C.I.11. Radioactive Waste Management

Chapter 11 of the final safety analysis report (FSAR) should describe the capabilities of the plant to control, collect, handle, process, store, and dispose of liquid, gaseous, and solid wastes that may contain radioactive materials, and the instrumentation used to monitor and control the release of radioactive effluents and wastes.

The information should cover normal operation, including anticipated operational occurrences (refueling, purging, equipment downtime, maintenance, etc.). The proposed radioactive waste (radwaste) treatment systems should have the capability to meet the requirements of 10 CFR Parts 20 and 50 and the recommendations of appropriate regulatory guides concerning system design, control, and monitoring of releases, and to maintain releases of radioactive materials at the "as low as is reasonably achievable" (ALARA) level in accordance with Appendix I to 10 CFR Part 50. As warranted, this chapter should specifically reference needed information that appears in other chapters of the FSAR.

C.I.11.1 *Source Terms*

This section addresses the sources of radioactivity that are generated within the core and have the potential of leaking to the reactor coolant system (RCS) during normal plant operation, including anticipated operational occurrences (AOOs), by way of defects in the fuel cladding.

Provide two source terms for (1) the primary coolant and reactor steam for BWRs, and (2) primary and secondary coolants for PWR plants. The first source term is a conservative or design basis source term which assumes a design basis fuel defect level. Provide the design basis reactor primary and secondary coolant fission, activation, and corrosion product activities. The reactor core fission product inventories are determined based on time-dependent fission product core inventories that are calculated by the ORIGEN code. The first source term serves as a basis for (1) radwaste system design capability to process radioactive wastes at design basis fuel defect level and fission product leakage level, (2) confirmation of compliance with radioactive gaseous and liquid effluent release standards and effluent monitoring requirements under routine operations and anticipated operational occurrences, and (3) shielding requirements and compliance with occupational radiation exposure limits.

The second source term is a realistic model which represents the expected average concentrations of radionuclides in the primary and secondary coolant. Provide realistic reactor primary and secondary coolant fission, activation, and corrosion product activities. The supporting information should describe expected liquid and gaseous source terms by plant systems, transport or leakage mechanisms, system flow rates, applicable radionuclide partitioning and decontamination factors, etc., and release pathways. For PWRs, provide these activities in the steam generator secondary side for the liquid and steam phases. These values should be determined using the model in ANSI/ANS 18.1-1999, NUREG-0016 (BWR-GALE code), and NUREG-0017 (PWR-GALE code).

The realistic source term provides the bases for estimating typical concentrations of the principal radionuclides. This source term model reflects the industry experience at a large number of operating reactor plants. The realistic source term is used to calculate the quantity of radioactive materials released annually in liquid and gaseous effluents during normal plant operation, including AOOs to demonstrate compliance with 10 CFR Part 20, Appendix B, Table 2, liquid and gaseous effluent concentration limits, 10 CFR 20.1302 dose limits, and the ALARA design objectives of Appendix I to 10 CFR Part 50.

Describe the mathematical models and parameters used for developing these two source terms to determine the specific activity and concentration of each radionuclide in the primary coolant and secondary coolant. Justify all assumptions. Demonstrate that the models and parameters used are consistent with NUREG-0016 (BWRs) or NUREG-0017 (PWRs) and the guidance provided in ANSI/ANS 18.1 and Regulatory Guide 1.112. If this guidance is not followed, describe the specific alternative methods used.

In determining the concentrations of activation and corrosion products used in the source term calculations, take into account the activation of water and constituents normally found in the reactor coolant system. Identify the source of each radionuclide (e.g., tritium, C-14, Ar-41, N–16), and indicate the concentration of each radionuclide. Provide the bases for all assumptions and parameters used, including all supporting references. Cite any previous pertinent operating experience, and its use as a supporting basis. The reactor coolant corrosion product and activation activities should be based on operating plant data and are independent of fuel defect level.

The source terms included in this section of the Regulatory Guide have a driving influence in establishing the design capacities and performance of radioactive waste management systems addressed in Section 11.2 (Liquid Waste Management Systems), Section 11.3 (Gaseous Waste Management System), Section 11.4 (Solid Waste Management System), and Section 11.5 (Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems). Similarly, the source terms included in this section of the Regulatory Guide are used to assess shielding requirements and occupational radiation exposures, as addressed in Section 12. Accordingly, analytical models, model assumptions, and system parameters used in developing source terms described in this section should be complete in their descriptions and include their technical bases to facilitate the review and evaluation of Sections 11.2, 11.3, 11.4, 11.5, and 12.

C.I.11.2 *Liquid Waste Management Systems*

In this section, describe the capabilities of the plant to monitor, control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including anticipated operational occurrences, using the guidance of NUREG-0016 (BWRs) or NUREG-0017 (PWRs).

Process and effluent radiological monitoring, instrumentation and sampling systems should be described in Section 11.5, using the information contained in this section and in Chapter 9 of the FSAR.

C.I.11.2.1 Design Bases

Describe the liquid management system (i.e., liquid radioactive waste handling and treatment systems) design, design objectives, design criteria, and methods of treatment in terms of expected annual quantities of radioactive material (by radionuclide) released, averaged over the life of the plant, and in terms of the expected doses to individuals at or beyond the site boundary. Describe the principal parameters used in calculating the releases of radioactive materials in liquid effluents using NUREG-0016 (BWRs) or NUREG-0017 (PWRs) and Regulatory Guide 1.112. If this guidance is not followed, describe the specific alternative methods used.

Include an evaluation that demonstrates the capability of the proposed systems to control releases of radioactive materials within the numerical design objectives of Appendix I to 10 CFR Part 50 and 10 CFR Part 20, Appendix B, effluent concentration limits.

Within this evaluation, provide a site-specific cost-benefit analysis for reducing population doses due to liquid effluents, pursuant to 10 CFR Part 50, Appendix I, and in accordance with the guidance in Regulatory Guides 1.110 and 1.113 and NUREG/CR-4013. If this guidance is not followed, describe the specific alternative methods used. More specifically, show that the proposed systems contain all items of reasonably demonstrated technology that, when added to the system in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio, effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. State all assumptions and describe the calculational methods used, including all supporting references.

Also provide an evaluation which shows that the proposed systems have sufficient capacity, redundancy, and flexibility to meet the concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 2, during periods of equipment downtime and during operation at design basis fission product leakage levels [i.e., for a PWR, leakage from fuel producing one percent of the reactor power or, for a BWR, fuel having a noble gas release rate of 3.7 MBq/sec per MWt (100 μCi/sec per MWt) measured after a 30 minute delay].

List the liquid radwaste system components and their design parameters (e.g., design and expected flows, design and expected temperatures, design and expected pressures, materials of construction, capacities, expected radionuclide concentrations, expected decontamination factors for radionuclides, and available holdup times). Also include an evaluation indicating the capabilities of the system to process surge waste flow rates associated with anticipated operational occurrences, such as anticipated waste flows from back-to-back refueling and equipment downtime. This evaluation should take into account the period of time that the system is required to be in service to process normal waste flows, the availability of standby equipment, alternate processing routes, and interconnections between subsystems. Discuss system capability to process wastes in the event of a single major equipment item failure (e.g., an evaporator outage). Discuss system capability to accept additional wastes during operations that result in excessive liquid waste generation.

Indicate system design capacity relative to the design and expected input flows, and the period of time the system is required to be in service to process normal waste flows. Describe design features implemented to preclude placing the components and structures of the system under adverse vacuum conditions.

Discuss any mobile or temporary equipment used for storing or processing liquid radwaste in accordance with Regulatory Guide 1.143. (For example, this includes discussion of equipment containing radioactive liquid radwaste in the non-seismic radwaste building.) If this guidance is not followed, describe the specific alternative methods used. Describe system design features and operational procedures used to ensure that interconnections between plant systems and mobile processing equipment will avoid the contamination of non-radioactive systems and uncontrolled releases of radioactivity in the environment (see IE Bulletin No. 80-10 for details). Discuss system capability of and requirements for utilizing portable processing equipment for refueling outages.

Provide the seismic design criteria, the bases governing chosen criteria, and the analytical procedures for equipment support elements and structures housing the liquid radwaste components. Also, provide the quality group classification for the liquid radwaste treatment components, equipment, and piping. Seismic and quality group classifications provided in Section 3.2 may be incorporated by reference. Describe how the requirements of General Design Criteria (GDC) 60, 61, and 64 of Appendix A to 10 CFR Part 50 will be implemented in monitoring and controlling effluent releases.

Describe the design features incorporated to reduce maintenance, equipment downtime, and liquid leakage or gaseous releases of radioactive materials to the building atmosphere. Describe the design features incorporated to facilitate cleaning or otherwise improve radwaste operations in accordance with the guidance of Regulatory Guides 1.140 and 1.143. If this guidance is not followed, describe the specific alternative methods used. Describe design features, including decontamination factors, that would reduce liquid input volumes or discharge of radioactive material in liquid effluents. If decontamination factors for vented gaseous wastes are different than those in Regulatory Guide 1.140, provide the supporting test data or description of simulated operating conditions (i.e., temperature, pressure, humidity, expected iodine concentrations, and flow rates). If not addressed here, the related discussions and supporting technical information should be presented in Section 11.3.

Describe the design features incorporated to prevent, control, and collect the release of radioactive materials due to overflows from all liquid tanks outside containment that could potentially contain radioactive materials. Discuss the effectiveness of both the physical and the monitoring precautions taken (e.g., dikes, level gauges, and automatic diversion of wastes from tanks exceeding a predetermined level). Discuss the potential for an operator error or equipment malfunction (single failures) to result in uncontrolled and unmonitored releases to the environment. Describe the design provisions and controls provided to preclude inadvertent or uncontrolled releases of radioactivity to the environs and consequences of potential releases of radioactive materials to a potable water supply system.

Describe the quality assurance procedures and indicate consistency with the guidance of Regulatory Guides 1.143 and 1.33. If this guidance is not followed, describe the specific alternative methods used. Reference Chapter 17 of the FSAR, as appropriate.

Discuss inspection and testing provisions implemented to enable periodic evaluation of system operability and required functional performance in accordance with the guidance of Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used.

In accordance with the requirements of 10 CFR 20.1406, describe how the above design features and operational procedures will minimize, to the extent practicable, contamination of the facility and the environment, facilitate decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Also include a discussion of any special design features that may be unique to the plant, topical reports incorporated by reference, and data obtained from previous experience with similar equipment and methods, and their use as a supporting basis.

C.I.11.2.2 System Description

Describe each liquid waste subsystem and the process flow diagrams indicating processing equipment, normal process routes, equipment capacities, and redundancy in equipment. Reference Chapters 9 and 10 of the FSAR, as appropriate, in the system description. Process flow diagrams should show methods of **operation and factors that influence waste treatment (e.g., system interfaces and potential bypass routes to non-radioactive systems, or unmonitored releases). For multi-unit stations, indicate those subsystems that are shared. Identify all equipment and components that will normally be shared between subsystems. Indicate the processing to be provided for all liquid radwaste, including turbine building floor drains and, in the case of a PWR, steam generator blowdown liquids.**

Provide system piping and instrumentation diagrams (P&IDs) and process flow diagrams showing methods of operation and factors that influence waste treatment (e.g., system interfaces and potential bypass routes). For each subsystem, tabulate or show on flow diagrams the maximum and expected inputs in terms of flow (m^3/day or gallons/day per reactor) and radioactivity (fraction of primary coolant activity) for normal operation, including anticipated operational occurrences. Provide the bases for the values used, including all supporting references.

Include P&IDs which indicate system interconnections and seismic and quality group interfaces. Describe any instrumentation and controls that govern operation. Indicate all potential bypasses of normal process routes, the conditions governing their use, and the anticipated frequency of bypass due to equipment downtime. Describe the segregation of liquid waste streams based on conductivity, radioactivity, and chemical composition, as appropriate. Also, indicate the location of secondary flow paths for each system. Describe both the normal operation of each system and the differences in system operation during anticipated operational occurrences, such as startups, shutdowns, and refueling.

C.I.11.2.3 Radioactive Releases

Provide the criteria for determining whether processed liquid wastes will be recycled for reuse or further treated or discharged to the environment. Discuss the influence of the plant water balance needs and of the expected tritium concentrations in process streams on the assumed release parameters, including in-plant dilution before the point of release.

Provide the parameters, assumptions, and bases used to calculate releases of radioactive materials in liquid effluents, using Regulatory Guide 1.112 (Appendix A for BWRs and Appendix B for PWRs). If this guidance is not followed, describe the specific alternative methods used. Provide the expected releases of radioactive materials (by radionuclide) in liquid effluents resulting from normal operation, including anticipated operational occurrences, and from design basis fuel leakage in MBq/yr (Ci/yr) per reactor. Describe expected release rates of radioactive material from the liquid waste management system, including location of process and effluent radiation monitoring systems, location of release points, effluent temperature, effluent flow rate, and size and shape of flow orifices.

Tabulate the releases by radionuclide for the total system and for each subsystem, and indicate the effluent concentrations. Demonstrate compliance with regulations by comparing the calculated effluents with the concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 2. Calculate doses to members of the public in unrestricted areas, using the guidance of Regulatory Guides 1.109 and 1.113. If this guidance is not followed, describe the specific alternative methods used. Compare the doses due to the effluents with the numerical design objectives of Appendix I to 10 CFR Part 50 and the dose limits of 10 CFR 20.1302 and the Environmental Protection Agency's (EPA) environmental standards in 40 CFR Part 190. Identify all release points of liquid wastes and the dilution factors (in-plant and beyond the point of release) considered in the evaluation. (The dilution factors provided for the activity released depend on site-specific features.)

C.I.11.3 *Gaseous Waste Management Systems*

In this section, describe the capabilities of the plant to monitor, control, collect, process, handle, store, and dispose of gaseous radioactive waste generated as the result of normal operation and anticipated operational occurrences, using the guidance of NUREG-0016 (BWRs) or NUREG-0017 (PWRs).

In this section, the term 'gaseous waste systems' applies to all plant systems having the potential to release radioactive materials in gaseous effluent to the environment, including building ventilation systems. Gaseous wastes include noble gases, halogens, tritium, Ar-41, C-14, and radioactive material in particulate form. The gaseous waste management system includes the gaseous radwaste system. The gaseous radwaste system serves to manage radioactive gases collected from the offgas system (including charcoal delay beds), waste gas storage and decay tanks, or from vented tanks. In addition, the gaseous waste management system includes management of the condenser air removal system, steam generator blowdown flash tank (if applicable), containment purge exhausts for PWRs, and management of the gland seal exhaust and mechanical vacuum pump operation exhaust for BWRs. The management for gaseous effluents to the environment from the above sources may, in turn, involve treatment systems to reduce releases of radioactive material in the effluents from the above sources.

Process and effluent radiological monitoring systems should be described in Section 11.5, using the information contained in this section and in Chapter 9 of the FSAR.

C.I.11.3.1 Design Bases

Describe the gaseous waste management system design, design objectives, design criteria and methods of treatment in terms of expected annual quantities of radioactive material (by radionuclide) released, averaged over the life of the plant, and the expected doses to individuals at or beyond the site boundary. Describe the principal parameters used in calculating the releases of radioactive materials in gaseous effluents (e.g., noble gases, radioiodine, tritium, C-14, and particulates) using the guidance of NUREG-0016 (BWRs) or NUREG-0017 (PWRs) and Regulatory Guide 1.112. If this guidance is not followed, describe the specific alternative methods used. Also include a description of the design objectives of the plant ventilation systems for normal and emergency operation, including anticipated operational occurrences, with respect to meeting the requirements of 10 CFR Parts 20 and 50.

Provide an evaluation showing the capability of the proposed systems to control releases of radioactive materials within the numerical design objectives of Appendix I to 10 CFR Part 50. Within this evaluation, provide a site-specific cost-benefit analysis for reducing population doses due to gaseous effluents, in compliance with 10 CFR Part 50, Appendix I, and in accordance with the guidance in Regulatory Guides 1.110 and 1.111 and NUREG/CR-4653. If this guidance is not followed, describe the specific alternative methods used. More specifically, show that the proposed systems contain all items of reasonably demonstrated technology that, when added to the system in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio, effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. State all assumptions and describe the calculational methods used, including all supporting references.

Also provide an evaluation which shows that the proposed systems have sufficient capacity, redundancy, and flexibility to meet the concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 1, during periods of equipment downtime and during operation at design basis fission product leakage levels [i.e., for a PWR, leakage from fuel producing one percent of the reactor power or, for a BWR, fuel having a noble gas release rate of 3.7 MBq/sec per MWt (100 μCi/sec per MWt) measured after a 30 minute delay].

List the gaseous radwaste system components and their design parameters (e.g., design and expected flows, design and expected temperatures, design and expected pressures, materials of construction, equipment and ventilation system design capacities, expected radionuclide concentrations, expected decontamination factors for radionuclides, and available holdup times). Provide an evaluation indicating the capabilities of the system to process surge waste flow rates associated with anticipated operational occurrences, such as cold startups, shutdowns, purging of containment, back-to-back refueling, and major processing equipment downtime. This evaluation should take into account the period of time that the system is required to be in service to process normal waste flow rates, availability of standby equipment, alternate processing routes, and interconnections between subsystems. Discuss system capability to process wastes in the event of a single major equipment item failure (e.g., charcoal adsorbers). Discuss system capability to accept additional wastes during operations which result in excessive gaseous waste generation.

Discuss any mobile or temporary equipment used for storing or processing gaseous radwaste in accordance with Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used. Describe system design features and operational procedures used to ensure that interconnections between plant systems and mobile processing equipment will avoid the contamination of non-radioactive systems and uncontrolled releases of radioactivity in the environment (see IE Bulletin No. 80-10 for details). Discuss system capability of and requirements for utilizing portable processing equipment for refueling outages.

Provide the seismic design criteria, the bases governing chosen criteria, and the analytical procedures pertaining to equipment support elements and structures housing the gaseous waste treatment system. Also, provide the quality group classification for the gaseous waste treatment components, equipment, and piping. Seismic and quality group classifications provided in Section 3.2 may be incorporated by reference. Describe how the requirements of GDC 60, 61, and 64 of Appendix A to 10 CFR Part 50 will be implemented in monitoring and controlling effluent releases.

Describe the design features incorporated to reduce maintenance, equipment downtime, leakage of gaseous waste or discharge of radioactive material in gaseous effluents, and gaseous releases of radioactive materials to the building atmosphere. Describe the design features incorporated to facilitate cleaning or otherwise improve radwaste operations, in accordance with the guidance of Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used.

Describe the process used for the design testing and maintenance of HEPA filters and charcoal adsorbers installed in ventilation exhaust systems, in accordance with the guidance of Regulatory Guide 1.140. If decontamination efficiencies for iodines are different than those in Regulatory Guide 1.140, provide the supporting test data or description of simulated operating conditions (i.e., design and expected temperatures, design and expected pressures, humidity, expected iodine concentrations, and design and expected flow rates). Also, include information and data addressing the effects of aging and positioning on charcoal adsorbers by airborne contaminants.

Describe the design features incorporated to prevent, control, and collect the release of radioactive materials in gaseous effluents due to equipment malfunction or operator error. Discuss the effectiveness of monitoring precautions taken (i.e., automatic termination of waste release from waste gas storage tanks when the release exceeds a predetermined level). Discuss the potential for an operator error or equipment malfunction (single failures) to result in uncontrolled and unmonitored releases of radioactivity to the environment, using Standard Review Plan (SRP) Branch Technical Position (BTP) ETSB 11-5 guidance. Describe the design provisions and controls provided to preclude inadvertent or uncontrolled releases of radioactivity to the environs.

For systems where the potential for an explosion or explosive mixture exists, identify and justify any equipment that is not designed to withstand the pressure peak of the explosion. Describe process instrumentation (including gas analyzers) and design features provided to prevent explosions as well as provisions to ensure that seals will not be permanently damaged or lost following an explosion.

Describe the quality assurance procedures and indicate consistency with the guidance of Regulatory Guides 1.143 and 1.33. If this guidance is not followed, describe the specific alternative methods used. Reference Chapter 17 of the FSAR, as appropriate.

Discuss inspection and testing provisions implemented to enable periodic evaluation of system operability and required functional performance in accordance with the guidance of Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used.

In accordance with the requirements of 10 CFR 20.1406, describe how the above design features and operational procedures will minimize, to the extent practicable, contamination of the facility and the environment, facilitate decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Also include a discussion of any special design features that may be unique to the plant, topical reports incorporated by reference, and data obtained from previous experience with similar equipment and methods.

C.I.11.3.2 System Description

Describe each gaseous waste subsystem and the process flow diagrams, indicating processing equipment, normal flow paths through the system, equipment capacities, and redundancy in equipment. Reference Chapters 9 and 10 of the FSAR, as appropriate. Process flow diagrams should show methods of operation and factors that influence waste treatment (e.g., system interfaces and potential bypass routes). For multi-unit stations, indicate those subsystems that are shared. Identify all equipment and components that will normally be shared between subsystems.

Provide system P&IDs and process flow diagrams showing methods of operation and factors that influence waste treatment (e.g., system interfaces and potential bypass routes). For each subsystem, tabulate or show on the flow diagrams the maximum and expected inputs in terms of flow (m^3/minute or ft^3/minute) and radioactivity content (fraction of primary coolant activity) for normal operation, including anticipated operational occurrences. Provide the bases for the values used, including all supporting references. Indicate the composition of carrier and blanket gases, and describe the segregation of streams containing hydrogen, if appropriate.

Include P&IDs which indicate system interconnections and seismic and quality group interfaces. Describe any instrumentation and controls that govern operation. Indicate all potential bypasses of normal process routes, the conditions governing their use, and the anticipated frequency of bypass due to equipment downtime. Provide the location of liquid seals, indicated on the P&IDs, and describe how blown seals will be automatically reestablished. Also, indicate the location of vents and secondary flow paths for each system. Describe both the normal operation of each system and the differences in system operation during anticipated operational occurrences such as startups, shutdowns, refueling, and purging of containment.

Describe all building ventilation systems expected to contain radioactive materials. Include building volumes, expected flow rates from buildings and equipment cubicles, filter characteristics, and the design criteria on which these are based. Describe both the normal operation of each ventilation system and the differences in operation during anticipated operational occurrences such as startup, shutdown, and refueling. Provide a tabulation showing the calculated concentrations of airborne radioactive material (by radionuclide) expected during normal operation and anticipated operational occurrences for equipment cubicles, corridors, and areas normally occupied by operating personnel.

Identify types of adsorbent media to be used in the gaseous radwaste system, and describe bounding operating conditions (e.g., pressure, temperature, humidity, flow rates, residence time, etc.).

Describe the subsystems in the steam and power conversion systems that are potential sources of gaseous radioactive effluents (e.g., turbine gland sealing systems, main condenser vacuum system). Provide the flow rates and concentrations of radioactive materials (by radionuclide) through these systems during normal operations and anticipated operational occurrences. Provide the bases for the values used, including all supporting references. Tabulate the expected frequency and quantity of steam released during steam dumps to the atmosphere (PWR) or pressure relief valve venting to the suppression pool (BWR). Provide the bases for the values used, including all supporting references. Reference other sections of the FSAR, as appropriate.

C.I.11.3.3 Radioactive Releases

Provide the criteria to be used for releasing gaseous wastes and acceptable release rates. Also describe the parameters, assumptions, and bases used to calculate releases of radioactive material in gaseous effluents, using Regulatory Guide 1.112 (Appendix A for BWRs and Appendix B for PWRs). If this guidance is not followed, describe the specific alternative methods used. Provide the expected releases of radioactive materials (by radionuclide) in gaseous effluents resulting from normal operation, including anticipated operational occurrences, in MBq/yr (Ci/yr) per reactor.

Tabulate the releases by radionuclide for the total system and each subsystem, and indicate effluent concentrations. Demonstrate compliance with regulations by comparing the calculated effluents with the concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 1. Calculate doses to members of the public in unrestricted areas, using the guidance in Regulatory Guides 1.109 and 1.111. If this guidance is not followed, describe the specific alternative methods used. Compare the doses due to the effluents with the numerical design objectives of Appendix I to 10 CFR Part 50 and the dose limits of 10 CFR 20.1302 and the EPA's environmental standards in 40 CFR Part 190. Indicate the atmospheric dispersion and deposition factors considered in the evaluation. (The atmospheric dispersion and deposition factors provided to assess the presence of airborne radioactivity at downwind locations depend on site-specific features.)

Identify all release points of gaseous waste to the environment and locations of process and effluent radiation monitoring systems on process flow diagrams, general arrangement drawings, or site plot plan. For release points, give:

(1) Height of release (both height above grade and height relative to adjacent buildings);
(2) Inside dimensions of release point exit;
(3) Effluent temperature;
(4) Effluent flow rate;
(5) Effluent exit velocity; and
(6) Size and shape of flow orifices.

C.I.11.4 *Solid Waste Management System*

In this section, describe the capabilities of the plant to monitor, control, collect, process, handle, package, and temporarily store prior to shipment wet, de-watered, and dry solid radioactive waste generated as a result of normal operation, including anticipated operational occurrences.

In this section, the term 'solid waste management system' implies a permanently installed system and/or the use of mobile system(s) with skid-mounted waste processing equipment connected to plant systems via temporary connections. A solid waste management system includes slurry waste collection and settling tanks, spent resin storage tanks, phase separators, and components and subsystems used to dewater or solidify radwaste prior to storage or offsite shipment.

Process and effluent radiological monitoring systems should be described in Section 11.5, using the information contained in this section and in Chapters 9 and 10 of the FSAR.

C.I.11.4.1. Design Bases

Describe the solid radioactive waste handling and treatment system design, design objectives, design criteria, and methods of treatment in terms of the types of wet and dry wastes to be processed (e.g., sludges, resins, evaporator bottoms, and dry materials such as contaminated tools, equipment, rags, plastic, filters, glass, paper, spent charcoals, and clothing and personal protective equipment), the maximum and expected and design volumes to be handled and processed, and the becquerel (curie) and radionuclide content (the activity and expected radionuclide distribution contained in the waste).

Within this evaluation, provide a site-specific cost-benefit analysis for reducing population doses due to radioactive material from the solid waste management system, in compliance with 10 CFR 50.34a (Appendix I), and in accordance with the guidance in Regulatory Guide 1.110. If this guidance is not followed, describe the specific alternative methods used. More specifically, show that the proposed systems contain all items of reasonably demonstrated technology that, when added to the system in order of diminishing cost-benefit return, can, for a favorable cost-benefit ratio, effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. State all assumptions and describe the calculational methods used, including all supporting references.

Discuss any mobile or temporary equipment used for storing or processing solid radwaste in accordance with the guidance in Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used. Describe system design features and operational procedures used to ensure that interconnections between plant systems and mobile processing equipment will avoid the contamination of non-radioactive systems and uncontrolled releases of radioactivity in the environment (see IE Bulletin No. 80-10 for details).

Provide the seismic design criteria, the bases governing chosen criteria, and the analytical procedures pertaining to equipment support elements and structures housing the solid radwaste system, including dedicated onsite radioactive waste storage facilities. Also, provide the quality group classification for the solid radwaste treatment components, equipment, and piping. Seismic and quality group classifications provided in Section 3.2 may be incorporated by reference. Describe how the requirements of 10 CFR Parts 20, 50, 61, and 71, and applicable U.S. Department of Transportation (DOT) regulations under 49 CFR Parts 171 - 180 will be implemented, and to what extent the guidance in BTP ETSB 11-3, Appendix 11-4-A to SRP Section 11.4 will be followed.

Describe the design features incorporated to reduce maintenance, equipment downtime, leakage and discharge of radioactive material.

Describe the design features incorporated to facilitate cleaning or otherwise improve radwaste operations, in accordance with the guidance of Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used.

Describe the design features incorporated to prevent, control, and collect the release of radioactive materials due to overflows from tanks containing liquids, sludges, spent resins, etc. Identify all tanks or equipment that use compressed gases for any function and provide information as to gas flow rates, amounts, or volumes per operation, expected number of operations per year, expected radionuclide concentration of offgases, treatment provided, and interfaces with ventilation exhaust systems. Discuss the effectiveness of the physical and monitoring precautions taken (e.g., retention basins, curbing, level gauges). Also discuss the potential for an operator error or equipment malfunction (single failures) to result in uncontrolled and unmonitored releases of radioactive material.

Describe the quality assurance procedures and indicate consistency with the guidance of Regulatory Guides 1.143 and 1.33. If this guidance is not followed, describe the specific alternative methods used. Reference Chapter 17 of the FSAR, as appropriate.

Discuss inspection and testing provisions implemented to enable periodic evaluation of system operability and required functional performance in accordance with the guidance of Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used.

In accordance with the requirements of 10 CFR 20.1406, describe how the above design features and operational procedures will minimize, to the extent practicable, contamination of the facility and the environment, facilitate decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Also, include a discussion of any special design features that may be unique to the plant, topical reports incorporated by reference, data obtained from previous experience with similar equipment and methods, and their use as a supporting basis.

C.I.11.4.2 System Description

Dry Solid Waste

Describe the dry solid waste subsystem to be used for processing dry filter media (e.g., ventilation filters, charcoal media, etc.), contaminated clothing, equipment, tools, and glassware, and miscellaneous radioactive wastes not amenable to solidification prior to packaging. Describe the use of sorting methods and waste volume reduction technologies, such as shredders, crushers, and compactors. List the system components and their design parameters, including design capacities and construction materials. Tabulate the maximum and expected waste inputs in terms of type (e.g., filters, tools), sources of waste, volume, and radionuclide and becquerel (curie) content. Provide the bases for the values used, including all supporting references. Indicate what fraction, if any, of all solid waste processing will be contracted out to waste brokers or specialized facilities. Describe the disposition of solid wastes generated by the plant once processed in such a manner. Indicate whether such processed wastes will be returned to the plant for subsequent disposal or will be shipped directly by the processor to an authorized low-level radioactive waste disposal facility under 10 CFR Part 61 or equivalent Agreement State regulations.

For plant using offgas treatment systems relying on charcoal beds, provide a description of the offgass treatment system, including number and size of tanks (main and guard) holding charcoals, their locations in plant buildings, and provisions for storing spent charcoals prior to shipment. Describe the radiological and physical properties of spent charcoals. Describe provisions for managing and shipping spent charcoal for disposal. Provide estimates of the project annual amounts (kg/yr, m^3/yr) of spent charcoal that will be shipped as radioactive waste.

Wet Solid Waste

Describe the method and solidification media to be used for solidifying each waste type, the type of container in which the wastes will be packaged, and the means to be used to ensure the absence of free liquid in the waste containers, including the process control program to ensure a solid matrix. Describe system design features and operational procedures used to ensure that interconnections between plant systems and mobile processing equipment will avoid the contamination of non-radioactive systems and uncontrolled releases of radioactivity in the environment (see IE Bulletin No. 80-10 for details).

Describe methods for solidification (i.e., removal of free water), including the method for dewatering, the solidifying agent used, and the implementation of a process control program to ensure a solid matrix, proper waste form characteristics, and/or complete dewatering. Indicate what fraction, if any, of all wet waste processing will be contracted out to waste brokers or specialized facilities. Describe the disposition of processed wet and liquid wastes generated by the plant once processed in such a manner. Indicate whether such processed wastes will be returned to the plant for subsequent disposal or will be shipped directly by the processor to an authorized low-level radioactive waste disposal facility under 10 CFR Part 61 or equivalent Agreement State regulations.

Demonstrate the compliance of the process control program with 10 CFR §§ 61.55 and 61.56 for wet solid wastes, 10 CFR Part 71, and applicable U.S. DOT regulations (49 CFR Parts 171 - 180). Include in the discussion the use of mobile systems and provide the process control program demonstrating conformance to GL-80-009 and GL-81-039 and consistency with the guidance in Regulatory Guide 1.143. If this guidance is not followed, describe the specific alternative methods used. Provide information concerning wet solid wastes contained in non-seismic radwaste buildings. In the event that additional onsite storage facilities are a part of COL applications, include a discussion of conformance to GL-81-038.

Packaging, Storage and Shipping

Describe the method of packaging and equipment to be used, along with the provisions for controlling airborne radioactivity due to aerosols generated during compaction and baling operations. Discuss the methods of handling and packaging large waste materials and equipment that have been activated during reactor operation (e.g., core components). Indicate what fraction, if any, of all waste processing will be contracted out to waste brokers or specialized facilities. Describe the disposition of all wastes generated by the plant once processed in such a manner. Indicate whether such processed wastes will be returned to the plant for subsequent disposal or will be shipped directly by the processor to an authorized low-level radioactive waste disposal facility under 10 CFR Parts 61 and 71 or equivalent Agreement State regulations, including applicable U.S. DOT regulations under 49 CFR Parts 171 - 180.

Provide a discussion addressing the expected distribution of Class A, B, C, and greater-than-class C wastes expected to be generated under the provisions of Part 61.55. Provide a discussion of the expected waste characteristics shipped for disposal under the provisions of Part 61.56. Provide a discussion on how waste acceptance criteria of radioactive waste disposal facilities will be met using facility operating procedures and process control program.

Describe compliance with Appendix G to 10 CFR Part 20 in addressing requirements for the transfers and manifesting of radioactive waste for disposal at authorized facilities.

Describe the type and size of containers to be used for packaging wastes and indicate compliance with 10 CFR Part 71 and 49 CFR Parts 171 - 180.

Describe the method of filling, handling, and monitoring for removable radioactive contamination in compliance with the limits of 49 CFR 173.443 and external radiation levels in compliance with 49 CFR 173.441.

Describe provisions for onsite storage of radioactive waste in response to Appendix 11.4-A of the Standard Review Plan. The SRP considers the need to establish onsite storage capabilities for several years (up to 5 years), with an emphasis on the future availability or accessibility to low -level waste disposal sites, and safety considerations in the storing, handling and eventual disposition of radioactive wastes.

Discuss provisions for packing, sealing, decontaminating, and moving the containers to storage and shipping areas. Also discuss the potential for radioactive spills due to dropping containers from cranes, forklifts, monorails, etc. Describe provisions for collecting and processing decontamination liquids and spillage. Describe provisions for waste storage prior to shipping, including storage provisions, storage capacity, and expected onsite storage time. Describe the expected and design volumes, the expected radionuclide contents, and the design bases for these values, including all supporting references. Provide layout drawings of the packaging, storage, and shipping areas.

Indicate the maximum and expected annual volumes and the activity becquerel (curie) and radionuclide content of wastes to be shipped offsite for each waste category.

Effluent Controls

Provide system P&IDs and process flow diagrams showing methods of operation and factors that influence waste treatment (e.g., system interfaces and potential bypass routes). For each subsystem, tabulate or show on the flow diagrams the normal process route, maximum and expected flow rates (m^3/day or gallons/day), equipment holdup times, expected radionuclide content of each flow for normal operation, including anticipated operational occurrences, and equipment capacities. Provide information on instrumentation used to monitor the performance of systems and control releases of radioactivity, including sensor and readout locations, operation ranges, alarm and controlling functions, and bases for alarm setpoints. Provide the bases for the values used, including all supporting references.

Provide P&IDs which indicate system interconnections and seismic and quality group interfaces. Describe any instrumentation and controls that govern operation. Indicate all potential bypasses of normal process routes, the conditions governing their use, and the anticipated frequency of bypass due to equipment downtime. Describe both the normal operation of each system and the differences in system operation during anticipated operational occurrences.

In addition, provide P&IDs and process flow diagrams showing the methods of operation, expected chemical content, and radionuclide concentrations of liquid wastes to be processed and handled by the solid waste management system. Also, indicate the expected volumes to be returned to the liquid radwaste system for further treatment.

Operation and Personnel Exposure

Describe design provisions incorporated in the equipment and facility design to reduce occupational radiation exposures, leakages, and spills, and to facilitate operation and maintenance. Describe waste processing equipment expected to exhibit elevated levels of external radiation, the placement of such equipment in shielded cubicles, and the use of temporary or permanent shielding mounted on or in the immediate vicinity of the equipment. Describe methods used to control and minimize the spread of radioactive contamination during sample collection and preparation for analysis. Describe how the ALARA provisions of Regulatory Guides 8.8 and 8.10 will be implemented in system designs and operation to ensure compliance with occupational dose limits of 10 CFR §§ 20.1201 and 20.1202 and occupational limits of 10 CFR Part 20, Appendix B, Table 1 [annual limit on intake (ALI) and derived air concentration (DAC)].

In accordance with the requirements of 10 CFR 20.1406, describe how the above design features and operational procedures will minimize, to the extent practicable, contamination of the facility and the environment, facilitate decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

C.I.11.4.3 Radioactive Releases

Calculate releases by radionuclide for the total system and for each subsystem. Demonstrate compliance with regulations by comparing the calculated releases with the concentration limits of 10 CFR Part 20, Appendix B, Table 2.

Describe the process used to demonstrate compliance with GDC 13, 60, 63, and 64 of 10 CFR Part 50, Appendix A, as they relate to monitoring and controlling radioactive releases during routine operations and accident conditions.

Describe how the process control program (PCP) and operational procedures will ensure compliance with the provisions of Parts 61.55 and 61.56 on waste classification and characteristic, waste transfers and shipping manifest requirements of Appendix G to Part 20, NRC and DOT shipping regulations (Part 71, and 49 CFR Parts 171 - 180), and waste acceptance criteria of authorized waste disposal facilities. Provide a copy of the process control program (PCP).

Compare the doses due to the releases with the numerical design objectives of Appendix I to 10 CFR Part 50 (§50.34a) and the dose limits of 10 CFR 20.1302 and the EPA's environmental radiation standards of 40 CFR Part 190. Indicate how the above regulations will be met during both normal operations and anticipated operational occurrences of the waste management system.

Identify all release points of radioactive material from the solid waste management system to the environment and locations of process and effluent radiation monitoring systems on process flow diagrams, general arrangement drawings, or site plot plan. For release points disposal methods, provide:

(1) Location of processing or release points;
(2) Material types (e.g., solid, liquid, gaseous, components, etc.)
(3) Material characteristics (e.g., chemical, radiological, and physical for plant effluents);
(4) Material properties (e.g., 10 CFR Part 61 classification and characteristics for waste disposal);
(5) Size, shape, and number of material containers and number of expected shipments; and
(6) Final disposition or disposal method (e.g., burial, recycling, etc.).

C.I.11.5 *Process and Effluent Radiological Monitoring and Sampling Systems*

In this section, describe the systems that monitor and sample the process and effluent streams in order to control releases of radioactive materials generated as the result of normal operations, including anticipated operational occurrences, and during postulated accidents.

The process sampling system should be described in Section 9.3.2 of the FSAR and summarized here, including flow diagrams and essential design features.

C.I.11.5.1 Design Bases

Describe the design objectives and design criteria for the process and effluent radiological monitoring instrumentation systems and sampling systems in accordance with the requirements of 10 CFR Parts 20 and 50. Indicate whether, and if so how, the guidance of Regulatory Guides 1.21, 1.33 and 4.15 will be followed. If it will not be followed, describe the specific alternative methods to be used. For the effluent monitoring system, distinguish between the design objectives for normal operations, including anticipated operational occurrences, and the design objectives for monitoring postulated accidents.

Describe both the site-specific and program aspects of the process and effluent monitoring and sampling in accordance with ANSI N13.1-1999 and ANSI N42.18-1980, Regulatory Guides 1.21, 1.97, and 4.15, and Appendix 11.5-A to SRP Section 11. If this guidance will not be followed, describe the specific alternative methods to be used.

C.I.11.5.2 System Description

Provide system descriptions for process and effluent radiological detectors and samplers used to monitor and control releases of radioactive materials generated as the result of normal operations, including anticipated operational occurrences, and during postulated accidents.

Identify the process and effluent streams to be monitored by radiation detection instrumentation or sampled for separate analyses, the purpose of each instrumented monitoring or sampling function provided, and the parameters to be determined through monitoring instrumentation or sampling and analysis (e.g., gross beta-gamma concentrations, radionuclide distribution, quantities of specific radionuclides).

For continuous process and effluent radiation monitors, provide the following information:

(1) Location of monitors and direct readouts;

(2) Location of sampling points and sampling stations, using the criteria of Tables 1 and 2 of SRP Section 11.5;

(3) Type of monitor, sensitivity, and measurement, analysis or determination to be made (e.g., gross beta-gamma concentration, radionuclide analysis);

(4) Description of instrumentation, related instrumentation, and sampling equipment, including redundancy, independence, calibration, and diversity of the components supplied;

(5) Calculation of the range of radioactivity concentrations to be monitored or sampled for normal operations, anticipated operational occurrences, and postulated accidents and bases in accordance with the requirements of GDC 13 and 64 of Appendix A of 10 CFR Part 50 and 10 CFR Parts 50.34(f)(2)(xvii) and 50.34(f)(2)(xxvii);

(6) Types and locations of annunciators, alarms, and automatic controls and actions initiated by each, including provisions for the termination of flow and releases;

(7) Provisions for emergency power supplies;

(8) Setpoints for trips/alarms and controls and bases for values chosen, including a discussion of how setpoints will be established for effluent streams containing multiple radionuclides;

(9) Description of provisions for radiological monitoring instrument calibration, maintenance, inspection, decontamination, and replacement;

(10) Description of provisions for purging sample lines, waste tank recirculation rates, input volumes to waste collection systems, representative sampling, and sampling frequency;

(11) Expected relationships between monitoring instrumentation readouts, sampling analytical results, and plant operations;

(12) Layout drawings, P&IDs, and process flow diagrams; and,

(13) Monitoring systems and procedures for detection of radioactivity in non-radioactive systems to prevent unmonitored and uncontrolled releases of radioactive material to the environment.

For each location subject to routine sampling, indicate whether, and if so how, the guidance of Regulatory Guide 1.21 and Appendix 11.5-A to SRP Section 11.5 will be followed. If it will not be followed, describe the specific alternative methods to be used. Provide the following information for each location:

(1) Basis for selecting the location;

(2) Expected flow, composition, and concentrations;

(3) Quantity to be measured (e.g., gross, beta-gamma, radionuclide concentrations);

(4) Sampling frequency, type of sample nozzle or other sample equipment designed in accordance with ANSI N13.1-1999, and procedures used to obtain representative samples; and,

(5) Analytical procedure and sensitivity for selected radioanalytical methods and types of sampling media.

Provide an offsite dose calculation manual (ODCM) containing description of the methodology and parameters used for calculation of offsite doses resulting from gaseous and liquid effluents and planned discharge flow rates, using the guidance of NUREG-1301 (PWRs) or NUREG-1302 (BWRs) and NUREG-0133. Address the 10 CFR Part 50, Appendix I, guidelines for maximally exposed offsite individual doses and population doses via liquid and gaseous effluents. Indicate how the guidance of Regulatory Guides 1.109 and 1.111 or 1.113 will be followed. If this guidance will not be followed, describe the specific alternative methods to be used.

Provide the plant's standard radiological effluent controls (SREC) describing how liquid and effluent release rates will be derived and parameters used in setting instrumentation alarm set-points to control or terminate effluent releases above 10 CFR Part 20, Appendix B, effluent concentrations (Table 2) in unrestricted areas. Describe how the guidance of NUREG-1301 (PWRS) or NUREG-1302 (BWRs) and NUREG-0133 were used in developing the bases of alarm set-points.

Provide the radiological environmental monitoring program (REMP) describing the scope of the program taking into account local land use census data in identifying all potential radiation exposure pathways, associated radioactive materials present in liquid and gaseous effluent, and direct external radiation from structures, systems, and components. Describe how the guidance of NUREG-1301 (PWRs) or NUREG-1302 (BWRs) and NUREG-0133 were used in developing the REMP.

Describe the process used to demonstrate compliance with GDC 13, 60, 61, 63, and 64 of 10 CFR Part 50, Appendix A, as they relate to monitoring and controlling radioactive releases during routine and accident conditions. Also describe the process used to demonstrate compliance with the requirements of 10 CFR Parts 50.34(f)(2)(xvii) and 50.34(f)(2)(xxvii).

Describe the process used to demonstrate compliance with Appendix I of 10 CFR Part 50, as it relates to ALARA numerical design objectives and requirements of 10 CFR Parts 50.34a and 50.36a.

Describe the process used to demonstrate compliance with 10 CFR 20.1302 dose limits and 10 CFR Part 20, Appendix B, effluent concentrations (Table 2) to members of the public in unrestricted areas, and EPA environmental radiation standards of 40 CFR Part 190.

C.I.11.5.3 Effluent Monitoring and Sampling

Indicate how the requirements of GDC 64 of 10 CFR Part 50, Appendix A, will be implemented with respect to effluent discharge paths for radioactivity that may be released from normal operations, including anticipated operational occurrences, and during postulated accidents.

Describe situations when sampling equipment is expected to exhibit elevated levels of external radiation, the placement of such equipment in shielded cubicles, and the use of temporary or permanent shielding mounted on or in the immediate vicinity of sampling equipment. Describe methods used to control and minimize the spread of radioactive contamination during sample collection and preparation for analysis. Describe how the ALARA provisions of Regulatory Guides 8.8 and 8.10 will be implemented in system designs and operation to ensure compliance with occupational dose limits of 10 CFR Parts 20.1201 and 20.1202 and 10 CFR Part 20, Appendix B, Table 1, occupational limits (ALI and DAC).

C.I.11.5.4 Process Monitoring and Sampling

Indicate how the requirements of GDC 60 of Appendix A to 10 CFR Part 50 will be implemented with respect to the automatic closure of isolation valves in gaseous and liquid effluent discharge paths. Indicate how the requirements of GDC 63 of Appendix A to 10 CFR Part 50 will be implemented with respect to the monitoring of radiation levels in radioactive waste process systems.

C.I.11.6 *References*

Regulatory Guide 1.21, "Measuring and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants."

Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operations)."

Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident."

Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I."

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

Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."

Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluent from Light-Water-Cooled Power Reactors."

Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I."

Regulatory Guide 1.140, "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures and Components in Light-Water-Cooled Nuclear Reactor Power Plants."

Regulatory Guide 4.15, “Quality Assurance for Radiological Monitoring Programs (Normal Operation) - Effluent Streams and the Environment.”

Regulatory Guide 8.8, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable.”

Regulatory Guide 8.10, “Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable.”

10 CFR Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities""

10 CFR Part 61, "Licensed Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 71, “Packaging and Transportation of Radioactive Material.”

10 CFR Part 100, “Reactor Site Criteria.”

General Design Criteria 13, “Instrumentation and Control,” as specified in Appendix A to 10 CFR Part 50, available electronically through the NRC’s public Web site, at www.nrc.gov.

General Design Criteria 60, “Control of Releases of Radioactive Materials to the Environment,” as specified in Appendix A to 10 CFR Part 50, available electronically through the NRC’s public Web site, at www.nrc.gov.

General Design Criteria 61, “Fuel Storage and Handling and Radioactivity Control,” as specified in Appendix A to 10 CFR Part 50, available electronically through the NRC’s public Web site , at www.nrc.gov.

General Design Criteria 63, “Monitoring Fuel and Waste Storage,” as specified in Appendix A to 10 CFR Part 50, available electronically through the NRC’s public Web site, at www.nrc.gov.

General Design Criteria 64, “Monitoring Radioactivity Releases,” as specified in Appendix A to 10 CFR Part 50, available electronically through the NRC’s public Web site, at www.nrc.gov.

Generic Letter 80-009, “Low Level Radioactive Waste Disposal.”

Generic Letter 81-038, “Storage of Low Level Radioactive Waste at Power Reactor Sites.”

Generic Letter 81-039, “NRC Volume Reduction Policy.”

Information Bulletin No. 80-10, “Contamination of Non-Radioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity in the Environment.”

NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWRs)," Revision 1.

NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWRs)," Revision 1.

NUREG-0133, “Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants.”

NUREG-1301, “Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors.”

NUREG-1302, “Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors.”

NUREG/CR-4013, “LADTAP II - Technical Reference and User Guide.”

NUREG/CR-4653, “GASPAR II - Technical Reference and User Guide.”

Branch Technical Position (BTP) ETSB 11-5, “Postulated Radioactive Releases Due to a Waste Gas System Leak or Failure” (attached to SRP Section 11.3).

Branch Technical Position (BTP) ETSB 11-3, "Design Guidance for Solid Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Reactor Plants" (attached to SRP Section 11.4).

Standard Review Plan Section 11.4, Appendix A, “Radiological Safety Guidance for Onsite Contingency Storage Capacity.”

Standard Review Plan Section 11.5, Appendix A, “Design Guidance for Radiological Effluent Monitors.”

ANSI N13.1-1999, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities."

ANSI/ANS 18.1-1999, “Radioactive Source Term for Normal Operation of Light-Water Reactors.”

ANSI N42.18-1980, "Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents." (Formerly designated as ANSI N13.10-1980.)