11.0 RADIOACTIVE WASTE MANAGEMENT

The radioactive waste management systems 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 normal operation (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; in-service inspection (ISI); and calibration) and anticipated operational occurrences (AOOs).

11.1 Source Terms

The radioactive source terms are used to identify the potential dose to members of the public and plant employees as a result of plant operation. This includes consideration of parameters used to determine the concentration of each isotope in the reactor coolant, fraction of fission product activity released to the reactor coolant, and concentrations of all nonfission product radioactive isotopes in the reactor coolant. Gaseous and liquid waste sources are considered in the evaluation of effluent releases.

Section 11.1 of the Levy Nuclear Plant (LNP) combined license (COL) Final Safety Analysis Report (FSAR), Revision 9, incorporates by reference, Section 11.1, "Source Terms," of Revision 19 of the AP1000 Design Control Document (DCD). In addition, in the LNP COL FSAR, the applicant provided the following:

Departures

- LNP DEP 6.4-1

The applicant provided additional information in Section 11.1 of the LNP COL FSAR about LNP DEP 6.4-1 related to design changes affecting habitability of the main control room and changes to the calculated doses to control room operators. This information, as well as related LNP DEP 6.4-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.2 of this SER.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed Section 11.1 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this section. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," and its supplements.

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

11.2 Liquid Waste Management Systems

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 the result of normal operation, including anticipated operational occurrences.

11.2.2 Summary of Application

Section 11.2 of the LNP COL FSAR, Revision 9, incorporates by reference Section 11.2 of the AP1000 DCD, Revision 19.

In addition, in LNP COL FSAR Section 11.2, the applicant provided the following:

AP1000 COL Information Items

- STD COL 11.2-1

The applicant provided additional information in Standard (STD) COL 11.2-1 to resolve COL Information Item 11.2-1 (COL Action Item 11.2-1). The additional information addresses the use of mobile or temporary equipment to process liquid effluents in LNP COL FSAR Section 11.2.1.2.5.2.

- STD COL 11.2-2

The applicant provided additional information in STD COL 11.2-2 to resolve COL Information Item 11.2-2 (COL Action Item 11.2-2). The additional information addresses the methodology for calculating doses and the cost-benefit analysis of population doses in LNP COL FSAR Section 11.2.3.5.

- LNP COL 11.2-1 and LNP COL 13.5-1

The applicant provided additional information in LNP COL 11.2-1 and LNP COL 13.5-1 to ensure that the total inventory of radioactivity contained in waste processing equipment, skid-mounted systems, and in-process waste located in the Radwaste Building is limited in accordance with RG 1.143, Revision 2. This information is provided to resolve STD COL 11.2-1 and RAI 11.02-5.

- LNP COL 11.2-2

The applicant provided additional information in LNP COL 11.2-2 to resolve COL Information Item 11.2-2 (COL Action Item 11.2-2). The additional information addresses the methodology for calculating doses and the cost-benefit analysis of population doses in LNP COL FSAR Section 11.2.3.5.

- LNP COL 2.4-5 and LNP COL 15.7-1

LNP COL FSAR Section 11.2 does not identify LNP COL 2.4-5 and LNP COL 15.7-1 as COL information items applicable to Section 11.2. However, LNP COL 2.4-5 and LNP COL 15.7-1 provide information regarding a postulated liquid waste tank failure, which is evaluated by the NRC staff as part of liquid waste management. Therefore, LNP COL 2.4-5 and LNP COL 15.7-1 are evaluated in Section 11.2.4 of this safety evaluation report (SER). In LNP COL FSAR Section 2.4, the applicant performed the consequence analysis of a postulated liquid waste tank failure in FSAR Section 2.4.13 to address COL Information Items 2.4-5 and 15.7-1.

- LNP COL 11.5-3

The applicant provided additional information in LNP COL 11.5-3 to resolve COL Information Item 11.5-3 (COL Action Item 11.5-3). The additional information addresses compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic licensing of production and utilization facilities," 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," Section II.A in LNP COL FSAR Section 11.2.3.5.

Supplemental Information

- STD SUP 11.2-1

The applicant added in LNP COL FSAR Section 11.2.3.6 supplemental (SUP) information to address the quality assurance (QA) program to be applied to the LWMS.

- LNP SUP 11.2-1

The applicant added in LNP COL FSAR Section 11.2.1.2.4 supplemental information to describe the exterior radwaste discharge piping. In a letter dated May 4, 2011, the applicant proposed to add to a future version of the FSAR supplemental information in LNP SUP 11.2-1 that describes site-specific design feature of the discharge piping. In a letter dated December 7, 2011, the applicant provided a voluntary supplemental response with additional detail to be incorporated in a future revision of the FSAR.

License Condition

- Part 10, License Condition, Radwaste Building Radioactivity Limits

LNP COL application, Part 10, Section 13, "Radwaste Building Radioactivity Limits," states that prior to initial fuel load, the licensee shall develop, implement, and maintain procedural controls limiting radionuclide inventory in each of the Radwaste Building Monitor Tanks, and separately in each of up to three Radwaste Building mobile radwaste processing systems to below A_2 quantities for radionuclides specified in Appendix A to 10 CFR Part 71 (Tables A-1 and A-3), as described in FSAR Section 13.5.2.2.5. The procedures shall also ensure that any additional equipment located in the RWB is limited to the A_2 quantities and that the total cumulative radioactive inventory contained in unpackaged wastes (including liquid waste, wet waste, solid

waste, gaseous waste, activated or contaminated metals and components, and contaminated waste present at any time in the Radwaste Building) is limited so that an unmitigated release, occurring over a 2 hour time period, would not result in a dose of greater than 500 millirem at the protected area boundary or an unmitigated exposure, occurring over a 2 hour time period, would not result in a dose of greater than 5 rem to site personnel located 10 feet from the total cumulative radioactive inventory.

11.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements.

The regulatory requirements applicable to the LWMS are as follows:

- 10 CFR 20.1301(e)
- 10 CFR 20.1302, “Compliance with dose limits for individual members of the public”
- 10 CFR 20.1406, “Minimization of contamination”
- 10 CFR 50.34a, “Design objectives for equipment to control release of radioactive material in effluents – nuclear power reactors”
- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criteria (GDC) 60, “Control of releases of radioactive materials to the environment”
- 10 CFR Part 50, Appendix A, GDC 61, “Fuel storage and handling and radioactivity control”
- 10 CFR Part 50, Appendix I, Sections II.A and II.D
- 10 CFR 52.80(a)
- Title 40 of the *Code of Federal Regulations* (40 CFR) Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations”

Guidance for accepting the additional information on the LWMS is in:

- The codes and standards listed in Table 1 of Regulatory Guide (RG) 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants,” Revision 2
- Regulatory Position C.1.1 of RG 1.143, Revision 2
- RG 1.109, “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,” Revision 1

- RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors"

- RG 1.113, "Estimating Aquatic Dispersion of Effluents form Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," Revision 1

- RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning"

The acceptance criteria associated with the LWMS are given in Section 11.2 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," and NUREG-0800, Section 2.4.13, Acceptance Criterion No. 5, including Branch Technical Position (BTP) 11-6.

11.2.4 Technical Evaluation

The NRC staff reviewed Section 11.2 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the LWMS. The results of the NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

The staff's review of this application included the following COL information and supplementary items:

- STD COL 11.2-1, Processing of Liquid Waste by Mobile Equipment

- STD COL 11.2-2, Liquid Radwaste Cost-Benefit Analysis Methodology

- LNP COL 11.2-1, Radwaste Building Source Term Inventories

- LNP COL 13.5-1, Radioactive Waste Management Procedures

- LNP COL 11.2-2, Cost-Benefit Analysis of Population Doses

- LNP COL 2.4-5, Accidental Release of Liquid Effluents into Groundwater and Surface Water

- LNP COL 15.7-1, Consequences of Tank Failure

- LNP COL 11.5-3, Individual Dose Limits in 10 CFR Part 50, Appendix I

- STD SUP 11.2-1, Quality Assurance

- LNP SUP 11.2-1, Radwaste Discharge Piping

In addition to the above items, the staff reviewed the entire section against Section 11.2 of NUREG-0800 to determine if the information in LNP COL FSAR Section 11.2 met the regulatory

requirements in the regulations stated above (SER Section 11.2.3) and the NUREG-0800 acceptance criteria. The relevant NUREG-0800 acceptance criteria are as follows:

- The LWMS should have the capability to meet the dose design objectives and include provisions to treat liquid radioactive wastes such that the following is true:

    A. The calculated annual total quantity of all radioactive materials released from each reactor at the site to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 0.03 millisievert (mSv) (3 millirem (mrem)) to the total body or 0.1 mSv (10 mrem) to any organ. RGs 1.109, 1.112, and 1.113 provide acceptable methods for performing this analysis.

    B. In addition to A, the LWMS should include all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return for a favorable cost-benefit ratio, can effect reductions in doses to the population reasonably expected to be within 80 kilometers (km) (50 miles (mi)) of the reactor. RG 1.110 provides an acceptable method for performing this analysis.

    C. The concentrations of radioactive materials in liquid effluents released to unrestricted areas should not exceed the concentration limits in Table 2, Column 2, of 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."

- The LWMS should be designed to meet the anticipated processing requirements of the plant. Adequate capacity should be provided to process liquid wastes during periods when major processing equipment may be down for maintenance (single failures) and during periods of excessive waste generation. Systems that have adequate capacity to process the anticipated wastes and that are capable of operating within the design objectives during normal operation, including anticipated operational occurrences, are acceptable. To meet these processing demands, interconnections between subsystems, redundant equipment, mobile equipment, and reserve storage capacity will be considered.

- System designs should describe features that will minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste, in accordance with the guidelines of RG 1.143, for liquids and liquid wastes produced during normal operation and anticipated operational occurrences, and the requirements of 10 CFR 20.1406. These system design features should be provided in the FSAR or the COL application to the extent that they are not addressed in a referenced certified design or DC application.

- BTP 11-6, as it relates to the assessment of a potential release of radioactive liquids following the postulated failure of a tank and its components that are located outside of

containment and impacts of the release of radioactive materials at the nearest potable water supply in an unrestricted area for direct human consumption or indirect consumption through animals, crops, and food processing.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (Vogtle Electric Generating Plant [VEGP] Units 3 and 4) were equally applicable to the LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP COL FSAR (and other parts of the COL application, as applicable) resulting from requests for additional information (RAIs).

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

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

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

The following portion of this technical evaluation section is reproduced from Section 11.2.4 of the VEGP SER:

AP1000 COL Information Items

The following portion of this technical evaluation section is reproduced from Section 11.2.4 of the BLN SER:

- *STD COL 11.2-1*

The applicant provided additional information in STD COL 11.2-1 to resolve COL Information Item 11.2-1. COL Information Item 11.2-1 states:

> *The Combined License applicant will discuss how any mobile or temporary equipment used for storing or processing liquid radwaste conforms to Regulatory Guide 1.143. For example, this includes discussion of equipment containing radioactive liquid radwaste in the non-seismic Radwaste Building.*

The commitment was also captured in COL Action Item 11.2-1 in Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

> *The COL applicant will provide information on how any mobile or temporary equipment used for storing or processing liquid radwaste conforms to RG 1.143.*

The applicant provided information in BLN COL FSAR Section 11.2.1.2.5.2 that addresses how any mobile or temporary equipment that will be used for storing or processing liquid radwaste conforms to RG 1.143. For example, this includes discussion of equipment containing radioactive liquid radwaste in the non-seismic Radwaste Building. The staff issued Request for Additional Information (RAI) 11.2-5 to clarify some of the language used in the COL concerning the extent of compliance with RG 1.143 for the temporary and mobile equipment. The applicant responded to this RAI by proposing a revision to the BLN COL FSAR text to clearly state that the applicable requirements in RG 1.143 pertain to mobile and temporary equipment.

The NRC staff reviewed the resolution of COL Information Item 11.2-1 related to the use of mobile or temporary equipment included under Section 11.2 of the BLN COL FSAR and found that the applicant's commitments for installing and operating mobile systems meets the acceptance criteria in Section 11.2 of NUREG-0800 and RG 1.143. The NRC staff verified that Revision 1 of the BLN COL FSAR (STD COL 11.2-1) adequately incorporates the above. As a result, RAI 11.2-5 is closed.

- *STD COL 11.2-2*

The discussion of VEGP COL 11.2-2 addresses the site-specific cost-benefit analysis performed to address the requirements of 10 CFR Part 50, Appendix I, regarding population doses due to liquid effluents. The applicant provided additional information in STD COL 11.2-2 to resolve COL Information Item 11.2-2 with regard to the cost-benefit analysis methodology.

The NRC staff reviewed the resolution of COL Information Item 11.2-2 related to the cost-benefit analysis methodology described in VEGP FSAR Section 11.2.3.5.1 and concluded that the methodology used for the analysis was consistent with the guidance of RG 1.110 and was, therefore, acceptable.

- LNP COL 11.2-1 and LNP COL 13.5-1

While BLN RAI 11.2-5 and COL FSAR Section 11.2.1.2.5.2 address mobile and temporary processing equipment, neither the response to BLN RAI 11.2-5 or information already contained in this FSAR section included a discussion of how the cumulative source term inventories of all relevant radioactive materials present in the Radwaste Building, including that in mobile or temporary equipment, conforms with the RG 1.143, Revision 2 dose acceptance criteria. Specifically, Regulatory Position C.5.1 of RG 1.143, Revision 2 states, "for a given structure housing radwaste processing systems or components, if the total design basis unmitigated radiological release

(considering the maximum inventory) at the boundary of the unprotected area is greater than 500 millirem per year or the maximum unmitigated exposure to site personnel within the protected area is greater than 5 rem per year, the external structures are classified as RW-IIa." Since the AP1000 Radwaste Building is classified as RW-IIc (a classification less stringent than RW-IIa), the inventories of radioactive materials in this building should be managed and controlled in a way that will not result in these dose criteria being exceeded.

After reviewing the response to BLN RAI 11.2-5 and the FSAR information addressing COL information item 11.2-1, the staff issued RAI 11.02-4 requesting that the applicant provide information related to the types and quantities of radioactive material within the Radwaste Building and describing how the unmitigated dose criteria to a worker and members of the public will be met, given the guidance and acceptance criteria of RG 1.143, Revision 2.

In the response to RAI 11.02-4, dated February 11, 2013, the applicant indicated that there will be three primary types of radioactive waste within the Radwaste Building. The three types of waste are; 1) liquid waste stored within the three 15,000 gallon monitor tanks, 2) waste associated with liquid mobile waste processing systems which may be utilized within the Radwaste Building, and 3) solid wastes and wastes which have been packaged and are ready for shipment.

The applicant provided information explaining how operational programs and procedures will ensure that the RG 1.143, Revision 2 dose criteria are not exceeded from the monitor tanks and mobile equipment. In this context, waste that is packaged and ready for shipment is not within the scope of RG 1.143, Revision 2. In its response, the applicant assumed that monitor tanks and a mobile skid-mounted processing system located in the radwaste building have the same radionuclide distributions and inventories as the effluent holdup tank listed in FSAR Table 2.4.13-202, normalized to the 10 CFR Part 71, Appendix A, A_2 limit (with A_2 quantities being calculated using 10 CFR Part 71, Appendix A information). The total radioactivity in a mobile skid-mounted processing equipment was assumed to be analogous to the radioactivity that would be contained in a demineralizer used for the same functional purpose. Using conservative assumptions, the applicant calculated dose rates that were less than the unmitigated release and exposure acceptance criteria of RG 1.143, Revision 2. In addition, the applicant provided a proposed FSAR markup and license condition requiring that procedures be developed, prior to fuel load, limiting the amount of radioactive materials in each of the monitor tanks and in the mobile processing equipment to below the 10 CFR Part 71 A_2 quantities.

While this response partially resolved the staff's technical and regulatory concerns, the effluent holdup tank radioactive source term, provided in FSAR Table 2.4.13-202, used in developing the A_2 quantities for the monitor tanks and mobile equipment was based on a fuel failure rate of 0.125 percent. While this fuel failure rate assumption is acceptable for complying with SRP Section 11.2, BTP 11-6, for the purposes of RG 1.143 the design basis failed fuel fraction of 0.25 percent should have been used instead, consistent with the guidance provided in SRP Section 12.2. In addition, while RG 1.143, Revision 2 indicates that the total building inventory should be considered in accordance with Regulatory Position C.5.1, it was unclear if the applicant was considering the cumulative source term of all components typically used in a mobile processing skid and if the cumulative source term from up to three mobile skids were being considered to support waste processing operations. AP1000 DCD, FSAR Chapter 11,

indicates that three mobile skids may be present at any one time in the Radwaste Building. Also, the staff was concerned that pre-processed or unpackaged waste may be present in the Radwaste Building, such as contaminated equipment or components or waste previously transferred from mobile equipment, and were potentially not being considered in the response and proposed FSAR markup and license condition. Finally, the staff determined that additional information should be provided in response to COL Information Items 11.2-1 and 11.4-1 since the responses to the COL items did not fully address how waste associated with mobile equipment or unpackaged waste would be controlled in complying with the safety classification assigned to the Radwaste Building. As a result, the staff closed RAI 11.02-4 and issued supplementary RAI 11.02-5 to resolve the above concerns and request additional information related to the response to COL Information Items 11.2-1 and 11.4-1 and conformance with RG 1.143, Revision 2, acceptance criteria.

In the initial response to RAI 11.02-5, dated April 26, 2013, the applicant revised the source term for an individual monitor tanks using the RCS source term and radionuclide concentrations described in FSAR Table 2.4.13-202 and DCD Table 11.1-2. This source term is based on the design basis defective fuel fraction of 0.25 percent. This source term was normalized to the 10 CFR Part 71, Appendix A, A_2 limit and is provided in Table 1 of the response. This source term was also used in calculating doses from each mobile waste processing skid, as each skid is also being limited to an inventory corresponding the 10 CFR Part 71, A_2 quantities. In addition, the applicant indicated that the source term assigned to each mobile skid was calculated assuming that the entire source term is contained in a demineralizer as a conservative approach in calculating doses. Using these source terms, the applicant recalculated the cumulative dose rate to a worker and member of the public from an unmitigated release. The applicant calculated a dose of 87 mrem to a member of the public at the protected area boundary using conservative assumptions. The dose to a worker was calculated to be 2,230 mrem at a distance of 10 feet from multiple radioactive sources in the building. However, the applicant did not provide the basis for the 10-foot distance in its analysis.

As a further commitment, the applicant updated FSAR Section 13.5.2.2.5 and proposed to revise operational procedures to include a provision requiring that spent filtration and adsorption media transferred from mobile radwaste processing systems be transferred and packaged for offsite shipment prior to placing the mobile radwaste processing system back into service. This provision is necessary to ensure that the total cumulative inventory of unpackaged waste in the RWB is not exceeded. Finally, the applicant updated its response to COL items 11.2-1 and 11.4-1 (FSAR Sections 11.2.1.2.5.2 and 11.4.6) and the proposed license condition, with new information, providing additional detail as to how the quantity of radioactive materials in the Radwaste Building will be controlled in ensuring that RG 1.143, Revision 2 dose acceptance criteria are met. However, even with the new information, staff determined that the proposed revision to the FSAR and new license condition did not provide sufficient information to ensure conformance with RG 1.143, Revision 2. Specifically, the applicant did not provide sufficient technical justification for the 10 foot distance used to calculate the unmitigated dose to a worker, and the proposed FSAR language and license condition did not ensure that all forms of unpackaged radioactive material in the Radwaste Building would be controlled during the operation of the plant.

Consequently, the staff requested that the applicant address these concerns, and the applicant provided an updated revision to the response on July 1, 2013. In this response, the proposed

FSAR markups were revised to include additional provisions to ensure that the total cumulative inventory of all unpackaged radioactive materials in the Radwaste Building would be limited to the unmitigated release and exposure criteria specified in RG 1.143, Revision 2. In addition, the applicant justified the assumed 10-foot distance in calculating the unmitigated dose to workers. The applicant explained that operator work stations and low dose rate waiting areas are typically no closer than 10 feet from the major sources of radioactivity located in the Radwaste Building. While the applicant provided a revised license condition in their response, the staff suggested specific revisions to the license condition to ensure that operational procedures limit all unpackaged waste in the Radwaste Building to the RG 1.143, Revision 2 dose acceptance criteria.

On August 23, 2013, the applicant provided a revised response to RAI 11.05-2 modifying the proposed license condition wording in LNP COL application, Part 10, License Conditions and ITAAC, and in Section 13, "Radwaste Building Radioactivity Limits" of the LNP FSAR, to ensure that operational procedures limit all unpackaged waste in the Radwaste Building to the RG 1.143, Revision 2 dose acceptance criteria, as suggested by the staff. In addition, the applicant proposed revised FSAR language in the response, but the proposed FSAR language was not entirely consistent with the proposed license condition. Finally, in a September 12, 2013, response (ML13259A147), the applicant proposed to revise the FSAR wording to make it consistent with the proposed license condition. The proposed FSAR wording and license condition ensure that the cumulative inventory of all unpackaged waste will be controlled in accordance with RG 1.143, Revision 2.

In summary, the applicant provided additional information in FSAR Sections 11.2.1.2.5.2, 11.4.6, and 13.5.2.2.5 which fully address COL Information Items 11.2-1 and 11.4-1 (a parallel discussion related to the resolution of COL Information Item 11.4-1 is provided in SER Section 11.4.4, below). Specifically, the applicant committed to the implementation of operational procedures that will ensure that the quantity of radioactive materials associated with each of the three monitoring tanks, in each of up to three mobile processing systems, and in any additional equipment located in the Radwaste Building, containing unpackaged waste, are limited to less than the 10 CFR Part 71, A_2 quantities. In addition, the applicant's procedures ensure that the total cumulative inventory of all unpackaged waste in the Radwaste Building (including the waste in the monitoring tanks, mobile processing systems, and any additional equipment, as well as any other unpackaged waste in the Radwaste Building) is limited consistent with the RG 1.143, Revision 2 dose acceptance criteria, given the safety classification RW-IIc assigned to the Radwaste Building. Finally, the revised license condition and FSAR language ensure that the applicant's procedures will conform with RG 1.143, Revision 2. Therefore, the September 12, 2013, response to RAI 11.02-5, including the proposed license condition, is acceptable. In addition, the response fully and adequately addresses COL Information Items 11.2-1 and 11.4-1. The staff confirmed that FSAR Sections 11.2.1.2.5.2, 11.4.6, and 13.5.2.2.5 were updated in accordance with the language in the September 12, 2013 letter.

- LNP COL 11.2-2

The applicant provided additional information in LNP COL 11.2-2 to resolve COL Information Item 11.2-2, which states:

> The analysis performed to determine offsite dose due to liquid effluents is based upon the AP1000 generic site parameters included in Chapter 1 and Tables 11.2-5 and 11.2-6. The Combined License [COL] applicant will provide a site specific cost-benefit analysis to address the requirements of 10 CFR 50, Appendix I, regarding population doses due to liquid effluents.

The commitment was also captured as COL Action Item 11.2-2 in Appendix F of NUREG-1793, which states:

> The applicant will provide a site-specific cost-benefit analysis to demonstrate compliance with 10 CFR Part 50, Appendix I, regarding population doses due to liquid effluents.

In LNP COL FSAR Section 11.2.3.5.3, the applicant provided a complete cost-benefit analysis for the site according to the guidance in RG 1.110 using the population doses stated in FSAR Section 11.2.3.5.2.

The results of the applicant's analysis showed that the lowest-cost option for liquid radwaste treatment system augments is a 20 gallons per minute (gpm) cartridge filter processing system at a cost of $11,140 per year. Assuming that this filter will eliminate all radioactive material from the liquid effluent, thereby eliminating all environmental dose consequence, the resulting cost per dose reduction was $9,858 per total body person-rem ($11,140/1.13 person-rem) and $9,207 per thyroid person-rem. These cost-benefit estimates are above the criterion of $1,000 per person-rem reduction, as specified in 10 CFR Part 50, Appendix I, Section II.D, for the inclusion of additional radwaste processing capabilities. Thus, the applicant concluded that the LWMS meets the as low as reasonably achievable (ALARA) requirements and requires no augments.

The NRC staff performed an independent assessment of the population doses, considering the reasonableness of the modeling assumptions as provided by the applicant in LNP COL FSAR Tables 11.2-201 and 11.2-202 and the guidance in RG 1.110. The staff's assessment, with independent calculations, confirmed the applicant's analytical results that the LWMS meets the cost-benefit design criterion of 10 CFR Part 50, Appendix I, Section II.D. Thus, the staff finds the applicant's assessment of the population doses acceptable.

- LNP COL 2.4-5 and LNP COL 15.7-1

The applicant provided additional information in LNP COL 2.4-5 and 15.7-1 to resolve COL Information Items 2.4-5 and 15.7-1.

COL Information Item 2.4-5 states:

> Combined License applicants referencing the AP1000 certified design will address site-specific information on the ability of the ground and surface water to disperse, dilute, or concentrate accidental releases of liquid effluents. Effects of these releases on existing and known future use of surface water resources will also be addressed.

The commitment was also captured as COL Action Item 2.4.1-1 in Appendix F of NUREG-1793, which states:

> The COL applicant will provide site specific information on the ability of the ground and surface water to disperse, dilute, or concentrate accidental releases of liquid effluents. The COL applicant will also address the effects of such releases on existing and known future use of surface water resources.

COL Information Item 15.7-1 states:

> Combined License applicants referencing the AP1000 certified design will perform an analysis of the consequences of potential release of radioactivity to the environment due to a liquid tank failure as outlined in subsection 15.7.3.

The commitment was also captured as COL Action Item 15.3.8-1 in Appendix F of NUREG-1793, which states:

> The COL applicant will perform a site-specific analysis of the consequences of a potential release of radioactivity to the environment as a result of a liquid tank failure.

LNP COL FSAR Section 2.4.13 addresses accidental release of liquid effluents into ground and surface water. The applicant postulated a release of the contents of the waste liquid system effluent hold-up tank, consistent with the guidance provided in BTP 11-6. BTP 11-6 provides guidance in assessing potential release of radioactive liquids at the nearest potable water supply located in an unrestricted area. BTP 11-6 further states the evaluation of the release should consider the use of water for direct human consumption or indirect consumption through animals (livestock watering), crops (agricultural irrigation), and food processing (water as an ingredient).

All the liquid radwaste system waste tanks were considered in the applicant's evaluation based on their location in a nonseismic building. The applicant determined that the effluent holdup tanks have both the highest potential radioactive isotope inventory and the largest volume, so these tanks were used to perform the analysis. The applicant considered these tanks a conservative selection for the purpose of calculating the effects of the failure of a radioactive liquid-containing tank. There are two 28,000-gallon holdup tanks per unit. For the evaluation, one tank was postulated to fail. The failed tank was assumed to be 80 percent full and contain radionuclide concentrations corresponding to 101 percent of the reactor coolant source term. The concentrations of radionuclides are taken from AP1000 DCD, Table 11.1-2, "Design Basis Reactor Coolant Activity."

The entire contents of the tank were assumed to be released to the Floridan aquifer, the principal source of potable water near the LNP site. This was deemed a conservative assumption based on the hydraulic conductivity of the Floridan aquifer which is about twice as high as that of the surficial aquifer and a presumption that most of the release would be to the surficial aquifer rather that the Floridan aquifer. The release migrates southwest in the direction of decreasing hydraulic head. There are public supply wells in the direction of groundwater flow, at least 5 miles from the LNP site. The nearest resident in the direction of groundwater flow is 2.7 km west-southwest of the LNP site. Groundwater is extracted from the Floridan aquifer for potable use at the LNP site.

The applicant analyzed two cases. The first was a hypothetical nearest well supplied by the Floridan aquifer at 2 km southwest of LNP. This location is in the direction of groundwater flow and is on the LNP site boundary. The second case examined the Lower Withlacoochee River. The applicant identified no users of this surface water, but assumed the pathway is groundwater that moves downgradient from the LNP site and resurfaces within the Lower Withlacoochee River, at a distance of approximately 7 km.

The applicable regulatory acceptance criteria for a liquid waste tank failure is that the postulated failure would not result in radionuclide concentrations in excess of 10 CFR Part 20, Appendix B, Table 2, Column 2, effluent concentration limits (ECLs) at the nearest source of potable water. These radionuclide concentrations correspond to a calculated dose of 50 mrem per year from the drinking water pathway. The applicant provided an analysis for compliance with 10 CFR Part 20 in LNP COL FSAR Section 2.4.13.2.3 and in LNP COL FSAR Tables 2.4.13-204 and 2.4.13-205. Compliance is demonstrated by evaluating the ratios of the calculated aquifer radionuclide concentration to its ECL value for all released radionuclides. Using standard, acceptable groundwater modeling techniques, the applicant demonstrated compliance by showing that the sum of the ECL ratios for both locations was less than unity. The result of this calculation was that the sum of the ratios was less than 10^{-10}, or essentially zero, at the Lower Withlacoochee River location, and 0.007 at the well location, or 0.7 percent of the 50 mrem criterion for inclusion of the pathway in considering the MEI.

The staff's analysis considered whether other surface water pathways, such as ingestion of fish living in water containing radionuclides and ingestion of crops irrigated with water containing radionuclides could significantly increase exposures. The staff performed an independent evaluation of the fish ingestion pathway at the Lower Withlacoochee River location and of the vegetable ingestion pathway for crop irrigation at the well location. The evaluations showed that these additional pathways are not significant. The independent evaluations are presented below.

LNP SER Table 11.2-1 presents the results of a conservative dose assessment for fish consumption from the Lower Withlacoochee River. The radionuclide concentrations assumed for this location are as presented in LNP COL FSAR Table 2.4.13-204. In LNP SER Table 11.2-1, the fifth column is the calculated dose for an individual consuming 21 kilograms (kg) per year fish from the Lower Withlacoochee River assuming the radionuclide concentrations in the river remain at the assumed concentrations for the year. (Assumed fish consumption quantities represent the maximally exposed individual (MEI) values from RG 1.109.)

As SER Table 11.2-1 shows, the conservatively calculated MEI dose for one year of exposure from the fish exposure pathway is less than 10^{-9} mrem, significantly less than the corresponding 50 mrem dose criterion.

The staff also performed a conservative dose assessment for ingestion of vegetables irrigated with groundwater from the hypothetical nearest well in the Floridan aquifer in the direction of groundwater flow. The radionuclide concentrations in water from the hypothetical well are calculated to be higher than those in the river, so the well water concentrations were used for estimating the dose from vegetables irrigated with water. The radionuclide concentrations for this location are those presented in LNP COL FSAR Table 2.4.13-205. Assuming this groundwater concentration for a year following a tank failure and the modeling of RG 1.109 for irrigated crops (60-day growing period and maximum individual vegetable consumption rate of 520 kilograms per year (kg/yr)), the resulting hypothetical dose to an individual would be 0.04 mrem. The staff determined that the calculated MEI dose of 0.04 mrem for one year of exposure from the ingestion of vegetables irrigated with water from the hypothetical nearest well in the Floridan aquifer is well below the threshold requiring inclusion in the comparison with the 50-mrem dose criterion.

In response to RAI 2.4.13-1, the applicant addressed the issue of dose from fish and vegetable ingestion associated with the tank failure accident. Based on a conservative analysis for fish living in water with radionuclide concentrations equal to that in the water of the hypothetical nearest well in the Floridan aquifer, the applicant concluded the dose would be 4.3E-3 mrem per year (mrem/yr). The applicant's estimate of dose from ingestion of vegetables irrigated with well water from the Floridan aquifer was 0.017 mrem/yr. This estimate is lower than the staff's evaluation because of different modeling and assumptions (e.g., the applicant assumed 14 kg/y consumption versus 520 kg/yr assumed by staff). Both the applicant's and the staff's assessments indicate no significant contribution to dose via the fish and irrigated crop pathways for the tank failure analysis.

Based on the above evaluations by the staff and the applicant's analysis in the FSAR and in its response to RAI 2.4.13-1, the staff finds potential doses to members of the public resulting from an accidental release of liquid effluents meet NUREG-0800, Section 2.4.13 Acceptance Criterion No. 5 and the referenced BTP 11-6.

- LNP COL 11.5-3

The applicant provided additional information in LNP COL 11.5-3 to resolve the COL Information Item 11.5-3, which states:

> The Combined License applicant is responsible for addressing the 10 CFR Part 50, Appendix I, Sections II.A and II.D guidelines for maximally exposed offsite individual doses and population doses via liquid and gaseous effluents.

The commitment was also captured as COL Action Item 11.5-3 in Appendix F of NUREG-1793, which states:

> The COL applicant is responsible for addressing the guidelines of Appendix I to 10 CFR Part 50, as they relate to maximally exposed offsite individual doses and population doses attributable to liquid and gaseous effluents.

In LNP COL FSAR Section 11.2.3.5, the applicant discussed the methods used to assure that individual and estimated population doses are maintained ALARA in accordance with 10 CFR Part 50, Appendix I. (This information is also applicable to LNP COL FSAR Sections 11.3.3.4 and 11.4.)

The NRC staff reviewed the applicant's response to LNP COL 11.5-3 related to compliance with 10 CFR Part 50, Appendix I, Sections II.A and II.D and issued RAI 11.2-1. RAI 11.2-1 requested that the applicant provide the details of the individual and population dose analyses.

In response to RAI 11.2-1, the applicant provided a description of the required model assumptions and input parameters needed to run LADTAP II computer codes to calculate radionuclide concentrations in Crystal Bay (Gulf of Mexico) that are released via the Crystal River Energy Complex (CREC) Discharge Canal.

Using radiological exposure models based on RG 1.109 and the LADTAP II computer program (NUREG/CR-4013, "LADTAP II - Technical Reference and User Guide," April 1986), the applicant calculated the estimated doses to a hypothetical MEI of the public and to the population within 80 km (50 mi) from the postulated liquid effluents discharged.

LNP COL FSAR Table 11.2-201, "Dilution Factors," and Table 11.2-202, "LADTAP II Input for Dose Rates," include liquid pathway parameters used as input to the dose calculation, including cooling tower blowdown flow rate, site-specific dilution factors, transit times to receptors, fish and invertebrate harvest rates, and recreational usage data for the Gulf of Mexico. Discharge is to the Gulf of Mexico, via the CREC. The applicant chose the simple dilution model to calculate dilution of the radioactive effluent. The only dilution assumed was that provided by the effluent mixing with the flow in the Discharge Canal. LNP COL FSAR Tables 11.2-203 and 11.2-204 list the liquid pathway doses to the MEI and surrounding population, respectively.

The applicant calculated a maximum annual individual total body dose to the teenager of 0.000052 mSv (0.0052 mrem) and a maximum annual individual organ dose to the adult GI-LLI of 0.000714 mSv (0.0714 mrem) from all applicable exposure pathways. The applicant compared the MEI doses with the 10 CFR Part 50, Appendix I, Section II.A criteria and showed the doses to be well below the limits of 0.03 mSv (3 mrem) to the total body and 0.1 mSv (10 mrem) to any organ.

The calculated annual population doses listed in LNP COL FSAR Table 11.2-204 are 0.0113 person-Sv (1.13 person-rem) to the total body, and 0.0121 person-Sv (1.21 person-rem) to the thyroid. The applicant used the population doses in the cost-benefit analysis previously described in this SER.

In response to RAI 11.2-1, the applicant explained the derivation of values used for population, water use, sport fish harvest, commercial fish harvest, and recreational time spent on the Gulf of

Mexico. The staff reviewed the derivation of these values and found them to be reasonable upper-bound estimates that are unlikely to be exceeded. Consequently, the staff used the applicant's values in their independent dose estimation.

The NRC staff performed an independent assessment using the LADTAP II computer code and compared the results to those of the applicant and the Appendix I criteria. The modeling assumptions used by the staff for the MEI and population dose calculations, as shown in SER Table 11.2-2, were consistent with the applicant's. Modeling parameter values, as shown in SER Table 11.2-3, were also consistent with the applicant's. The results of the staff's calculations were consistent with those of the applicant's.

SER Table 11.2-4 compares the resulting dose estimates between the applicant's analysis and the 10 CFR Part 50, Appendix I criteria. Table 11.2-4 shows that all doses are below the Appendix I criteria. The NRC staff determined that the applicant had provided a bounding assessment demonstrating its capability to comply with the regulatory requirements in 10 CFR Part 20 and 10 CFR Part 50, Appendix I and, therefore, considers COL Information Item 11.5-3 resolved and RAI 11.2-1 closed.

Liquid Radwaste Discharge Path Recirculation

In the course of an environmental audit site visit, the staff found that periodically detectable levels of tritium from the Crystal River Nuclear Generating Plant Unit 3 (CR-3) discharge have been measured in the CR-3 intake canal water in samples collected as part of the routine radiological environmental monitoring program at CR-3. This indicated a potential recirculation pathway relevant to 10 CFR Part 50, Appendix I guidelines applicable to LNP liquid releases, since the LNP discharge would be via the CR-3 discharge structure/canal. In RAI 11.2-3, the applicant was requested to provide an evaluation of this potential recirculation pathway and to provide additional information, as applicable, on the impact this recirculation path could have on potential doses from liquid effluents. In response to RAI 11.2-3, the applicant stated that the existence of a recirculation path would not have an effect on the calculated doses from LNP liquid effluents or compliance with 10 CFR Part 50, Appendix I. The applicant provided an analysis that showed that any recirculation that would occur was nonuniform in both magnitude and time/duration. As indicated, the receiving water body (Gulf of Mexico) and the periodic recirculation is not defined as a confined system (impoundment) that would lead to buildup in radioactivity levels over time.

The staff performed a simplified, conservative assessment of the periodic recirculation that could occur, considering the CR-3 circulation flow and the LNP discharge flow. Since the flow in the CR-3 circulation loop is calculated as 20 times greater than the discharge flow from LNP, the concentration of radionuclides in the LNP discharge canal would be diluted by a corresponding factor. Under certain tide and wind conditions, some of this discharge, with the diluted concentration of radionuclides, could be drawn back into the CR-3 intake. An earthen dike separates the CR-3 intake canal from the discharge area to minimize any recirculation effect. Recirculation would only occur during flood tidal conditions where the tidal flow would reverse the discharge plume into the area of the intake for CR-3. Since the discharge canal is not a closed loop, recirculation would be for a limited duration, affected by the shifts in local flows caused by diurnal tides and winds. Neglecting the effect of the earthen dike, the near-field concentration entering the intake canal could be as high as that being discharged to the Gulf of Mexico (i.e., the LNP discharge concentration divided by 21). This condition would exist for only

as long as the opposing tidal currents prevailed, which would be a maximum of 6 hours before reversal of flow. Depending on the residence time for water in the intake/discharge canal loop, the result of the continuous intermittent reconcentration is that the average concentration, for the purposes of 10 CFR Part 50, Appendix I compliance, would be not more than 1.5 to 1.6 times the LNP discharge concentration, divided by the dilution factor of 21.

The applicant's assessment takes no credit for the earthen dike constructed to minimize the recirculation effect and assumes 100 percent recirculation, which does not appear likely. As presented in the applicant's response, the calculated liquid pathway doses with no recirculation considered were less than 0.8 percent of the applicable dose criterion of 10 CFR Part 50, Appendix I. Thus, a potential 1.5 or 1.6 recirculation factor would not result in doses more than 2 percent of the dose criterion. The NRC staff verified the applicant's statement that the existence of a recirculation path would not have an effect relative to 10 CFR Part 50, Appendix I. Therefore, this issue is resolved and RAI 11.2-3 is closed.

The following portion of this technical evaluation section is reproduced from Section 11.2.4 of the VEGP SER:

Supplemental Information

> *The following portion of this technical evaluation section is reproduced from Section 11.2.4 of the BLN SER:*
>
> - *STD SUP 11.2-1*
>
> *The applicant provided supplemental information in BLN COL FSAR Section 11.2.3.6, "Quality Assurance," addressing the quality assurance program to be applied to the liquid waste system and stated that the program complies with the guidance presented in RG 1.143.*
>
> *The NRC staff reviewed this supplemental quality assurance information included in BLN COL FSAR Section 11.2.3.6 and finds that this supplemental statement commits the applicant to the regulatory positions in RG 1.143 related to quality assurance and is acceptable.*

- LNP SUP 11.2-1

The applicant provided supplemental information addressing the exterior radwaste discharge piping in LNP COL FSAR Section 11.2.1.2.4, "Controlled Release of Radioactivity." In letters dated May 4, 2011, and December 7, 2011, the applicant proposed adding to the FSAR descriptions of the site-specific design features of the discharge piping.

This matter is related to 10 CFR 20.1406 and is addressed in SER Section 12.3.

License Condition

In a letter dated August 23, 2013, the applicant proposed the following license condition:

> Prior to initial fuel load, the licensee shall develop, implement, and maintain procedural controls limiting radionuclide inventory in each of the Radwaste Building Monitor Tanks, and separately in each of up to three (3) Radwaste Building mobile radwaste processing systems to below A_2 quantities for radionuclides specified in Appendix A to 10 CFR Part 71 (Tables A-1 and A-3), as described in FSAR Section 13.5.2.2.5. The procedures shall also ensure that any additional equipment located in the RWB is limited to the A_2 quantities and that the total cumulative radioactive inventory contained in unpackaged wastes (including liquid waste, wet waste, solid waste, gaseous waste, activated or contaminated metals and components, and contaminated waste present at any time in the Radwaste Building) is limited so that an unmitigated release, occurring over a 2-hour time period, would not result in a dose of greater than 500 millirem at the protected area boundary or an unmitigated exposure, occurring over a 2 hour time period, would not result in a dose of greater than 5 rem to site personnel located 10 feet from the total cumulative radioactive inventory.

The evaluation of this license condition is discussed above in the evaluation of LNP COL 11.2-1 and LNP COL 13.5-1.

Demonstrating Compliance with 10 CFR 20.1301(e)

10 CFR 20.1301(e) requires that NRC-licensed facilities comply with the Environmental Protection Agency (EPA) generally applicable environmental radiation standards of 40 CFR Part 190 for facilities that are part of the fuel cycle. The EPA annual dose limits are 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ. Meeting the requirements of 10 CFR 20.1301(e) requires the consideration of all potential sources of external radiation and radioactivity, including liquid and gaseous effluents and external radiation exposures from buildings, storage tanks, and radioactive waste storage areas. The EPA standards apply to the entire site or facility, whether it has a single unit or multiple units.

The staff's review of the LNP COL FSAR (Revision 0) revealed that the applicant did not provide sufficient information demonstrating compliance with 10 CFR 20.1301(e). The staff issued RAI 11.2-2 requesting that the applicant provide this information.

The applicant demonstrated compliance with the EPA standard in the LNP COL FSAR by summing the annual individual liquid and gaseous effluent doses for the planned LNP Units 1 and 2, as well as the existing CR-3. The applicant lists the results in LNP COL FSAR Table 11.2-205. SER Table 11.2-5 lists these dose summations and compares them to the dose requirements in 40 CFR Part 190. The expected doses are below the EPA limits. The staff confirmed that the doses listed in Table 11.2-5 are correct and determined that the applicant's effluent releases would be within the 40 CFR Part 190 standard. RAI 11.2-2 is closed.

Demonstrating Compliance with 10 CFR 20.1302

The annual average concentration of radioactive material released in liquid effluents at the boundary of the unrestricted area must not exceed the values specified in Table 2 of

Appendix B to 10 CFR Part 20. The applicant demonstrated compliance with this requirement by referencing the AP1000 DCD. Section 11.2.3.4 of the DCD shows that even at the Technical Specification limit for percent failed fuel defects, the nominal blowdown flow provides sufficient dilution to ensure that the expected effluent release concentrations would be less than those specified in Table 2 of Appendix B to 10 CFR Part 20.

In NUREG-1793, the staff evaluated and accepted the conclusions of Section 11.2.3.4 of the AP1000 DCD. Based on this acceptance, the staff concludes that the applicant complies with 10 CFR 20.1302.

Demonstrating Compliance with 10 CFR 20.1406

10 CFR 20.1406 requires the applicant to provide a description of how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste. The applicant demonstrated compliance with this requirement by incorporating by reference the design descriptions provided in the AP1000 DCD and providing the description of operating programs in LNP COL FSAR Section 12.3. The staff's evaluation and conclusion pertaining to compliance with 10 CFR 20.1406 are included in SER Sections 12.3 and 12.5.

11.2.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff proposes to include the following license condition:

- License Condition (11-1) – Before initial fuel load, the licensee shall develop, implement, and maintain procedural controls limiting radionuclide inventory in each of the Radwaste Building Monitor Tanks, and separately in each of up to three (3) Radwaste Building mobile radwaste processing systems to below A_2 quantities for radionuclides specified in Appendix A to 10 CFR Part 71 (Tables A-1 and A-3), as described in FSAR Subsection 13.5.2.2.5. The procedures shall also ensure that any additional equipment located in the RWB is limited to below A_2 quantities and that the total cumulative radioactive inventory contained in unpackaged wastes (including liquid waste, wet waste, solid waste, gaseous waste, activated or contaminated metals and components, and contaminated waste present at any time in the Radwaste Building) is limited so that an unmitigated release, occurring over a two hour time period, would not result in a dose of greater than 500 millirem at the protected area boundary or an unmitigated exposure, occurring over a two hour time period, would not result in a dose of greater than 5 rem to site personnel located 10 feet from the total cumulative radioactive inventory.

11.2.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the LWMS, and there is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff evaluated the additional COL information (STD COL 11.2-1, STD COL 11.2-2, LNP COL 11.2-1, LNP COL 11.2-2, LNP COL 2.4-5, LNP COL 15.7-1, LNP COL 11.5-3, LNP COL 13.5-1, STD SUP 11.2-1, and LNP SUP 11.2-1) and the proposed license condition in the application against the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 11.2, and other NRC regulatory guides. The applicant has satisfactorily addressed all RAIs related to Section 11.2.

The staff verified that the applicant has provided sufficient information and that the review and calculations support the conclusions that the LWMS (as a permanently installed system or in combination with mobile systems) includes the equipment necessary to control releases of radioactive materials in liquid effluents in accordance with GDC 60 and 61 of Appendix A to 10 CFR Part 50 and the requirements of 10 CFR 50.34a. The staff concludes that the design of the LWMS is acceptable and meets the requirements of 10 CFR 20.1301(e), 10 CFR 20.1302, 10 CFR 20.1406, 10 CFR 50.34a, 10 CFR 52.79(a)(3), GDC 60 and 61, and Appendix I to 10 CFR Part 50.

11.3 Gaseous Waste Management System

11.3.1 Introduction

The gaseous waste management system (GWMS) is designed to control, collect, process, handle, store, and dispose of gaseous radioactive waste generated as the result of normal operation, including anticipated operational occurrences.

11.3.2 Summary of Application

Section 11.3 of the LNP COL FSAR, Revision 9, incorporates by reference Section 11.3 of the AP1000 DCD, Revision 19.

In addition, in LNP COL FSAR Section 11.3, the applicant provided the following:

AP1000 COL Information Items

- STD COL 11.3-1

The applicant provided additional information in STD COL 11.3-1 to resolve COL Information Item 11.3-1 (COL Action Item 11.3-1) regarding gaseous radwaste cost-benefit analysis methodology.

- LNP COL 11.3-1

The applicant provided additional information in LNP COL 11.3-1 to resolve COL Information Item 11.3-1 (COL Action Item 11.3-1). The additional information addresses the estimated doses to the public from the gaseous waste system and the associated cost-benefit analysis in LNP COL FSAR Section 11.3.3.4.

- LNP COL 11.5-3

The applicant provided additional information in LNP COL 11.5-3 to resolve COL Information Item 11.5-3 (COL Action Item 11.5-3). The additional information addresses compliance with 10 CFR Part 50, Appendix I, Sections II.B and II.C related to operation of the gaseous waste system in LNP COL FSAR Section 11.3.3.4.

Supplemental Information

- STD SUP 11.3-1

The applicant added supplemental information in LNP COL FSAR Section 11.3.3.6 to address the QA program to be applied to the GWMS.

- STD SUP 11.3-2

The applicant added supplemental information in LNP COL FSAR Section 11.3.3 to address the gaseous effluent site interface parameter.

11.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements.

In addition, the regulatory basis for acceptance of the additional information on the GWMS is established in:

- 10 CFR 20.1301(e)
- 10 CFR 20.1302
- 10 CFR 20.1406
- 10 CFR 50.34a
- 10 CFR Part 50, Appendix A, GDC 60
- 10 CFR Part 50, Appendix A, GDC 61
- 10 CFR Part 50, Appendix I, Sections II.B, II.C and II.D
- 10 CFR 52.79(a)(3)
- 10 CFR 52.80(a)

Guidance for meeting these requirements is in:

- Regulatory Position C.2 of RG 1.143, Revision 2

- RG 1.109, Revision 1

- RG 1.110
- RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Nuclear Power Reactors," Revision 1
- RG 4.21

The acceptance criteria associated with the GWMS are given in Section 11.3 of NUREG-0800, including BTP 11-5.

11.3.4 Technical Evaluation

The NRC staff reviewed Section 11.3 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the GWMS. The results of the NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

The staff's review of this application included the following COL information and supplementary items:

- STD COL 11.3-1, Gaseous Radwaste Cost-Benefit Analysis Methodology
- LNP COL 11.3-1, Cost-Benefit Analysis of Population Doses
- LNP COL 11.5-3, 10 CFR Part 50, Appendix I, Sections II.B and II.C
- STD SUP 11.3-1, Supplemental Information on Quality Assurance
- STD SUP 11.3-2, Supplemental Information on Gaseous Effluent Site Interface Parameters

In addition to the above items, the staff reviewed the entire section against Section 11.3 of NUREG-0800 to determine if the information in LNP COL FSAR Section 11.3 met the regulatory requirements in the regulations stated above (SER Section 11.3.3) and NUREG-0800 acceptance criteria. The relevant NUREG-0800 acceptance criteria are as follows:

- The GWMS should have the capability to meet the dose design objectives and should include provisions to treat gaseous radioactive wastes, such that the following is true:

    A. The calculated annual total quantity of all radioactive materials released from each reactor to the atmosphere will not result in an estimated annual external dose from gaseous effluents to any individual in unrestricted areas in excess of 0.05 mSv (5 mrem) to the total body or 0.15 mSv (15 mrem) to the skin. RGs 1.109 and 1.111 provide acceptable methods for performing this analysis.

B. The calculated annual total quantity of radioactive materials released from each reactor to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level, which could be occupied by individuals in unrestricted areas in excess of 0.01 centiGray (cGy) (10 millirads (mrad)) for gamma radiation or 0.02 cGy (20 mrad) for beta radiation. RGs 1.109 and 1.111 provide acceptable methods for performing this analysis.

C. The calculated annual total quantity of radioiodines, carbon-14, tritium, and all radioactive materials in particulate form released from each reactor at the site in effluents to the atmosphere will not result in an estimated annual dose or dose commitment from such releases for any individual in an unrestricted area from all pathways of exposure in excess of 0.15 mSv (15 mrem) to any organ. RGs 1.109 and 1.111 provide acceptable methods for performing this analysis.

D. In addition to 1.A, 1.B, and 1.C, above, the GWMS should include all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, for a favorable cost-benefit ratio, can effect reductions in dose to the population reasonably expected to be within 80 km (50 mi) of the reactor. RG 1.110 provides an acceptable method for performing this analysis.

E. The concentrations of radioactive materials in gaseous effluents released to an unrestricted area should not exceed the limits specified in Table 2, Column 1, of Appendix B to 10 CFR Part 20.

F. The regulatory position in RG 1.143 is met, as it relates to the definition of the boundary of the GWMS, beginning at the interface from plant systems to the point of controlled discharges to the environment as defined in the Offsite Dose Calculation Manual (ODCM), or at the point of storage in holdup tanks or decay beds for gaseous wastes produced during normal operation and anticipated operational occurrences.

- System designs should describe features that will minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste in accordance with RG 1.143, for gaseous wastes produced during normal operation and anticipated operational occurrences, and the requirements of 10 CFR 20.1406. These system design features should be provided in the FSAR or the COL application to the extent that they are not addressed in a referenced certified design or design certification application.

- BTP 11-5, as it relates to potential releases of radioactive materials (noble gases) as a result of postulated leakage or failure of a waste gas storage tank or offgas charcoal delay bed.

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

Units 3 and 4) were equally applicable to the LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

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

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

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

AP1000 COL Information Items

The following portion of this technical evaluation section is reproduced from Section 11.3.4 of the VEGP SER:

- *STD COL 11.3-1*

  The discussion of VEGP COL 11.3-1 addresses the site-specific cost-benefit analysis performed to address the requirements of 10 CFR Part 50, Appendix I, regarding population doses due to gaseous effluents. The applicant provided additional information in STD COL 11.3-1 to resolve COL Information Item 11.3-1 with regard to the cost-benefit analysis methodology.

  The NRC staff reviewed the resolution to COL Information Item 11.3-1 related to the cost-benefit analysis methodology described in VEGP COL FSAR Section 11.3.3.4 and concluded that the methodology used for the analysis was consistent with the guidance of RG 1.110 and was, therefore, acceptable.

- LNP COL 11.3-1

The applicant provided additional information in LNP COL 11.3-1 to resolve COL Information Item 11.3-1. COL Information Item 11.3-1 states:

> The analysis performed to determine offsite dose due to gaseous effluents is based upon the AP1000 generic site parameters included in Chapter 1 and Tables 11.3-1, 11.3-2 and 11.3-4. The Combined License applicant will provide a site specific cost-benefit analysis to demonstrate compliance with 10 CFR 50, Appendix I, regarding population doses due to gaseous effluents.

The commitment was also captured in COL Action Item 11.5-3 in Appendix F of NUREG-1793, which states:

> The COL applicant will provide a site-specific cost-benefit analysis to demonstrate compliance with 10 CFR 50, Appendix I, regarding population doses due to gaseous effluents.

The NRC staff reviewed the resolution of COL Information Item 11.3-1 related to the cost-benefit analysis included under Sections 11.3.3.4.4 and 11.3.5.1 of the LNP COL FSAR.

The applicant performed a site-specific analysis to determine that the offsite dose due to gaseous effluents is bounded by the AP1000 site parameters included in AP1000 DCD Chapter 1 and Tables 11.3-1, 11.3-2, and 11.3-4. The applicant discussed the site-specific cost-benefit analysis in LNP COL FSAR Section 11.3.3.4 to address the requirements of 10 CFR Part 50, Appendix I, Section II.D, regarding population doses due to gaseous effluents. The dose and dose rate to man was calculated using the GASPAR II computer code, which is based on the methodology presented in RG 1.109.

As shown in LNP COL FSAR Section 11.3.3.4.4 and SER Table 11.3-1, the LNP population doses are 5.74 person-rem total body and 8.33 person-rem thyroid.

The results of the applicant's analysis showed that the lowest-cost option for gaseous radwaste treatment system augments is a steam generator flash tank vent to main condenser at a total annual cost (TAC) of $6,320. Assuming that this augment will eliminate all radioactive materials from the gaseous effluent, the resulting cost per dose reduction was $1,100 per total body person-rem ($6,320/5.74 person-rem) and $759 per thyroid person-rem ($6,320/8.33 person-rem). While the costs per person-rem reduction exceed the $1,000 per person-rem criterion in Appendix I to Part 50 for the total body dose, the costs per person-rem reduction are below the $1,000 per person-rem criterion for the thyroid dose and, therefore, warranted further evaluation.

The applicant evaluated four potential augments for the thyroid dose as described below. Since the estimated thyroid dose of 8.33 person-rem exceeds the 6.32 person-rem threshold value ($6,320 augment at $1,000 per person-rem), those system augments listed in RG 1.110 with a TAC less than $8,330 were evaluated by the applicant to determine if any would be cost-beneficial.

As noted above, the lowest-cost option evaluated by the applicant for gaseous radwaste treatment system augments is a steam generator flash tank vent to main condenser. The TAC for this augment is $6,320; thus to be cost beneficial at $1,000 per person-rem, this augment must remove at least 6.32 person-rem (thyroid), that is to decrease the thyroid dose from 8.33 to 2.01 person-rem. This augment would be to a system not included in the AP1000 design, installation of a flash tank. Therefore, the TAC for this augment is underestimated in the AP1000 design. The AP1000 design instead uses steam generator blowdown heat exchangers that prevent flashing prior to blowdown flow entering the main condenser, effectively performing the same function as the augment. Therefore, the applicant determined that this augment could not provide enough dose reduction to be cost beneficial.

The second option evaluated was a main condenser vacuum pump charcoal/high-efficiency particulate air (HEPA) filtration system, with a TAC of $7,690. Thus, to be cost-beneficial, this augment would need to decrease the thyroid dose by 7.69 person-rem, from 8.33 to 0.64 person-rem. However, as shown in AP1000 DCD Table 11.3-3, sheet 2 of 3, incorporated by reference by the applicant, no iodine would be released through the condenser air removal system, so this augment does not affect the iodine discharged by the plant, which accounts for 2.63 person-rem of the thyroid population dose. Therefore, the applicant determined that the dose reduction necessary to be cost beneficial could not be achieved by this augment.

The third option evaluated was a 1,000 cubic feet per minute (cfm) charcoal/HEPA filtration system, with a TAC of $7,580. Thus, this augment would need to decrease the thyroid dose by 7.58 person-rem, from 8.33 to 0.75 person-rem. The applicant conservatively assumed that this small capacity augment could be placed in the ventilation system at some point where it would eliminate all iodine and particulate releases. However, this augment would not be effective in reducing noble gas, carbon-14, or airborne tritium releases, which together account for 5.59 person-rem of the 8.33 person-rem thyroid population dose. Therefore, the applicant determined that the dose reduction necessary to be cost beneficial could not be achieved by this augment.

The fourth option evaluated was a 600 ft^3 gas decay tank, with a TAC of $7,460. Thus, this augment would need to decrease the thyroid dose by 7.46 person-rem, from 8.33 to 0.87 person-rem. However, as shown in AP1000 DCD Table 11.3-3, incorporated by reference by the applicant, no iodine is released through the waste gas system. This augment does not affect the iodine discharged by the plant, which accounts for 2.63 person-rem of the thyroid population dose. Therefore, the applicant determined that the dose reduction necessary to be cost beneficial could not be achieved by this augment.

The applicant concluded that none of the radwaste augments are cost-beneficial in reducing the annual dose from gaseous effluents for LNP, as they cannot achieve the dose reduction. The staff reviewed these evaluations and concurred that these augments were not sufficiently effective to be cost beneficial considering the cost criterion of $1,000 per person-rem for an augment in 10 CFR Part 50, Appendix I, Section II.D. Thus, the staff concluded that the GWMS meets ALARA requirements and requires no augments.

- LNP COL 11.5-3

The applicant provided additional information in LNP COL 11.5-3 to resolve COL Information Item 11.5-3. COL Information Item 11.5-3 states:

> The Combined License applicant is responsible for addressing the 10 CFR 50, Appendix I guidelines for maximally exposed offsite individual doses and population doses via liquid and gaseous effluents.

The commitment was also captured in COL Action Item 11.5-3 in Appendix F of NUREG-1793, which states:

> The COL applicant is responsible for addressing the guidelines of Appendix I to 10 CFR Part 50, as they relate to maximally exposed offsite individual doses and population doses attributable to liquid and gaseous effluents.

The NRC staff reviewed the resolution to COL Information Item 11.5-3 related to compliance with Appendix I to 10 CFR Part 50 included under Section 11.3.3.4 of the LNP COL FSAR and issued RAI 11.3-1 requesting the applicant provide the details of the individual and population dose analyses.

In response to RAI 11.3-1, the applicant evaluated the impacts from gaseous effluent releases by considering the probable pathways to individuals and populations near the proposed new units. The applicant estimated the total-body and organ dose to the MEI from the gaseous effluent release pathways, and also calculated a collective total body and organ dose for the population within 80 km (50 mi) of the LNP site. The estimates of the maximum doses to the public are based on the AP1000 reactor's normal operational effluent releases, as discussed in the AP1000 DCD. The applicant evaluated the impact of these doses by comparing them to applicable regulatory limits.

If built, the postulated two new units at the LNP site would release gaseous effluents into the atmosphere. The applicant calculated doses for several airborne pathways, including direct exposure to a radioactive plume, direct exposure to radioactivity deposited on the ground, inhalation of airborne radioactivity and ingestion of contaminated agricultural products including vegetables, milk, and meat. The applicant assumed that the MEI consumes only goat milk (based on no milk cows within 5 miles), while the population consumes only cow milk.

In response to RAI 11.3-1, the applicant provided a description of all required model assumptions and input parameters needed to run the GASPAR II computer code. Using radiological exposure models based on RG 1.109 and the GASPAR II computer program (NUREG/CR-4653, "GASPAR II - Technical Reference and User Guide," March 1987), the applicant calculated the estimated doses to a hypothetical MEI of the public and to the population within 80 km (50 mi) from the postulated gaseous effluents discharged.

The applicant maximized the estimated MEI doses by choosing conservative locations and dispersion data for the calculations. Since the application was originally submitted, the applicant accumulated an additional two years of meteorological data and revised the atmospheric dispersion and ground deposition factors.

LNP COL FSAR Tables 11.3-201 through 11.3-205 include gaseous pathway parameters used as input to the dose calculation, including population data and site-specific agricultural usage information. The applicant provided detailed justifications for these parameter values in the response to RAI 11.3-1. LNP COL FSAR Tables 11.3-206, 11.3-207, and 11.3-208 list the gaseous pathway doses to the MEI and surrounding population.

The applicant calculated the gaseous pathway doses to the MEI. The results (LNP COL FSAR Tables 11.3-206 and 11.3-207) show, using conservative locations, a gamma annual air dose of 0.0167 milliGray (mGy) (1.67 mrad), a beta annual air dose of 0.0935 mGy (9.35 mrad); a total

annual body dose of 0.0306 mSv (3.06 mrem) and an annual skin dose of 0.0839 mSv (8.39 mrem).

The calculated annual population doses listed in LNP COL FSAR Table 11.3-208 are 0.0574 person-Sv (5.74 person-rem) to the total body, and 0.0833 person-Sv (8.33 person-rem) to the thyroid. The applicant uses the population doses in the cost-benefit analysis described in the LNP COL FSAR and evaluated in this SER.

The NRC staff performed an independent assessment using the GASPAR II computer code and compared its results to the applicant's and the Appendix I criteria. The modeling assumptions used and parameter values used were consistent with the applicant's.

In response to RAI 11.3-1, the applicant explained the derivation of values used for agricultural and usage parameters including the total production of vegetables, milk, and meat in the 50-mile area around the site. The staff evaluated and verified the derivation of these values and found them to be reasonable upper bound estimates that are unlikely to be exceeded. Consequently, the staff used the applicant's agricultural and usage values listed in LNP COL FSAR Table 11.3-201 for its dose estimation.

The staff evaluated and agreed with the approach taken by the applicant to calculate maximum annual individual doses from gaseous effluents. Using this same approach, the staff verified the individual doses in the FSAR by independently running the GASPAR II computer code with the applicant's parameter values. SER Table 11.3-2 compares the dose estimates resulting from the applicant's analyses to the 10 CFR Part 50, Appendix I criteria. All doses are below the Appendix I, Section II.B and II.C criteria.

The staff evaluated and agreed with the approach taken by the applicant to calculate population doses from gaseous effluents. Using this same approach, the staff verified the population doses in the LNP COL FSAR by independently running the GASPAR II computer code with the applicant's parameter values. The applicant then used these doses in a cost-benefit analysis for augments to the GWMS. SER Table 11.3-3 summarizes the results of the applicant's and staff's analysis of population doses. The NRC staff concludes that the applicant has provided a bounding assessment demonstrating its capability to comply with the regulatory requirements in 10 CFR Part 20 and 10 CFR Part 50, Appendix I. RAI 11.3-1 is closed.

The following portion of this technical evaluation section is reproduced from Section 11.3.4 of the VEGP SER:

> *Supplemental Information*
>
> *The following portion of this technical evaluation section is reproduced from Section 11.3.4 of the BLN SER:*
>
> - *STD SUP 11.3-1*
>
> *The applicant provided supplemental information in BLN COL FSAR Section 11.3.3.6, "Quality Assurance," addressing the quality assurance program to be applied to the gaseous waste system and stated that the program complies with the guidance presented in RG 1.143.*

The NRC staff reviewed this supplemental quality assurance information included in BLN COL FSAR Section 11.3.3.6 and finds that this supplemental statement commits the applicant to the regulatory positions in RG 1.143 related to quality assurance and is acceptable.

The following portion of this technical evaluation section is reproduced from Section 11.3.4 of the VEGP SER:

- *STD SUP 11.3-2*

The applicant provided additional information in VEGP COL FSAR Section 11.3.3 to address gaseous effluent site interface parameters. The applicant stated that there are no gaseous effluent site interface parameters outside the Westinghouse scope. The staff finds this statement true because all gaseous effluent release points are through the main gas vent and the turbine building exhaust and are part of the certified design.

Postulated Radioactive Release Due to a Waste Gas Leak or Failure

NUREG-0800, Section 11.3, acceptance criteria and BTP 11-5 require the staff to evaluate the results of a postulated radioactive release resulting from a leakage or failure of a waste gas storage tank or offgas charcoal delay bed. The waste gas system is part of the radioactive GWMS and information on the system is considered as part of the design information required by 10 CFR 50.34a.

The AP1000 DCD and NUREG-1793 addressed the results of this analysis. In response to RAI SRP11.3-CHPB-02 covering AP1000 DCD, Revision 17, Westinghouse detailed the results of this analysis for inclusion in the next revision of the DCD. As documented in the staff's SER for the AP1000 DCD, the staff found this analysis acceptable and that it encompassed the site-specific parameters for the VEGP site. Once the staff confirms the inclusion of the failure analysis in a future revision of the AP1000 DCD and the incorporation by reference of that DCD revision by the VEGP applicant, the staff will consider this item closed for the VEGP COL FSAR. This is considered ***Confirmatory Item 11.3-1****.*

Demonstrating Compliance with 10 CFR 20.1301(e)

The staff discusses compliance with 10 CFR 20.1301(e) in Section 11.2.4 of this SER.

Demonstrating Compliance with 10 CFR 20.1302

The annual average concentration of radioactive material released in gaseous effluents at the boundary of the unrestricted area must not exceed the values specified in Table 2 of Appendix B to 10 CFR Part 20. The applicant demonstrated compliance with this requirement by referencing the AP1000 DCD. Section 11.3.3.5 of the DCD shows that even at the Technical Specification limit

for percent failed fuel defects, the site provides sufficient atmospheric dilution to ensure that the expected effluent release concentrations will be less than those specified in Table 2 of Appendix B to 10 CFR Part 20.

In NUREG-1793, the staff evaluated and accepted the conclusions of Section 11.3.3.5 of the DCD. Based on this acceptance, the staff concludes that the applicant complies with 10 CFR 20.1302.

Demonstrating Compliance with 10 CFR 20.1406

The staff discusses compliance with 10 CFR 20.1406 in Section 11.2.4 of this SER.

Resolution of Standard Content Confirmatory Item 11.3-1

Confirmatory Item 11.3-1 is a commitment by the staff to confirm the site-specific characteristics for the LNP site are enveloped by the DCD site parameters. The staff reviewed and compared the LNP site-specific and DCD parameters and confirmed that the site-specific parameters are enveloped by the DCD parameters. As a result, Confirmatory Item 11.3-1 is now closed.

11.3.5 Post Combined License Activities

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

11.3.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the GWMS, and there is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff evaluated the additional COL information (STD COL 11.3-1, LNP COL 11.3-1, LNP COL 11.5-3, STD SUP 11.3-1, and STD SUP 11.3-2) in the application against the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 11.3, and other NRC regulatory guides. The applicant has satisfactorily addressed all RAIs related to Section 11.3.

STD SUP 11.3-2, related to a postulated radioactive release resulting from a leakage or failure of a waste gas storage tank or offgas charcoal delay bed, is acceptable because it demonstrates compliance with 10 CFR 50.34a.

In other areas of the evaluation of the GWMS, the staff verified that the applicant has provided sufficient information and that the review and calculations support the conclusion that the GWMS includes the equipment necessary to control releases of radioactive materials in gaseous effluents in accordance with GDC 60 and 61 of Appendix A to 10 CFR Part 50 and the requirements of 10 CFR 50.34a. The staff finds that the applicant meets the requirements in GDC 60 and 61 by demonstrating conformance to 10 CFR Part 50, Appendix I. The staff also

concludes that the design of the GWMS meets the requirements of 10 CFR 20.1301(e), 10 CFR 20.1302, 10 CFR 20.1406, 10 CFR 50.34a, 10 CFR 52.79(a)(3), GDC 60 and 61, and Appendix I to 10 CFR Part 50.

11.4 Solid Waste Management (Related to RG 1.206, Section C.III.1, Chapter 11, C.I.11.4, "Solid Waste Management System")

11.4.1 Introduction

The solid waste management system (SWMS) is designed to collect and accumulate spent ion exchange resins and deep-bed filtration media, spent filter cartridges, dry active wastes, and mixed wastes generated from normal plant operation, including anticipated operational occurrences. Processing and packaging of wastes are by mobile systems and the packaged waste is stored in the auxiliary and radwaste buildings until it is shipped offsite to a licensed disposal facility.

11.4.2 Summary of Application

Section 11.4 of the LNP COL FSAR, Revision 9, incorporates by reference Section 11.4 of the AP1000 DCD, Revision 19.

In addition, in LNP COL FSAR Section 11.4, the applicant provided the following:

AP1000 COL Information Items

- STD COL 11.4-1

The applicant provided additional information in STD COL 11.4-1 to address COL Information Item 11.4-1 (COL Action Item 11.4-1). The additional information provides a process control program (PCP) for both wet and dry solid wastes.

- LNP COL 11.4-1

The applicant provided additional information in LNP COL FSAR Section 11.4.2.4.3 to address alternatives for temporary storage of Class B and C LLRW. In addition, the applicant provided additional information related to conformance with RG 1.143, Revision 2.

Supplemental Information

- STD SUP 11.4-1

The applicant provided supplemental information in LNP COL FSAR Section 11.4.5 to address how the solid radwaste system complies with the guidance in RG 1.143, Revision 2.
STD SUP 11.4-1 also addresses the processes to be followed to ship waste that complies with 10 CFR 61.55 and 10 CFR 61.56 in LNP COL FSAR Section 11.4.6.1.

- LNP SUP 11.4-1

The applicant added supplemental information in LNP COL FSAR Sections 11.4.2.4.3 and 11.4.6.3 describing alternatives for management of Class B and C low-level radioactive waste (LLRW) and long term onsite storage facilities for LLRW, respectively.

License Conditions

- Part 10, License Condition 3, Operational Program Implementation

LNP COL FSAR Section 13.4, Table 13.4-201, "Operational Programs Required by NRC Regulations," identifies Item 9, the PCP, as a program required by regulations that must be implemented by a milestone (prior to initial fuel load) to be identified as a license condition.

- Part 10, License Condition 6, Operational Program Readiness

The applicant proposed a license condition to provide a schedule to support NRC inspection of operational programs including the PCP.

11.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements.

In addition, the regulatory basis for acceptance of the supplemental information on the SWMS is established in:

- 10 CFR Part 20, "Standards for protection against radiation"
- 10 CFR Part 50, "Domestic licensing of production and utilization facilities"
- 10 CFR Part 50, Appendix A, GDC 60
- 10 CFR 52.79(a)(3)
- 10 CFR Part 71, "Packaging and transportation of radioactive material"
- 49 CFR Part 173, "Shippers—General requirements for shipments and packagings"
- State regulations and disposal site waste form requirements for burial at a low level waste disposal site that is licensed in accordance with 10 CFR Part 61, "Licensing requirements for land disposal of radioactive waste," or equivalent State regulations
- Table 1 and Regulatory Positions C.3.2 and C.3.3 of RG 1.143, Revision 2

The acceptance criteria associated with the SWMS are given in NUREG-0800, Section 11.4, including BTP 11-3.

11.4.4 Technical Evaluation

The NRC staff reviewed Section 11.4 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the SWMS. The results of the NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

The staff's review of this application included the following COL information item and supplemental information:

- STD COL 11.4-1, Solid Waste Management System Process Control Program
- LNP COL 11.4-1, Alternatives for B and C Wastes
- STD SUP 11.4-1, Quality Assurance
- LNP SUP 11.4-1, Long Term Onsite Storage Facility

In addition to the above items, the staff reviewed the entire section against NUREG-0800, Section 11.4, to determine if the information in LNP COL FSAR Section 11.4 met the regulatory requirements in the regulations stated above (SER Section 11.4.3) and NUREG-0800 acceptance criteria. The relevant NUREG-0800 acceptance criteria are as follows:

- All effluent releases (gaseous and liquid) associated with the operation (normal and anticipated operational occurrences) of the SWMS will comply with 10 CFR Part 20 and RG 1.143, Revision 2, as they relate to the definition of the boundary of the SWMS beginning at the interface from plant systems, including multi-unit stations, to the points of controlled liquid and gaseous effluent discharges to the environment or designated onsite storage locations, as defined in the PCP and ODCM.

- Operational Programs. For COL reviews, the description of the operational program and proposed implementation milestone for the PCP aspect of the Process and Effluent Monitoring and Sampling Program are reviewed in accordance with 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 50.34a, 10 CFR 50.36a, "Technical specifications on effluents from nuclear power reactors;" and 10 CFR Part 50, Appendix I, Sections II and IV. Its implementation is required by a license condition.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP Units 3 and 4) were equally applicable to the LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

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

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

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

Although the staff concluded that the evaluation performed for the standard content is directly applicable to the LNP COL application, there is a difference in how the LNP applicant addressed STD COL 11.4-1 and how the VEGP applicant addressed this review item. This difference is evaluated by the staff below, following the standard content material for STD COL 11.4-1.

The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the VEGP SER:

AP1000 COL Information Items

The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the BLN SER:

- *STD COL 11.4-1*

The applicant provided additional information in STD COL 11.4-1 to resolve COL Information Item 11.4-1. COL Information Item 11.4-1 states:

> *The Combined License applicant will develop a process control program in compliance with 10 CFR Sections 61.55 and 61.56 for wet solid wastes and 10 CFR Part 71 and DOT regulations for both wet and dry solid wastes. Process control programs will also be provided by vendors providing mobile or portable processing or storage systems. It will be the plant operator's responsibility to assure that the vendors have appropriate process control programs for the scope of work being contracted at any particular time. The process control program will identify the operating procedures for storing or processing wet solid wastes. The mobile systems process control program will include a discussion of conformance to Regulatory Guide 1.143, Generic Letter GL-80-009, and Generic Letter GL-81-039 and, information of equipment containing wet solid wastes in the non-seismic Radwaste Building. In the event additional onsite storage facilities are a part of Combined License plans, this program will include a discussion of conformance to Generic Letter GL-81-038.*

The commitment was also captured as COL Action Item 11.4-1 in Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

The COL applicant will develop a process control program for both wet and dry solid wastes.

In BLN COL FSAR Section 11.4.6, the applicant addressed this COL information item. The applicant adopted NEI 07-10, "FSAR Template Guidance for Process Control Program (PCP) Description." The PCP describes the administrative and operational controls used for the solidification of liquid or wet solid waste and the dewatering of wet solid waste. It provides the necessary controls such that the final disposal waste product meets applicable federal regulations (10 CFR Parts 20, 50, 61, 71 and 49 CFR Part 173), state regulations, and disposal site waste form requirements for burial at a low level waste disposal site licensed in accordance with 10 CFR Part 61. Waste processing equipment and services may be provided by the plant or by third-party vendors. In a letter dated January 8, 2009, (ML082910077), the NRC accepted NEI 07-10, Revision 3. Specifically, the NRC staff indicated that for COL applications NEI 07-10, Revision 3, provides an acceptable template for assuring that the administrative and operational controls for waste processing, processing parameters, and surveillance requirements within the scope of the PCP will meet the requirements of 10 CFR 52.79. In a letter dated April 23, 2009 (ML091170073), the applicant proposed to revise BLN FSAR Section 11.4 to incorporate the approved NEI 07-10 Revision 3. Since the BLN COL FSAR Section 11.4 has not adopted the approved version of the NEI Template, this is ***Confirmatory Item 11.4-1.*** *Each process used meets the applicable requirements of the PCP. BLN COL FSAR Table 13.4-201 provides milestones for PCP implementation and is acceptable.*

In STD COL 11.4-1, the applicant states that "no additional onsite radwaste storage is required beyond that described in the DCD." The applicant should explain why this statement is included or should remove it. In section 11.4 of NUREG-1793, the staff stated that if a need for onsite storage of low-level waste has been identified beyond that provided in AP1000 Standard Design because of unavailability of offsite storage, the applicant should submit the details of any proposed onsite storage facility to the NRC. The applicant needs to provide any arrangements for offsite storage for low-level waste or to submit plans for onsite storage. This is identified as ***Open Item 11.4-1****.*

The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the VEGP SER:

<u>Resolution of Standard Content Confirmatory Item 11.4-1</u>

To address Confirmatory Item 11.4-1 in the BLN SER with open items, the applicant updated VEGP COL FSAR Section 11.4.6 to indicate adoption of the NRC-approved version of NEI 07-10A. VEGP adoption of this template effectively resolves Confirmatory Item 11.4-1.

Resolution of Standard Content Open Item 11.4-1

To address Open Item 11.4-1 in the BLN SER with open items, the applicant updated VEGP COL FSAR Section 11.4 with information supporting the statement that no additional onsite radwaste storage was required beyond that described in the DCD. This additional information is contained in VEGP COL 11.4-1 and VEGP SUP 11.4-1 and is evaluated below.

Resolution of Standard Content Open Item 11.4-1

The resolution of Open Item 11.4-1 in the BLN SER with open items is addressed below in the evaluation of LNP COL 11.4-1.

- LNP COL 11.4-1

The applicant's response to RAIs 11.4-1 and 11.4-2 addressed Open Item 11.4-1. The applicant expects to have no need for permanent on-site storage of LLRW. In addition, should the need ever arise to increase the temporary storage capacity of LLRW beyond the capacity of the AP1000 design, the applicant stated they would design and build an onsite temporary storage facility in accordance with the design and operational objectives and guidance in Appendix 11.4-A of NUREG-0800, Section 11.4. The applicant indicated they could perform this work after performing an analysis under 10 CFR 50.59 and, if necessary, request a license amendment.

The applicant indicated in their response that they did not, at the time of application, have offsite disposal capacity for Class B and C LLRW, but that they do have access to offsite disposal of Class A waste. The applicant provided a voluntary supplemental response with additional detail and update of the status of waste disposal access. The staff evaluated the applicant's long-term ability to store Class B and C waste onsite without having to add a temporary storage facility.

The applicant described potential to extend the storage capacity of the AP1000 design for Class B and C waste by prudently managing waste throughput. The applicant indicated that the AP1000 design has more than one year of storage capacity in the Auxiliary Building for Class B and C wet wastes. In addition, the staff's independent analysis of the capacity of the AP1000 Radwaste Building demonstrated that the volume of Class B and C waste comprises less than 2 percent of all LLRW, and determined this is reasonably consistent with the applicant's supplemental response to RAI 11.04-2 modifying FSAR Section 11.4.2.4.3, which conservatively estimates that 5 percent of all solid LLRW generated during operation are Class B and C wastes. The applicant indicated that by frequently disposing of Class A waste, the AP1000 design can accommodate between 10 and 20 years' generation of Class B and C waste in the Radwaste Building. Based on this analysis, the staff concludes that the applicant will not need an additional onsite storage facility for Class B and C waste until a significant portion of the operating life of the plant has transpired.

Should the need for additional onsite storage capacity arise during the lifetime of operation, the licensee described their capability to follow the regulatory process in 10 CFR 50.59 or apply for a license amendment to add more capacity. In its responses to RAIs 11.4-1 and 11.4-2, the applicant committed to follow the guidance in Appendix 11.4-A of NUREG-0800, Section 11.4

for the design and operation of an additional temporary storage facility. The responses provided an additional assessment of the potential capacity needs and contingency arrangements should additional onsite storage become necessary after commencement of operation and proposed further revisions to FSAR Sections 11.4.6 and 11.4.7. In a supplemental response letter dated April 14, 2011, the applicant provided additional detail and revisions to FSAR Section 11.4. Based on the staff's analysis of the long-term storage capacity of the AP1000 and the applicant's commitment to follow the proper design and operational guidance in Appendix 11.4-A of NUREG-0800 should it need to add additional storage capacity, the staff considers Open Item 11.4-1 resolved. The staff verified that the LNP COL FSAR was appropriately revised to reflect the responses to RAIs 11.4-1 and 11.4-2. The staff is tracking the FSAR revisions proposed in the April 14, 2011, voluntary letter as **LNP Confirmatory Item 11.4-1.**

Resolution of LNP Confirmatory Item 11.4-1

LNP Confirmatory Item 11.4-1 is a commitment by the applicant to revise LNP COL FSAR Sections 11.4.2.4.3 and 11.4.6, including adding Section 11.4.6.3, to provide additional information on alternatives for management of Class B and C LLRW and long term onsite storage facilities for LLRW, respectively, as indicated in the April 14, 2011, letter. The staff confirmed that the LNP COL FSAR has been appropriately revised. As a result, LNP Confirmatory Item 11.4-1 is now closed.

In addition to RAIs 11.4-1 and 11.4-2, the staff issued RAI 11.02-5, asking the applicant to provide additional information in response to COL Information Item 11.4-1 in order to ensure that the inventory of radioactive materials contained in all unpackaged waste held in the Radwaste Building is controlled in accordance with the RG 1.143, Revision 2, dose acceptance criteria. As a result, the applicant provided additional information in FSAR Section 11.4.6 indicating that when disposable filtration and adsorption media are removed from radwaste processing systems in the Radwaste Building, that the mobile radwaste processing system not be placed back into service until the media that have been removed are packaged and ready for shipment. In addition, the applicant provided additional information in FSAR Sections 11.2.1.2.5.2 and 13.5.2.2.5 related to controlling the quantity of unpackaged waste in the Radwaste Building as part of the response to RAI 11.02-5. This information and associated operational commitments ensure that all unpackaged waste held in the Radwaste Building are controlled in accordance with the provisions of RG 1.143, Revision 2. The information resolving COL Information Item 11.4-1 was included in FSAR Revision 6. Therefore, COL Information Item 11.4-1 is resolved. A more detailed discussion related to the resolution of RAI 11.02-5 is included in SER Section 11.2.4, above.

The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the VEGP SER:

> *Supplemental Information*
>
> *The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the BLN SER:*

- *STD SUP 11.4-1*

The applicant provided supplemental information in Section 11.4.5 of the BLN COL FSAR to describe the QA program applicable to design, construction, installation and testing provisions of the solid radwaste system. This QA program is established by procedures and complies with the guidance presented in RG 1.143.

In BLN FSAR Section 11.4.6, the applicant also added a description of procedures relating to waste shipments, waste stream processing, verifying waste as non-radioactive, periodic system maintenance, personnel training, and document revision, clearing with third party vendors. The staff reviewed the descriptions and found them to be comprehensive and acceptable.

The NRC staff reviewed the supplemental information provided in STD SUP 11.4-1 related to the QA program for the solid radwaste system included under Section 11.4.4 of the BLN COL FSAR and finds that this supplemental statement commits the applicant to the regulatory positions in RG 1.143 related to quality assurance.

- LNP SUP 11.4-1

In a December 4, 2009, response to RAI 11.04-2, the applicant explained that, should it need additional onsite storage of LLRW, it could construct an additional onsite storage facility, and that Greater Than Class C LLRW would be addressed similarly to spent fuel.

The applicant made a subsequent voluntary response to RAI 11.04-2 by letter dated April 14, 2011, and proposed a new Section 11.4.6.3 containing information about expanding onsite LLRW storage capacity in the event that disposal facilities or offsite storage facilities are not available.

The staff reviewed the applicant's plans for increasing onsite storage and determined that the applicant would be able to comply with the applicable requirements of 10 CFR Part 20 and 10 CFR Part 50, concerning occupational and public exposures, ALARA programs, and radiological monitoring for onsite and offsite exposures and releases.

Based on the independent analysis and safety review, the NRC staff concludes that the applicant has provided sufficient information to demonstrate that it can safely handle and store LLRW that might accumulate due to unavailability of permanent disposal capacity. The staff considers RAI 11.4-1, RAI 11.4-2, and Open Item 11.4-1 resolved, and the staff assigned tracking of the FSAR revisions proposed in the April 14, 2011, voluntary letter as **LNP Confirmatory Item 11.4-1**.

Resolution of LNP Confirmatory Item 11.4-1

LNP Confirmatory Item 11.4-1 is a commitment by the applicant to revise LNP COL FSAR Sections 11.4.2.4.3 and 11.4.6, including adding Section 11.4.6.3, to provide additional information on alternatives for management of Class B and C LLRW and long term onsite storage facilities for LLRW, respectively, as indicated in the April 14, 2011, letter. The staff

confirmed that the LNP COL FSAR has been appropriately revised. As a result, LNP Confirmatory Item 11.4-1 is now closed.

The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the VEGP SER:

> *License Conditions*
>
> - *Part 10, License Condition 3, Operational Program Implementation*
>
> *VEGP COL FSAR Section 11.4.6 describes the process control program. VEGP COL FSAR Table 13.4-201 provides the milestone (prior to initial fuel load) for implementation of the process control program and is acceptable as described in the staff's SER related to NEI 07-10.*
>
> - *Part 10, License Condition 6, Operational Program Readiness*
>
> *The applicant proposed a license condition to provide a schedule to support NRC inspection of operational programs including the process control program. The proposed license condition is consistent with the policy established in SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria [ITAAC]," and is acceptable.*
>
> *Compliance with 10 CFR Part 50 Appendix I Design Criteria*
>
> *The design of the SWMS described in the AP1000 DCD has no release points directly to the environment. Compliance with Appendix I ALARA criteria is strictly based on the releases from the LWMS and GWMS and not the SWMS.*

11.4.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff proposes to include the following two license conditions:

- License Condition (11-2) – Before initial fuel load, the licensee shall implement an operational program for process and effluent monitoring and sampling. The program shall include the subprogram and documents for a Process Control Program.

- License Condition (11-3) – No later than 12 months after issuance of the COL, the licensee shall submit to the Director of the Office of New Reactors (NRO) a schedule that supports planning for and conduct of NRC inspections of the operational program for process and effluent monitoring and sampling (including process control program). The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational program for process and effluent monitoring and sampling (including process control program) has been fully implemented.

11.4.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the SWMS, and there is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff evaluated the COL information (STD COL 11.4-1, LNP COL 11.4-1, STD SUP 11.4-1, and LNP SUP 11.4-1) in the application against the relevant NRC regulations, the acceptance criteria in NUREG-0800, Section 11.4, and other NRC regulatory guides. The applicant has satisfactorily addressed the RAIs related to LNP COL FSAR Section 11.4, Standard Content Confirmatory Item 11.4-1, Open Item 11.4-1, and LNP Confirmatory Item 11.4-1.

Based on the evaluation above, the staff determined that the applicant's means for handling radioactive solid waste during normal operations, including anticipated operational occurrences, are consistent with GDC 60. In accordance with 10 CFR 52.79(a)(3), the staff also determined that the applicant has provided sufficient information regarding the kinds and quantities of radioactive materials expected to be produced in the operation of the facility and the means for controlling and limiting radioactive effluents and exposures within the limits set forth in 10 CFR Part 20. The staff verified that the applicant has provided sufficient information and that the review supports the conclusion that the design and operation of the SWMS is acceptable and meets the requirements of GDC 61 of Appendix A of 10 CFR Part 50; 10 CFR 50.34a; 10 CFR 52.79(a)(3);10 CFR 20.1301(e); 10 CFR 20.1406; Appendix I to 10 CFR Part 50; and 10 CFR Parts 61 and 71.

11.5 Radiation Monitoring (Related to RG 1.206, Section C.III.1, Chapter 11, C.I.11.5, "Process and Effluent Radiological Monitoring and Sampling Systems")

11.5.1 Introduction

The radiation monitoring systems are used to monitor liquid and gaseous process streams and effluents from the LWMS, GWMS, and SWMS. The radiation monitoring system includes subsystems used to collect process and effluent samples during normal operation and anticipated operational occurrences, and under post-accident conditions.

11.5.2 Summary of Application

Section 11.5 of the LNP COL FSAR, Revision 9, incorporates by reference Section 11.5 of the AP1000 DCD, Revision 19.

In addition, in LNP COL FSAR Section 11.5, the applicant provided the following:

Departure

- LNP DEP 6.4-1

The applicant provided additional information in Section 11.5 of the LNP COL FSAR about LNP DEP 6.4-1 related to design changes affecting habitability of the main control room and changes to the calculated doses to control room operators. This information, as well as related LNP DEP 6.4-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.2 of this SER.

AP1000 COL Information Items

- STD COL 11.5-1

The applicant provided additional information in STD COL 11.5-1 to resolve COL Information Item 11.5-1 (COL Action Item 11.5-1). The information addresses the ODCM.

- STD COL 11.5-2

The applicant provided additional information in STD COL 11.5-2 to resolve COL Information Item 11.5-2 (COL Action Item 11.5-2). The information provides programmatic aspects of the effluent monitoring and sampling program.

- LNP COL 11.5-2

The applicant provided additional information in LNP COL 11.5-2 to add language to LNP COL FSAR Section 11.5.3 addressing extension of the applicant's program for QA of radioactive effluent and environmental monitoring for their existing licensed facilities to apply to LNP Units 1 and 2.

- LNP COL 11.5-3

The applicant provided additional information in LNP COL 11.5-3 to resolve COL Information Item 11.5-3 (COL Action Item 11.5-3). The information relates to the 10 CFR Part 50, Appendix I guidelines.

License Conditions

- Part 10, License Condition 3, Operational Program Implementation, Item G.3

LNP COL FSAR Section 13.4, Table 13.4-201, "Operational Programs Required by NRC Regulations," identifies three entries under Item 9, "Process and Effluent Monitoring and Sampling Program," as follows: (1) Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls; (2) Offsite Dose Calculation Manual; and (3) Radiological Environmental Monitoring program, as programs identified in FSAR Section 11.5 that are required to be implemented by a milestone. In accordance with License Condition 3, Item G.3, these programs are to be implemented prior to initial fuel load.

- Part 10, License Condition 6, Operational Program Readiness

The applicant proposed a license condition to provide a schedule to support the NRC's inspection of operational programs including the Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls, the ODCM; and the Radiological Environmental Monitoring program.

11.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements.

In addition, the regulatory basis for acceptance of the additional information on radiation monitoring is established in:

- 10 CFR Part 50, Appendix A, GDC 64, "Monitoring radioactivity releases"
- 10 CFR Part 20
- 10 CFR Part 50
- 10 CFR Part 52, "Licenses, certifications, and approvals for nuclear power plants"
- 10 CFR Part 61
- 10 CFR Part 71
- American National Standards Institute/Health Physics Society (ANSI/HPS) N13.1, "Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities"
- ANSI N42.18, "Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents"
- RG 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," Revision 2
- RG 4.15, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment," Revision 2

The applicable acceptance criteria are identified in NUREG-0800, Section 11.5.

11.5.4 Technical Evaluation

The NRC staff reviewed Section 11.5 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information

relating to the radiation monitoring system. The results of the NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

The staff's review of this application included the following information in the LNP COL FSAR:

- STD COL 11.5-1, ODCM
- STD COL 11.5-2, Programmatic Aspects of the Effluent Monitoring and Sampling Program
- LNP COL 11.5-2, which adds language to LNP COL FSAR Section 11.5.3 addressing extension of the applicant's existing program for quality assurance of radioactive effluent and environmental monitoring to apply to LNP Units 1 and 2.
- LNP COL 11.5-3, 10 CFR Part 50, Appendix I Guidelines

In addition to the above items, the staff reviewed the entire section against NUREG-0800, Section 11.5, to determine if the information in LNP COL FSAR Section 11.5 met the regulatory requirements in the regulations stated above (SER Section 11.5.3) and NUREG-0800 acceptance criteria. The relevant NUREG-0800 acceptance criteria are as follows:

- Provisions should be made to ensure representative sampling from radioactive process streams and tank contents. Recirculation pumps for liquid waste tanks (collection or sample test tanks) should be capable of recirculating at a rate of not less than two tank volumes in 8 hours. For gaseous and liquid process stream samples, provisions should be made for purging sampling lines and for reducing the plate-out of radioactive materials in sample lines. Provisions for gaseous sampling from ducts and stacks should be consistent with ANSI/HPS N13.1-1999.
- For COL reviews, the description of the operational program and proposed implementation milestone for the radiological effluent technical specification/standard radiological effluent control, ODCM and Radiological Environmental Monitoring Program aspects of the Process and Effluent Monitoring and Sampling Program are reviewed in accordance with 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR Part 50, Appendix I, Sections II and IV. Its implementation is required by a license condition.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP Units 3 and 4) were equally applicable to the LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

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

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

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

The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the VEGP SER:

AP1000 COL Information Items

The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the BLN SER:

- *STD COL 11.5-1*

The applicant provided additional information in STD COL 11.5-1 to resolve COL Information Item 11.5-1. COL Information Item 11.5-1 states:

> *The Combined License applicant will develop an offsite dose calculation manual that contains the methodology and parameters used for calculation of offsite doses resulting from gaseous and liquid effluents. The Combined License applicant will address operational setpoints for the radiation monitors and address programs for monitoring and controlling the release of radioactive material to the environment, which eliminates the potential for unmonitored and uncontrolled release. The offsite dose calculation manual will include planned discharge flow rates.*

This commitment was also captured as COL Action Item 11.5-1 in Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

> *The COL applicant will develop an offsite dose calculation manual that contains the methodology and parameters used to calculate offsite doses resulting from gaseous and liquid effluents.*

In BLN COL FSAR Section 11.5.7, the applicant adopts NEI 07-09, "FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description." The ODCM program description contains: (1) the methodology and parameters used for calculating doses resulting from liquid and gaseous effluents; (2) operational setpoints, including planned discharge rates, for radiation monitors and monitoring programs; and (3) the limitations on operation of the radwaste systems, including functional capability of monitoring

instruments, concentrations of effluents, sampling, analysis, 10 CFR Part 50, Appendix I dose and dose commitments and reporting. In a letter dated January 27, 2009 (ML083530745), the NRC accepted NEI 07-09, Revision 4. Specifically, the NRC indicated that for COL applications, NEI 07-09, Revision 4 provides an acceptable template assuring that the ODCM program meets applicable NRC regulations and guidance. In a letter dated April 23, 2009 (ML091170073), the applicant proposed to revise BLN COL FSAR Section 11.5 to incorporate the approved NEI 07-09, Revision 4. Since the BLN COL FSAR Section 11.5 has not adopted the approved version of the NEI Template, this is ***Confirmatory Item 11.5-1****. BLN COL FSAR Table 13.4-201 provides milestones for ODCM implementation. This section also addresses Plant Interface Item 11.4, "requirements for offsite sampling and monitoring of effluent concentrations." The staff finds the applicant's consideration of Plant Interface Item 11.4 to be acceptable based on a review of the ODCM program (NEI 07-09). The NRC staff reviewed the resolution of STD COL 11.5-1 related to the ODCM included under Section 11.5.7 of the BLN COL FSAR and considers it adequately addressed in NEI 07-09.*

The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the VEGP SER:

<u>Resolution of Standard Content Confirmatory Item 11.5-1</u>

To address Confirmatory Item 11.5-1, the applicant updated the VEGP FSAR Section 11.5.7 to indicate adoption of the NRC-approved version of NEI 07-09A. VEGP adoption of this template effectively resolves Confirmatory Item 11.5-1.

The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the BLN SER:

- *STD COL 11.5-2*

The applicant provided additional information in STD COL 11.5-2 to resolve COL Information Item 11.5-2 (COL Action Item 11.5-2).
COL Information Item 11.5-2 states:

> *The Combined License applicant is responsible for the site-specific and program aspects of the process and effluent monitoring and sampling in accordance with ANSI N13.1 and RGs 1.21 and 4.15.*

The commitment was also captured as COL Action Item 11.5-2 in Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

> *The COL applicant is responsible for ensuring that the process and effluent monitoring and sampling program at its site conforms to the guidelines of ANSI N13.1-1969, RG 1.21, and RG 4.15.*

In BLN COL FSAR Sections 11.5.1.2, 11.5.2.4, 11.5.4, 11.5.4.1, 11.5.4.2 and 11.5.6.5, the applicant described the programmatic aspects of the effluent monitoring and sampling program. In addition, the applicant provided in BLN COL 11.5-2 specific language regarding the applicant's extension of the existing TVA program for quality assurance of radiological effluent and environmental monitoring which is based on RG 4.15, Revision 1, instead of the most current Revision 2. To maintain consistency, the applicant proposes to apply the same program to BLN Units 3 and 4.

The NRC staff reviewed the resolution of BLN COL 11.5-2 related to the effluent monitoring and sampling program included under Sections 11.5.1.2, 11.5.2.4, 11.5.3, 11.5.4, 11.5.4.1, 11.5.4.2 and 11.5.6.5 of the BLN COL FSAR and considers it adequately addressed in NEI 07-09.

- LNP COL 11.5-2

In LNP COL 11.5-2, in addition to accepting NEI 07-09A, the applicant extended its existing, NRC-accepted program for QA, including RG 4.15, Revision 1, for effluent and environmental monitoring, to LNP Units 1 and 2. By using the current program, the applicant will avoid confusion and the potential for error because the program for the existing and planned units will share the same equipment and personnel. The staff finds this acceptable.

- LNP COL 11.5-3

The applicant provided additional information in LNP COL 11.5-3 to resolve COL Information Item 11.5-3, which states:

> The Combined License applicant is responsible for addressing the 10 CFR 50, Appendix I guidelines for maximally exposed offsite individual doses and population doses via liquid and gaseous effluents.

The commitment was also captured as COL Action Item 11.5-3 in Appendix F of NUREG-1793, which states:

> The COL applicant is responsible for addressing the guidelines of Appendix I to 10 CFR Part 50, as they relate to maximally exposed offsite individual doses and population doses attributable to liquid and gaseous effluents.

The applicant addressed this COL item by adding information to LNP COL FSAR Sections 11.2.3.5 and 11.3.3.4 for liquid and gaseous effluents, respectively.

The NRC staff reviewed the resolution of LNP COL 11.5-3 related to compliance with 10 CFR Part 50, Appendix I, as discussed in SER Sections 11.2.4 and 11.3.4, and considers it adequately addressed.

The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the VEGP SER:

> *The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the BLN SER:*
>
> *Section 11.5.4.2, Representative Sampling*
>
> *In this section, the applicant describes how it will take representative samples for analysis. Based on the staff's review, the staff issued RAIs 11.5-1 and 11.5-2. RAI 11.5-1 requested clarification about the use of ANSI/HPS N13.1-1999. RAI 11.5-2 requested more information concerning how the applicant ensures representative liquid effluent and environmental sampling.*
>
> *In response to RAI 11.5-1, the applicant revised its commitment to use the 1999 standard. Because the applicant made no changes to the certified design, it removed the commitment to use ANSI/HPS N13.1-1999, and committed to ANSI N13.1-1969 to be consistent with the AP1000 certified design. ANSI withdrew the 1969 standard and replaced it with ANSI/HPS N13.1-1999 because the approach taken in the 1969 standard did not provide assurance that the sample in the effluent vent would be representative. The 1999 standard differs significantly from the earlier version in that it is now performance based. NUREG-0800 Section 11.5 (2007) uses the 1999 standard as acceptance criteria. The staff is pursuing this issue through the DC because it deals with the design of the sampling systems for radioactive gas streams.*
>
> *The applicant provided a response to RAI 11.5-2 and the staff finds the response acceptable. The response provided a more detailed description of how the applicant will assure that liquid samples will be representative. The applicant committed to follow the recommendations in ANSI N42.18 and RG 1.21. In addition, the applicant provided more operational descriptions for composite sampling. The NRC staff verified that Revision 1 of the BLN COL FSAR adequately addressed the above. As a result, RAI 11.5-2 is closed.*

The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the VEGP SER:

> *License Conditions*
>
> - *Part 10, License Condition 3, Operational Program Implementation, Item G.3*
>
> *VEGP COL FSAR Section 11.5.3 describes effluent monitoring and sampling and Section 11.5.7 describes the offsite dose calculation manual. License Condition 3, Item G.3 requires the licensee to implement the "Process and Effluent Monitoring and Sampling" program prior to initial fuel load. VEGP COL FSAR Section 13.4, Table 13.4-201, "Operational Programs Required by NRC Regulations," identifies three entries under Item 9, "Process and Effluent Monitoring and Sampling Program," as follows: (1) Radiological Effluent*

Technical Specifications/Standard Radiological Effluent Controls, (2) Offsite Dose Calculation Manual; and (3) Radiological Environmental Monitoring program, as programs identified in FSAR Section 11.5 required to be implemented by a milestone. The ODCM includes the Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls and the Radiological Environmental Monitoring program. In accordance with License Condition 3, Item G.3, these programs are to be implemented prior to initial fuel load. VEGP COL FSAR Table 13.4-201 provides the milestones (prior to initial fuel load) for implementation of these elements of the Process and Effluent Monitoring and Sampling Program and is acceptable as described in the staff's SER related to NEI 07-09.

- *Part 10, License Condition 6, Operational Program Readiness*

The applicant proposed a license condition to provide a schedule to support NRC inspection of operational programs including the ODCM, effluent technical specifications, and the radiological environmental monitoring program. The proposed license condition is consistent with the policy established in SECY-05-0197 and is acceptable.

11.5.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff proposes to include the following two license conditions:

- License Condition (11-4) – Before initial fuel load, the licensee shall implement an operational program for process and effluent monitoring and sampling. The program shall include the following subprograms and documents:

    a. Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls

    b. Offsite Dose Calculation Manual

    c. Radiological Environmental Monitoring Program

- License Condition (11-5) – No later than 12 months after issuance of the COL, the licensee shall submit to the Director of NRO a schedule that supports planning for and conduct of NRC inspections of the operational program for process and effluent monitoring and sampling (including Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls, Offsite Dose Calculation Manual, and Radiological Environmental Monitoring Program). The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the above operational program has been fully implemented.

11.5.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to the radiation

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

In addition, the staff evaluated the additional COL information (STD COL 11.5-1, STD COL 11.5-2, LNP COL 11.5-2, and LNP COL 11.5-3) in the application against the relevant NRC regulations, the acceptance criteria defined in NUREG-0800, Section 11.5, and other NRC regulatory guides. The staff concludes that the applicant has satisfactorily addressed all RAIs related to Section 11.5 and Confirmatory Item 11.5-1.

LNP DEP 6.4-1, related to design changes affecting habitability of the main control room and changes to the calculated doses to control room operators, is reviewed and found acceptable by the staff in Section 21.2 of this SER.

The staff verified that the applicant has provided sufficient information and that the review supports the conclusion that the process and effluent radiological monitoring and sampling systems are sufficient to comply with applicable portions of GDC 64 of Appendix A of 10 CFR Part 50; applicable requirements of 10 CFR Parts 20, 50, and 52; the guidance in ANSI/HPS N13.1, ANSI N42.18, RGs 1.21 and 4.15; and applicable acceptance criteria in NUREG-0800, Section 11.5.

Table 11.2-1. Dose from Consumption of Fish from Lower Withlacoochee River from Postulated Tank Release

Radionuclide	Surface Water Concentration in the Lower Withlacoochee River [C][1] (pCi/liter)	Total Body Dose Conversion Factor [DCF][2] (mrem/pCi)	Bio-accumulation Factor [BF][3] (pCi/kg per pCi/liter)	Dose from consumption of fish from Withlacoochee River for 1 year [DF][4] (mrem)
H-3	1.8E-5	1.05E-7	9.0E-1	3.6E-11
I-129	8.5E-8	9.21E-6	1.5E+1	2.5E-10
Mn-54	5.7E-87	8.73E-7	4.0E+2	~ 0
Fe-55	1.3E-29	4.43E-7	1.0E+2	~ 0
Co-60	6.0E-17	4.72E-6	5.0E+1	~ 0
Sr-90	9.6E-48	1.86E-3	3.0E+1	~ 0
Total				2.9E-10

1) Surface water concentrations from LNP COL FSAR Table 2.4.13–204.
2) Ingestion dose conversion factors for adults from RG 1.109, Table E-11, except for DCF for I-129, which is from NUREG-0172, Table 4.
3) Bio-accumulation factors for freshwater fish from RG 1.109, Table A-1.
4) DF = C x DCF x BF x 21 kg/year. The 21 kg/year of fish consumption is the amount consumed by an adult MEI (from RG 1.109, Table A-1).

Table 11.2-2. Comparison of Important Modeling Assumptions Used to Demonstrate Compliance with 10 CFR Part 50, Appendix I Criteria

Pathways and Parameters	Application	NRC Staff's Analysis
Drinking water pathway for MEI and population	No	No
Fish ingestion pathway for MEI and population	Yes	Yes
Recreational use of river for MEI and population	Yes	Yes
Irrigation pathway for the MEI (including irrigated vegetable ingestion and ingestion of milk and meat from livestock grazing on irrigated land)	No	No
Surface Water Dilution Model	Mixing in CR-3 Discharge Canal	Mixing in CR-3 Discharge Canal

Table 11.2-3. Modeling Parameter Values Used to Demonstrate Compliance with 10 CFR Part 50, Appendix I Criteria *

Parameter	Value	Basis
Annual radionuclide release (Ci/yr)	Multiple values	DCD Table 11.2-7
Effluent discharge rate (cfs)	63	FSAR Table 11.2-201
Dilution factors	21	FSAR Table 11.2-201
Transit time (hr)	0	FSAR Table 11.2-202
Reconcentration model	None	FSAR Table 11.2-202
Sport fishing harvest (kg/yr)	210,246	FSAR Table 11.2-202
Commercial fishing harvest (kg/yr)	734,960	FSAR Table 11.2-202
Sport Invertebrate harvest (kg/yr)	142,438	FSAR Table 11.2-202
Commercial Invertebrate harvest (kg/yr)	1,424,384	FSAR Table 11.2-202
Swimming/Boating/Shoreline usage (person-hours per year)	32,071,440 for Boating 32,541,940 for Others	FSAR Table 11.2-202

* Staff used LADTAP II default values for parameters not listed in the table

Table 11.2-4. Comparison of Maximum Individual Doses (mrem/yr) Used to Demonstrate Compliance with 10 CFR Part 50, Appendix I Criteria

Organ/Body	Application*	10 CFR Part 50, Appendix I, Section II.A
GI-LLI	7.14E-02	10
Total Body	5.20E-03	3
Thyroid	1.27E-02	10

* Taken from LNP COL FSAR Table 11.2-203

Table 11.2-5. Comparison of Maximum Individual Doses to 40 CFR Part 190 (mrem/yr)

Organ/Body	Application*	40 CFR Part 190
Total Body	5.5	25
Thyroid	12.9	75
Other Organ (Child - Bone)	19.5	25

* Taken from LNP COL FSAR Table 11.2-205

Table 11.3-1. Population Doses Breakdown by Source

Source	Total Body (person-rem)	Thyroid (person-rem)	Percent of Total Thyroid Dose
Noble Gases	1.02E+00	1.02E+00	12 Percent
Iodine	5.08E-03	2.63E+00	32 Percent
Particulates	1.33E-01	9.83E-02	1 Percent
C-14	3.48E+00	3.48E+00	42 Percent
H-3	1.09E+00	1.09E+00	13 Percent
Total	5.74E+00	8.33E+00	100 Percent

Table 11.3-2. Comparison of Maximum Annual Individual Doses

Description	Application	10 CFR Part 50, Appendix I, Sections II.B and II.C
Noble Gases		
• Gamma Dose (mrad)	1.67*	10
• Beta Dose (mrad)	9.35*	20
• Total Body (mrem)	3.06**	5
• Skin (mrem)	8.39**	15
Radioiodines and Particulates		
• Maximum Organ (mrem)	9.71***	15

* Taken from LNP COL FSAR Table 11.3-207
** Taken from LNP COL FSAR Table 11.3-206
*** Dose for the child bone (conservatively includes plume exposure pathway)

Table 11.3-3. Comparison of Population Doses (person-rem/yr)

Organ/Body	Application*	NRC Staff's Analysis
Total Body	5.74	5.75
Thyroid	8.33	8.08

* Taken from LNP COL FSAR Table 11.3-208