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 anticipated operational occurrences (e.g., refueling, purging, equipment downtime, maintenance).

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 Vogtle Electric Generating Plant (VEGP) Combined Operating License (COL) Final Safety Analysis Report (FSAR), Revision 5, incorporates by reference, with no departures or supplements, Section 11.1, "Source Terms," of Revision 19 of the AP1000 Design Control Document (DCD). The Nuclear Regulatory Commission (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 VEGP COL application are documented in NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," and its supplements.

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 VEGP COL FSAR, Revision 5, incorporates by reference Section 11.2 of the AP1000 DCD, Revision 19, and Section 11.2.3 of the Vogtle Early Site Permit (ESP) Application Site Safety Analysis Report (SSAR), Revision *5*.

[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.

In addition, in VEGP 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 VEGP COL FSAR Section 11.2.1.2.5.2.

- STD COL 11.2-2

The applicant added additional information in STD COL 11.2-2 to resolve COL Information Item 11.2-2 (COL Action Item 11.2-2) regarding liquid radwaste cost-benefit analysis methodology.

- VEGP COL 11.2-2

The applicant provided additional information in VEGP COL 11.2-2 to resolve COL Information Item 11.2-2 (COL Action Item 11.2-2). The additional information addresses the dilution factors used for dose calculations and the cost-benefit analysis of population doses in VEGP COL FSAR Sections 11.2.3.3 and 11.2.3.5.

- VEGP COL 2.4-5 and VEGP COL 15.7-1

VEGP COL FSAR Section 11.2 does not identify VEGP COL 2.4-5 and VEGP COL 15.7-1 as COL information items applicable to Section 11.2. However, VEGP COL 2.4-5 and VEGP 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, VEGP COL 2.4-5 and VEGP COL 15.7-1 are evaluated in SER Section 11.2.4. In VEGP COL FSAR Section 2.4, the applicant incorporated by reference VEGP ESP SSAR Section 2.4.13 to address COL Information Items 2.4-5 and 15.7-1.

- VEGP COL 11.5-3

The applicant provided additional information in VEGP 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 VEGP COL FSAR Section 11.2.3.5.

- VEGP ESP COL 2.4-1

The applicant added additional information to address VEGP Early Site Permit (ESP) COL 2.4-1 regarding the use of chelating agents.

Supplemental Information

- STD SUP 11.2-1

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

- VEGP SUP 11.2-1

The applicant added supplemental information in VEGP COL FSAR Section 11.2.1.2.4 regarding the exterior radwaste discharge piping. On September 10, 2010, the applicant provided additional supplemental information regarding the exterior radwaste discharge piping.

- VEGP SUP 11.2-2

The applicant added supplemental information in VEGP COL FSAR Section 11.2.3 to address the liquid effluent site interface parameter.

11.2.3 Regulatory Basis

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

In addition, the regulatory basis for acceptance of the supplementary information on the LWMS is established in:

- 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 50.34(a), “Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors.”
- 10 CFR Part 50, Appendix A, 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), “Contents of applications; additional technical information”
- Title 40 of the *Code of Federal Regulations* (40 CFR) Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations”

Guidance for accepting the supplementary 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 VEGP COL FSAR and checked the referenced DCD and the VEGP ESP SSAR to ensure that the combination of the DCD, the VEGP ESP SSAR, 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 contained 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 VEGP COL application are documented in NUREG-1793 and its supplements and in NUREG-1923, "Safety Evaluation Report for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant (VEGP) ESP Site."

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

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

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

- VEGP COL 15.7-1, Consequences of Tank Failure
- VEGP COL 11.5-3, Individual Dose Limits in 10 CFR Part 50, Appendix I
- VEGP ESP COL 2.4-1, Use of Chelating Agents
- STD SUP 11.2-1, Quality Assurance
- VEGP SUP 11.2-1, Supplemental Information on Exterior Radwaste Discharge Piping
- VEGP SUP 11.2-2, Supplemental Information on Liquid Effluent Site Interface Parameter

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 VEGP COL FSAR Section 11.2 met the regulatory requirements in the regulations stated above (safety evaluation report (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, located outside containment, and impacts of the release of radioactive materials at the nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

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 design certification (DC) and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER with open items issued for the Bellefonte Nuclear Plant (BLN) Units 3 and 4 COL application were equally applicable to the VEGP Units 3 and 4 COL application, the staff undertook the following reviews:

- The staff compared the BLN COL FSAR, Revision 1, to the VEGP COL FSAR. In performing this comparison, the staff considered changes made to the VEGP COL FSAR (and other parts of the COL application, as applicable) resulting from requests for additional information (RAIs) and open and confirmatory items identified in the BLN SER with open items.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content (the BLN SER) 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 VEGP COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. There were no confirmatory items or open items to resolve.

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.

- VEGP COL 11.2-2

The applicant provided additional information in VEGP COL 11.2-2 to resolve COL Information Item 11.2-2. COL Information Item 11.2-2 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 in 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.

The NRC staff reviewed the resolution of COL Information Item 11.2-2 related to the cost-benefit analysis included under Section 11.2.3.5 of the VEGP COL FSAR and issued RAI 11.2-1. This RAI stated that the applicant needed to provide a detailed and plant-specific cost-benefit analysis. The applicant provided this analysis in a response to the RAI.

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 at $11,140 per year. Assuming that this filter will eliminate all radioactive material from the liquid effluent, the resulting cost per dose reduction was $586,316 per total body person-rem and $5,063,636 per thyroid person-rem. This is well above the maximum costs criterion of $1,000 per person-rem for an augment in 10 CFR Part 50, Appendix I. Thus, the applicant concluded that the LWMS meets the as low as reasonably achievable (ALARA) requirements of 10 CFR Part 50, Appendix I, Section II.D, and requires no augments.

The NRC staff performed an independent assessment of the 50-mile population doses, considering the reasonableness of the modeling assumptions as provided by the applicant in VEGP ESP SSAR Tables 11.2-1 and 11.2-2 and the guidance in RG 1.110. The NRC staff concluded in NUREG-1923, Section 11.3.2, that the applicant's results represent conservative upper bound estimates for three reasons:

- First, the applicant assumed the drinking of Savannah River water when no such use has been shown to exist within 100 miles downstream of the site.

- Second, the applicant ignored the dilution flow from the plant discharge water.

- Third, the applicant used a low estimate of annual average river flow.

The staff's calculations, using the applicant's population dose values, support the applicant's position that the LWMS meets the cost-benefit design criterion of 10 CFR Part 50, Appendix I, Section II.D. As a result, RAI 11.2-1 is closed.

- VEGP COL 2.4-5 and VEGP COL 15.7-1

The applicant provided additional information in VEGP COL 2.4-5 and VEGP COL 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 in 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 applicant 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 in 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.

The applicant incorporated by reference Section 2.4.13 of the VEGP ESP SSAR to address accidental release of liquid effluents into ground and surface water. Based on the staff's review of Section 2.4.13, the staff issued RAI 2.4.13-1. RAI 2.4.13-1 notes that NUREG-0800 Section 2.4.13, under Acceptance Criterion No. 5, references BTP 11-6, which provides guidance in assessing potential release of radioactive liquids at the nearest potable water supply located in an unrestricted area for direct human consumption or indirectly through animals, crops, and food processing. BTP 11-6 provides further guidance concerning how the evaluation of the release should consider the use of water for direct human consumption or indirectly through animals (livestock watering), crops (agricultural irrigation), and food processing (water as an ingredient).

RAI 2.4.13-1 also notes that the applicant's analysis did not include a discussion of pathways other than drinking water and that the analysis should discuss these other pathways, especially

the pathways, such as fish and crop irrigation that might result in concentration of the source term. RAI 2.4.13-1 requested the applicant to either discuss other pathways, or justify why it need not.

In a letter from Southern Nuclear Operating Company (SNC) to the NRC dated December 23, 2008, the applicant addressed RAI 2.4.13-1. The applicant's response provided justification for why other pathways did not need to be included in the analysis. In summary, its analysis concluded that tritium accounts for 99.99 percent of the total hypothetical radionuclide activity at the point of exit from the restricted area and, since tritium does not bioaccumulate in the environment, evaluation of secondary exposure pathways is not warranted. The staff reviewed the applicant's analysis and performed an independent evaluation (as presented below).

VEGP SER Table 11.2-1 presents the results of a conservative dose assessment assuming the drinking water and fish consumption exposure pathways for the surface water concentration for radionuclides in Mallard Pond within the restricted area. The radionuclide concentrations assumed are those as presented in VEGP ESP SSAR Table 2.4.13-5. The third column is the calculated dose for an individual consuming 730 liters per year drinking water from the pond; and the fourth column is the calculated dose for intake of 21 kg per year fish from the pond, assuming the pond activity levels remain at the calculated maximum for the year. (Intake quantities represent the maximally exposed individual (MEI) from RG 1.109.)

The applicable regulatory acceptance criterion 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, limits at the nearest source of potable water, where the radionuclide concentrations correspond to a calculated dose of 50 mrem per year from the drinking water pathway. As VEGP SER Table 11.2-1 shows, the conservatively calculated MEI dose for one year's exposure for the applicable exposure pathways (4.4 mrem from drinking water and 0.90 mrem fish consumption) is less than this corresponding 50 mrem dose criterion. Any actual exposures to members of the public would be a small fraction of the above, considering additional dilution from Mallard Pond to the unrestricted area, where the nearest municipal water user is more than 100 river miles downstream, as is indicated in VEGP ESP SSAR Table 2.4.1-9.

Based on the above evaluation and the applicant's response to RAI 2.4.13-1, the NRC staff finds potential doses to members of the public resulting from an accidental release of liquid effluents meet Acceptance Criterion #5 and the referenced BTP 11-6. Therefore, RAI 2.4.13-1 is closed.

- VEGP COL 11.5-3

The applicant provided additional information in VEGP COL 11.5-3 to resolve the COL applicant's responsibilities set forth in Section 11.5.7 of the AP1000 DCD, which states:

> The COL 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 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 applicant incorporated by reference Section 11.2.3 of the VEGP ESP SSAR to address liquid radioactive releases and the methods used to assure that individual and estimated population doses are maintained ALARA in accordance with 10 CFR Part 50, Appendix I. Additionally, the applicant summarized the total body population dose within 50 miles of VEGP Units 3 and 4, as well as the corresponding thyroid dose due to liquid effluents.

The liquid effluent release parameters in VEGP ESP SSAR Tables 11.2-1, 11.2-2, and 11.2-3 were used by the applicant to calculate the annual liquid pathway doses to the MEI in VEGP ESP SSAR Table 11.2-4. The applicant compared these doses with the 10 CFR Part 50, Appendix I criteria in VEGP ESP SSAR Table 11.2-5. The NRC staff reviewed these calculated doses and found that they satisfied the MEI dose limits for liquid releases in 10 CFR Part 50, Appendix I, Section II.A, thereby demonstrating that the liquid radwaste system design is capable of maintaining doses within the design objectives of 10 CFR Part 50, Appendix I. The NRC staff performed an independent assessment and determined that the applicant's results represent conservative upper bound estimates.

The NRC staff concluded in NUREG-1923 that the applicant had provided a bounding assessment for liquid effluents demonstrating its capability to comply with the regulatory requirements in 10 CFR Part 20 and Appendix I to 10 CFR Part 50.

- VEGP ESP COL 2.4-1

This item is addressed in Section 2.4.13 of this 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.*

- VEGP SUP 11.2-1

The applicant provided additional information in VEGP SUP 11.2-1 related to the exterior radwaste discharge piping. This item is related to 10 CFR 20.1406 and is addressed in SER Section 12.3.

- VEGP SUP 11.2-2

The applicant stated that the only liquid effluent site interface parameter outside the Westinghouse scope is the release point to the Savannah River. The staff finds this statement true because the release point to the environment of liquid radioactive effluent is site-specific and to the Savannah River.

Demonstrating Compliance with 10 CFR 20.1301(e)

10 CFR 20.1301(e) requires that NRC-licensed facilities comply with the 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, radioactive waste storage areas, and N-16 skyshine from boiling-water reactor (BWR) turbine buildings. 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 VEGP ESP SSAR revealed that the applicant analyzed the above-discussed items and presented the results in SSAR Tables 11.2-6. The applicant's results included the sum of doses from the two proposed units and the two existing units at the site.

For the total site, the applicant's results are less than the maximum doses specified in 40 CFR 190.10(a) of 25 mrem/yr whole body, 75 mrem/yr thyroid, and 25 mrem/yr any other organ. Therefore, the NRC staff determined that the doses as analyzed by the applicant meet the requirements of 40 CFR Part 190 and 10 CFR 20.1301(e).

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 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 additional design features of the liquid effluent discharge pipe and operating programs in VEGP COL FSAR Section 11.2. The information in FSAR Section 11.2.1.2.4 describing the additional design features of the liquid effluent discharge pipe is evaluated in SER Section 12.3. The operational programs are evaluated in SER Section 12.5.

11.2.5 Post Combined License Activities

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

11.2.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD and the VEGP ESP SSAR. 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 VEGP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VEGP COL application are documented in NUREG-1793 and its supplements and in NUREG-1923.

In addition, the staff evaluated the additional COL information (STD COL 11.2-1, STD COL 11.2-2, VEGP ESP COL 2.4-1, VEGP COL 11.2-2, VEGP COL 2.4-5, VEGP COL 15.7-1, VEGP COL 11.5-3, STD SUP 11.2-1, VEGP SUP 11.2-1, and VEGP SUP 11.2-2) 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 RAIs related to Section 11.2.

The staff verified that the applicant had provided sufficient information and that the review and calculations support the conclusions that follow. The staff concludes 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, 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 VEGP COL FSAR, Revision 5, incorporates by reference Section 11.3 of the AP1000 DCD, Revision 19, and Section 11.3.3 of the VEGP ESP SSAR, Revision 5.

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

AP1000 COL Information Items

- STD COL 11.3-1

The applicant added 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.

- VEGP COL 11.3-1

The applicant provided additional information in VEGP 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 VEGP COL FSAR Section 11.3.3.4.

- VEGP COL 11.5-3

The applicant provided additional information in VEGP 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 VEGP COL FSAR Section 11.3.3.4.

Supplemental Information

- STD SUP 11.3-1

The applicant added supplemental information in VEGP 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 VEGP 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 the FSERs related to the DCD and the VEGP ESP.

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

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

Guidance for meeting these requirements is in:

- Regulatory Position C.2 of RG 1.143
- RG 1.109
- 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 applicable acceptance criteria are identified 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 VEGP COL FSAR and checked the referenced DCD and the VEGP ESP SSAR to ensure that the combination of the DCD, VEGP ESP SSAR, 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 contained 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 VEGP COL application are documented in NUREG-1793 and its supplements and in NUREG-1923.

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
- VEGP COL 11.3-1, Cost-Benefit Analysis of Population Doses
- VEGP 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 VEGP 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) for gamma radiation or 0.02 cGy (20 millirads) 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 contained 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 or the DC application, update in the SAR, or the COL application to the extent not addressed in a referenced certified design.

- 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 with open items issued for the BLN Units 3 and 4 COL application were equally applicable to the VEGP Units 3 and 4 COL application, the staff undertook the following reviews:

- The staff compared the BLN COL FSAR, Revision 1, to the VEGP COL FSAR. In performing this comparison, the staff considered changes made to the VEGP COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs and open and confirmatory items identified in the BLN SER with open items.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content (the BLN SER) 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 VEGP COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. There were no confirmatory items or open items to resolve.

AP1000 COL Information Items

- 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 of 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.

- VEGP COL 11.3-1

The applicant provided additional information in VEGP 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 11.3.3.4.2 and 11.3.5.1 of the VEGP COL FSAR and issued RAI 11.3-1 because the Nuclear Energy Institute (NEI) Template 07-11, "Generic Template Guidance for Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors," cited by SNC had been withdrawn by NEI from further consideration. This RAI asked the applicant to provide a detailed and plant-specific cost-benefit analysis.

In response to RAI 11.3-1, the applicant performed a site-specific analysis to determine whether the offsite dose due to gaseous effluents is bounded by the AP1000 site parameters included in Chapter 1 and Tables 11.3-1, 11.3-2 and 11.3-4 of the DCD. The applicant discussed the site-specific cost-benefit analysis in VEGP 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.

The applicant's analysis showed that the lowest cost option for gaseous radwaste treatment system augments is the Steam Generator Flash Tank Vent to Main Condenser at $6,320 per year. Assuming that this augment will eliminate all radioactivity from the gaseous effluent, the resulting cost per dose reduction was $7,022 per total body person-rem and $2,107 per thyroid person-rem. This is above the maximum cost criterion of $1,000 per person-rem for an augment in 10 CFR Part 50, Appendix I. Thus, the applicant concluded that the GWMS meets ALARA and requires no augments.

The NRC staff performed an independent assessment using the 50-mile population doses calculated by the staff (see following section) and the guidance in RG 1.110 and came to the same conclusion. The staff evaluated a different augment, the 1000 cubic-feet-per-minute Charcoal and High Efficiency Particulate Air (HEPA) filtration system; because this is the lowest cost augment that would effectively remove radioiodines and particulates, which are the major contributors to the population dose. VEGP SER Table 11.3-1 lists the cost-benefit ratios calculated by the applicant and staff and compares them to the Appendix I criterion. The NRC staff verified that Revision 2 of the VEGP COL FSAR adequately addresses the plant-specific cost-benefit analysis. The staff confirmed that the GWMS meets ALARA requirements and requires no augments. As a result, RAI 11.3-1 is closed.

- VEGP COL 11.5-3

The applicant provided additional information in VEGP 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 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 applicant incorporated by reference Section 11.3.3 of the VEGP ESP SSAR to address gaseous radioactive releases. Additionally, the applicant summarized total body population dose within 50 miles of VEGP Units 3 and 4, as well as the corresponding thyroid dose due to gaseous effluents.

The applicant, in Section 11.3.3 of the VEGP ESP SSAR, discussed the methods used to assure that individual and estimated population doses are maintained ALARA in accordance with 10 CFR Part 50, Appendix I. The gaseous effluent release parameters in VEGP ESP SSAR Tables 11.3-1, 11.3-2, and 11.3-4 were used by the applicant to calculate the annual gaseous pathway doses to the MEIs in VEGP ESP SSAR Table 11.3-5. The applicant compared these doses with the 10 CFR Part 50, Appendix I criteria in VEGP ESP SSAR Table 11.3-6. The NRC staff performed an independent assessment of the population doses, considering the reasonableness of the modeling assumptions as provided by the applicant in VEGP ESP SSAR Tables 11.3-1, 11.3-2, and 11.3-4 and the guidance in RG 1.110 and achieved results similar to those of the applicant. The NRC staff concluded, in NUREG-1923, that the applicant's calculated doses are correct and appropriate. Based on its findings concerning the VEGP ESP SSAR, the NRC staff concluded that the VEGP COL FSAR provides a bounding assessment for gaseous effluents, demonstrating its capability to comply with the regulatory requirements in 10 CFR Part 20 and 10 CFR Part 50, Appendix I.

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.

- 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**.

Resolution of Standard Content Confirmatory Item 11.3-1

Confirmatory Item 11.3-1 is a commitment by the applicant to incorporate changes, by reference, proposed by Westinghouse to Section 11.3.3.4 of the AP1000 DCD to include the results of the postulated radioactive release resulting from a leakage or failure of a waste gas storage tank or offgas charcoal delay bed. The staff verified that the applicant has incorporated the AP1000 DCD Revision 18 that includes the above changes. As a result, Confirmatory Item 11.3-1 is now closed.

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.

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 and the VEGP ESP SSAR. 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 VEGP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VEGP COL application are documented in NUREG-1793 and its supplements and in NUREG-1923.

In addition, the staff evaluated the additional COL information (STD COL 11.3-1, VEGP COL 11.3-1, VEGP 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 RAIs related to Section 11.3.

The staff verified that the applicant had 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 3, 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 3 by conforming to the guidance in BTP 11-5. 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, GDC 3, 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 VEGP COL FSAR, Revision 5, incorporates by reference Section 11.4 of the AP1000 DCD, Revision 19.

In addition, in VEGP 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 for both wet and dry solid wastes.

- VEGP COL 11.4-1

The applicant provided additional information in VEGP COL FSAR Section 11.4.2.4.3 to address COL Information Item 11.4-1 (COL Action Item 11.4-1). The additional information describes options available for managing Class B and C low-level radioactive waste.

Supplemental Information

- VEGP SUP 11.4-1

The applicant provided supplemental information in VEGP COL FSAR Section 11.4.6.3 to address long-term onsite storage of radioactive waste.

- STD SUP 11.4-1

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

License Condition

- Part 10, License Condition 3, Operational Program Implementation

VEGP COL FSAR Section 13.4, Table 13.4-201, "Operational Programs Required by NRC Regulations," identifies Item 9, the process control program, 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 process control program.

11.4.3 Regulatory Basis

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

In addition, the regulatory basis for acceptance of the supplemental information on the SWMS is established in several codes and standards. These include:

- 10 CFR Part 20
- 10 CFR Part 50
- 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report"
- 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

The applicable acceptance criteria are identified in NUREG-0800, Section 11.4, including BTP 11-3.

11.4.4 Technical Evaluation

The NRC staff reviewed Section 11.4 of the VEGP 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 contained 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 VEGP 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
- VEGP COL 11.4-1, Alternatives for B and C Wastes
- VEGP SUP 11.4-1, Long Term On-Site Storage Facility
- STD SUP 11.4-1, Quality Assurance

In addition to the above items, the staff reviewed the entire section against NUREG-0800, Section 11.4, to determine if the information in BLN 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, as they relate to the definition of the boundary of the SWMS beginning at the interface from plant systems, including multiunit 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 with open items issued for the BLN Units 3 and 4 COL application were equally applicable to the VEGP Units 3 and 4 COL application, the staff undertook the following reviews:

- The staff compared the BLN COL FSAR, Revision 1, to the VEGP COL FSAR. In performing this comparison, the staff considered changes made to the VEGP COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs and open and confirmatory items identified in the BLN SER with open items.
- The staff confirmed that all responses to RAIs identified in the corresponding standard content (the BLN SER) 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 VEGP COL application. This standard content material is

identified in this SER by use of italicized, double-indented formatting. There was one confirmatory item (Confirmatory Item 11.4-1) and one open item (Open Item 11.4-1) related to the standard content in the BLN SER. The resolution of those items is addressed in this 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****.*

Resolution of Standard Content Confirmatory Item 11.4-1

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.

- VEGP COL 11.4-1

In a September 23, 2009, response to RAI 11.4-1 and RAI 11.4-2, the applicant provided additional information in VEGP COL 11.4-1 to address alternatives for interim storage of Class B and C low-level radioactive waste.

The applicant's revision of FSAR Section 11.4.2.4.3 specifies three options the applicant has to store Class B and C low-level radioactive waste without ever needing to construct additional onsite storage. These options include fully utilizing the present storage capacity of the AP1000 for Class B and C waste, using vendor services to store Class B and C waste offsite, and gaining access to storage facilities at another licensed nuclear plant. The staff has examined each of the potential options described by the applicant.

One of the options for waste storage is the prudent use of the AP1000 design. The applicant can extend the design storage capacity of the AP1000 capacity for Class B and C waste by prudently managing waste throughput. The applicant points out that Class B and C wastes are wet wastes and the AP1000 design has more than one year of storage capacity in the Auxiliary Building for this waste. In addition, the staff's own analysis of the capacity of the AP1000

Radwaste Building shows that the anticipated volume of Class B and C waste comprises less than 2 percent of the anticipated volume of all low-level radioactive waste. By frequently disposing of Class A waste, the AP1000 design can likely store at least 10 years' generation of Class B and C waste in the Radwaste Building. The staff concludes that, in combination with other options discussed in this section, this option could significantly postpone or possibly eliminate the need to design and build additional onsite storage for Class B and C waste.

Another option is to process and store Class B and C waste offsite by using vendor services. The applicant states that it has Waste Control Specialists (WCS) of Texas available for offsite storage. The staff also is aware of other commercial vendors of low-level waste management services, namely Studsvik facilities in Memphis and Erwin, Tennessee. Based on a review of the licenses for these facilities, the staff found that these facilities also are available to the applicant to process and store Class B and C waste. This option could both reduce the final volume of Class B and C waste and prolong the time before the applicant would need onsite storage.

Lastly, the applicant may gain access to a storage facility at another licensed nuclear plant. SNC is currently the licensed operator of Joseph M. Farley Nuclear Plant, Edwin I. Hatch Nuclear Plant, and VEGP Units 1 and 2. Currently, all three facilities either have additional onsite storage facilities or have plans to develop additional storage capacity. If the applicant ever required additional storage capacity, it could arrange for additional offsite storage with the three other facilities within the same operating company.

Based on the above three options presented in the application, the staff concludes that the applicant has provided reasonable assurance that it will have enough onsite and offsite contingent storage capacity for Class B and C low-level radioactive waste to eliminate, or at least significantly delay, the need to design and build additional onsite storage for Class B and C waste.

Supplemental Information

- VEGP SUP 11.4-1

In STD COL 11.4-1, the applicant states that, "no additional onsite radwaste storage is required beyond that described in the DCD." Additionally, VEGP SUP 11.4-1, addressed in VEGP FSAR Section 11.4.6.3, discusses the long-term onsite storage facility and briefly states that the applicant may use the planned VEGP Units 1 and 2 low-level radwaste storage facility should disposal facilities not be available.

Based on these statements by the applicant, the NRC issued two RAIs asking for more information concerning long-term storage of low-level radioactive waste.

In a September 23, 2009, response to RAI 11.4-1 and RAI 11.4-2, the applicant explained that, should it need additional onsite storage of Class B and C low-level radioactive waste, it could construct an additional onsite storage facility.

The applicant explained how it could expand onsite storage capacity. The applicant discussed design and operational issues needed to safely store the waste and comply with 10 CFR Parts 20 and 50 in FSAR Section 11.4.6.3.

The staff considers the applicant's response adequate given the large uncertainties in the situation. Currently, it is impossible to predict the volume of Class B and C waste that the applicant might need to store onsite. Given the options discussed above, one could reasonably assume this volume to be within the capacity of the design and the applicant would not have the need for additional onsite storage. The applicant did provide a reasonable response by specifying the design objectives and operating considerations for an onsite storage facility consistent with NRC guidance and good radioactive waste management practices.

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 in 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 could safely handle and store any low-level radioactive waste that might accumulate due to any potential unavailability of permanent disposal. The staff considers RAI 11.4-1, RAI 11.4-2, and Open Item 11.4-1 resolved.

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.

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 (11-1) - Prior to 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 (11-2) - 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 VEGP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VEGP COL application are documented in NUREG-1793 and its supplements.

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

The staff verified that the applicant had provided sufficient information and that the review supports the conclusion that the design and operation of the SWMS, which discharges radioactive releases through the LWMS and GWMS, is acceptable and meets the requirements of GDC 3, 60, and 61 of Appendix A of 10 CFR Part 50, 10 CFR 50.34a, 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 VEGP COL FSAR, Revision 5, incorporates by reference Section 11.5 of the AP1000 DCD, Revision 19.

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

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 Offsite Dose Calculation Manual (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.

- VEGP COL 11.5-2

The applicant provided additional information in VEGP COL 11.5-2 to add language to VEGP COL FSAR Section 11.5.3 addressing extension of the existing SNC program for QA of radioactive effluent and environmental monitoring to apply to VEGP Units 3 and 4.

- VEGP COL 11.5-3

The applicant provided additional information in VEGP 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 Condition

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

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 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 Offsite Dose Calculation Manual, and the Radiological Environmental Monitoring program.

11.5.3 Regulatory Basis

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

In addition, the regulatory basis for acceptance of the supplementary information on radiation monitoring addressed in COL Information Items 11.5-1, 11.5-2, and 11.5-3 is established in the requirements and guidelines of:

- 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 VEGP 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 contained 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 VEGP COL application are documented in NUREG-1793 and its supplements.

The staff reviewed the information contained in the VEGP COL FSAR:

AP1000 COL Information Items

- STD COL 11.5-1, ODCM

- STD COL 11.5-2, Programmatic Aspects of the Effluent Monitoring and Sampling Program

- VEGP COL 11.5-2 adds language to VEGP COL FSAR Section 11.5.3 addressing extension of the existing SNC program for quality assurance of radioactive effluent and environmental monitoring to apply to VEGP Units 3 and 4.

- VEGP 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 VEGP 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 (RETS)/SREC, ODCM and Radiological Environmental Monitoring Program (REMP) 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 with open items issued for the BLN Units 3 and 4 COL application were equally applicable to the VEGP Units 3 and 4 COL application, the staff undertook the following reviews:

- The staff compared the BLN COL FSAR, Revision 1, to the VEGP COL FSAR. In performing this comparison, the staff considered changes made to the VEGP COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs and open and confirmatory items identified in the BLN SER with open items.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content (the BLN SER) 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 VEGP COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. There was one confirmatory item (Confirmatory Item 11.5-1) related to the standard content in the BLN SER. Its resolution is addressed in this 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.*

Resolution of Standard Content Confirmatory Item 11.5-1

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.

- VEGP COL 11.5-2

In VEGP COL 11.5-2, the applicant extended the existing, NRC-approved SNC QA program, including RG 4.15, Revision 1, for effluent and environmental monitoring to Units 3 and 4. By using the current program, the applicant will also 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.

- VEGP COL 11.5-3

The applicant provided additional information in VEGP 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 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 VEGP 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 VEGP 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 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.*

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 (11-3) - Prior to 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 (11-4) - 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 VEGP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the VEGP 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, VEGP COL 11.5-2, and VEGP COL 11.5-3) in the application against the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 11.5, and other NRC regulatory guides. The applicant has satisfactorily addressed all RAIs and Confirmatory Item 11.5-1 related to Section 11.5.

The staff verified that the applicant has provided sufficient information and that the review supports the conclusion that follows: The staff concludes that the Process and Effluent Radiological Monitoring and Sampling Systems is 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; 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. Estimated Radionuclide Concentrations in Mallard Pond and Corresponding Estimated Doses

Radionuclide	Surface Water Concentration in Mallard Pond [C][1] (pCi/liter)	Total Body Dose Conversion Factor [DCF][2] (mrem/pCi)	Dose from drinking water from Mallard Pond for 1 year [DW][3] (mrem)	Bio-accumulation Factor [BF][4] (pCi/kg per pCi/liter)	Dose from consumption of fish from Mallard Pond for 1 year [DF][5] (mrem)
H-3	5.76E+4	1.05 E-7	4.4	9.0E-1	0.14
Mn-54	2.49E-1	8.72E-7	1.6E-4	4.0E+2	1.8E-3
Fe-55	7.52E+0	4.43E-7	2.4E-3	1.0E+2	7E-3
I-129	6.04E-4	9.21E-6	4.1E-6	1.5E+1	7.8E-6
Sr-90	4.21E-4	1.86E-3	5.7E-4	3.0E+1	4.9E-4
Ag-110m	1.82E-2	8.79E-8	1.2E-6	2.3E+0	7.7E-8
Cs-137	2.58E-1	7.14E-5	1.3E-2	2.0E+3	7.7E-1
Ce-144	1.23E-2	2.62E-8	2.4E-7	1.0E+0	6.8E-9
Total			4.4		0.90

1) Surface water concentrations from VEGP ESP SSAR, Table 2.4.13-5.
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) DW = C x DCF x 730 liters/year. The 730 liters/year is the amount of drinking water consumed by an adult maximally exposed individual (from RG 1.109, Table E-5).
4) Bioaccumulation factors for freshwater fish from RG 1.109, Table A-1, except for Ag-110m, which is from ORNL-4992, Table 4.12A (Reference 8 of RG 1.109, Appendix A).
5) DF = C x DCF x BF x 21 kg/year. The 21 kg/year of fish consumption is the amount consumed by an adult maximally exposed individual (from RG 1.109, Table A-1).

Table 11.3-1. Comparison of Cost-Benefit Ratios ($ per Person-Rem)

Organ/Body	Application	NRC Staff's Analysis	Maximum Cost-Benefit Ratio in 10 CFR Part 50 Appendix I
Total Body	7,022	8,419	1,000
Thyroid	2,107	2,526	1,000