

10.4.7.4 Technical Evaluation

The NRC staff reviewed Section 10.4.7 of the VCSNS COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the condensate and feedwater system. The results of the NRC staff's evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP Units 3 and 4) were equally applicable to the VCSNS Units 2 and 3 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 2, to the VCSNS COL FSAR. In performing this comparison, the staff considered changes made to the VCSNS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the standard content to be directly applicable to the VCSNS COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) includes evaluation material from the SER for the BLN Units 3 and 4 COL application.

The staff reviewed the information in the VCSNS COL FSAR:

AP1000 COL Information Item

- VCS COL 10.4-2

In VCSNS COL FSAR Section 10.4.7.2.1, the applicant provided additional information in VCS COL 10.4-2 to address the COL information item in Section 10.4.12.2, "Condensate, Feedwater and Auxiliary Steam System Chemistry Control," of the AP1000 DCD, which states:

> The Combined License applicant will address the oxygen scavenging agent and pH adjuster selection for the turbine island chemical feed system.

The commitment was also captured as COL Action Item 10.5-4 in Appendix F of NUREG-1793:

> The COL applicant is responsible for chemistry control of the condensate, feedwater, and auxiliary steam system.

The VCSNS COL FSAR modified Section 10.4.7.2.1 of the AP1000 DCD, to state:

> The oxygen scavenger agent is hydrazine and the pH control agent is morpholine.

The NRC staff reviewed the resolution to VCS COL 10.4-2 regarding the text added to Section 10.4.7.2.1, related to condensate, feedwater, and auxiliary steam system chemistry control.

The description of the secondary water chemistry control program is addressed in the AP1000 DCD, Section 10.3.5. Consistency with industry guidelines was addressed in the AP1000 DCD, Section 10.3.5.5, which stated that action taken when chemistry parameters are outside normal operating ranges will, in general, be consistent with action levels described in Reference 1 ("PWR Secondary Water Chemistry Guidelines," EPRI technical report (TR) TR-102134-R5, March 2000). However, the AP1000 DCD does not specify the oxygen scavenger or pH control chemicals to be used. This is to be addressed by COL Information Item 10.4-2 of the AP1000 DCD.

Revision 6 of the EPRI Secondary Water Chemistry Guidelines (EPRI Guidelines), which is the latest published version of these guidelines, does not require a specific oxygen scavenging agent. However, the guidelines do note that hydrazine is the most commonly used oxygen scavenger for PWR secondary systems and is generally recognized as effective for this purpose. Therefore, the staff finds the identified oxygen scavenger agent is consistent with the EPRI guidelines.

For pH control, the EPRI secondary water chemistry guidelines do not require specific amines. Section 3.3.1 of the EPRI Guidelines recommends a plant-specific amine be selected based on a number of factors. Section 3.3.1 of the EPRI Guidelines lists several amines that have been used or are being used in PWR plants as pH control agents, including morpholine. Section 3.3.1.2 of the EPRI Guidelines states that if implementing advanced amine treatment, a site-specific materials compatibility review will be necessary to ensure that components, particularly elastomers, are compatible with the amine. The EPRI Guidelines, in Table 5-4, "Recirculating Steam Generator Power Operation (≥30% Reactor Power) Feedwater Sample," refer to several other EPRI reports for guidance for optimization of the pH in conjunction with the amine selected. The applicant did not explicitly describe how the selected amine was qualified, or how the pH will be optimized in conjunction with the selected amines.

Although the applicant did not explicitly describe how the selected amines were qualified, STD SUP 10.4-2 ensures that the qualification of the chosen oxygen scavenging and pH control chemicals will be consistent with the EPRI PWR Secondary Water Chemistry Guidelines. (See evaluation of STD SUP 10.4-2 below under evaluation of supplemental information).

The staff finds the pH control and oxygen scavenger chemical acceptable because the proposed chemicals will be qualified and the resulting pH optimized following the guidance of the EPRI PWR Secondary Water Chemistry Guidelines, which is referenced in NUREG-0800 as acceptable guidance to ensure that the secondary water chemistry program meets GDC 14. On the basis of the information provided by the applicant and the acceptance criteria in BTP 5-1, the staff concludes that the proposed secondary chemistry that uses hydrazine and morpholine is acceptable.

The following portion of this technical evaluation section is reproduced from Section 10.4.7.4 of the VEGP SER:

Supplemental Information

- *STD SUP 10.4-1*

The applicant provided supplemental information as part of the BLN COL FSAR regarding operations and maintenance procedures. The applicant added the following text to the end of Section 10.4.7.2.1 of the AP1000 DCD, Revision 17*:*

Operations and maintenance procedures include appropriate precautions to avoid steam/water hammer occurrences.

The NRC staff reviewed the standard supplemental information provided in STD SUP 10.4-1 regarding the text added to Section 10.4.7.2.1 related to operations and maintenance procedures.

In Section 10.4.7 of NUREG-0800, Acceptance Criteria 2, provides acceptable methods of compliance with the requirements in GDC 4, as it applies to fluid flow instabilities, (e.g., water hammer). Criteria 2B, "Meeting the guidance related to feedwater-control-induced water hammer," states that guidance for water hammer and mitigation is found in NUREG-0927. The supplemental information added to the BLN COL FSAR states that operations and maintenance procedures include appropriate precautions to avoid steam/water hammer occurrences; however, the supplemental information being proposed by the applicant did not identify what type of precautions included in the procedures minimize the potential for water hammer occurrences. In order to ensure that the procedures adequately address water hammer prevention and mitigation, the staff requested in RAI 10.4-7-1, in a letter dated June 3, 2008, that the applicant provide a more detailed statement concerning the use of operations and maintenance procedures, including information on what specific elements in the procedures (i.e., venting) will result in reduced potential of water hammer occurrences.

In its response, dated July 17, 2008, concerning reducing the potential for water hammer events, the applicant identified that they programmatically integrate into the AP1000 Operations Procedure development good operating practice and operating experience including, but not limited to, Institute of Nuclear Power Operations (INPO) significant event reports and significant operating event reports, NRC information notices and bulletins, and other industry operating experience information. Further, the applicant explained that specific operating experience to preclude or mitigate water hammer is included in this population of operating experience. In addition, the applicant explained that the AP1000 has been designed to prevent or minimize steam and water hammer. The applicant agreed to revise the procedure elements in BLN COL FSAR Section 10.4.7.2.1, and described in STD SUP 10.4-1, to include additional precautions to minimize the potential for steam and water hammer.

The revised STD SUP 10.4-1, in BLN COL FSAR Section 10.4.7.2.1 now reads as follows:

> *Operations and maintenance procedures include precautions, when appropriate, to minimize the potential for steam and water hammer, including:*
>
> - *Prevention of rapid valve motion.*
> - *Process for avoiding introduction of voids into water-filled lines and components.*

- *Proper filling and venting of water-filled lines and components.*
- *Process for avoiding introduction of steam or heated water that can flash into water-filled lines and components.*
- *Cautions for introduction of water into steam-filled lines or components.*
- *Proper warmup of steam-filled lines.*
- *Proper drainage of steam-filled lines.*
- *The effects of valve alignments on line conditions.*

Based on its review, the staff finds the applicant's response acceptable because a detailed list of the procedural precautions that would reduce or minimize the occurrence of water hammer was provided and included as a proposed revision to the COL application, Part 2, BLN COL FSAR Section 10.4.7.2.1. Further, the staff reviewed the precautions and compared them to the industry experience and staff guidance in accordance with Section 10.4.7 of NUREG-0800 and BTP 10-2. The staff finds that the applicant has adequately addressed the steam and water hammer. Therefore, the staff's concern described in RAI 10.4.7-1 is resolved.

- *STD SUP 10.4-2*

The applicant provided supplemental information explaining that the EPRI PWR Secondary Water Chemistry Guidelines will be used for guidance on selection of pH control agents and pH optimization as described in NEI 97-06.

EPRI documents provide detailed guidelines for both qualification of the selected pH control chemicals and the optimization of the secondary pH. While the staff does not review or accept the EPRI PWR Secondary Water Chemistry Guidelines through a safety evaluation, these guidelines are recognized as representing the industry consensus on best practices in water chemistry control and have been proven to be effective via many years of successful operating experience. As such, the staff finds the application of the guidance of the EPRI PWR Secondary Water Chemistry Guidelines, and a programmatic commitment to use these guidelines, to be an acceptable method for the applicant to ensure compliance with GDC 14. As discussed in a Federal Register (FR) notice, dated March 2, 2005, 70 FR 10298, the reference to NEI 97-06 and the associated water chemistry guidelines provide reasonable assurance that steam generator tube integrity will be maintained.

10.4.7.5 Post Combined License Activities

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

10.4.7.6 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 condensate and feedwater system, and there is no outstanding information expected to be addressed in the VCSNS COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

In addition, the staff concludes that the relevant information presented in the VCSNS COL FSAR is acceptable and meets the requirements of GDC 4 and GDC 14 and the guidance in Sections 10.4.6, 10.4.7, and 5.4.2.1 of NUREG-0800, NUREG-0927, BTP 5-1, and BTP 10-2. The staff based its conclusions on the following:

- VCS COL 10.4-2 and STD SUP 10.4-2, relating to the condensate, feedwater, and auxiliary system chemistry control program, are in accordance with EPRI PWR Secondary Water Chemistry Guidelines, which is referenced in NUREG-0800 Sections 10.4.6 and 5.4.2.1, including BTP 5-1 of NUREG-0800. Meeting these guidelines ensures that GDC 14 is met with respect to integrity of the reactor coolant pressure boundary, specifically as the secondary water chemistry program ensures the integrity of the SG tubing.

- STD SUP 10.4-1, relating to operations and maintenance, is acceptable to the staff because the applicant has provided a detailed list of the procedural precautions that are consistent with Section 10.4.7 of NUREG-0800 and the BTP 10-2 acceptance criteria.

10.4.8 Steam Generator Blowdown System (Related to RG 1.206, Section C.III.1, Chapter 10, C.I.10.4.8, "Steam Generator Blowdown System (PWR)")

The SG blowdown system assists in maintaining acceptable secondary coolant water chemistry during normal operation and during anticipated operational occurrences, such as main condenser inleakage or primary to secondary SG tube leakage. It does this by processing water from each SG and removing impurities.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.8 of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.9 Startup Feedwater System

The startup feedwater system provides a supply of feedwater to the SGs during plant startup, hot standby and shutdown conditions, and during transients in the event of main feedwater system unavailability. The startup feedwater system is composed of components from the AP1000 main and startup feedwater system and SG system.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.9 of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.10 Auxiliary Steam System

The auxiliary steam system provides the steam required for plant use during startup, shutdown, and normal operation. Steam is supplied from either the auxiliary boiler or the main steam system.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.10 of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.11 Turbine Island Chemical Feed

The turbine island chemical feed system injects required chemicals into the condensate, feedwater, auxiliary steam, service water, and demineralized water treatment. Chemical feed system components are located in the turbine building.

Section 10.4 of the VCSNS COL FSAR, Revision 2, incorporates by reference, with no departures or supplements, Section 10.4.11 of Revision 17 of the AP1000 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 results of the NRC staff's technical evaluation of the information incorporated by reference in the VCSNS COL application are documented in NUREG-1793 and its supplements.

10.4.12 Combined License Information

Section 10.4.12 of the VCSNS COL FSAR incorporates by reference Section 10.4.12, "Combined License Information," of Revision 17 of the AP1000 DCD. The NRC staff reviewed Section 10.4.12 of the VCSNS COL FSAR and checked the referenced DCD to ensure the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1]

The applicant addressed COL Information Items 10.4-1, 10.4-2, and 10.4-3. These items are discussed and evaluated in Sections 10.4.5, 10.4.7, and 9.2.5 of this SER, respectively.

10.4.12 Combined License Information

Section 10.4.12 of the VCSNS COL FSAR incorporates by reference Section 10.4.12, "Combined License Information," of Revision 17 of the AP1000 DCD. The NRC staff reviewed Section 10.4.12 of the VCSNS COL FSAR and checked the referenced DCD to ensure the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1]

The applicant addressed COL Information Items 10.4-1, 10.4-2, and 10.4-3. These items are discussed and evaluated in Sections 10.4.5, 10.4.7, and 9.2.5 of this SER, respectively.

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