11.0 RADIOACTIVE WASTE MANAGEMENT

The radioactive waste management systems (RWMSs) are designed to control, collect, handle, process, store, and dispose of liquid, gaseous, and solid wastes that may contain radioactive materials. The systems include the instrumentation used to monitor and control the release of radioactive effluents and wastes and are designed for normal operation (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; inservice inspection (ISI); and calibration) and anticipated operational occurrences (AOOs).

11.1 Source Terms

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

Section 11.1 of the Turkey Point Units 6 and 7 combined license (COL) Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference, Section 11.1, "Source Terms," of Revision 19 of the AP1000 Design Control Document (DCD).

In addition, in the Turkey Point Units 6 and 7 COL FSAR, the applicant provided the following:

Departure

- PTN DEP 6.4-1

The applicant provided information in Section 11.1 of the Turkey Point Units 6 and 7 COL FSAR about PTN DEP 6.4-1 related to design changes affecting habitability of the main control room and changes to the calculated doses to control room operators. This information, as well as related PTN DEP 6.4-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.2 of this report.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed Section 11.1 of the Turkey Point Units 6 and 7 COL FSAR and checked the referenced DCD to ensure that no issue relating to this section remained for review. The staff's review confirmed that there is no outstanding issue related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application are documented in NUREG 1793, "Final Safety Evaluation Report [FSER] 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 AOOs.

11.2.2 Summary of Application

Section 11.2 of the Turkey Point Units 6 and 7 COL FSAR, Revision 8, incorporates by reference Section 11.2 of the AP1000 DCD, Revision 19.

In addition, in Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 COL FSAR, Sections 11.2.1.2.5.2 and 11.2.5.1.

- PTN COL 11.2-2

The applicant provided additional information in Turkey Point Nuclear Plant (PTN) 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 Turkey Point Units 6 and 7 COL FSAR, Sections 11.2.3.5 and 11.2.5.2.

- PTN COL 2.4-5 and PTN COL 15.7-1

Turkey Point Units 6 and 7 COL FSAR, Section 11.2, does not identify PTN COL 2.4-5 and PTN COL 15.7-1 as COL information items applicable to Section 11.2. However, PTN COL 2.4-5 and PTN COL 15.7-1 provide information regarding a postulated liquid waste tank failure, which is evaluated by the staff as part of LWMS. Therefore, PTN COL 2.4-5 and PTN COL 15.7-1 are evaluated in Section 11.2.4 of this safety evaluation report (SER). In Turkey Point Units 6 and 7 COL FSAR, Section 2.4.13, the applicant performed the consequence analysis of a postulated liquid waste tank failure to address COL Information Items 2.4-5 and 15.7-1.

- PTN COL 11.5-3

The applicant provided additional information in PTN 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* (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 Turkey Point Units 6 and 7 COL FSAR, Section 11.2.3.5.

Supplemental Information

- STD SUP 11.2-1

The applicant added, in Turkey Point Units 6 and 7 COL FSAR, Section 11.2.3.6, supplemental information to address the quality assurance (QA) program to be applied to the LWMS.

- PTN SUP 11.2-1

The applicant added, in Turkey Point Units 6 and 7 COL FSAR, Section 11.2.3.6, supplemental information related to the discharge of effluent to deep well injection wells.

- PTN SUP 11.2-2

The applicant added in, Turkey Point Units 6 and 7 COL FSAR, Section 11.2.3.5, supplemental information related to the QA program.

11.2.3 Regulatory Basis

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

The regulatory requirements applicable to the LWMS are as follows:

- 10 CFR 20.1301(e)
- 10 CFR 20.1302, “Compliance with dose limits for individual members of the public”
- 10 CFR 20.1406, “Minimization of contamination”
- 10 CFR 20.2002, “Method for obtaining approval of proposed disposal procedures”
- 10 CFR 50.34a, “Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors”
- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion (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)

- 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, Revision 2, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants"

- Regulatory Position C.1.1 of RG 1.143, Revision 2

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

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

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

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

- SECY-07-0060, "Basis and Justification for Approval Process for 10 CFR 20.2002 Authorizations and Options for Change"

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 staff reviewed Section 11.2 of the Turkey Point Units 6 and 7 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. The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the LWMS. The results of the staff's evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.

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

- STD COL 11.2-1, Processing of Liquid Waste by Mobile Equipment
- PTN COL 11.2-2, Liquid Radwaste Cost-Benefit Analysis Methodology
- PTN COL 2.4-5, Accidental Release of Liquid Effluents into Groundwater and Surface Water
- PTN COL 15.7-1, Consequences of Tank Failure
- PTN COL 11.5-3, Individual Dose Limits in 10 CFR Part 50, Appendix I
- STD SUP 11.2-1, Quality Assurance
- PTN SUP 11.2-1, Effluent Discharge Point
- PTN SUP 11.2-2, Quality Assurance

In addition to the above items, the staff reviewed the entire section against Section 11.2 of NUREG-0800 to determine whether the information in Turkey Point Units 6 and 7 COL FSAR, Section 11.2, met the regulatory requirements in the regulations stated above (SER Section 11.2.3) and the NUREG-0800 acceptance criteria. The relevant NUREG-0800 acceptance criteria are as follows:

- The LWMS should have the capability to meet the dose design objectives and include provisions to treat liquid radioactive wastes such that the following is true:
  - A. The calculated annual total quantity of all radioactive materials released from each reactor at the site to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 0.03 millisievert (mSv) (3 millirem (mrem)) to the total body or 0.1 mSv (10 mrem) to any organ. RGs 1.109, 1.112, and 1.113 provide acceptable methods for performing this analysis.
  - B. 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.
- 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 of containment, and impacts of the release of radioactive materials at the nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

Section 1.2.3 of this SER provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the design certification (DC) and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (Vogtle Electric Generating Plant (VEGP) Units 3 and 4) were equally applicable to the Turkey Point Units 6 and 7 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the Turkey Point Units 6 and 7 COL FSAR. In performing this comparison, the staff considered changes made to the Turkey Point Units 6 and 7 COL FSAR (and other parts of the COL application, as applicable) resulting from requests for additional information (RAIs).
- The staff confirmed that all responses to RAIs identified in the corresponding STD content evaluation were endorsed.
- The staff confirmed that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the STD content to be directly applicable to the Turkey Point Units 6 and 7 COL application. This STD content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the

reference COL application (VEGP) contains evaluation material from the SER for the Bellefonte Nuclear Plant (BLN) Units 3 and 4 COL application.

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

> *AP1000 COL Information Items*
>
> *The following portion of this technical evaluation section is reproduced from Section 11.2.4 of the BLN SER:*
>
> - *STD COL 11.2-1*
>
> *The applicant provided additional information in STD COL 11.2-1 to resolve COL Information Item 11.2-1. COL Information Item 11.2-1 states:*
>
> > *The Combined License applicant will discuss how any mobile or temporary equipment used for storing or processing liquid radwaste conforms to Regulatory Guide 1.143. For example, this includes discussion of equipment containing radioactive liquid radwaste in the non-seismic Radwaste Building.*
>
> *The commitment was also captured in COL Action Item 11.2-1 in Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:*
>
> > *The COL applicant will provide information on how any mobile or temporary equipment used for storing or processing liquid radwaste conforms to RG 1.143.*
>
> *The applicant provided information in BLN COL FSAR Section 11.2.1.2.5.2 that addresses how any mobile or temporary equipment that will be used for storing or processing liquid radwaste conforms to RG 1.143. For example, this includes discussion of equipment containing radioactive liquid radwaste in the non-seismic Radwaste Building. The staff issued Request for Additional Information (RAI) 11.2-5 to clarify some of the language used in the COL concerning the extent of compliance with RG 1.143 for the temporary and mobile equipment. The applicant responded to this RAI by proposing a revision to the BLN COL FSAR text to clearly state that the applicable requirements in RG 1.143 pertain to mobile and temporary equipment.*
>
> *The NRC staff reviewed the resolution of COL Information Item 11.2-1 related to the use of mobile or temporary equipment included under Section 11.2 of the BLN COL FSAR and found that the applicant's commitments for installing and operating mobile systems meets the acceptance criteria in Section 11.2 of NUREG-0800 and RG 1.143. The NRC staff verified that Revision 1 of the BLN COL FSAR (STD COL 11.2-1) adequately incorporates the above. As a result, RAI 11.2-5 is closed.*

While BLN RAI 11.2-5 and COL FSAR, Section 11.2.1.2.5.2, address mobile and temporary processing equipment, neither the response to BLN RAI 11.2-5 nor information already contained in this FSAR section included a discussion of how the cumulative source term inventories of all relevant radioactive materials present in the radwaste building (RWB), including that in mobile or temporary equipment, conform with the RG 1.143, Revision 2, dose acceptance criteria. Specifically, Regulatory Position C.5.1 of RG 1.143, Revision 2, states, "for a given structure housing radwaste processing systems or components, if the total design basis unmitigated radiological release (considering the maximum inventory) at the boundary of the unprotected area is greater than 500 millirem per year or the maximum unmitigated exposure to site personnel within the protected area is greater than 5 rem per year, the external structures are classified as RW-IIa." Since the AP1000 RWB is classified as RW-IIc (a classification less stringent than RW-IIa), the inventories of radioactive materials in this building should be managed and controlled in a way that will not result in these dose criteria being exceeded.

After reviewing the response to BLN RAI 11.2-5 and the FSAR information addressing COL Information Item 11.2-1, the staff issued RAI 11.02-4 to the Levy Nuclear Plant (LNP) requesting that the applicant provide information related to the types and quantities of radioactive material within the RWB and describe how the unmitigated dose criteria to a worker and members of the public will be met, given the guidance and acceptance criteria of RG 1.143, Revision 2.

In a letter dated October 23, 2014, Florida Power & Light Company (FPL) submitted a site-specific response to LNP RAI 11.02-4 applicable to the Turkey Point Units 6 and 7 COL application. This response also resolved questions asked in LNP RAI 11.02-5, for the Turkey Point Units 6 and 7 COL application. The staff notes that Turkey Point Units 6 and 7 each has its own RWB; however, in following the guidance of RG 1.143, Revision 2, each RWB is considered independently for determining the building classifications. Since each RWB is essentially the same and contains the same equipment (the only difference between the buildings for the purposes of radiological classification is the distance to the protected area boundary, in which case the applicant assumed the most limiting distance as applicable to both buildings), the analysis provided by the applicant and discussion below applies to both RWBs, equivalently.

In the response, the applicant indicated that there will be three primary types of radioactive waste within the RWBs. The three types of waste are: (1) liquid waste stored within the three 56,780-L (15,000-gal) monitor tanks, (2) waste associated with liquid mobile waste processing systems, which may be utilized within the radwaste buildings (the AP1000 DCD Chapter 11 indicates that up to three mobile skids may be located in the radwaste building), and (3) solid wastes and wastes that have been packaged and are ready for shipment.

The applicant provided information explaining how operational programs and procedures will ensure that the RG 1.143, Revision 2, dose criteria are not exceeded from the monitor tanks and mobile equipment. In its response, the applicant assumed that each monitor tank and mobile skid-mounted processing system located in the radwaste buildings have the same radionuclide distributions and inventories as the design-basis (0.25-percent failed fuel fraction) reactor coolant activity listed in FSAR Table 2.4.13-201, normalized to the 10 CFR Part 71, Appendix A, A_2 limit. The total radioactivity in each mobile skid-mounted processing skid was assumed to be analogous to the radioactivity that would be contained in a 1,415.8-L (50-ft^3) demineralizer used for the same functional purpose (the monitoring tanks and the mobile equipment each have the same activity; however, each mobile skid is modeled as a 1,415.8-L

(50-ft^3) demineralizer and the monitoring tanks are modeled based on the specific dimensions of the monitoring tanks). The A_2 activity for radionuclides in monitor tanks and mobile equipment can be found in Table 1 of the response.

Using the source term for the monitoring tanks and mobile equipment, as described above, the applicant calculated the dose rate at the nearest protected area boundary for an unmitigated release from the Turkey Point Units 6 and 7 RWBs. The applicant indicated that the closest distance to the protected area boundary from either of the Turkey Point Units 6 and 7 RWBs is 110 m (360.9 ft). This distance appears consistent with figures found within Chapter 1 of the FSAR. Since the monitoring tanks contain liquid radwaste, the applicant conservatively assumed that the entire liquid inventory of all three monitor tanks combined is released from the building and flows on the surface of the ground to the protected area boundary. The source is modeled as a rectangular source 53.3 m (175 ft) by 110 m (360 ft), with a depth of 2.92 cm (1.15 in.), extending from the radwaste building to the protected area boundary.

This source term is conservative as it does not account for any drainage of the liquid into the ground. The applicant calculated a dose rate 3 ft above the surface of the water of 0.47 mSv/hr (47.0 mrem/hr) to a member of the public at the protected area boundary. The applicant also calculated the dose from each mobile skid assuming that the activity in each skid remains attached to the media used to remove radioactive contaminants from the process fluids. The direct dose from the mobile skids was calculated at the protected area boundary from each skid. The total dose rate from three skids was calculated at 6.46E-3 mSv/hr (0.646 mrem/hr). Therefore, the total dose at the protected area boundary over a period of 2 hours was calculated as 0.952 mSv (95.2 mrem). The 2-hour timeframe is consistent with the timeframe used in similar radiological analyses and is therefore acceptable. The staff confirmed that the assumptions, calculations, and results seem reasonable and finds them to be acceptable for the dose at the protected area boundary, in accordance with RG 1.143, Revision 2.

To calculate the unmitigated exposure to a worker, the applicant assumed that a worker stood 3 m (10 ft) away from the unshielded monitor tank source term and separately 3 m (10 ft) away from the unshielded mobile processing system source term. The resulting worker doses were calculated as 0.49 mSv/hr (49 mrem/hr) and 3.23 mSv/hr (323 mrem/hr), respectively. Both dose rates were multiplied by 3 and added together to account for the total dose from three tanks and three mobile skids. The resulting 2-hour unmitigated exposure to site personnel was calculated as 22.3 mSv (2,230 mrem). This dose is less than the 50 mSv (5,000 mrem) specified in RG 1.143, Revision 2. The 3-m (10-ft) distance was chosen because unlimited worker occupancy workstations and low dose rate waiting areas are located no closer than 3 m (10 ft) from a mobile radwaste processing system or a waste monitoring tank. In addition, routine work practices limit stay times in close proximity to high dose rate radiation sources. Therefore, the staff finds the 3-m (10-ft) distance to be acceptable for the purposes of calculating the unmitigated dose to a worker for the purposes of RG 1.143, Revision 2. The staff confirmed the applicant's calculation results for the dose to a worker and finds these doses to be acceptable.

In the response, the applicant also provided additional information in FSAR Sections 11.2.1.2.5.2, 11.4.6, and 13.5.2.2.6, which fully address COL Information Items 11.2-1 and 11.4-1 (a parallel discussion related to the resolution of COL Information Item 11.4-1 is provided in SER Section 11.4.4 below) and the guidance and criteria of RG 1.143, Revision 2. In order to ensure that the total activity in the RWB is accounted for, the revisions to FSAR Sections 11.4.6 and 13.5.2.2.5 include a statement indicating that the waste removed from mobile radwaste processing systems will be packaged and ready for shipment

prior to placing the processing equipment back into service. Waste that is packaged and ready for shipment is outside the scope of RG 1.143, Revision 2.

While the calculations described above are acceptable for determining the unmitigated dose at the protected area boundary and the unmitigated exposure to workers for preoperational calculational purposes, the applicant and the staff acknowledge that, during operation, there will be unknown quantities of low to moderate activity unpackaged solid waste stored in the RWB. Since the exact types and quantities of this material cannot be determined at this time and because the procedures for ensuring that the criteria in RG 1.143, Revision 2, and the FSAR are being met have not yet been developed, the applicant proposed a license condition. The license condition ensures that procedural controls will be developed to ensure that the source terms are appropriately limited (the monitor tanks and mobile equipment are limited to the 10 CFR Part 71, Appendix A, A_2 values), that the total cumulative inventory of all unpackaged radioactive materials are accounted for in the unmitigated release and exposure calculations, and that doses are calculated, in accordance with RG 1.143, Revision 2. The license condition is discussed in more detail in SER Section 11.2.5 below.

While the applicant's response generally satisfies the staff's questions and concerns related to LNP RAI 11.02-4, the response indicated that high-activity filter cartridges are stored in shielded portable casks in the RWB. This statement is inconsistent with DCD Section 11.4.2.1, which indicates that high-activity filter cartridges are stored in the auxiliary building. High-activity dry waste is defined, in DCD Section 11.4.2.3.3, as waste with a contact dose rate greater than 1 mSv/hr (100 mrem/hr). A modification allowing storage of high-activity filter cartridges in the radwaste building would have to be reviewed in accordance with RG 1.143, Revision 2, if unpackaged, or SRP Section 11.4-A, if packaged, and this evaluation was not performed in the applicant's RAI response. Therefore, on February 3, 2015, the applicant submitted a revision to the initial response, removing the statement indicating that high-activity filter cartridges will be stored in the RWB. The staff finds this to be acceptable.

In summary, the applicant's responses, FSAR changes, and proposed license condition provide reasonable assurance that the total cumulative inventory of all unpackaged waste in the RWB (including the waste in the monitoring tanks, mobile processing systems, and any additional equipment, as well as any other unpackaged waste in the radwaste building) is limited consistent with the RG 1.143, Revision 2, dose acceptance criteria, given the safety classification RW-IIc assigned to the radwaste building. In addition, the response fully and adequately addresses COL Information Items 11.2-1 and 11.4-1. The proposed FSAR changes have been incorporated into the FSAR.

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

The discussion of PTN 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 PTN COL 11.2-2 to resolve COL Information Item 11.2-2 with regard to the cost-benefit analysis methodology.

The staff reviewed the resolution to COL Information Item 11.2-2 related to the cost-benefit analysis methodology described in Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.2.3.5, and issued RAI 5695, Questions 11.02-1 and 11.02-2 dated May 21, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12142A044). RAI 5695, Question 11.02-1 stated that the applicant needed to provide information to support dose estimates or explain why some exposure scenarios

(e.g., hypothetical future intrusion) may be excluded from consideration. The staff reviewed the applicant's response to RAI 5695, Question 11.02-1 in its letter dated July 13, 2012 (ADAMS Accession No. ML12199A149), and has summarized key points below.

The applicant's analysis indicated no credible exposure scenarios for drinking water existed since the Boulder Zone is highly brackish (i.e., not potable), is more than 883.9 m (2,900 ft) below soil level, and more than 274.3 m (900 ft) below the base of any drinking water source. The applicant then concluded that no cost-benefit analysis was required since no credible exposure pathway existed. The staff issued RAI 6985, Question 11.02-6, dated February 20, 2013, which requested additional information on other potential exposure pathways.

RAI 5695, Question 11.02-2 asked the applicant for clarification regarding the applicant's cost-benefit analysis. In two responses to RAI 5695, Question 11.02-2 dated July 13, 2012, and supplemental response dated April 7, 2015, the applicant proposed to include clarifying details to address the calculation for the cost-benefit analysis. The details of this analysis are provided in the discussion below.

After RAI 5695, Questions 11.02-1 and 11.02-2 were issued on May 21, 2012, the staff recognized additional unique challenges related to the use of deep injection wells. Supplemental RAI 6985, Question 11.02-6 expanded upon and replaced RAI 5695, Questions 11.02-1 and 11.02-2. RAI 5695, Questions 11.02-1 and 11.02-2 were closed pending resolution of Supplemental RAI 6985, Question 11.02-6.

As described in FSAR Section 11.2.3.5, Turkey Point Units 6 and 7 will use a nontraditional disposal method for U.S. Nuclear Regulatory Commission (NRC)-licensed radioactive material in liquid effluents (i.e., deep well injection into the Boulder Zone (about 883.9 m (2,900 ft) below ground surface)) versus the traditional liquid effluent disposal methods that involve the direct discharge into surface waters where the liquid effluent is diluted and dispersed in the receiving waters and is immediately available for potential dose to members of the public.

Migration within and out of the injection zone (Boulder Zone) was evaluated as part of the liquid effluent pathway analysis portion of the performance assessment (PA), to determine if the potential exists for increasing activity concentrations of long-lived radionuclides over the total assumed operation time period of 60 years for each unit. The applicant's evaluation focused on four long-lived radionuclides (tritium, cesium-134 (Cs-134), cesium-137 (Cs-137), and strontium-90 (Sr-90)) which were considered to be the most significant potential dose contributors.

The applicant's analysis of the potential for migration within the injection zone determined that the injectate plume is not expected to reach the hypothesized receptor location—3.54 km (2.2 mi) from the injection point in the Boulder Zone, the distance to the nearest privately owned land parcel—until more than 10 years after initiation of injection. Maximum activity concentrations over the model duration (100 years) at the hypothesized receptor location were estimated for the four radionuclides under consideration, which indicated maximum concentrations would be less than the as-injected concentrations. These maximum concentrations were used to compute the annual doses.

Additionally, the potential for vertical migration out of the injection zone toward drinking water sources in higher strata was evaluated. This analysis concluded that it is not anticipated, under normal operating conditions, that radioactivity injected into the Boulder Zone would reach either

an underground source of drinking water or the surface environment—primarily due to confinement, slow movement, and radioactive decay of the injectate plume.

Although the applicant intends to use a nontraditional disposal method which will serve to isolate the liquid radioactive waste, a cost-benefit analysis (in accordance with 10 CFR Part 50, Appendix I, Section II.D) is required to determine whether radwaste system augments can yield reductions in the 80.5-km (50-mi) population doses at a cost of less than $10 per person-Sv ($1,000 per person-rem). In estimating the potential 80.5-km (50-mi) population dose, the applicant selected the maximally exposed individual (MEI) doses in the inadvertent intrusion scenario because they bound those due to off-normal operation. The applicant calculated these annual doses to the MEI due to the ingestion of water and irrigated foods to be 2.7E-2 mSv (2.7 mrem) to the total body and 3.8E-2 mSv (3.8 mrem) to the liver (the organ receiving the maximum dose) per unit. While these doses are based on consumption rates for the MEI, it is conservatively assumed that the average member of the population also receives these doses.

The applicant's analysis noted that, of the liquid radwaste system (WLS) augments listed in RG 1.110, the one with the lowest annual cost (and thus the first potentially justifiable augment based on an averted dose consideration) is a 20-gpm cartridge filter at $11,140. To be justified for installation, this augment would need to avert at least 1.11E-1 person-Sv (11.14 person-rem) in a 50-mi population ($11,400 divided by $1,000 per person-rem averted).

Although 10 CFR Part 50, Appendix I, indicates that the thyroid is the only organ to be considered in the cost-benefit analysis, it is conservatively assumed that the bounding organ dose (3.8E-2 mSv (3.8 mrem) to the liver per unit) applies to the thyroid. Dividing 1.11E-1 person-Sv (11.14 person-rem) by the MEI doses of 2.7E-5 Sv (2.7E-3 rem) to the total body and 3.8E-5 Sv (3.8E-3 rem) to the organ yields populations of 4,125 and 2,931 persons, respectively. Accordingly, the minimum 80.5-km (50-mi) population justifying installation of the cartridge filter augment is 2,931 persons. Consistent with the intruder exposure analysis, each member of this exposed population (cohort) would need to obtain all of their water from a well located 3.54 km (2.2 mi) from Turkey Point Units 6 and 7. The applicant stated that this cohort does not now exist, nor is it considered reasonable to assume it will exist in the future.

The applicant concluded that, due to regulatory constraints and the quality of water in the Boulder Zone, the postulated inadvertent intrusion scenario is not considered reasonable given that the cohort population would need to ingest water and irrigated foods produced from the postulated well on privately owned land.

The staff performed a thorough review of the applicant's analysis and, considering the conservatisms used in the analysis, the regulatory constraints, and the quality of water in the Boulder Zone, concurs with the applicant's conclusion that no liquid radwaste treatment system augment is justified.

- PTN COL 2.4-5 and PTN COL 15.7-1

The applicant provided additional information in PTN COL 2.4-5 and PTN 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 as COL Action Item 2.4.1-1 in Appendix F of NUREG-1793, which states:

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

COL Information Item 15.7-1 states:

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

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

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

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

The staff performed an independent dose assessment using the applicant's groundwater (GW) transport modeling coupled with the pathway modeling of RG 1.109. The staff's evaluation of the primary conceptual model resulted in a potential dose of 0.44 mSv (44 mrem) (fish and invertebrate pathways), where the primary difference with the applicant's doses is due to differences in consumption rates. The staff assumed the recommended maximum individual consumption rates of 27 kg/year fish and 5 kg/year invertebrate. For the alternate conceptual model, the staff's analysis resulted in a potential total body dose of 0.52 mSv (52 mrem), based on consumption of 27 kg/year fish and 5 kg/year invertebrate and inclusion of a near-field dilution factor for the receiving water body of Biscayne Bay.

The applicant's calculation presented radionuclide concentration in sediment at the entry point into Biscayne Bay. To model the aquatic food pathway, no additional dilution is taken for the invertebrate calculation, assuming the invertebrates reside in the sediments. However, for the fish pathway, tidal dilution is assumed, recognizing that the fish do not reside in the sediments and significant dilution is afforded by the tidal flow. A contaminated GW flux (conservatively evaluated based on applicant's data) into Biscayne Bay is diluted by the tidal flux. This application is consistent with DC/COL-ISG-013, where credit for the near-field dilution in the

receiving water body is acceptable. The assigned near-field dilution is evaluated, considering conservative tidal flow and the release rate into Biscayne Bay.

The staff's independent calculations yielded a dose of 0.52 mSv (52 mrem) total body for the invertebrate and fish pathways using consumption rates for the maximum exposed individual (adult) from RG 1.109, Revision 1. Based on the applicant's response to RAI 5643, Question 2.04.12-6, dated June 27, 2011, and the above evaluation, the 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.

The staff confirmed the estimated total dose rate from radionuclides in the bay was below the exposure level of 1 mSv/yr (100 mrem/year) given in 10 CFR 20.1301, "Dose limits for individual members of the public."

- PTN COL 11.5-3

The applicant provided additional information in PTN COL 11.5-3 to resolve the COL responsibilities stated 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 the staff's FSER for the AP1000 DCD (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, in FSAR Section 11.2.3.5, discussed the planned discharge of liquid radioactive effluents via deep well injection to the Boulder Zone of the Lower Floridan aquifer, contending that this means of disposal would result in no doses to the population from normal operations. There was no other discussion presented relevant to ensuring that individual and estimated population doses are maintained "as low as is reasonably achievable" (ALARA) in accordance with 10 CFR Part 50, Appendix I (this information is also applicable to FSAR Sections 11.3.3.4 and 11.4).

The staff reviewed the applicant's response to PTN COL 11.5-3 related to compliance with 10 CFR Part 50, Appendix I, Sections II.A and II.D; determined that the proposed method of disposal of liquid radioactive effluents falls under alternate disposal requirements of 10 CFR 20.2002; and issued RAI 5695, Question 11.02-2 requesting the applicant to specifically address those requirements. As previously noted, the staff issued Supplemental RAI 6985, Question 11.02-6, on February 20, 2013, which expanded upon and replaced RAI 5695, Questions 11.02-1 and 11.02-2 (RAI 5695, Questions 11.02-1 and 11.02-2 were closed pending resolution of Supplemental RAI 6985, Question 11.02-6).

The staff's review of the applicant's described intrusion scenario raised a number of questions. The staff issued RAI 5695, Question 11.02-4 asking the applicant to address those questions. RAI 6985, Question 11.02-6 requested that the applicant provide an evaluation of potential

leakage of injectate along well casings upward toward the Upper Floridan and Biscayne Aquifers.

The staff's evaluation and conclusion of the acceptability of the proposed disposal method via deep well injection, potential radiological impacts to offsite intruders, and regulatory compliance with 10 CFR 20.1301, 20.1302, 20.1406, and 20.2002, and 10 CFR Part 50, Appendix I, design objectives and ALARA provisions are described below under "Demonstrating Compliance with 10 CFR 20.2002."

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

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

- PTN SUP 11.2-1

The applicant provided additional information in PTN SUP 11.2-1 stating that the liquid radwaste discharge release point is where the LWMS effluent discharge pipe connects to the blowdown sump discharge pipe to deep injection wells. The applicant also stated that the LWMS effluent discharge piping is double-walled piping up to this point.

The staff reviewed this supplemental information included in Turkey Point Units 6 and 7 COL FSAR Section 11.2.1.2.4 and finds that this supplemental statement is acceptable. A detailed evaluation of PTN SUP 11.2-1 is contained in Section 12.3 of this SER.

- PTN SUP 11.2-2

The applicant provided additional information in PTN SUP 11.2-2 stating that the quality assurance program for design, construction, procurement, materials, welding, fabrication, inspection, and testing activities conforms to the quality control provisions of the codes and standards recommended in Table 1 of RG 1.143.

Following a review of FPL, Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.2.3.6, the staff identified an issue on the QA plan and commitment to follow the guidance of RG 1.143 given that its guidance applies to LWMS systems and components not covered by the

requirements of Appendix B to 10 CFR Part 50. In RAI 7097, Question 11.02-7, the staff closed out the prior RAI on the same topic for the purpose of consolidating the technical and regulatory review. The closed RAI is RAI 6919, Question 11.02-5. In RAI 7097, Question 11.02-7, the applicant was requested to address and resolve the following regulatory and technical aspects in defining the scope of the QA program for the LWMS.

Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.2.3.6, presented supplemental information on QA and commits to follow the guidance of RG 1.143 in recognition that the guidance of RG 1.143 would apply to LWMS subsystems and components not covered by the requirements of Appendix B to 10 CFR Part 50. A review of FPL Quality Assurance Program Description (FPL-2, Revision 3, September 30, 2012) indicated that the commitment to NRC regulatory guides and quality standards did not identify the guidance of RG 1.143 for RWMSs.

Similarly, a review of FSAR, Revision 4, Section 17.3 (as related to design, procurement, fabrication, and installation) and Section 17.5 (as related to QA program descriptions) found the sections did not acknowledge the guidance of RG 1.143 in light of the provisions of Appendix B to 10 CFR Part 50. While Turkey Point Units 6 and 7 FSAR, Revision 4, Sections 11.2 to 11.4, on RWMS stated that the extent of control of Appendix B to 10 CFR Part 50 to such systems is limited, procedural controls would be established to ensure compliance with the guidance of RG 1.143.

However, the staff review of FSAR Revision 4, Sections 13.4 and 13.5, indicated that there was no information identifying the unique aspect of RG 1.143 on the development of a QA program since it was outside of the scope of Appendix B to 10 CFR Part 50. Since the applicant planned to rely on skid-mounted RWMS, there were no commitments as to how the guidance of RG 1.143 would be evaluated and applied in specifying design performance criteria, developing procurement specifications, and confirming proper installation and interfaces with permanently installed RWMS and building services. For permanently installed RWMS, the AP1000 DCD addresses the guidance of RG 1.143 for its design, but leaves the implementation of a supporting QA program to the applicant. Note that, for one type of skid-mounted RWMS, FSAR, Revision 19, Section 11.2.5.1, of the AP1000 DCD states that the applicant will address how mobile or temporary equipment used to process and store wastes will conform with the guidance of RG 1.143. The staff concludes that the applicant's COL FSAR, Revision 4, did not provide such information.

In light of the above, the staff finds that the application was incomplete in demonstrating how the provisions of RG 1.143 would be applied when using skid-mounted RWMS and silent on the implementation of operational programs (including QA) and procedures for all RWMSs. Accordingly, the staff issued RAI 7097, Question 11.02-7 on June 13, 2013, which requested that the applicant address the following concerns and revise the corresponding sections of the FSAR on the use of RWMS.

(1) Describe how the guidance of RG 1.143 will be evaluated and applied in specifying design performance criteria, developing procuring specifications, and confirming the proper installation and operation, including operational system interfaces with radioactive systems and features in protecting nonradioactive plant systems and building services.

(2) Describe the elements of the QA program for all RWMSs under the provisions of RG 1.143 and how this aspect of the QA program will be applied and integrated in operational programs and procedures in FSAR, Sections 13.4 and 13.5.

(3) Given the above, the applicant is requested to make parallel reviews and revisions in FSAR, Section 11.2.3.6 (QA) for the LWMS; Section 11.3.3.6 (QA) for the gaseous waste management system (GWMS); and FSAR, Section 11.4.5 (QA) for the solid waste management system (SWMS).

The staff reviewed the applicant's response to RAI 7097, Question 11.02-7, dated July 31, 2013. The applicant explained how the provisions of RG 1.143 will be applied when using skid-mounted RWMS and on the implementation of operational programs (including QA) and procedures for all RWMSs. The staff finds that this clarifying information is acceptable because the applicant committed to the guidance of RG 1.143, and committed to the regulatory positions established within the RG for C.1 through C.6 by highlighting the DCD sections where the commitments were made and this requirement is also captured by License Condition (11-1). These commitments will ensure that the necessary regulatory requirements are met and this requirement is also captured by License Condition (11-1). NRC RAI 7097, Question 11.02-7 is therefore resolved.

Demonstrating Compliance with 10 CFR 20.1301(e)

In 10 CFR 20.1301(e), the staff requires that NRC-licensed facilities comply with the U.S. Environmental Protection Agency (EPA) generally applicable environmental radiation standards of 40 CFR Part 190 for facilities that are part of the fuel cycle. The EPA annual dose limits are 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ. Meeting the requirements of 10 CFR 20.1301(e) requires the consideration of all potential sources of external radiation and radioactivity, including liquid and gaseous effluents and external radiation exposures from buildings, storage tanks, radioactive waste storage areas, and nitrogen-16 skyshine from boiling-water reactor (BWR) turbine buildings. The EPA STDs apply to the entire site or facility, whether it has single or multiple units.

The staff's review of the FSAR (Revision 0) revealed that the applicant did not provide any information demonstrating compliance with 10 CFR 20.1301(e). Because of this, the staff issued RAI 5695, Question 11.02-1 requesting that the FSAR demonstrate compliance with the EPA standard.

The applicant provided the demonstration (FSAR Revision 4) by summing the annual individual liquid and gaseous effluent doses for the proposed Turkey Point Units 6 and 7 as well as the existing Units 3 and 4. It listed the results in FSAR Table 11.3-206. Table 11.2-1 below lists these dose summations and compares them to the dose requirements in 40 CFR Part 190. The expected doses are below the EPA dose limits.

Table 11.2-1 Comparison of Maximum Individual Doses to 40 CFR Part 190 (mSv/yr) (mrem/year)

Organ/Body	Application *	40 CFR Part 190
Total Body	7.8E-2 (7.8)	2.5E-1 (25)
Thyroid	1.5E-1 (15)	7.5E-1 (75)
Other Organ (Lung)	8.4E-2 (8.4)	2.5E-1 (25)
* Taken from FSAR Table 11.3-206		

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. Subsection 11.2.3.4 of the DCD shows that even at the Technical Specification (TS) limit for percent failed fuel defects, the nominal blowdown flow provides sufficient 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.

However, the liquid waste disposal for Turkey Point Units 6 and 7 is via deep injection well, not as an effluent with dilution by the normal blowdown flow. In response to RAI 6985, Question 11.02-6, Item 6, the applicant addresses the minimum dilution flow required to control liquid radwaste discharges. The applicant incorporates changes to Sections 11.2.1.2.4 and 11.5.3 that included a discussion about maintaining the effluent concentration limits (ECLs) found in 10 CFR Part 20, Appendix B, by specifying and maintaining flow rates at the blowdown sump discharge to at least the minimum dilution factor. To ensure compliance with the ECLs, the applicant calculated and applied dilution flow prior to each batch release of liquid radwaste. The staff has reviewed the description of the stated flow rates in its response and finds the response to item 6 of RAI 6985, Question 11.02-6 acceptable.

Based on this acceptance, the staff concludes that the applicant has complied with 10 CFR 20.1302.

Demonstrating Compliance with 10 CFR 20.1406

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

With respect to the use of deep well injection for the disposal of treated liquid waste, the staff's evaluation of the related operational considerations in controlling and monitoring such discharges, via the Offsite Dose Calculation Manual (ODCM) and implementation of the Radiological Environmental Monitoring Program (REMP) for monitoring wells, is presented in

SER Section 11.5, using information drawn from this SER section and SER Sections 9.2.12 and 12.3. SER Section 12.3 contains the staff's evaluation and conclusion pertaining to compliance with 10 CFR 20.1406.

Evaluation of Proposed Disposal Method for Liquid Radioactive Effluents and Demonstrating Compliance with 10 CFR 20.2002

Following a review of FPL, Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.2, the staff identified several issues associated with the proposed disposal method for liquid radioactive waste via deep well injection into the Boulder Zone, using 12 injection wells and 6 monitoring wells installed on the site.

Regulatory Background

In FSAR Revision 6, Section 11.2.3.5, PTN COL 11.2-2, the applicant proposes a disposal method for liquid radioactive effluents using deep well injection into the Boulder Zone. When compared to routine effluent discharges in surface waters, the radioactivity injected in the Boulder Zone is expected to be isolated from the surface environment and out of reach of traditional radiation exposure scenarios and pathways considered by NRC regulations and guidance. Traditional effluent discharge methods dilute and disperse the radioactivity in the environment, but this disposal method confines the radioactivity into a slow-moving and expanding plume with the total inventory of long-lived radionuclides increasing over the operating life of the plant. As a result, radiological assessment methods and assumed exposure scenarios used to quantify radiological impacts and compliance with NRC regulations for effluents discharged in surface water bodies are not directly applicable.

The deep well injection method involves technical and regulatory considerations that are not explicitly addressed under 10 CFR 50.34a and 50.36a, "Technical specifications on effluents from nuclear power reactors," and 10 CFR Part 50, Appendix I, design objectives and ALARA provisions in controlling radioactive effluent releases. Similarly, the requirements of 10 CFR 20.1301 and 20.1302 and 40 CFR Part 190 (under 10 CFR 20.1301(e)), in complying with ECLs and doses to members of the public, also do not explicitly address deep well injection. However, the applicant must still meet applicable requirements under these regulations in applying the deep well injection method for waste disposal.

Accordingly, the applicant has performed and provided an analysis in its current application under the provisions of 10 CFR 20.2002.

In 10 CFR 20.2002, the staff provides an applicant with a method to obtain approval for proposed procedures, not otherwise authorized in the regulations, for disposal of licensed material generated in the applicant's activities. Under 10 CFR 20.2002, an applicant has to provide (a) a description of the waste, including the chemical and physical properties important to risk evaluation and the proposed manner and conditions of disposal; (b) an analysis of the environment in which wastes will be disposed; (c) the nature and location of other potentially affected licensed and unlicensed facilities; and (d) analyses and procedures to ensure that doses are maintained ALARA and within the dose limits of 10 CFR Part 20. The staff typically approves 10 CFR 20.2002 requests that will result in a dose to a member of the public (including all exposure groups) that is no more than "a few millirem/year" (this information is in SECY-07-0060, Attachment 1, and NUREG-1757, Volume 1, Revision 2, "Decommissioning Process for Materials Licensees," Section 15.12). As is noted in the SECY paper, the staff selected this criterion because it is a fraction of the dose associated with naturally occurring

background radiation, a fraction of the annual public dose limit, and an attainable objective in the majority of cases.

In this context, the staff considers its well-established 10 CFR Part 50 light-water-reactor criteria (including those prescribed by Appendix I) in determining whether all releases of radioactive material to the environment are ALARA and what monitoring, design criteria, and other conditions apply. As a result, the staff's evaluation of this disposal method under 10 CFR 20.2002 does not preclude the staff from considering the substantial technical requirements, design criteria, technical specification (TS), monitoring, and annual reporting called for by other provisions of 10 CFR Parts 20 and 50.

Moreover, the staff notes that there is a need to ensure that NRC and Florida Department of Environmental Protection (FDEP) requirements, when issued, are not conflicting and do not impose duplicative requirements, such as for radiological monitoring, periodic inspections and testing in confirming the mechanical integrity of the injection and monitoring wells, and requirements for well abandonment and closure at the end of their operational cycles or in the event of well failures and migration of radioactive materials in Upper Floridan aquifers.

For these reasons, there are a number of issues that the staff needed to consider in bridging and integrating these regulatory requirements and NRC acceptance criteria. The issues involved the resolution of geohydrological characteristics of the Boulder Zone; use of information described in the construction and testing of the first exploratory and monitoring wells (this information is in FPL reports of September 2012); development of an appropriate radioactive source term confined within an amorphous plume; development of an approach and method for modeling potential exposure scenarios that consider well failures and intrusion scenarios as expected operational occurrences using current land-use practices for this part of Florida; identification of surrogate criteria in achieving the same regulatory objectives since some current regulatory requirements do not apply to this disposal method; identification of FDEP permit conditions that would fulfill or supplement NRC requirements on installation, testing, operation, and environmental monitoring; and insertion of specific license conditions on the design features of injection and monitoring wells whose construction would not be completed before the issuance of the combined license.

RAI Questions on Proposed Deep Well Injection Disposal Method

The information provided in FSAR Revision 6, Sections 9.2, 10.4.5, and 11.2, and responses to the staff RAIs presented in FPL correspondence (May 22, 2012, and July 13, 2012) were not sufficient to validate and confirm the estimated doses of the assumed exposure scenario. Additional detail needed to be provided to enable the staff to confirm that the estimated doses in the FSAR are bounding and acceptable. Without this information, the staff was unable to make a determination that the applicant meets the acceptance criteria in SRP Section 11.2 and complies with the requirements of 10 CFR 20.2002, 20.1301, 20.1302, and 20.1406, and 10 CFR Part 50, Appendix I, numerical guides, design objectives, and ALARA provisions. A Supplemental RAI (RAI 6985, Question 11.02-6) on the proposed deep well injection method consolidates and subsumes the issues identified in prior NRC staff RAIs. As a result, the following RAIs are closed: RAI 5695, Questions 11.02-1, 11.02-2, 11.02-3, and 11.02-4.

The applicant provided responses to RAI 6985, Question 11.02-6, in two parts. In a letter dated August 9, 2013, the applicant provided responses to RAI 6985, Questions 11.02-6(5) to 11.02-6(11), while a January 15, 2014, letter included responses to RAI 6985,

Questions 11.02-6(1) to 11.02-6(4). The staff's evaluation and determination of acceptability of the responses are presented below.

In items 1 through 4 of RAI 6985, Question 11.02-6, the applicant was requested to consider radiological impacts of the disposal method should radioactivity be brought up to the surface by (1) drilling activities undertaken at a location beyond the control of the applicant and expose well drillers to radioactive material, (2) failure of a well casing or packing that could contaminate the Upper Floridan Aquifer and expose water users to radioactive material, and (3) upward migration of the injectate flow from the Boulder Zone into the base of the Upper Floridan aquifer. In item 2, the applicant was asked to consider several scenarios when assessing the radiological impacts of dose as seen in the original question above. Item 3 asked the applicant to consider the cumulative inventories of long-lived radionuclides expected to be present after 40 years of operation for both reactors. Item 4 requested the applicant to consider its application of retardation factors and to indicate the presence of residual concentrations of organic compounds in reclaimed municipal waste water was considered in developing distribution coefficients and retardation factors.

The response to RAI 6985, Question 11.02-6 (1-4), described three models used by the applicant to evaluate transport of radionuclides from the deep well injection. These models were evaluated by NRC hydrology staff to determine whether they provide a reasonable and conservative basis for dose calculations. The model results were also compared to results from independent confirmatory simulations conducted by the staff.

Radial Transport Model

The applicant used a two-dimensional cross-sectional model of the Boulder Zone to evaluate the maximum extent of injectate and radionuclide transport within the Boulder Zone. In addition, this model provided radionuclide concentrations as a function of distance from the injection well. The description of the model implementation in the SEAWAT code was reviewed, although a detailed examination of the input files was not conducted. The model implementation appears to use technically sound procedures. Parameters used in the modeling were based on data from the site investigation, appropriate literature values, and conservative assumptions. Transport was driven by advection, dispersion, and density differences. Radionuclide decay was considered, but no adsorption to solids was assumed. The applicant conducted an analysis to evaluate the sensitivity of model results to changes in parameter values. Key findings were that the injectate plume did not extend the 12.4 km (7.7 mi) to the Ocean Reef receptor location, but it did extend the 3.54 km (2.2 mi) to the closest private land parcel. Maximum tritium concentration 3.54 km (2.2 mi) from the injection location occurred at about 22 years after the start of injection. The maximum tritium concentration ratio (concentration at the receptor divided by the injectate concentration) was about 0.3.

The staff's confirmatory analysis assumed the injection displaced native water within the Boulder Zone to a constant depth of 74 m (242.8 ft) (the depth of the injection well) to create an expanding cylinder of injectate in the Boulder Zone. The radius of the injectate cylinder expands over time, reaching a radius of 3.54 km (2.2 mi) after 23.5 years. Assuming radionuclide decay, this travel time results in a concentration ratio for tritium of 0.27. The staff's results are bounded by the analysis of the applicant.

Vertical Transport Model

The applicant used a three-dimensional model, also implemented with SEAWAT, to evaluate vertical transport through the middle confining unit (MCU). No preferential pathway in the MCU was assumed. The primary model parameter controlling vertical flow in the MCU is the value of vertical hydraulic conductivity. Literature values reported for this parameter range over 10 orders of magnitude. The applicant used a value that is about 10 times smaller than the geometric mean, and one-half the harmonic mean, of the exploratory well EW-1 measurements. (Three of 16 values reported there were less than the value used by the applicant in the model.) Based on model results, the applicant reported that the injectate travelled approximately 94.4 m (310 ft) upward into the MCU during the 100-year simulation. The applicant evaluated the sensitivity of these results and reported that the travel distance into the MCU is linearly related to the vertical hydraulic conductivity and the inverse porosity.

The staff's confirmatory analysis used a one-dimensional analysis of density-dependent flow. Using the applicant's value of vertical hydraulic conductivity in the MCU, the staff's analysis results in the injectate travelling about 100 ft into the MCU in 100 years. For a layered hydrogeologic unit, vertical flow would be proportional to the harmonic mean of the individual layer hydraulic conductivities. Using the harmonic mean of the exploratory well EW-1 measurements, the staff estimated that the injectate would travel 68.9 m (226 ft) in 100 years. The staff's results are bounded by the applicant's results.

Liquid Dose Pathway

The applicant made conservative assumptions in evaluating transport through a preferential pathway in the MCU. The applicant assumed a continuous pathway from the Boulder Zone to the Upper Floridan aquifer and assumed that injectate in the Boulder Zone would be instantaneously transported, without dilution, through the pathway. Concentrations in the Upper Floridan aquifer were assumed to be those calculated using the Radial Transport model. The staff evaluated the applicant's assumptions and determined that these assumptions represent a bounding transport pathway between the Boulder Zone and the Upper Floridan aquifer.

The applicant performed a screening analysis using the LADTAP II code to determine what radionuclides were the largest contributors to dose from AP1000 DCD Table 11.2-7, considering the ingestion pathways of drinking water, and irrigated milk, meat, and vegetables for decay times spanning 5 to 100 years. The cumulative inventory present in the Boulder Zone at the end of Turkey Point Units 6 and 7 plant operations was also determined. The applicant presented a comparison of the subsurface activity present at the year in which both units cease operation. The applicant's analysis determined that tritium, Sr-90, Cs-134, and Cs-137 contribute over 99 percent of the dose to the total body and all organs after a decay time of 10 years or more from this comparison. This decay time is used because, according to the radial transport model, the plume does not reach the nearest resident until 10 years after the first injection. These four radionuclides would be retained and used as input for the dose analysis.

The model presented by the applicant contains the following assumptions: no soil retention or retardation by soil absorption is being accounted for, model period time of 60 years per unit, 1-year interval between startup for Turkey Point Units 6 and 7; entire simulation is 100 years leaving a 39-year interval to evaluate radionuclide migration after injection stops. Outages of 30 days or less are not modeled, and it is assumed that injection is continuous for 60 years per

reactor. The continuous injection assumption maximizes radionuclide concentrations at the receptors since it assumes greater liquid radwaste generation, release, and plume expansion. Since the plume expands faster, there is less time for radionuclides to decay before reaching the receptor. Considering these assumptions, the applicant stated that the approximate average annual injection rate is 23,583 L/min (6,230 gpm) for a single unit or 47,166 L/min (12,460 gpm) for two units. These flow rates are based on the DCD minimum dilution flow rate of 22,712 L/min (6,000 gpm), as found in DCD Section 11.2.3.3. Based on these assumptions, the staff determines that this approach appears to be conservative for an offsite exposure scenario.

The applicant identified two potential receptor locations. The first receptor location is 3.54 km (2.2 mi) northwest (NW) from the injection point, and the second is 12.4 km (7.7 mi) southeast. The receptor at 3.54 km (2.2 mi) is considered a highly improbable receptor since the flow of the Upper Floridan Aquifer is to the east of this location. The receptor located at 12.4 km (7.7 mi), however, does use water from the Upper Floridan Aquifer for irrigation purposes.

To provide a bounding analysis, the applicant determined that a tritium concentration of 1,369 Bq/L (37,000 pCi/L) would yield a limiting child total body dose of 6E-2 mSv/yr (6 mrem/year) which is equivalent to the total body design objective of 3E-2 mSv/yr (3 mrem/year) per unit. Tritium was used since it was also determined by the applicant to contribute 90 percent of the total dose. Then using the radial transport GW model, as discussed above, the applicant determined the distance that the 1,369 Bq/L (37,000 pCi/L) would travel over the selected timeframes of 5, 10, 25, 50, 75, and 100 years.

Based on the liquid pathway analysis, the applicant provided detailed dose calculations for the two locations identified above. From this analysis, the applicant determined that the model projected it would take more than 10 years for the plume to reach the nearest receptor at 3.54 km (2.2 mi) and the plume would not reach the receptor at 12.4 km (7.7 mi) during the 100-year simulation. The applicant's analysis showed that, for times after 100 years, the size of the plume, as a function of radionuclide concentration, is decreasing at a faster rate due to decay than increasing by migration since injection into the deep well stops at year 61 of the simulation.

As a result of the GW modeling, the applicant determined that the bounding exposure scenario was the extraction and use of water from directly above a hypothetical failure of the MCU after injection and flow through the Boulder Zone.

A detailed discussion was provided regarding potential future land uses, based on (a) Miami-Dade County Comprehensive Development Master Plan, considering wetlands identification; (b) the Future Land Use Map for Homestead; and (c) proposed Comprehensive Everglades Restoration Plan. This discussion determined that there were no future land uses that required special consideration in the GW use and exposure modeling.

In item 1 of RAI 6985, Question 11.02-6, the staff stated three different exposure scenarios for the applicant to consider. In the applicant's response, the applicant provided scenarios for analysis for each of the following: (1) Normal Operations, (2) Off-Normal Operations, and (3) Inadvertent Intrusion. In addition, the following areas were considered: (1) Plant Area, (2) Property Area, and (3) Beyond Property Area. Because of well design/construction, FDEP requirements, the applicant's site access restrictions, and the GW modeling, no Plant Area or Property Area exposure scenarios were identified as feasible since the restrictions to the site area and GW modeling did not yield a scenario where members of the public would be exposed.

However, for the Beyond Property Area scenario, the failure of the middle confining area and GW migration into the Upper Floridan Aquifer was considered. For this Beyond Property Area scenario, the 3.54-km (2.2-mi) and 12.4-km (7.7-mi) receptors were both considered.

The exposure scenarios described include: (1) off-normal operation with an MCU failure located 3.54 km (2.2 mi) from the effluent injection point and member of the public Upper Floridan aquifer use resulting in exposure through the drinking water pathway, (2) MCU failure and individual member of the public Upper Floridan aquifer use at 12.4 km (7.7 mi) for drinking water only, and (3) inadvertent intrusion with a member of the public drilling a well into the Upper Floridan aquifer immediately above a failure of the MCU located 3.54 km (2.2 mi) from the effluent injection point then unknowing use of the contaminated Upper Floridan groundwater for the use of drinking water ingestion, irrigation, milk animals, and livestock.

For the water exposure pathway, the dose modeling parameters as used for the RAI response were based on RG 1.109 exposure assumptions, such as age groups, exposure times, as used in the LADTAP II code. The GW modeling calculated was used to calculate the maximum radionuclide concentration in the Upper Floridan aquifer at the offsite location 3.54 km (2.2 mi) away. This modeling resulting in the following radionuclide concentrations:

- Tritium: 1.1E3 Bq/L (3.1E04 pCi/L)
- Cs-134: 2.9E-4 Bq/L (7.7E-03 pCi/L)
- Cs-137: 2.8E-2 Bq/L (7.6E-01 pCi/L)
- Sr-90: 2.1E-5 Bq/L (5.6E-04 pCi/L)

The annual effluent source term, conservatively adjusted to reflect a longer annual operations time and coupled with the GW migration and transit time, was used in the dose calculation. These maximum concentrations were assumed to occur concurrently for purposes of the dose calculations. The applicant's description of the dose modeling then proceeds to explain the use of the LADTAP II code, which requires the extrapolation of the source term and a derived dilution and transit time, for performing the dose calculations.

For the inadvertent intruder, it was assumed that a drinking water well was drilled into the Upper Floridan aquifer at the 3.54-km (2.2-mi) distance. It was assumed the well was located directly above a conduit (between the Boulder zone and the Upper Floridan aquifer). Exposure assumptions were presented addressing the drilling process, where the drillers would be exposed to the radioactive concentrations as modeled at the 2.2-mi distance. Direct exposure to the drilling mud (containing the transported injectate radionuclide concentration) and inhalation exposure to an evaporating puddle are assumed in this calculation.

The applicant's dose calculations, for Turkey Point Units 6 and 7, yielded a total body dose of 5.5E-2 mSv/yr (5.5 mrem/year) for the inadvertent intruder at 3.54 km (2.2 mi) NW of the injection point: 1.8E-2 mSv/yr) (1.8 mrem/year) from drinking water and 3.6E-2 mSv/yr (3.6 mrem/year) from irrigated foods. Tritium accounted for 99 percent of the drinking water dose and 92 percent of the irrigated foods dose. The maximum organ (liver) dose was 7.6E-2 mSv/yr (7.6 mrem/year), with drinking water being 25 percent and irrigated foods 75 percent of total. Tritium constituted 95 percent of the organ drinking water dose and 58 percent of the irrigated food dose. The dose from the drilling operation was calculated to be less than 1E-3 mSv (0.1 mrem) (total body and maximum organ-liver).

In a supplemental clarification question asked by the staff, on RAI 6985, Question 11.02-6, the staff requested that the applicant provide a clarification to the response concerning the distribution coefficients (Kd). In the supplemental response dated June 4, 2014, the applicant provided a revision to its original response. This revision provided clarification on the use of Kd in evaluating the dose calculations in the scenario for a driller. The response from the applicant emphasized the contribution of tritium on the total dose and the small impact the other three radionuclides would have if they were retained in soil. To confirm this, the staff performed independent calculations to confirm that the doses from inhalation and immersion in the drilling scenario were small. The results of the staff's analysis agreed that the contribution from Sr-90, Cs-134, and Cs-137 is a small contributor to dose and the staff agrees with the approach taken by the applicant.

The staff reviewed the source term used to assess doses to a member of the public via the deep well injection pathway. In its review, the staff raised a question on whether the source term described in 11.2 for the inadvertent intruder scenario was based on a one-unit or two-unit source term contribution. In RAI 7908, Question 11.02-8, the staff requested clarification on the dose assessment included in FSAR Section 11.2, Revision 6, for the intruder scenario to show how doses, when calculated on a per-unit basis, remain in compliance with the design objective of 10 CFR Part 50, Appendix I.

In its response to RAI 7908, Question 11.02-8, dated June 23, 2015, the applicant described the plant blowdown sump pump discharge to the Lower Floridan aquifer (Boulder Zone) by the deep well injection system (DIS). In FSAR Section 11.2.3.5, the applicant described its PA to assess the environmental fate and transport of Turkey Point Units 6 and 7 liquid effluent releases by deep well injection. The PA coupled numerical GW modeling techniques with a liquid pathway analysis to identify the maximum exposed members of the public (MEI) in unrestricted areas as a result of the Turkey Point Units 6 and 7 liquid effluent releases. For the dose assessment, the AP1000 DCD single-unit source term is divided by dilution flow from a single unit to yield the injectate concentration. As described, the injectate concentrations in FSAR Table 11.2-201 are independent of the number of units operating since two units would produce twice the source term as well as twice the dilution flow.

The applicant's analysis indicated that concentrations at offsite receptors are sensitive to the number of units operating, since migration times to offsite locations would be influenced based on the injectate flow rate. Modeling two-unit source term and flows yields the highest calculated offsite dose. As indicated in FSAR Section 11.2.3.5.2.2, "the two-unit case is more limiting as it results in a greater extent of plume expansion at any given point in time as well as a higher cumulative radionuclide inventory." Also in response to RAI 7908, Question 11.02-8, the applicant provided some clarifying details on June 23, 2015, to make clear that the source term found in Section 11.2 is for two units. The staff finds this response and clarifying information acceptable because the basis of the source term is now clearly described in the DCD, and staff can confirm resulting dose calculations. The information provided in response to the RAI 7908, Question 11.02-8 is found acceptable and, hence, RAI 7908, Question 11.02-8 is resolved.

The applicant's dose assessment, as presented in FSAR Table 11.2-209, was based on RG 1.109 modeling assumptions, supplemented by an EPA model for exposure to a sludge or slurry from well excavation to model the potential dose during a well drilling operation. The resulting doses were divided by 2 to yield the doses per unit to facilitate comparisons with the per-unit limits in 10 CFR Part 50, Appendix I. The doses in Tables 11.2-208 and 11.2-210 are both for two units.

The staff's design-basis doses of 10 CFR Part 50, Appendix I, have been selected as suitable doses for evaluating compliance with the ALARA dose requirement of 10 CFR 20.2002(d). The 10 CFR Part 50, Appendix I, design objective doses are 3 mrem/year to total body and 10 mrem/year maximum organ from liquid effluents. These doses are consistent with the staff's acceptance criterion of a "few millirem" (this information is in SECY-07-0060, Attachment 1, and NUREG-1757, Volume 1, Revision 2, Section 15.12) for compliance with the ALARA requirement of 10 CFR 20.2002(d).

The applicant's dose assessment identified an intruder as the controlling scenario. This pathway analysis modeled a failure in the MCU with this failure occurring at the nearest offsite location of private ownership and with a private well used for irrigation purposes. The calculated maximum dose was to the child from the drinking water and irrigated crops pathway, where the total body dose was 5.5 mrem/year and maximum organ (liver) was 7.6 mrem/year.

The staff performed an independent dose assessment for the intruder scenario. The staff's verification calculations were in general agreement with the applicant's calculations, based on the assumptions and modeling assumptions presented by the applicant. The staff's calculation confirmed the overall conservatism of the applicant assessment, where the staff's results indicated a maximum individual (child) potential dose of 4.0E-2 mSv/yr (4.0 mrem/year) to total body and 4.2E-2 mSv/yr (4.2 mrem/year) to liver for the drinking water and irrigated crop pathways combined.

As identified in the applicant's response by letter dated January 15, 2014, in response to RAI 6985, Question 11.02-6, the assumed location for the intruder scenario (3.54 km (2.2 mi)) represents the closest privately owned land parcel, that could be occupied at some time in the future. Considering water use practices and the Miami-Dade County Comprehensive Development Master Plan, individual potable water systems, including private wells, are considered interim facilities with use when alternative public water supply is not available and land use and water resources are suitable for interim use. Considering these limitations, the assumption that the resident well is the primary drinking water source for the intruder scenario represents a highly unlikely situation. There are numerous situations of the use of GW for irrigation purposes; therefore, this exposure pathway is considered plausible.

Considering the above, the staff based its compliance dose assessment on the irrigated crop exposure scenario alone. For this assessment, MEI is 2.4E-2 mSv/yr (2.4 mrem/year) child total body and 3.1E-2 mSv/yr (3.1 mrem/year) child liver from the irrigated vegetable pathway. This dose is less than the Appendix I design objective doses of 3E-2 mSv/yr (3 mrem/year) total body and 1E-1 mSv/yr (10 mrem/year) maximum organ for liquid radioactive effluents, and therefore considered ALARA from a design standpoint.

The staff evaluated and agrees with the modeling scenarios proposed by the applicant and determines that the assumptions taken are conservative and acceptable for evaluating potential offsite doses. SER Table 11.2-2 provides a comparison of the resulting dose estimates between the applicant's analyses, the staff's analysis, and the 10 CFR Part 50, Appendix I, criteria. All doses are below the Appendix I, Section II.A, criteria. The staff concludes that the applicant has provided a bounding assessment demonstrating its capability to comply with regulatory requirements in 10 CFR Part 20 and Appendix I to 10 CFR Part 50.

Table 11.2-2 Comparison of Maximum Annual Individual Doses with NRC Dose Limits (mSv/yr) (mrem/year)

Pathway of Exposure	COL Application *	NRC Staff's Analysis	10 CFR Part 50, Appendix I Section II.A Criteria
Drinking Water			
• Total Body mSv (mrem)	** 0.018 (1.8)	0.018 (1.8)	Total Body 3E-2 (3)
• Liver mSv (mrem)	** 0.036 (3.6)	0.020 (2.0)	
Irrigated Vegetables			
• Total Body mSv (mrem)	0.036 (3.6)	0.024 (2.4)	Max Organ 1E-1(10)
• Liver mSv (mrem)	0.057 (5.7)	0.031 (3.1)	

* Adapted from RAI 11.02-6 response
** Applicant presented one-half these values in FSAR Revision 6, Table 11.2-209, to represent a per-unit application for compliance with the Appendix I design basis, which is also on a per-unit basis.

The applicant responded to RAI 6985, Questions 11.02-06-5 to 11.02-0-11 on August 9, 2013. On April 22, 2014, the applicant provided a supplement to RAI 11.02-6-5 to 11.02-6-11.

In item 5 of RAI 6985, Question 11.02-6 dated February 20, 2013, the applicant was requested to address: (1) a rise in pressure given the combined operation of multiple wells and (2) potential fractures and formation of hydraulic connections, followed by upwelling into the above confining units. In the supplemental response dated April 22, 2014, the applicant provided a detailed response to supplement questions the staff raised on the August 9, 2013, response. The response included information discussing the potential pressure rises, upwelling, or both due to the DIS and included short-term injection tests on the deep injection wells to establish a range of pressures. These short-term injection tests were also used to verify the SEAWAT models described above to estimate transport distances and times.

Within the discussion, the applicant made the following assumptions regarding to the deep well injection operational parameters: all 12 injection wells are operating concurrently at a rate of 26,498 L/min (7,000 gpm) (assumed maximum anticipated injection rate), there is no dissipation of the increased formation pressure between operating injection wells, and the cumulative formation pressure is additive for each well.

In observing the analysis conducted in the response, the applicant determined that the total pressure increase in the Boulder Zone due to pressure and buoyant forces is approximately 50.2 psi. Using the equations described by the applicant in its response, the applicant calculated the pressure increase needed to create a potential fracture in the confining zone to be 582.9 psi, a pressure that is about 12 times larger than the original calculated pressure increase. Additionally, the applicant calculated a minimum downhole pressure increase needed to create a potential fracture of 377 psi, a number 7.5 times greater than the calculated pressure increase.

The applicant also highlighted that Rule 62-528.415(1)(a) of the Florida Administrative Code (F.A.C.) prohibits operating at pressures that would initiate new fractures or propagate existing fractures in the injection zone, initiate new fractures in the confining zone, or significantly alter the fluid containment capabilities of the confining zone.

To address the second request of item 5, the applicant provided details regarding the integrity of the deep injection wells by describing the well casings, joints, and mechanic integrity of the system over time. Each injection well is constructed with concentric steel casing to isolate and protect GW from the injected fluid. Each well will be constructed with new and unused steel casings designed to last for at least 60 years. The well casings are selected to provide protection against casing failures during cementing operations, protect against failures during the operation of the well and subsequent pressure testing, and provide sufficient corrosion protection. Groundwater protection is achieved through encasing select piping in cement; the injection tubing is reinforced with a fiberglass reinforced plastic (FRP) injection tubing to protect the environment from injection fluids and subsequent corrosion. A corrosion inhibitor also fills the gaps of the injection tubing to maintain corrosion control.

To ensure proper installation, testing will be conducted prior to the operation of the DIS. The testing programs include testing each injection well and hydraulic pressure testing of the pipeline. Mechanical integrity testing is defined by FDEP and consists of a video survey, pressure testing of the annual space between the 61-cm (24-in.) diameter casing and the FRP injection tubing, performance of high-resolution temperature log, and a performance of a radioactive tracer survey to detect the presence of breaches in the cement at the base of the casing.

Should any upwelling or failures of the injection occur, the applicant has first identified that 11 wells (9 active and 2 backup) are sufficient for disposal of the cooling water. If GW monitoring detects an upwelling of the injected fluid, FPL is required to report this information to FDEP. Based on the nature of the problem, FPL would remove the problematic wells from service, investigate the problem, and repair the problematic wells. FPL must comply with the remedial measure set up by FDEP, and if plugging and abandonment is required, FPL will follow the imposed requirements of FDEP. Well Plugging and Abandonment procedures are described in the applicant's response and the response references Rule 62-528.435, F.A.C. A proposed plugging and abandonment plan for each Class I injection well is required to be submitted with each Class I injection well construction and operation permit application. The staff reviewed the description, including design and operational controls, to minimize potential for hydraulic connectivity following an upwelling into the above confining units. The staff finds the response to item 5 of RAI 6985, Question 11.02-6 acceptable because FPL is required to follow the programs and procedures set in places by FDEP, and the information provided to staff to describe the efforts in place to address upwelling is adequate.

In item 6 of RAI 6985, Question 11.02-6, the applicant was asked to reconcile differences in stated flow rates and citations for the location of such information. Several examples are provided in the question stated above. In the response dated April 22, 2014, the applicant provided clarifications on the stated flow rates and citations. The applicant provided discussions for the reclaimed water supply, makeup water supply using saltwater, makeup flow rates when using the reclaimed water supply, and makeup flow rates when using saltwater as cooling water. Each discussion contained the information about amounts and flow rates of water used.

The cooling tower blowdown flow to the blowdown sump is 36,770 L/min (9,714 gpm) for Turkey Point Units 6 and 7, and therefore an additional dilution flow of 8,650 L/min (2,286 gpm) is required to meet the 45,420 L/min (12,000 gpm) dilution flow requirement. This makeup flow will be supplied from the makeup reservoir. The makeup water reservoir will have a capacity of 1040-1140 million L (275-300 million gallons) of reclaimed water and is capable of supplying the plant makeup and alternate dilution flow for approximately 5 days of full power with no

replenishment. When using saltwater as cooling water there is sufficient blowdown from cooling towers to supply the 45420 L/min (12,000 gpm) dilution flow requirement. To maintain chemistry of the makeup water reservoir the saltwater makeup to the cooling towers will be supplied directly into the cooling tower basins and not into the makeup water reservoir.

The estimated makeup flow when using reclaimed water for the cooling water system is 145,360 L/min (38,400 gpm). The total flow to all of the deep injection wells is approximately 47,320 L/min (12,500 gpm) and 49,210 L/min (13,000 gpm) for normal and maximum flow rates. A minimum of two deep injection wells will be used, resulting in a normal and maximum flow rate per injection well of 23,660 L/min (6,250 gpm) and 24,610 L/min (6,500 gpm), respectively. When using saltwater as cooling, the estimated flow rate is 327,060 L/min (86,400 gpm). The estimated flow into the deep injection well is 219,550 L/min (58,000 gpm) and 223,340 L/min (59,000 gpm) for normal and maximum flow rates. For this injection, a minimum of nine wells will be used resulting in 24,430 L/min (6,445 gpm) and 24,810 L/min (6,555 gpm) for normal and maximum flow rates per injection well.

FDEP set up a maximum linear injection velocity of 3 m/s (10 fps) into the deep injection well. To meet these requirements, the applicant provided a calculation in its response. The resulting calculation shows that using 3.0 m/s (10 fps) allows for 49,020 L/min (12,950 gpm) of flow into the deep injection well. As discussed before, the applicant calculated 24,610-L/min (6,500-gpm) maximum flow rate per injection well that will be used, which is significantly less than the calculated FDEP requirement. To account for the estimated makeup water flow of 327,060 L (86400 gallons), a back calculation was performed using the 24,810-L/min (6,555-gpm) maximum flow rate. Using 16.62-in. inside diameter piping and the maximum flow of 24,810 L/min (6,555 gpm), it was calculated that the maximum velocity of fluid into a deep injection well would be 3.0 m/s (9.7 fps). The staff finds that this complies with FDEP's requirement of 3.0 m/s (10 fps), and is acceptable.

In the response to item 6, the applicant also addressed the minimum dilution flow required to control liquid radwaste discharges. The applicant incorporated changes to Sections 11.2.1.2.4 and 11.5.3 that include a discussion about maintaining the ECLs found in 10 CFR Part 20, Appendix B, by specifying and maintaining flow rates at the blowdown sump discharge to at least the minimum dilution factor. To ensure compliance with the ECLs, the dilution flow is calculated and applied prior to each batch release of liquid radwaste. The staff reviewed the description of the stated flow rates in its response and finds the response to item 6 of Question 11.02-6 acceptable because the DCD changes to reflect maintaining a minimum flow rate to ensure compliance with the ECLs are clear and adequate and staff can ensure that the applicant will be in compliance with 10 CFR Part 20, Appendix B limits.

In item 7 of RAI 6985, Question 11.02-6, the applicant was asked to describe deep well injection rates under different plant conditions, procedural controls for the disposal of liquid effluents whenever the plant is in an outage mode, sources of dilution flow rates in this operating status, and expected dilution flow rates. The applicant was also requested to address whether it will impose in the ODCM and standard radiological effluent control (SREC) restrictions such that discharges of liquid effluents will not be initiated unless a minimum dilution flow rate is established in demonstrating compliance with effluent concentration limits and unity rule of 10 CFR Part 20, Appendix B, Table 2, Column 2; dose limits of 10 CFR 20.1301, 20.1302, and 20.1301(e); and numerical guides, design objectives, and ALARA provisions of Appendix I to 10 CFR Part 50 for liquid effluents.

In the response to item 7 dated April 22, 2014, the applicant provided information regarding the injection paths. The applicant stated that the injection from the blowdown sump may be used during outage mode. The alternate dilution water, which is only required when reclaimed water is being used as the cooling water, is provided from the makeup water reservoir or radial collector wells. In cases where dilution water is unavailable, the liquid radwaste discharges can be temporarily stored and released when sufficient dilution flow is made available. As with the response to item 6 above, the applicant referenced the changes into Sections 11.2.1.2.4 and 11.5.3 to describe efforts to maintain effluents to the ECLs in 10 CFR Part 20, Appendix B. The staff reviewed and finds the descriptions of the deep well injection rates acceptable and finds the response to item 7 of RAI 6985, Question 11.02-6 acceptable because the applicant adequately describes the provisions in place to maintain a minimum dilution flow to meet the ECLs in 10 CFR Part 20, Appendix B.

In item 8 of RAI 6985, Question 11.02-6, the applicant was asked to assess a postulated event involving the failure of some injection equipment and to consider programs and procedures used to control radiation exposures and doses to plant workers in responding to accidental spills of injectate. In the response to item 8, dated April 22, 2014, the applicant stated that the DIS is designed to have redundant measures to allow for isolation of failed equipment. The DIS also has overpressure protection measures in place to prevent overpressurization from the blowout of seals and operator errors.

The applicant stated that redundant isolation valves will be installed on the injectate main line to allow for isolation of the main line in case of damage or failures of the line. Each feeder line will also have redundant isolation valves that will allow for isolation of each individual injectate line. There are multiple valves on each deep injection well to prevent upward flow of injected fluid and discharge onto the concrete containment pad. The valve arrangement consists of 18-in. gate valve on the wellhead, which is located 3 ft above the injection well exit into the group, and an 18-in. butterfly valve located on the horizontal run of surface pipe on the concrete containment pad. The aboveground piping at the injection wells will be accessible for visual inspection to detect any leakage from pipes and valves.

The applicant stated that vent and drain valves will be installed on multiple locations of each branch line. The vent valves are installed to remove air coming out of the solution or air that is introduced by the air/vacuum release valves. The vents are located on the high points of each DIS, the points where air is most likely to collect. During normal operations, the vent and drain lines will be capped and the valves locked closed to prevent inadvertent operation. The valves will be manually operated as needed for pump startup. Personnel will be present to allow air to escape and then close the vent valves when the line fills with water. Each DIS is designed to minimize inadvertent or unidentified release to the environment. Integrity of each system is monitored for leakage by performing periodic walkdowns.

The applicant stated that each DIS is designed to minimize damage to the injection equipment. These design measures aim to minimize the likelihood of damage by a moving vehicle, overpressurization, blowout of seals, or joint failures. In the event of equipment failure, such as damage caused by a moving vehicle, valves would close to isolate the damaged equipment to minimize the volume of spilled injectate, and the affected injection wells would be removed from service for repairs. Once repairs are complete, the system would be pressure tested to confirm a leakproof repair. In this scenario, one of the redundant injection wells would be placed into service to make up for the temporarily out-of-service injection well. Once the repair and pressure testing is completed, the well affected by damage could be returned to service. In the

case in which the main pipe is damaged, all feeder lines in addition to the main line would isolate to prevent injectate from backflowing into the main piping.

In the case in which injectate is spilled and pooled on the ground, it would be contained and properly managed as potentially contaminated material in accordance with Radiation Protection and ALARA program requirements. Any spillage would be pumped into a tank for transport to a pumping station where it will be pumped down into an injection well, and any soil impacted by an injectate spill would be removed and managed as potential radioactive waste. The staff reviewed the response to item 8 of RAI 6985, Question 11.02-6 and finds the response acceptable because as seen in the preceding text, the applicant describes the redundant isolation valves, the vent and drain valves used to isolate DIS for maintenance or removal. The staff finds that this information adequately addresses features used to minimize the spread of contamination as is required by 10 CFR 20.1406

In Item 9 of RAI 6985, Question 11.02-6, the applicant was asked to describe 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. In the response to Item 9, dated April 22, 2014, the applicant provided information to support 10 CFR 20.1406 criteria, for minimization of contamination.

As discussed above for Item 8, the applicant described several measures in effect to minimize the sources of contamination by describing the use of isolation valves to isolated damaged lines and to prevent backflow into lines. Description of periodic visual walkdowns of the system and a discussion about the treatment of potential spills if there would be a spillage on the pad are described. Since the pad is made of concrete, water would pool from a leak, any pooled water would be pumped into a tank, and any affected soil would be treated as potentially contaminated material.

The applicant also discussed requirements set in place by the State to conduct mechanic integrity tests to ensure there is no fluid movement into an underground water source. The wells also require periodic sampling that will first be performed on a weekly basis during the first 6 months of operation. After 6 months, the applicant intends to request the State allow a reduced frequency for sampling to perform monthly integrity testing. The staff reviewed the information contained in the response to Item 9 to describe the practices in place to minimize, to the extent practicable, the generation of radioactive waste and finds the response to item 9 of Question 11.02-6 acceptable because the applicant adequately describes additional features used to minimize the spread of contamination as is required by 10 CFR 20.1406.

In Item 10 of RAI 6985, Question 11.02-6, the applicant was asked to describe sampling locations and elevations above the Boulder Zone, sampling frequency, and analytical programs for detecting the presence of long-lived and environmentally mobile radionuclides. In the response to Item 10, dated April 22, 2014, the applicant provided information on the baseline GW monitoring prior to the start of operations, monitoring of GW at the plant during operations, and a determination through the sampling of tritium to confirm whether there is any radioactivity present in GW.

The description of the monitoring program identifies tritium as the largest contributor to the activities released per year per reactor. As such, the applicant stated that tritium will be monitored on a monthly basis at the dual zone monitoring wells. Tritium will serve as an indicator of well failure or confining unit layer breakthrough. The other nuclides described in the

AP1000 DCD will also be considered in the monitoring program based on half-life, mobility, and detectability. After the baseline readings have been obtained, the applicant plans to adjust monitoring to a quarterly frequency. Gamma isotopic and gross beta will also be monitored first monthly, then quarterly once a baseline has been established.

In the event in which operational and radiochemical monitoring of the deep injection wells indicates the presence of plant effluent, through the detection of tritium, the following production wells will be sampled on a monthly basis for tritium and gross alpha/beta radioactivity: PW-1, PW-3, and PW-4. This monitoring is done to check any potential movements of plant effluent to the Upper Floridan aquifer. If these production wells indicate the presence of tritium due to Turkey Point Units 6 and 7 operations, FPL's mitigating actions will include removal of the applicable water supply well from operation and investigation of the DIS for well failure or confining unit failures.

Additional responses to controlling and radioactive material include confirmatory monitoring, removal of affected DIS components from service, and other actions as needed to protect the members of the public and plant workers. The off-normal operations prompt detection and a mitigating strategies program will be a part of the Turkey Point Units 6 and 7 ODCM/REMP. The staff reviewed the response to item 10 to describe sampling locations and elevations above the Boulder Zone, sampling frequency, and analytical programs in detecting the presence of long-lived and environmentally mobile radionuclides and finds the response to item 10 of Question 11.02-6 acceptable because the applicant adequately describes the measures in place to monitor radioactive releases, also describes efforts to control radioactive releases.

In item 11 of Question 11.02-6, the applicant was asked to address the presence of naturally occurring radioactivity in the Upper and Lower Floridan aquifers as part of the REMP. In the response to item 11, the applicant stated that FDEP regulates deep injection wells through its Underground Injection control program. Inside this program, FPL will have radiological monitoring to assess the operation of the injection wells to include gross alpha and combined radium-226 and radium-228, which will be sampled monthly. The frequency will be reduced to quarterly sampling once the operation testing phase is completed.

In addition to the State-regulated program, the applicant will have additional background and operational system monitoring to check for injection well failure and confining unit layer breakthrough, using tritium as an indicator to show leakage or breakthrough at the site. Prior to deep well injection startup, a baseline radiochemical sampling will be performed for gross alpha/beta radioactivity, gamma isotropic, and tritium. FPL proposes to have 6 months' worth of weekly sampling at the available dual zone monitoring wells prior to plant operations. FPL will not have continual background monitoring of naturally occurring radioactivity since tritium monitoring is what will determine injection well failure or confining unit layer breakthrough at the site. The staff reviewed the response to Item 11, in which the applicant described the use of the REMP to address the presence of naturally occurring radioactive material in the Upper and Lower Floridan aquifers, and finds the response to Item 11 of Question 11.02-6 acceptable. The response is acceptable because the applicant adequately describes additional monitoring for naturally occurring radioactive material.

The staff reviewed the entirety of NRC 6985, Question 11.02-6, dated February 20, 2013, and as indicated above, finds the response acceptable. Accordingly, RAI 6985, Question 11.02-6 is resolved.

Compliance with 10 CFR 20.2002

> *As stated in 10 CFR 20.2002: "A licensee or applicant for a license may apply to the Commission for approval of proposed procedures, not otherwise authorized in the regulations in this chapter, to dispose of licensed material generated in the licensee's activities. Each application shall include:*
>
> *(a) A description of the waste containing licensed material to be disposed of, including the physical and chemical properties important to risk evaluation, and the proposed manner and conditions of waste disposal; and*
>
> *(b) An analysis and evaluation of pertinent information on the nature of the environment; and*
>
> *(c) The nature and location of other potentially affected licensed and unlicensed facilities; and*
>
> *(d) Analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this part.*

The staff's evaluation of the applicant's proposed disposal of liquid waste in compliance with 10 CFR 20.2002 is addressed below.

10 CFR 20.2002(a) A description of the waste containing licensed material to be disposed of, including the physical and chemical properties.

In FSAR Section 11.2, the applicant describes disposal of liquid wastewater effluent via deep well injection into the Boulder Zone. Based on a screening analysis of the DCD Table 11.2-7 inventory, the applicant identifies four radionuclides (tritium, cesium-134, cesium-137 and strontium-90) as the most significant dose contributors to the total body and organs of a child and then proceeds with modelling and evaluation based on those nuclides. Details of the deep well injection system design are presented in FSAR Section 9.2.12.

In FSAR Section 11.5.3, the applicant states that the activity concentration of the radwaste portion of the effluent is controlled to meet 10 CFR Part 20, Appendix B, ECLs, by maintaining sufficient dilution through the blowdown sump discharge pumps, which will provide at least the minimum dilution needed to reduce concentrations to below the ECL values. The required minimum dilution is calculated and applied before the release of liquid radwaste to the sump (batch is the only release mode anticipated) to ensure the activity concentration of the mixture is less than the 10 CFR Part 20, Appendix B, ECLs. The procedural methods and controls are to be in accordance with the Turkey Point Turkey Point Units 6 and 7 ODCM.

Staff review of the liquid radwaste system confirmed a design meeting the guidance of RG1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants." As defined in the Guide, "for the purposes of this guide, the radwaste systems are considered to begin at the interface valves in each line

from other systems provided for collecting wastes that may contain radioactive materials and to include related instrumentation and control systems. The radwaste system terminates at the point of controlled discharge to the environment, at the point of recycle to the primary or secondary water system storage tanks, or at the point of storage of packaged solid wastes."

Processed liquid radioactive waste from Turkey Point Turkey Point Units 6 and 7 operation is discharged to the plant blowdown sump pump discharge line before release to the Lower Floridan aquifer (Boulder Zone) by the DIS. Piping from the blowdown sump dilution connection point is routed to the deep injection wells, distributed in two branches; one branch is oriented in a north-south direction and located to the east of Unit 6. The second branch is oriented in the east-west direction and located to the south of Turkey Point Units 6 and 7.

The applicant describes that this injectate piping to each deep injection well isolation valve is single-walled, partially buried, and constructed of material suitable for the range of injectate composition, flow rates, and pressures, as well as environmental factors. The injectate piping contains manifolds, valves, and controls necessary to supply any appropriate combination of the deep injection wells. The injectate piping also includes appurtenances, such as vacuum breakers, vent lines, and access ways, as necessary, for proper operation and maintenance of the piping. The piping, manifolds, valves, controls, and appurtenances are designed to minimize inadvertent or unidentified releases to the environment. Integrity of the injectate piping will be monitored for leakage or will be accessible for visual inspection or remote surveillance in conjunction with groundwater monitoring, as necessary, as part of the Turkey Point Units 6 and 7 Groundwater Monitoring Program.

The applicant provided additional information in PTN SUP 11.2-2 stating that the liquid radwaste discharge release point is where the WLS effluent discharge pipe connects to the blowdown sump discharge pipe to deep injection wells.

The applicant defines the DIS as the point of controlled discharge to the environment. Dilution of the liquid radwaste is initiated as the radwaste enters the DIS in the discharge stream from the blowdown sump. The guard pipe-enclosed radwaste discharge piping connects to the blowdown sump discharge piping downstream of the blowdown sump pumps. Dilution of the liquid radwaste is initiated as the radwaste enters the blowdown sump discharge stream. The content of the blowdown sump is a combination of waste streams largely comprised of reclaimed water or seawater from circulating water system blowdown during plant operation or from the alternate dilution flow paths when circulating water system (CWS) blowdown is not sufficient or available for dilution. Failure of the DIS does not affect the ability of safety-related systems to perform their intended function. The DIS is a flow path for liquid radwaste and liquid nonradioactive waste discharge and provides underground disposal of plant wastewater, including CWS blowdown and liquid radwaste, into the Boulder Zone. The applicant has also stated that the WLS effluent discharge piping is double-walled piping up to this point.

Typically, all other nuclear plants operating in the United States that release radioactive waste release it to surface waters – and are not controlled nor

restricted by NRC regulations beyond that point. The DIS injection wells proposed are governed by Florida Department of Environmental Protection (FL-DEP) regulations and also subject to EPA regulations. They are classified and regulated as hazardous Class 1 injection wells. The staff concludes that because the FL-DEP is experienced in regulation injection wells and its associated regulations are comprehensive in this area, issues associated with integrity of the well, protection of the strata of the injection zone and the confining zone are adequately addressed through the FL-DEP regulations and permitting system. Consequently, the applicant has provided adequate information to provide reasonable assurance that requirements of 10 CFR 20.2002(a) are being met.

10 CFR 20.2002(b) An analysis and evaluation of pertinent information on the nature of the environment; and

The applicant analysis and evaluation of the nature of the environment in described in detail in FSAR Chapter 2, and additionally in the FSAR Section 11.2 dose modelling evaluation and the FSAR Section 2.4.13 liquid tank failure analysis. Additional analysis is described in the applicant's ER, section 2.3.2.2. The staff concludes that the information provided in response to staff RAIs on the DIS is sufficient to support the analysis of hazards associated with the proposed deep well injection disposal. Consequently, the applicant has provided adequate information to provide reasonable assurance that the requirements of 10 CFR 20.2002(b) are being met.

10 CFR 20.2002(c) The nature and location of other potentially affected licensed and unlicensed facilities; and

The applicant describes the nature and location of other potentially licensed and unlicensed facilities in detail in FSAR Chapter 2, and additionally in the FSAR Section 11.2 dose modelling evaluation. Additionally, the nature and location of other potentially affected licensed and unlicensed facilities will have to be described in the applicant's construction permit for the deep wells. The staff concludes that the information provided in response to staff RAIs on the DIS is sufficient to support the analysis of hazards associated with the proposed deep well injection disposal. Consequently the applicant has provided adequate information to provide reasonable assurance that the requirements of 10 CFR 20.2002(c) are being met.

10 CFR 20.2002(d) Analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this part.

In its response to RAI 6985, Question 11.2-06, Items 1-4, dated January 15, 2014 the applicant provided detailed modeling of groundwater migration and potential doses due to both normal offsite water use as well as intruder scenario. The resulting hypothetical dose to a maximum exposed offsite individual was 5.5E-2 mSv (5.5 mrem) per year. This dose is consistent with the NRC's acceptance criterion of a few millirem, as stated in SECY-07-0060, Attachment 1, and NUREG-1757, Vol. 1, Rev. 2, Section 15.12.

Additionally, in response to RAI 5695, Question 11.02-2, regarding the need for a cost benefit analysis, the applicant provided a credible argument concluding that no liquid radwaste system augment is justified for installation based on an Appendix I averted dose cost-benefit evaluation of the hypothetical exposed population. Refer to the discussion on "PTN COL 11.2-2, Liquid Radwaste Cost-benefit Analysis Methodology" above for details.

The staff concludes that the information provided by the applicant in response to staff RAIs is considered adequate for demonstration of compliance with 10 CFR 20.2002 given the discussions provided above for meeting the subparts of 10 CFR 20.2002.

11.2.5 Post-Combined License Activities

The applicant proposed a license condition to ensure that radionuclide inventories in the Turkey Point Units 6 and 7 RWBs are properly controlled and that all relevant sources of radioactive material are accounted for and appropriately calculated in accordance with RG 1.143, Revision 2, and the RWB classification of RW-IIc. The license condition language in this section has been modified, per a letter from the applicant dated April 8, 2016 (ADAMS Accession No. ML16103A507), confirming the acceptability of the following license conditions, proposed by the staff. These changes do not affect the staff's above analysis of the conditions, and therefore, for the reasons discussed in the technical evaluation section above, the staff finds the following license conditions acceptable:

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

11.2.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information related to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR. The results of the staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application is documented in NUREG-1793 and its supplements.

In addition, the staff evaluated the additional COL information items (STD COL 11.2-1, PTN COL 11.2-2, PTN COL 11.5-3, PTN COL 2.4-5, PTN COL 15.7-1, STD SUP 11.2-1, and PTN 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 staff reviewed

the applicant's proposed methodology on the deep well injection. The methods and calculations discussed by the applicant have been reviewed and confirmed by independent NRC staff calculations. The staff determines that the applicant has demonstrated the ability to control, track, and evaluate liquid effluent releases from Turkey Point Units 6 and 7. The applicant has satisfactorily addressed all RAIs related to Section 11.2.

The staff confirmed that the applicant 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. Therefore, subject to the resolution of the two confirmatory items discussed above, 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 10 CFR 20.2002.

11.3 Gaseous Waste Management System

11.3.1 Introduction

The GWMS is designed to control, collect, process, handle, store, and dispose of gaseous radioactive waste generated as the result of normal operation, including AOOs.

11.3.2 Summary of Application

Section 11.3 of the Turkey Point Units 6 and 7 COL FSAR, Revision 8, incorporates by reference Section 11.3 of the AP1000 DCD, Revision 19.

In addition, in Turkey Point Units 6 and 7 COL FSAR, Section 11.3, the applicant provided the following:

AP1000 COL Information Items

- PTN COL 11.3-1

The applicant added additional information in PTN COL 11.3-1 regarding gaseous radwaste cost-benefit analysis methodology (PTN COL FSAR, Section 11.3.3.4.3), as well as additional information to resolve COL Information Item 11.3-1 (COL Action Item 11.3-1), which addresses the estimated doses to the public from the gaseous waste system and the associated cost-benefit analysis in PTN COL FSAR, Section 11.3.3.4.3.4.

- PTN COL 11.5-3

The applicant provided additional information in PTN 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 PTN COL FSAR, Section 11.3.3.4.

Supplemental Information

- STD SUP 11.3-1

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

- PTN SUP 11.3-1

The applicant added supplemental information in Turkey Point Units 6 and 7 COL FSAR, Section 11.3.3.6, to address conformance of the QA program to RG 1.143.

11.3.3 Regulatory Basis

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

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

- 10 CFR 20.1301(e) as it relates to compliance with 40 CFR 190
- 10 CFR 20.1302, “Compliance with dose limits for individual members of the public”
- 10 CFR 20.1406, “Minimization of contamination”
- 10 CFR 50.34a, “Design objectives for equipment to control releases of radioactive material in effluents – nuclear power reactors”
- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” GDC 3, “Fire protection”
- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” GDC 60, “Control of releases of radioactive materials to the environment”
- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” GDC 61, “Fuel storage and handling and radioactivity control”
- 10 CFR Part 50, Appendix I, Sections II.B, II.C, and II.D, as they relate to gaseous effluent dose objectives and associated cost-benefit analysis
- 10 CFR 52.80(a) as it relates to those inspections, tests, analysis that the applicant shall perform, and the necessary acceptance criteria that are necessary to show the facility shall be constructed and operated in conformity with the COL

Guidance for meeting these requirements is in:

- Regulatory Position C.2 of RG 1.143
- RG 1.109, Revision 1, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I”
- RG 1.110, “Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors”

- RG 1.111, Revision 1, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Nuclear Power Reactors"
- RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning"

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

11.3.4 Technical Evaluation

The staff reviewed Section 11.3 of the Turkey Point Units 6 and 7 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[1] The 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 staff's evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.

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

- PTN COL 11.3-1, Gaseous Radwaste Cost-Benefit Analysis Methodology
- PTN COL 11.3-3, Cost-Benefit Analysis of Population Doses, and 10 CFR Part 50, Appendix I, Sections II.B and II.C
- STD SUP 11.3-1, Supplemental Information on Quality Assurance
- PTN SUP 11.3-1, Supplemental Information on RG 1.143 Conformance

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 Turkey Point Units 6 and 7 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

[1] Section 1.2.2 contains a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a DC.

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 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 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 off-gas charcoal delay bed.

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

and 4) were equally applicable to the Turkey Point Units 6 and 7 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the Turkey Point Units 6 and 7 COL FSAR. In performing this comparison, the staff considered changes made to the Turkey Point Units 6 and 7 COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.
- The staff confirmed that all responses to RAIs identified in the corresponding STD content evaluation were endorsed.
- The staff confirmed that the site-specific differences were not relevant.

The staff completed its review and finds the evaluation performed for the STD content to be directly applicable to the Turkey Point Units 6 and 7 COL application. This STD content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) contains evaluation material from the SER for the BLN Units 3 and 4 COL application.

AP1000 COL Information Items

- PTN COL 11.3-1, Gaseous Radwaste Cost-Benefit Analysis

The applicant provided additional information in PTN 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 the staff's FSER for the AP1000 DCD (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 applicant performed a site-specific analysis to determine that the offsite dose due to gaseous effluents is bounded by the AP1000 site parameters included in FSAR, Revision 5, Chapter 1, and Tables 11.3-1, 11.3-2, and 11.3-4 from the DCD. The applicant discussed the site-specific cost-benefit analysis in Turkey Point Units 6 and 7 COL FSAR, Section 11.3.3.4.4, 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. The population doses, 4.0 person-rem total body per reactor and 7.5 person-rem thyroid

per reactor, are given in the FSAR Table 11.3-207. Assuming that this augment will eliminate all radioactivity from the liquid effluent, the resulting cost per dose reduction was $1,580 per total body person-rem ($6,320/4.0) and $843 per thyroid person-rem ($6,320/7.5). While the costs per person-rem reduction exceed the $1,000 per person-rem criterion considering the total body dose, the costs considering the thyroid dose are below the $1,000 per person-rem and, therefore, warrant further evaluation.

Since the estimated thyroid dose of 7.5 person-rem exceeds the 6.32 person-rem threshold value ($6,320 augment at $1,000 per person-rem), those system augments listed in RG 1.110 with a total annual cost less than $7,500 were evaluated to determine if they would be cost beneficial. The only such augment is the one already mentioned above. Addition of this augment presumes that the design already includes a steam generator flash tank. The AP1000 design does not include a steam generator flash tank, but instead uses steam generator piping blowdown heat exchangers that provide cooling of the blowdown fluid and prevent flashing prior to blowdown entering the main condenser. Adding the installation of a flash tank to this augment is expected to cause the estimated total annual cost to be $1,170 and would result in the conclusion that this augment is not cost beneficial.

The applicant went on to state that, although the cost of thyroid dose reduction is just below the threshold, this is assuming the augment completely eliminates the dose. As shown in Table 11.3-1 below (based on Turkey Point Units 6 and 7 COL, Revision 5, FSAR Table 11.3-207), 2.1 of the 7.5 person-rem thyroid dose is due to noble gases, which will not be mitigated by the steam generator flash tank vent to main condenser. With the noble gas contribution unaffected by the augment, the cost of thyroid dose reduction is $1,170 per person-rem thyroid and is, therefore, not cost beneficial.

The staff reviewed this evaluation and concurs with the applicant's results, as shown in Table 11.3-2, predicated on the applicant's calculated population doses. The staff-derived total annual cost is estimated to be $6,654, $1,663 per person-rem total body and $887 per person-rem thyroid. The thyroid augmented cost, once adjusted for radionuclides contributing doses to the thyroid, is estimated to be $1,230 per person-rem thyroid. This evaluation confirms the applicant's results, given their relatively close agreements.

Table 11.3-1 Applicant Population Doses Breakdown by Source

Source	Total Body (person-rem)	Thyroid (person-rem)
Noble Gases	2.1	2.1
Iodine	0.013	3.5
Particulates	1.2	1.2
C-14	0.21	0.21
H-3	0.48	0.48
Total	4.0	7.5

Source: Turkey Point Units 6 and 7, Revision 7, FSAR Table 11.3-207

Table 11.3-2 NRC Staff Population Doses and Breakdown

Source	Total Body (person-rem)	Thyroid (person-rem)
Noble Gases	2.14	2.14
Iodine	0.013	3.50
Particulates	1.23	1.21
C-14	0.12	0.12
H-3	0.45	0.45
Total	3.95	7.42

The augment considered is already the lowest cost augment available. This is above the costs criterion of $1,000 per person-rem for an augment in 10 CFR Part 50, Appendix I, Section II.D. Thus, when the applicant's calculated population doses are confirmed, the staff will be able to conclude that the GWMS meets ALARA requirements and requires no augments.

- PTN COL 11.5-3

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

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

The commitment was also captured in COL Action Item 11.5-3 in Appendix F of the staff's FSER for the AP1000 DCD (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 staff reviewed the resolution to COL Information Item 11.5-3 related to the compliance with Appendix I to 10 CFR Part 50 included under Section 11.3.3.4 of the COL and issued RAI 7112, Question 11.03-1 requesting the applicant to provide more of the details of the individual and population dose analysis, since the information presented in Turkey Point Units 6 and 7 FSAR (Revision 0) is incomplete.

If built, the postulated two new units at the site would release gaseous effluents into the atmosphere. The applicant calculated doses for several airborne pathways, including direct exposure to a radioactive plume, direct exposure to radioactivity deposited on the ground, inhalation of airborne radioactivity and ingestion of contaminated agricultural products, including vegetables and meat. The applicant assumed that the 50-mile population around the plant consumes both cow and goat milk, while the nearest resident who receives the maximum estimate does drinks no milk.

Using radiological exposure models based on RG 1.109 and the GASPAR II computer program (NUREG/CR-4653, "GASPAR II: Technical Reference and User Guide," March 1987), the applicant calculated the estimated doses to a hypothetical MEI of the public and to the population within 50 mi (80 km) from the postulated gaseous effluents discharged.

The applicant maximized the estimated MEI doses by choosing conservative locations and dispersion data for the calculations.

Turkey Point Units 6 and 7 COL, Revision 8, FSAR Tables 11.3-201, -202, and -203 describe assumptions and include gaseous pathway parameters used as input in dose calculations, including population data, and site-specific agricultural usage information. Turkey Point Units 6 and 7 COL, Revision 8, FSAR Tables 11.3-204, -205, and -206 list doses for gaseous releases and exposure pathways for the MEI and surrounding population, respectively.

The applicant calculated the gaseous pathway doses to the MEI. The results (FSAR Revision 8, Tables 11.3-204 and -205) show, for assumed conservative locations, a gamma annual air dose of 0.042 mGy or 4.2 mrad, a beta annual air dose of 0.18 mGy or 18 mrad, a total annual body dose of 0.00038 mSv or 0.038 mrem, and an annual skin dose of 0.00053 mSv or 0.053 mrem. The most limiting age group is the child, with organ doses of 0.0015 mSv or 0.15 mrem to bone and 0.0024 mSv or 0.24 mrem to the thyroid. The calculated annual population doses listed in revised FSAR Revision 5, Table 11.3-207 are 0.04 person-Sv (4.0 person-rem) to the total body and 0.075 person-Sv (7.5 person-rem) to the thyroid. The applicant uses the population doses in the cost-benefit analysis described in this SER.

Table 11.3-3 Comparison of Maximum Annual Individual Doses with NRC Dose Limits

Description	COL Application	10 CFR Part 50, Appendix I, Sections II.B and II.C Criteria
Noble Gases		
• Gamma Dose [mGy (mrad)]	* 4.2E-2 (4.2)	1.0E-1 (10)
• Beta Dose [mGy (mrad)]	* 1.8E-1 (18)	2.0E-1 (20)
• Total Body [mSv (mrem)]	2.6E-2 (2.6)	5.0E-2 (5)
• Skin [mSv (mrem)]	1.3E-1 (13)	1.5E-1 (15)
Radioiodines and Particulates		
• Maximum Organ [mSv (mrem)]	** (0.24)	1.5E-1 (15)

* Taken from FSAR Revision 7, Table 11.3-205
** Dose for the child thyroid, taken from FSAR Revision 7, Table 11.3-204

The staff performed an independent assessment using the GASPAR II computer code and compared its results to the applicant's and Part 50, Appendix I, criteria and Part 20, Appendix B, ECLs for gaseous effluents. Following a review of COL FSAR, Revision 4, Section 11.3, the staff identified eight issues in demonstrating compliance with gaseous effluent releases and dose limits to members of the public under 10 CFR 20.1301, 20.1302, and 20.1301(e) and Part 50, Appendix I, design objectives and ALARA provisions. Based on this review of the information and conduct of confirmatory analyses, the staff identified inconsistencies and a need to clarify assumptions used in the analyses and results presented by the applicant and include site-specific information and analyses in demonstrating compliance with gaseous effluent releases and dose limits to members of the public under 10 CFR 20.1301, 20.1302, and 20.1301(e) and Part 50, Appendix I, design objectives and ALARA provisions. In RAI 7112, Question 11.03-1, dated August 7, 2013, the applicant was requested to address and resolve the issues identified by the staff. In a response dated September 9, 2013, to RAI 7112, Question 11.03-1, the applicant provided supplemental information for the staff's evaluation.

The staff evaluated and agrees with the approach taken by the applicant to calculate maximum annual individual doses from gaseous effluents. Using this same approach, the staff confirmed the individual doses in the FSAR by independently running the GASPAR II computer code with the applicant's parameter values. SER Table 11.3-4 provides a comparison of the resulting dose estimates between the applicant's analyses and the Part 50, Appendix I criteria. All doses are well below the Appendix I, Sections II.B and II.C, criteria. The staff concludes that the applicant has provided a bounding assessment demonstrating its capability to comply with the regulatory requirements in 10 CFR Part 20 and Appendix I to 10 CFR Part 50.

Table 11.3-4 Comparison of COL MEI Doses with the Staff Results

Pathway	Age Group	Organ	COL Application * mSv/yr (mrem/year)	The Staff's Analysis mSv/yr (mrem/year)
Plume and ground deposition	Teen	Whole body	2.6E-2 (2.6)	2.55E-2 (2.55)
External plume exposure	All	Skin	1.3E-1 (1.3E1)	1.28E-1 (1.28E1)
External ground exposure	All	Skin	1.2E-2 (1.2)	1.23E-2 (1.23)
Inhalation	Child	Thyroid	1.4E-4 (1.4E-2)	1.37E-4 (1.37E-2)
Meat	Child	Bone	1.8E-4 (1.8E-2)	1.79E-4 (1.79E-2)
Vegetables	Child	Thyroid	2.1E-3 (2.1E-1)	2.06E-3 (2.06E-1)
Most limiting	Child	T-Body Bone Thyroid	3.8E-4 (3.8E-2) 1.5E-3 (1.5E-1) 2.4E-3 (2.4E-1)	3.8E-4 (3.8E-2) 1.5E-3 (1.5E-1) 2.4E-3 (2.4E-1)

* Taken from FSAR Section 11.3.3.4 and Table 11.3-206

In confirming that gaseous effluent concentrations are in compliance with Part 20, Appendix B, Table 2, Column 1, limits and the unity rule for radionuclide mixtures, the applicant provided an updated evaluation by comparing the exclusion area boundary (EAB) atmospheric dispersion parameter of AP1000 DCD, FSAR, Revision 19, Section 11.3.3.2 and Table 11.3-4 (sheet 2), with the corresponding FPL site-specific EAB atmospheric dispersion parameter presented in FSAR, Revision 5, Section 2.3.5. The applicant presented a comparison in COL Revision 5, FSAR 11.3.3.2 in demonstrating compliance with Part 20, Appendix B, Table 2, Column 1, limits and the unity rule since the result of this analysis and regulatory compliance are dependent on site-specific meteorological data. Using a site-specific EAB atmospheric dispersion parameter, the applicant adjusted upward the results of the sum-of-the-ratio by a factor of 1.7, as the difference between the EAB atmospheric dispersion parameters. The adjusted sum-of-the-ratio is 0.051 for routine effluent releases and 0.56 for maximum effluent releases. The staff confirmed this adjustment with a sum-of-the-ratio of 0.051 for routine releases and 0.58 for maximum releases. The adjusted sum-of-the-ratio is acceptable since it is less than the calculated value for unity and in conformance with Part 20, Appendix B, Footnote 4. The staff

confirmed that the corresponding revisions were made to COL Revision 7, FSAR Section 11.3.3.2 and, therefore, closes out this item in RAI 7117, Question 11.03-1.

In confirming that gaseous effluent concentrations are in compliance with the guidance of NUREG-0800, SRP Section 11.3, and BTP 11-5 (Postulated Radioactive Releases Due to a Waste Gas System Leak or Failure), the applicant did not compare the results of AP1000 DCD FSAR, Revision 19, Section 11.3.3.4 (2nd paragraph), and the EAB atmospheric dispersion parameter of AP1000 DCD, FSAR, Revision 19, Section 2.1, Table 2-1 (sheet 3), with the corresponding site-specific EAB atmospheric dispersion parameter (0-2 hour X/Q) presented in COL FSAR, Revision 5, Section 2.3.4. As part of RAI 7112, Question 11.03-1, the applicant was requested to address and acknowledge this comparison in COL FSAR 11.3.3 in demonstrating compliance with AP1000 DCD FSAR, Revision 19, Section 11.3.3.4, and SRP Section 11.3 and BTP 11-5 since the dose result of this analysis and regulatory compliance are dependent on site-specific meteorological data. In a response dated March 6, 2014, to RAI 7112, Question 11.03-1, the applicant provided supplemental information for the staff's evaluation. In its evaluation, the staff determined that the applicant's response provided clarifying text in the FSAR Section 11.3.3.4, to state that: "The site-specific atmospheric dispersion factor for the site boundary is bounded by the value given in DCD Table 2-1. Hence the single failure of an active component in the gaseous radwaste system yields a whole body dose less than 0.1 rem." The staff finds this response acceptable because the staff has confirmed that the atmospheric dispersion factor for the site boundary is less than the value described in the AP1000 DCD and also determines that the calculated value would be less than what is currently estimated in the DCD. Therefore, the staff's findings made in NUREG-1793 and its supplements are still valid. The staff has confirmed the changes in Revision 6 of the application. RAI 7117, Question 11.03-1 is resolved.

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

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

The applicant provided additional information in PTN SUP 11.3-1 stating that the quality assurance program for design, construction, procurement, materials, welding, fabrication,

inspection and testing activities conforms to the quality control provisions of the codes and STDs recommended in Table 1 of RG 1.143.

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

> *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 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 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 TS 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.

Demonstrating Compliance with 10 CFR Part 50 Appendix I

Pursuant to 10 CFR Part 50, Appendix I, Sections II.B, II.C, and II.D, the applicant is responsible for addressing the requirements for dose objectives in controlling doses to a hypothetical maximally exposed member of the public and populations living near the proposed nuclear power plant. The requirements define dose objectives for gaseous effluents and require a cost-benefit analysis in justifying installed processing and treatment equipment of the GWMS, including any augmentation to the design in complying with 10 CFR Part 50, Appendix I. The applicant demonstrated compliance with 10 CFR Part 50, Appendix I, Sections II.B, II.C, and II.D requirements, by performing the required cost-benefit analysis through PTN COL 11.3-1, and performed the required dose compliance through PTN COL 11.5-3. The staff independently confirmed the results of the cost-benefit analysis and compliance with the dose objectives and finds that the applicant is in compliance with 10 CFR Part 50, Appendix I, Sections II.B, II.C, and II.D.

11.3.5 Post-Combined License Activities

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

11.3.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR. The results of the NRC staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.

In addition, the staff evaluated the additional COL information (PTN COL 11.3-1, PTN COL 11.5-3, and STD SUP 11.3-1) in the application against the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 11.3, and other NRC regulatory guides.

In other areas of the evaluation of the GWMS, the staff confirmed that the applicant 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 has met the requirements in GDC 3 by conforming to the guidance in BTP 11-5. 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 System

11.4.1 Introduction

The 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 AOOs. 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 off site to a licensed disposal facility.

11.4.2 Summary of Application

Section 11.4 of the Turkey Point Units 6 and 7 COL FSAR, Revision 8, incorporates by reference Section 11.4 of the AP1000 DCD, Revision 19.

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

AP1000 COL Information Items

- STD COL 11.4-1

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

Supplemental Information

- STD SUP 11.4-1

The applicant provided supplemental information in PTN 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 PTN COL FSAR, Section 11.4.6.1.

- PTN SUP 11.4-1

The applicant provided additional information in PTN SUP 11.4-1 to describe its disposition of packaged waste.

- PTN SUP 11.4-2

The applicant added in Turkey Point Units 6 and 7 COL FSAR, Section 11.4.5, supplemental information to address conformance of the QA program to RG 1.143.

License Condition

- Part 10, License Condition 3, Operational Program Implementation

PTN 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 PCP.

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 STDs. These include:

- 10 CFR Part 20, "Standards for Protection Against Radiation"
- 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"
- 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 acceptance criteria associated with the SWMS are given in NUREG-0800, Section 11.4, including BTP 11-3.

11.4.4 Technical Evaluation

The staff reviewed Section 11.4 of the Turkey Point Units 6 and 7 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[2] The 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 staff's evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 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
- STD SUP 11.4-1, Quality Assurance

[2] Section 1.2.2 contains a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a DC.

- PTN SUP 11.4-1, Disposition of Packaged Waste
- PTN SUP 11.4-2, Supplemental Information on RG 1.143 Conformance

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, 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 staff to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP, Units 3 and 4) were equally applicable to the Turkey Point Units 6 and 7 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the Turkey Point Units 6 and 7 COL FSAR. In performing this comparison, the staff considered changes made to the Turkey Point Units 6 and 7 COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.
- The staff confirmed that all responses to RAIs identified in the corresponding STD content evaluation were endorsed.
- The staff confirmed that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the STD content to be directly applicable to the Turkey Point Units 6 and 7 COL application. This STD content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) contains evaluation material from the SER for the BLN, Units 3 and 4, COL application.

Although the staff concluded that the evaluation performed for the standard content is directly applicable to the Turkey Point Units 6 and 7 COL application, there is a difference in how the Turkey Point Units 6 and 7 applicant addressed STD COL 11.4-1 and how the VEGP applicant addressed this review item. This difference is evaluated by the staff below, following the STD content material for STD COL 11.4-1.

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

AP1000 COL Information Items

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

- *STD COL 11.4-1*

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

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

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

> *The COL applicant will develop a process control program for both wet and dry solid wastes.*
>
> *In BLN COL FSAR Section 11.4.6, the applicant addressed this COL information item. The applicant adopted NEI 07-10[A], "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[A], Revision 3. Specifically, the NRC staff indicated that for COL applications NEI 07-10[A], 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[A] Revision 3. Since the BLN COL FSAR Section 11.4 has not adopted the approved version of the NEI Template, this is ***Confirmatory Item 11.4-1.*** *Each process used meets the applicable requirements of the PCP. BLN COL FSAR Table 13.4-201 provides milestones for PCP implementation and is acceptable.*

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

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

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 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 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 in VEGP COL 11.4-1 and VEGP SUP 11.4-1 and is evaluated below.

Evaluation of Site-Specific Information for STD COL 11.4-1

Regarding the Resolution of STD Content Open Item 11.4-1, the staff does not consider the open item relevant to the Turkey Point Units 6 and 7 COL application because the applicant has available offsite disposal of all types of low-level radioactive waste through its membership in

the Atlantic Compact. Therefore, an update of the Turkey Point Units 6 and 7 COL FSAR is not necessary to resolve this item.

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

> *Supplemental Information*
>
> *The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the BLN SER:*
>
> - *STD SUP 11.4-1*
>
> *The applicant provided supplemental information in Section 11.4.5 of the PTN 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.*

In addition to the above, the applicant provided a site-specific response to LNP RAI 11.02-4. The Turkey Point Units 6 and 7 response to LNP RAI 11.02-4 also resolved questions asked in LNP RAI 11.02-5. The response was dated October 23, 2014, and was partially revised by a response received February 3, 2015. In the response, the applicant provided additional information in relation to COL Information Item 11.4-1 in order to ensure that the inventory of radioactive materials contained in all unpackaged waste held in the RWB is controlled in accordance with the RG 1.143, Revision 2, dose acceptance criteria. This response, along with the associated operational commitments and proposed license condition ensure that all unpackaged waste held in the RWB is controlled in accordance with the provisions of RG 1.143, Revision 2. A detailed discussion of these responses, including aspects related to SER Section 11.4, is provided in Section 11.2.4 of this SER. The FSAR changes proposed in the response are being tracked as **Confirmatory Item** 11.4-1 pending the applicant's update of the FSAR.

Resolution of Turkey Point Confirmatory Item 11.4-1

Confirmatory Item 11.4-1 is an applicant commitment to revise its FSAR Sections 11.2.1.2.5.2, 11.4.6, and 13.5.2.2.5 regarding the solid waste management system process control program.

The staff verified that the Turkey Point Units 6 and 7 COL FSAR, Revision 8 was appropriately revised. As a result, Confirmatory Item 11.4-1 is now closed.

Additionally, the applicant provided the following supplemental information item:

- PTN SUP 11.4-1

The applicant provided supplemental information in Section 11.4.5 of the Turkey Point Units 6 and 7 COL FSAR to describe its planned contracting arrangement for disposal of low-level radioactive waste. This is related to STD COL 11.4-1 above and Open Item 11.4-1. The staff has issued RAI 7104, Question 11.04-1, requesting the applicant to provide additional information related to its long-term disposition of low-level radioactive waste. This discussion is provided in the section below, titled "Compliance with 10 CFR Part 50, Appendix I, Design Criteria."

- PTN SUP 11.4-2

The applicant provided additional information in PTN SUP 11.3-1, stating that the quality assurance program for design, construction, procurement, materials, welding, fabrication, inspection, and testing activities conforms to the quality control provisions of the codes and STDs recommended in Table 1 of RG 1.143.

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

> *License Conditions*
>
> - *Part 10, License Condition 3, Operational Program Implementation*
>
> *VEGP COL FSAR Section 11.4.6 describes the process control program. VEGP COL FSAR Table 13.4-201 provides the milestone (prior to initial fuel load) for implementation of the process control program and is acceptable as described in the staff's SER related to NEI 07-10.*
>
> - *Part 10, License Condition 6, Operational Program Readiness*
>
> *The applicant proposed a license condition to provide a schedule to support NRC inspection of operational programs including the process control program. The proposed license condition is consistent with the policy established in SECY-05-0197 and is acceptable.*

These above license conditions are captured in section 11.4.5 of this SER as License Conditions 11-2 and 11-3.

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.

The following portion of this technical evaluation is based on the staff's review of Turkey Point Units 6 and 7 COL FSAR Section 11.4 of the application:

Following a review of Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.4, the staff identified three issues. The first issue was with the development of a radioactive waste management program for 10 CFR 61.55 Class C wastes. The second issue involved plant-specific operational considerations associated that there is a commitment to comply with the guidance of RG 1.143 and AP1000 DCD in not exceeding the 10 CFR Part 71, Appendix A, A_2 quantities of radioactive materials contained in skid-mounted solid waste processing equipment when installed in the radwaste building to meet RW-IIc requirements (as discussed in detail in Section 11.2.4 of this SER). In the final issue staff requested a correction of inconsistent listing of references dealing with topics covered in COL FSAR Section 11.3. In RAI 7104, Question 11.04-1 and RAI 6920, Question 11.04.02, the applicant was requested to address and resolve the following technical aspects:

(1) FPL, Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.4.2.4.3, and PTN SUP 11.4-2 present supplemental information on plans to develop additional storage capacity if warranted by operational needs. In describing the approach, PTN SUP 11.4-2 refers to AP1000 DCD FSAR, Section 11.4.2.4.2, on generation rates of radioactive wastes by referring to "paragraph ten" in that DCD subsection. However, a review of AP1000 DCD FSAR, Revision 19, Section 11.4.2.4.2, indicates that it only describes an option involving the potential use of a licensed central radwaste processing facility for waste processing and disposal, and does not present any data on waste generation rates. Moreover, this subsection consists of only one brief paragraph, without any subparagraphs. In RAI 7104, Question 11.04-1, dated August 7, 2013, the applicant was requested to review the supplemental information provided in PTN SUP 11.4-2 and change the DCD citation to the correct one. In a response dated September 9, 2013 to RAI 7104, Question 11.04-1, the applicant agreed to make the necessary revisions and provide supplemental information in developing contingency plans for the storage of low-level radioactive wastes in the event that access to offsite storage and disposal are not available. In COL Revision 7, FSAR Section 11.4.2.4.3, the applicant made the necessary corrections and added supplemental information on contingency plans for waste storage and disposal and identified the use of NRC guidance in developing such plans. The staff confirmed that the corresponding revisions were made to COL Revision 7, FSAR Section 11.4.2.4.3 and, therefore, closes out this item in RAI 7104, Question 11.04-1.

(2) On a separate matter, the staff noted that, in Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.4.7, the citation of references 202, 203, and 204 are incorrectly located in this FSAR section. A review of Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.3 and Table 11.3-203, indicates that these three references support the dose assessment analysis used in demonstrating regulatory compliance with releases of gaseous effluents in unrestricted areas. In RAI 7112, Question 11.03-1, the applicant was requested to delete references 202, 203, and 204 in FSAR Section 11.4.7 (or explain why the references are included in that FSAR section), or relocate them to the reference section of FSAR Section 11.3. In a response dated September 9, 2013, the applicant agreed to make the corrections by deleting the extraneous references in COL FSAR Section 11.4.7. The staff confirmed that the corresponding revisions were made to COL Revision 7, FSAR Section 11.4.7, and, therefore, closes out this item in NRC 7112, Question 11.03-1.

11.4.5 Post-Combined License Activities

The staff proposes two license conditions. The first license condition, 11-1 relates to STD COL 11.4-1 in that a PCP will be developed and implemented. The second license condition, 11-2, captures the concepts related to STD COL 13.4-1. The intent is to highlight that the PCP, among other operational programs, is an operational program that will be inspected prior to fuel load. The license condition language in this section has been modified, per a letter from the applicant dated April 8, 2016 (ADAMS Accession No. ML16103A507), confirming the acceptability of the following license conditions, proposed by the staff. These changes do not affect the staff's above analysis of the conditions, and therefore, for the reasons discussed in the technical evaluation section above, the staff finds the following license conditions acceptable:

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

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

11.4.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR. The results of the staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.

In addition, the staff evaluated the additional COL information (STD COL 11.4-1, STD SUP 11.4-1, and PTN 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 staff also confirmed that the PCP will be developed and implemented in accordance with the recommendations and guidance of NEI 07-10A.

The staff confirmed that the applicant has provided sufficient information and that the review supports the conclusion that follows. The staff concludes 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, 20.1301(e), 20.1406, and Appendix I to 10 CFR Part 50, and 10 CFR Parts 61 and 71.

11.5 Radiation Monitoring

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 AOOs and under post-accident conditions.

11.5.2 Summary of Application

Section 11.5 of the Turkey Point Units 6 and 7 COL FSAR, Revision 8, incorporates by reference Section 11.5 of the AP1000 DCD, Revision 19.

In addition, in Turkey Point Units 6 and 7 COL FSAR Section 11.5, the applicant provided the following:

Departures

- PTN DEP 6.4-1

The applicant provided information in Section 11.5 of the Turkey Point Units 6 and 7 COL FSAR about PTN DEP 6.4-1 related to design changes affecting habitability of the main control room and changes to the calculated doses to control room operators. This information, as well as related PTN DEP 6.4-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.2 of this report.

AP1000 COL Information Items

- STD COL 11.5-1

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

- STD COL 11.5-2

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

- PTN COL 11.5-2

The applicant provided additional information in PTN COL 11.5-2 to add language to Turkey Point Units 6 and 7 COL FSAR Section 11.5.3 addressing extension of the existing Unit 1 program for QA of radioactive effluent and environmental monitoring to apply to Turkey Point Units 6 and 7.

- PTN COL 11.5-3

The applicant provided additional information in PTN 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

Turkey Point Units 6 and 7 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. 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 staff's inspection of operational programs including the Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls, the ODCM, and the REMP.

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 50, Appendix A, GDC 64, "Monitoring radioactivity releases"
- 10 CFR Part 20, "Standards for Protection against Radiation"
- 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"
- 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants"
- 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
- 10 CFR Part 71, "Packaging and Transportation of Radioactive Material"
- 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, Revision 2, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste"

- RG 4.15, Revision 2, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment"

The applicable acceptance criteria associated with the radiation monitoring system are given in NUREG-0800, Section 11.5.

11.5.4 Technical Evaluation

The staff reviewed Section 11.5 of the Turkey Point Units 6 and 7 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[3] The 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 staff's evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.

The staff reviewed the information contained in the Turkey Point Units 6 and 7 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
- PTN COL 11.5-2 adds language to Turkey Point Units 6 and 7 COL FSAR Section 11.5.3 addressing extension of the existing Unit 1 program for quality assurance of radioactive effluent and environmental monitoring to apply to Turkey Point Units 6 and 7.
- PTN 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 Turkey Point Units 6 and 7 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 aspects of

[3] Section 1.2.2 contains a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a DC.

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 staff to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP, Units 3 and 4) were equally applicable to the Turkey Point Units 6 and 7 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the Turkey Point Units 6 and 7 COL FSAR. In performing this comparison, the staff considered changes made to the Turkey Point Units 6 and 7 COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.
- The staff confirmed that all responses to RAIs identified in the corresponding STD content evaluation were endorsed.
- The staff confirmed that the site-specific differences were not relevant.

The staff completed its review and finds the evaluation performed for the STD content to be directly applicable to the Turkey Point Units 6 and 7 COL application. This STD content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) contains evaluation material from the SER for the BLN, Units 3 and 4, COL application.

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

AP1000 COL Information Items

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

- *STD COL 11.5-1*

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

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

unmonitored and uncontrolled release. The offsite dose calculation manual will include planned discharge flow rates.

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

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

In BLN COL FSAR Section 11.5.7, the applicant adopts NEI 07-09[A], "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[A], Revision 4. Specifically, the NRC indicated that for COL applications, NEI 07-09[A], 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[A], 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[A]). 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[A].*

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

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

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

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

- *STD COL 11.5-2*

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

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

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

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

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

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

In STD COL 11.5-2, the applicant adopted RG 4.15, Revision 2, instead of the Revision 1, which was adopted by BLN. The staff concludes that Revision 2 is acceptable because it is the more current version.

- PTN COL 11.5-2

In PTN COL 11.5-2, the applicant extended the existing NRC-approved Progress Energy QA program, including RG 4.15, Revision 1, for effluent and environmental monitoring to Turkey Point Units 6 and 7. The staff finds this acceptable because the current program is a proven methodology. 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.

- PTN COL 11.5-3

The applicant provided additional information in PTN 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 the staff's FSER for the AP1000 DCD (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 Turkey Point Units 6 and 7 COL FSAR Sections 11.2.3.5 and 11.3.3.4 for liquid and gaseous effluents, respectively.

The staff reviewed the resolution of PTN 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 that the applicant adequately addressed applicable regulatory requirements based on the evaluations provided in SER sections 11.2.4 and 11.3.4 to calculate and verify estimated annual releases.

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

> *The following portion of this technical evaluation section is reproduced from Section 11.5.4 of the BLN SER:*
>
> *<u>Section 11.5.4.2, Representative Sampling</u>*
>
> *In this section, the applicant describes how it will take representative samples for analysis. Based on the staff's review, the staff issued RAIs 11.5-1 and 11.5-2. RAI 11.5-1 requested clarification about the use of ANSI/HPS N13.1-1999. RAI 11.5-2 requested more information concerning how the applicant ensures representative liquid effluent and environmental sampling.*
>
> *In response to RAI 11.5-1, the applicant revised its commitment to use the 1999 standard. Because the applicant made no changes to the certified design, it removed the commitment to use ANSI/HPS N13.1-1999, and committed to ANSI N13.1-1969 to be consistent with the AP1000 certified design. ANSI withdrew the 1969 standard and replaced it with ANSI/HPS N13.1-1999 because the approach taken in the 1969 standard did not provide assurance that the sample in the effluent vent would be representative. The 1999 standard differs significantly from the earlier version in that it is now performance based. NUREG-0800 Section 11.5 (2007) uses the 1999 standard as acceptance criteria. The staff is pursuing this issue through the DC*

because it deals with the design of the sampling systems for radioactive gas streams.

The applicant provided a response to RAI 11.5-2 and the staff finds the response acceptable. The response provided a more detailed description of how the applicant will assure that liquid samples will be representative. The applicant committed to follow the recommendations in ANSI N42.18 and RG 1.21. In addition, the applicant provided more operational descriptions for composite sampling. The NRC staff verified that Revision 1 of the BLN COL FSAR adequately addressed the above. As a result, RAI 11.5-2 is closed.

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

License Condition

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

VEGP 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[A].

- *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.

The following portion of this technical evaluation is based on the staff's review of FPL COL FSAR Section 11.5 of the Turkey Point Units 6 and 7 application:

Following a review of FPL, Turkey Point Units 6 and 7 FSAR, Revision 4, Section 11.5, the staff identified four issues with the development of a plant- and site-specific ODCM and associated regulatory compliance using NRC and industry technical guidance. In RAIs 6919, Question 11.05-1 and 7103, Question 11.05-2, the applicant was requested to address and resolve the following technical aspects:

(1) FSAR, Revision 3, Section 11.5.8, endorses the use of Nuclear Energy Institute (NEI) ODCM Template 07-09A (Revision 0, March 2009) to meet COL Information Item 11.5-1 until a plant- and site-specific ODCM is prepared, before fuel load, under the requirements of a license condition described in FSAR Section 13.4, Table 13.4-201, item 9. The development of the site-specific ODCM and implementing procedures should meet the provisions of GL 89-01 (Supplement No. 1), Radiological Assessment Branch Technical Position (Revision 1, November 1979) included as Appendix A in NUREG-1301, as ODCM guidance for pressurized-water reactors (PWRs), and the guidance of NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and NUREG-0543, "Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190)." However, FSAR, Revision 3, Section 11.5.8, does not address unique site-specific conditions that are not covered in the NEI ODCM Template 07-09A. The FSAR does not consider how the ODCM will control gaseous effluent releases and doses to members of the public given that Units 3 and 4 and Turkey Point Units 6 and 7 will be contributing to and sharing a single dose allocation to members of the public under 10 CFR 20.1301 and 20.1302, 10 CFR 20.1301(e) in complying with 40 CFR Part 190, and the unity rule in meeting liquid and gaseous effluent concentration limits of 10 CFR Part 20 (Appendix B, Table 2, Columns 1 and 2). NUREG-0543 addresses compliance issues for sites with multiple reactor units when considering all sources of radiation exposures, including doses due to liquid and gaseous effluent releases and contributions from external radiation from buildings and staging areas containing radioactive materials and wastes. Accordingly, the applicant is requested to describe in FSAR, Section 11.5.8, the administrative program and procedures that will be used to coordinate all liquid and gaseous effluent releases and dose allocations to members of the public between Units 3 and 4 and Turkey Point Units 6 and 7 in complying with NRC regulations, as noted above.

(2) FPL, Turkey Point Units 6 and 7 FSAR, Revision 4, Sections 11.5.3 and 11.5.4, present supplemental information on effluent and process monitoring and sampling. Based on a review of the corresponding information presented in the AP1000 DCD Section 11.5.2 and Table 11.5-1 and parallel discussions presented in the Turkey Point Units 6 and 7 ER, Revision 4, Section 3.6.3.2, the staff notes that the ER commits to the use of a radiation monitor installed on the common discharge line of the turbine building sumps. This monitor performs an automatic control function by tripping the discharge pump upon detecting elevated levels of radioactivity in the common discharge line. The description also states that, if necessary, contaminated wastewater from the turbine building sumps will be diverted to the WLS for processing and disposal. The applicant is requested to introduce this information in FSAR, Sections 11.2 and 11.5, since the radiation monitor and its operating features are not described there. The applicant should describe the design features of the turbine building sumps and connections to a common discharge line, provide the basis for the placement and type of radiation monitor installed on the common discharge line of the sumps, describe the associated automatic control features and alarm functions, and describe how discharges will be diverted (manual or automatic

method) to the liquid radwaste processing system upon tripping an alarm setpoint. In addressing associated regulatory requirements and guidance, the applicant is requested to integrate this potential radioactive discharge path in the Turkey Point Units 6 and 7 Offsite Dose Calculation Manual in demonstrating compliance with 10 CFR Part 20 liquid effluent concentration and dose limits for members of the public, 10 CFR 20.1406 in minimizing the contamination of plant facilities and the environment, Part 50, Appendix I, on design objectives and ALARA provisions; and describe equipment features and operational commitments that are consistent with the guidance of NUREG-0800, SRP Sections 11.2 and 11.5, RGs 1.206, 1.143, and 4.21, IE Bulletin 80-10, and NEI 08-08A in avoiding unmonitored and uncontrolled releases of radioactive materials in unrestricted areas.

(3) FPL, Turkey Point Units 6 and 7, FSAR, Revision 4, Section 11.5.8, endorses the use of NEI ODCM Template 07-09A (Revision 0, March 2009) to meet COL Information Item 11.5-1 until a plant- and site-specific ODCM is prepared, before fuel load, under the requirements of a license condition described in FSAR Section 13.4, Table 13.4-201, item 9. However, a comparison of FSAR, Revision 4, Section 11.5.8, and Turkey Point Units 6 and 7 ER, Revision 4, Sections 3.3, 6.2.2, and 6.7.4, indicates that a simple endorsement of NEI ODCM Template 07-09A and Units 3 and 4 ODCM does not address the unique site-specific conditions associated with deep well injection for the disposal of radioactive effluents and associated radiological environmental monitoring. The applicant is requested to introduce this information in FSAR, Sections 11.2 and 11.5, since it is not contained there. The applicant should identify which portions of NEI ODCM Template 07-09A will need to be modified, describe the new information addressing deep well injection, describe methods that will be used in controlling and monitoring discharges of liquid effluents via deep well injection, and describe how water samples will be collected and sampled from each dual zone monitoring well, including well development and purging, containment and processing of purged well water, and sample processing including sample collection, sample preservation, and quality control.

(4) FPL, Turkey Point Units 6 and 7 ER, Revision 4, Section 3.3.1 and Figure 3.3-1 (sheet 1), describe how Miami-Dade Water and Sewer Department (MDWASD) reclaimed water will be further treated on site by the FPL reclaimed water treatment facility prior to being pumped into the circulating water system. The treatment process is described as including trickling filters, clarifiers, deep bed filters, and equipment to handle solid wastes generated by the onsite treatment system. A review of Turkey Point Units 6 and 7 ER, Revision 4, Figure 3.3-1 (sheet 1), indicates that some end products of the processing may be bypassed to the plant blowdown sump as warranted by operational conditions. Solid waste would be disposed using current operating practices, such as recycling and landfill disposal, as described in Turkey Point Units 6 and 7 ER, Revision 4, Section 3.6.3.3. The staff notes that the corresponding information presented in the Turkey Point Units 6 and 7 ER, Revision 4, Section 3.6.3, and FSAR, Section 11.5, does not acknowledge that the use of an onsite treatment for MDWASD reclaimed water might result in the reconcentration of naturally occurring radioactivity and other forms of radioactivity, which should not be attributed to plant operations. In addition, the potential presence of such radioactive materials in sludge and solids generated by the FPL reclaimed water treatment facility might pose operational and disposal challenges, given an estimated daily generation rate of over 400 t of solids per day under normal operations (ER, Revision 4, Section 3.6.3.3). Moreover, the bypass of liquid wastes from the onsite treatment facility to the plant blowdown sump may introduce radioactivity (if present in MDWASD reclaimed water) which would then need to be accounted for in demonstrating compliance with Part 20

and Part 50, Appendix I, requirements once discharged via deep well injections. As a result, the applicant is requested to expand its radiological monitoring program, at least initially, to routinely collect and analyze samples from reclaimed waste water obtained from the MDWASD, reclaimed waste water treated by the FPL reclaimed water treatment facility, and solid wastes and sludge generated by the FPL reclaimed water treatment facility. The applicant is requested to expand the scope of its site waste management program to include provisions and procedures to handle, store, contain, and ship for disposal solid wastes and sludge should radioactive materials be detected with radiological characteristics not associated with the operations of Turkey Point Units 6 and 7. The procedure should describe steps that, if radioactive materials of other origins are detected in MDWASD reclaimed water, will cause the bypass from the onsite reclaimed water treatment system to be locked out (manually or automatically) to prevent the inadvertent introduction of radioactive materials in the plant blowdown sump. If such measures cannot be readily implemented, the applicant is requested to augment the scope of the radiological monitoring and sampling program to include waste treatment products and treated water from the onsite reclaimed water treatment facility and commit to revise the site- and plant-specific ODCM accordingly.

In letters dated January 16, 2013, and July 31, 2013, the applicant provided responses to RAI 6918, Question 11.05-1 and RAI 7103, Question 11.05-2. In the responses, the applicant proposed the following changes and corrections to the information presented in the noted FSAR sections. The staff's evaluation and determination of acceptability of the responses are presented below.

In response to RAI 6918, Question 11.05-1, the applicant described the administrative controls to be implemented by the licenses of Turkey Point Units 6 and 7 and Turkey Point Units 3 and 4 by coordinating the direct radiation contributions and liquid and gaseous effluent releases so that the site dose limits for 10 CFR Part 20 and 40 CFR Part 190 are not exceeded. The administrative controls and coordination process will be described in the ODCM. To support this description, the applicant provided text to be inserted in Section 11.5.8 describing administrative controls that will coordinate direct doses, liquid effluent, and gaseous effluent that will be released from the site. The staff has reviewed the response to RAI 6918, Question 11.05-1 and the staff finds that the applicant provided sufficient information because the licensee commits to controlling effluent releases in accordance with acceptable methods. The staff has confirmed the additional text has been incorporated in Revision 6 of Turkey Point Units 6 and 7 COL Application and the staff considers RAI 6918, Question 11.05-1 resolved.

In response to RAI 7103, Question 11.05-2, the applicant provided clarification on the above-stated RAI. To address the concern of the stated radiation monitor being referenced in ER Section 3.6.3.2 and not in FSAR Section 11, the applicant stated that the stated monitor in the ER is the same monitor as the waste water discharge radiation monitor mentioned in Section 11.5.2.3.3 of the AP1000 DCD. The DCD information has been incorporated by reference in the Turkey Point Units 6 and 7 FSAR Section 11.5 as a result. The applicant also stated that DCD Section 9.2.9.2, supplemented by FSAR Section 9.2.9.2.2, describes the oil-water separator for discharge flowpaths. This information is again supplemented in Section 9.2.12 for the DIS.

In response to the concern that the NEI ODCM template was not developed to specifically accommodate radioactive discharges to the subsurface environment, the applicant provided a discussion to explain the use of maintaining effluent controls that can be adopted directly into Turkey Point Units 6 and 7 ODCM. The ODCM, which will be made available for the staff's

review prior to fuel load, will reflect the operations of the DIS operations fate-transport-dosimetry model for normal operations and AOOs. The analysis for dose modeling is assessed in RAI 6985, Question 11.02-6 in Section 11.2 of this SER.

In response to the question by the staff to address the presence of and reconcentration of radioactive materials from the MDWASD, the staff also requested that the applicant address the potential presence of such radioactive materials in sludge and solids generated by the FPL reclaimed water treatment facility. The applicant stated that, if present, a fraction of this radioactive material will be adsorbed in the radioactive waste treatment facility (RWTF) treatment sludge and another fraction will remain in the treated RWTF effluent provided as circulation water supply to Turkey Point Units 6 and 7. The RWTF effluent fraction will ultimately be comingled with Turkey Point Units 6 and 7 blowdown and be disposed during DIS operations. The RWTF sludge fraction will be characterized as required to demonstrate compliance with the waste acceptance criteria established by commercial disposal facilities. The applicant also stated that effluent end products that may be bypassed to the plant blowdown sump will be characterized to enable their differentiation from radioactive materials that are attributed from Turkey Point Units 6 and 7 operations.

The staff reviewed the response to RAI 7103, Question, 11.05-2, and finds the response acceptable because the applicant has provided a sufficient description of the aspects that differ from NEI ODCM template, and the applicant highlights that the ODCM will be available for staff review prior to fuel load. License condition (11-5) also captures the fact that staff will have the opportunity to inspect the ODCM, among other documents, prior to fuel load. The staff has confirmed that the applicant has incorporated these revisions in Revision 6, and the staff considers RAI 7103, Question 11.5-02 resolved.

11.5.5 Post-Combined License Activities

The license condition language in this section has been modified, per a letter from the applicant dated April 8, 2016 (ADAMS Accession No. ML16103A507), confirming the acceptability of the following license conditions, proposed by the staff. These changes do not affect the staff's above analysis of the conditions, and therefore, for the reasons discussed in the technical evaluation section above, the staff finds the following license conditions acceptable:

License Condition (11-4) – 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 (11-5) – No later than 12 months after issuance of the COL, the licensee shall submit to the Director of NRO a schedule that supports planning for and conduct of NRC inspections of the operational program for process and effluent monitoring and sampling (including Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls, Offsite Dose Calculation Manual, and Radiological Environmental Monitoring Program). The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the above operational program has been fully implemented.

11.5.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR. The results of the staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 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, PTN COL 11.5-2, and PTN 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 staff concludes that the applicant has satisfactorily addressed all RAIs related to Section 11.5.

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

The staff confirmed 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, NEI ODCM Template 07-09A, and applicable acceptance criteria in NUREG-0800, Section 11.5.