11.0 RADIOACTIVE WASTE MANAGEMENT

The AP1000 radioactive waste (radwaste) management systems control the handling and treatment of liquid, gaseous, and solid radwaste. These systems include the liquid radwaste system (WLS), the gaseous radwaste system (WGS), and the solid radwaste system (WSS). The WLS is designed to control, collect, process, store, and dispose of liquid radioactive wastes. The WLS is discussed in Section 11.2 of this report. The WLS contains holdup tanks, process pumps, other processing equipment including monitor tanks, and appropriate instrumentation and controls. Ion exchange is the principal waste treatment process in the WLS.

The WGS collects, processes, and monitors gaseous releases. The WGS is discussed in Section 11.3 of this report. The WGS collects gaseous wastes that are potentially radioactive or hydrogen-bearing (i.e., those wastes resulting from degassing the reactor coolant and the contents of the reactor coolant drain tank (RCDT)), stores them for decay in charcoal delay beds, and subsequently releases them to the environment via the plant vent. The WSS controls the processing of solid wastes generated during reactor operation, as well as the packaging and storage of such processed wastes before shipment to a licensed disposal facility. The WSS is discussed in Section 11.4 of this report. The process and effluent radiological monitoring instrumentation and sampling systems, which are discussed in Section 11.5 of this report, detect and measure the radioactive materials in plant liquid and gaseous processes and effluent streams.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the additional and amended information provided by Westinghouse using the guidance in Chapter 11 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (SRP), Revision 3, issued March 2007. The NRC developed the original NUREG-1793 using the guidance from Regulatory Guide (RG) 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," Revision 3, issued November 1978. Therefore this Supplement follows the format of the original NUREG-1793.

The scope of this review includes Chapter 11, Sections 11.2 through 11.5 of Revision 16 and 17 of AP1000 design certification amendment, Tier 2 and Tier 1, Chapter 2, Sections 2.3.10 "Liquid Radwaste System", 2.3.11 "Gaseous Radwaste System" and 3.5 "Radwaste Monitoring" which includes the associated inspection, test analyses, and acceptance criteria (ITAAC). Section 11.1 did not contain any technical changes in Revision 16 and 17; therefore, the staff did not include Section 11.1 in this supplement.

This section describes the staff's evaluation and findings of the AP1000 Design Control, Document (DCD), Revisions 16 and 17. The staff reviewed Revision 16 upon receipt; however, after review the staff issued several requests for additional information (RAIs) and the applicant issued Revision 17 prior to the resolution of these RAIs. Hence, this review and evaluation encompasses both revisions.

11.2 Liquid Waste Management System

11.2.1 Summary of Technical Information

In AP1000 DCD, Revision 17 and Technical Report (TR)-134, the applicant proposed to make

five technical changes as described below:

1) In DCD Section 11.2, the applicant proposed to increase overall liquid waste holdup capacity and improve operational flexibility by adding three additional liquid waste monitor tanks (and associated pumps, piping, instruments, and valves). The applicant proposed to house the new tanks 56,781 liters (15,000 gallons) each in the radwaste buildings. The new tanks are identical to the three existing monitor tanks, which are housed in the auxiliary building. The applicant has documented these changes in Westinghouse TR-116, "Additional Liquid Radwaste Monitor Tanks and Radwaste Building Extension," APP-GW-GLN-116,
Revision 0.

2) In DCD Sections 11.2.1.2.4 and 11.2.1.3, the applicant added statements certifying compliance with 10 CFR 20.1406. These changes are documented in Westinghouse TR-98, "Compliance with 10 CFR 20.1406," APP-GW-GLN-098, Revision 0.

3) In DCD Section 11.2, Figure 11.2-2, "Liquid Radwaste System Piping and Instrumentation Diagram, Sheet 1, the applicant proposed changing the figure to show the addition of a flow element to monitor letdown flow from the chemical and volume control system to the liquid waste system. The applicant documented this chemical and volume control system Post Accident Monitoring System (PAMS) instrument modification in TR-118, "Chemical and Volume Control System PAMS Instrument Modifications," APP-GW-GLN-118, Revision 0.

4) In DCD Sections 11.2.5.3 and 11.2.5.4, the applicant proposed updates to document the closure of combined license (COL) Information Items 11.2-3 and 11.2-4 respectively and as described in TR-48, "Identification of Ion Exchange and Adsorbent Media," APP-GW-GLR-008, Revision 0 and in TR-73, "Dilution and Control of Boric Acid Discharge," APP-GW-GLR-014, Revision 0.

5) In DCD Section 11.2.3.3, 11.2.3.5 and 11.2.5.2, the applicant proposed changes related to the liquid effluent release requirements in Parts 20 and 50.

The changes in Revision 17 to AP1000 DCD reflect the responses to the RAIs from Revision 16.
The evaluation below discusses these changes and other information pertaining to SRP acceptance criteria, provides an overview of staff RAIs, the applicant's responses, and the staff's evaluation of the responses.

11.2.2 Evaluation

The staff reviewed all technical changes and ITAACs to the liquid waste management system in accordance with Standard Review Plan (SRP) Section 11.2, "Liquid Waste Management System" and all changes identified by change marks in AP1000 DCD, Revision 16 and 17, or described in Westinghouse Technical Report TR-134, "AP1000 Impacts to Support COLA Standardization," APP-GW-GLR-134, Revision 4. In addition, the staff reviewed all changes to the liquid waste management system-based design description and ITAAC in AP1000 DCD Tier 1 Section 2.3.10.

11.2.2.1 Addition of Three Liquid Waste Monitor Tanks

In TR-116, “Additional Liquid Radwaste Monitor Tanks and Radwaste Building Extension," the applicant proposed to add three additional liquid waste monitor tanks (and associated pumps, piping, instruments, and valves). The applicant proposed to house the new tanks, 56,781 liters (15,000 gallons) each in the radwaste building.

In Tier 2 DCD Section 11.2, the staff noted that a potential exists for the quantity of radionuclides in the radwaste building portion of the liquid waste management system to exceed the A_1 value, thus requiring these structures, systems and components (SSCs) to be designated as RW-IIa in accordance with Regulatory Guide (RG) 1.143. However, these SSCs were designated as RW-IIc in Tier 2 DCD Section 1, Appendix 1A. In a September 9, 2008 letter, the applicant responded to the staff’s concern and provided an analysis to show that the concentrations will be less than the A_1 and A_2 levels. The applicant then modified Revision 17 of the DCD to state that the contents of each monitor tank in the non-seismic radwaste building will be less that the A_1 and A_2 levels of 10 CFR 71 Appendix A, Table A-1. The staff finds this response acceptable and RAI-SRP-11.2 CHPB-06 is closed.

In DCD Section 3.2, Table 3.2-3, Sheets 63 and 64, the staff noted that the additional equipment for the liquid radwaste system was not included in the table, nor was the location of the added liquid radwaste system components included in the radwaste building. Moreover, in Table 3.2-3, the applicant did not identify the new WLS piping interconnecting the Auxiliary and Radwaste buildings and its classification. The applicant added the necessary information to the diagrams and table in Revision 17. The staff reviewed these changes and found them acceptable. RAI-SRP-11.2CHPB-07 is closed.

Based on the evaluation of DCD Section 11.2 and the response to the RAI, the staff concludes that the applicant properly identified all design information related to the three additional liquid waste monitor tanks and associated equipment, and provided an adequate demonstration that design objectives for equipment necessary to control releases of radioactive effluents to the environment have been met in accordance with 10 CFR 50.34a.

11.2.2.2 Documentation of Compliance with 10 CFR 20.1406

In TR-98, “Compliance with 10 CFR 20.1406,” APP-GW-GLN-098, Revision 0, the applicant proposed to comply with the regulation by selection of design technology. Table TR98-1 in TR-98 “AP1000 Features Applicable to 10 CFR 20.1406” lists specific examples of how the AP1000 design complies with 10 CFR 20.1406 (Items 19, 22, 23, 24, 25, and 26). The staff reviewed the items listed in Table TR98-1 pertaining to the WLS and found that the applicant addressed the minimization of waste generation in 10 CFR 20.1406.

The staff issued regulatory guidance for 10 CFR 20.1406 in RG 4.21 after Revision 16 but before the issuance of Revision 17. As such, the staff documented its review according to Regulatory Guide 4.21 in Chapter 12. The staff finds that this change does not affect the design and performance aspects of the WLS.

11.2.2.3 Chemical and Volume Control System Post Accident Monitoring System Instrument Modifications

In DCD Section 11.2, Figure 11.2-2, "Liquid Radwaste System Piping and Instrumentation Diagram" Sheet 1, the applicant changed the figure to include a flow element to monitor letdown flow from the chemical and volume control system to the WLS. The staff concluded that this change does not affect the design and performance aspects of the WLS and provides additional capabilities to monitor the flow to the WLS.

11.2.2.4 Closure of COL Information Item 11.2-3 and 11.2-4

In DCD Sections 11.2.5.3 and 11.2.5.4, the applicant proposed updates to document the closure of COL Information Items 11.2-3 and 11.2-4 respectively as described in TR-48, "Identification of Ion Exchange and Adsorbent Media," APP-GW-GLR-008, Revision 0 and in TR-73, "Dilution and Control of Boric Acid Discharge," APP-GW-GLR-014, Revision 0. The applicant proposed that media selection should be a matter for the plant operator, and should not be identified at the COL application stage. The two reports, APP-GW-GLR-008 and 014, describe this process and give justification to show that COL information Items 11.2-3 and 11.2-4 should be deleted. For both of these applications, the staff considered that this media will be replaced multiple times throughout the operating life of the plant. Since these changes are operational in nature and do not affect the design and performance aspects of the WLS, the staff finds these changes acceptable.

11.2.2.5 Changes Related to the Effluent Release Requirements in Parts 20 and 50

Revision 16 to Section 11.2.3.3 (Dilution Factor) omitted compliance with the annual offsite dose limits of 10 CFR 50 Appendix I, Section II.A. The DCD stated that the plant operator selected dilution flow rates to ensure compliance with the effluent concentration limits of 10 CFR 20 and any local requirements. Plant operators must also ensure that the annual releases are within the dose limits of Appendix I, which in some situations may be the limiting case. Because of this omission, the staff issued an RAI requesting the applicant to incorporate Section II.A requirements. The applicant added this requirement to Revision 17. The staff reviewed this change and concluded that it was acceptable and closed RAI-SRP11.2-CHPB-01.

Revision 16 to Section 11.2.3.5 stated that the estimated doses from liquid effluents are site specific and discussed in DCD Section 11.2.5. Section 11.2.5 only stated that the combined license applicant will provide a site-specific cost-benefit analysis to address the requirements of 10 CFR 50, Appendix I, Section II.D regarding population doses due to liquid effluents. The combined license applicant must also comply with the individual dose limits to members of the public in 10 CFR 50 Appendix I and 10 CFR 20.1301(e). Because of this omission, the staff issued an RAI requesting the applicant to incorporate the individual dose requirements of Parts 20 and 50. The applicant added these requirements to Revision 17. The staff reviewed this change and concluded that it was acceptable and closed RAI-SRP11.2-CHPB-02.

The staff found an inconsistency between the estimated dose sections in Section 11.2 (Liquid Waste Management System) and 11.3 (Gaseous Waste Management System). No individual doses were calculated for liquid effluents, but doses were calculated for gaseous releases. The staff issued an RAI asking the applicant to address this inconsistency. Revision 17 to the DCD addressed this inconsistency by adding text that requires compliance with Section II.A of Appendix I to Part 50. The staff reviewed this change and concluded that it was acceptable and closed RAI-SRP11.2-CHPB-03.

11.2.2.6 Preoperational Testing Information

Section 11.2.4, Preoperational Testing, of Revision 16 and 17 did not address the testing and inspection of ion exchange resin. The initial performance of the liquid radioactive waste system depends on the existence and performance of ion exchange resin in the ion exchange vessels. Westinghouse based the annual liquid effluent release of radioactivity estimated in Section 11.2 on assuming that the media provided a specific level of decontamination as listed in Table 11.2-5, "Decontamination Factors." The applicant did not specify any preoperational testing and inspections to ensure that the resin is properly installed and performing to assumed levels at initial start up.

The staff issued RAI-SRP11.2-CHPB-05 requesting a statement in the DCD indicating that the applicant will confirm the presence of the correct amount of resin in the liquid radwaste system ion exchange vessels. On April 3, 2009, the applicant submitted a proposed revision to Section 11.2.4.3. This revision stated that an inspection of the system would confirm that the applicant installed the proper volume of media into the appropriate components. The staff finds this confirmation acceptable. The staff will close RAI–SRP11.2-CHPB-05 after confirming the change in the next revision to the DCD. For tracking purposes, the staff identifies this as Confirmatory Item **CI-SRP11.2-CHPB-01**.

11.2.2.7 Reactor Coolant System Effluents

In Revision 17, the applicant included additional operator actions when returning the contents of the monitoring tanks for further processing. When radioactivity exceeds operational targets, the operator is instructed to recirculate and sample the contents of the monitoring tanks. The staff reviewed this change and found it to be more specific and appropriate. Thus, the staff concluded that this change was acceptable.

11.2.2.8 Tier 1 Section 2.3.10, Liquid Radwaste System

The applicant added three additional WLS monitoring tanks and a letdown flow monitor to reflect the current design changes in Tier 1 Section 2.3.10. These are conforming changes and have no impact on the staff's conclusion about the acceptability of the design of the WLS.

11.2.3 Conclusion

After satisfactory resolution of the Confirmatory Item CI-SRP11.2-CHPB-01 contained in this section the following conclusions apply.

In NUREG-1793 Supplement 1, the staff documented its conclusion that the AP1000 design and DCD (up to and including Revision 15 of the DCD) were acceptable and that Westinghouse's application for design certification met the requirements of Subpart B to 10 CFR Part 52, "License, Certifications, and Approvals for Nuclear Power Plants" that are applicable and technically relevant to the AP1000 standard plant design.

In the previous evaluation of the AP1000 DCD, Section 11.2, "Liquid Waste Management System," the staff identified acceptance criteria based on the design's meeting relevant requirements in 10 CFR 20.1302 as it relates to limits on doses to persons in unrestricted areas, 10 CFR 50.34a as it relates to the inclusion of sufficient design information to demonstrate the design objectives for equipment necessary to control releases of radioactive effluents to the environment, GDC 60 as it relates to the design of liquid waste management systems to control releases of liquid radioactive effluents, and GDC 61 as it relates to the design of liquid waste

management systems to ensure adequate safety under normal and postulated accident conditions.

The staff reviewed the applicant's proposed changes to the AP1000 liquid waste management system as documented in AP1000 DCD, Revision 16 and 17, and in Westinghouse TR-134, Revision 4. The staff concluded that the applicant's proposed changes do not affect the ability of the AP1000 liquid waste management system to meet the applicable acceptance criteria in SRP 11.2. The staff also concluded that the applicant had properly incorporated design changes into the appropriate sections of AP1000 DCD, Revision 16 and 17, as supplemented by Westinghouse TR-134, Revision 4. The staff determined that the AP1000 liquid waste management system continued to meet all applicable acceptance criteria and the applicant documented the changes in the updated AP1000 DCD. The staff also concluded that all of the changes related to the liquid waste management system design description and ITAAC as described in AP1000 DCD Tier 1 Section 2.3.10 are acceptable.

11.3 Gaseous Waste Management System

11.3.1 Summary of Technical Information

In AP1000 DCD, Revision 17, the applicant proposed ten technical changes to the Gaseous Waste Management System as supported by information presented in Westinghouse technical reports; TR-48 "Request for Closure of COL Items in DCD Chapter 11 Identification of Adsorbent Media," APP-GW-GLR-008, Revision 0, TR-98, "Compliance with 10CFR20.1406," APP-GW-GLN-098, Revision 0, and TR-103, "Fluid System Changes" APP-GW-GLN-019, Revision 2. A description of each Revision 16 technical change is provided below:

1) The applicant demonstrated compliance with 10 CFR 20.1406 through the selection of design technology. This change is documented in TR-98, "Compliance with 10 CFR 20.1406," APP-GW-GLN-098, Revision 0. The applicant identified this change in AP1000 DCD Revision 16, Tier 2 page 11.3-4.

2) The applicant completed COL Item 11.3.5.2 by providing the requested information in Westinghouse TR-48 "Request for Closure of COL Items in DCD Chapter 11 Identification of Adsorbent Media," APP-GW-GLR-008, Revision 0. The applicant has identified this change in AP1000 DCD Revision 16, Tier 2 pages 11.3-4 and 11.3-11.

3) The applicant changed Figure 11.3-1, "Gaseous Radwaste System Piping and Instrumentation Diagram," to update the drawing nomenclature. This change was documented TR-103, "Fluid System Changes" APP-GW-GLN-019, Revision 2. The applicant identified this change in AP1000 DCD Revision 16, Tier 2 page 11.3-20.

4) On page 11.3-2 in the DCD section on Water Incursion (Section 11.3.1.2.2.2), the applicant added the automatic isolation of the guard bed inlet on high moisture separator level.

5) In the General Description (Section 11.3.2.1) on page 11.3-5, the applicant changed the temperature of the influent gas from 7 degrees C (45 degrees F) to 4 degrees C (40 degrees F).

6) In the General Description (Section 11.3.2.1) on page 11.3-5 and in Section 11.3.2.3.3 on pages 11.3-7 and 11.3-8, the applicant reduced the capacity of each of the two activated carbon delay beds from 100 percent system capacity to 50 percent capacity.

7) In order to maintain a slight positive pressure in the WGS when the system is inactive, the applicant originally proposed to inject a small nitrogen flow into the system. In Revision 17, the applicant eliminated the nitrogen injection and relied on a closed discharge isolation valve to maintain positive pressure. The applicant documented this change in Section 11.3.2.2.1, Normal Operation, on page 11.3-5.

8) The applicant previously stated that the gas leaving the moisture separator would be monitored for moisture content and a high alarm would alert the operator to a condition requiring attention. The applicant revised the design and operation of the system to monitor temperature and not moisture. The applicant documented this change in Section 11.3.2.2.1, Normal Operation, on page 11.3-6 and in Table 11.3-2 "Component Data (Nominal) – Gaseous Radwaste System."

9) The applicant removed the Xenon and Krypton dynamic adsorption coefficients and holdup times from Table 11.3-1 "Gaseous Radwaste System Parameters" on page 11.3-12.

10) The applicant removed some of the parameter data and revised some of the remaining parameter values in Table 11.3-2, Component Data (Nominal) – Gaseous Radwaste System" on page 11.3-13.

The evaluation below discusses these changes and other information pertaining to the SRP acceptance criteria, provides an overview of staff RAIs, the applicant's responses, and the staff's evaluation of the responses.

11.3.2 Evaluation

The staff reviewed all technical changes to the WGS in accordance with SRP Section 11.3, "Gaseous Waste Management System" and all changes identified by change marks in AP1000 DCD, Revision 16 and 17, or described in Westinghouse TR-134, "AP1000 Impacts to Support COLA Standardization," APP-GW-GLR-134, Revision 4. In addition, the staff reviewed all changes to the gaseous waste management system design description and ITAAC in AP1000 DCD Tier 1 Section 2.3.11.

11.3.2.1 Compliance with 20.1406

In TR-98, "Compliance with 10 CFR 20.1406," APP-GW-GLN-098, Revision 0, the applicant proposed to comply with the regulation by the selection of design technology. Table TR-98-1 in TR-98 "AP1000 Features Applicable to 10 CFR 20.1406" lists specific examples of how the AP1000 design complies with 10 CFR 20.1406 (Items 19, 22, 23, 24, 25, and 26). The staff reviewed the items listed in Table TR-98-1 pertaining to the WGS and found that the applicant addressed the minimization of waste generation in 10 CFR 20.1406.

The NRC staff issued regulatory guidance for 10 CFR 20.1406 in Regulatory Guide 4.21 after Revision 16 but before the issuance of Revision 17. As such, the staff documented its review according to Regulatory Guide 4.21 in Chapter 12. The staff finds that this change does not affect the design and performance aspects of the gaseous waste management system.

11.3.2.2 Completion of COL Item 11.3.5.2

The applicant addressed COL item 11.3.5.2 by providing the requested information in

Westinghouse TR-48 “Request for Closure of COL Items in DCD Chapter 11 Identification of Adsorbent Media,” APP-GW-GLR-008, Revision 0. The applicant proposed that media selection should be a matter for the plant operator, and should not be identified at the COL application stage. The two reports, APP-GW-GLR-008 and 014, describe this process and justify the deletion of COL Information Item 11.3.5.2. For both of these applications, the staff considered that this media was a consumable item, designed for replacement when expended. The media will be replaced multiple times throughout the operating life of the plant. For these reasons, the staff concluded that these changes are operational in nature and do not affect the design and performance aspects of the WGS.

11.3.2.3 Revision of Figure 11.3-1 Piping and Instrumentation Diagram

The applicant proposed a change to Figure 11.3-1, “Gaseous Radwaste System Piping and Instrumentation Diagram”, to update the drawing nomenclature. The staff concluded that the updated nomenclature did not affect the design or performance of the system and considered the change in nomenclature editorial.

11.3.2.4 Addition of Automatic Isolation of the Guard Bed Inlet on High Moisture Separator Level

In Section 11.3.1.2.2.2, “Water Incursion,” the applicant removed an automatic isolation of the guard bed inlet on high moisture separator level. The staff concluded that this change was acceptable because the system has an automatic isolation on temperature, a moisture separator, drain traps, and the guard bed. These all provide protection from wetting of the activated carbon delay beds. Activated carbon loses its retention properties when wet.

11.3.2.5 Temperature of the Influent Gas Changed From 7 degrees C (45 degrees F) to 4 degrees C (40 degrees F)

In Section 11.3.2.1, “General Description,” the applicant changed the outlet gas temperature from the gas cooler from about 7 degrees C (45 degrees F) to about 4 degrees C (40 degrees F). This change is small and conservative, which does not affect the conclusions in NUREG-1793. The staff found this change acceptable.

11.3.2.6 Reduced Capacity of Each of the Two Activated Carbon Delay Beds from 100 Percent System Capacity to 50 Percent Capacity

In Section 11.3.2.3.3, “Gaseous Radwaste System Tanks,” the applicant proposed to reduce each activated carbon delay bed capacity from 100 percent of the system capacity to 50 percent of the system capacity during design basis conditions. A single bed still provided adequate performance under normal conditions. The staff issued RAI-SRP11.3-CHPB-04 requesting additional information to verify compliance with SRP 11.3, “SRP Acceptance Criteria,” Item 2 regarding the capacity of the system to meet the anticipated processing requirements of the plant.

On April 3, 2009, the applicant responded to RAI-SRP11.3-CHPB-04 and provided an analysis to determine the effects of operation with one charcoal delay bed out of service. The applicant used the PWR-GALE code to determine gaseous effluent releases assuming delay times for noble gases with only one delay bed in service. The applicant then compared the expected airborne concentrations and doses at the site boundary to those using the holdup times for two delay beds. The results of the analysis for the one delay bed showed that the effluent

concentrations and doses at the site boundary increased by negligible amounts and were still well within the limits of 10 CFR 20 Appendix B, Table 2, and the design limits of Appendix I to Part 50.

The staff reviewed this analysis and concluded that the applicant used reasonable delay times and an approved computer code to simulate the performance of one delay bed. The staff found the response acceptable and RAI-SRP11.3-CHPB-04 is closed.

11.3.2.7 Elimination of the Nitrogen Injection and Reliance on a Closed Discharge Isolation Valve to Maintain Positive Pressure in WGS

In Section 11.3.2.2.1, the applicant used the discharge isolation valve to maintain the gaseous radwaste system at a positive pressure. In DCD Section 11.3.2.3.4, "Remotely Operated Valves," the applicant provided information regarding the nitrogen purge pressure control valve. The applicant stated that this valve maintains a small positive pressure in the gaseous radwaste system to prevent ingress of air during periods of low flow. Section 11.3.1.2.3.1, "Prevention of Hydrogen Ignition," stated that the discharge isolation valve of the gaseous radwaste system is continuously pressurized with nitrogen to prevent ingress of air into the system from the discharge path. The staff concluded that this change is acceptable as a provision to preclude the ingress of air and does not affect the conclusions in NUREG-1793.

11.3.2.8 Monitoring Temperature Instead of Moisture of the Gas leaving the Moisture Separator

In Section 11.3.2.2.1, "Normal Operation," and Table 11.3-2, "Component Data (Nominal) – Gaseous Radwaste System of Instrument Indication and Alarms," the applicant changed the monitored parameter of the gas leaving the moisture separator to temperature instead of moisture. The high temperature alarm indicates a reduced performance of the moisture separators and alerts the operator of an abnormal situation. Since this change performs the same function as the moisture alarm in the previous revisions, the staff finds this change acceptable.

11.3.2.9 Removal of the Xenon and Krypton Dynamic Adsorption Coefficients and Holdup Times from Table 11.3-1

In DCD Table 11.3-1, "Gaseous Radwaste System Parameters," the applicant removed the dynamic adsorption coefficients and holdup times for noble gases. With the removal of this information, the staff questioned the justification of the holdup times used to calculate the Krypton and Xenon releases in the gaseous effluents. In addition, the staff used these holdup times to conclude that no alteration in system operation would be necessary due to adverse meteorological conditions. The staff asked (RAI-SRP11.3-CHPB-04) the reason for removing the coefficients and holdup times from the table.

On April 3, 2009, the applicant responded to the staff concern and stated that the dynamic adsorption coefficients and holdup times were removed from the table to avoid confusion. The applicant did not use this data in any analysis. Furthermore, these coefficients and holdup times are less conservative than what the applicant used to calculate the release of noble gases using the GALE code.

The staff confirmed that the applicant did not use this data in any analysis; therefore, any conclusions regarding effluent releases remain unchanged. Even using the more conservative dynamic coefficients and holdup times from the GALE code, the resulting concentrations and

doses are low enough to provide an ample margin of safety should adverse meteorological conditions occur. The staff found the response acceptable and closed RAI-SRP11.3-CHPB-04.

11.3.2.10 Removal of Some of the Parameter Data and Revising Some of the Remaining Parameter Values in Table 11.3-2

The applicant revised DCD Table 11.3-2, "Component Data (Nominal) – Gaseous Radwaste System" to reflect the performance of the current design. The changes include pump operating pressure, heat exchanger type, and heat exchanger operating temperature, pressure, and flow. These changes have been reviewed by the staff and have been found to be minor, do not affect the performance of the system to meet the design objectives and the conclusions in NUREG-1793, and are therefore acceptable.

11.3.2.11 Additional SRP 11.3 Acceptance Criteria

The NRC staff noted that Section 11.3.3 was missing the consequence evaluation of a gaseous waste system leak or failure. The acceptance criteria in SRP 11.3 are based on the availability of this information as part of the evaluation and relies on the approach specified in Branch Technical Position 11-5. Based on the SER for Revision 15, the applicant performed this analysis in response to an RAI, but the description of the analysis and results were not included in the DCD. The staff issued RAI SRP11.3-CHPB-02 requesting the inclusion of this analysis in the DCD.

On January 13, 2009, the applicant responded to RAI SRP11.3-CHPB-02 stating that Section 11.3.3 will be revised to include the consequence analysis. The applicant will base its analysis on 1 percent fuel defects, 1-hour bypass of the charcoal beds, 30 minute decay prior to release to the environment, and updated atmospheric dispersion factors. At this time, the applicant has not submitted the consequence analysis and proposed revisions to the DCD for the staff review. This issue remains an open item until the staff receives and evaluates the resulting analysis, and then confirms the conclusions and changes to the DCD. For tracking purposes, the staff identified this as Open Item **OI-SRP11.3-CHPB-01**.

11.3.2.12 Tier 1 Section 2.3.11, Gaseous Radwaste System

The applicant revised this section to indicate that the activated carbon delay beds will be designed to one-half Seismic Category I instead of full Seismic Category 1. Since the WGS is not a safety related system, the staff finds that this change is in accordance with RG 1.143 and is acceptable.

11.3.3 Conclusion

After satisfactory resolution of Open Item OI-SRP11.3-CHPB-01 in this section, the following conclusions apply.

In NUREG-1793 Supplement 1, the staff concluded that the AP1000 design and DCD (up to and including Revision 15 of the DCD) was acceptable and that Westinghouse's application for the design certification met the requirements of Subpart B to 10 CFR Part 52, "License, Certifications, and Approvals for Nuclear Power Plants," that are applicable and technically relevant to the AP1000 standard plant design.

In the previous evaluation of the AP1000 DCD, Section 11.3, Gaseous Waste Management

System, the staff identified acceptance criteria based on the design's meeting relevant requirements in 10 CFR 20.1302 as it relates to limits on doses to persons in unrestricted areas, 10 CFR 50.34a as it relates to the inclusion of sufficient design information to demonstrate the design objectives for equipment necessary to control releases of radioactive effluents to the environment, GDC 60 as it relates to the design of the gaseous waste management system to control releases of radioactive effluents, and GDC 61 as it relates to the design of the gaseous waste management systems to ensure adequate safety under normal and postulated accident conditions.

The staff reviewed the applicant's proposed changes to the AP1000 gaseous waste management system as documented in AP1000 DCD, Revision 16 and 17, and in Westinghouse TR-134, Revision 4. The staff concluded that the applicant's proposed changes do not affect the ability of the AP1000 gaseous waste management system to meet the applicable acceptance criteria in SRP 11.3. The staff also concluded that the applicant had properly incorporated design changes into the appropriate sections of AP1000 DCD, Revision 16 and 17, as supplemented by Westinghouse TR-134, Revision 4. The staff determined that the AP1000 gaseous waste management system continued to meet all applicable acceptance criteria and the applicant documented these changes in the updated AP1000 DCD. The staff also concluded that all of the changes related to the gaseous waste management system design description and ITAAC in AP1000 DCD Tier 1 Section 2.3.11 are acceptable.

11.4 Solid Waste Management System

11.4.1 Summary of Technical Information

In AP1000 DCD, Revision 17, the applicant proposed to make changes to Section 11.4 of the DCD. The applicant proposed two technical changes that were supported by information presented in Westinghouse TRs; TR-98, "Compliance with 10 CFR 20.1406," APP-GW-GLN-098, Revision 0, and TR-103 "Fluid System Changes," APP-GW-GLN-019, Revision 2. The description of each technical change is provided below:

1) The applicant proposed to demonstrate compliance with 10 CFR 20.1406 through the selection of design technology. This change is documented in TR-98, "Compliance with 10 CFR 20.1406," APP-GW-GLN-098, Revision 0. The applicant has identified this change on AP1000 DCD Revision 16, Tier 2 pages 11.4-3 and 11.4-14.

2) The applicant proposed to change the type of pump used for spent resin transfer. This change is documented in TR-103 "Fluid System Changes," APP-GW-GLN-019, Revision 2. The applicant has identified this change on AP1000 DCD Revision 16, Tier 2 Table 11.4-10, and page 11.4-32.

The applicant made no technical changes in Revision 17. The evaluation below discusses technical changes provided in updated revisions to the DCD, and provides an overview of staff RAIs, the applicant's responses, and the staff's evaluation of the responses.

11.4.2 Evaluation

The staff reviewed all changes to the solid waste management system as described in AP1000 DCD Revision 17 in accordance with the guidance in SRP Section 11.4, "Solid Waste Management System." The regulatory basis for Section 11.4 of the AP1000 DCD is documented in NUREG-1793, "Final Safety Evaluation Report Related to Certification of the

AP1000 Standard Design." The following evaluation discusses the results of the staff's review. In addition, the staff reviewed the solid waste management system design description and ITAAC in AP1000 DCD Tier 1 Section 2.3.11 and identified no changes to this section.

11.4.2.1 Documentation of Compliance with 10 CFR 20.1406

In TR-98, "Compliance with 10 CFR 20.1406," APP-GW-GLN-098, Revision 0, the applicant proposed to comply with the regulation by the selection of design technology. Table TR98-1 in TR-98, "AP1000 Features Applicable to 10 CFR 20.1406," lists specific examples of how the AP1000 design complies with 10 CFR 20.1406 (Items 19, 22, 23, 24, 25, and 26). The staff reviewed the items listed in table TR98-1 pertaining to the solid waste management system and found that the applicant addressed the minimization of waste generation in 10 CFR 20.1406.

The NRC staff issued regulatory guidance for 10 CFR 20.1406 in RG 4.21 after Revision 16, but before the issuance of Revision 17. As such, the staff documented its review according to RG 4.21 in Chapter 12. The staff concluded that this change does not affect the design and performance aspects of the solid waste management system.

11.4.2.2 Spent Resin Transfer Pump

TR-103, "Fluid System Changes," APP-GW-GLN-019, Revision 2, the applicant stated that utilities have reported operational problems due to wear of progressive cavity pumps, and the grinding of resin beads. The crushed beads are difficult to dewater and could create a storage problem. To remedy this situation, the applicant proposed to replace the progressive cavity pump with a material handling positive displacement pump. The staff concluded that this change does not affect the design of the WSS. The staff finds that the conclusions of NUREG-1793 regarding the acceptability of the WSS remain valid.

11.4.3 Conclusion

In NUREG-1793 Supplement 1, the staff concluded that the AP1000 design and DCD (up to and including Revision 15 of the DCD) was acceptable and that Westinghouse's application for design certification met the requirements of Subpart B to 10 CFR Part 52, "License, Certifications, and Approvals for Nuclear Power Plants" that are applicable and technically relevant to the AP1000 standard plant design.

In the previous evaluation of the AP1000 DCD, Section 11.4, "Solid Waste Management System," the staff identified acceptance criteria based on the design's meeting the relevant requirements in 10 CFR 20.1302 as it relates to limits on dose to persons in unrestricted areas, 10 CFR 50.34a as it relates to the inclusion of sufficient design information to demonstrate the design objectives for equipment necessary to control releases of radioactive effluents to the environment, GDC 60 as it relates to the design of waste management systems to control releases of radioactive effluents, and GDC 61 as it relates to the design of waste management systems to ensure adequate safety under normal and postulated accident conditions.

The staff reviewed the applicant's proposed changes to the AP1000 solid waste management system as documented in AP1000 DCD, Revision 16 and 17, and in Westinghouse TR-134, Revision 4. The staff concluded that the applicant's proposed changes do not affect the ability of the AP1000 solid waste management system to meet the applicable acceptance criteria in SRP 11.4. The staff also concluded that the applicant had properly incorporated design changes into the appropriate sections of AP1000 DCD, Revision 16 and 17, as supplemented

by Westinghouse TR-134, Revision 4. The staff determined that the AP1000 solid waste management system continued to meet all applicable acceptance criteria and the applicant documented the changes in the updated AP1000 DCD. The staff also concluded that all of the changes related to the gaseous waste management system design description and ITAAC in AP1000 DCD Tier 1 Section 2.3.11 were acceptable. In addition, the staff reviewed the solid waste management design description and ITAAC in AP1000 DCD Tier 1 Section 2.3.11 and found no changes to this section.

11.5 Radiation Monitoring

This section describes the staff's evaluation and findings of the AP1000 DCD, Revisions 16 and 17. The staff reviewed Revision 16 upon receipt and after review issued several requests for additional information (RAIs). Prior to resolving these RAIs, the applicant issued Revision 17 to the DCD. Hence, this review and evaluation encompasses both revisions.

11.5.1 Summary of Technical Information

In AP1000 DCD, Revision 16, the applicant made changes to Section 11.5 of the DCD. In Revision 16, the applicant only made editorial changes by renaming the Technical Support Center to the Control Support Area. The staff reviewed these changes and found them to be editorial in nature.

In Revision 17, the applicant proposed the following five (5) technical changes:

1) The applicant switched the radiation monitor for the service water blowdown from an off-line monitor to an inline monitor. The applicant documented this change on page 11.5-5 in section 11.5.2.3.1.

2) The applicant eliminated the statement that it will follow the design guidelines of ANSI N13.1 for the discharge radiation monitor of the turbine island vent. The applicant documented this change in section 11.5.2.3.3 on page 11.5-11.

3) The applicant switched the radiation monitor for the liquid radwaste discharge from an off-line monitor to an inline monitor. The applicant documented this change on page 11.5-11 and 12 in section 11.5.2.3.3.

4) The applicant made several changes to the monitors and specifications listed in Table 11.5-1. These changes included the following:

   - addition of two main steam line monitors for N-16
   - lowering the minimum and maximum of the nominal range of the steam generator blowdown monitors by an order of magnitude
   - adding the detection of Ar-51 and N-13 to the containment atmosphere monitors
   - lowering the minimum and maximum of the nominal range for the fuel handling building, auxiliary building, and annex building exhaust vents by an order of magnitude
   - changing the nominal range for the monitors of the main control room air supply duct, containment air filtration exhaust, HP and hot machine shop exhaust, radwaste building exhaust, and the gaseous and liquid radwaste discharge

5) The applicant made several changes to the monitors and specifications listed in Table 11.5-2. These changes included the following:

- the addition of a liquid and gaseous monitor for radwaste area 2
- the addition of a containment area personal hatch monitor at maintenance elevation level 30.48 m (100.0 ft)
- specifying the location of the containment area monitor at operating deck – 41.22 m (135 ft, 3 in)
- removing the rail car bay area as a service area for monitor RMS-JE-RE013

The evaluation below discusses these changes and other information, and provides an overview of staff RAIs, the applicant's responses, and staff's evaluation of the responses.

11.5.2 Evaluation

The staff reviewed the entire section and all technical changes to the radiation monitoring systems in accordance with SRP Section 11.5, "Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems." The staff reviewed the entire section and all changes identified by change marks in AP1000 DCD, Revision 16 and 17, or described in Westinghouse Technical Report TR-134, "AP1000 Impacts to Support COLA Standardization," APP-GW-GLR-134, Revision 4.

11.5.2.1 Offline to Inline Monitors for Service Water and Radwaste Liquid Discharges

The change from off-line to inline monitoring for the service water blowdown, liquid radwaste discharge, and the waste water discharge has the advantage of reducing the potential for liquid leaks, reducing the likelihood of equipment failure, and reducing areas within the system where radioactivity can accumulate and present exposure problems. For these reasons, the staff concluded that the change from offline to inline monitoring is acceptable.

11.5.2.2 Removal of Commitment to ANSI N13.1 for Turbine Vent Monitor

The applicant removed the commitment to follow ANSI N13.1 for the design of the monitoring system for the turbine island vent. This action raises a question about what design guidance the applicant would follow for this vent. SRP 11.3 states that ANSI/HPS N13.1-1999 should be used. The staff issued RAI SRP-11.5 CHPB-03 requesting that the applicant specify what design guidance it will follow.

On March 23, 2009, the applicant responded to the RAI by stating that as the turbine island vent monitor is an inline noble gas monitor and not a sample extraction monitor, ANSI N13.1 does not apply. The applicant then further stated that the monitor complies with ANSI N42.18-1980.

The staff concluded that this response was acceptable given the fact that the 1980 version of ANSI N42.18 does not differ appreciably from the current version. The staff closed RAI SRP11.5-CHPB-03.

11.5.2.3 Offline to Inline Monitors for Wastewater Discharge

The applicant changed the radiation monitor from an offline monitor to an inline monitor for the wastewater discharge. The staff concluded that the use of an inline monitor is preferable to an off line type. In addition, the applicant found an inconsistency between the descriptions of the

action of the radiation monitor for the wastewater discharge between DCD section 9.2.9 and 11.5.2. To make section 11.5.2 consistent with the design description in 9.2.9, the applicant eliminated the statement that this monitor controls the basin transfer pumps. The staff concluded that this change is acceptable because section 11.5 now reflects the actual design and function of the monitor originally described in 9.2.9.

11.5.2.4 Changes to Table 11.5-1

The staff reviewed the changes to Table 11.5-1. The staff found the changes acceptable for the following reasons:

- the additional monitors provide improved monitoring capabilities for the main steam line
- the addition of argon and nitrogen monitoring in the containment atmosphere improve the monitoring capabilities of this system
- the steam generator blowdown monitors have improved sensitivity
- the fuel handling, auxiliary building, and annex building exhaust vent monitors have improved sensitivity
- the changes to the nominal ranges for main control room air supply duct, containment air filtration exhaust, HP and hot machine shop exhaust, radwaste building exhaust, and the gaseous and liquid radwaste discharge do not change the overall ability of the monitors to perform their intended function

11.5.2.5 Changes to Table 11.5-2

The staff reviewed the changes to Table 11.5-2. The staff concluded that the additional monitoring and location specificity improves the overall area monitoring and is thus acceptable. However, the staff required clarification on the change that removed the rail car bay area as a service area for monitor RMS-JE-RE013. This action seemed to leave the rail car bay area unmonitored. The staff issued RAI SRP-11.5 CHPB-04 to obtain clarification.

The applicant responded that it did not remove the monitor from the rail car bay area but renamed the area. The applicant will revise the title of the area monitor to be consistent with the title of the area. This response is acceptable since the rail car area remains monitored. The staff needs to confirm the change in the next revision of the DCD and will track this as confirmatory item CI SRP11.5-CHPB-01.

11.5.2.6 Additional SRP 11.5 Acceptance Criteria

Section 11.5 states that the radiation monitoring system is designed in accordance with ANSI N13.1-1969. This standard was withdrawn and replaced in 1999 because the approach taken in the 1969 does not provide assurance that the sample in the effluent vent would be representative. The 1999 revision to ANSI N13.1 differs significantly from the earlier version in that it is now performance based. SRP 11.5 (2007) uses the 1999 standard as acceptance criteria.

The 1969 standard does not provide assurance that the sample from the effluent vent is representative of the particulate matter and reactive vapors passing through the vent. The ability to obtain a representative sample is important since it supports the ability of the licensee to determine public and occupational exposure to radioactivity. The staff concluded that the applicant should use the new standard to ensure that the measurements are accurate. The staff issued RAI SRP11.5-CHPB-01 to the applicant requesting a change to the newer standard.

On April 13, 2009, the applicant responded to the RAI by stating that committing to the 1999 standard would introduce an excessive degree of uncertainty into the detailed design and construction of the AP1000. To address the limitations of the 1969 standard the applicant proposed an alternative approach relying on best design practices and performance testing and criteria similar to the 1999 standard.

The staff reviewed the response and found that the applicant adopted all relevant performance tests and criteria in the 1999 standard. Once built, the applicant will test the system to ensure that it meets the performance objectives of the 1999 standard. The staff finds this response acceptable and needs to confirm the change in the next revision of the DCD. The staff will track this as confirmatory item **CI-SRP11.5-CHPB-02**.

11.5.3 Conclusion

After satisfactory resolution of confirmatory items **CI-SRP11.5-01** and **CI-SRP11.5-02** contained in this section, the following conclusions apply.

In NUREG-1793 and its Supplement 1, the staff documented its conclusion that the AP1000 design and DCD (up to and including Revision 15 of the DCD) was acceptable and that Westinghouse's application for design certification met the requirements of Subpart B to 10 CFR Part 52, "License, Certifications, and Approvals for Nuclear Power Plants" that are applicable and technically relevant to the AP1000 standard plant design.

In its previous evaluations of the AP1000 DCD, Section 11.5, Radiation Monitoring, the staff identified acceptance criteria based on SRP 11.5, Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems. The staff reviewed the AP1000 radiation monitoring and sampling systems for compliance with these requirements, as referenced in SRP Section 11.5 and determined that the monitoring systems, as documented in AP1000 DCD, Revision 15, was acceptable because the design conformed to all applicable acceptance criteria.

The staff reviewed the applicant's proposed changes to the AP1000 DCD Section 11.5 as documented in AP1000 DCD, Revision 16 and 17, and in Westinghouse TR-134, Revision 4. The staff concluded that the applicant's proposed changes did not affect the ability of the AP1000 radiation monitoring instrumentation and sampling systems to meet the applicable acceptance criteria in SRP 11.5. The staff also concluded that the design changes have been properly incorporated into the appropriate sections of AP1000 DCD, Revision 16 and 17, as supplemented by Westinghouse TR-134, Revision 4. On the basis that the AP1000 the monitoring system for process and effluents continues to meet all applicable acceptance criteria and the changes are properly documented in the updated AP1000 DCD, the staff concluded that all of the changes related to the system design of the AP1000 process and effluent radiation monitoring are acceptable.