

## 9.0 Auxiliary Systems

<b>9.1</b>	<b>Fuel Storage and Handling</b> .....	9-1
9.1.1	New Fuel Storage.....	9-1
9.1.2	Spent Fuel Storage .....	9-2
9.1.3	Spent Fuel Cooling and Cleanup System .....	9-2
9.1.4	Light Load Handling System (Related to Refueling) .....	9-3
9.1.5	Overhead Heavy Load Handling System .....	9-6
<b>9.2</b>	<b>Water Systems</b> .....	9-11
9.2.1	Plant Service Water System.....	9-11
9.2.2	Reactor Component Cooling Water System .....	9-21
9.2.3	Makeup Water System .....	9-22
9.2.4	Potable and Sanitary Water Systems.....	9-24
9.2.5	Ultimate Heat Sink.....	9-27
9.2.6	Condensate Storage and Transfer System .....	9-30
9.2.7	Chilled Water System.....	9-32
9.2.8	Turbine Component Cooling Water System.....	9-33
9.2.9	Hot Water System .....	9-33
9.2.10	Station Water System.....	9-33
<b>9.3</b>	<b>Process Auxiliaries</b> .....	9-36
9.3.1	Compressed Air Systems .....	9-36
9.3.2	Process Sampling System .....	9-36
9.3.3	Equipment and Floor Drain System .....	9-39
9.3.4	Chemical and Volume Control System.....	9-40
9.3.5	Standby Liquid Control System .....	9-40
9.3.6	Instrument Air System .....	9-42
9.3.7	Service Air System .....	9-42
9.3.8	High Pressure Nitrogen Supply System .....	9-43
9.3.9	Hydrogen Water Chemistry System .....	9-43
9.3.10	Oxygen Injection System.....	9-47
9.3.11	Zinc Injection System .....	9-49
9.3.12	Auxiliary Boiler System.....	9-51
<b>9.4</b>	<b>Heating, Ventilation, and Air Conditioning</b> .....	9-51

<b>9.5</b>	<b>Other Auxiliary Systems</b> .....	9-52
9.5.1	Fire Protection System .....	9-52
9.5.2	Communication Systems.....	9-63
9.5.3	Lighting System.....	9-70
9.5.4	Diesel Generator Fuel Oil Storage and Transfer System .....	9-70
9.5.5	Diesel Generator Jacket Cooling Water System .....	9-74
9.5.6	Diesel Generator Starting Air System .....	9-74
9.5.7	Diesel Generator Lubrication System.....	9-75
9.5.8	Diesel Generator Combustion Air Intake and Exhaust System.....	9-75

## 9.0 AUXILIARY SYSTEMS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 Combined License (COL) auxiliary systems for the Economic Simplified Boiling-Water Reactor Standard (ESBWR) design including fuel handling and storage, process water and cooling systems, process auxiliaries, alternate shutdown, fire protection, plant communication systems, lighting and diesel generator systems.

### 9.1 Fuel Storage and Handling

#### 9.1.1 New Fuel Storage

Section 9.1.1, "New Fuel Storage," of the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference Section 9.1.1, "New Fuel Storage," of the ESBWR Design Control Document (DCD), Revision 10, referenced in Title 10 *Code of Federal Regulations* (CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix E, "Design Certification Rule for the ESBWR Design." As documented in NUREG-1966, "Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," the U.S. Nuclear Regulatory Commission (NRC) staff reviewed and approved Section 9.1.1 of the certified ESBWR DCD. The staff reviewed the COL application (COLA) and checked the referenced DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

Section 9.1.1.7 of the ESBWR DCD indicates that the applicant is to address DCD COL Item 9.1-4-A related to programs that address fuel handling operations, including criticality safety. The COL applicant removed the two references that DCD Section 9.1.1.7 made to COL 9.1-4-A and addressed them as STD COL 9.1-4-A in Section 9.1.4 of the COL FSAR. The staff's review of STD COL 9.1-4-A is discussed in Section 9.1.4 of this safety evaluation report (SER).

The seismic evaluations for new fuel storage performed in the ESBWR DCD are based on ESBWR standard plant seismic inputs. The North Anna 3 site-specific seismic demands exceed the certified seismic design response spectra (CSDRS). Therefore, the applicant introduced the departure NAPS DEP 3.7-1, "Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra," and referenced it in Section 9.1.1.5 of the North Anna 3 COL FSAR, Revision 9 submitted June, 2016. The applicant performed a site-specific assessment of the new fuel storage rack structural design using the DCD methodology, as approved by the staff in NUREG-1966, the ESBWR DCD Final Safety Evaluation Report (FSER). The North Anna 3 site-specific seismic demands, evaluated in Section 3.7 of this SER, result in changes to the size of anchor bolts for new fuel storage racks in the buffer pool and higher embedment loads than in the ESBWR DCD, Revision 10. The staff evaluated NAPS DEP 3.7-1 with respect to the new fuel storage seismic structure loads in Section 3.8 of this SER.

The inclusion of NAPS DEP 3.7-1 in Section 9.1.1 was verified by the staff in the North Anna 3 FSAR, Revision 9, which incorporated the appropriate changes described in the applicant's

---

<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.2.2, for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

revised seismic request for additional information (RAI) responses on May 18, 2016 (Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML16146A789). Therefore, Confirmatory Item 09.01-1 from the staff advanced SER for North Anna 3 is resolved and closed.

The staff's review confirms that the applicant has addressed the required information, and no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to new fuel storage that were incorporated by reference have been resolved.

### **9.1.2 Spent Fuel Storage**

Section 9.1.2, "Spent Fuel Storage," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.1.2, "Spent Fuel Storage," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.1.2 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The seismic evaluations for spent fuel storage performed in the ESBWR DCD are based on ESBWR standard plant seismic inputs. The North Anna 3 site-specific seismic demands exceed the CSDRS, so the applicant introduced the departure NAPS DEP 3.7-1, "Seismic Design," and referenced it in Section 9.1.2.4 of the North Anna 3 COL FSAR, Draft Revision 9 submitted on May 20, 2016 (ADAMS Accession No. ML16146A789). The applicant performed a site-specific assessment of the spent fuel storage rack structural design using the DCD methodology, as approved by the staff in NUREG-1966. The North Anna 3 site-specific seismic demands, evaluated in Section 3.7 of the SER, result in changes to the size of anchor bolts and the welds from the enveloping plate to the base plates for spent fuel storage racks in the buffer pool deep pit and higher embedment loads than in the ESBWR DCD, Revision 10. The staff evaluated NAPS DEP 3.7-1 with respect to the spent fuel pool (SFP) seismic structure loads in Section 3.8 of this SER.

The inclusion of NAPS DEP 3.7-1 was verified by the staff in the North Anna 3 FSAR, Revision 9, which incorporated the appropriate changes described in the applicant's revised seismic RAI responses on May 18, 2016. Therefore, Confirmatory Item 09.01-2 from the staff advanced SER for North Anna 3 is resolved and closed.

The staff's review confirms that the applicant has addressed the required information, and no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to spent fuel storage that were incorporated by reference are resolved.

### **9.1.3 Spent Fuel Cooling and Cleanup System**

Section 9.1.3, "Spent Fuel Cooling and Cleanup System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.1.3, "Spent Fuel Cooling and Cleanup System," of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and

approved Section 9.1.3 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Spent Fuel Cooling and Cleanup System" that were incorporated by reference have been resolved.

## **9.1.4 Light Load Handling System (Related to Refueling)**

### **9.1.4.1 Introduction**

The light load handling system is used to handle the spent fuel assemblies underwater from the time they leave the reactor vessel until they are placed in a container for shipment from the site. Characteristics of the system are aimed at avoiding criticality accidents, radioactivity releases resulting from damage to irradiated fuel, and unacceptable personnel radiation exposure.

### **9.1.4.2 Summary of Application**

Section 9.1.4, "Light Load Handling System (Related to Refueling)," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.1.4 of the certified ESBWR DCD, Revision 10. In addition, in North Anna 3 COL FSAR, Section 9.1.4, the applicant provided the following:

#### COL Item

- STD COL 9.1-4-A Fuel Handling Operations

The applicant provided additional information in STD COL 9.1-4-A to address DCD COL Item 9.1.4-A. The applicant described the scope of the fuel handling procedures and procedures for equipment used to move fuel. The applicant states that these procedures will be developed 6 months before fuel receipt. The applicant states that the fuel handling equipment is inspected for operating conditions before each refueling and that a quality assurance (QA) program is applied to monitoring, implementing and assuring compliance with fuel handling procedures. The QA program is described in Section 17.5 of the COL FSAR.

### **9.1.4.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966, FSER related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the "Light Load Handling System (Related To Refueling)" and the associated acceptance criteria are in Section 9.1.4 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," the Standard Review Plan (SRP).

The applicable regulatory requirements and associated guidance for fuel handling operations are as follows:

- General Design Criterion (GDC) 61, "Fuel Storage and Handling and Radioactivity Control," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR

Part 50, "Domestic Licensing of Production and Utilization Facilities," as it relates to radioactive releases resulting from fuel damage and the avoidance of excessive personnel radiation exposure.

- GDC 62, "Prevention of Criticality in Fuel Storage and Handling," as it relates to prevention of criticality accidents.
- Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007.

#### **9.1.4.4 Technical Evaluation**

As documented in NUREG-1966, the staff reviewed and approved Section 9.1.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.1.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD that represent the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the "Light Load Handling System (Related to Refueling)."

The staff's review of the information contained in the North Anna 3 COL FSAR is as follows:

##### COL Items

- STD COL 9.1-4-A Fuel Handling Operations

The staff reviewed STD COL 9.1-4-A, Fuel Handling Operations, related to the fuel handling operations included under Section 9.1.4 of the North Anna 3 COL FSAR. DCD COL Item 9.1.4-A in Section 9.1.6, "COL Information," of the ESBWR DCD, Revision 10, states that the applicant will provide a description of programs that address the following:

- Criticality safety of fuel handling operations
- Fuel handling procedures
- Maintenance manuals and procedures for equipment used to move fuel
- Equipment inspection and test plans for equipment used to move fuel
- Personnel qualifications, training, and control programs for fuel handling personnel
- [Quality Assurance] QA programs to monitor, implement, and assure compliance to fuel handling operations

In FSAR Section 9.1.4.13, "Refueling Operations," and FSAR Section 9.1.4.19, "Inspection and Testing Requirements," the applicant addressed DCD COL Item 9.1.4-A in STD COL 9.1-4-A. The applicant added a paragraph in FSAR Section 9.1.4.13 identifying the general subject matter of fuel handling procedures that will be developed. The program described by the applicant in FSAR Section 9.1.4.13 provides procedures for fuel handling, inspection and testing

of fuel handling equipment in adequate time to support training and qualification of fuel handling personnel. These procedures will be completed 6 months prior to fuel receipt. In further response to DCD COL Item 9.1.4-A (STD COL 9.1-4-A), the applicant states that qualifications, training and the control programs for fuel handling personnel are addressed in FSAR Section 13.2, "Training." In RAI 09.01.04-1 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to clarify how FSAR Section 13.2 addresses personnel qualification and training for fuel handlers. In their response to RAI 09.01.04-1 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that FSAR Section 13.2 refers to Appendix 13BB, "Training Program," which incorporates by reference Nuclear Energy Institute (NEI) 06-13A, "Template for an Industry Training Program Description." On December 5, 2008, the NRC endorsed NEI 06-13A, Revision 1, as an acceptable template for describing reactor operator (RO) and non-licensed plant staff training programs for COLAs. The staff finds that the applicant has adequately addressed training and qualification of fuel handlers. Therefore, RAI 09.01.04-1 is resolved and closed.

Also in response to DCD COL Item 9.1.4-A, the applicant revised Section 9.1.4.19 of the FSAR to identify that the QA program described in FSAR Section 17.5, "Quality Assurance Program Description-Design Certification, Early Site Permits, and New License Applicants," will monitor, implement and assure compliance with fuel handling procedures. The applicant also states that fuel handling equipment is inspected prior to each refueling. In RAI 09.01.04-2 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to clarify how testing and inspection before each refueling operation ensures that safety features and interlocks perform satisfactorily and prevent excessive personnel radiation exposure and fuel damage, in keeping with the requirements of GDC 61. In their response to RAI 09.01.04-2 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that the fuel handling procedures required by FSAR Section 9.1.4.13 include checking the status of interlocks. The interlocks for the refueling machine and the fuel handling machine are specified in ESBWR DCD, Section 9.1.4.5, "Refueling Equipment." Additionally, the applicant stated that the ESBWR DCD Technical Specifications (TS) includes TS 3.9.1, "Refueling Equipment Interlocks," which prevent operation of the refueling equipment with fuel loaded over the core whenever any control rod is withdrawn, and prevent control rod withdrawal whenever fuel-loaded refueling equipment is over the core. The staff finds that the applicant's response to RAI 09.01.04-2 is satisfactory and it clarifies the applicant's response in STD COL 9.1-4-A to DCD COL Item 9.1.4-A. Therefore, RAI 09.01.04-2 is resolved and closed.

The staff evaluated COL Item STD COL 9.1-4-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.1.4, along with GDC 61 and 62 and the guidance in RG 1.206. The staff finds that the applicant has satisfactorily addressed this COL Item.

#### **9.1.4.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.1.4.6 Conclusions**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the "Light Load Handling System (Related to Refueling)," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E,

Section VI.B.1, all nuclear safety issues relating to the light load handling system (Related To Refueling), that were incorporated by reference are resolved.

In addition, the staff compared the additional information in the application to the relevant NRC regulations, the guidance in SRP Section 9.1.4, and other NRC regulatory guides. The staff's review concludes that the applicant's information is acceptable and meets the requirements of GDC 61 and 62 and the guidance in RG 1.206. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.1-4-A.

## **9.1.5 Overhead Heavy Load Handling System**

### **9.1.5.1 Introduction**

The overhead heavy load handling systems for North Anna 3 are used to lift loads whose weight is greater than the combined weight of a single spent fuel assembly and its handling device. The principal equipment is the fuel building (FB) crane and reactor building (RB) crane. The overhead heavy load handling system is designed to ensure that inadvertent operations or equipment malfunctions, separately or in combination, will not cause a release of radioactivity, a criticality accident, inability to cool fuel within the reactor vessel or SFP, or prevent safe shutdown of the reactor.

### **9.1.5.2 Summary of Application**

Section 9.1.5, "Overhead Heavy Load Handling System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.1.5 of the certified ESBWR DCD, Revision 10. In addition, in North Anna 3 COL FSAR, Section 9.1.5, the applicant provides the following:

#### COL Items

- STD COL 9.1-5-A Handling of Heavy Loads

The applicant provided additional information in STD COL 9.1-5-A to address DCD COL Item 9.1-5-A. The applicant described the scope of the heavy load handling procedures. The applicant stated that they will be developed prior to fuel load. The applicant stated that the fuel handling equipment is inspected for operating conditions before each refueling. The applicant described the criteria for inspection of special lifting devices and the inspection and testing of cranes. The applicant described the training and qualification standard for crane operators and the application of specific quality program controls for heavy load handling. The QA program is described in Section 17.5 of the COL FSAR.

### **9.1.5.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966, the FSER related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the overhead heavy load handling system and the associated acceptance criteria are in SRP Section 9.1.5.

The regulatory basis for acceptance of the COL information items is established in:



- GDC 1, “Quality Standards and Records,” of 10 CFR Part 50, as it relates to design, fabrication, and testing of structures, systems, and components (SSCs) important to maintain quality standards.
- GDC 4, “Environmental and Dynamic Effects Design Bases” of 10 CFR Part 50, as it relates to the protection of fuel and safety-related equipment from the effects of internally generated missiles (i.e., dropped loads).

#### **9.1.5.4 Technical Evaluation**

As documented in NUREG–1966, the staff reviewed and approved Section 9.1.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.1.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.<sup>1</sup>

The staff’s review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

##### COL Items

- STD COL 9.1-5-A Handling of Heavy Loads

The staff reviewed STD COL 9.1-5-A related to the handling of heavy loads included under Section 9.1.5 of the North Anna 3 COL FSAR. DCD COL Item 9.1-5-A in Section 9.1.6, “COL Information,” of the ESBWR DCD Tier 2, Revision 10 states that the applicant will provide a description of the program governing heavy loads handling, and the schedule for implementation, that addresses the following:

- Heavy loads and heavy load handling equipment outside the scope of loads described in the referenced certified design and the associated heavy load attributes (load weight and typical load path);
- Requirements for heavy load handling safe load paths and routing plans including descriptions of automatic and manual interlocks not described in the referenced certified design and safety devices and procedures to assure safe load path compliance;
- Summary description of requirements to develop heavy load handling equipment maintenance manuals and procedures;
- Requirements for heavy load handling equipment inspection and test plans;
- Requirements for heavy load personnel qualifications, training, and control programs;
- QA program requirements to monitor, implement, and ensure compliance with the heavy load handling program; and

- Issues described in Regulatory Issue Summary (RIS) 2005-25, Supplement 1, “Clarification of NRC Guidelines for Control of Heavy Loads,” related to the use of non-metallic slings with single failure proof lifting devices.

In FSAR Section 9.1.5, “Overhead Heavy Load Handling Systems,” the applicant states that no heavy loads are identified that are outside the scope of the certified design.

In accordance with the ESBWR DCD COL Item 9.1-5-A, the COL applicant is to provide a description of automatic and manual interlocks not described in the reference certified design. The applicant’s response in STD COL 9.1-5-A in North Anna 3, Revision 1 of the FSAR did not provide this information. In RAI 09.01.05-2 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff requested that the applicant provide this additional information. In their response to RAI 09.01.05-2 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that there are neither heavy load handling equipment nor interlocks associated with heavy load handling equipment that are outside the scope of the certified design. Therefore, RAI 09.01.05-02 is resolved and closed. Based on the information provided by the applicant in the North Anna 3 FSAR, Revision 8, Section 9.1.5.9, the staff finds that the applicant has satisfied this element of the COL information item requirement.

In FSAR Sections 9.1.5.6, “Other Overhead Load Handling Systems,” 9.1.5.8, “Operational Responsibilities”, and 9.1.5.9, “Safety Evaluations,” the applicant addressed ESBWR DCD COL Item 9.1-5-A in STD COL 9.1-5-A.

The second item listed in COL Item STD COL 9.1-5-A pertains to requirements for heavy load handling safe load paths and routing plans. In FSAR Section 9.1.5.8, the applicant discusses the development of administrative procedures. In that section, the applicant specifies that North Anna 3 FSAR, Section 13.5, “Plant Procedures,” requires the development of administrative procedures to control heavy loads prior to fuel load. The section also specifies that heavy load handling procedures address approved safe load paths and exclusion areas. The applicant states that paths are defined in procedures and equipment layout drawings, and that safe load path procedures address specific requirements. There are procedures to limit the height and the times that heavy loads are carried over the SFP, reactor vessel, or the safe shutdown equipment. In addition, when heavy loads could be carried but are not required to be carried directly over the SFP, reactor vessel, or the safe shutdown equipment, procedures will define an area over which loads shall not be carried so that if the load is dropped, it will not result in damage to spent fuel or operable safe shutdown equipment or compromise reactor vessel integrity. A requirement for supervision to be present during heavy load lifts to enforce procedural requirements is also discussed in FSAR Section 9.1.5.8. Based on the information that was provided by the applicant in FSAR Section 13.5 and Section 9.1.5.8, the staff finds that the applicant has satisfied this element of the COL information item requirement since it specifies that the heavy load handling program will include program elements for safe paths, routing plans, and administrative controls.

The third and fourth item listed above in COL Item STD COL 9.1-5-A pertains to the applicant providing a description of requirements to develop heavy load handling equipment maintenance manuals and procedures, and with the requirements for heavy load handling equipment inspection and test plans.

In FSAR Section 9.1.5.8, a list of items to be addressed by the heavy loads handling procedures is provided. Among those are procedures to address equipment identification, required equipment inspections and acceptance criteria prior to performing lift and movement operations,

safety precautions and limitations, rigging arrangement for loads and special tools, rigging hardware, and equipment required for the heavy load lifts.

Inspection and test plans for heavy load handling equipment is addressed in the North Anna 3 FSAR, Revision 8, by the addition of two paragraphs in Section 9.1.5.6 titled "Special Lifting Devices" and "Other Lifting Devices," and a paragraph in Section 9.1.5.8 titled "Inspection and Testing." The "Special Lifting Devices" paragraph describes the inspection and test plans for special lifting devices. Special lifting devices are specifically designed lifting equipment for loads of greater than 4,500 kg (10,000 lbs) and are designed and constructed in accordance with American National Standards Institute (ANSI) N14.6, "Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or more." The "Other Lifting Devices" paragraph states that "slings used for heavy load lifts meet the requirements specified for slings in ASME/ANSI B30.9 and the guidance specified in NUREG-0612, Section 5.1.1(5)."

Additionally, to address COL Item STD COL Item 9.1-5-A, the applicant replaced the information in ESBWR DCD, Section 9.1.5.8 with a revised FSAR Section 9.1.5.8, "Operational Responsibilities," that includes a new "Inspection and Testing" paragraph. In this paragraph, the applicant references ASME/ANSI B30.2, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)," B30.11, "Monorails and Underhung Cranes," and B30.16, "Overhead Hoists (Underhung)," as the applicable standards for crane testing and inspection.

In North Anna 3 FSAR, Revision 1, the applicant took exception to the acceptance criteria in the standard and proposed visual criteria of no cracks in place of the nondestructive examination (NDE) requirements specified. Additionally, for the Dryer/Separator Strongback, the applicant took exception to the NDE of load bearing welds every five refueling outages. Instead the applicant proposed visual and dimensional examinations prior to the initial lift each outage. In the "Other Lifting Devices" paragraph, the applicant identifies ASME/ANSI B30.9, "Slings," as the industry standard for testing and inspection requirements for slings used for heavy loads. In addition, the applicant also identified a change to the load rating criteria for slings used for heavy lifts, which are addressed by ASME/ANSI B30.9, and NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." Section 5.1.1(5) of NUREG-0612 discusses the use of both the static and maximum dynamic load to determine the proper size and rating of slings. The applicant proposes to exclude dynamic loads for sizing of slings.

The applicant did not provide adequate justification for these exceptions. Therefore, in RAI 09.01.05-1 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to provide their justification for these exceptions. In their response to RAI 09.01.05-1 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant changed "STD COL 9.1-6-5" to "STD COL 9.1-5-A." In STD 9.1-5-A, the applicant removed all exceptions to the guidelines specified in ANSI N14.6 for special lifting devices and revised their FSAR to state that "testing and inspection of special lifting devices follow the guidelines of ANSI N14.6." The applicant also removed their proposal to exclude dynamic loads for sizing of slings and revised their FSAR to state that "slings used for heavy load lifts meet the requirements specified for slings in ASME/ANSI B30.9 and the guidance specified in NUREG-0612, Section 5.1.1(5)." The staff finds these changes consistent with the guidelines of SRP Section 9.1.5; thus these changes are acceptable and RAI 09.01.05-1 is resolved and closed.

Based on the information that the applicant has added to FSAR Sections 9.1.5.6 and 9.1.5.8, the staff finds that the applicant has satisfied these elements of the COL information item requirements.

The fifth item listed in STD COL 9.1-5-A pertains to the requirement for heavy load personnel qualifications, training, and control programs. The applicant stated in Section 9.1.5.8 that the operators will be trained and qualified to meet the requirements of ASME/ANSI B30.2. Based on this information, the staff finds that the applicant has satisfied these elements of the COL information item requirement.

The sixth item listed in COL Item STD COL 9.1-5-A pertains to QA program requirements to monitor, implement, and ensure compliance with the heavy load handling program. In Section 9.1.5.8 of the FSAR, the applicant states that the QA program described in Section 17.5, "Quality Assurances Program Description-Design Certification, Early Site Permits, and New License Applicants," is applicable to the heavy loads handling program. Based on this information, the staff finds that the applicant has satisfied these elements of the COL information item requirement.

The seventh, and last issue, listed in COL Item STD COL 9.1-5-A pertains to issues described in RIS 2005-25, Supplement 1. In FSAR Sections 9.1.5.8, the applicant addresses how the procedures address issues described in RIS 2005-25, related to the use of non-metallic slings with single failure proof cranes. This section states that heavy load handling procedures will address "the use of slings constructed from metallic material where single-failure-proof features of the handling system are credited in achieving a very low probability of a load drop as described in RIS 2005-25, Supplement 1, and Clarification of NRC Guidelines for Control of Heavy Loads." Based on this information, the staff finds that the applicant has satisfied these elements of the COL information item requirement.

The staff evaluated COL Item STD COL 9.1-5-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.1.5. Based on the above evaluation, the staff finds that the applicant has satisfactorily addressed DCD COL Item 9.1-5-A. The staff also finds that since there will be a QA program with requirements to monitor, implement, and ensure compliance with the heavy load handling program including the program requirements for inspection and testing of equipment, and the program requirements regarding the qualification, and training of personnel, that GDC 1 requirements related to design, fabrication, and testing of SSCs important to maintain quality standards are satisfied. Furthermore, the staff finds that since the heavy load handling program will implement procedures that will provide for the protection of fuel and safety-related equipment from the effects of internally generated missiles that could be generated in the event of a heavy load drop, the requirements of GDC 4 are also satisfied.

#### **9.1.5.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.1.5.6 Conclusions**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the "Overhead Heavy Load Handling System" and no outstanding information is expected to be addressed in the COL FSAR related to this Section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the overhead heavy load handling system, that were incorporated by reference are resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 9.1.5, and other NRC regulatory guides. The staff's review concludes that the information in this FSAR is acceptable because it meets the requirements of GDC 1 and GDC 4 and satisfactorily addresses DCD COL Item 9.1-5-A.

## **9.2 Water Systems**

### **9.2.1 Plant Service Water System**

#### **9.2.1.1 Introduction**

This section of the North Anna 3 COL FSAR describes the plant service water system (PSWS). The system is designed primarily to transfer heat from nonsafety-related heat load components in the Reactor and Turbine Buildings to the environment. The PSWS consists of two independent and fully redundant systems that continuously recirculate raw water through the reactor component cooling water system (RCCWS) and turbine component cooling water system heat exchangers. The source of cooling water for the PSWS is the Auxiliary Heat Sink (AHS), and the heat removed is rejected back to the AHS. The AHS for North Anna 3 consists of mechanical draft plume abated cooling towers. The PSWS is a nonsafety-related system that provides defense-in-depth decay heat removal during normal plant operating and transient conditions. Also, as discussed in the ESBWR DCD Section 19A, "Regulatory Treatment of Non-Safety Systems," the PSWS is subject to regulatory treatment of non-safety systems (RTNSS) based on RTNSS Criterion C considerations.

#### **9.2.1.2 Summary of Application**

Section 9.2.1, "Plant Service Water System," of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.2.1, "Plant Service Water System," of the certified ESBWR DCD, Revision 10.

In addition, in North Anna 3 FSAR, Section 9.2.1 the applicant provided the following:

#### COL Item

- NAPS COL 9.2.1-1-A Material Selection

In FSAR Section 9.2.1.2, the applicant provided additional information in NAPS COL 9.2.1-1-A to address DCD COL Item 9.2.1-1-A. The applicant selected fiberglass reinforced polyester pipe (FRPP) for the buried portion of the PSWS to preclude long term corrosion. The applicant also stated that appropriate chemical treatment is added to the PSWS basin to mitigate the long-term effects of fouling and corrosion within the PSWS.

#### Supplemental Information

- NAPS SUP 9.2.1-1 Basin Reserve Storage Capacity

In FSAR Table 9.2-2R, the applicant provided the following supplemental information. The PSWS cooling tower basin reserve water storage capacity is 2.6 million gallons, which is needed to provide heat removal capability for 7 days without active makeup.

- NAPS SUP 9.2.1-2 FRP Piping Testing and Inspections

In FSAR Section 9.2.1.4, the applicant provided additional information to address the PSWS FRPP material initial testing and periodic inspection.

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

The applicant provided additional information to replace conceptual design information (CDI) contained in the ESBWR DCD. The portions of PSWS that are not a part of the ESBWR Standard Plant consist of the heat rejection facilities (Normal Plant Heat Sink and AHS), which are dependent on actual site conditions. The North Anna PSWS rejects heat only through the AHS mechanical draft cooling towers. The applicant provided Figure 9.2-1R, "Plant Service Water System Simplified Diagram," depicting the PSWS.

- NAPS CDI Table 9.2-2R, "PSWS Component Design Characteristics"

The applicant provided additional information in Table 9.2-2R to replace CDI in the ESBWR DCD. The applicant provided site-specific temperature parameters and the heat load for the cooling tower design.

- Interface Requirement

Section 4.1, "Plant Service Water System," of the ESBWR DCD Tier 1 information specifies as an interface requirement that the PSWS plant-specific heat rejection facilities must be capable of supporting the post-72-hour cooling function of the PSWS and must ensure that PSWS pumps have sufficient available net positive suction head (NPSH) at the pump suction. Part 10 of the COLA, Section 2.4.3, Table 2.4.3-1, "ITAAC for Plant Service Water Reserve Storage Capacity," provides the required plant-specific Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for this interface requirement.

**9.2.1.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966, the FSER related to the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the PSWS and the associated acceptance criteria are in SRP Section 9.2.1.

The applicable regulatory requirements for the PSWS are as follows:

- GDC 2, "Design Bases for Protection Against Natural Phenomena"
- GDC 4
- GDC 44, "Cooling Water"
- GDC 45, "Inspection of Cooling Water System"
- GDC 46, "Testing of Cooling Water System"

- Item (a) of 10 CFR 52.80, “Contents of applications; additional technical information,” which requires the applicant to address ITAAC

#### 9.2.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.1 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the DCD and the information in the COLA represent the complete scope of information relating to this review topic.<sup>1</sup>

The staff’s review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the PSWS.

The PSWS is a nonsafety-related system that provides defense-in-depth decay heat removal capability and is subject to RTNSS based upon risk considerations (i.e., RTNSS Criterion C). RTNSS Criterion C is described in SECY-94-084, “Policy, Technical, and Licensing Issues Pertaining to Evolutional and Advanced Light-Water Reactor Designs,” dated March 28, 1994 (ADAMS Accession No. ML003708068) and in SECY-95-132, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs (SECY-94-084),” dated May 22, 1995 (ADAMS Accession No. ML003708005). The staff’s evaluation of plant-specific PSWS considerations for the ESBWR design focuses primarily on confirming the capability of the PSWS to perform its defense-in-depth and RTNSS functions; confirming that the PSWS will not adversely impact safety-related SSCs; and confirming that ITAAC, test program specifications, and RTNSS availability controls for PSWS are appropriate.

The staff reviewed the relevant information in the COL FSAR as follows:

##### COL Item

- NAPS COL 9.2.1-1-A Material Selection

The staff reviewed NAPS COL 9.2.1-1-A related to the underground piping material selection under Section 9.2.1 of the North Anna 3 COL FSAR. In accordance with DCD Tier 2, Section 9.2.1.6, “COL Information,” the COL applicant needs to determine PSWS material selections and provide provisions to preclude long-term corrosion and fouling based on site water quality analysis based on the ESBWR DCD Tier 2, Section 9.2.1.2, “System Description.” The applicant addressed this COL information item by including the following plant-specific information in Section 9.2.1.2 of the North Anna 3 FSAR, Revision 8:

Fiberglass pressure pipe that meets the requirements of [American Society of Mechanical Engineers] ASME B31.1, Power Piping Code, Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lined with Nonmetals, including applicable ASTM and AWWA standards, is used for below-grade piping. Fiberglass pressure pipe is not susceptible to internal corrosion from the chemically treated water or to external corrosion from ground contact.

The PSWS provides defense-in-depth decay heat removal capability and is subject to RTNSS criterion which does not require the same level of treatment as safety-related SSCs. However, specifications and limitations for using FRPP should be properly described in the FSAR to assure that FRPP is capable of performing in accordance with the Commission’s policy on

RTNSS for the PSWS. The impact of using FRPP on reliability and availability assumptions needs to be addressed especially with respect to common cause failure considerations. Finally, the effects of using FRPP on the consequences of pipe failure during seismic events (such as flood effects) need to be addressed in accordance with GDC 2 requirements. The staff, therefore, requested the applicant in RAI 09.02.01-2 dated July 15, 2008 (ADAMS Accession No. ML081970390), to provide additional information to address these considerations and to update the FSAR accordingly. The staff reviewed the applicant's response to RAI 09.02.01-2 dated August 28, 2008 (ADAMS Accession No. ML082460847), and determined the following:

- With respect to criteria and limitations for using FRPP, the applicant indicated that this is addressed by incorporating DCD Chapter 3, Sections 9.2.1.1 and 19A.8.3, and Table 19A-4, "Capability of RTNSS Related Structures." The staff found that aside from general design considerations that apply to the PSWS and RTNSS Criterion C systems and components, the referenced information indicates that the ASME Power Piping Code B31.1, "Power Piping," applies for piping and valves, International Building Code-2003 applies for seismic capability, and Institute of Electrical and Electronics Engineers, Inc., (IEEE) 344, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," (1987) applies for demonstrating structural integrity. However, the referenced information does not describe FRPP specifications that apply and limitations on use that are necessary to accommodate PSWS operating and transient conditions (such as temperature extremes and water hammer) commensurate with defense-in-depth and RTNSS considerations. Variations in manufacturing techniques and product formulations can lead to inferior components and if FRPP support requirements are not properly specified, water intrusion problems could lead to common cause and common mode PSWS failures.
- With respect to reliability and availability assumptions, the applicant indicated that the PSWS design information that is incorporated by reference (discussed in the above bullet) assures that the use of FRPP will not adversely affect reliability and availability assumptions for the PSWS. However, it is not clear that PSWS availability and reliability assumptions will be satisfied without establishing design specifications and limitations for using FRPP. Variations in manufacturing techniques and product formulations can lead to inferior components and if FRPP support requirements are not properly specified, water intrusion problems could lead to common cause and common mode PSWS failures. Furthermore, without establishing FRPP design specifications, it is not clear how the Commission's design reliability assurance program (D-RAP) as described in SRP Section 17.4, "Reliability Assurance Program," can be properly implemented.

As a follow-up to the fiberglass issues, the staff issued RAI 09.02.01-13 dated May 6, 2009 (ADAMS Accession No. ML091260337), requesting the following information:

Describe the special treatment QA provisions applicable to supplemental quality class S/N (Special Quality Assurance/Non-Safety Related) for the FRPP used in PSWS for RTNSS systems. This special treatment should include the following considerations:

- Describe how operating experiences (OE), whereas buried fiberglass materials have been utilized in a similar application such as water service with similar piping size, pressure and temperatures, will be addressed in the selection of the buried fiberglass materials.



- Describe if the ASME B31.1, “Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lines with Nonmetals,” will be utilized for the fiberglass design and installation. In addition, describe any material classification, for example American Society for Testing and Materials or American Water Works Association that better defines the piping and fittings standards to be utilized.
- Provide details of the buried fiberglass application related to the special QA requirement associated with RTNSS.

In its response to RAI 09.02.01-13 dated September 2, 2014 (ADAMS Accession No. ML14247A264), the applicant provided additional information related to acceptable application of FRPP for North Anna 3 and that the North Anna 3 PSWS FRPP will meet the requirements of ASME B31.1, “Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lines with Nonmetals,” including the applicable American Society for Testing and Materials (ASTM) and American Water Works Association (AWWA) standards for FRPP that have been incorporated into the Code. North Anna 3 FSAR, Section 9.2.1 includes the requirement to meet these industry standards. Therefore, the staff determined this issue and the RAI are closed.

With respect to the consequences of PSWS pipe failures during seismic events, the applicant referred to Tier 2 of the DCD, Section 9.2.1.3, “Safety Evaluation,” which stipulates that a failure of all or any portion of the PSWS will not impact any plant safety function. Because the plant design-bases include flooding effects due to failure of all of the PSWS, failures that may occur due to the use of FRPP are encompassed by the plant design bases. Therefore, the staff finds that the use of FRPP relative to flooding considerations is acceptable.

In addressing COL 9.2.1-1-A , the staff noted that the applicant only addressed buried PSWS piping but did not address material selections for any other parts of the PSWS, including cooling towers and related components. Consequently, the staff asked the applicant in RAI 09.02.01-3 dated July 15, 2008 (ADAMS Accession No. ML081970390), to provide additional information to specify and explain the material selections that pertain to the rest of the PSWS. The applicant’s response to RAI 09.02.01-3 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that material selections for the PSWS (which include the AHS) will take into consideration PSWS water quality, water treatment options that are compatible with Lake Anna discharge limits, economic considerations, and DCD-related RTNSS criteria. However, no mention was made of using only materials (including materials in the AHS) that are both suitable and compatible for their assigned applications and for the conditions that exist. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-9 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address the specific composition or properties of those materials to be used in the PSWS. The applicant responded to RAI 09.02.01-9 dated July 8, 2009 (ADAMS Accession No. ML091910257), stating that Carbon steel that meets ASTM standards is used as the pipe material for above grade portions of the PSWS and the water treatment regime mitigates the long-term effects of fouling and corrosion within the PSWS. The applicant revised the COL Item 9.2.1-1-A in FSAR Section 9.2.1 and therefore this RAI and issue is resolved and closed.

SRP Section 9.2.1 and Generic Letter (GL) 89-13, “Service Water System Problems Affecting Safety-Related Equipment” (as referred to by SRP Section 9.2.1), provide guidance for

evaluating long-term corrosion and fouling considerations associated with service water systems. In particular, these considerations include:

- a. Establishing a program of surveillance and control techniques to prevent flow blockage problems due to biofouling;
- b. Establishing a routine inspection and maintenance program to assure that corrosion, erosion, protective coating failure, silting, biofouling and others that are applicable cannot degrade the PSWS defense-in-depth and RTNSS cooling functions; and
- c. Establishing a test program to verify (initially and periodically) the heat transfer capability of heat exchangers that are important to safety.

In order to prevent long-term corrosion and fouling of the PSWS, the applicant proposes to chemically treat the water in the PSWS cooling tower basin based on site water quality analysis. The FSAR does not explain what specific vulnerabilities are considered to be pertinent based upon siting considerations and industry OE that applies, and why chemical treatment alone is sufficient for addressing these vulnerabilities. While chemical treatment is a common practice and suitable for minimizing PSWS corrosion and fouling problems to some extent, it does not adequately address all of the potential PSWS vulnerabilities that have been identified over time as a result of industry OE as reflected in GL 89-13. The staff asked the applicant in RAI 09.02.01-4 dated July 15, 2008 (ADAMS Accession No. ML081970390), to address the considerations referred to above and to fully address this COL information item.

The applicant responded to RAI 09.02.01-4 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicating that PSWS is a closed system with makeup water treated to preclude long-term corrosion and fouling based on the site water quality analysis. However, the applicant did not address the question that was asked in that anticipated site and system-specific vulnerabilities and degradation mechanisms, and programmatic controls to address these considerations, were not described. Because the PSWS for North Anna 3 is relied upon for defense-in-depth and RTNSS considerations, reliability is an important factor. Consequently, programmatic controls are necessary to periodically monitor the condition and performance of the PSWS components over time to maintain the availability and reliability of the system. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-10 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address how the PSWS will be treated in accordance with 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Plant Plants," and Nuclear Management and Resources Council (NUMARC) (now NEI) 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plant." In addition, the staff asked the applicant to describe or provide drawings which indicate the design of the chemical control system, chemical addition system, or water treatment system for the PSWS.

In response to RAI 09.02.01-10 dated August 3, 2009 (ADAMS Accession No. ML092180975), the applicant responded by stating that the North Anna 3 PSWS is subject to reliability and availability controls in accordance with the Maintenance Rule Program requirements and as stated in DCD Section 19A.8.2, all RTNSS systems are in scope of D-RAP, as described in FSAR Section 17.4. Since SSCs that are in the scope of the D-RAP are initially classified as high safety-significant (HSS) for the Maintenance Rule Program, the PSWS is initially classified as HSS. The staff finds that including the PSWS system in the scope of the Maintenance Rule

D-RAP and revising its system drawing Figure 9.2-1R showing the chemical treatment connection is acceptable, and therefore this RAI and issue is resolved and closed.

The staff evaluated COL Item NAPS COL 9.2.1-1-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

Supplemental Information and Conceptual Design Information

- NAPS SUP 9.2.1-1 Basin Reserve Storage Capacity
- NAPS SUP 9.2.1-2 FRP Piping Testing and Inspections
- NAPS CDI System Description
- NAPS CDI PSWS Component Design Characteristics

Tier 2 of the DCD, Section 9.2.1.2, states that the heat rejection facilities are dependent upon actual site conditions and are not part of the ESBWR standard plant. The conceptual design, for the standard plant, uses a normal power heat sink (NPHS) and an AHS as the heat rejection facilities. The NPHS is a dry cooling array and hybrid cooling tower and the AHS consists of mechanical draft cooling towers. A cross-tie for the standard plant permits aligning PSWS to either of these heat sinks.

The applicant provided supplemental (NAPS CDI) information in Section 9.2.1.2 of the North Anna 3 COL FSAR to address this item. The NAPS CDI indicates that the AHS is the heat rejection facility for North Anna 3, which consists of mechanical draft plume abated cooling towers. The FSAR provides Table 9.2-2R, "PSWS Component Design Characteristics," and a revised Figure 9.2-1R, "Plant Service Water System Simplified Diagram," that incorporate the AHS. Table 9.2-2R provides supplemental plant-specific information (NAPS SUP 9.2.1-1) that specifies the basin reserve storage capacity as  $1.18 \times 10^4 \text{ m}^3$  (2.6 million gal). In addition to this, the staff noted that the FSAR also repeats the information that was included in Tier 2 of the DCD and there is no distinction between the plant-specific (NAPS CDI) and the standard plant design information. In order to avoid confusion in the future the staff asked the applicant in RAI 09.02.01-5 dated July 15, 2008 (ADAMS Accession No. ML081970390), to provide appropriate clarification. The applicant's response to RAI 09.02.01-5 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that the information in its entirety is supplemental to address the CDI provided in the DCD. However, only the heat rejection facility that is used for the PSWS is identified as CDI in the DCD. Consequently, most of the information that the applicant provided as supplemental is in fact part of the certified design and cannot be characterized as NAPS CDI. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-11 dated May 6, 2009 (ADAMS Accession No. ML091260337), to clearly identify the plant-specific information in the FSAR that addressed the CDI identified in the ESBWR DCD. The applicant responded to RAI 09.02.01-11 dated July 8, 2009 (ADAMS Accession No. ML091910257), and stated that North Anna 3 FSAR, Section 9.2.1.2, Table 9.2-2R, and Figure 9.2-1R will be revised to clearly identify the plant-specific information that addresses CDI identified in the ESBWR DCD. The staff confirmed the information was revised in North Anna 3 FSAR, Revision 8 and therefore this RAI and issue is resolved and closed.

SRP Section 9.2.5, RG 1.27, and GL 89-13 provide guidance that is pertinent for evaluating heat rejection facilities. Important considerations include those discussed above under interface requirements, other plant-specific vulnerabilities and degradation mechanisms that are anticipated based on OE, and the potential impacts of postulated failures or other interactions

on safety-related SSCs. The FSAR does not address these considerations. In addition, the FSAR does not address bounding conditions and limiting assumptions that pertain to the functional capability of the cooling towers and programmatic controls that assure functional capability of the cooling towers will be maintained over the life of the plant. Consequently, the staff asked the applicant in RAI 09.02.01-6 dated July 15, 2008 (ADAMS Accession No. ML081970390), to revise the NAPS CDI accordingly to include this information. The applicant's response to RAI 09.02.01-6 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that the information requested by the staff is the type of information that is normally provided for a safety-related system. Because the PSWS is nonsafety-related system, the applicant felt that the information in the FSAR was adequate. Although the PSWS is a nonsafety-related system, it is relied upon for providing defense-in-depth cooling for the reactor and SFP, and it is subject to RTNSS considerations. As such, PSWS reliability and availability are important factors. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-10 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address how the PSWS (including AHS cooling towers) will be treated in accordance with 10 CFR 50.65, RG 1.160, and NUMARC 93-01. In its response to RAI 09.02.01-10 dated August 3, 2009 (ADAMS Accession No. ML092180975), the applicant stated that the PSWS is subject to reliability and availability controls in accordance with the Maintenance Rule Program requirements. In addition, as stated in DCD Section 19A.8.2, all RTNSS systems are in the scope of the D-RAP, as described in FSAR Section 17.4. Further, as described in FSAR Section 17.4.1, SSCs that are in the scope of the D-RAP are initially classified as HSS for the Maintenance Rule-Program, with any exceptions requiring expert panel review. The PSWS is initially classified as HSS. Since this system will be classified appropriately as described and the staff confirmed the information was revised in North Anna 3 FSAR, Revision 8 this RAI and issue is resolved and closed.

In a follow-up question to RAI 09.02.01-13, the staff issued RAI 09.02.01-15 dated April 29, 2014 (ADAMS Accession No. ML14119A462), and requested additional information on the piping materials initial testing and periodic inspections related to the quality standards that ensure the RTNSS performance requirements described in Chapter 19A for the PSWS system are met. Specifically the staff requested that the quality standards for the FRPP be represented for the PSWS fiberglass material in the North Anna 3 FSAR including additional ITAAC that should be applied to address pressure testing, cyclic testing, or installation of sleeves. The applicant provided its amended response in a letter dated September 2, 2014 (ADAMS Accession No. ML14247A264), and stated that the FSAR will be revised to incorporate the appropriate quality requirements for FRPP material including design loads, applicable codes and standards, and pre-service testing and in-service inspection requirements. In addition the applicant stated that the PSWS design is part of the standard plant and the PSWS piping is within the scope of the standard plant, as is shown in DCD Figure 9.2-1, therefore the standard plant ITAAC applies and there is no site-specific PSWS system ITAAC required. The applicant revised FSAR Section 9.2.1.4 with an additional North Anna 3 supplement item NAPS SUP 9.2.1-2 describing the inspections and tests that would be site-specific for the North Anna 3 PSWS FRPP material as well as including the PSWS system piping in the NEI sponsored, "Underground Piping and Tank Integrity Program," which is developed in accordance with NEI 09-14, "Guideline for the Management of Underground Piping and Tank Integrity." With these COLA changes including the addition of NAPS SUP 9.2.1-2 the staff finds that the RAI 09.02.01-15 and issue is resolved and closed. The staff verified that the North Anna 3 FSAR, Revision 9 incorporated the appropriate changes described in the applicant's response to RAI 09.02.01-15. Therefore, Confirmatory Item 09.02-1 from the staff advanced SER for North Anna 3 is resolved and closed.

The staff evaluated the four items listed above using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

### Interface Requirement

Tier 1 of the ESBWR DCD, Section 4.1, specifies as an interface requirement that the PSWS plant-specific heat rejection facilities must be capable of supporting the post-72-hour RTNSS cooling function of the PSWS. In particular, the PSWS must be capable of removing at least  $2.02 \times 10^7$  mega-joule (MJ) or ( $1.92 \times 10^{10}$  British thermal unit (BTU)) over a period of 7 days without active makeup. The COL applicant is required to develop plant-specific ITAAC that demonstrate that each train of the plant-specific cooling tower and basin satisfies this interface requirement.

The applicant provided plant-specific ITAAC item, "ITAAC for Plant Service Water Reserve Storage Capacity," for the PSWS in Section 2.4.3, "ITAAC for Plant Service Water System (Portion Outside the Scope of the Certified Design)," Table 2.4.3-1, "ITAAC for Plant Service Water Reserve Storage Capacity," of Part 10 of the COLA. The proposed design is for the PSWS to contain an inventory of cooling water sufficient for removing heat from the RCCWS from time 0 (at shutdown) through day 7 without active makeup. The acceptance criteria proposed by the applicant was that the minimum usable water volume in the cooling tower basins (Trains A and B) and associated pump forebay would be  $1.18 \times 10^4 \text{ m}^3$  (2.6 million gal), a volume sufficient to remove at least  $2.02 \times 10^7$  MJ ( $1.92 \times 10^{10}$  BTU) over a period of 7 days without active makeup.

SRP Section 9.2.5 and RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants" (as referred to by SRP Section 9.2.5), provides guidance for evaluating the adequacy of cooling towers. Important factors that need to be considered when demonstrating that cooling towers are capable of dissipating the required heat load include (among other things) the capability to satisfy the PSWS pump minimum NPSH requirements for the most limiting cooling tower basin water level, temperature, and flow conditions; the maximum allowed PSWS water supply temperature; and the most limiting meteorological assumptions that pertain to the site for determining: (a) heat dissipation capability, and (b) water inventory requirements. Transient analyses that take these factors into consideration (including margin for expected degradation and operating flexibility) and confirmatory testing are usually necessary in order to demonstrate that cooling tower performance satisfies the specified heat removal capability.

The ITAAC proposed by the applicant, which specifies a cooling tower basin water inventory requirement, is as a way of demonstrating that the heat removal capability specified by the DCD is capable of performing its defense-in-depth and RTNSS functions. However, the proposed ITAAC did not adequately demonstrate that the cooling towers are capable of dissipating the heat load as specified in the DCD. The staff asked the applicant in RAI 09.02.01-1 dated July 15, 2008 (ADAMS Accession No. ML081970390), to address the considerations referred to above and revise the ITAAC accordingly. The staff reviewed the applicant's response to RAI 09.02.01-1 dated August 28, 2008 (ADAMS Accession No. ML082460847), and found it only addressed the required volume of water in the cooling tower basin to support up to 7 days. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-8 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address additional acceptance criteria that confirms the PSWS can remove the required heat capacity over a period of 7 days without active makeup. In its response to RAI 09.02.01-8 dated July 8, 2009 (ADAMS Accession No. ML091910257), the applicant revised the ITAAC to clarify the required water volume in the

PSWS basin is sufficient to ensure the DCD required heat removal capability over the 7 day period including confirmation that there is sufficient available NPSH at the PSWS pump suction location for the lowest probable water level of the heat sink.

The staff evaluated the interface requirement using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

### ITAAC Considerations

As specified in the COLA, Part 10, Section 1, "Tier 1/ITAAC," the ITAAC from Tier 1 of the DCD is incorporated by reference. However, Part 10, Section 2.4.3, "ITAAC for Plant Service Water System (Portion Outside the Scope of the Certified Design)," proposes ITAAC for the interface requirement that is specified in Section 4.1 of the DCD Tier 1. The adequacy of the plant-specific ITAAC that are proposed is evaluated above under "Interface Requirements." The applicant's responses to RAI Questions 09.02.01-1 and 09.02.01-8 were reviewed and determined to be acceptable in the above staff's evaluation.

### Initial Plant Test Program

As indicated in the FSAR, Chapter 14.2, "Initial Plant Test Program for Final Safety Analysis Reports," the initial plant test program specified by Tier 2 of the DCD for the PSWS is incorporated by reference. The PSWS initial test program is discussed in the DCD Tier 2, Sections 14.2.8.1.51, "Plant Service Water System Preoperational Test," and 14.2.8.2.18, "Plant Service Water System Performance Test." However, these tests do not verify that performance of the CDI portions of the PSWS (including AHS) satisfies design specifications for the various modes of operation. The staff asked the applicant in RAI 09.02.01-7 dated July 15, 2008 (ADAMS Accession No. ML081970390), to establish and describe initial plant test program requirements for the PSWS accordingly. The applicant's response to RAI 09.02.01-7 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that the preoperational and startup test programs that are incorporated by reference include testing for the CDI portions of the PSWS. The staff noted that the referenced test programs do not fully address CDI in that cooling tower performance, including fan functions and heat dissipation capability, are not evaluated. Also, the capability of the PSWS to properly function without initiating a water hammer following a loss of power is not addressed by the test program. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-12 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address how the design capability of the AHS will be verified by the initial plant test program and how design features which minimize an AHS/PSWS water hammer event are tested or verified that a water hammer event does not occur. The applicant's response to RAI 09.02.01-12 dated August 3, 2009 (ADAMS Accession No. ML092180975), provided revisions to FSAR Section 14.2.8.1.51 and Section 14.2.8.2.18 by adding supplemental information NAPS SUP 14.2-4 and NAPS SUP 14.2-5 in order to clarify the purpose and criteria of the PSWS preoperational test, along with the purpose and description of the PSWS performance test. Based on the staff's review of this RAI response, the staff finds the applicant has addressed the initial test program related to the AHS in the CDI. In addition, the staff finds that the water hammer design features had been added and had been adequately addressed to ensure the CDI had been properly tested. Therefore, this RAI 09.02.01-12 is resolved and closed. Furthermore, the staff has confirmed that the above was incorporated in North Anna 3 FSAR, Revision 8.

The staff evaluated the initial plant test program for the PSWS using the relevant NRC regulations and acceptance criteria in SRP Section 9.2., along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL item.

#### **9.2.1.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.2.1.6 Conclusions**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the PSWS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the PSWS that were incorporated by reference are resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 9.2.1, and other NRC regulatory guides. The staff's review concludes that the applicant's information is acceptable and meets the requirements of GDC 2, 4, 44, 45, 46, and 10 CFR 52.80(a). The staff has evaluated COL Items NAPS COL 9.2.1-A, NAPS SUP 9.2.1-1, NAPS SUP 9.2.1-2, NAPS CDI, along with the DCD ITAAC and Interface Requirement for this Section to the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1 and SRP Section 9.2.5. The staff's evaluation finds that the applicant has satisfactorily addressed these items and therefore the North Anna 3 PSWS as described is acceptable.

### **9.2.2 Reactor Component Cooling Water System**

Section 9.2.2, "Reactor Component Cooling Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements, Section 9.2.2, "Reactor Component Cooling Water System," of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.2.2 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the RCCWS that were incorporated by reference have been resolved.

## **9.2.3 Makeup Water System**

### **9.2.3.1 Introduction**

The makeup water system (MWS) provides high purity demineralized water to various plant systems. The MWS consists of two subsystems: a demineralization subsystem and a storage and transfer subsystem. The demineralization subsystem takes station water and treats it to the required water quality standards by removing dissolved solids, organics and other impurities. Treated water is stored in a demineralized water storage tank and distributed throughout the plant using transfer pumps. Except for the piping penetrating containment and the associated containment isolation valves, the MWS is not safety related. However, if available, the MWS can provide makeup to the isolation condenser/passive containment cooling (IC/PCCS) pools following an anticipated operational occurrence (AOO) or any abnormal event.

### **9.2.3.2 Summary of Application**

Section 9.2.3, "Makeup Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.3, "Makeup Water System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.2.3, the applicant provided the following:

#### *Site-Specific Information Replacing Conceptual Design Information*

- NAPS CDI System Description

The applicant provided site-specific information to replace the CDI contained in the ESBWR DCD. The applicant added activated carbon filters upstream of the reverse osmosis unit based on site-specific considerations. The demineralized makeup water is stored in an outdoor demineralized water storage tank and distributed throughout the plant using transfer pumps. Freeze protection is provided for the demineralized water storage tank and piping exposed to freezing conditions. Table 9.2-9R, "Major Makeup Water System Components," in the North Anna 3 COLA lists the major MWS components.

### **9.2.3.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the MWS are in SRP Section 9.2.3.

In addition, the relevant requirements of the Commission regulations for the MWS and the associated acceptance criteria:

- GDC 2, in that failure of the nonsafety-related system or component due to natural phenomena such as earthquakes, tornadoes, hurricanes, and floods should not adversely affect SSCs important to safety
- RG 1.29, Revision 4 "Seismic Design Classification," March 2007



#### 9.2.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.3 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.3 of the North Anna 3 COL FSAR, Revision 8 and checked the referenced ESBWR DCD, to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the MWS.

The staff's review of FSAR Section 9.2.3 is limited to the following North Anna 3 COL FSAR site-specific design replacing the CDI in the ESBWR DCD, Revision 10.

##### Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

In FSAR Section 9.2.3.2, the applicant replaced the introductory text and demineralization subsystem portions of the ESBWR DCD, Section 9.2.3.2. In FSAR Section 9.2.3.2, the applicant provided site-specific system descriptions of the MWS.

The MWS consists of two subsystems: (1) the demineralization subsystem, and (2) the storage and transfer subsystem. The makeup water transfer pumps and the demineralization subsystem are sized to meet the demineralized water needs of all operational conditions except for shutdown/refueling/startup. During the shutdown/refueling/startup mode, the increases in plant water consumption require use of a temporary demineralization subsystem and temporary makeup water transfer pumps to be used as a supplemental water source.

The MWS major components are housed entirely in the water treatment building except for the demineralized water storage tank (which is outdoors and adjacent to this building) and the distribution piping to the interface systems. The site-specific design includes freeze protection for the demineralized water storage tank and piping exposed to freezing conditions.

The staff reviewed the site-specific MWS and its components and finds that the applicant's proposed system design is similar to the MWS described in Section 9.2.3.2 of the ESBWR DCD, Revision 10. The NAPS MWS components and associated piping in contact with demineralized water are fabricated from corrosion resistant materials such as stainless steel to prevent contamination of the makeup water.

Water for the demineralization subsystem is provided by the station water system (SWS). Production of demineralized water by the demineralization subsystem can be initiated and shut down either automatically (based on the demineralized water storage tank level) or manually. The applicant described the process and sequence of chemical treatment of the station water to produce demineralized water. The applicant's water treatment process is similar to that described in the DCD Section 9.2.3.2. After the chemical treatment process, the treated water is then transferred to the MWS demineralized storage tank.

The staff reviewed the design information provided in the FSAR Section 9.2.3 for NAPS MWS and finds that the applicant did not identify any further supplements and/or departures, except the above discussed site-specific information. The site-specific portion of the MWS is

nonsafety-related and its failure does not compromise any safety-related system or component nor does it prevent a safe-shutdown. Also, the site-specific design will not change the conclusion of ESBWR DCD for MWS, as it relates to GDC 2. Accordingly, the staff finds the site-specific design information meets the requirements of GDC 2 and therefore is acceptable.

Also, the site-specific portion of the MWS does not interface with any potentially radioactive system. Therefore, no interface requirements needed to be satisfied.

#### **9.2.3.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.2.3.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the MWS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the MWS that were incorporated by reference are resolved.

In addition, the staff compared the additional North Anna 3 CDI information in the application to the relevant NRC regulations and regulatory guides. The staff's review concludes that the applicant has provided sufficient information on the site-specific CDI for the MWS. The staff also finds that the CDI for the MWS meets the guidance of Regulatory Position C.2 of RG 1.29 regarding nonsafety-related systems because the failure of the nonsafety-related portions of the systems does not impact any safety-related SSCs. With respect to MWS failures and GDC 2, SSCs important to safety are able to withstand the effects of failure of the MWS as well as natural phenomena without loss of capability to perform their safety function. The staff finds that these requirements have been met. Accordingly, the staff finds the site-specific design information meets the regulatory requirements, as discussed in each section above, and therefore is acceptable.

### **9.2.4 Potable and Sanitary Water Systems**

#### **9.2.4.1 Introduction**

The potable water system (PWS) supplies clean water for domestic use and human consumption. The sanitary waste discharge system (SWDS) collects and treats sanitary wastes from plant restrooms and locker room facilities. The system design ensures that there is no possibility for radioactive contamination of the potable water or the sanitary waste drainage system. Neither the PWS nor the SWDS has a safety design basis.

#### **9.2.4.2 Summary of Application**

Section 9.2.4, "Potable and Sanitary Water Systems," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.4, "Potable and Sanitary Water Systems," of the ESBWR DCD, Revision 10. In addition, in FSAR Section 9.2.4, the applicant provided the following:

## Site Specific Information Replacing Conceptual Design Information

- NAPS CDI Potable and Sanitary Water Systems

The applicant provided additional information to replace CDI contained in the ESBWR DCD. The applicant described the site-specific potable and sanitary water system. The PWS consists of ground wells at various locations on site. For each well house there is a submersible well pump, compressor, hydro-pneumatic tank and interconnecting piping and valves. The North Anna 3 potable water header is connected to the North Anna 1 and 2 domestic water system with a normally closed valve. The sanitary wastes are collected in underground tanks located throughout the yard and pumped to an on-site sewage treatment plant. Neither the PWS nor the SWDS interconnects with any system that contains radioactive fluids. The SWDS is monitored for radioactivity. The applicant provided Figure 9.2-202, "Potable Water System Simplified Diagram," depicting the PWS and Figure 9.2-203, "Sanitary Waste Discharge System Simplified Diagram," depicting the SWDS.

### **9.2.4.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966. In addition, the relevant requirements of the Commission regulations for the PWS and the SWDS and the associated acceptance criteria are in SRP Section 9.2.4.

The applicable regulatory requirements for the potable and sanitary water system are as follows:

- GDC 60, "Control of Releases of Radioactive Materials to the Environment," of 10 CFR Part 50, Appendix A which relates to design provisions provided to control the release of liquid effluents containing radioactive material from contaminating the PSWS.

Since the PWS/SWDS may affect SSCs due to nonsafety-related equipment failures, additional regulatory requirements are as follows:

- GDC 2 as it relates to structures housing the system and the system itself having the capability of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes and floods without loss of safety-related functions.
- GDC 4 as it relates to effects of missiles inside and outside of the containment, pipe whip, jets, and environmental conditions from high and moderate energy line breaks and dynamic effects of flow instabilities and loads (e.g., water hammer) during normal plant operation, as well as during accident conditions.

### **9.2.4.4 Technical Evaluation**

As documented in NUREG-1966, the staff reviewed and approved Section 9.2.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD, to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that information in the application and the information incorporated by reference address the required information related to the PWS/SWDS.

The staff reviewed the relevant information in the COL FSAR:

Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI Potable and Sanitary Water Systems

The staff reviewed NAPS CDI related to the site-specific design of the potable and sanitary water system included under Section 9.2.4 of the North Anna 3 COL FSAR, Revision 8. Meeting the requirements of GDC 60 for this system ensures that design provisions are in place to prevent liquid effluents containing radioactive materials from contaminating the PWS and SWDS and potentially being released to the environment.

The PWS and SWDS do not perform any safety-related function and are not connected to any safety-related systems. Failure of these systems does not affect any safety-related components or prevent a safe shutdown of the plant.

The proposed source of potable water for the PWS is water from ground wells, at a supply capacity of 12.6 liters per second (200 gallons per minute). It is stated in the application that the water quality will meet the standards of the authorities having jurisdiction. The PWS does not handle radioactive fluids, and it is not connected to and does not interface with any system potentially containing radioactive fluids. However, potable water is supplied to areas where potential backflow could cause radiological contamination. In the unlikely event of radiological intrusion into the PWS in these areas, the applicant has proposed use of backflow preventers to prevent the spread of contamination into the PWS. The staff concludes that because the PWS is not connected to or does not interface with systems that contain radioactivity, and backflow preventers are installed in areas of potential contamination, acceptable design provisions have been made to prevent the inadvertent contamination of the PWS with radioactive material.

The proposed SWDS consists of an onsite sewage treatment plant with a normal capacity of 94,500 liters per day (25,000 gallons per day) or a maximum capacity of 189,000 liters per day (50,000 gallons per day) of sanitary sewage. The effluent is discharged to the waste heat treatment facility. The effluent meets standards established by Federal, state, and local regulations and permits. The SWDS does not handle radioactive fluids. It is not connected to and does not interface with any system potentially containing radioactive fluids.

The staff requested information related to process and effluent monitoring and sampling provisions for the SWDS in RAI 11.05-2 dated May 19, 2008 (ADAMS Accession No. ML081410065). In their response to RAI 11.05-2 dated June 30, 2008 (ADAMS Accession No. ML081900515), the applicant removed composite samplers from the SWDS design and proposed a per batch sewage treatment plant sludge tank grab sampling program. The North Anna 3 FSAR was updated to reflect these changes. The staff concludes that the grab sampling program is adequate in detecting potential radiological contamination and preventing uncontrolled radioactive releases to the environment from this system for the following reasons: the SWDS is not connected to or does not interface with systems that contain radioactivity; sewage treatment plant sludge tank sampling will be performed; and acceptable design provisions have been made to prevent the inadvertent contamination of the SWDS with radioactive material and inadvertent radioactive releases to the environment.

Based on the staff's review of the applicant's design criteria and design bases for the potable and sanitary water systems, the staff finds that acceptable design provisions have been made to prevent the inadvertent contamination of the systems with radioactive material, and therefore find the proposed design of the potable and sanitary water system meets the requirements of GDC 60 and is acceptable.

The staff finds that the site-specific CDI presented within this section of the North Anna 3 COL FSAR is acceptable and meets the requirements of GDC 2, 4, and 60. The staff bases its conclusion on the fact that the potable and sanitary water systems have no safety-related functions and failure of the system would not compromise any safety-related system or component, nor would it prevent a safe shutdown of the plant. The North Anna 3 CDI for the PWS and SWDS have no interface with any safety-related equipment, and no interconnections exist between the PWS and SWDS and any potentially radioactive system. In addition, flooding consequences from the PWS storage tank was evaluated and determined to be acceptable since safety-related or RTNSS SSCs would not be negatively affected from performing their intended functions.

#### **9.2.4.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.2.4.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to the potable and sanitary water systems, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the potable and sanitary water systems that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 9.2.4, and NRC regulatory guides. The staff concludes that the applicant's information on CDI in this section of the North Anna 3 COL FSAR is acceptable and meets the requirements of GDC 2, 4, and 60.

The staff bases its conclusion on the fact that the potable and sanitary water systems have no safety-related function and failure of the system would not compromise any safety-related system or component, nor would it prevent a safe shutdown of the plant. The North Anna 3 CDI for the PWS/SWDS have no interface with any safety-related equipment, and no interconnections exist between the PWS/SWDS and any potentially radioactive system. In addition, flooding consequences from the PWS storage tank was evaluated and determined to be acceptable since safety-related or RTNSS SSCs would not be negatively affected from performing their intended functions.

### **9.2.5 Ultimate Heat Sink**

#### **9.2.5.1 Introduction**

The Ultimate Heat Sink (UHS) consists of the IC/PCCS pools, which provide the heat transfer mechanism for the reactor and containment to the atmosphere. The Fire Protection System

(FPS) provides makeup water for the IC/PCCS pools, and SFP from the primary (seismic Category I) firewater storage tanks via the safety-related Fuel and Auxiliary Pools Cooling System (FAPCS) piping, and other water sources that are credited for providing makeup water for the IC/PCCS pools, and SFP after water from the firewater storage tanks has been depleted. The Dryer/Separator pool and Reactor Well provide sufficient makeup water for the IC/PCCS expansion pools to support operation of the IC System and PCCS System during the initial 72 hours following an accident. A source of makeup water for the SFP is not credited during this period. After the initial 72 hours, the FPS is relied upon for supplying the necessary makeup water for the IC/PCCS pools or the SFP for up to 7 days. The parts of the UHS that are relied upon for the first 72 hours following an accident are safety-related and are evaluated in Section 5.4.6, "Isolation Condenser System (ICS)," and Section 6.2.2, "Passive Containment Cooling System." The parts of the UHS that are relied upon for providing makeup water during the period from 72 hours through 7 days post-accident are not required to be safety-related, but must be readily available on-site and are subject to RTNSS as discussed in Chapter 19A of the ESBWR DCD, Revision 10. This section evaluates the adequacy of the capability that is credited for providing makeup water to the IC/PCCS pools, or SFP after the initial 7 days have elapsed following an accident.

#### **9.2.5.2 Summary of Application**

Section 9.2.5, "Ultimate Heat Sink," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.5, "Ultimate Heat Sink," of the ESBWR DCD, Revision 10. In addition, in FSAR Section 9.2.5, the applicant provided the following:

##### COL Item

- STD COL 9.2.5-1-A Post Seven Day Makeup to UHS

The applicant provided additional information in STD COL 9.2.5-1-A to address DCD COL Item 9.2.5-1-A. The applicant stated that procedures will be provided to identify and prioritize available makeup water seven days after an accident and provide instructions for establishing the necessary connections. The procedures will be developed in accordance with the procedure development milestone in Section 13.5.

#### **9.2.5.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the UHS and the associated acceptance criteria are in SRP Section 9.2.5.

The applicable regulatory guidance for the evaluation of COL 9.2.5-1-A is as follows:

- GDC 2, 4, 44, 45, and 46
- GDC 5, "Sharing of Structures, Systems, and Components"

#### **9.2.5.4 Technical Evaluation**

As documented in NUREG-1966, the staff reviewed and approved Section 9.2.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.5 of the North Anna 3 COL FSAR, Revision 8 and checked the referenced ESBWR DCD to ensure that the combination of the

information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and information incorporated by reference address the required information related to the UHS.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item

- STD COL 9.2.5-1-A Post Seven Day Makeup to UHS

The staff reviewed STD COL 9.2.5-1-A related to the makeup water to the UHS included under Section 9.2.5 of the North Anna 3 COL FSAR, Revision 8. As discussed above in the Introduction Section, the UHS consists of both safety-related and nonsafety-related SSCs. The staff's evaluation of the UHS for the ESBWR design focuses primarily on assuring that sufficient makeup water is available and can be supplied to the IC/PCCS pools, or SFP for long-term cooling after the initial 7 days have elapsed following an accident. Acceptability is judged based upon conformance with the regulatory basis referred to above, as applied to the standard plant design and reflected in Tier 2 of the ESBWR DCD, Revision 10, Section 9.2.5.

This COL information item is listed in Tier 2 of the ESBWR DCD, Section 9.2.5.1, "COL Information," and specifies that COL applicants need to develop procedures for supplying makeup water to the IC/PCCS pools or SFP 7 days after an accident. During the period from 72 hours up to 7 days following an accident, the FPS is credited for providing post-accident makeup water to the UHS through safety-related FAPCS piping. After 7 days, the applicant can either use offsite makeup sources to replenish the UHS water supply via safety-related FAPCS connections that are located outside the RB and FB, or the applicant can use on-site water sources if they are available. The minimum required flow rate that is specified for post-72 hour makeup is 46 meter (m) <sup>3</sup>/hr or (200 gallon per minute (gpm)), and makeup water quality is normally required to meet demineralized water chemistry specifications. However, during accident conditions, makeup water quality that satisfies FPS or SWS chemistry specifications can be used. The post 7-day makeup water source is not required to be safety-related or subject to RTNSS, but should be from sources that are diverse or highly reliable. These considerations are discussed in Tier 2 of the ESBWR DCD, Section 9.2.5, which specifically states: "The COL applicant will develop procedures to supply makeup water 7 days after an accident (9.2.5-1-A)."

The applicant provided the following response for this COL Item:

Procedures that identify and prioritize available makeup sources seven days after an accident, and provide instructions for establishing necessary connections, will be developed in accordance with the procedure development milestone in Section 13.5.

Except for the development milestones that are referred to by the proposed response, it is not clear to what extent the other provisions of Section 13.5, "Plant Procedures," will be implemented, what makeup considerations will be addressed, what criteria will be satisfied, and how soon after an accident the makeup capability will be assessed. Therefore, the staff asked the applicant in RAI 09.02.05-1 dated June 19, 2008 (ADAMS Accession No. ML081710161) to provide additional information to address these considerations. In a response to RAI 09.02.05-1 dated August 4, 2008 (ADAMS Accession No. ML082200626), the applicant described details

associated with UHS makeup procedure development. For “STD COL 9.2.5-1-A,” the applicant has stated that procedures will be provided to identify and prioritize available makeup sources for 7 days after an accident. In addition, the applicant made reference to Section 13.5.2.1.4, “Emergency Operating Procedures,” and stated that this UHS makeup procedure under, “STD COL 9.2.5-1-A”, will be developed through the implementation of the operating procedure development process. The staff determined that this approach is acceptable since the applicant will develop this procedure and develop the details to address available means of makeup delivery which includes permanent plant systems, portable equipment and temporary delivery/processing systems in North Anna 3 FSAR, Section 9.2.5. Based on the RAI response, the statement in FSAR Section 9.2.5, and the schedule defined in FSAR Section 13.5, the staff determined this issue and RAI 09.02.05-1 are closed.

The staff evaluated STD COL 9.2.5-1-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 5, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

#### **9.2.5.5 Post Combined License Activities**

Procedures that identify and prioritize available makeup sources 7 days after an accident, and provide instructions for establishing necessary connections, will be developed in accordance with the procedure development milestone in FSAR Section 13.5.

#### **9.2.5.6 Conclusions**

The staff’s finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff’s review confirms that the applicant has addressed the required information relating to the UHS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the UHS that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, regulatory guides and the guidance in SRP Section 9.2.5. The staff’s review concludes that the applicant’s information is acceptable and meets the requirements of GDC 2, 4, 5, 44, 45, and 46. Therefore, the staff finds that the applicant has satisfactorily addressed DCD COL Item 9.2.5-1-A.

### **9.2.6 Condensate Storage and Transfer System**

#### **9.2.6.1 Introduction**

The condensate storage and transfer system (CS&TS) supplies condensate-quality water for makeup to selected plant systems. It consists of two independent and 100 percent redundant transfer pumps, that takes suction from a single condensate storage tank (CST), and provides water to interface systems as required. The CST serves as a reservoir for the CS&TS water inventory and is the normal source of water for makeup to selected plant systems. It also provides storage capacity for condensate rejected from the condensate and feedwater system, for condensate quality liquid waste management system effluent during normal operation, and for condensate and feedwater system and hotwell inventory during system maintenance outages. The CS&TS is not a safety-related system, and does not perform any safety-related function.



### 9.2.6.2 Summary of Application

Section 9.2.6, “Condensate Storage and Transfer System,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.6,” Condensate Storage and Transfer System,” of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.2.6, the applicant provided the following:

#### Supplemental Information

- STD SUP 9.2.6-1 System Description

The applicant provided the following supplemental information. The applicant stated that freeze protection is provided for the North Anna 3 CS&TS.

### 9.2.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the CS&TS and the associated acceptance criteria are in SRP Section 9.2.6.

SRP Section 9.2.6 states that “The safety-related portions of the condensate storage facility are protected from the effects of natural phenomena including cold weather, tornadoes, and flooding such that the event will not adversely affect the safety function of the system.”

Since the CS&TS is not a safety-related system, and does not perform any safety-related functions, there is no applicable regulatory requirement for the freeze protection for the CS&TS.

### 9.2.6.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.6 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.6 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the CS&TS.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

#### Supplemental Information

- STD SUP 9.2.6-1 System Description

The staff reviewed STD SUP 9.2.6-1 related to the freeze protection for the CS&TS included under Section 9.2.6 of the North Anna 3 COL FSAR. The staff reviewed conformance of Section 9.2.6 of the North Anna COL FSAR to the relevant NRC regulations and acceptance criteria defined in SRP Section 9.2.6, “Condensate Storage Facilities.” The staff’s review finds

that the applicant appropriately incorporated by reference Section 9.2.6 of the ESBWR DCD, Revision 10, with the following Tier 2 supplemental information added:

The applicant provided supplemental information as part of the FSAR with regards to CS&TS freeze protection. In FSAR Section 9.2.6, the applicant added the following text to the end of the first paragraph of Section 9.2.6.2 of the ESBWR DCD, Revision 10: "Freeze protection is provided for the CS&TS."

The staff reviewed the standard supplemental information provided in STD SUP 9.2.6-1. Freeze protection for the CS&TS is addressed in Tier 2, Section 1.2.2.12.2, "Condensate Storage and Transfer System," of the ESBWR DCD, Revision 10. Although the CS&TS does not perform or ensure any safety-related function, and is not required to achieve or maintain safe shutdown, DCD Tier 2, Section 1.2.2.12.2 specifies that if required, the CS&TS will be provided with freeze protection. A general discussion on freeze protection is provided in FSAR Section 1.2.2.12.16, "Freeze Protection." The incorporation of freeze protection in the CS&TS design is a system enhancement that has no impact on the system's regulatory compliance, but could result in increased system reliability and availability; therefore the staff finds the proposed standard supplement acceptable.

#### **9.2.6.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.2.6.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the CS&TS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the CS&TS that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, regulatory guides, and the guidance in SRP Section 9.2.6. The staff's review concludes that the applicant's information provided in STD SUP 9.2.6-1 is acceptable. The staff bases its conclusion on the fact that freeze protection in the CS&TS design is a system enhancement that has no impact on the system's regulatory compliance.

#### **9.2.7 Chilled Water System**

Section 9.2.7, "Chilled Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.2.7, "Chilled Water System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.2.7 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Chilled Water System" that were incorporated by reference have been resolved.

### **9.2.8 Turbine Component Cooling Water System**

Section 9.2.8, "Turbine Component Cooling Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.2.8, "Turbine Component Cooling Water System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.2.8 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Turbine Component Cooling Water System" that were incorporated by reference have been resolved.

### **9.2.9 Hot Water System**

Section 9.2.9, "Hot Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.2.9, "Hot Water System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.2.9 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Hot Water System" that were incorporated by reference have been resolved.

### **9.2.10 Station Water System**

#### **9.2.10.1 Introduction**

The SWS provides filtered and treated water as makeup to the circulating water system (CWS) cooling tower basin, the PSWS cooling tower basin, the MWS and to fill the primary firewater tanks.

#### **9.2.10.2 Summary of Application**

Section 9.2.10, "Station Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.10, "Station Water System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.2.10, the applicant provided the following:

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI Detailed System Description

The applicant provided additional site-specific information to replace CDI contained in the ESBWR DCD and described the SWS. The SWS is comprised of two subsystems: (1) the plant cooling tower makeup subsystem (PCTMS) which provides makeup to the plant service water cooling towers and the main CWS cooling tower and (2) the pretreated water supply system (PWSS) which is used for filling the primary firewater tanks. The applicant provided Tables 9.2-203, "Station Water System – Plant Cooling Tower Makeup System Component Design Parameters," and 9.2-204, "Station Water System – Pretreated Water Supply System Component Design Parameters," which list the design parameters of the SWS equipment. The applicant provided Figures 9.2-204, "Station Water System – Plant Cooling Tower Makeup System (PCTMS)," and 9.2-205, "Station Water System – Pretreated Water Supply System (PWSS)," which depict the SWS.

**9.2.10.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, there is no associated SRP section for the SWS.

The applicable regulatory guidance for the evaluation of NAPS CDI is as follows:

- GDC 2, in that failure of the nonsafety-related system or component due to natural phenomena such as earthquakes, tornadoes, hurricanes, and floods should not adversely affect the safety-related SSCs.

**9.2.10.4 Technical Evaluation**

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.10 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.10 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the SWS.

The staff reviewed the information in the COL FSAR as follows:

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI Detailed System Description

The staff reviewed NAPS CDI related to the ESBWR conceptual design of the SWS and the design parameters for the SWS components included under Section 9.2.10 of the North Anna 3 COL FSAR.

In FSAR Section 9.2.10.2, "System Description," the applicant replaced the "Detailed System Description" portion of this section in the reference ESBWR DCD, Revision 10. In FSAR Section 9.2.10.2, the applicant provided the site-specific detailed description of SWS design proposed for North Anna 3. The SWS consists of two subsystems as previously stated: (1) PCTMS, and (2) PWSS.

The PCTMS provides makeup water to the cooling tower basins for both PSWS and CWS. The supply of water makes up for losses resulting from evaporation, drift, and blowdown from the cooling towers. In addition, the PCTMS provides makeup water to replace water used for strainer backwashes. The PCTMS consists of a water source, pumps, strainers, connecting piping, valves, and instrumentation. The applicant provided a simplified system diagram in FSAR Figure 9.2-204, "Station Water System – Plant Cooling Tower Makeup System (PCTMS)," and component design parameters for the PCTMS in FSAR Table 9.2-203, "Station Water System – Plant Cooling Tower Makeup System Component Design Parameters."

The PWSS chemically conditions and filters the water supplied to the MWS for further treatment for use as demineralized water. The PWSS also supplies water to the FPS for filling the primary firewater tanks. In addition, the PWSS provides cooling tower makeup to the PSWS as an alternate to the PCTMS. The PWSS also provides water for the strainers and filter backwashes. The PWSS consists of a water source, pumps, strainers, filters, chemical injection equipment, and station water storage tank, connecting piping, valves, and instrumentation. Further, the applicant provided a simplified system diagram in FSAR Figure 9.2-205, "Station Water System – Pretreated Water Supply System (PWSS)," and component design parameters for the PCTMS in Table 9.2-204, "Station Water System – Pretreated Water Supply System Component Design Parameters."

The staff reviewed the site-specific design information provided in NAPS FSAR Section 9.2.10.2, and finds that the applicant replaced the detailed system description from the reference ESBWR DCD, Section 9.2.10.2, "System Description," as the site-specific NAPS CDI.

The SWS design in the application is identical to that in the DCD. Also, the staff finds that the applicant did not identify any departures and/or supplements, except that the applicant included additional information by providing the SWS-PWSS flow diagram in FSAR Figure 9.2-205 and component design parameters in FSAR Table 9.2-204. Additionally, the staff referred to Section 9.2.10.3, "Safety Evaluation," in the ESBWR DCD and finds that the SWS has no safety-related function. The DCD further states that failure of the SWS does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant. Further, the NAPS SWS has no interface with any safety-related equipment, and no interconnections exist between the SWS and any potentially radioactive system. The design information provided in the North Anna 3 COLA does not impact the conclusions in the ESBWR staff SER, and therefore the staff finds the North Anna 3 SWS design acceptable.

Based on the above discussion, the staff finds that the North Anna 3 SWS meets the requirements of GDC 2, since, it is a nonsafety-related system, and failure of the system or its components due to natural phenomena will have no adverse effects on safety-related SSCs.

#### Site Specific Pre-Operational Tests

In NAPS SUP 14.2-3 the applicant provided information in Section 14.2.9.1.1, "Station Water System Pre-Operation Test," to address SWS pre-operational testing. The preoperational testing review is performed under Section 14.2 of this SER.

### **9.2.10.5 Post Combined License Activities**

There are no post COL activities related to this section.

### **9.2.10.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the SWS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the SWS that were incorporated by reference are resolved.

In addition, the staff concludes that the site-specific design portion of the North Anna 3 SWS is acceptable and meets the relevant NRC regulations and regulatory guides. The staff's review concludes that the applicant's information is acceptable and meets the requirements of GDC 2.

## **9.3 Process Auxiliaries**

### **9.3.1 Compressed Air Systems**

Section 9.3.1, "Compressed Air Systems," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.1, "Compressed Air Systems," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.3.1 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Compressed Air Systems" that were incorporated by reference have been resolved.

### **9.3.2 Process Sampling System**

#### **9.3.2.1 Introduction**

The process sampling system is designed to collect representative water and gaseous samples for analysis contained in the reactor coolant system (RCS) and associated auxiliary system process streams during all normal modes of operation and following an accident. The proposed design includes permanently installed sample lines, sampling panels with analyzers and associated sampling equipment, provisions for local grab sampling, and permanent shielding. Provisions are made to ensure that representative samples are obtained from turbulent flow zones to ensure adequate mixing. Continuous sample flows are routed from selected locations to the sampling stations where pressure, temperature, and flow adjustments are made as necessary. Effluents from sample stations are returned to an appropriate process stream or to the radwaste drain headers through a common return line.

### 9.3.2.2 Summary of Application

Section 9.3.2, "Process Sampling System," of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.3.2, "Process Sampling System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.2, the applicant provided the following:

#### COL Item

- STD COL 9.3.2-1-A Post Accident Sampling Program

The applicant provided additional information in STD COL 9.3.2-1-A to address DCD COL Item 9.3.2-1-A. The applicant described the post-accident sampling (PAS) program. The PAS program consists of emergency operating procedures that rely on installed post-accident radiation monitoring instrumentation, plant procedures for obtaining highly radioactive grab samples, a containment monitoring system capable of operation in post loss-of-coolant accident (LOCA) mode, and effluent radiation monitoring. The PAS program functions in lieu of a dedicated post-accident sampling system (PASS).

### 9.3.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the PAS program and the associated acceptance criteria are in SRP Section 9.3.2.

The applicable regulatory requirements for the PAS program are as follows:

- GDC 64, "Monitoring Radioactivity Releases"
- Item (b) of 10 CFR 20.1101(b), "Radiation Protection Programs"
- Section IV.B of Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 CFR Part 50

### 9.3.2.4 Technical Evaluation

As documented in NUREG-1966, the staff reviewed and approved Section 9.3.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the PAS program.

### COL Item

- STD COL 9.3.2-1-A Post Accident Sampling Program

The staff reviewed STD COL 9.3.2-1-A related to the PAS program included under Section 9.3.2 of the North Anna 3 COL FSAR. The staff reviewed conformance of Section 9.3.2 of the North Anna 3 COL FSAR to the guidance in RG 1.206, Section C.III.1, Chapter 9, C.I.9.3.2, "Process and Post-Accident Sampling Systems." The staff's review of the North Anna 3 COL FSAR, Section 9.3.2 finds that it appropriately incorporates by reference Section 9.3.2 of the ESBWR DCD, Revision 10. In addition the applicant provided information on the North Anna 3 PAS program as required by STD COL 9.3.2-1-A of the ESBWR DCD. The PAS program meets the guidance provided in SRP Section 9.3.2.1.6 for actions required in lieu of a PASS as follows:

Emergency Operating Procedures that rely on Emergency Action Levels, defined in the Emergency Plan (EP), are used to classify fuel damage events. These procedures rely on installed post-accident radiation monitoring instrumentation described in DCD Section 7.5 and do not require the capability to obtain and analyze highly radioactive coolant samples although sample analyses may be used for classification as well.

Plant procedures contain instructions for obtaining highly radioactive grab samples from the following:

- Reactor Coolant – from the reactor water cleanup/shutdown cooling sample line using the RB Sample Station. These samples can be analyzed for the parameters indicated in DCD Table 9.3-1. If coolant activity is greater than 1.0 Ci/ml, handling of the samples is delayed to avoid overexposure of personnel.
- Suppression Pool – from FAPCS sample line at the RB Sample Station. These samples can be analyzed for the parameters indicated in DCD Table 9.3-1. If coolant activity is greater than 1.0 Ci/ml, handling of the samples is delayed to avoid overexposure of personnel.
- Containment Atmosphere - may be taken as described in DCD Section 11.5.3.2.11 and analyzed for fission products.
- DCD Section 7.5.2.2 describes Containment Monitoring System operation in post-LOCA mode for gaseous sampling for O<sub>2</sub> and H<sub>2</sub>.
- Effluent radiation monitoring is described in DCD Section 7.5. Field sampling and monitoring capability is maintained in accordance with the EP.
- Post-accident monitoring is adequate to implement the EP without reliance on post-accident sampling capability; therefore, the absence of a dedicated Post-Accident Sampling System does not reduce the effectiveness of the EP.

As part of the review of FSAR, Revision 0, Section 11.5, the staff noted that FSAR Section 9.3.2.2 (System Description) refers incorrectly to Section 11.5.3.2.12 of the ESBWR DCD (Tier 2) regarding available provisions for sampling the containment atmosphere. This section of the ESBWR DCD addresses the radiation monitoring system for the technical support center (TSC) air intake and not the containment.



Accordingly, the applicant was requested in RAI 9.03.02-1 dated June 11, 2008 (ADAMS Accession No. ML081640399), to update the reference citation in FSAR Section 9.3.2.2 with the proper DCD Tier 2, Chapter 11.5 section addressing provisions for the sampling of containment atmosphere. In response to RAI 09.03.02-1 dated July 23, 2008 (ADAMS Accession No. ML082140231), the applicant proposed a revision to the section of the FSAR by correcting the improper reference. The staff finds that the applicant has revised their FSAR accordingly and RAI 09.03.02-1 is resolved and closed. The staff finds that the North Anna 3 COL FSAR, Revision 8, has adequately addressed STD COL 9.3.2-1-A by providing information that adequately describes the North Anna 3 PAS program capability.

The staff evaluated COL Item STD COL 9.3.2-1-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.3.2. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.3.2-1-A with respect to the requirements of GDC 64, 10 CFR 20.1101(b) and Section IV.B of Appendix E to 10 CFR Part 50.

#### **9.3.2.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.3.2.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the PAS program, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the PAS, that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 9.3.2, and other NRC regulatory guides. The staff's review concludes that the applicant's information presented in this section of the FSAR is acceptable and meets the requirements of GDC 64, 10 CFR 20.1101(b), and Section IV.B of Appendix E to 10 CFR Part 50. Therefore, staff finds that the applicant has satisfactorily addressed DCD COL Item 9.3.2-1-A.

#### **9.3.3 Equipment and Floor Drain System**

Section 9.3.3, "Equipment and Floor Drain System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.3, "Equipment and Floor Drain System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.3.3 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Equipment and Floor Drain System" that were incorporated by reference have been resolved.

### **9.3.4 Chemical and Volume Control System**

Section 9.3.4, “Chemical and Volume Control System,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.4, “Chemical and Volume Control System,” of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.4 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff’s review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the “Chemical and Volume Control System” that were incorporated by reference have been resolved.

### **9.3.5 Standby Liquid Control System**

#### **9.3.5.1 Introduction**

The Standby Liquid Control System (SLCS) is an independent reactivity control system designed to provide both manual and automatically initiated capability for bringing the reactor from full power and minimum control rod inventory to a subcritical condition with the reactor in the most reactive state without taking credit for control rod movement. The SLCS performs safety-related functions; therefore, it is classified as safety-related and is designed as a seismic Category I system. The SLCS meets the following safety design bases by providing: (1) a diverse backup capability, independent of normal reactor shutdown methods, to shut down the reactor when the control rods fail to insert during AOOs and anticipated transients without scram (ATWS), and (2) makeup water to the reactor pressure vessel (RPV) to mitigate the consequences of a LOCA.

The SLCS is a passive system that consists of two identical and separate trains. Each SLCS train includes a nitrogen-pressurized accumulator containing sodium pentaborate solution and is connected by piping through two parallel injection explosive-actuated (squib) valves to the RPV. Each train provides 50 percent of the required SLCS injection capacity required for an ATWS.

#### **9.3.5.2 Summary of Application**

Section 9.3.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.3.5 of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.5, the applicant provided the following:

#### Supplemental Information

- STD SUP 9.3.5-1 System Description

The applicant provided the following supplemental information:

STD SUP 9.3.5-1 added the following to the end of the fifth paragraph under “Detailed System Description” of DCD Section 9.3.5.2, “System Description”:

The above provisions adequately prevent loss of solubility of borated solutions (sodium pentaborate).

### 9.3.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the SLCS and the associated acceptance criteria are in SRP Section 9.3.5.

The applicable regulatory requirements for the SLCS thermal environmental conditions are as follows:

- GDC 2, 4, and 5
- GDC 26, “Reactivity control system redundancy and capability”
- GDC 27, “Combined reactivity control systems capability”
- Item (c)(4) of 10 CFR 50.62, “Requirements for reduction or risk from ATWS events for light-water-cooled nuclear power plants”
- 10 CFR 52.80(a)

### 9.3.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the SLCS.

The staff reviewed the information in the COL FSAR as follows:

#### Supplemental Information

- STD SUP 9.3.5-1 System Description

The staff reviewed STD SUP 9.3.5-1-A related to the SLCS included under Section 9.3.5 of the North Anna 3 COL FSAR. The staff reviewed conformance of Section 9.3.5 of the COL FSAR to the guidance in RG 1.206, Section C.III.1, Chapter 9, C.I.9.3.5, “Standby Liquid Control System (BWRs).” The staff’s review of Section 9.3.5 of the COL FSAR finds that it appropriately incorporates by reference Section 9.3.5 of the ESBWR DCD, Revision 10.

The staff review of this application is limited to STD SUP 9.3.5-1, in which the applicant summarized that the provisions adequately prevent loss of solubility of borated solutions (sodium pentaborate).

The staff reviewed the resolution to the supplementary item related to the provisions to prevent loss of solubility of borated solutions (sodium pentaborate) included under Section 9.3.5.2 of the North Anna 3 COL FSAR. STD SUP 9.3.5-1, a supplemental information item, is an editorial change that enlightens and summarizes the technical information of the previous paragraphs in the DCD with respect to preventing the loss of solubility of borated solutions of the SLCS. The statement does not alter the technical information related to preventing loss of solubility of borated solutions or affect compliance with the relevant regulatory requirements and hence is acceptable. Because it is just an editorial change, the staff expects no additional information in the COL FSAR related to STD SUP 9.3.5-1.

#### **9.3.5.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.3.5.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant addressed the required information relating to the SLCS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the SLCS that were incorporated by reference are resolved.

In addition, the staff compared the supplemental information in the COLA to the relevant NRC regulations, the guidance in SRP Section 9.3.5, and other NRC regulatory guides. The staff's review concludes that applicant's information in this section of the COL FSAR is acceptable and meets the requirements of GDC 2, 4, 5, 26, and 27; 10 CFR 50.62(c)(4); and 10 CFR 52.80(a).

#### **9.3.6 Instrument Air System**

Section 9.3.6, "Instrument Air System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.6, "Instrument Air System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.3.6 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Instrument Air System" that were incorporated by reference have been resolved.

#### **9.3.7 Service Air System**

Section 9.3.7, "Service Air System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.7, "Service Air System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.3.7 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Service Air System" that were incorporated by reference have been resolved.

### **9.3.8 High Pressure Nitrogen Supply System**

Section 9.3.8, "High Pressure Nitrogen Supply System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.8, "High Pressure Nitrogen Supply System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.3.8 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "High Pressure Nitrogen Supply System" that were incorporated by reference have been resolved.

### **9.3.9 Hydrogen Water Chemistry System**

#### **9.3.9.1 Introduction**

The hydrogen water chemistry system (HWCS) is designed to inject hydrogen into the feedwater system at the suction of the feedwater pumps to reduce oxidizing species in the RCS. The addition of hydrogen reduces the likelihood of corrosion failures that would adversely affect plant availability. Oxygen is injected into the off-gas system to ensure a proper mixture of hydrogen and oxygen.

ESBWR DCD Section 9.3.9 addresses information related to the ESBWR HWCS. The HWCS is not within the certified scope of the ESBWR. The ESBWR Standard Plant Design includes the capability to incorporate a HWCS, but the system itself is not part of the ESBWR Standard Plant Design.

#### **9.3.9.2 Summary of Application**

Section 9.3.9, "Hydrogen Water Chemistry," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 3.9, "Hydrogen Water Chemistry," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.9, the applicant provided the following:

### COL Items

- STD COL 9.3.9-1-A Implementation of Hydrogen Water Chemistry

The applicant provided additional information in STD COL 9.3.9-1-A to address DCD COL Item 9.3.9-1-A. The applicant stated that the hydrogen water chemistry (HWC) option is included in the plant's design.

- NAPS COL 9.3.9-2-A Hydrogen and Oxygen Storage and Supply

The applicant provided additional information in NAPS COL 9.3.9-2-A to address DCD COL Item 9.3.9-2-A. The applicant stated that the hydrogen supply system for the HWCS is integrated with the generator hydrogen supply system and is described in DCD Section 10.2.2.2.8.

### Site Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant described the HWC injection points and states that a monitoring system is provided to track the effectiveness of the HWCS.

- NAPS CDI Hydrogen Storage Facility

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant provided a description of the hydrogen storage facility.

The hydrogen is stored in two independent 6,000 gallon ASME Section VIII, Division 1 cryogenic tanks located outside the plant protected area.

Separate skid mounted gaseous bulk hydrogen storage bottles ensure hydrogen supply for generator cooling as a backup for the liquid hydrogen supply for North Anna 3.

- STD CDI Power Generation Design Basis

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant stated that hydrogen is injected into the feedwater at the suction of the feedwater pumps and oxygen is injected into the off-gas system.

- STD CDI Inspection and Testing Requirements

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant stated that the connections for the HWCS are tested and inspected with the feedwater and off-gas piping. Major components of the HWCS are inspected and tested as separate components prior to installation.

- STD CDI Instrumentation and Controls

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant stated that instrumentation is provided to control the injection of hydrogen and augment the injection of oxygen.

### 9.3.9.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD.

There is no associated SRP section for the HWCS.

The applicable industry requirements for the HWCS, which have been endorsed by the NRC, are as follows:

- Electric Power Research Institute (EPRI) Report NP-4947-SR, “BWR Hydrogen Water Chemistry Guidelines,”
- EPRI Report NP-5283-SR-A, “Guidelines for Permanent BWR Hydrogen Water Chemistry Installations,”

### 9.3.9.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.9 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.9 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the HWCS.

The staff reviewed the information in the COL FSAR as follows:

#### COL Items

- STD COL 9.3.9-1-A Implementation of Hydrogen Water Chemistry

The HWCS is composed of hydrogen and oxygen supply systems to inject hydrogen in the feedwater and oxygen in the off-gas while several monitoring systems track the effectiveness of the HWCS. Provisions are made in the design to allow for installation of a system adding hydrogen to the feedwater at the suction of the feedwater pumps. The ESBWR DCD requires that the HWCS utilizes the guidance included in the EPRI Report NP-4947-SR, “BWR Hydrogen Water Chemistry Guidelines,” 1987 Revision. The report provides guidelines on how to operate the HWCS. The staff has endorsed the report in its SER of the EPRI Utility Requirements Document and on that basis the staff finds EPRI Report NP-4947-SR, 1987 Revision acceptable. In addition, the staff finds that the North Anna COL FSAR has adequately addressed STD COL 9.3.2-1-A by providing information that adequately describes the North Anna 3 HWCS and incorporates the EPRI guidance.

- NAPS COL 9.3.9-2-A Hydrogen and Oxygen Storage and Supply

The HWCS is nonsafety-related; however, given the potential for hydrogen combustion or detonation, the handling of hydrogen at nuclear power plant facilities needs to be safe, reliable, and consistent with the requirements for using hydrogen gas. The ESBWR DCD requires that any HWCS installations including the means for storing and handling hydrogen meet the EPRI Report NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations." The report provides guidance to store and handle hydrogen at nuclear power facilities. The staff has endorsed EPRI Report NP-5283-SR-A in its letter J.E. Richardson to G.H. Niels dated July 13, 1987. Because it follows the NRC-endorsed report, the staff finds that the North Anna COL FSAR specifies an acceptable method to handle and store hydrogen for the HWCS and incorporates the EPRI guidance. The staff evaluated the potential accidents from hydrogen storage in Section 2.2.3 of this SER.

Site-Specific Information Replacing Conceptual Design Information

The staff finds that all the NAPS and STD CDIs listed below are acceptable because they do not affect the staff's safety evaluation of the HWCS in the ESBWR DCD. These site-specific CDIs also do not affect the COL applicant's incorporation of the EPRI guidelines as the main guidance for the proper operation and installation of the HWCS.

- NAPS CDI System Description

The staff finds the site-specific additional information acceptable because it provides the design details for the North Anna 3 monitoring system to track the effectiveness of the HWCS that meet the NRC-endorsed EPRI guidelines.

- NAPS CDI Hydrogen Storage Facility

The staff finds that the North Anna COL FSAR provides the additional site-specific information that specifies an acceptable method to store hydrogen that meet the NRC-endorsed EPRI guidelines.

- STD CDI Power Generation Design Basis

The staff finds the CDI acceptable because it provides the site-specific additional information as to the designed location where the gas is injected to meet the NRC-endorsed EPRI guidelines.

- STD CDI Inspection and Testing Requirements

The staff finds the CDI acceptable because the site-specific additional information will ensure that the HWCS will work as designed and will meet the NRC-endorsed EPRI guidelines.

- STD CDI Instrumentation and Controls

The staff finds the CDI acceptable because the site-specific additional information provides the design detailed information on the proper functionality of the HWCS to meet the NRC-endorsed EPRI guidelines.



### **9.3.9.5 Post Combined License Activities**

There are no post COL activities related to this section.

### **9.3.9.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the HWCS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the HWCS that were incorporated by reference are resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant NRC regulations, the guidance in applicable industry standards, and other NRC regulatory guides. The staff's review concludes that the applicant's information on STD CDI and NAP3 CDI in this FSAR section is acceptable and meets the NRC-endorsed EPRI guidelines.

The staff also finds that the applicant has satisfactorily addressed DCD COL Items 9.3.9-1-A and 9.3.9-2-A with respect to the NRC-endorsed EPRI guidelines.

### **9.3.10 Oxygen Injection System**

#### **9.3.10.1 Introduction**

The oxygen injection system (OIS) is designed to add oxygen to the Condensate and Feedwater System in order to reduce corrosion and suppress corrosion product release. The OIS does not perform any safety-related function. This section of the North Anna 3 COL FSAR addresses information related to the ESBWR OIS. Industry experience has shown that the most beneficial oxygen concentration is between 30 to 200 ppb. The OIS is also designed to inject oxygen into the off-gas system when the HWC is implemented, to ensure that excess hydrogen in the off-gas stream is recombined.

#### **9.3.10.2 Summary of Application**

Section 9.3.10, "Oxygen Injection System," of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.3.10 of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.10, the applicant provided the following;

#### COL Item

- NAPS COL 9.3.10-1-A Oxygen Storage Facility

The applicant provided additional information in NAPS COL 9.3.10-1-A to address DCD COL Item 9.3.10-1-A. The applicant described the bulk oxygen storage facility which consists of a 9,000 gallon ASME Section VIII, Division 1 cryogenic tank located outside the plant fenced area. The tank is equipped with an atmospheric vaporizer, a pressure regulating valve, an excess flow check valve and relief valves.

### 9.3.10.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, there is no associated SRP section, for the oxygen storage facility. However, the staff uses the following applicable industry standards and requirements for the HWCS:

- EPRI Report NP-4947-SR, 1987 Revision
- EPRI Report NP-5283-SR-A, 1987 Revision

### 9.3.10.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.10 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.10 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the OIS.

The staff reviewed the information in the COL FSAR as follows:

#### COL Item

- NAPS COL 9.3.10-1-A Oxygen Storage Facility

The staff reviewed NAPS COL 9.3.10-1-A related to the oxygen storage facility included under Section 9.3.10 of the North Anna 3 COL FSAR, Revision 8. The OIS is designed to add sufficient oxygen (30 to 200 ppb) to reduce corrosion, general corrosion, and the release of corrosion products in the condensate and feedwater systems. The requirements for design, operation, maintenance, surveillance, and testing of the oxygen storage facility are specified in EPRI Report NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations." The ESBWR DCD specifies that any HWCS installations meet the EPRI Report NP-5283-SR-A. In addition, the oxygen storage facility is located in an area where the amount of combustible material is limited through design and administrative controls. North Anna 3 COL FSAR uses the guidance of EPRI Report NP-5283-SR-A to store and handle oxygen. The staff has endorsed EPRI Report NP-5283-SR-A in its letter J.E. Richardson to G.H. Niels dated July 13, 1987. Therefore, the staff finds that the North Anna COL FSAR specifies an acceptable method to handle and store oxygen.

In addition, the staff finds that the North Anna 3 COL FSAR has adequately addressed NAPS COL 9.3.10-1-A by providing information that adequately describes the North Anna 3 oxygen injection module of the HWCS and by providing an acceptable description of the oxygen storage facility.

### 9.3.10.5 Post Combined License Activities

There are no post COL activities related to this section.

### 9.3.10.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the OIS, and no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the OIS, that were incorporated by reference are resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant NRC regulations, the guidance in applicable industry standards, and other NRC regulatory guides. The staff's review concludes that the applicant's information in this FSAR section is acceptable and meets the NRC endorsed EPRI guidelines. The staff also finds that the applicant has satisfactorily addressed DCD COL Item 9.3.10-1-A with respect to the NRC endorsed EPRI guidelines.

### 9.3.11 Zinc Injection System

#### 9.3.11.1 Introduction

Minimizing the plateout of radioactive cobalt on reactor coolant piping can lead to potentially lower dose rates in the vicinity of this piping and result in correspondingly lower doses to personnel in the portions of the plant containing this piping. In order to minimize the plateout of radioactive cobalt on reactor coolant piping and other components, the North Anna 3 design will incorporate a Zinc Injection System (ZNIS). The ESBWR standard plant design includes the capability to connect a ZNIS and space, but the system itself is not part of the ESBWR standard plant design and is not a safety-related system. Each applicant first would determine based on material properties if a ZNIS system is needed. If it is needed then the applicant provides a system description.

#### 9.3.11.2 Summary of Application

Section 9.3.11, "Zinc Injection System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.3.11, "Zinc Injection System," of the certified ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.11, the applicant provided the following;

- NAPS COL 9.3.11-1-A Applicant Determination if a Zinc Injection System is needed

The site-specific design includes the ZNIS for control of reactor coolant cobalt.

- NAPS COL 9.3.11-2-A System Description

A passive ZNIS system is provided which consists of a simple recirculation loop around the feedwater pumps that continuously injects small amounts of depleted zinc oxide into the reactor feedwater through the dissolution of depleted zinc oxide pellets contained in the ZNIS vessel.

#### Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

The referenced DCD includes CDI for certain systems, or portions of systems, that are outside the scope of the standard plant design. The ESBWR standard plant design includes provisions for connecting an optional ZNIS which includes the following design considerations: (1) piping connections for a bypass loop around the feedwater pumps, and (2) space for ZNIS equipment that is considered site-specific CDI.

### 9.3.11.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD.

There is no associated SRP section for the ZNIS.

The industry guidelines applicable to HWCS and related to the effects of water impurities on reactor internals, which have been endorsed by the NRC, are as follows:

- EPRI Report NP-4947-SR, “BWR Hydrogen Water Chemistry Guidelines,”
- EPRI Report NP-5283-SR-A, “Guidelines for Permanent BWR Hydrogen Water Chemistry Installations”

### 9.3.11.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.11 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.11 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the ZNIS.

The staff reviewed the information in the COL FSAR as follows:

#### COL Item

- NAPS COL 9.3.11-1-A Applicant Determination if a Zinc Injection System is needed
- NAPS COL 9.3.11-2-A System Description

In the North Anna 3 FSAR, the applicant stated that these COL Items (STD COL 9.3.11-1-A and STD COL 9.3.11-2-A) address the provisions for a ZNIS for North Anna 3. The staff’s review confirms that the applicant has addressed the relevant information and no outstanding information is expected to be addressed in the COL FSAR related to this section. From a dose reduction perspective of the ZNIS, the staff in Section 12.3 of this SER, provides an evaluation of the applicant’s use of a ZNIS for North Anna 3.

- NAPS CDI System Description

The staff finds the CDI item acceptable because it provides for the optional provision for a ZNIS for North Anna 3 which would provide a reduction of on-site dose to plant personnel addressed in this SER in Section 12.3.

#### **9.3.11.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.3.11.6 Conclusion**

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Zinc Injection System" that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant guidance in applicable industry standards. The staff's review concludes that the applicant's information in this FSAR section is acceptable and meets the NRC-endorsed EPRI guidelines.

#### **9.3.12 Auxiliary Boiler System**

Section 9.3.12, "Auxiliary Boiler System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.12, "Auxiliary Boiler System" of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.3.12 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Auxiliary Boiler System" that were incorporated by reference have been resolved.

#### **9.4 Heating, Ventilation, and Air Conditioning**

Section 9.4, "Heating, Ventilation, and Air Conditioning," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.4, "Heating, Ventilation, and Air Conditioning," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.4 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR

Part 52, all nuclear safety issues relating to the heating, ventilation, and air conditioning, that were incorporated by reference have been resolved.

## **9.5 Other Auxiliary Systems**

### **9.5.1 Fire Protection System**

#### **9.5.1.1 Introduction**

This section of the North Anna 3 COL FSAR describes the FPS which provides assurance, through a defense-in-depth philosophy, that the Commission's fire protection objectives are satisfied. These objectives are: (1) to prevent fires from starting; (2) to detect rapidly, control, and extinguish promptly those fires that do occur; and (3) to provide protection for SSCs important to safety so that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant. In addition, FPS must be designed such that their failure or inadvertent operation does not adversely impact the ability of the SSCs important to safety to perform their safety functions. The FPS has a RTNSS function to provide post 72-hour makeup to the IC/PCCS pools or the SFP depending on the makeup needs.

#### **9.5.1.2 Summary of Application**

Section 9.5.1, Appendix 9A, and Appendix 9B of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.5.1, Appendix 9A, and Appendix 9B of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.5.1, the applicant provided the following:

#### **COL Items:**

- NAPS COL 9.5.1-1-A Secondary Firewater Storage Source

The applicant provided additional information in NAPS COL 9.5.1-1-A to address DCD COL Item 9.5.1-1-A. The applicant identified Lake Anna as the secondary source of water. The lake has a capacity well in excess of 550,000 gallons as specified in ESBWR DCD, Revision 10, and as per guidance given in RG 1.189, Revision 2, "Fire Protection for Nuclear Power Plants," Regulatory Position 3.2.1.

- NAPS COL 9.5.1-2-A Secondary Firewater Capacity

The applicant provided additional information in NAPS COL 9.5.1-2-A to address DCD COL Item 9.5.1-2-A. The applicant stated that tests will be performed to demonstrate that the secondary fire protection pump circuit supplies the required flow and pressure at the Turbine Building/Yard interface boundary. DCD Section 14.2.8.1.39 which is incorporated by reference states that FPS tests are in accordance with the criteria in codes and standards listed in Table 9.5-1. FSAR Table 1.9-201 and Table 1.9-204 supplements DCD Table 9.5-1 for those systems outside the scope of the DCD and operational aspects of the fire detection and suppression systems. Table 1.9-204 adds additional codes and standards applicable to the site-specific Yard criteria. Therefore, secondary pump curve tests and flow tests will be in accordance with National Fire Protection Association (NFPA) 20, "Standard for the Installation of Stationary Pumps for Fire Protection."

- NAPS COL 9.5.1-4-A Piping and Instrumentation Diagrams

The applicant provided additional information in NAPS COL 9.5.1-4-A to address DCD COL Item 9.5.1-4-A. The applicant provided Figures 9.5-201, 9.5-202 and 9.5-203 depicting the site-specific firewater supply piping.

- STD COL 9.5.1-5-A Fire Barriers

The applicant provided additional information in STD COL 9.5.1-5-A to address DCD COL Item 9.5.1-5-A. The applicant stated that the mechanical and electrical penetration seals are qualified to RG 1.189 through testing by an independent laboratory. Certification test results will be available for review at least 6 months before receipt of fuel.

- STD COL 9.5.1-6-A Smoke Control

The applicant provided additional information in STD COL 9.5.1-6-A to address DCD COL Item 9.5.1-6-A. The applicant stated that the procedures for manual smoke control will be developed as part of the Fire Protection Program implementation. The program will be operational for areas storing new fuel prior to receipt of the fuel. Other elements of the Fire Protection Program will be operational before initial fuel load.

- STD COL 9.5.1-7-A Fire Hazards Analysis (FHA) Compliance Review

The applicant provided additional information in STD COL 9.5.1-7-A to address DCD COL Item 9.5.1-7-A. The applicant stated that the compliance review of the as-built design against the assumptions and requirements stated in the FHA will be completed in accordance with the milestone schedule in FSAR Section 13.4. ESBWR DCD, Revision 10 includes the specific items to be reviewed.

- STD COL 9.5.1-8-A Fire Protection Program Description

The applicant provided additional information in STD COL 9.5.1-8-A to address DCD COL Item 9.5.1-8-A. The applicant stated that the Fire Protection Program elements necessary to support receipt and storage of fuel onsite for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area are fully operational prior to receipt for new fuel. The remaining required elements of the Fire Protection Program will be fully operational prior to initial fuel load per FSAR Section 13.4.

- NAPS COL 9.5.1-10-A Fire Brigade

The applicant provided additional information in NAPS COL 9.5.1-10-A to address DCD COL Item 9.5.1-10-A. The applicant stated that the fire brigade will be implemented in accordance with the milestones in FSAR Section 13.4 for the Fire Protection Program.

- STD COL 9.5.1-11-A Quality Assurance

The applicant provided additional information in STD COL 9.5.1-11-A to address DCD COL Item 9.5.1-11-A. The applicant stated the following:

“Quality assurance controls are applied to the activities involved in the design, procurement, installation, and testing and the administrative controls of FPS, in accordance with the measures outlined in Chapter 17.

For the operational fire protection program, the Quality Assurance Program implements the requirements of RG 1.189 through site-specific administrative controls procedures. The procedures will be developed six months before fuel receipt and will be fully implemented prior to fuel receipt.”

- NAPS COL 9A.7-1-A Yard Fire Zone Drawings

The applicant provided additional information in STD COL 9A.7-1-A to address DCD COL Item 9A.7-1-A. STD COL 9A.7-1-A provides Yard fire zone drawings for the site-specific portions of the Yard.

- NAPS COL 9A.7-2-A Detailed Fire Hazards Analysis of the Yard

The applicant provided additional information in STD COL 9A.7-2-A to address DCD COL Item 9A.7-2-A. NAPS COL 9A.7-2-A commits to performing a detailed FHA of the Yard area that is outside the scope of the certified design.

#### Supplemental Information

- NAPS SUP 9.5.1-1 and NAPS SUP 9A-01 Codes, Standards and Regulatory Guidance

The applicant provided Table 9.5-201 to supplement DCD Table 9.5-1 for those portions of the Fire Protection Program that are not addressed in the ESBWR DCD and for operational aspects of the fire detection and suppression systems.

- STD SUP 9.5.1-3 Combustible and Ignition Source Controls

The applicant revised FSAR Section 9.5.1.15.6 to add combustible and ignition source controls for areas adjacent to the main control room (MCR) and in computer rooms that are not part of the MCR complex and prohibit storage of transient combustibles below the raised floor in the MCR complex and prohibit the storage of hazardous chemicals in areas that contain or expose equipment important to safety.

#### **9.5.1.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the Fire Protection Program and the associated acceptance criteria are given in SRP Section 9.5.1.

The applicable regulatory requirements for the Fire Protection Program are as follows:

- 10 CFR 50.48(a), “Fire protection,”
- 10 CFR Part 50 Appendix A, GDC 3, “Fire protection,”
- 10 CFR Part 50 Appendix A, GDC 5
- 10 CFR Part 50 Appendix A, GDC 19, “Control Room,”



- 10 CFR Part 50 Appendix A, GDC 23, “Protection system failure modes,”
- RG 1.189, Revision 2

In addition to the regulatory requirements and guidance provided above, SRP Section 9.5.1 provides enhanced fire protection criteria for new reactor designs, as documented in SECY-90-016, “Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements,” dated January 12, 1990; SECY-93-087, “Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs,” dated April 2, 1993; and SECY-94-084. SECY-90-016 provides enhanced fire protection criteria for evolutionary LWRs. SECY-93-087 recommends that the enhanced criteria be extended to include passive reactor designs. The Commission approved SECY-90-016 and SECY-93-087 in staff requirements memoranda. SECY-94-084, in part, provides criteria defining safe-shutdown conditions for passive LWR designs.

#### **9.5.1.4 Technical Evaluation**

As documented in NUREG–1966, the staff reviewed and approved Section 9.5.1 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.5.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the FPS.

The staff reviewed the information in the COL FSAR as follows:

The staff reviewed the relevant information in the COL FSAR and the applicant’s responses to RAI letters accordingly and concludes that the relevant information in the COL and Supplemental Information Items, and responses to RAIs is acceptable and meets the requirements of GDC 3, 5, 19 and 23 of Appendix A to 10 CFR Part 50, 10 CFR 50.48 and is in conformance with SECY-90-016, SECY-93-087 and SECY-94-084 as shown below:

North Anna 3 conforms to the SRP Section 9.5.1 acceptance criteria with the following exceptions:

- SRP Acceptance Criterion 1 (RG 1.174, Revision 1 – PRA Insights) does not apply to North Anna 3. PRA has not been applied to the design of the plant-specific Fire Protection Program.
- SRP Acceptance Criterion 2 (RG 1.188, Revision 1 – License Renewal) and 4 (RG 1.191 – Decommissioning) are not applicable to the North Anna 3 COLA.
- SRP Acceptance Criterion 3 (RG 1.189, Revision 1 – Fire Protection): North Anna 3 conforms except that the site executive in charge of construction (Vice President – Nuclear Development) is in charge of fire protection during construction as described in North Anna 3 COL FSAR, Revision 7, Table 1.9-202 and Section 13.1.

- SRP Acceptance Criterion 5 (RG 1.206, Regulatory Position C.III.1, Section C.I.9.5.1 – Fire Protection Program): North Anna 3 conforms to the nine requirements listed in Section C.I.9.5.1 as per North Anna 3 COL FSAR, FSAR, Revision 8, Section 9.5.1, Appendix 9A, Appendix 9B, Section 13.1.1.2.1, Section 13.1.1.2.10, Section 13.1.1.3.2.2.4, and Section 13.1.2.1.1. See also the RAI technical evaluations shown below.
- SRP Acceptance Criterion 6 (SECY-90-016, SECY-93-087, and SECY-94-084): North Anna 3 conforms as per North Anna 3 COL FSAR, Revision 8, Table 1.9-201 and the technical evaluation below for RAI 09.05.01-16 and STD COL Item 9.5.1-6-A.
- SRP Acceptance Criterion 7 implementation milestones: North Anna 3 does not conform to the requirement for the Fire Protection Program to be fully implemented prior to fuel receipt at the plant site. North Anna 3 will use a two tier approach such that the elements of the Fire Protection Program necessary to support receipt and storage of fuel onsite for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area are fully operational prior to receipt for new fuel. Other required elements of the Fire Protection Program described in this FSAR section are fully operational prior to initial fuel loading per FSAR Section 13.4.

The staff reviewed the relevant information in the COL FSAR:

COL Item

- NAPS COL 9.5.1-1-A Secondary Firewater Storage Source

The staff reviewed NAPS COL 9.5.1-1-A related to secondary firewater sources included under Section 9.5.1.4 of the North Anna 3 COL FSAR, Revision 8. The staff determined that the volume of the secondary firewater source, identified to be Lake Anna, is well in excess of the 550,000 gallons minimum specified in ESBWR DCD, Revision 10. The staff therefore finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- NAPS COL 9.5.1-2-A Secondary Firewater Capacity

The staff reviewed NAPS COL 9.5.1-2-A related to secondary firewater capacity included under Section 9.5.1.4 of the North Anna 3 COL FSAR, Revision 8. The staff determined that each secondary fire pump will be tested to show that each pump can supply a minimum of 2,130 gpm with sufficient discharge pressure to develop a minimum of 107 psig line pressure at the Turbine Building/Yard interface boundary which is the same as the DCD requirement. This test cannot be performed until the system is built. This activity will be completed prior to fuel receipt. DCD Section 14.2.8.1.39, which is incorporated by reference, states that FPS tests are in accordance with the criteria in codes and standards listed in Table 9.5-1 and by FSAR Table 9.5-201. Therefore, secondary pump curve tests and flow test will be in accordance with NFPA 20. Accordingly, the staff finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- NAPS COL 9.5.1-4-A Piping and Instrumentation Diagrams

The staff reviewed NAPS COL 9.5.1-4-A related to the site-specific simplified piping and instrumentation diagrams included under Section 9.5.1 of the North Anna 3 COL FSAR,

Revision 8. The staff reviewed Figures 9.5.201, 9.5.202, and 9.5.203 of the North Anna 3 COLA and DCD Figure 9.5.1, and determined that these figures do provide simplified diagrams of the site-specific firewater piping as requested by the DCD. The staff requested in RAI 09.05.01-17 dated July 27, 2008 (ADAMS Accession No. ML082100346), the applicant to include all the appropriate fire water loads of the plant in these figures. The applicant responded to RAI 09.05.01-17 dated September 4, 2008 (ADAMS Accession No. ML082530448), clarifying a few inconsistencies between these figures in the ESBWR DCD and the North Anna 3 FSAR COL. Included in the response was a clarification that North Anna 3 does not have a dedicated warehouse but will utilize the existing warehouse buildings that support North Anna 1 and 2. The North Anna 3 sharing of the Units 1 and 2 existing warehouse buildings does not adversely affect the Fire Protection Program at North Anna 3 because there is no equipment important to safety and in use located in these structures. The staff finds that North Anna 3 COL FSAR, Revision 7 fully addresses this COL information item.

- STD COL 9.5.1-5-A Fire Barriers

The staff reviewed NAPS COL 9.5.1-5-A related to the qualification of fire barriers included under Section 9.5.1.10 of the North Anna 3 COL FSAR, Revision 8. The staff determined that mechanical and electrical penetration seals and electrical raceway fire barrier systems will be qualified to the requirements delineated in RG 1.189 by a recognized testing laboratory in accordance with the applicable guidance of NFPA 251, "Standard Methods of Tests of Fire Resistance of Building Construction and Materials," and/or American Society for Testing and Materials (ASTM) E-119, "Standard Test Methods for Fire Tests of Building Construction and Materials." Detailed design in this area is not complete. Specific design and certification test results for penetration seal designs and electrical raceway fire barrier systems will be available for inspection at least 6 months prior to fuel receipt. The staff therefore finds that North Anna 3 COL FSAR, Revision 8, fully addresses this COL information item.

- STD COL 9.5.1-6-A Smoke Control

The staff reviewed STD COL 9.5.1-6-A related to manual smoke control included under Section 9.5.1.11 of the North Anna 3 COL FSAR, Revision 8. The staff determined that procedures for manual smoke control will be developed as part of the Fire Protection Program implementation in accordance with milestones in FSAR Section 13.4. Smoke removal provisions are in accordance with NFPA 804, "Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants," except Sections 8.4.3 (3) and 8.4.3.2 as per the DCD. NFPA 804 has not been endorsed by the NRC but is considered acceptable where it does not conflict with regulatory requirements and guidance. The staff in RAI 09.05.01-3 dated June 11, 2008 (ADAMS Accession No. ML081630351) requested that the applicant should specify the appropriate NRC regulatory requirements and guidance when conflicts exist with NFPA 804. The applicant's response to RAI 09.05.01-3 dated July 23, 2008 (ADAMS Accession No. ML082140230) stated that should a conflict exist between RG 1.189 and NFPA 804, the North Anna 3 COLA conforms to RG 1.189. Automatic sprinkler protection is provided where applicable to limit heat and smoke generation as per the DCD. The staff noted that the North Anna 3 COL FSAR did not provide enough information regarding the enhanced fire protection requirements for new reactors found in SECY 90-016 and SECY 93-087. Specifically, the requirement related to the mitigation of the spread of smoke, hot gases, and fire suppressants from the fire-affected safety division to any non-fire-affected safety division. The staff requested additional information describing how the FHA will evaluate the potential for the migration of smoke, hot gases, or fire suppressant to prevent safe shutdown and will verify that



Section 13.4 for the Fire Protection Program. The staff accepts North Anna 3's fire brigade implementation milestones as given in Section 13.4 since they will provide appropriate protection consistent with the plant's completion schedule. Additionally, the fire brigade requirements are incorporated by reference to the DCD. The staff finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- STD COL 9.5.1-11-A Quality Assurance

The staff reviewed STD COL 9.5.1-11-A related to implementation of the QA program included under Section 9.5.1 of the North Anna 3 COL FSAR, Revision 8. The staff determined that the QA controls for activities involved in the design, procurement, installation, and testing and administrative controls of FPS for safety-related areas is in accordance with the measures outlined in Chapter 17. The applicant's response to RAI 09.05.01-11 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to safety-related areas, QA controls will be applied to fire protection for nonsafety-related areas, consistent with FSAR Appendix 17BB. This includes areas with nonsafety-related SSCs that are significant contributors to plant safety. For the operational Fire Protection Program, the QA Program implements the requirements of RG 1.189 through site-specific administrative controls procedures. These operational QA procedures will be developed 6 months prior to fuel receipt and will be fully implemented prior to fuel receipt. The staff accepts North Anna 3's fire protection QA program milestones since they will provide appropriate protection consistent with the plant's completion schedule. The staff finds that North Anna 3 COL FSAR, Revision 7 fully addresses this COL information item.

- NAPS COL 9A.7-1-A Yard Fire Zone Drawings

The staff reviewed STD COL 9A.7-1-A related to site Yard fire zone drawings included under Appendix 9A of the North Anna 3 COL FSAR, Revision 7. The staff reviewed the revised Yard fire zone drawings, Figures 9A.2-201 through 9A.2-206, and the information in Section 9A.4.7, and determined that the site-specific Yard fire zones have been included as needed and reflect design evolution changes unrelated to fire protection, and added missing information. The staff finds that North Anna 3 COL FSAR, Revision 7 fully addresses this COL information item (see also NAPS COL 9.5.1-4-A evaluation above).

- NAPS COL 9A.7-2-A Detailed Fire Hazards Analysis of the Yard

The staff reviewed STD COL 9A.7-2-A related to site detailed FHA included under Appendix 9A of the North Anna 3 COL FSAR, Revision 7. The staff reviewed the information in Sections 9A.4.7, 9A.5.7, 9A.5.8, 9A.5.9, and 9A.5.12 and determined that the detailed FHA of the plant areas that are outside the scope of the certified design will be completed 6 months prior to fuel load. The staff accepts North Anna 3's site-specific FHA milestones since they will provide appropriate protection consistent with the plant's completion schedule. The staff finds that North Anna 3 COL FSAR, Revision 8, fully addresses this COL information item.

#### Supplemental Information

- NAPS SUP 9.5.1-1 and 9A-01 Codes, Standards and Regulatory Guidance

The staff reviewed NAPS SUP 9.5.1-1 and NAPS SUP 9A-01 related to the codes and standards included under Section 9.5.1 and Appendix 9A of the North Anna 3 COL FSAR,

Revision 7. The staff determined that revised Table 9.5-201 added the codes and standards that are applicable for those portions of the Fire Protection Program outside the scope of the DCD and for the operational aspects of the Fire Protection Program. Section 9.5.1.15.1, Fire Protection Program Criteria, of the North Anna 3 COL FSAR also utilized Table 9.5-201 to supplement DCD Table 9.5-1. These added codes and standards are acceptable for North Anna 3 since the NFPA standards listed are referenced in RG 1.189; the Virginia Statewide Building Code is a local code that is required to be met by North Anna 3; Environmental Protection Agency standards are Federal standards that apply to North Anna 3; and the ASME Code, Section IX is approved for use by the NRC; where applicable. Additionally, two footnotes were removed from DCD Table 9.5-2 that do not apply to the North Anna 3 COLA.

- NAPS SUP 9.5.1-1 Primary and Secondary Firewater Source

The staff reviewed NAPS SUP 9.5.1-1 related to the water treatment of the primary and secondary firewater sources under Section 9.5.1.4 of the North Anna 3 COL FSAR, Revision 8. The staff determined that revised Section 9.5.1.4 under FSAR, Revision 7, changed the firewater treatment chemical for the primary fire source to Hydrogen Peroxide. The Hydrogen Peroxide is injected into the discharge side of the PWSS pumps which draws water from Lake Anna and then supplies the treated water to various areas of the plant including filling of the primary firewater storage tanks. The secondary firewater source is treated using Hypochlorite. The Hypochlorite is injected into the discharge side of the secondary fire pumps located in the Station Water Intake Building. The staff was concerned about the non-filtering of the secondary water source; however, the applicant stated that although strainers are used, filtering is not required because of the small amount of total suspended solids in the lake water. Based on the water quality requirements with NFPA 13, "Standard for Installation of Sprinkler Systems," and the applicant's maintenance program for maintaining the fire water at an acceptable level, the staff finds the use of strainers and chemical cleaning agents sufficient to maintain the water quality. The staff determined that Hydrogen Peroxide and Hypochlorite are acceptable water treatment agents for fire suppression systems for their ability to combat biofouling and microbiologically induced corrosion. These agents used in conjunction with strainers, and applicable filtering media form an acceptable level of water quality expected in fire suppression systems as per RG 1.189 and applicable NFPA codes.

- STD SUP 9.5.1-3 Combustible and Ignition Source Controls

The staff reviewed revised FSAR Section 9.5.1.15.6 and the applicant's responses to RAIs 09.05.01-5, 6, and 7 to add combustible and ignition source controls for areas adjacent to the MCR and in computer rooms that are not part of the MCR complex and prohibit storage of transient combustibles below the raised floor in the MCR complex and prohibit the storage of hazardous chemicals in areas that contain or expose equipment important to safety. The development of these procedures will be as per North Anna 3 COL FSAR, Section 13.5.

The staff noted that the ESBWR DCD took exception to the RG 1.189 guidance to provide automatic suppression in the rooms adjacent to the MCR. In RAI 09.05.01-5 dated June 11, 2008 (ADAMS Accession No. ML081630351), the staff requested the applicant to describe the program to control the fire hazard presented by paper or other combustible materials, as well as potential ignition sources (e.g., coffee makers) in the MCR complex. The applicant's response to RAI 09.05.01-5 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to the administrative controls described in ESBWR DCD Section 9.5.1.15.6, the North Anna 3 FSAR will be revised to include administrative requirements to specifically control combustible materials and potential ignition sources in rooms adjacent to the MCR. The staff

finds that the response to this RAI is acceptable and that the proposed FSAR revision has been incorporated into the North Anna 3 COL FSAR, Revision 8 as required.

The staff also noted that the ESBWR DCD took exception to the RG 1.189 guidance to providing automatic fire suppression below the raised floor in the MCR complex. In RAI 09.05.01-6 dated June 11, 2008 (ADAMS Accession No. ML081630351), the staff requested the applicant to describe the approach restricting transient combustibles in this area and describe the extent to which cabling below the raised floor will be contained in conduit. The applicant's response to RAI 09.05.01-6 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to the administrative controls described in ESBWR DCD Section 9.5.1.15.6, the North Anna 3 COL FSAR will be revised to prohibit the storage of transient combustibles below the raised floor in the MCR complex. Regarding cables in conduit under the raised floor, the applicant stated that North Anna 3 does not specify any site-specific design criteria outside the scope of the DCD. The staff finds that the response to this RAI is acceptable and that the proposed FSAR revision has been incorporated into the North Anna 3 COL FSAR, Revision 7 as required.

The staff also noted that the ESBWR DCD took exception to the RG 1.189 guidance to providing fixed automatic suppression for computer rooms for computers performing functions important to safety that are not part of the MCR complex. In RAI 09.05.01-7 dated June 11, 2008 (ADAMS Accession No. ML081630351), the staff requested the applicant to describe the program controlling the fire hazard presented by paper or other combustible materials, as well as potential ignition sources in these rooms. The applicant's response to RAI 09.05.01-7 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to the administrative controls described in ESBWR DCD Section 9.5.1.15.6, the North Anna 3 COL FSAR will be revised to include administrative requirements to specifically control combustible materials and potential sources in computer rooms that are not part of the MCR complex. The staff finds that the response to this RAI is acceptable and that the proposed FSAR revision has been incorporated into the North Anna 3 COL FSAR, Revision 7 as required.

The staff finds that the combustible and ignition controls are acceptable and meet the guidance of RG 1.189. The staff also finds that the proposed FSAR revisions have been incorporated into the North Anna 3 COL FSAR, Revision 8 as required.

#### Multiple Spurious Actuations

The staff noted that the application lacked information regarding the assumptions and methodologies that will be used by the applicant to identify, assess, and resolve the potential for multiple spurious actuations that may prevent post-fire safe-shutdown. This is a subject area of great interest, and the NRC published and/or endorsed guidance in this matter. In a staff RAI 09.05.01-2 dated June 11, 2008 (ADAMS Accession No. ML081630351) a question in regards to this issue was submitted to the applicant. The applicant's response to RAI 09.05.01-2 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that GE Hitachi (GEH) will address this issue in a related DCD RAI and that the NRC stated during a July 9, 2008, conference call that the applicant did not need to provide a response to this RAI since GEH was to address this issue. This issue was subsequently addressed in the ESBWR DCD, Revision 10, which includes revised language in Section 9A.2.4 regarding acceptance criteria guidelines for the multiple spurious actuation analysis and resolution methodology. The ESBWR DCD, Revision 10, states the fire hazard analysis will be conducted in accordance with RG 1.189 and NFPA 804. The staff noted that the fire hazard analysis includes a multiple spurious actuation review. The ESBWR DCD states the circuit routing will conform to methodology provided in

Revision 1 of NEI 00-01, "Guidance for Post-Fire Safe Shutdown Analysis," in accordance with Regulatory Issue Summary (RIS) 05-030, "Clarification of Post-Fire Safe-Shutdown Circuit Regulatory Requirements." The ESBWR DCD also states that post-fire safe-shutdown circuit analysis will assume that any spurious actuations associated with a postulated fire occur simultaneously or in rapid succession. The staff finds this methodology acceptable and meets the guidance found in RG 1.189. The staff finds that the response to this RAI and current language of ESBWR DCD, Revision 10 is acceptable and that there are no FSAR changes required. Therefore, this DCD item is resolved and closed.

In RAI 09.05.01-18 dated July 27, 2008 (ADAMS Accession No. ML082100346) Fire Fighting Strategies for MCR Cabinets, the staff noted that the ESBWR DCD took exception to the RG 1.189 guidance to providing smoke detectors in the MCR cabinets and consoles. However, the COL applicant lacked the detailed descriptions of the cabinet design features that would facilitate rapid identification of the specific cabinet/console that is on fire and facilitate rapid access to the cabinets/consoles for firefighting. The applicant's response to RAI 09.05.01-18 dated September 4, 2008 (ADAMS Accession No. ML082530448), stated that the requirements to develop specific firefighting procedures and train fire brigade members are addressed in the ESBWR DCD and in the North Anna 3 COL FSAR. ESBWR DCD, Section 9.5.1.15.5 requires that procedures be developed to, in part, define the strategies established for fighting fires in safety-related areas and areas presenting a hazard to safe shutdown equipment. Strategies for fighting fires in the MCR will be included in these procedures and will address specific cabinet design features, as appropriate. The development of these procedures will be as per North Anna 3 COL FSAR, Table 13.5-202. The staff finds that the response to this RAI is acceptable and that there are no FSAR changes required.

#### **9.5.1.5 Post Combined License Activities**

The applicant identified the following items:

- STD COL 9.5.1-2-A commits to testing each secondary firewater pump prior to fuel receipt to verify it can supply a minimum of 2,130 gpm with a minimum pressure of 107 psig line pressure at the Turbine Building/Yard interface boundary. (see FSAR 9.5.1.4 and 14.2.8.1.39)
- STD COL 9.5.1-5-A commits to having specific design and certification test results for penetration seals and electrical raceway fire barrier systems available for inspection 6 months prior to fuel receipt to address COL Item STD COL 9.5.1-5-A. (see FSAR 9.5.1.10)
- STD COL 9.5.1-6-A commits to establishing procedures for manual smoke control as part of the Fire Protection Program implementation to address COL Item 9.5.1-6-A. The smoke removal provisions will be completed in accordance with the milestone schedule established in FSAR Section 13.4. (see FSAR 9.5.1.11)
- STD COL 9.5.1-7-A commits to performing an as-built design compliance review against the assumptions and requirements stated in the FHA to address COL tem 9.5.1-7-A. The as-built FHA will be completed in accordance with the milestone schedule established in FSAR Section 13.4. (see FSAR 9.5.1.12)



- STD COL 9.5.1-8-A commits to having the Fire Protection Program operational to address COL Item 9.5.1-8-A. The Fire Protection Program elements necessary to support receipt and storage of fuel onsite for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area will be fully operational prior to receipt for new fuel. The remaining required elements of the Fire Protection Program will be fully operational prior to initial fuel load. The Fire Protection Program elements will be operational in accordance with the milestone schedule established in FSAR Section 13.4. (see FSAR 9.5.1.15)
- NAPS COL 9.5.1-10-A commits to providing for fire brigade implementation in accordance with the milestones in FSAR Section 13.4 to address COL Item 9.5.1-10-A. In addition, the applicant's response to RAI 09.05.01-18 commits to developing fire-fighting strategies for the MCR complex along with those procedures discussed in ESBWR DCD, Section 9.5.1.15.5 and in accordance with North Anna 3 COL FSAR, Table 13.5-202. (see FSAR 9.5.1.15.4 and 9.5.1.15.5)

### **9.5.1.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the FPS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the MWS that were incorporated by reference are resolved.

The staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of GDC 3, 5, 19, and 23 of Appendix A to 10 CFR Part 50, 10 CFR 50.48 and is in conformance with RG 1.189, SECY-90-016, SECY-93-087, and SECY-94-084. The staff based this conclusion on the above technical evaluations of the relevant information given in the COL and Supplemental Information Items, and responses to RAIs.

## **9.5.2 Communication Systems**

### **9.5.2.1 Introduction**

This section of the North Anna 3 COL FSAR describes the communication systems which provide interplant communications and plant-to-offsite communications during normal, maintenance, transient, fire, and accident conditions.

### **9.5.2.2 Summary of Application**

Section 9.5.2, "Communication System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.5.2, "Communication System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.5.2.5, the applicant provided the following:

COL Items

- NAPS COL 9.5.2.5-1-A Emergency Notification System

This COL Item requested a description of the Emergency Notification System (ENS). The applicant stated that the information required is addressed in FSAR Section 9.5.2.2.

- NAPS COL 9.5.2.5-2-A Grid Transmission Operator

This COL Item requested a description of the transmission system operator communication link. The applicant stated that the information required is addressed in FSAR Section 9.5.2.2 and in the EP Sections II.F.1.

- NAPS COL 9.5.2.5-3-A Offsite Interfaces (1)

This COL Item requested a description of the means of communication with the MCR, TSC, emergency operations facility (EOF), state and local emergency operation centers and radiological field personnel in accordance with NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 1981 and NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants." The applicant stated that the information required is addressed in FSAR Section 9.5.2.2 and in the EP Sections II.E.1 and II.F.1.

- NAPS COL 9.5.2.5-4-A Offsite Interfaces (2)

This COL Item requested a description of the communication methods from the MCR, TSC, and EOF to the NRC headquarters including establishment of Emergency Response Data Systems (ERDS) in accordance with NUREG-0696. The applicant stated that the information required is addressed in FSAR Section 9.5.2.2 and in the EP Sections II.E.1 and II.F.1.

- NAPS COL 9.5.2.5-5-A Fire Brigade Radio System

This COL Item requested a description of the Fire Brigade Radio System. The applicant stated that the information required is addressed in FSAR Section 9.5.2.2.

### **9.5.2.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966, the FSER for the ESBWR DCD.

In addition, the relevant requirements of the Commission regulations for the communications systems and the associated acceptance criteria are given in SRP Section 9.5.2.

The applicable regulatory requirements for the ENS and prompt communications among principal response organizations and emergency response personnel are as follows:

- 10 CFR Part 50, Appendix E, Part IV.E.9
- 10 CFR 50.47(b)(5) and (b)(6)

The related acceptance criteria are as follows:

- NRC Bulletin (BL) 80-15, "Possible Loss of Emergency Notification System (ENS) with Loss of Offsite Power," June 18, 1980
- NUREG-0696, February 1981.
- NUREG-0654/FEMA-REP-1, Revision 1
- RG 1.189, Section 4.1.7
- GL 91-14, "Emergency Telecommunications," dated September 23, 1991

#### **9.5.2.4 Technical Evaluation**

As documented in NUREG-1966, the staff reviewed and approved Section 9.5.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.5.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the Communication Systems.

The staff examined the EP Sections II.E and II.F which are relevant to the COL Item responses. The detailed review of EP Sections II.E and II.F is reflected in SER Section 13.3, "Emergency Planning." The detailed review of the completely independent radio subsystem for security purposes is reflected in SER Section 13.6, "Physical Security." The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the communications system. The staff reviewed conformance of Section 9.5.2 of the North Anna 3 COL FSAR to the guidance in RG 1.206, Section C.III.1, Chapter 9, C.I.9.5.2, "Communications Systems." The staff's review finds that the applicant appropriately incorporates by reference Section 9.5.2 of the ESBWR DCD, Revision 10.

The ESBWR DCD, Section 9.5.2, "Communications System," lists communications systems that are to provide the means to conveniently and effectively communicate between various parts of the nuclear power plant and with offsite company, governmental, support agencies, and other locations during normal operations, testing and drills, and during maintenance, transient, fire, emergency, and accident conditions under maximum potential noise levels.

In addition, DCD Section 9.5.2 identified site communication systems that are made up of the following subsystems

- Plant page/party-line subsystem;
- Private automatic branch exchange subsystem;
- Plant sound-powered telephone subsystem;
- Plant radio subsystem;
- Evacuation alarm and remote warning subsystem;

- Emergency offsite communication subsystem; and
- Completely independent radio subsystem for security purposes.

DCD Section 9.5.2.1 provides the safety design basis and the power generation design basis while DCD Section 9.5.2.2 provides a summary system description for these site communications except for the completely independent radio subsystem for security purposes that is described in DCD Section 13.6.

The staff reviewed the relevant information in the North Anna 3 COL Part 2: FSAR and examined the relevant information in Part 5: EP, Sections II.E and II.F. The detailed review of the completely independent radio subsystem for security purposes is reflected in SER Section 13.6, "Physical Security," of this SER.

The communications system is considered a nonsafety system, because it serves no safety-related function and the reactor can be shut down without the communications system. However, an adequate communications system is both required by regulation and considered important to overall safety as well as power generation. The subsystems identified above are independent of one another such that a failure in one subsystem does not adversely affect the performance of the other subsystems.

Based on the capability of these communications described in Section 9.5.2, the staff finds the design of the communications system adequately meets the requirements of 10 CFR Part 50, Appendix E, Section IV.E.9, because the multiple communication subsystems provide at least one onsite and one offsite communications system with each system having a backup power source.

### COL Items

- NAPS COL 9.5.2.5-1-A                      Emergency Notification System

The staff reviewed NAPS COL 9.5.2.5-1-A related to the ENS included under Section 9.5.2 of the North Anna 3 COL FSAR. The DCD COL Item 9.5.2.5-1-A states that "The COL applicant will describe the ENS provisions required by 10 CFR 50.47(b)(6) and address recommendations described in BL 80-15." The applicant addressed this Item in Section 9.5.2.5 with departure/supplement NAPS COL 9.5.2.5-1-A in their application by stating, "This COL Item is addressed in Section 9.5.2.2." The staff reviewed the resolution to the DCD COL Item 9.5.2.5-1-A involving the ENS included under Section 9.5.2.2 of the North Anna 3 COLA. In Section 9.5.2.2 under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-1-A)" in the first bullet is replaced by a paragraph labeled "NAPS COL 9.5.2.5-1-A" that describes key features of the ENS.

The regulation at 10 CFR 50.47(b)(6) requires that provisions exist for prompt communications among response organizations to emergency personnel and to the public. The key provisions of NRC BL 80-15 states in part that, "... all extensions of the ENS located at your facility(ies) would remain fully operable from the facility(ies) to the NRC Operations Center in the event of a loss of offsite power to your facility(ies)." The ENS phone lines are fiber-optic phone lines through a telephone utility switch that is located on site in the telephone equipment building. They are routed directly to the local telephone company central office. The normal power source for the ENS telephone utility switch is nonsafety-related station power, which will be lost during a loss of offsite power event. The phone system normal power source is provided with a battery backup that lasts for a period of approximately 8 hours. Through NAPS

COL 9.5.2.5-1-A, North Anna 3 will take action to ensure that the ENS is in compliance with the recommendations of NRC BL 80-15, which is concerned with having a "... safeguards instrumentation bus backed up by automatic transfer to batteries and an inverter or equally reliable power supply." Accordingly, based on the description provided in NAPS COL 9.5.2.5-1-A, and North Anna 3 COLA Part 5, EP, Section F on emergency communications, and the IBR ESBWR DCD, Section 9.5.2, and verification by ITAAC in North Anna 3 COLA Part 10: Table 2.3-1, Section 3.0, the ENS has adequately addressed the recommendations in NRC BL 80-15. As a backup, in addition to the circuits to the local telephone company, a separate Company-owned communication network exists which provides communication between the nuclear power station, the Company system operations center, and the NRC. Based on the above, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-1-A.

- NAPS COL 9.5.2.5-2-A Grid Transmission Operator

The staff reviewed NAPS COL 9.5.2.5-2-A related to the grid transmission operator communications included under Section 9.5.2 of the North Anna 3 COL FSAR. The DCD COL Item 9.5.2.5-2-A states "The COL applicant will describe the voice communication link availability with the grid transmission operator." The applicant addressed this Item in Section 9.5.2.5 with departure/supplement NAPS COL 9.5.2.5-2-A by stating "This COL Item is addressed in Section 9.5.2.2 and EP Section II.F.1. "

The staff reviewed the resolution to the DCD COL Item 9.5.2.5-2-A involving the grid transmission operator communication link included under Section 9.5.2.2 of the North Anna 3 COLA and addressed in EP Section II.F.1. In Section 9.5.2.2 under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-1-A)" in the last bullet is replaced by a paragraph labeled "NAPS COL 9.5.2.5-2-A" that states "Transmission System Operator Communications Link: Voice communications with the grid operator are provided via a Company-owned and maintained fiber optic transmission system that allows telephone communications with the entire Corporate System. Access to this mode of transmission is made via the plant telephone system. A dedicated handset is provided between the Control Room and the power system operator." Further, this mode of communication to the grid transmission operator is backed up by the regular commercial telephone system. The North Anna 3 COLA Part 5: EP, Section II.F.1 states that the applicant maintains reliable, 24-hour per day communications links within the plant and the plant and external emergency response organizations. Based on this, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-2-A.

- NAPS COL 9.5.2.5-3-A Offsite Interfaces (1)

The staff reviewed NAPS COL 9.5.2.5-3-A related to the offsite interfaces included under Section 9.5.2 of the North Anna 3 COL FSAR and examined the EP, Sections II.E and II.F as related to emergency communications. The DCD COL Item 9.5.2.5-3-A states "the COL applicant will describe the means of communication between the control room, TSC, EOF, state and local emergency operation centers and radiological field personnel in accordance with NUREG-0696 and NUREG-0654." The applicant addressed this item with departure/supplement NAPS COL 9.5.2.5-3-A stating, "this COL Item is addressed in Section 9.5.2.2 and EP Sections II.E.1 and II.F.1." In Section 9.5.2.2, under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-3-A)" in the second bullet is replaced with "NAPS COL 9.5.2.5-3-A. The Health Physics Network (HPN) is described in the Emergency Plan." In Section 9.5.2.2, under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-3-A)" in the fourth bullet is replaced with "NAPS COL 9.5.2.5-3-A

The crisis management radio system is part of the plant radio system described in DCD Section 9.5.2.2.” In Section 9.5.2.2, under Emergency Communication Systems, the following is added as an additional bullet after the last bullet “NAPS COL 9.5.2.5-3-A, Insta-Phone System.” The primary method for notification of State and local authorities is the Insta-phone, which is accessible from the MCR, TSC, and EOF. The Insta-phone is described in the Emergency Plan.” The North Anna 3 COLA Part 5: EP, including Sections II.E and II.F, is evaluated in SER Section 13.3, “Emergency Planning.”

In the North Anna 3 COLA Part 5: EP, Section II.E and II.F, the applicant states that systems and procedures needed to provide the capability for 24-hour per day prompt notification to affected Commonwealth of Virginia, risk jurisdiction, and Federal authorities following the declaration of any emergency condition, consistent with emergency classification and action levels, are provided and maintained. The primary notification and communication method is the Insta-phone system, which is accessible from the MCR, TSC, and EOF. Back-up notification and communication is through the commercial telephone network system. Message content and verification methods are established in advance in implementing procedures. Communication systems that allow communications between the site and fixed and mobile medical support facilities are maintained and include both commercial telephone communications with fixed facilities and radio communications to ambulances. Further, the equipment, methods, and procedures for communication are tested and evaluated on a periodic basis through test and drills. For example, communications with the facility and EOF and the Commonwealth of Virginia and risk jurisdiction warning points are tested monthly, while communications between Virginia/risk jurisdiction emergency operating centers and field assessment teams are tested annually. Battery backup or alternate power in the case of the loss of AC power is provided for most subsystems. The North Anna 3 COLA Part 5: EP lists the requirements and the corresponding COLA EP provision where the requirement is addressed. Based on the above and that onsite and offsite emergency communications will be verified by ITAAC described in COLA Part 10: Table 2.3-1, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-3-A.

- NAPS COL 9.5.2.5-4-A                      Offsite Interfaces (2)

The staff reviewed NAPS COL 9.5.2.5-4-A related to the offsite interfaces included under Section 9.5.2 of the North Anna 3 COL FSAR and examined the EP Sections II.E and II.F. The DCD COL Item 9.5.2.5-4-A states “the COL applicant will describe the communication method from the control room, TSC, and EOF to NRC headquarters, including establishment of Emergency Response Data Systems (ERDS) in accordance with NUREG–0696.” The applicant addressed this Item with departure/supplement NAPS COL 9.5.2.5-4-A stating “this COL Item is addressed in Section 9.5.2.2 and EP Sections II.E.1 and II.F.1.” In Section 9.5.2.2, under Emergency Communication Systems, the parenthetical “(COL 9.5.2.5-4-A)” in the third bullet is replaced with “NAPS COL 9.5.2.5-4-A.” Communication from the MCR, TSC, and EOF to NRC headquarters including establishment of ERDS is described in the EP. The North Anna 3 COLA Part 5: EP including Sections II.E and II.F is evaluated in SER Section 13.3, “Emergency Plan.”

In the North Anna 3 COLA Part 5: EP, Section II.F.1, the applicant states that separate telephone lines are dedicated and maintained for communications with the NRC. These include the ENS, the Management Counterpart Link (MCL), the HPN, the Reactor Safety Counterpart Link (RSCL), the Protective Measures Counterpart Link (PMCL), the Local Area Network (LAN) Access, and an ERDS. The ENS lines located in the MCR, TSC, and EOF are used for initial notifications, as well as ongoing information about plant systems, status, and parameters. The MCL lines located in the TSC and EOF provide for internal discussion between the NRC

Executive Team Director and members of his/her team and the NRC site director, or between licensee site management. The HPN lines located in the TSC and EOF provide for communication concerning radiological and meteorological matters. The RSCL lines located in the TSC and EOF provide for internal NRC discussions regarding plant and equipment conditions. PMCL lines located in the TSC and EOF provide for internal NRC discussions on radiological releases, meteorological conditions, and protective measures. The LAN Access with jacks in the TSC and EOF provides access to the NRC LAN. The applicant will take action to ensure that North Anna 3 will have an ERDS that will be activated within 1 hour of the declaration of an Alert or higher emergency classification in accordance with regulations and facility procedures. The North Anna 3 COLA Part 5: EP lists the requirements and the corresponding COLA EP provision where the requirement is addressed. Based on the above and that offsite communication with the NRC including the ERDS between the onsite computer system and the NRC Operations Center will be verified by ITAAC described in COLA Part 10: Table 2.3-1, the staff finds that the applicant has adequately addressed the DCD COL Item 9.5.2.5-4-A.

- NAPS COL 9.5.2.5-5-A Fire Brigade Radio System

The staff reviewed NAPS COL 9.5.2.5-5-A related to the Fire Brigade Radio System included under Section 9.5.2 of the North Anna 3 COL FSAR. The DCD COL Item 9.5.2.5-5-A states “the COL applicant will describe the Fire Brigade Radio System.” The applicant addressed this item with departure/supplement NAPS COL 9.5.2.5-5-A stating “This COL Item is addressed in Section 9.5.2.2.” In Section 9.5.2.2 under Emergency Communication Systems the parenthetical “(COL 9.5.2.5-5-A)” in the fifth bullet is replaced with “NAPS COL 9.5.2.5-5-A. The Fire Brigade Radio System is part of the plant radio system described in DCD Section 9.5.2.2.” The ESBWR DCD, Section 9.5.2.2 described the plant radio system for use during normal and emergency communications within the plants. The plant radio system radios are equipped with multiple channels including a fire brigade channel and an emergency channel, each which can be used as alternate security channels if required. Portable, hand-held radios provide two-way voice communication between the various units for fire brigade members who need mobile communications and communications to communication consoles in selected plant locations including the MCR and remote shutdown rooms. The radio system includes antennas distributed throughout the plant with a centralized rebroadcast transmitter providing communication within the plant and satellite buildings. Lower power portable radios are used with this system to ensure that there is no Electromagnetic Interference with Instrumentation and Control circuits, and operate at frequencies that ensure they do not interfere with the plants instrument and controls distributed control and information systems (DCIS) functions. By using radio equipment equipped with tone-coded squelch communications can be directed to an individual, all-channel (zoned), or all-system calls except the emergency channel is not coded. Capability is provided whereby calls can be made between the telephone system and the in-plant radio system. The power for base stations and consoles is provided by security system power supply backed by batteries and a standby generator. Based on the above, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-5-A.

#### **9.5.2.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.5.2.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the communication systems, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the communication systems that were incorporated by reference are resolved.

In addition, to the extent that an item addresses that portion of the communications system used in intra-plant and plant-to-offsite communications, the staff concludes that the site-specific COL information items discussed in this section of the COL FSAR are acceptable and meet the requirements of 10 CFR Part 50, Appendix E, Section IV.E.9 and 10 CFR 50.47(b)(5) and (b)(6); and guidance in RG 1.189, Regulatory Position 4.1.7. The staff bases its conclusion on the following: (1) The design provides for at least one acceptable onsite and one acceptable offsite communication system, each with a backup power source as described directly through COLA information or information incorporated by reference of the ESBWR DCD; (2) the design provides communications systems with a capability for prompt notification and continuing communication to the NRC; (3) the design provides communications systems with capability for prompt notification and continuing communication with site, local and state response organizations; (4) the design provides a variety of diverse communication systems involving both private links, commercial links, site public address, microwave, facsimiles, and radio with the capability of adequately supporting both normal use and emergency situations; and (5) the nonsafety communication systems do not prevent completion of safety functions.

### **9.5.3 Lighting System**

Section 9.5.3, "Lighting System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.3, "Lighting System" of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.5.3 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Lighting System," that were incorporated by reference have been resolved.

### **9.5.4 Diesel Generator Fuel Oil Storage and Transfer System**

#### **9.5.4.1 Introduction**

This section of the North Anna 3 COL FSAR describes the diesel generator (DG) fuel oil system which stores and transfers fuel oil for the diesel engines that provide standby onsite power. The system for each diesel engine includes a fuel oil storage tank, fuel oil day tank, fuel oil transfer pump, strainers/filters, oil purifier (or tank connections for tying into a purification system), instrumentation, controls, and the necessary interconnecting piping and valves. The ESBWR design provides two sets of DGs – standby diesel generators (SDGs) and ancillary diesel generators (ADGs).



#### **9.5.4.2 Summary of Application**

Section 9.5.4, “Diesel Generator Fuel Oil Storage and Transfer System,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.5.4, “Diesel Generator Fuel Oil Storage and Transfer System,” of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.5.4, the applicant provided the following:

##### COL Items

- STD COL 9.5.4-1-A Fuel Oil Capacity

The applicant provided additional information in STD COL 9.5.4-1-A to address DCD COL Item 9.5.4-1-A. The applicant described the procedural controls in place to ensure that sufficient fuel oil is available onsite to allow each DG to operate continuously for 7 days at its calculated design load.

- NAPS COL 9.5.4-2-A Protection of Underground Piping

The applicant provided additional information in NAPS COL 9.5.4-2-A to address DCD COL Item 9.5.4-2-A. The applicant stated that the underground piping portion of the fuel oil transfer system is made of carbon steel and that it is protected with a waterproof coating and an impressed current cathodic protection system to control external corrosion.

#### **9.5.4.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the Diesel Generator Fuel Oil Storage and Transfer System (DGFOSTS) and the associated acceptance criteria are in SRP Section 9.5.4.

The specific regulatory requirements are as follows:

- GDC 17, “Electric power systems,” requires an onsite electric power system to permit functioning of SSCs important to safety. The SDGs and ADGs are not classified as safety-related. However, since the SDGs and ADGs are RTNSS Criterion B and C systems respectively, availability of both SDGs and ADGs are required according to the Availability Controls Manual (Availability Control Limiting Condition for Operation 3.8.1 and 3.8.2).
- RG 1.137, “Fuel-Oil Systems for Standby Diesel Generators,” provides regulatory guidance with respect to maintaining a 7-day supply of fuel oil and for protection of the system from internal and external corrosion.

#### **9.5.4.4 Technical Evaluation**

As documented in NUREG–1966, the staff reviewed and approved Section 9.5.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.5.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the

information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup>

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the DGFOSTS.

The SDG and ADG are not classified as safety-related. However, since the diesels are RTNSS Criterion B and C systems, availability of both SDG and ADG is required according to the Availability Controls Manual (Availability Control Limiting Condition for Operation 3.8.1 and 3.8.2).

### COL Items

- STD COL 9.5.4-1-A Fuel Oil Capacity

The staff reviewed STD COL 9.5.4-1-A related to the fuel oil capacity included under Section 9.5.4 of the North Anna 3 COL FSAR. DCD COL Item 9.5.4-1-A in Section 9.5.4.6, "COL Information," of the ESBWR DCD specifies that the COL applicant needs to establish procedural controls to ensure a minimum fuel oil capacity is maintained onsite. In FSAR Section 9.5.4.2, "System Description," the applicant addressed DCD COL Item 9.5.4-1-A (STD COL 9.5.4-1-A) by indicating that procedures will be developed in accordance with the milestone and processes described in FSAR Section 13.5, "Plant Procedures." Those procedures will ensure sufficient diesel fuel oil inventory is available onsite so that the DG can operate continually for 7 days. The procedures will ensure that the quantity of DG fuel oil in the fuel oil storage tanks is monitored on a periodic basis and that the diesel fuel oil usage is tracked against planned deliveries. Regular transport will replenish the fuel oil inventory during periods of high demand and ensure continued supply in the event of adverse weather conditions. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.5.4-1A in that the necessary procedures will be developed in accordance with FSAR Section 13.5.

The applicant stated that the procedures will ensure sufficient fuel oil to operate the DGs continually for 7 days. In RAI 09.05.04-2 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to verify that enough fuel oil inventory is available to operate the DGs at continuous maximum rating for 7 days. In their response to RAI 09.05.04-2 dated August 4, 2008 (ADAMS Accession No. ML081760334), the applicant provided an FSAR markup stating that procedures ensure sufficient diesel fuel oil inventory is available onsite so that the SDGs and ADGs can operate continually for 7 days with each operating at its calculated design load, with appropriate margins. The staff found that the term "appropriate margins" is an ambiguous term for use in the FSAR. Therefore the staff requested the applicant in supplemental RAI 09.05.04-7 dated May 6, 2009 (ADAMS Accession No. ML091260337), to specify that the margins are in accordance with American Nuclear Society 59.51-1997, "Fuel Oil Systems for Safety-Related Emergency Diesel Generators."

In response to supplemental RAI 09.05.04-7 dated August 3, 2009 (ADAMS Accession No. ML092180975), the applicant (Dominion) stated that ANS 59.51-1997, "Fuel Oil Systems for Safety-Related Emergency Diesel Generators," is not applicable to the ESBWR nonsafety-related SDGs and ADGs. The applicant updated the North Anna FSAR to describe the sufficient margin for the 7-day fuel oil inventory requirement that accounts for usable fuel in the tank, level instrument uncertainty, and the potential for future load growth. The staff finds this response

acceptable since the 7-day fuel oil inventory is maintained in accordance with RG 1.137 with sufficient margin that is clearly defined in the FSAR. Therefore, this RAI 09.05.04-7 is closed.

The staff evaluated COL Item STD COL 9.5.4-1-A to the relevant NRC regulations and acceptance criteria in SRP Section 9.5.4. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.5.4-1.

- NAPS COL 9.5.4-2-A Protection of Underground Piping

The staff reviewed NAPS COL 9.5.4-2-A related to the protection of underground piping included under Section 9.5.4 of the North Anna 3 COL FSAR. DCD COL Item 9.5.4-2-A in Section 9.5.4.6, "COL Information," of the ESBWR DCD specifies that the COL applicant needs to describe the material and corrosion protection for the underground piping portion of the fuel oil transfer system. In FSAR Section 9.5.4.2, the applicant addressed DCD COL Item 9.5.4-2-A (NAPS COL 9.5.4-2-A) by indicating that the material for the underground piping portion of the fuel oil transfer system is carbon steel and that a corrosion protection system is in place for the internal and external surfaces of piping systems. The buried section of the piping is protected with a waterproof protective coating and an impressed current type cathodic protection is used to control external corrosion.

Section 9.5.4.2 of the DCD states the system will be designed and constructed according to "the latest industry standards for buried pipe including provisions for corrosion protection," but it does not identify the standards to be used. Therefore, the staff asked the applicant to clarify the corrosion protection methods for the internal and external surfaces of buried DG fuel oil piping and identify the applicable industry standards in RAI 09.05.04-6 dated October 20, 2008 (ADAMS Accession No. ML082940356).

The applicant's response to RAI 09.05.04-6 dated December 3, 2008 (ADAMS Accession No. ML083460148), stated a corrosion allowance, rather than a corrosion protection system, is included in the pipe wall thickness to address the possibility of internal corrosion. This is acceptable to the staff because it is a method listed in ASME B31.1, which is the code applicable to this piping system. For the coating and impressed current cathodic protection system for external corrosion control, the applicant stated it would follow the applicable guidance in ASME B31.1 Non-mandatory Appendix IV ("Corrosion Control for ASME B31.1 Power Piping Systems") and American Petroleum Institute (API) Recommended Practice 1632 ("Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems"). The staff finds the API Recommended Practice acceptable because it refers users to National Association of Corrosion Engineers (NACE) RP-0169 and recommends the same corrosion protection criteria contained therein. NACE RP-0169 is the cathodic protection guidance accepted by RG 1.137. ASME B31.1 Appendix IV is an acceptable industry standard for external corrosion control because it addresses underground piping.

Based on the RAIs, the applicant proposed the paragraph below for NAPS COL 9.5.4-2-A. This deletes the reference to a corrosion protection system for the internal surface and adds a sentence to identify piping as the only underground component:

The only underground component of the SDGs fuel oil storage and transfer system is carbon steel piping. A corrosion protection system consistent with the guidance contained in ASME B31.1, Power Piping Code, Nonmandatory Appendix IV, Corrosion Control for ASME B31.1 Power Piping Systems, and American Petroleum Institute (API) Recommended Practice 1632 is provided for external surfaces of buried piping systems.

The buried sections of the piping are provided with waterproof protective coating and an impressed current type cathodic protection to control external corrosion.

As discussed above, the corrosion control methods and industry standards applied to the buried piping are appropriate and meets the industry acceptance criteria as stated. Since the applicant included this statement in its FSAR, Revision 8, the staff considers this issue and RAI closed.

#### **9.5.4.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **9.5.4.6 Conclusions**

The staff's finding related to information incorporated by reference is in NUREG-1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the DGFOSTS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the DGFOSTS that were incorporated by reference are resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 9.5.4, and other NRC regulatory guides. The staff's review concludes that the applicant's information in this section of the COL FSAR is acceptable and meets the requirements of GDC 17 and RG 1.137. The staff also finds that the applicant has satisfactorily addressed DCD COL Items 9.5.4-1-A and 9.5.4-2-A.

### **9.5.5 Diesel Generator Jacket Cooling Water System**

Section 9.5.5, "Diesel Generator Jacket Cooling Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.5, "Diesel Generator Jacket Cooling Water System" of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.5.5 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator jacket cooling water system, that were incorporated by reference have been resolved.

### **9.5.6 Diesel Generator Starting Air System**

Section 9.5.6, "Diesel Generator Starting Air System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.6, "Diesel Generator Starting Air System" of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.5.6 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator starting air system, that were incorporated by reference have been resolved.

#### **9.5.7 Diesel Generator Lubrication System**

Section 9.5.7, "Diesel Generator Lubrication System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.7, "Diesel Generator Lubrication System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.5.7 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator lubrication system, that were incorporated by reference have been resolved.

#### **9.5.8 Diesel Generator Combustion Air Intake and Exhaust System**

Section 9.5.8, "Diesel Generator Combustion Air Intake and Exhaust System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.8, "Diesel Generator Combustion Air Intake and Exhaust System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG-1966, the staff reviewed and approved Section 9.5.8 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup>

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator combustion air intake and exhaust system, that were incorporated by reference have been resolved.

## References

1. 10 CFR 20.11019(b), "Radiation protection programs."
2. 10 CFR 50.47, "Emergency plans."
3. 10 CFR 50.48, "Fire protection."
4. 10 CFR 50.62, "Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants."
5. 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants."
6. 10 CFR 52.63, "Finality of standard design certification."
7. 10 CFR 52.80, "Contents of applications; additional technical information."
8. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."
9. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
10. 10 CFR Part 50, Appendix A, GDC 1, "Quality standards and records."
11. 10 CFR Part 50, Appendix A, GDC 17, "Electric power systems."
12. 10 CFR Part 50, Appendix A, GDC 19, "Control room."
13. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."
14. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."
15. 10 CFR Part 50, Appendix A, GDC 23, "Protection system failure modes."
16. 10 CFR Part 50, Appendix A, GDC 26, "Reactivity control system redundancy and capability."
17. 10 CFR Part 50, Appendix A, GDC 27, "Combined reactivity control systems capability."
18. 10 CFR Part 50, Appendix A, GDC 3, "Fire protection."
19. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and dynamic effects design bases."
20. 10 CFR Part 50, Appendix A, GDC 44, "Cooling water."
21. 10 CFR Part 50, Appendix A, GDC 45, "Inspection of cooling water system."
22. 10 CFR Part 50, Appendix A, GDC 46, "Testing of cooling water system."
23. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of structures, systems, and components."

24. 10 CFR Part 50, Appendix A, GDC 60, "Control of releases of radioactive material to the environment."
25. 10 CFR Part 50, Appendix A, GDC 61, "Fuel storage and handling and radioactivity control."
26. 10 CFR Part 50, Appendix A, GDC 62, "Prevention of criticality in fuel storage and handling."
27. 10 CFR Part 50, Appendix A, GDC 64, "Monitoring radioactivity releases."
28. 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."
29. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."
30. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."
31. ANS 59.51-1997, "Fuel Oil Systems for Safety-Related Emergency Diesel Generators."
32. ANSI N14.6-1993, "Special Lifting Devices for Shipping Containers Weighing 10000 Pounds (4500 kg) or More."
33. ANSI/ASME B30.10-2009, "Hooks."
34. ANSI/ASME B30.11-2010, "Monorails and Underhung Cranes."
35. ANSI/ASME B30.16-2007, "Overhead Hoists (Underhung)."
36. ANSI/ASME B30.2-2005, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)."
37. ANSI/ASME B30.9-2006, "Slings."
38. API Recommended Practice 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," Third Edition, January 1, 1996.
39. ASHRAE, "2005 ASHRAE Handbook - Fundamentals - I-P Units," 2005.
40. ASHRAE, "2009 ASHRAE Handbook - Fundamentals," 2009.
41. ASME B31.1, "Non-mandatory Appendix III, Rules for Nonmetallic Piping and Piping Lines with Nonmetals."
42. ASME B31.1-2004, "Power Piping."
43. ASME B31.3-2002, "Process Piping."
44. ASME Boiler and Pressure Code (BPVC).
45. ASME BPVC, Section III, "Rules for Construction of Nuclear Facility Components," 2001 Edition, 2003 Addenda.

46. ASME BPVC, Section XI, "Rules for In-service Inspection of Nuclear Power Plant Components," 2001 Edition, 2003 Addenda.
47. ASME NQA-1-1994, "Quality Assurance Requirements for Nuclear
48. ASME OM Code-2001 including Addenda through 2003, "Code for Operation and Maintenance of Nuclear Power Plants."
49. ASME OM-S/G-2003, "Standards and Guides for Operation and Maintenance of Nuclear Power Plants."
50. ASME Section VIII, "Rules for Construction of Pressure Vessels," 2001 Edition, 2003 Addenda.
51. ASME, BPVC, Section VIII, "Rules for Construction of Pressure Vessels," Division 1, 2001 Edition, 2003 Addenda.
52. ASTM E119, "Standard Test Methods for Fire Tests of Building Construction and Materials," 2010.
53. EPRI, NP-4947-SR, "BWR Hydrogen Water Chemistry Guidelines," Revised 1987.
54. EPRI, NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations," Revised September 1987.
55. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).
56. ICC IBC (2003), the International Building Code Chapter 16, "Structural Design," applies for seismic capability.
57. IEEE Std 344-1987, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."
58. NACE RP0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems"; reaffirmed as Standard Practice (SP) 0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," 2007.
59. NEI 00-01, Revision 3, "Guidance for Post-Fire Safe Shutdown Circuit Analysis, " October 2011 (ADAMS Accession No. ML112910147).
60. NEI 06-13A, Revision 2, "Template for an Industry Training Program Description," March 2009 (ADAMS Accession No. ML090910554).
61. NEI 09-14, Revision 1, "Guideline For The Management Of Underground Piping And Tank Integrity," December 2010 (ADAMS Accession No. ML110700122).
62. NFPA 13, "Standard for Installation of Sprinkler Systems," 2013.
63. NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection," 2010.
64. NFPA 251, "Standard Method of Tests of Fire Resistance of Building," 2006.



65. NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials," 2008.
66. NFPA 804, "Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants," 2006.
67. NRC BL 80-15, "Possible Loss of Emergency Notification System (ENS) with Loss of Offsite Power," June 18, 1980 (ADAMS Accession No. ML031210543).
68. NRC BTP SPLB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," 2003 (ADAMS Accession No. ML070660454).
69. NRC GL 1989-013, "Service Water System Problems Affecting Safety-Related Equipment," July 18, 1989 (ADAMS Accession No. ML031150348).
70. NRC GL 1991-014, "Emergency Telecommunications," September 23, 1991 (ADAMS Accession No. ML031140150).
71. NRC RG 1.137, Revision 2, "Fuel Oil Systems For Emergency Power Supplies," (ADAMS Accession No. ML12300A122).
72. NRC RG 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," March 1997, (ADAMS Accession No. ML003761662).
73. NRC RG 1.174, Revision 1, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," May 2011, (ADAMS Accession No. ML100910008).
74. NRC RG 1.188, Revision 1, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses," September 2005, (ADAMS Accession No. ML051920430).
75. NRC RG 1.189, Revision 2, "Fire Protection for Operating Nuclear Power Plants," October 2009 (ADAMS Accession No. ML092580550).
76. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).
77. NRC RG 1.27, Revision 2, "Ultimate Heat Sink for Nuclear Power Plants (for Comment)," January 1976. (ADAMS Accession No. ML003739969).
78. NRC RG 1.29, Revision 4, "Seismic Design Classification," March 2007 (ADAMS Accession No. ML070310052).
79. NRC RIS 05-030, "Clarification of Post-Fire Safe-Shutdown Circuit Regulatory Requirements," December 20, 2005 (ADAMS Accession No. ML053360069).
80. NRC RIS 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads," May 29, 2007 (ADAMS Accession No. ML071210434).

81. NRC SECY-90-016, "Evolutionary Light-Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," January 12, 1990 (ADAMS Accession No. ML003707849), and the related SRM, dated June 26, 1990 (ADAMS Accession No. ML003707885).
82. NRC SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," April 2, 1993 (ADAMS Accession No. ML003708021), and the related SRM, dated July 21, 1993 (ADAMS Accession No. ML003708056).
83. NRC SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs," March 28, 1994 (ADAMS Accession No. ML003708068), and the related SRM, dated June 30, 1994 (ADAMS Accession No. ML003708098).
84. NRC SECY-95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084)," May 22, 1995 (ADAMS Accession No. ML003708005), and the related SRM, dated June 28, 1995 (ADAMS Accession No. ML003708019).
85. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).
86. NRC Staff NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36," July 1980 (ADAMS Accession No. ML070250180).
87. NRC Staff NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980 (ADAMS Accession No. ML 040420012).
88. NRC Staff NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980 (ADAMS Accession No. ML040420012).
89. NRC Staff NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 28, 1981 (ADAMS Accession No. ML051390358).
90. NRC Staff NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 28, 1981. (ADAMS Accession No. ML051390358.) NRC TSTF-419, "Analysis of NRC Position Regarding TSTF-363, 408, and 419," September 9, 2001 (ADAMS Accession No. ML012690166).
91. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).
92. NUMARC 93-01, Revision 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," April 1996 (ADAMS Accession No. ML101020415).

93. VUSBC (Virginia Statewide Building Code), July 14, 2014 incorporates by reference the IBC (2003).