11.0 RADIOACTIVE WASTE MANAGEMENT

The radioactive waste management systems (RWMS) are designed to control, collect, handle, process, store, and dispose of liquid, gaseous, and solid wastes that may contain radioactive materials. The systems include the instrumentation used to monitor and control the release of radioactive effluents and wastes and are designed for both normal operations (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; in-service inspection; and calibration) and anticipated operational occurrences (AOOs) (activities such as loss of power to all recirculation pumps, tripping of the turbine generator set, isolation of the main condenser, and loss-of-offsite power).

11.1 Source Terms

This section of the North Anna 3 combined license (COL) final safety analysis report (FSAR) addresses sources of radioactivity that are generated within the core and have the potential of leaking into the reactor coolant system during normal operation, including an AOO, by way of defects in the fuel cladding. There are two types of source terms for the reactor primary coolant and steam. The first addresses the design basis, and the second describes the anticipated average concentrations in reactor coolant and steam over the life of a boiling-water reactor.

Section 11.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference with no departures or supplements Section 11.1, "Source Terms," of Revision 10 of the design control document (DCD) for the economic simplified boiling-water reactor (ESBWR), referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants". The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the application and checked the referenced DCD to ensure that no issues relating to this section remained for review.[1] The NRC staff's review confirmed that there are no outstanding issues 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 source term have been resolved.

11.2 Liquid Waste Management System

11.2.1 Introduction

The liquid waste management system (LWMS) is designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as a result of normal operations, including AOOs. The LWMS is designed to reduce and control radioactive releases into the environment. The LWMS is comprised of four types of major subsystems that are permanently installed equipment connected to other plant equipment, thus permitting liquid wastes from various plant systems to be segregated and processed separately:

1) equipment (low conductivity) drain subsystem;
2) floor (high conductivity) drain subsystem;
3) chemical drain subsystem; and

[1] See *"Finality of Referenced NRC Approvals"* in Section 1.2.2 of the safety evaluation report (SER), for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

4) detergent drain subsystem.

The LWMS processing subsystems rely on mixed bed demineralizers, charcoal filters and beds and cartridge filters, reverse osmosis, and organic and neutralization treatments. Cross-connections between radwaste subsystems provide additional flexibility in processing wastes by alternate methods and provide redundancy if one subsystem is inoperative. The LWMS is located in the radwaste building (RWB). The LWMS is designed to process the maximum design basis input in one week, assuming a 40-hour work week, or processing one tank of liquid waste in one operating shift. Releases from the LWMS are conducted as each batch releases through a single liquid waste discharge line. The LWMS is equipped with radiation monitoring instrumentation that automatically terminates effluent releases if radioactivity levels in discharges exceed effluent concentration limits (ECLs) under 10 CFR Part 20. The system provides for sampling at several process points, administrative controls, and detection and alarm of abnormal conditions against accidental discharges in the environment. Radioactive liquid wastes are collected in various collection tanks located within the auxiliary building (A/B) and reactor building (R/B). Airborne releases from LWMS components (e.g., tanks) and ventilation exhaust systems servicing radiologically controlled areas are conducted through the radioactive waste vent stack, which is evaluated in Subsection 11.3.4 of this safety evaluation report.

11.2.2 Summary of Application

Section 11.2 of the North Anna 3 COL FSAR incorporates by reference Section 11.2 of the ESBWR DCD, Rev. 10. In addition, in FSAR Section 11.2 and Part 7, "Departures Report," the applicant provided the following departures, exemptions, and supplements.

Exemption and Tier 1 and Tier 2 Departures

- Exemption 4: Design Of The Cooling Tower Blow-Down Line

The applicant proposed a site-specific Tier 1 DCD departure from DCD Tier 1, Section 2.10.1, "Design Description," in regards to the design of the cooling tower blow-down line.

- NAPS DEP 12.3-1 Liquid Radwaste Effluent Discharge Piping Flow Path

This departure will change the North Anna 3 liquid effluent discharge pathway description to the environment as described in the DCD as Tier 2 information. The liquid effluent discharges from the LWMS to the environment will use only the liquid radioactive waste effluent discharge pipeline and not discharge the processed liquid effluent into the cooling tower blowdown line and then on to the environment. This departure will simplify design and construction of the cooling tower blowdown line.

COL Items

- STD COL 11.2-1-A Implementation of Inspection and Enforcement (IE) Bulletin 80-10

This COL item addresses LWMS subsystem interfaces and connections that are considered nonradioactive but that could later become radioactive through improper interfaces with radioactive systems, as described in the guidance and information in Inspection and

Enforcement (IE) Bulletin 80-10, “Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release to Environment,” dated May 6, 1980.

- STD COL 11.2-2-A Implementation of 10 CFR 20.1406

This COL item addresses compliance with 10 CFR 20.1406, “Minimization of Contamination,” as it relates to the design and operational procedures of LWMS treatment subsystems. In Subsection 11.2.2.3 of the North Anna 3 COL FSAR, the applicant provided additional information identifying various sections of the FSAR (Sections 12.3, 13.5, 12.4, and 12.5) that address how to comply with the requirements of 10 CFR 20.1406.

Supplemental Information

- NAPS SUP 11.2-1 Implementation of Section II.D of Appendix I to10 CFR Part 50 (Cost-Benefit Analysis)

Section 11.2.1 of the North Anna 3 COL FSAR provides plant-and site-specific cost-benefit analysis. The cost-benefit analysis is based on the guidance of Regulatory Guide (RG) 1.110, “Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (for Comment),” issued in March 1976. RG 1.110 describes the results that demonstrate compliance with the as low as is reasonably achievable (ALARA) cost-benefit requirements in Section II.D of Appendix I, “Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion As Low as is Reasonably Achievable for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents,” to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities”. The supplemental information presents a cost-benefit analysis demonstrating that any augmentation of the LWMS treatment subsystem is not cost beneficial. The applicant provided additional information regarding the cost parameters used to determine the total annual cost for the lowest cost systemic augmentation and concluded that no augmentations would be cost beneficial.

- NAPS SUP 11.2-2 Ground Water Protection

In Subsection 11.2.3.2 of the North Anna 3 COL FSAR, the applicant provided supplemental information addressing the monitoring program for the LWMS and plant blowdown underground piping. This supplemental information describes features to reduce the potential for unmonitored and uncontrolled releases to the environment. Nuclear Energy Institute (NEI) 08-08A, “Generic FSAR Template Guidance for Life Cycle Minimization of Contamination,” is also cited as a reference and template for monitoring for leakage downstream of LWMS connections. FSAR Section 12.3.1.5.2 also describes the ground water monitoring program.

- Branch Technical Position 11-6 Postulated Radioactive Releases Due to Liquid-containing Tank Failures

The review of the impacts of an accidental release of radioactive liquids in groundwater or surface water and effects on existing users or likely future users of groundwater or surface water resources is performed using the guidance in SRP Sections 2.4.1, “Hydrologic Description”; 2.4.12, “Groundwater”; and 2.4.13, “Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters”; and information and guidance from Branch Technical Position (BTP) 11-6, “Postulated Radioactive Releases Due to Liquid-containing Tank Failures”. BTP 11-6 provides guidance in assessing, in accordance with 10 CFR 20 concentration limits, a

potential release of radioactive liquids following the postulated failure of a tank and its components, located outside of containment, and impacts of the release of radioactive materials at the nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

- ISG-013 — Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks

Interim Staff Guidance (ISG)-013, issued January 2013, is used for "Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks", for COL Applications. The purpose of this ISG is to clarify previous NRC guidance regarding reviewing the analysis of the radiological consequences of accidental releases of radioactive materials to groundwater and surface water. Such analyses are required as part of the licensing review of application for new nuclear power reactor applications under 10 CFR Part 50 and 10 CFR Part 52. NUREG-0800 (the SRP), Sections 2.4.13 and 11.2, and BTP 11-6, describe acceptable guidance on how to assess the radiological consequences of such releases.

11.2.3 Regulatory Basis

The regulatory basis for information incorporated by reference is in NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," (the Final Safety Evaluation Report (FSER) related to the ESBWR DCD). In addition, the relevant requirements of the Commission regulations for the LWMS, and the associated acceptance criteria, are in Section 11.2 of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," (hereafter referred to as the Standard Review Plan [SRP]).

The staff also followed the guidance in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," issued in June 2007, to evaluate Section 11.2 of the North Anna 3 FSAR for compliance with NRC regulations.

An applicant who seeks to depart from information in Tier 1 of a DCD for a certified standard design must request an exemption, as does an applicant who believes its proposed design need not comply with one or more NRC regulations. Exemptions are submitted pursuant to 10 CFR 52.7 and 52.93 and special circumstances as defined in 10 CFR 50.12(a) must be present.

In particular, the regulatory basis for the acceptance of the COL items and supplementary information on the LWMS appears in the following:

- Appendix B, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage," to 10 CFR Part 20, "Standards for Protection against Radiation";

- 10 CFR 20.1406, "Minimization of contamination";

- 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors";

- Sections II.A and II.D of Appendix I to 10 CFR Part 50;

- 10 CFR Part 52.63(b)(1); and

- 10 CFR Part 52.93, exceptions and variances.

The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:

- ISG-013, NUREG-0800, SRP Sections 2.4.13 and 11.2 with BTP 11-6 address the radiological consequences of an accidental release of radioactive liquid to the environment. The focus and objective of each guidance document, however, is different.

- BTP 11-6, SRP Section 11.2, "Liquid Waste Management System," and BTP 11-6, "Postulated Radioactive Releases Due to Liquid-Containing Tank Failures," as they relate to the assessment of radiological impacts associated with liquid effluent releases.

- RG 1.109, Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," issued October 1977.

- RG 1.110, Revision 1, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors," issued October 2013.

- IE Bulletin 80-10, "Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment," issued May 6, 1980.

- NEI 08-08A, "Nuclear Energy Institute, Generic FSAR Template Guidance for Life Cycle Minimization of Contamination." (ADAMS Accession Nos. ML093220461, ML093220530).

11.2.4 Technical Evaluation

As documented in NUREG-1966, the staff reviewed and approved Section 11.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.2 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 appropriately represents the complete scope of information relating to this review topic[1]. The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to the LWMS.

In addition, the staff reviewed the applicant's proposed resolution to the departures, exemptions, COL items, and supplemental information, in the North Anna 3 COL FSAR Section 11.2 and in the COL Part 7, "Departures Report" as follows.

Exemption and Tier 1 and Tier 2 Departures

- Exemption 4: Design Of The Cooling Tower Blow-Down Line

As permitted by 10 CFR 52.7 and Section VIII.A.4 of the Design Certification Rule, an exemption is requested for certain information described in ESBWR DCD Tier 1, Section 2.10.1, "Design Description." The last sentence of the fourth paragraph states: "The LWMS either returns processed water to the condensate system or discharges to the environment via the circulating water system." This description is revised to: "The LWMS either returns processed water to the condensate system or discharges to the environment using the liquid radwaste effluent discharge pipeline." This departure is included in Section 11.2.3.2. This departure also changes the label in FSAR Figure 11.2-1bR to: "Discharge via Radiation Monitor to Liquid Radwaste Effluent Discharge Pipeline." DCD Section 12.3.1.5.1, "Design Considerations," indicates the "Cooling Tower Blowdown Line" is one of four piping segments designed to contain radioactive materials, will have to run underground, and will be designed to preclude inadvertent or unidentified leakage to the environment. DCD Tier 1 describes the use of the circulating water system for discharge of LWMS effluent. The applicant requests an exemption from DCD Tier 1 information in Part 7 of the COL application (Exemption 4).

The ESBWR DCD Tier 1 Section 2.10.1, describes that the LWMS discharges processed water "to the environment via the circulating water system." This description refers to the expected use of the cooling tower blowdown line in the circulating water system to transfer liquid radwaste effluent to the environment. To simplify the design of the cooling tower blowdown line for North Anna 3, the liquid radwaste effluent discharge pipeline in the LWMS will be designed to not discharge to the cooling tower blowdown line. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB to the environment. As a result, an exemption from ESBWR DCD Tier 1 to revise the discharge piping information for the LWMS was requested by the applicant.

An exemption must be obtained if information proposed in the COL application is inconsistent with one or more NRC regulations. Exemptions are submitted pursuant to 10 CFR 52.7 and 10 CFR 52.93 and must comply with the special circumstances in 10 CFR 50.12(a).

Pursuant to 10 CFR 52.7 and Section VIII.A.4 of the Design Certification Rule, Dominion requests an exemption from ESBWR DCD Tier 1 information. The applicant proposed this exemption to allow Departure 12.3-1. The basic exemption request is to change the last sentence of the fourth paragraph. The sentence reads: "The LWMS either returns processed water to the condensate system or discharges to the environment via the circulating water system". This description would be changed to read: "The LWMS either returns processed water to the condensate system or discharges to the environment using the liquid radwaste effluent discharge pipeline."

This departure refers to the initial expected Tier 1 design of the cooling tower blowdown line in the circulating water system to provide dilution water flow to transfer liquid radwaste effluent to the environment and at the same time decrease the concentration and liquid effluent dose to the environment by maintaining at least a dilution factor of 1000.

The staff in a Request for Additional Information (RAI) 7689, Question 11.02-8, dated November 14, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession Number No. ML14318A620 that the applicant provide information concerning the "independent dilution pump," its location, general procedure for use, interlocks, actuations and capabilities. This information should be able to support and maintain the liquid effluent release dilution factor of 1000 for North Anna 3, with or without the dilution flow from Units 1 and 2. This information should also be described in the FSAR.

In its response to RAI 7689, Question 11.02-8, dated January 8, 2015, (ADAMS Accession No ML15009A235), the applicant stated that the LWMS will be designed to recycle all processed water with a goal to operate North Anna 3 as a zero liquid release plant. Under some conditions such as high water inventory some liquid effluent release may be required (Reference FSAR Section 12.2.2.3). Liquid effluent releases are batch processes that are considered to be infrequent evolutions, and a liquid effluent release from North Anna 3 will be procedurally controlled to occur when adequate dilution flow is available. FSAR Section 11.2.3.2 describes that a release point dilution factor of 1000 (minimum) is maintained, with dilution flow provided by either Units 1 and 2's circulating water system or an independent dilution pump. FSAR Section 11.2.3.2 was written to provide the option to use an alternate dilution method, an independent dilution pump, in the event circulating water flow from Units 1 and 2 was unavailable (e.g., both units shut down and their circulating water systems out of service). However, Dominion does not intend to install an alternate method of providing dilution and will rely on the existing Units 1 and 2 circulating water systems to provide the required dilution flow.

Additionally, in RAI 7677 dated November 14, 2014**,** Question 12.03-55**,** (ADAMS Accession No. ML14318A573) the staff requested additional design information concerning the changes to be made to accommodate the new liquid effluent release point. These questions related to: 1) providing drawings and distances for the routing of the radwaste effluent discharge line, 2) questions on whether the discharge line is accessible for inspection, how much of the line is buried, how it will be monitored for leak detection, 3) the material and diameter of the discharge line, 4) at what point will the dilution in the route of the discharge line be input, 5) what criteria will be used for dilution from the independent dilution pump or the Unit 1 and 2 circulating water system, 6) what design features will be employed to meet the requirements of 10 CFR 20.1406, and 7) clarify the use of in-line components in this radwaste effluent discharge line. These specific items related to the radwaste effluent discharge line are addressed in Section 12.3.

To simplify the design of the cooling tower blowdown line, the liquid radwaste effluent discharge pipeline in the LWMS will be designed to not discharge to the cooling tower blowdown line. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB directly to the environment. In order to maintain a dilution factor of 1000 while releasing liquid radwaste effluent to the environment, the applicant must ensure that the circulating water system from Units 1 and 2 must be turned on. The applicant, by providing dilution water flow to maintain a dilution factor (DF) of 1000 during liquid effluent releases from North Anna 3, has met the effluent release requirements as described in the application. An exemption from DCD Tier 1 to revise the discharge piping information for the LWMS is acceptable by the staff based upon the applicant maintaining a dilution factor of 1000 as described in Section 11.2.3.2. Therefore, RAI 7689 is resolved and closed.

Exemption Approval determination:

In the North Anna 3 COLA, Revision 8, Part 7, "Departures Report," the applicant requested an exemption from the provisions of 10 CFR Part 52, Appendix D, Section III.B, "Design Certification Rule for the ESBWR Design, Scope and Contents," which requires an applicant referencing a certified design to incorporate by reference Tier 1 information. Specifically, in North Anna Part 7, Exemption 4, the applicant proposed to revise the ESBWR DCD, Tier 1, Section 12.3.1.5.1, "Design Considerations," to accommodate site specific design considerations that would simplify the cooling tower blow-down line by not sending liquid radwaste discharge through that section of piping.

Regulations

- 10 CFR Part 52, Appendix E, Section VIII.A.4 states that exemptions from Tier 1 information are governed by the requirements of 10 CFR 52.63(b) and 10 CFR 52.98(f). 10 CFR Part 52, Appendix E, Section VIII.A.4 also states that the Commission will deny such a request if it finds that the design change will result in a significant reduction in the level of safety otherwise provided by the design.

- 10 CFR Part 52.63(b)(1) allows an applicant to request NRC approval for an exemption from one or more elements of the certification information. The Commission may only grant such a request if it determines that the request complies with the requirements of 10 CFR 52.7, which, in turn, points to the requirements listed in 10 CFR 50.12 for specific exemptions, and if the special circumstances present outweigh the potential decrease in safety due to reduced standardization. Therefore, any exemption from the Tier 1 information certified by 10 CFR Part 52, Appendix D must meet the requirements of 10 CFR 50.12, 10 CFR 52.7, and 10 CFR 52.63(b)(1).

Evaluation of Exemption

As stated in 10 CFR Part 52, Appendix E, Section VIII.A.4, an exemption from Tier 1 information is governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, the Commission will deny an exemption request if it finds that the requested change to Tier 1 information will result in a significant decrease in safety. Pursuant to 10 CFR 52.63(b)(1), the Commission may, upon application by an applicant or licensee referencing a certified design, grant exemptions from one or more elements of the certification information, as long as the criteria given in 10 CFR 50.12 are met and the special circumstances as defined by 10 CFR 50.12 outweigh any potential decrease in safety due to reduced standardization.

Applicable criteria for when the Commission may grant the requested specific exemption are provided in 10 CFR 50.12(a)(1) and (a)(2). 10 CFR 50.12(a)(1) provides that the requested exemption must be authorized by law, not present an undue risk to the public health and safety, and be consistent with the common defense and security. The provisions of 10 CFR 50.12(a)(2) list six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present in order for NRC to consider granting an exemption request. The applicant stated that the requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "…[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of each of these findings is presented below.

Authorized by Law

This exemption would allow the applicant to implement approved changes to Tier 1 information. This is a permanent exemption limited in scope to particular Tier 1 information, and subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section III.B.
As stated above, 10 CFR 52.63(b)(1) allows the NRC to grant exemptions from one or more elements of the certification information, namely, Tier 1. The staff determined that granting of the applicant's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or NRC regulations. Therefore, as required by 10 CFR 50.12(a)(1), the exemption is authorized by law.

No Undue Risk to Public Health and Safety

The underlying purpose of ESBWR DCD, Tier 1, design of the cooling tower blowdown line identifies the standard ESBWR cooling tower blowdown configuration that will function in a manner in which the staff has determined, satisfies NRC requirements. The change in design function of the cooling tower blow-down line will not change the requirements of liquid rad-waste release and the applicant has stated that there will not be plans to release liquid rad-waste from the plant except in unusual circumstances where the releases will be done in a controlled procedure manner ensuring that the proper amount of effluent dilution is available. The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant and will maintain a level of detail consistent with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. The affected design description in the plant-specific Tier 1 DCD will continue to provide the detail necessary to support the LWMS release requirements and the associated design function. These proposed changes are evaluated and found to be acceptable. Therefore, the staff finds the exemption presents no undue risk to public health and safety as required by 10 CFR 50.12(a)(1).

Consistent with Common Defense and Security

The proposed exemption would allow the applicant to implement modifications to the Tier 1 information requested in the applicant's submittal. This is a permanent exemption limited in scope to particular Tier 1 information. Subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. This change is not related to security issues. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption is consistent with the common defense and security.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purposes of the rule or is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the specific ESBWR DCD Tier 1, cooling tower blow-down line being modified is to allow liquid radwaste effluent dilution when discharging to the environment. Since North Anna 3 does not plan to discharge any liquid waste referred to as a "0" release plant except under very unusual circumstances where dilution from the North Anna 1 or North Anna 2 plants are available in accordance with procedures. Accordingly, special circumstances are present because application of the requirement to incorporate the certified design information in specific ESBWR DCD Tier 1, Section 12.3.1.5.1, "Design Considerations," is not necessary to achieve the underlying purpose of the rule. Therefore, the staff finds that special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from Tier 1, exist.

Special Circumstances Outweigh Reduced Standardization

This exemption would allow the applicant to change certain ESBWR DCD Tier 1 information proposed in the North Anna 3 COL application. The key design functions of the LWMS will be maintained. Based on the nature of the proposed changes to the generic ESBWR DCD Tier 1 cooling tower blow-down line design, and the understanding that these changes support the design function of the LWMS, it is likely that all other ESBWR licensees and applicants would request the same exemption given a similar "0" liquid release operational consideration.

However, this exemption request and the associated changes to North Anna 3 COL Tier 1 information, demonstrate that there is a minimal change from the standard information provided in the ESBWR DCD. Consequently, the decrease in safety due to reduced standardization would also be minimal. For this reason, the staff determined that even if other ESBWR licensees and applicants do not request similar departures, the special circumstances outweigh the potential decrease in safety due to reduced standardization of the ESBWR design, as required by 10 CFR 52.63(b)(1).

No Significant Reduction in Safety

The proposed exemption would modify the function of the North Anna 3 LWMS discharge flow path described in the ESBWR DCD. Therefore, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design, as required by 10 CFR Part 52, Appendix E, Section VIII.A.4.

Conclusion

For the reasons set forth above, the staff has concluded that pursuant to 10 CFR Part 52, Appendix E, Section VIII.A.4, the exemption: (1) is authorized by law: (2) presents no undue risk to the public health and safety: (3) is consistent with the common defense and security: (4) has special circumstances that outweigh the potential decrease in safety due to reduced standardization: and (5) does not significantly reduce the level of safety at the licensee's facility. Therefore, the staff finds that the applicant's request to depart from the information in ESBWR DCD Tier 1, design of the cooling tower blowdown line, to be acceptable and the applicant's request for an exemption from these Tier 1 requirements is granted.

- NAPS DEP 12.3-1 Liquid Radwaste Effluent Discharge Piping Flow Path

This Tier 2 departure is permitted by 10 CFR 52.7 and Section VIII.A.3 of the Design Certification Rule. This Tier 2 departure from the ESBWR DCD describes the liquid radwaste effluent discharge piping flow path. The pipeline to transfer liquid radwaste from the RWB to the environment does not adversely affect any intended DCD design function. This departure evaluation was determined to comply with the requirements of the ESBWR Design Certification Rule, 10 CFR Part 52, Appendix. E, Section VIII.B.5.b which states that an applicant who references this appendix may depart from Tier 2 information, without prior NRC approval.

The staff has reviewed this departure submittal and agrees with the applicant's determination concerning the departure to describe the liquid radwaste effluent discharge and this Tier 2 departure does not change the function of this line as described in the ESBWR DCD. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB directly to the environment only as necessary.

COL Items

- STD COL 11.2-1-A Implementation of IE Bulletin 80-10

The guidance from IE Bulletin 80-10 includes information on the identification and restriction of non-contaminated systems that have the potential of becoming contaminated. The applicant has addressed this COL information item in the COL application with STD COL 11.2-1-A. In FSAR Section 11.2.2.3, "Detailed System Component Description," the applicant proposes to

use specific equipment connection configurations and plant sampling. Specifically, the use of double-check valves in each line where a non-radioactive system is connected to a radioactive or potentially radioactive system. A tell-tale connection is proposed for installation in each line to confirm the integrity of the line and check valves. The FSAR stated that to ensure that contamination has not occurred in permanently installed clean systems, sampling of these systems further upstream has been included in the plant sampling program.

FSAR Section 11.2.2.3 presents an updated description of some portions of the LWMS that sample the permanently installed non-radioactive plant system in upstream locations of radioactive systems, to avoid uncontrolled and unmonitored releases into the environment. A review of that information indicates that there is no specific information describing those sampling provisions or where samples would be collected to confirm that clean plant systems have not been cross-contaminated by radioactive process streams. This information would ensure that appropriate provisions are identified in the and are not likely to be omitted during the development of the sampling and analysis program for the North Anna 3 Offsite Dose Calculation Manual (ODCM), confirming compliance with liquid effluent concentration limits of Table 2 in Appendix B to 10 CFR Part 20 and design objectives in Appendix I to 10 CFR Part 50. The applicant provided additional information and proposed a revision to STD COL 11.2-1-A. The revision clarified that the plant procedures would describe the sampling of non-radioactive systems that could become potentially contaminated through the improper interface with radioactive systems. The proposed revision also notes that the determination of which system to consider and sample would be based on the requirements contained in the plant ODCM. The ODCM takes into account site-specific conditions and guidance from RG 1.109 in identifying exposure pathways and offsite dose receptors. The staff finds that these design features and operational program demonstrate compliance with IE Bulletin 80-10 and are therefore acceptable.

The staff thus concluded that STD COL 11.2-1-A is consistent with IE Bulletin 80-10 and is therefore acceptable.

- STD COL 11.2-2-A Implementation of 10 CFR 20. *

Subsection 12.3.1.5 of the North Anna 3 COL FSAR addresses this COL item by providing information on design, operational, and programmatic considerations to minimize contamination and ensure compliance with 10 CFR 20.1406. The staff's evaluation of this information is in Section 12.3.4 of this SER.

Supplemental Information

- NAPS SUP 11.2-1 Implementation of Section II.D of Appendix I to 10 CFR Part 50 (Cost-Benefit Analysis)

FSAR Section 11.2.1 (STD SUP 11.2-1) includes the basis of the cost-benefit analysis in justifying, in part, the LWMS design. This is a plant and site-specific cost-benefit analysis demonstrating compliance with Section II.D of Appendix I to 10 CFR Part 50. The applicant is to provide sufficient information for the staff to evaluate the bases and assumptions used in the analysis and for the staff to conduct an independent confirmation of compliance with NRC regulations and guidance. The FSAR includes the results of a cost-benefit analysis and supporting data using the guidance in RG 1.110. The applicant's analysis showed that the lowest-cost option for the LWMS augment is a 20 gallon per minute (gpm) filter cartridge at a

cost of $11,380 per year, resulting in a corresponding collective dose of 11.38 person-rem to the total body or thyroid.

FSAR Section 12.2.2.4.2 states that annual collective population doses due to liquid effluent releases are estimated to be 0.84 person-rem to the total body and 0.99 person-rem to the thyroid, based on the LWMS described in the ESBWR DCD. Assuming that the 20 gpm filter cartridge augment removes all remaining radioactivity in liquid effluents after treatment through the LWMS, the resulting lowest cost liquid radwaste augment is $11,380/year. This value is above the $1,000 per person-rem (total body or thyroid) ALARA criterion in Section II.D of Appendix I to 10 CFR Part 50 for both the total body and the thyroid. Thus, the applicant concluded that the LWMS meets the ALARA requirement and no further system augments are necessary.

The staff conducted an independent assessment of the applicant's cost-benefit analysis using the information presented in FSAR Sections 11.2.1 and 12.2.2.4.2 and the NRC calculated collective population doses, and guidance in RGs 1.110 and 1.109. The staff analysis confirmed the applicant's conclusions.

None of the radwaste augments that are provided in RG 1.110 are found to be cost beneficial in reducing the annual population total body and thyroid doses. The staff analysis also confirmed that the cost-benefit ratios are above the $1,000 per person-rem (total body or thyroid) ALARA criterion in Section II.D of Appendix I to 10 CFR Part 50 and that the LWMS augment would not further reduce collective doses below the FSAR estimates. The staff found that NA3 SUP 11.2-1 meets the requirements of Section II.D of Appendix I to 10 CFR Part 50 and is therefore acceptable.

The staff's review and evaluation of compliance with liquid effluent concentration limits and dose limits for maximally exposed individuals are addressed in Section 12.2 of the North Anna 3 FSAR and Section 12.2 of this SER.

- NAPS SUP 11.2-2 Ground Water Protection

In Subsection 11.2.3.2 of the North Anna 3 COL FSAR, the applicant provided supplemental information addressing the monitoring program for the LWMS and plant blowdown underground piping. In SER Section 12.3.4 under COL Item STD COL 12.3-4-A, the staff evaluated the required monitoring program for the underground piping to ensure that the potential for unmonitored, uncontrolled releases of radioactivity into the environment is minimized, in accordance with the requirements of 10 CFR 20.1406. Therefore, the staff found NAPS SUP 11.2-2 acceptable.

- Branch Technical Position 11-6

The review of the impacts of an accidental release of radioactive liquids in groundwater or surface water and effects on existing users or likely future users of groundwater or surface water resources is performed using the guidance in SRP Sections 2.4.1, "Hydrologic Description"; 2.4.12, "Groundwater"; and 2.4.13, "Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters"; and information and guidance from BTP 11-6, "Postulated Radioactive Releases Due to Liquid-Containing Tank Failures". BTP 11-6 provides guidance in assessing, in accordance with 10 CFR Part 20 concentration limits, a potential release of radioactive liquids following the postulated failure of a tank and its components, located outside of containment, and impacts of the release of radioactive materials at the

nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

The primary focus of ISG-013, is to provide guidance defining the mechanism of the assumed tank failure, development of the radioactive source term, assumptions and level of conservatism used in the analysis, and approach applied in assessing the radiological impacts at the assumed location of the dose receptor. Because of the complexity of the issues related to the radiological consequences of groundwater contamination, guidance on this topic has been divided between this ISG-013 and ISG-014. These two ISGs are intended to be used together.

Concerning liquid containing tank failure, the applicant is responsible for providing site-specific hydrogeological data (such as contaminant migration time), and analysis to demonstrate that the potential groundwater contamination resulting from radioactive release due to liquid containing tank failure is bounded by the analysis. This information is usually discussed in FSAR Subsection 11.2.3.2. From the staff's review of FSAR Sections 11.2.3.2 and 2.4.13 the staff determined that information in the FSAR required updating and/or needed to be addressed for conformance to SRP Sections 11.2.3 and 2.4.13, and BTP 11-6. As a result, the staff requested in RAI 7697, dated November 14, 2014 question 11.02-9 (ADAMS Accession No. ML14318A702), that the applicant update FSAR Sections 11.2.3.2 and 2.4.13. ESBWR DCD Section 11.2.3.2, states that an assessment of liquid releases following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6 is provided in DCD Section 15.3.16. FSAR Section 15.3.16 did not contain an assessment of liquid releases following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6. Neither BTP 11-6 nor ISG-013 are mentioned in FSAR Section 15.3.16.

The applicant responded to RAI 7697, Question 11.02-9, by letter dated November 8, 2014, (ADAMS Accession No. ML15009A235), concerning information added in FSAR Sections 2.4.13, 15.3.16 and 11.2.3.2. The applicant's response addressed the staff's concerns by adding additional information in FSAR Sections 15.3.16 and 11.2.3.2 stating that the assessment of liquid releases following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6 is addressed in FSAR Section 2.4.13. Additionally, the applicant's assessment of liquid release following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6, in FSAR Section 2.4.13, did not include reference to a source term utilized to aid in the assessment of a postulated liquid tank rupture. As a result, the staff requested in RAI 7772, Question 2.4.13-06, dated January 07, 2014, (ADAMS Accession No.ML14347A001) that the applicant provide the source term for the postulated Condensate Storage Tank (CST), liquid tank rupture, and list the source term in the FSAR. In its response to RAI 7772, Question 2.4.13-06, dated January 27, 2015, (ADAMS Accession No ML15028A392), the applicant described the CST source term in FSAR Section 2.4.13, and providing the basis for the CST source term in the RAI response. The applicant then provided a table of the CST source term developed in FSAR Section 12.2, FSAR Table 12.2-205, "Bounding Radionuclide Concentration in the Condensate Storage Tank."

Finally, the applicant's assessment of the dose to the environment, in FSAR Section 2.4.13, resulting from the postulated CST liquid tank rupture, in accordance with (IAW) ISG-013, did not provide a summary all of the parameters used, with the CST source term, to develop a dose assessment evaluation of 28 mrem, using the NRC approved computer code LADTAP II. This evaluation is to demonstrate that the applicant can show the dose assessment is within the 10 CFR 20.1301 regulation limit of 100 mrem. As a result, in RAI 7774, Question 2.4.13-05, dated December 19, 2014 (ADAMS Accession No. ML14353A468) the staff requested that the applicant provide the information used to determine the effluent dose assessment evaluation,

the input and output files from the LADTAP II analysis, and any basis required for any input parameters to the LADTAP II computer code.

In its response to RAI 7774, Question 2.4.13-05, dated January 29, 2015, (ADAMS Accession No.ML15042A219), the applicant provided the standard information described in NUREG-0800 SRP, Section 2.4.13 as necessary to perform the dose assessment relating to the postulated CST liquid tank rupture. The staff evaluated the body of information provided in response to RAIs 7697, 7772, and 7774, to show compliance with 10 CFR 20.1301 and consistent with BTP 11-6. The staff determined that this package of material, along with a staff analysis to verify and validate the applicant's calculations, was acceptable. Therefore, RAIs 7697, 7772, and 7774 are resolved and closed. **The FSAR updates will be tracked as a Confirmatory Item [Item 11.2-01].**

11.2.5 Post Combined License Activities

There are no post COL activities for this section.

11.2.6 Conclusion

The NRC 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 finds that the application included all required information related to the LWMS relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. 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 LWMS that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.2, NRC RGs, and industry standards. The staff's review concluded that the LWMS (as a permanently installed system and in combination with other plant systems) includes the equipment necessary to control releases of radioactive materials in liquid effluents, in accordance with the requirements in 10 CFR 50.34a. Furthermore, the staff concluded that the LWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance in RGs 1.109, RG 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- Using site-specific conditions, the applicant has met the ALARA criterion required in Section II.D of Appendix I to 10 CFR Part 50. The staff considered the potential effectiveness of augmenting the LWMS using items of reasonably demonstrated technology. The staff determined that further treatment is not expected to produce further reductions in collective population doses reasonably expected within an 80-kilometer (50-mile) radius of the reactor, at a cost of less than $1,000 per person-rem or person-thyroid-rem.

- The staff determined that the applicant has adequately addressed the standard COL items regarding IE Bulletin 80-10 and 10 CFR 20.1406.

- The staff found it reasonable that the identified Tier 2 departure regarding the description of the LWMS flow path is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5.

- To simplify the design of the cooling tower blowdown line, the liquid radwaste effluent discharge pipeline in the LWMS will be designed to not discharge to the cooling tower blowdown line. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB directly to the environment. In order to maintain a dilution factor of 1000 while releasing liquid radwaste effluent to the environment, the applicant must ensure that the circulating water system from Units 1 and 2 must be turned on. The applicant, by providing dilution water flow to maintain a DF of 1000 during liquid effluent releases from North Anna 3, has met the effluent release requirements as described in the application. An exemption from DCD Tier 1 to revise the discharge piping information for the LWMS is approved by the staff based upon the applicant maintaining a dilution factor of 1000 as described in Section 11.2.3.2.

11.3 Gaseous Waste Management System

11.3.1 Introduction

The gaseous waste management system (GWMS) is designed to receive and process radioactive gases and hydrogen-bearing gases generated during process operation. The gaseous radioactive effluents come from two main sources in the plant: (1) building ventilation systems servicing radiologically controlled areas; and (2) the power cycle off gas system (OGS). The GWMS and its OGS are used to control, collect, process, hold for decay, and discharge gaseous radioactive wastes generated during normal operation, including AOOs. The OGS is located in the turbine building and its major components include preheaters; recombiners; cooler/condensers; dryers; activated charcoal beds (guard and delay); and associated valves, pumps, and instrumentation. The gases removed from the condenser are radioactive. They must therefore be treated before being released into the environment to ensure that radioactivity levels are reduced to acceptable levels and are ALARA. The GWMS is designed to reduce and control radioactivity releases into the environment. Releases from the OGS are conducted via the turbine building stack. Releases from building ventilation exhaust systems servicing radiologically controlled areas are conducted through their respective buildings: reactor/fuel building stack, turbine building stack, and RWB stack.

11.3.2 Summary of Application

Section 11.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 11.3 of the certified ESBWR DCD, Revision 10. In addition, in FSAR Section 11.3, the applicant provided the following:

COL Items

- NAPS ESP COL 11.1-1 Implementation of Section II.D of Appendix I to10 CFR Part 50 (cost-benefit analysis)

A COL or Construction Permit (CP) applicant should verify that the calculated gaseous and liquid effluent concentrations and radiological doses to members of the public from radioactive gaseous and liquid effluents for any facility to be built on the North Anna site are bounded by the radiological doses and gaseous and liquid effluent concentrations included in the Early Site Permit (ESP) application and reviewed by the NRC. The COL applicant should also include in the radwaste (gaseous and liquid effluents) system all items of reasonably demonstrated technology that effect reductions in population dose to maintain doses ALARA in accordance with Appendix I, Section II.D, to 10 CFR Part 50.

The applicant used RG 1.110 as the basis for a cost-benefit evaluation to assess gaseous radwaste system augmentations. The results of the cost-benefit analysis demonstrate compliance with the ALARA cost-benefit requirements in Section II.D of Appendix I to 10 CFR Part 50. The applicant considered augmentations applicable to the ESBWR conceptual design and concluded that no gaseous radioactive waste system augmentations are cost beneficial.

11.3.3 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 GWMS, and the associated acceptance criteria, are in Section 11.3 of the SRP.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.3 of the North Anna 3 COL FSAR for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the supplementary information on GWMS appears in the following:

- 10 CFR 50.34a.
- Sections II.B, II.C, and II.D of Appendix I to 10 CFR Part 50.
- The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:
- RG 1.109
- RG 1.110

11.3.4 Technical Evaluation

As documented in NUREG-1966, the staff reviewed and approved Section 11.3 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.3 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the GWMS.

The staff reviewed the relevant information in the FSAR supplement. The following paragraphs discuss the staff's evaluations of the applicant's information on specific technical and regulatory topics.

COL Items

- NAPS ESP COL 11.1-1 Implementation of Section II.D of Appendix I to10 CFR Part 50 (cost-benefit analysis)

The applicant included a plant and site-specific cost-benefit analysis to justify, in part, the FSAR Section 11.3 GWMS design. The cost-benefit analysis is based on the guidance in RG 1.110 and 1.109, with the results demonstrating compliance with ALARA cost-benefit requirements in Section II.D of Appendix I to 10 CFR Part 50.

The applicant considered the lowest-cost option for a gaseous radwaste treatment system augment that applies to a BWR as a threshold cost value. The lowest-cost option for a gaseous radwaste treatment system augment that applies to BWRs is the 1000 cfm Charcoal/HEPA Filtration System at $7,960 per year, which yields a threshold value of 7.96 person-rem whole body or thyroid from gaseous effluents for BWRs.

As shown in FSAR Table 12.2-204, the calculated North Anna 3 whole body dose is 4.3 person-rem, which is lower than 7.96 person-rem whole body dose. This comparison determines by the guidance in RG 1.110 that there is not any gaseous radwaste treatment system augment that is cost beneficial at $1000 per person-rem to reduce whole body dose.

The North Anna 3 thyroid dose shown in FSAR Table 12.2-204 from gaseous effluents is 25 person-rem/yr, which exceeds the 7.96 person-rem/yr threshold value for a BWR. Additional analysis was provided to address the thyroid dose. Based on the estimated 25 person-rem/year thyroid dose, those radwaste augments with a total annual cost (TAC) values less than $25,000 were considered. In some cases, the radwaste augments had insufficient capacity to be considered. Other radwaste augments with greater process capacities were eliminated because they had TAC values greater than $25,000. RG 1.110 radwaste system augments were considered, including the 15,000 cfm HEPA Filtration System, the 3-Ton Charcoal Adsorber, a Charcoal/(HEPA) Filtration System, a 600 ft3 Gas Decay Tank, or a 1000 cfm Charcoal/HEPA Filtration System.

In some cases, the normal flow rates exceed the proposed HEPA filtration system and the augment is not effective for North Anna 3, and is eliminated from further consideration. Other plant design capacities of a system, the normal design flow exceeds the design capacity of the radwaste augment, therefore, this augment is not effective for North Anna 3 and is eliminated from further consideration. Additional radwaste augments provide minimal reduction in the thyroid dose such that the calculated annual benefit is less than the annual cost of the radwaste augment and is eliminated from further consideration. None of the gaseous radwaste augments are cost-beneficial in reducing the annual thyroid dose from gaseous effluents for Unit 3.

The staff evaluated this analysis and determined that in accordance with RG 1.110 guidance there were no radwaste augments that are cost-beneficial in reducing either the annual whole body or thyroid dose. Based on this comparison, no gaseous radwaste treatment system augment is cost-beneficial in reducing annual whole body or thyroid dose and the cost-benefit analysis demonstrates compliance with 10 CFR 50, Appendix I, Section II.D.

11.3.5 Post Combined License Activities

There are no post COL activities for this section.

11.3.6 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 finds that the application

includes all required information related to the GWMS relevant to this section and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. 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 GWMS that were incorporated by reference, have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.3, NRC RGs, and industry standards. The staff concluded that the GWMS includes the equipment necessary to control releases of radioactive materials in gaseous effluents in accordance with the requirements in 10 CFR 50.34a. Furthermore, the staff concluded that the GWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance of RGs 1.109 and 1.110.

11.4 Solid Waste Management System

11.4.1 Introduction

The Solid Waste Management System (SWMS) is designed to provide collection, processing, packaging, and storage for radioactive wastes such as spent resins, sludge, oil waste, and dry active waste (DAW) produced during normal operation and AOOs including startup, shutdown, and refueling operations. The SWMS is located in the RWB and is designed to collect, process, control, package, and temporarily store wet and dry solid radioactive wastes before shipment. The SWMS processes wastes from the LWMS, reactor water cleanup/shutdown cooling system, fuel and auxiliary pools cooling system, and condensate purification system. The SWMS comprises the following four subsystems: SWMS collection subsystem, SWMS processing subsystem, dry solid waste accumulation and conditioning subsystem container storage subsystem.

The SWMS collection subsystem consists of high- and low-activity resin holdup tanks, phase separators, a condensate resin holdup tank, decant pumps, sampling points, control panels, instrumentation, vents and drains, and high and low activity transfer pumps. There are no provisions to release liquid and gaseous wastes directly from the SWMS system. All liquid effluent releases are conducted through the LWMS for process liquids generated during the operation of the SWMS. Airborne releases from the SWMS and ventilation exhaust systems servicing radiologically controlled areas, where process equipment is located, are monitored and discharged through the RWB stack.

The container storage subsystem and the dry solid waste accumulation and conditioning subsystem are conceptual descriptions of methods the COL licensee would use to handle and process solid wastes and packaged solid wastes. Therefore, the DCD describes the process without including equipment and system flow diagrams. Figures 11.4-1 and 11.4-4 in DCD Tier 2 provide overviews of the processes that would be used to handle dry solid and wet wastes. The COL licensee will address the actual processes in the operational programs and procedures, which will consider the regulatory requirements of the NRC, U.S. Department of Transportation (DOT), and State and local agencies for processing, storing, packaging, shipping, radiological monitoring, and disposing of radioactive wastes.

11.4.2 Summary of Application

Section 11.4 of the North Anna 3 COL FSAR incorporates by reference Section 11.4 of the ESBWR, DCD, Revision 10.

North Anna 3 COL FSAR Section 11.4 describes the development and implementation of a plant-specific process control program (PCP) for operating procedures and technical specifications on the classification, treatment, and disposal of radioactive wastes processed by the SWMS. The applicant endorses by reference NEI Template 07-10 for the development of the PCP in meeting the intent of Generic Letter (GL) 89-01. The implementation milestone for the development of the PCP is described in FSAR Section 13.4. FSAR Section 11.5 describes the process to control and monitor all liquid and gaseous effluent releases associated with the processing of radioactive wastes. FSAR Section 12.2 presents information on the estimated amounts of radioactivity in liquid and gaseous effluent releases, effluent concentrations released into the environment, and associated doses to members of the public. FSAR Section 13.5 outlines the types of operational procedures that would be used to operate the SWMS. FSAR Section 14.2 describes the initial test program, including pre-operational and startup tests for the SWMS. North Anna 3 COLA, Part 10: Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) presents the specific ITAAC for the SWMS.

In addition, in FSAR Section 11.4, the applicant provided supplemental information as follows:

Tier 2 Departure Not Requiring Prior NRC Approval

- NA3 DEP 11.4-1 — Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The ESBWR DCD identifies that the RWB provides onsite storage space for a six-month volume of packaged waste. The applicant stated that Departure NA3 DEP 11.4-1 configures the North Anna 3 RWB to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This departure is accomplished by reconfiguring the arrangement of systems and components within the design of the ESBWR RWB. The applicant provided various revised tables and figures for the new arrangement of systems and components in the reconfigured RWB.

COL items

- STD COL 11.4-1-A — SWMS Processing Subsystem Regulatory Guide Compliance

The COL applicant is responsible for ensuring that SWMS subsystems comply with the guidance of RG 1.143, Revision 2 and RG 8.8, Revision 3, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable,” issued in June 1978 for the testing and operation of all SWMS subsystems. The applicant provided additional information regarding the SWMS testing according to guidance in RG 1.143 and RG 8.8.

- STD COL 11.4-2-A — Compliance with IE Bulletin 80-10

This COL item evaluates SWMS subsystems against the guidance and information in IE Bulletin 80-10 in identifying and rectifying connections to systems that are considered nonradioactive,

but that could become radioactive through improper interfaces with radioactive systems (i.e., a nonradioactive system that could become contaminated as a result of leakage, valving errors, or other operating conditions in radioactive systems). The applicant provided additional details about the types of design features, including the installation of double check valves and tell-tale connections, for the purpose of confirming the integrity of SWMS piping and connections. There are normal sample points further upstream that will be included in the plant-specific sampling program.

- STD COL 11.4-3-A Process Control Program

The applicant included, by reference, NEI 07-10A Revision 0, "Generic FSAR Template Guidance for Process Control Program (PCP)," issued in March 2009 (ML091460627), as the basis for the PCP. The applicant noted that Section 13.4 of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the PCP.

- STD COL 11.4-4-A Temporary Storage Facility

In the North Anna 3 COL FSAR, the applicant indicated that the RWB was reconfigured to accommodate at least 10 years of packaged Class B and C waste and approximately 3 months of packaged Class A waste, during routine operations and AOOs. The COL item addresses the use of a temporary storage facility and an overall site management plan for radioactive wastes using the guidance in Section 11.4 of the SRP (NUREG-0800, March 2007).

- STD COL 11.4-5-A Compliance with 10 CFR 20.1406

This COL item addresses site-specific information for demonstrating compliance with 10 CFR 20.1406 and RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," issued in June 2008, as it relates to the design and operational procedures of SWMS treatment subsystems to minimize contamination, facilitate eventual decommissioning, and minimize the generation of radioactive waste. In Section 11.4.1 of the North Anna 3 COL FSAR, the applicant provided additional information identifying various sections of the FSAR (Sections 12.3, 12.4, 12.5, and 13.5) that address how to comply with the implementation of 10 CFR 20.1406.

Supplemental Information

- STD SUP 11.4-1 Implementation of Section II.D of Appendix I to 10 CFR Part 50 (Cost-Benefit Analysis)

In Section 11.4.1 of the North Anna 3 COL FSAR the applicant presented supplemental information regarding the cost-benefit analysis for the SWMS and references the cost-benefit analyses in FSAR Sections 11.2.1 and 11.3.1, for processing and treating liquid and gaseous effluents as byproducts of the SWMS operation. Hence, no augmentations are needed for the SWMS.

11.4.3 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 SWMS, and the associated acceptance criteria, are in Section 11.4 of NUREG–0800.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.4 of the North Anna 3 COL FSAR for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the supplementary information on the SWMS appears in the following:

- 10 CFR 20.1406.
- Sections II.A, II.B, II.C and II.D of Appendix I to 10 CFR Part 50.
- 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:

- RG 1.109.
- IE 80-10.
- RG 8.8, Revision 3, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable."
- RG 1.143, Revision 2.
- GL 89-01.

In addition, in accordance with Section VIII, "Processes for Changes and Departures," of "Appendix E to Part 52-Design Certification Rule for the Economic Simplified Boiling Water Reactor," the applicant identified a Tier 2 departure. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52 Appendix E Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59.

11.4.4 Technical Evaluation

As documented in NUREG-1966, the staff reviewed and approved Section 11.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.4 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.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to the SWMS.

The staff reviewed the applicant's proposed resolution to the COL items and the departure included in Section 11.4 of the North Anna 3 COL FSAR as follows:

Tier 2 Departure Not Requiring Prior NRC Approval

- NAPS3 DEP 11.4-1 — Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The ESBWR DCD identifies that the RWB provides onsite storage space for a six-month volume of packaged waste. The applicant stated that Departure NAPS3 DEP 11.4-1 configures the North Anna 3 RWB to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste.

This departure identifies a plant-specific deviation from design information in the ESBWR DCD for low-level radioactive waste storage. The North Anna 3 RWB is configured to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. The departure is accomplished by reconfiguring the arrangement of systems and components within the ESBWR RWB. The applicant provided various figures and tables in Section 11.4 of the North Anna 3 COL FSAR to identify changes in equipment and systems. The applicant also added figures and tables to Section 12.3 that identify the revised layout and radiation protection needs. The major change to Section 11.4 is the elimination of the condensate resin transfer pumps and the addition of high- and low-activity circulation pumps (Figures 11.4-1R and 11.4-2R and Table 11.4-1R). In addition, the applicant identified the estimated annual volume of radwaste requiring long-term management in FSAR Table 11.4-2R.

In Part 7, "Departure Report," of the COL application, the applicant provided the results of the evaluation of this departure. The applicant added that the departure affects both the Tier 1 and Tier 2 information, but the departure has no safety significance. The applicant identified the Tier 1 changes as changes to the description of the locations of area radiation monitors in the RWB.

The staff reviewed the applicant's information in Parts 2, 7, and 10 of the COL application. The revised Table 2.3.2-1 reports the changes affecting Part 10 that relate to ITAAC. A comparison of this table to the table in ESBWR DCD Tier 1 reveals that the proposed changes relate to the RWB layout changes, specifically to the renaming of the assigned locations. The staff found that this name change does not present a risk to public health and safety.

During the review of Section 11.4, the staff noticed in section 11.4.2.2.4, "Container Storage Subsystem", that the high integrity containers (HICs) are provided with shield "bells." The applicant stated, a shield bell is a steel, vertical right circular cylinder with an open bottom. It is capable of venting to the general area. Shield bells are placed over HICs to provide radiation shielding and also provide structural integrity to permit stacking of HICs.

The guidance contained in RG 1.206 "Combined License Applications for Nuclear Power Plants" C.I.12.3.1 "Facility Design Features," notes that the applicant is to describe the design features provided to maintain occupational radiation exposure (ORE) ALARA. The guidance contained in SRP Appendix 11.4-A "Design Guidance for Temporary Storage of Low-Level Radioactive Waste" states that storage plans should address container protection and that good engineering judgment should be used to ensure that radioactive materials are contained safely. The guidance of SRP Appendix 11.4-A also states that when significant handling and personnel exposure can be anticipated, licensees should incorporate ALARA methodology in accordance with RG 8.8 "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as is Reasonably Achievable."

North Anna 3 COL FSAR 11.4.2.2. Container Storage Subsystems, states, "Shield bells also provide structural integrity to permit stacking of HICs. The HICs must be stacked two levels high to accommodate the storage needs." CNS-8 120B is the designation for a shielded transportation cask that is not designed to be stacked. HICs such as the model PL8-120 High Density Polyethylene (HDPE) or L8-120 carbon steel containers are also not designed to be

directly stacked. However, North Anna 3 COL FSAR 11.4.2.2.4 states that "The HICs are provided with shield "bells." A shield bell is a steel, vertical right circular cylinder with an open bottom. It is capable of venting to the general area. Shield bells are placed over HICs to provide radiation shielding."

In RAI 7701, Question 11.04-12, dated December 05, 2014 (ADAMS Accession No. ML14344A105), the staff requested that the applicant revise and update the North Anna 3 COL FSAR Section 11.4.2.2.4 to appropriately describe the waste storage container (i.e., container type and volume), the design features provided to protect the structural integrity of stored waste and the design provisions for maintaining ORE ALARA while stacking waste containers, or provide the specific alternative approaches used and the associated justification. The staff also requested that the applicant revise and provide the design to be used (e.g., stacking rings) to allow stacking HICs two levels high.

In its response to RAI 7701, Question 11.04-12, dated January 20, 2015, (ADAMS Accession No. ML15022A198), the applicant stated that the FSAR will be revised to clarify the design characteristics of the HICs and the design features provided for stacking HICs in order to maintain structural integrity and ORE ALARA. The shield bells will provide the full structural support to permit stacking of the 120 cubic foot HICs. The HICs themselves will not support any load due to stacking. The FSAR Section11.4.2.2.4 "Container Storage Subsystem" has been revised to clarify the design features that allow the stacking of HICs. The HDPE HICs will have shield bells that provide complete structural integrity to permit the stacking of HICs two levels to accommodate storage needs. The staff finds that this clarification is acceptable, and RAI 7701, Question 11.04-12 resolved and closed. **This is being tracked as a Confirmatory Item [Item 11.2-02**]

With regard to storage capacity, Table 11.4-2-R shows that Class B and C wastes are generated at a rate of about 15.6 cubic meters per year (m^3/yr) (552 cubic feet per year [ft^3/yr]), requiring 156 m^3 (5,520 ft^3) of storage volume for a 10-year inventory. The same table shows a 3-month Class A waste volume of 91 m^3/yr (3,210 ft^3/yr) for dry active waste and about 24 m^3/yr (874.6 ft^3/yr) for wet solid waste. Figure 1.2-23R (depicting the RWB at elevation 4650) indicates the storage of Class B and C wastes in Room 6390, Class A wet solid waste in Room 6391, and Class A dry active waste in Room 6392. The staff reviewed these rooms and determined that all three rooms have sufficient surface area and volume to store the waste for the required period. Therefore, the staff concluded that the new storage areas for managing Classes A, B, and C radioactive wastes have sufficient volume to accommodate the accumulated waste.

The applicant stated that Departure North Anna 3 DEP 11.4-1 only affects Tier 2, and its evaluation determined that this departure does not require prior NRC approval in accordance with Appendix E to 10 CFR Part 52. The staff found it reasonable that the departure does not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

COL Items

- STD COL 11.4-1-A — SWMS Processing Subsystem Regulatory Guide Compliance

The COL item addresses the compliance of the SWMS subsystems with the guidance in RG 1.143, Revision 2, and RG 8.8 for the testing and operation of all SWMS subsystems. The

applicant addressed this information item in STD COL 11.4-1-A. The applicant noted that SWMS subsystems used to process wet solid radioactive wastes, are tested using a process that complies with RG 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants." The staff determined that the information provided by the applicant is acceptable. Therefore, COL Item 11.4.-1-A has been satisfied. The evaluation of the compliance with RG 8.8 is addressed in Section 12.1 of the SER.

The applicant supplemented STD COL 11.4-1-A with North Anna 3 SUP 11.4-1. As described in Section 12.1 of the SER, the applicant's additional information is consistent with RG 1.143 and RG 8.8 and is therefore acceptable. This action closes the phase 2, Confirmatory Item 11.04-4.

- STD COL 11.4-2-A Compliance with IE Bulletin 80-10

The COL item addresses the evaluation of the SWMS subsystems against the guidance and information in IE Bulletin 80-10. The purpose is to identify and rectify connections to systems that are considered nonradioactive but that could become radioactive through improper interfaces with radioactive systems (i.e., a non-radioactive system that could become contaminated due to leakage, valving errors, or other operating conditions in radioactive systems). IE Bulletin 80-10 includes information on identifying and restricting non-contaminated systems that could become contaminated.

The applicant has addressed this COL information item in the COL application with STD COL 11.4-2-A. FSAR Section 11.4.2.3, "Detailed System Component Description," presents an updated description of some portions of the SWMS on sampling permanently installed non-radioactive plant system in upstream locations of radioactive systems. These provisions are intended to avoid uncontrolled and unmonitored releases into the environment. Specifically, the applicant proposed using double-check valves in each line where a non-radioactive system is connected to a radioactive or potentially radioactive system. These valves are expected to service subsystems connected to non-radioactive portable systems. The installation of tell-tale connection in each line is expected to confirm the integrity of the line and check valves. The FSAR stated that to ensure that contamination has not occurred in permanently installed clean systems, sampling these systems further upstream is included in the plant sampling program.

In Subsection 11.4.2.3.5 of the North Anna 3 COL FSAR, the applicant stated that the plant-specific procedures describe the sampling of nonradioactive systems that could potentially become contaminated by cross-connecting with systems that contain radioactive material. In addition, the ODCM will address potential conditions where normally nonradioactive systems might become contaminated. The staff found this information to be consistent with IE Bulletin 80-10 and is therefore acceptable.

- STD COL 11.4-3-A Process Control Program

The COL item addresses the implementation of a plant-specific PCP using operating procedures and technical specifications, as they relate to the classification, treatment, and disposal of radioactive wastes processed by the SWMS in accordance with the NRC, DOT and State and local agency regulatory requirements. The applicant included, by reference, NEI Template 07-10A as the basis for the PCP. The NEI template presents the functional elements of a PCP, which, if met, would demonstrate compliance with 10 CFR 50.34a and 50.36a. The template describes technical and regulatory

considerations used to process solid, wet, and liquid wastes with selected waste processing technologies and methods. The PCP identifies surveillance requirements that are consistent with the plant's technical specifications, administrative procedures, operational procedures, quality assurance and quality control program, radiological controls and monitoring program, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, instructions on using the NRC uniform radioactive shipping waste manifest, and the process for initiating and documenting changes to the North Anna 3 PCP and its supporting procedures. The basis for acceptance in the staff's review is conformance of the applicant's endorsement of the DCD SWMS design and proposed North Anna 3 PCP. The milestones for the development and implementation of the PCP are addressed in FSAR Section 13.4 of the North Anna 3 COL. The staff determined that this item is satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (Item 9), which lists the milestones for the development and implementation of the PCP before fuel load, with the requirement identified as a license condition. The applicant updated FSAR Section 11.4.2.3, STD COL 11.4-3-A by referencing NEI PCP Template 07-10A in applicable FSAR subsections and references. NEI PCP Template 07-10A (Revision 0, March 2009) has been reviewed and found acceptable by the staff. The staff concluded that STD COL 11.4-3-A meets the requirements and is acceptable (process control program compliance with 10 CFR 50.34a and 50.36a).

In Subsection 11.4.2.3.5 of the North Anna 3 COL FSAR, the applicant's resolution of STD COL 11.4-3-A for waste classification and process control is consistent with NEI 07-10A and is therefore acceptable. Section 13.4, "Operational Programs Required by NRC Regulations," of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the PCP before the fuel loading. In Table 13.4-201, "Operational Programs Required by NRC Regulations," the applicant identified the implementation milestones for operational programs including the operational program related to the PCP. The staff reviewed the applicant's milestones for developing and implementing the PCP and found the applicants license condition of North Anna 3 COL Part 10 Section 3.6, "Operational Program Readiness," to be acceptable. This action closes Confirmatory Item of the phase 2 SER 11.04-1B.

- STD COL 11.4-4-A Temporary Storage Facility

In previous revisions of the North Anna 3 COL FSAR, the applicant stated that North Anna 3 does not use any temporary storage facilities to support plant operation. The corresponding ESBWR DCD Tier 2 COL item states that it is the responsibility of the COL applicant to consider the development of an overall site management plan for the storage of radioactive waste using the guidance of SRP Section 11.4. Confirmatory item phase 2 SER 11.04-3 was closed in RAI 11.04-3 response dated May 21, 2009 ADAMS Accession No. ML091540526). Temporary storage would be added as necessary if needed.

- STD COL 11.4-5-A Compliance with 10 CFR 20.1406

The applicant stated that Subsection 12.3.1.5 addresses this COL item. Subsection 12.3.1.5 provides information on design features as well as on measures used in operating procedures to minimize contamination and to ensure compliance with 10 CFR 20.1406. Section 12.3.4 of this Safety Evaluation Report (SER) provides the staff's evaluation of this information.

Supplemental Information

- STD SUP 11.4-1 — Implementation of Section II.D of Appendix I to 10 CFR Part 50 (cost-benefit analysis)

The applicant added a new supplement (STD SUP 11.4-1) to Section 11.4.1 of the North Anna 3 COL FSAR, which states that the cost-benefit analyses in Sections 11.2.1 and 11.3.1 include the incremental amounts of liquid and gaseous wastes that would be produced during the operation of the SWMS. As a result, no other SWMS design augmentations are necessary to handle the incremental amounts of liquid and gaseous wastes. The staff found the applicant's supplemental information acceptable, because the cost-benefit analyses in FSAR Sections 11.2 and 11.3 consider routinely expected sources of radioactivity discharged via the three plant stacks. For example, releases from the RWB ventilation exhaust systems servicing radiologically controlled areas—including the SWMS components—and the venting of SWMS tanks and vessels are conducted through the RWB stack. As a result, all releases from the SWMS are monitored and controlled at the release point, and all releases controlled through the implementation of the ODCM. Therefore, the staff concluded that the applicant has adequately addressed STD SUP 11.4-1.

11.4.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff has identified the following license condition from North Anna 3 COL Part 10 Section 3.6, which establishes the operational program for process and effluent monitoring and sampling (including the PCP):

> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:
>
> - The implementation of site-specific Severe Accident Management Guidelines.
> - The spent fuel rack coupon monitoring program implementation.

The applicant's Table 13.4-201, included the following elements:

a. Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls.

b. Offsite Dose Calculation Manual.

c. Radiological Environmental Monitoring Program.

11.4.6 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 determined that the

application includes all required information relating to the SWMS relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. 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 SWMS that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.4, NRC RGs, and industry standards. The staff concluded that the SWMS (as a permanently installed system and in combination with other plant systems) includes the equipment necessary to process liquid, wet, and dry solid wastes and contains provisions for controlling the release of radioactive materials in effluents in accordance with the requirements in 10 CFR 50.34a. The staff's review concluded that the SWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance in RGs 8.8, 1.143, 1.109 and 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- Using site-specific conditions, the applicant has met the ALARA criterion required in Section II.D of Appendix I to 10 CFR Part 50, because all associated effluent releases are expected to be managed through the operation of the LWMS and GWMS. The staff considered the potential effectiveness of augmenting the LWMS and GWMS using items of reasonably demonstrated technology. The staff determined that additional treatment is not expected to produce further reductions in collective population doses reasonably expected within an 80-kilometer (50-mile) radius of the reactor, at a cost of less than $1,000 per person-rem or person-thyroid-rem.

- The staff determined that the applicant has adequately addressed the standard COL items regarding IE Bulletin 80-10 and 10 CFR 20.1406.

- The applicant's proposed PCP as it relates to classifying, processing, and disposing of radioactive wastes meets the requirements of 10 CFR Part 61. The staff concluded that the endorsement of NEI 07-10A, Revision 0, and the SWMS supplemental information in FSAR Section 11.4 are consistent with the requirements of GL 89-01.

11.5 Process Radiation Monitoring System

11.5.1 Introduction

The process radiation monitoring system (PRMS) are used to monitor liquid and gaseous process streams and effluent releases from the RWMS during normal operation, AOOs, and post-accident conditions. The systems include radiation monitors to detect and measure radioactivity and radiation levels and to provide indication of radioactive release rates or concentration levels in process and effluent streams. The PRMS include sampling systems to extract samples from process or effluent streams and to provide the means to collect samples on filtration and in adsorbent media. The PRMS provide the means to establish alarm set points for the purpose of indicating when excessive radioactivity levels are present, track and record rates of radioactivity releases, and initiate protective isolation actions, such as terminating or diverting process or effluent flows.

Typically, the system consists of skid-mounted radiation monitoring equipment and permanently installed sampling lines with the equipment being located at points to measure radioactivity or collect samples that are representative of process flows and effluent releases. Samples

collected on filtration and in adsorbent media are evaluated by laboratory analyses in confirming measurement results recorded by radiation monitors and determining radioactivity levels associated with radionuclides that are not readily detected by radiation monitoring devices. The system includes local instrumentation readout panels and alarm functions in addition to those located in control rooms. The PRMS does not generate additional sources of radioactive materials associated with its operation given that it is used only to control and monitor liquid and gaseous process streams and effluents discharged to the environment. Fluid samples collected from process and effluent streams are returned to their origins and are not discharged locally.

11.5.2 Summary of Application

Section 11.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 11.5 of the ESBWR DCD, Revision 10. In addition, in FSAR Section 11.5, the applicant provided the following:

COL Items

- STD COL 11.5-1-A Sensitivity or Subsystem Lower Limit of Detection

This COL item addresses the derivation of lower limits of detection or detection sensitivity levels for each PRMS effluent subsystem, following the requirements of the ODCM for North Anna 3. The applicant stated that the ODCM provides the methodology for deriving the lower limit of detection for each effluent monitor.

- STD COL 11.5-2-A Offsite Dose Calculation Manual (ODCM)

This COL item addresses the development of a plant- and site-specific ODCM for calculating offsite doses resulting from liquid and gaseous effluents. In FSAR Subsection 11.5.4.5, the applicant incorporated by reference NEI 07-09A Revision 0, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," dated March 31, 2009 (ML091050234). The ODCM is used to control and monitor all liquid and gaseous effluent releases and to implement an environmental sampling and monitoring program. Section 13.4 of the North Anna 3 COL FSAR addresses the milestones for the development and implementation of the ODCM.

- STD COL 11.5-3-A Process and Effluent Monitoring and Sampling Program

This COL item addresses the implementation of a site-specific monitoring and sampling program, as described in the ODCM for North Anna 3. In addition, the applicant included Table 11.5-201 as a replacement for Table 11.5-5 in ESBWR DCD Tier 2, which details provisions for sampling liquid streams.

- STD COL 11.5-4-A Site-Specific Offsite Dose Calculation

This COL item addresses compliance with the design objectives in Appendix I to 10 CFR Part 50 for controlling doses to a hypothetical maximally exposed member of the public and populations living near North Anna 3.

- STD COL 11.5-5-A Instrumentation Sensitivities

The COL item addresses the derivation of instrumentation detection sensitivity levels and bases for sampling all expected liquid and gaseous effluent release points described in the ODCM for North Anna 3.

11.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is NUREG-1966. In addition, the relevant requirements of the Commission regulations for the PRMS, and the associated acceptance criteria, are in Section 11.5 of NUREG–0800.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.5 of the North Anna 3 FSAR for compliance with NRC regulations.

In particular, the regulatory basis for accepting the additional information related the PRMS appears in the following:

- 10 CFR 20.1301(e),
- 10 CFR 20.1302, “Compliance with dose limits for individual members of the public.”
- 10 CFR 50.34a, “Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors.”
- 10 CFR 50.36a, “Technical specifications on effluents from nuclear power reactors.”
- Sections II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50.

The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:

Additional requirements include those of 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii) for monitoring gaseous effluents from potential accident release points, consistent with GDC 63 and GDC 64.

SRP acceptance criteria include industry codes and standards, such as American National Standards Institute/Health Physics Society N13.1 and American Nuclear Society ANS N42.18, and the guidance in the following NRC documents:

- RG 1.109.
- RG 1.110.
- RG 1.206.
- RG 1.21, Revision 1, “Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants,” June 1974.
- RG 1.33, Revision 2, “Quality Assurance Program Requirements (Operation),” February 1978.

- RG 1.97, Revision 4, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants,” June 2006.

- RG 4.1, Revision 2, “Radiological Environmental Monitoring for Nuclear Power Plants,” June 2009.

- RG 4.15, Revision 2, “Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment,” July 2007.

- BTP 7-10, Revision 5, “Guidance on Application of Regulatory Guide 1.97,” issued March 2007, in SRP Section 7.5.

- GL 89–01.

- IE Bulletin 80-10.

11.5.4 Technical Evaluation

As documented in NUREG-1966, the staff reviewed and approved Section 11.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.5 of 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the PRMS.

The staff reviewed the applicant’s proposed resolution to the COL items included under Section 11.5 of the North Anna 3 COL FSAR as follows:

COL Items

- STD COL 11.5-1-A Sensitivity or Subsystem Lower Limit of Detection

The COL item addresses the derivation of lower limits of detection for each effluent PRMS subsystem, following the requirements of the ODCM for North Anna 3. The applicant outlined, given the endorsement of NEI ODCM Template 07-09A, methods used to derive the lower limits of detection for PRMS subsystems in monitoring and controlling liquid and gaseous effluent releases. The milestones for the development and implementation of the ODCM are addressed in FSAR Section 13.4 of the North Anna 3 COL. The staff finds this item satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (Item 9), which lists the milestones for the development and implementation of the ODCM before fuel load, as a license condition as described in North Anna 3 COLA Part 10, Section 3.6, “Operational Program Readiness.”

In Subsection 11.5.4.7 of the North Anna 3 COL FSAR, the applicant stated that the ODCM will provide the methodology for deriving the lower limit of detection for the PRMS subsystem in monitoring and controlling liquid and gaseous effluent releases. DCD Tables 11.5-2 and 11.5-4 provide the estimated sensitivities of process radiation monitors. If the plant configuration and radiation background require changes to these sensitivity ranges, the ranges will be adjusted in

accordance with written procedures consistent with the bases defined in DCD Table 11.5-9. The applicant will update the FSAR if changes to values in DCD Tables 11.5-2 and 11.5-4 are needed. The staff's review found that the applicant's response adequately addresses STD COL 11.5-1-A and the guidance in RGs 1.21, 1.33, 1.97, 1.206, 4.1, and 4.15 and complies with 10 CFR Part 20, 10 CFR Part 50, and BTP 7-10.

- STD COL 11.5-2-A Offsite Dose Calculation Manual

The COL item addresses the development of a plant- and site-specific ODCM for calculating offsite doses resulting from liquid and gaseous effluents. FSAR, Section 11.5.4.5. The applicant endorsed by reference, NEI ODCM Template 07-09A as the basis of its ODCM as an operational program document. The NEI template presents the functional elements of an ODCM that, if met, would demonstrate compliance with Part 50.34a and 50.36a and Appendix I to 10 CFR Part 50. The NEI ODCM Template identifies monitoring criteria, liquid and gaseous radiological effluent controls, monitoring instrumentation, methods for deriving lower limits of detection and detection sensitivities, methods for establishing instrumentation alarm set-points, dose limits for members of the public, requirements for process and effluent sampling in various plant systems, requirements limiting effluent releases, surveillance requirements, methods for calculating effluent release rates and doses, elements of a radiological environmental monitoring program, elements of a quality assurance and quality control program, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, process for initiating and documenting changes to the North Anna 3 ODCM and supporting procedures, and record keeping. The staff finds this item satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (Item 9), which lists the milestones for the development and implementation of the ODCM before fuel load as a license condition in North Anna 3 COL Application Part 10, Section 3.6, "Operational Program Readiness." Accordingly, the applicant updated the provisions of FSAR Section 11.5.4.5, (STD COL 11.5-2-A), by referencing NEI ODCM Template 07-09A in applicable FSAR subsections and references.

In addition, the applicant will include in the ODCM, before fuel load, the provisions for sampling liquid and gaseous waste streams identified in Table 11.5-201 and DCD Table 11.5-7 and batch liquid releases identified in DCD Table 11.5-7. Section 13.4, "Operational Programs Required by NRC Regulations," of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the ODCM.

- STD COL 11.5-3-A Process and Effluent Monitoring Program

This COL item addresses the development and implementation of a site-specific monitoring and sampling program described in the ODCM for North Anna 3. Section 13.4 of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the radiological environmental monitoring program in Table 13.4-201 under Item 9.

Subsection 11.5.4.6 of the North Anna 3 COL FSAR, regarding process and effluent monitoring and sampling presents information in Table 11.5-201, "Provisions for Sampling Liquid Streams," on sampling for several North Anna 3 plant systems, including the plant service water system (PSWS) (Item 2), storm drains and cooling tower blowdown (Item 11), and sanitary wastewater (Item 14).

The staff verified that the applicant has incorporated the changes noted above in the North Anna 3 COL FSAR. In addition, STD COL 11.5-3-A is acceptable because it meets the guidance in RGs 1.21, 1.33, 1.97, 1.206, 4.1, and 4.15 and complies with 10 CFR Part 20, 10 CFR Part 50, and BTP 7-10.

- STD COL 11.5-4-A Site-Specific Offsite Dose Calculation

This COL item addresses compliance with the design objectives in Appendix I to 10 CFR Part 50 of controlling doses to a hypothetical, maximally exposed member of the public and populations living near North Anna 3. In Subsection 11.5.4.8 of the North Anna 3 COL FSAR, the applicant stated that the ODCM addresses the guidelines in Appendix I to 10 CFR Part 50 and FSAR Section 12.2.2 provides the site-specific doses to members of the public. The staff's evaluation under COL Item STD COL 11.5-2-A provides further discussion on the ODCM, which is in compliance with Sections II.A through II.C of Appendix I to 10 CFR Part 50. The staff determined that the applicant's response adequately addresses this COL item, and is therefore acceptable.

- STD COL 11.5-5-A Instrumentation Sensitivities

In Subsection 11.5.4.9 of the North Anna 3 COL FSAR, the applicant stated that the ODCM will describe the instrument sensitivities, sampling, and analytical frequencies and the basis for each gaseous and liquid sample. The applicant referenced FSAR Subsection 11.5.4.5 for a discussion on the development and implementation of the ODCM. The staff's evaluation under COL Item STD COL 11.5-2-A provides further discussion on the ODCM (in terms of compliance with the guidance in RGs 1.21, 1.33, 1.97, 4.1, and 4.15 and complies with 10 CFR Part 20, 10 CFR Part 50, and BTP 7-10). The staff found that the applicant adequately addresses STD COL 11.5-5-A, and is therefore acceptable.

11.5.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff has identified the following license conditions from North Anna 3 COL Part 10 Section 3.6:

> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:
>
> - The implementation of site-specific Severe Accident Management Guidelines.
>
> - The spent fuel rack coupon monitoring program implementation.

The applicant's Table 13.4-201, includes the following elements:

a. Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls.

b. Offsite Dose Calculation Manual.

c. Radiological Environmental Monitoring Program.

11.5.6 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 determined that the application includes all required information related to the PRMS relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. 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 PRMS that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.5, NRC RGs, and industry standards. The staff's review concluded that the applicant has presented adequate information in the North Anna 3 COL FSAR to meet the requirements of the PRMS, which includes the equipment necessary to monitor process and effluent streams; describes an operational program to control releases of radioactive materials associated with the operation of the LWMS, GWMS, and SWMS; and incorporates provisions to implement a sampling and monitoring program. Furthermore, the staff concluded that the PRMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance of RGs 1.109 and 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- The PRMS includes the instrumentation for monitoring and sampling radioactivity in contaminated liquid and gaseous process and effluent streams and in solid wastes during routine operations, AOOs, and accident conditions. The staff evaluated the proposed provisions for sampling and monitoring appropriate process streams and effluent release points, including nonradioactive systems that could become contaminated through interfaces with radioactive systems.

- The applicant's proposed development of the ODCM for North Anna 3, as it relates to controlling and monitoring effluent releases and doses to members of the public, meets the requirements of Appendix I to 10 CFR Part 50; 10 CFR 20.1301(e); and 10 CFR 20.1302. Therefore, the staff concluded that the endorsement of NEI 07-09A, Revision 0, and the PRMS supplemental information in FSAR Section 11.5 are consistent with GL 89-01.