U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

11.3 GASEOUS WASTE MANAGEMENT SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of effectiveness of radwaste systems and health physics in meeting effluent concentration limits in unrestricted areas and dose limits for members of the public.

Secondary - Organization responsible for the review of radwaste system design features, system capacities, and performance in processing and treating offgas waste streams before being discharged to the environment.

Organization responsible for the review of building ventilation system design features, system capacities, and performance in treating gaseous waste streams before being discharged to the environment.

Organization responsible for the review of hydrogen and oxygen controls in preventing and monitoring concentrations of potential explosive gas mixtures in offgas systems.

I. AREAS OF REVIEW

For reviews of early site permits (ESP), construction permits (CP), standard design certification (DC), and combined licenses (COL) that do not reference a DC, the U.S. Nuclear Regulatory Commission (NRC) staff reviews the information in the applicant's Safety Analysis Report

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(Preliminary Safety Analysis Report (PSAR) or Final Safety Analysis Report (FSAR)) as it relates to the gaseous waste management system (GWMS). For operating licenses (OL) or COLs that reference a DC, the staff confirms that the information accepted at the CP or standard DC stage is appropriately incorporated in the relevant sections of OL or COL applications, and that proposed departures are adequately justified and documented.

This section of the staff's Standard Review Plan (SRP) addresses the evaluation of plant systems used to manage and treat process and effluent streams before being released from pressurized water reactors (PWRs) and boiling water reactors (BWRs). The staff's evaluation assesses whether an applicant demonstrates compliance with regulatory limits on gaseous effluent discharges and associated doses to members of the public in ensuring that releases and doses are as low as reasonably achievable (ALARA).

In PWRs and BWRs, the GWMS is designed to ensure that gaseous wastes produced during normal operation, including anticipated operational occurrences (AOOs), are handled, processed, stored, and released or routed to their final destination in accordance with the relevant NRC regulations. A subsystem, the gaseous radwaste system (GRS), provides for the management of radioactive gases generated by offgas system, which includes waste gas storage tanks, waste gas decay tanks, and charcoal delay beds, depending on the type of plant and design features.

The GWMS processes gases from the condenser air removal system, steam generator blowdown flash tank, containment purge exhausts, and gland seal exhausters. The system also includes hydrogen and oxygen recombiners and instrumentation to control hydrogen and oxygen levels. Finally, the GWMS services building ventilation system exhausts used to process ambient atmospheres from radiologically controlled areas where radioactive systems and components are located, and radioactive gases and vapors vented from components, such as tanks, vessels, and process equipment. The management for gaseous effluents to the environment from the above sources may, in turn, involve the use of mobile equipment connected to permanently installed systems to reduce releases of radioactive materials in effluents.

The GWMS has been categorized as nonsafety-related and nonrisk-significant. Failure of systems must not compromise any safety-related system or component, nor may it prevent the safe shutdown of the plant. However, the failure of specific systems or components may have some impacts on the means to treat, control, and monitor gaseous effluent releases and compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20 regulations in controlling gaseous effluent releases to unrestricted areas and doses to members of the public. The GWMS is relied on to control releases of radioactive materials in gaseous effluents to the environment; therefore it has a direct impact in complying with 10 CFR Part 20 regulations. As such, the review of the GWMS must be sufficient to assure that the staff has reasonable assurance that public health and safety is adequately protected. The applicant's Final Safety Analysis Report (FSAR) must provide sufficient information to confirm that any failure of essential systems will not compromise public health and safety under NRC regulations.

The review of the GWMS includes the design, design objectives, design criteria, methods of treatment, system interfaces, bypass routes to nonradioactive systems, expected releases, components to terminate or divert effluent releases, and methods and principal parameters used in deriving effluent source terms and releases of radioactive materials (as noble gases, radioiodines, tritium, carbon-14, and particulates). The review includes system piping and instrumentation diagrams (P&IDs), process flow diagrams showing methods of operation that influence waste treatment, and any additional equipment necessary to route effluents to the point of discharge, such as plant stacks and building exhaust vents. SRP Section 12.3-12.4,

“Radiation Protection Design Features,” considers the presence of N-16 in assessing doses from external radiation from the turbine buildings of BWR plants.

The specific areas of review include the following topics:

1. Equipment and ventilation system design capacities, expected flow rates or volumes, source terms and radionuclide concentrations, expected decontamination factors or removal efficiencies for radionuclides, and holdup or decay time in tanks and charcoal delay beds.

2. System design capacity relative to the design and expected input flow rates and volumes, and the period of time the system is required to be in service to process normal waste flow rates and volumes.

3. Availability of standby equipment, alternate processing routes, and interconnections between permanently installed systems and skid-mounted processing equipment in order to evaluate the overall ability of the system to meet anticipated demands imposed by major processing equipment downtime and waste volume surges caused by AOOs.

4. Assigned quality group classifications of structures, piping and equipment, and the bases governing the design criteria (safety classifications and applicable codes and standards) for natural phenomena and man-induced hazards using the guidance of Regulatory Guide (RG) 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants,” for gaseous wastes produced during normal operation and AOOs.

5. Design provisions incorporated in the equipment and facility design to facilitate operation and maintenance using the guidance of RG 1.143 for gaseous wastes produced during normal operation and AOOs.

6. Quality assurance (QA) provisions for radioactive waste management systems, structures, and components in support of design criteria using the guidance of RG 1.143 for gaseous wastes produced during normal operation and AOOs.

7. Design features that would reduce the volumes of gaseous waste processed by the GWMS; reduce radioactivity levels and discharges of radioactive materials in gaseous effluents; minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste, using the guidance of RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning,” and NUREG/CR-3587, "Identification and Evaluation of Facility Techniques for Decommissioning of Light Water Reactors.”

8. Design features to reduce leakage of gaseous waste or discharges of radioactive materials in gaseous effluents to avoid uncontrolled and unmonitored releases to the environment (as described in IE Bulletin 80-10, “Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment,” and RG 4.21), special design features, topical reports incorporated by reference, and data obtained from previous experience with similar systems as described in the application and other supporting documents (e.g., SAR as the design basis documentation from other operating plants).

9. Design features used to collect and vent radioactive gases and vapors from tanks, vessels, and processing equipment to the appropriate radioactive exhaust ventilation and filtration systems consistent with the guidance of SRP Sections 9.4, SRP Section 11.3, “Gaseous Waste Management System”; and SRP Section 11.5, “Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems”; and RG 1.52, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants”; RG 1.140, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants”; and RG 1.143.

10. Design features describing automatic control features and justification for the placement of isolation valves and radiation detectors on process piping and effluent discharge lines to ensure the timely closure of such valves upon the detection of elevated radioactivity levels. If part of the design, description of controls in monitoring deviations of in-plant exhaust flow rates and features to terminate releases or isolating process flows when deviations exceed preset limits.

11. Design features to preclude the possibility of internal explosions or detonations if the potential for hydrogen and oxygen explosive mixtures exists in system components.

12. For stations with multiple reactor units, descriptions and design features of equipment and components (either as permanently installed systems or in combination with mobile processing equipment) normally shared between interconnected processing and treatment systems.

13. Types and characteristics of filtration and adsorbent media to treat gaseous process and effluent streams, including expected removal efficiencies, decontamination factors, and holdup or decay times and the applications of these characteristics in estimating releases by specific waste streams and treatment methods. The information describing the types of proposed filtration and adsorption media should include details from the applicant or suppliers, as generic or plant-specific information, in characterizing removal efficiencies, decontamination factors, and holdup or decay times.

14. Definition of the boundary of the GWMS, beginning at the interface from plant systems provided for the collection of process streams and radioactive gaseous waste to the points of controlled discharges to the environment as defined in the Offsite Dose Calculation Manual (ODCM), or at the point of storage in holdup tanks or decay beds using the guidance of RG 1.143 for gaseous wastes produced during normal operation and AOOs.

15. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For DC and COL reviews, the staff reviews the applicant's proposed ITAAC associated with the systems, structures, and components (SSCs) related to this SRP section using SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of the related sections of the application have been reviewed against acceptance criteria contained in this SRP section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate using the guidance of SRP Section 14.3 and RG 1.215, “Guidance for ITAAC Closure under 10 CFR Part 52.”

16. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will address COL action items and requirements and restrictions (e.g., interface requirements and site parameters), and note instances where an

applicant has submitted conceptual design information for portions of the plant for which the application does not seek certification, consistent with requirements of 10 CFR 52.47(a)(24) through 52.47(a)(26), 10 CFR 52.79(d)(2), and 10 CFR 52.80(a).

17. For a COL application referencing a DC. For a COL, the applicant must address COL action items, requirements, and restrictions included in the referenced DC. The review should ensure that plant design features of the certified design are maintained in the COL application and that, if requested, the 10 CFR Part 52 process for seeking exemptions, changes, and departures is observed in changing FSAR Tier 1, Tier 2, and Tier 2* information. Additionally, the review should confirm that the applicant has addressed the requirements and restrictions (e.g., system interfaces and site parameters) included in the referenced DC and how they are being incorporated under plant- and site-specific conditions.

18. ESP Application Reviews. For an ESP application, submitted under 10 CFR Part 52, Subpart A, the review is limited to the information forming the basis of the radioactive effluent source terms, as defined by selected reactor technologies (e.g., based on one design, or a plant parameter envelope approach based on two or more designs) in bounding radioactive gaseous effluents for all defined release points. The application should provide enough information for the staff to conclude that the application provides a bounding assessment in demonstrating the capability to comply with the regulatory requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I design objectives. Accordingly, the review should ensure that physical attributes (relevant to the review conducted under this SRP section) of the site that could affect the design basis of SSCs that are important to safety or risk significant are reflected in the site characteristics, design parameters, and conditions stipulated in the ESP, including COL action items. The staff should consider external exposure to the airborne plume, external exposure to contaminated ground, inhalation of airborne activity, ingestion of agricultural products impacted by plume deposition, and consumption of meat and milk products from livestock grazing on impacted pastures.

Review Interfaces

The staff should use the following SRP section interfaces as the basis for reviewing supplemental or complementary information provided in the FSAR for a specific plant design. The reviewer of this SRP section should verify specific information, as needed to complete the evaluation, and coordinate this review with that of primary reviewers of the sections listed below.

Other SRP sections interface with this section as follows:

1. Review of the independent source terms and dose calculations for the purpose of assessing the performance of the GWMS against the NRC requirements of 10 CFR 20.1301 and 10 CFR 20.1302; Table 2, Column 1, and Note 4 of Appendix B to 10 CFR Part 20; and design objectives and ALARA provisions of Appendix I to 10 CFR Part 50, is conducted under SRP Section 11.1 using the guidance in RG 1.112, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors”; NUREG-0016, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWRs),” or NUREG-0017, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWRs),” and American National Standards Institute/American Nuclear Society (ANSI/ANS) 18.1-1999, as modified to reflect specific design features.

2. Review of design provisions of the GWMS to control, sample, and monitor radioactive materials in gaseous processes and effluent streams is performed under SRP Section 11.5 using consider the guidance of ANSI/HPS N13.1-2011 for the placement of sample probes in stacks and ductwork, and in establishing sampling flow rates for the purpose of obtaining representative samples.

3. The reviews of compliance with certified standard designs and early site permits, COL information items, and conformance with regulatory guidance (RG, Commission Papers (SECY), Regulatory Issue Summary (RIS), bulletins, notices, and generic letters (GL)) are performed using the guidance in SRP Chapter 1, "Introduction and Interfaces," Items 1.8 and 1.9.

4. The review of the definition of the exclusion area boundary (EAB) and administrative controls in managing gaseous effluent releases is performed using the guidance in SRP Sections 2.1.2, "Exclusion Area Authority and Control," and 11.5.

5. The review of proposed short- and long-term atmospheric dispersion (X/Q) and deposition (D/Q) parameters, as they relate to the calculations of offsite gaseous effluent concentrations and doses to members of the public is performed under SRP Section 2.3.

6. The review of the design of the plant stack and building ventilation exhaust vents, as they relate to their site locations, release heights, exhaust flow and velocity rates, and flow temperatures in determining the type of release and atmospheric dispersion (X/Q) and deposition (D/Q) parameters is performed using the guidance in SRP Section 2.3.

7. Review of the dose calculation methods and parameters of the Standard Radiological Effluent Controls (SREC), as they relate to the ODCM is performed using the guidance in SRP Sections 11.5, 13.4, "Operational Programs," and 13.5.

8. Review of the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena, such as the safe-shutdown earthquake, the probable maximum flood, and tornadoes and tornado missiles, is performed using the guidance in SRP Sections 3.3.1, "Wind Loadings," 3.3.2, "Tornado Loadings," 3.4.2, Analysis Procedures," 3.5.3, "Barrier Design Procedures," 3.7.1, "Seismic Design Parameters," through 3.7.4, "Seismic Instrumentation," 3.8.4, "Other Seismic Category I Structures," and 3.8.5, "Foundations," and RG 1.143 with respect to natural phenomena and man-induced hazards used in assigning safety classifications to SSCs for the GWMS.

9. The review of the GWMS fire protection program for storage and use of flammable gases, combustible radioactive wastes (e.g., spent high-efficiency particulate air (HEPA) filters, and activated charcoals), and generation of combustible gas mixtures (H_2 and O_2) is performed using the guidance in SRP Sections 9.5.1.1, "Fire Protection Program," and 11.4, "Solid Waste Management System," using the guidance in RG 1.189 and 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," as they relate to the conduct of fire hazards analysis involving the presence of combustible gases and flammable materials.

10. Review of the acceptability of the seismic and quality group classifications for structures and system components is performed using the guidance in SRP Sections 3.2.1, "Seismic Classification," and 3.2.2, "System Quality Group Classification."

11. The review of radiation monitoring instrumentation and controls used by the GWMS, including provisions for automatic control features and interdependence with parameters other than radioactivity (e.g., valve and damper positions, and system differential pressure, flow rate, and temperature), is performed using the guidance SRP Sections 11.5 and 9.3.2, "Process and Post-accident Sampling Systems." The review addresses the types and placement of such sensors in plant systems, basis of operational ranges and qualification of sensing elements in supporting the functions of radiation monitoring systems. The review considers functional interdependence and logic in alarming, terminating and/or diverting process or effluent streams to comply with doses and effluent concentration limits under 10 CFR Part 20 and design objectives of Appendix I to 10 CFR Part 50. The review also addresses design features to prevent radioactive contamination of otherwise nonradioactive plant systems in avoiding unmonitored and uncontrolled releases of radioactive materials to the environment using the guidance of RG 1.143 and 4.21 and IE Bulletin 80-10.

12. The review of the demineralized water makeup system, if used as a supply for the water seal system, is performed in SRP Section 9.2.3, "Demineralized Water Makeup System," as it relates to the supply of seal water to systems and instrumentation containing radioactivity and design features to prevent the contamination of nonradioactive systems and avoid unmonitored and uncontrolled releases to the environment.

13. The review of interconnections of the GWMS with process gases collected from equipment vents and ambient atmospheres is performed in SRP Sections 5.2.5, "Reactor Coolant Pressure Boundary Leakage Detection"; 5.4.8, "Reactor Water Cleanup System (BWR)"; 5.4.13, "Isolation Condenser System (BWR)"; 6.5, 9.1.2, "New and Spent Fuel Storage"; 9.1.3, "Spent Fuel Pool Cooling and Cleanup System"; 9.2.4, "Potable and Sanitary Water Systems"; 9.2.6, "Condensate Storage Facilities"; 9.3.3, 9.3.4, "Chemical and Volume Control System (PWR) (Including Boron Recovery System)"; 9.4, and 10.4.

14. The review of interconnections of the GWMS with primary and secondary coolant systems as they relate to features provided to limit or reduce the buildup of radioactivity in tanks, steam generators, and other components is performed in SRP Sections 5.2, 5.4, 12.3-12.4, and SRP Section 11.5 and Branch Technical Position (BTP) 5-1 as they relate to the sensitivity of installed radioactivity detectors in complying with the guidelines of Nuclear Energy Institute (NEI) 97-06 and applicable Electric Power Research Institute (EPRI) guidance described in SRP Section 12.3-12.4.

15. The review of interconnections between the GWMS discharge flow to the plant stack and the flow from other building exhaust ventilation systems and basis in deriving atmospheric dispersion and deposition parameters to unrestricted areas is performed in SRP Sections 2.3.5, 9.4, and 11.5 using site-specific conditions.

16. Review of applicable technical specifications (TS) for the GWMS is performed using the guidance in SRP Sections 11.5 and 16.0. Under SRP Section 16, the TS address the elements of administrative programs on radioactive effluent controls and monitoring. The associated guidance is discussed in standard technical specifications, including NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433, and NUREG-1434.

17. Review of the QA program is performed using the guidance in SRP Chapter 17 for any portion of the GWMS that may be covered by 10 CFR Part 50, Appendix B requirements, depending on design features. The guidance of RG 1.143 applies to the balance of the GWMS since it is not a safety-related system.

18. For any portion of the GWMS post-accident systems that supports safety-related functions, as identified by the applicant, the review of these design features is performed using the guidance in SRP Chapter 7 and SRP Section 13.3, “Emergency Planning.” In this context, the review, using the guidance in RG 1.97, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants,” addresses the performance, design, qualification, display, quality assurance, and selection of monitoring variables for radiation monitoring equipment required for accident monitoring and sampling.

19. With respect to the operation of the GWMS and associated releases of gaseous effluents to unrestricted areas regulated under 10 CFR Part 20, the review of instrumentation and components, with respect to capability, reliability, and conformance to the acceptable criteria is performed using the guidance in SRP Sections 7.1, “Instrumentation and Controls – Introduction,” 7.5, “Information Systems Important to Safety,” 7.6, “Interlock Systems Important to Safety,” and 7.7, ” Control Systems,” and related branch technical positions in SRP Chapter 7, as mandated by design and operational considerations.

20. Review of design features of building exhaust and ventilation systems servicing radiologically controlled areas where GWMS equipment and radioactive materials are located and used to vent tanks and process equipment (e.g., use of HEPA and charcoal filters) is conducted using the guidance in SRP Section 9.4 and, for instrumentation used to monitor and control radioactive effluent releases, SRP Section 11.5. SRP Section 11.5 provides guidance on the review of instrumentation used to monitor and control (terminate and/or divert) gaseous radioactive effluent releases and process streams associated with ventilation systems.

21. The review of design features for the protection of potable and sanitary water systems from water vapor condensate generated by the GWMS is conducted using the guidance in SRP Sections 9.2.4 and 11.5, as they relate to system interfaces in avoiding potential bypass routes to nonradioactive systems.

22. The review of design features of the GWMS attributed for compliance with 10 CFR 20.1406, using RG 4.21, is performed using the guidance in SRP Section 12.3-12.4.

23. The review of design features of the GWMS credited for radiation protection of plant workers and compliance with 10 CFR Part 20, using RG 8.8, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable,” and 8.10, “Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable,” is performed using the guidance in SRP Chapter 12.

24. The review of design features of GWMS systems and components associated with the plant’s initial testing plan, description of tests, and testing acceptance criteria is performed under SRP Sections 14.2, “Preparation of Environmental Reports for Nuclear Power Stations,” and 11.5, using the guidance in RG 1.68, “Initial Test Programs for Water-Cooled Nuclear Power Plants,” with information drawn from SRP Sections 5.2, 5.4, 6.2, 6.5, 9.1 through 9.4, and 10.4.

25. The completeness of the description of the GWMS design and its operational features are reviewed using the guidance in SRP Section 14.3.7, to ensure that there is sufficient information for introduction in FSAR Tier 1, in confirming that ITAAC are inspectable and compliance can be demonstrated with no ambiguity.

26. The review conducted using the guidance in BTP 11-5 addresses potential releases of radioactive materials (noble gases, and radioiodines as warranted) following the postulated leakage or failure of a waste gas storage tank or charcoal delay tank and doses at the EAB using short-term atmospheric dispersion (X/Q) parameters, as addressed in SRP Section 2.3.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following regulations of the NRC:

1. 10 CFR 20.1101(b), as it relates to the use of procedures and engineering controls in maintaining doses to members of the public ALARA.

2. 10 CFR 20.1301, 10 CFR 20.1302, and Table 2, Column 1 and Note 4 of Appendix B to 10 CFR Part 20, as they relate to radioactivity in gaseous effluents released to unrestricted areas.

3. 10 CFR 20.1406, as it relates to the design and operational procedures (for applications other than renewals, after August 20, 1997) for minimizing contamination, facilitating eventual decommissioning, and minimizing the generation of radioactive waste.

4. 10 CFR 50.34, as it relates to the kinds and quantities of radioactive materials expected to be produced during operations and the means to control and limit radioactive effluent releases and radiation exposures within the limits of 10 CFR 20.1301 and 10 CFR 20.1302 for members of the public.

5. 10 CFR 50.34(f), as it relates to additional Three Mile Island (TMI)-related requirements and TMI Action Plan Items and Generic Safety Issues (GSIs) identified in NUREG-0933, “Resolution of Generic Safety Issues (Formerly entitled “A Prioritization of Generic Safety Issues”).”

6. 10 CFR 50.34a, as it relates to the availability of sufficient design information to demonstrate that design objectives for equipment necessary to control releases of radioactive effluents to the environment have been met.

7. 10 CFR 50.36a(b), as it relates to experience with the design, construction, and operations of nuclear power reactors in complying with 10 CFR 20.1301 and in maintaining doses to members of the public ALARA.

8. 10 CFR 50.59, as implemented using the guidance in RG 1.187, “Guidance for Implementation of 10 CFR 50.59 Changes, Tests, and Experiments,” as it relates to design changes and differences in treatment performance characteristics of GWMS components in demonstrating compliance with effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2.

9. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, as it relates to the design bases of structures housing GWMS and its components using the guidance of RG 1.143 in assigning seismic, safety, and quality group classifications for natural phenomena and man-induced hazards as defined in RG 1.143 and in assigning the safety classifications to GWMS SSCs for design purposes.

10. 10 CFR Part 50, Appendix A, GDC 3 as it relates to the design of gaseous waste treatment systems and operational safeguards to minimize the generation of explosive gas mixtures and effects of explosive mixtures of hydrogen and oxygen on systems and components, using RG 1.189 and 1.205 as they relate to the conduct of fire hazards analysis involving the presence of combustible gases and flammable materials.

11. 10 CFR Part 50, Appendix A, GDC 60, as it relates to the ability of the GWMS to control releases of radioactive materials to the environment.

12. 10 CFR Part 50, Appendix A, GDC 61, as it relates to the ability of the GWMS design to ensure adequate safety under normal and postulated accident conditions, as provided in SRP Section 11.3 using guidance in BTP 11-5 and the analysis of RG 1.143 in assigning the safety classification to SSCs of the GWMS for design purposes.

13. 10 CFR Part 50, Appendix B, as it applies to GWMS systems and components not covered by the QA guidance of RG 1.143.

14. 10 CFR Part 50, Appendix I, Sections II.B, II.C, and II.D, as they relate to the numerical guidelines for design objectives and limiting conditions for operation to meet the ALARA criterion.

15. 40 CFR Part 190 (Environmental Protection Agency (EPA)) generally applicable environmental radiation standards) for nuclear power operations, as implemented under 10 CFR 20.1301(e), as it relates to limits on total annual doses from all sources of radioactivity contained in gaseous effluents and external radiation from site buildings and facilities (with single or multiple reactor units). SRP Sections 11.2, “Liquid Waste Management System,” and 11.4 evaluate source terms and doses from liquid effluents and solid wastes. SRP Section 11.5 addresses the means to demonstrate compliance with all sources of effluents. SRP Section 12.3-12.4 evaluates doses associated with external radiation from buildings and sources of radioactivity contained in systems and components, including skyshine from BWR turbine buildings.

16. 10 CFR Part 52.17(a)(1)(ii), which requires that an ESP application include the anticipated levels of radioactive effluents released in plant environs and provide a bounding assessment in demonstrating the capability to comply with the regulatory requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I design objectives.

17. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act (AEA), and the NRC regulations. For the GWMS, ITAAC should be assigned to systems and components that are used to comply with 10 CFR Part 20 requirements on airborne effluent releases. Such systems and components may include radiation monitoring equipment and dampers that would terminate or divert a release upon detecting elevated levels of radioactivity or departures in discharge flow rates from which alarm set points are derived for radiation monitoring instrumentation.

18. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient

to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the AEA, and the NRC regulations respectively.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC regulations identified above are set forth below. The SRP is not a substitute for the NRC regulations, and compliance with it is not required. However, an applicant is required to identify differences between this SRP section and design features, analytical techniques, and procedural measures proposed for the facility, and discuss how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of complying with regulations that underlie SRP acceptance criteria and meeting NRC regulatory requirements under 10 CFR 50.34(h), 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), and 10 CFR 52.79(a)(41), for CP, OL, ESP, DC AND COL applications as appropriate.

1. The GWMS should have the capability to meet the design objectives of Part 50, Appendix I and should include provisions to treat gaseous radioactive wastes such that the following is true:

   A. The calculated annual total quantity of all radioactive materials released from each reactor to the atmosphere will not result in an estimated annual external dose from gaseous effluents to any individual in unrestricted areas in excess of 0.05 mSv (5 mrem) to the total body or 0.15 mSv (15 mrem) to the skin under 10 CFR Part 50, Appendix I, Sections II.B and II.C. RG 1.109, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I,” RG 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors,” and 1.112 provide acceptable methods for performing this analysis using the GASPAR II computer code (NUREG/CR-4653).

   B. The calculated annual total quantity of radioactive materials released from each reactor to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of 0.01 cGy (10 millirads) for gamma radiation or 0.02 cGy (20 millirads) for beta radiation under 10 CFR Part 50, Appendix I, Section II.B. RG 1.109, 1.111, and 1.112 provide acceptable methods for performing this analysis using the GASPAR II computer code (NUREG/CR-4653).

   C. The calculated annual total quantity of radioiodines, carbon-14, tritium, and all radioactive materials in particulate form released from each reactor at the site in effluents to the atmosphere will not result in an estimated annual dose or dose commitment from such releases for any individual in an unrestricted area from all pathways of exposure in excess of 0.15 mSv (15 mrem) to any organ under 10 CFR Part 50, Appendix I, Section II.C. RG 1.109, 1.111, and 1.112 provide acceptable methods for performing this analysis using the GASPAR II computer code (NUREG/CR-4653).

   D. The concentrations of radioactive materials in gaseous effluents released to an unrestricted area will not exceed the limits specified in Table 2, Column 1, and Note 4 of Appendix B to 10 CFR Part 20.

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

2. The GWMS should be designed with adequate capacity to process gaseous wastes during periods when major processing equipment may be down for maintenance (single failures) and during periods of excessive waste generation. Systems that have adequate capacity to process the anticipated wastes and that are capable of operating within the design objectives during normal operation, including AOOs, are acceptable. To meet these processing demands, the reviewer will consider shared systems, redundant equipment, mobile equipment, and reserve storage and treatment capacity.

3. The seismic design and the quality group and safety classifications of components used in the GWMS and structures housing the system should conform to RG 1.143. The design should include precautions to stop continuous leakage paths (i.e., to provide liquid seals downstream of rupture discs) and to prevent permanent loss of the liquid seals in the event of an explosion due to gaseous wastes produced during normal operation and AOOs. RG 1.143 provides guidance in assigning safety classifications to structures and radioactive waste management systems in protecting SSCs against natural phenomena and man-induced hazards. In addressing the regulatory positions of RG 1.143 on safety classifications of radwaste SSCs against unmitigated releases of radioactive materials or unmitigated radiation exposures to site personnel, the acceptance criteria are 1 mSv (100 mrem) for members of the public assumed to be located at or beyond the restricted area or in unrestricted areas (whichever is most limiting), and 5 rem (50 mSv) for a plant worker assumed to be located in the restricted area. In classifying system components, the radioactive inventories of components are compared to the criteria in determining the appropriate classification. RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Part I, C.I.3, Sections 3.2.1 and 3.2.2, and SRP Section 3.8.4, identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the recommendations of RG 1.143.

4. The GWMS should be designed to meet the requirements of 10 CFR 20.1406. System designs should describe features that will minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste using the guidance of Interim Staff Guidance (ISG) DC/COL-ISG-06, “Final Interim Staff Guidance Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications,“ RG 1.33, “Quality Assurance Program Requirements (Operation),” 1.143 and 4.21, and NEI 08-08A (ADAMS Accession No ML093220530) for gaseous wastes produced during normal operation and AOOs.

5. System designs should use the guidance in RG 1.52, 1.140 and 1.143 for the design, testing, and maintenance of HEPA filters and charcoal absorbers installed in normal ventilation exhaust systems. If decontamination factors for radioiodines that differ from those specified in RG 1.140 are used for design purposes, they should be supported by test data or industry standards under operating or simulated operating conditions, such as temperature, pressure, humidity, expected iodine concentrations, flow rate, type of charcoal (grade, mesh size and bulk density), and numbers and volume of delay tanks,

dynamic adsorption coefficients for charcoal media, and estimated retention times. The test data should also consider the effects of aging and poisoning by airborne contaminants.

6. For processing systems equipped with automatic control features, the application should provide the justification for the placement of isolation dampers/valves and radiation detectors on process piping and effluent discharge lines to ensure the timely closure of such valves upon the detection of elevated radioactivity levels, and, if part of the design, controls in monitoring deviations of in-plant exhaust flow rates and terminating releases or isolating process flows when deviations exceed preset limits. Other considerations may include determining whether system logic demands that a valve or damper should fail in the closed position in protecting the system from further contamination, terminating releases to the environment, or diverting process streams or effluents to appropriate treatment systems. Acceptable guidance is discussed in SRP Section 11.5 and ANS N42.18-2004.

7. For the GRS portion of the GWMS, the staff should evaluate the system assuming potential releases of radioactive materials (noble gases and radioiodines, as necessary) as a result of postulated leakage or failure of a waste gas storage tank or charcoal delay tank, and assess radiation exposures at the EAB. The radiological consequence assumes short-term atmospheric dispersion (X/Q) parameters in the limiting EAB sector, as addressed in SRP Section 2.3. Acceptable guidance and dose criteria are discussed in this SRP section, with reference to BTP 11-5 in conducting the consequence analysis and assessing dose results.

8. The review of design provisions of the GWMS to sample radioactive materials in gaseous processes and effluent streams should consider the guidance of ANSI/HPS N13.1-2011 for the placement of sample probes in stacks and ductwork, and in establishing sampling flow rates for the purpose of obtaining representative samples. The sampling system should minimize sample losses and distortion of the sample's chemical and physical properties.

9. If the potential for explosive mixtures of hydrogen and oxygen exists, the GRS portion of the GWMS should either be designed to withstand the effects of a hydrogen explosion or be provided with dual gas analyzers with automatic control functions to preclude the formation or buildup of explosive gas mixtures. The GRS is normally the only portion of the system that is vulnerable to potential hydrogen explosion.

   A. For a system designed to withstand the effects of a hydrogen explosion, the design pressure of the system should be approximately 20 times the operating absolute pressure (including the intermediate stage condenser for BWR offgas systems).

   B. Small allowances should be made to conform to standard design pressures for off-the-shelf components (e.g., if the system operating pressure is nominally 103 kPa (15 psia) but could approach 138 kPa (20 psia) by design, piping could be designed to 2413 kPa (350 psia), since the next higher standard pressure rating is 4137 kPa (600 psia)).

   C. The process gas stream should be analyzed for potentially explosive gas mixtures and annunciated both locally and in the control room.

D. For systems not designed to withstand a hydrogen explosion, dual gas analyzers with automatic control functions should preclude the formation or buildup of explosive hydrogen/oxygen mixtures. In this context, "dual gas analyzers" is defined as two independent gas analyzers continuously operating and providing two independent measurements verifying that hydrogen and/or oxygen are not present in potentially explosive concentrations. Gas analyzers should annunciate alarms both locally and in the control room. Analyzer "high alarm" setpoints should be set at approximately 2 percent and "high-high alarm" setpoints should be set at a maximum of 4 percent hydrogen or oxygen.

Control features to reduce the potential for explosion should be automatically initiated at the "high-high alarm" setting. The automatic control features should be as follows:

i. For systems designed to preclude explosions by maintaining either hydrogen or oxygen below 4 percent, the source of hydrogen or oxygen (as appropriate) should be automatically isolated from the system (valves should fail in closed position).

ii. For systems using recombiners, if the downstream hydrogen and/or oxygen concentration exceeds 4 percent (as appropriate), acceptable control features include automatic switching to an alternate recombiner train.

iii. Injection of diluents to reduce concentrations below the limits specified herein.

Systems designed to operate below 4 percent hydrogen and below 4 percent oxygen may be analyzed for either hydrogen or oxygen; systems designed to operate below 4 percent hydrogen only (no oxygen restrictions) should be analyzed for hydrogen; and systems designed to operate above 4 percent hydrogen should be analyzed for oxygen.

For BWR systems with steam dilution upstream of the recombiners, analysis for hydrogen (oxygen analysis is not an acceptable alternative) should be downstream of the recombiners and upstream of the delay portions of the system. Analysis upstream of the recombiners is not expected if the system is designed to assure the availability of dilution steam during operation.

For PWR systems using recombiners, analysis for hydrogen and/or oxygen should be downstream of the recombiners. In addition, unless the system design features preclude explosive gas mixtures of hydrogen and oxygen upstream of the recombiners, analysis for hydrogen and/or oxygen (as appropriate) should be upstream of the recombiners as well.

The number of gas analyzers and control features at each location should follow the guidance of this SRP section. One gas analyzer upstream and one gas analyzer downstream of the recombiners should not be construed as dual gas analyzers. For systems involving pressurized storage tanks (excluding surge tanks), at least one gas analyzer should be provided between the compressor and the storage tanks. Dual gas analyzers set to sequentially measure concentrations both upstream and downstream of a recombiner are acceptable. When two or more potentially explosive process streams are combined before entering a component, each stream or the combination thereof, should have dual gas analyzers.

If gas analyzers are to be used to sequentially measure several points in a system not designed to withstand a hydrogen explosion, at least one gas analyzer, which is continuously on stream, should be provided in protecting the system. The continuous gas analyzer should be located at a point common to streams and measured sequentially (i.e., the analyzer should be sampling the combined stream).

Gas analyzers should have daily sensor checks, monthly functional checks, and quarterly calibrations.

Gas analyzers installed in systems designed to withstand a hydrogen explosion should be capable of withstanding a hydrogen explosion; gas analyzers installed in the systems not designed to withstand a hydrogen explosion need not be capable of withstanding a hydrogen explosion (similar requirements apply to radiation monitors which are internal to lines containing potentially explosive mixtures).

All gas analyzer instrumentation systems should be nonsparking.

10. For an ESP application, the dose estimates to a hypothetical maximally exposed member of the public from gaseous effluents using radiological exposure models are developed based on RGs 1.109, 1.111, and 1.112, and appropriate computer codes, such as the GASPAR II computer code (NUREG/CR-4653) for gaseous effluents.

11. The relevant RG, ISG and BTP are as follows:

    A. RG 1.109, as it relates to the use of acceptable methods for calculating annual doses to the maximally exposed individual in demonstrating compliance with 10 CFR Part 50, Appendix I design objectives and ALARA provisions.

    B. RG 1.110, as it relates to performing a cost-benefit analysis for reducing cumulative dose to the population by using available technology.

    C. RG 1.111, as it relates to the use of acceptable methods for estimating atmospheric dispersion and deposition parameters of gaseous effluents in demonstrating compliance with 10 CFR Part 50, Appendix I dose objectives and effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 1 and Note 4 for radionuclide mixtures.

    D. RG 1.112, as it relates to the use of acceptable methods for calculating annual average releases of radioactive materials in gaseous effluents.

    E. RG 1.143, as it relates to quality assurance provisions for radioactive waste management systems, structures and components including GWMS systems and components not covered by the QA requirements of Appendix B to 10 CFR Part 50.

    F. RG 1.143, as it relates to the seismic design, safety, and quality group classifications of components used in the GWMS and structures housing the systems and the provisions used to control leakages of liquids (collected as water vapor condensate) produced during normal operation and AOOs, and natural phenomena and man-induced hazards listed in RG 1.143 in assigning the safety classifications to SSCs of the GWMS for design purposes.

G. RG 1.143, as it relates to the definition of the boundary of the GWMS, beginning at the interface from plant systems provided for the collection of process streams and radioactive gaseous waste to the points of controlled discharges to the environment as defined in the ODCM, or at the point of storage in holdup tanks or decay beds in accordance with the guidance of RG 1.143 for gaseous wastes produced during normal operation and AOOs.

H. DC/COL-ISG-05, NUREG-0016 and NUREG-0017, as they relate to the use of the gaseous and liquid effluent (GALE) 86 Code in calculating routine radioactive releases in gaseous and liquid effluents from BWR and PWR plants.

I. DC/COL-ISG-06, NEI 08-08A, and RG 4.21, as they relate to acceptable levels of detail and content required to demonstrate compliance with 10 CFR 20.1406.

J. NUREG-1430, as it relates to Standard Technical Specifications - Babcock and Wilcox Plants.

K. NUREG-1431, as it relates to Standard Technical Specifications - Westinghouse Plants.

L. NUREG-1432, as it relates to Standard Technical Specifications - Combustion Engineering Plants.

M. NUREG-1433, as it relates to Standard Technical Specifications - General Electric Plants (BWR/4).

N. NUREG-1434, as it relates to Standard Technical Specifications - General Electric Plants (BWR/6).

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. 10 CFR 20.1302 requires that surveys of radiation levels in unrestricted areas and radioactive materials in effluents released to unrestricted areas be performed to demonstrate system compliance with the dose limits to individual members of the public contained in 10 CFR 20.1301.

   10 CFR 20.1302 identifies two approaches, either of which can demonstrate compliance with the dose limits of 10 CFR 20.1301 and 10 CFR 20.1301(e). Each one of these approaches requires a demonstration of the following:

   A. That the annual average concentrations of radioactive materials released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table 2, Column 1, and Note 4 of Appendix B, to 10 CFR Part 20.

   B. That the annual and hourly doses from external sources to an individual continuously present in an unrestricted area will not exceed 0.5 mSv (0.05 rem) and 0.02 mSv (0.002 rem), respectively.

Meeting the above requirements provides reasonable assurance that the dose limits to individual members of the public specified in 10 CFR 20.1301 will not be exceeded. The review detailed in this SRP section will evaluate the ability of the system to meet the dose requirements identified above. SRP Section 11.2 identifies compliance with the limits on gaseous effluent concentrations in unrestricted areas as an acceptance criterion; consequently, the ability of a facility to meet this criterion will be evaluated and using the guidance in SRP Section 11.3.

In calculating offsite gaseous effluent concentrations and doses to members of the public, the acceptability of the proposed short- and long-term atmospheric dispersion and deposition parameters is reviewed using the guidance in SRP Sections 2.3.4 and 2.3.5.

2. 10 CFR 20.1406 requires that applicants describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste. DC/COL-ISG-06, NEI 08-08A, and RG 4.21 provide guidance for use in implementation of the requirements of 10 CFR 20.1406. Specific guidance to meet 10 CFR 20.1406 is identified in RG 4.21, Regulatory Positions C.1 through C.4. DC/COL-ISG-06 is incorporated in SRP Section 12.3-12.4.

3. SRP Section 11.3, Acceptance Criterion II.5 gives the technical rationale for 10 CFR 50.34a requirements. Meeting the requirements of 10 CFR 50.34a, as they relate to the GWMS, provides assurance that each nuclear power reactor will meet the criterion that controlled releases of radioactive materials in effluents to unrestricted areas in its vicinity will be kept ALARA and that the GWMS will have the necessary design features and equipment to control releases of gaseous effluent to the environment in accordance with the requirements of 10 CFR 20.1301 and 10 CFR 20.1302, Appendix I to 10 CFR Part 50, and GDC 60 and 61. See separate discussion, below, on the requirements of 10 CFR Part 20.1301(e).

4. Radioactive materials should be processed, handled, and stored using equipment, methods, and procedures that avoid or minimize potential releases of radioactivity in the event of a fire. GDC 3 relates to fire protection features for SSCs important to safety and can be used to provide guidance for GWMS design features and operational safeguards to prevent, for example, fires of contaminated charcoal adsorption media and HEPA filters used in ventilation systems, and to control and minimize the generation of explosive H2 and O2 gas mixtures in portions of the offgas system. When spent-activated carbon is stored in bulk quantities, storage methods and procedures should consider the potential for spontaneous heating and auto-ignition of activated carbon, which may be due to radioactive decay heat and adsorption of various vapors and gases, including oxygen.

   With regard to the GRS portion of the GWMS, if a potential for explosive hydrogen and oxygen mixtures exists, then designing the GRS to withstand the effects of such an explosion or providing the GRS with dual instrumentation and design features to annunciate and prevent the buildup of potentially explosive mixtures, satisfies the requirements of GDC 3.

   Using GDC 3 as guidance for SSCs important to safety provides assurance that the GRS is protected from the effects of an explosive mixture of hydrogen and oxygen, and that the safety functions of other SSCs will not be compromised in meeting effluent discharge concentrations of 10 CFR Part 20 associated with releases of contaminated

fire protection water and combustion gases and smoke. Specific NRC guidance is provided in RG 1.189 and 1.205, IE Information Notices 83-14, 84-72, 88-08, and 90-50, and in NUREG/CR-4601.

5. Compliance with GDC 60 requires that each nuclear power plant design shall include means to control releases of radioactive materials in gaseous effluents to the environment during normal reactor operation, including AOOs.

   GDC 60 requires that the waste management systems provide for a holdup capacity sufficient to retain radioactive waste, particularly where unfavorable site environmental conditions may impose unusual operational limitations upon the release of effluents. The holdup capacityshould provide sufficient decay time for shorter-lived radionuclides before they are processed further or released to the environment. The holdup times are used in the source term calculations based on the methods described in RG 1.112 and NUREG-0016 (BWRs) or NUREG-0017 (PWRs) and ANSI/ANS 18.1-1999, as modified to reflect specific design features.

   The review should evaluate the types and characteristics of filtration systems and adsorbent media proposed to treat gaseous process and effluent streams, including type of charcoal media (grade, mesh size, and bulk density), number and volume of charcoal delay tanks, dynamic adsorption coefficients for charcoal media, and retention times, removal efficiencies and decontamination factors, taking into account the expected physical, chemical, and radiological properties of gaseous process and effluent streams, and processing flow rates. The review should determine whether performance meets or exceeds that noted in RG 1.52 and 1.140, and the method discussed in NUREG-0016 or NUREG-0017 (as modified). The above information may be drawn from standard DCs, industry standards, and/or topical reports and industry data for new or alternate gaseous waste treatment methods.

   Meeting the requirements of GDC 60 provides assurance that releases of radioactive materials in gaseous effluents to unrestricted areas during normal operation of the plant and AOOs will not result in offsite radiation doses exceeding the design objectives specified in Appendix I to 10 CFR Part 50 and concentrations of radioactive materials in gaseous effluents in any unrestricted area exceeding the limits specified in Table 2, Column 1, and Note 4 of Appendix B to 10 CFR Part 20.

   The control of radioactive gases and vapors, generated as byproducts of the operation of the liquid waste management system (LWMS) and solid waste management system (SWMS) is addressed here through the design considerations of exhaust ventilation and treatment systems using the guidance in the guidance of SRP Sections 9.4, 11.2, 11.4, and 11.5, RG 1.52, 1.140 and 1.143, and industry standards. The guidance addresses the design, testing, and maintenance of HEPA filters and charcoal absorbers installed in exhaust ventilation systems servicing radioactive systems and radiologically controlled plant areas where LWMS and GMWS components are located. The guidance also address radiation monitoring systems and provisions to sample and analyze process flows and gaseous effluent releases.

6. Compliance with GDC 61 requires that the GWMS and other systems (either as permanently installed systems or in combination with mobile equipment) that contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions, including adverse vacuum conditions. This criterion specifies that such facilities shall be designed with a capability to permit inspection and testing of components important to safety and with suitable shielding for radiation protection.

Meeting the requirements of GDC 61 provides assurance that releases of radioactive materials during normal operation and during AOOs will not result in radioactive material concentrations and radiation doses that exceed the limits specified in 10 CFR 20.1302. This criterion specifies that such facilities shall be designed with a capability to permit inspection and testing of components important to safety and with suitable shielding for radiation protection, using the guidance of RG 1.52, 1.140, and 1.143 relating to the design, testing, and maintenance criteria for air filtration and adsorption units. The use of this guidance should ensure that the GWMS will continue to perform its safety functions under postulated accident conditions and meet the requirements of GDC 2 and Part 20.

RG 1.143 describes design guidance acceptable to the staff related to seismic, safety, and quality group classifications and quality assurance provisions for SSCs systems of the GWMS for gaseous wastes and effluents produced during normal operation and AOOs. RG 1.143 provides guidance in assigning safety classifications to structures and radioactive waste management systems in protecting SSCs against natural phenomena and man-induced hazards. For unmitigated releases of radioactive materials, the acceptance criterion of RG 1.143 is 1 mSv (100 mrem) for members of the public assumed to be located at or beyond the restricted area or in unrestricted areas (whichever is most limiting). For unmitigated radiation exposures to site personnel, the acceptance criterion is 5 rem (50 mSv) for a plant worker assumed to be located in the restricted area. In classifying system components, the radioactivity inventories of components are compared to the acceptance criteria in determining the appropriate safety classification. In addition, RG 1.206, Part I, C.I.3, Sections 3.2.1 and 3.2.2, and SRP Section 3.8.4 identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the recommendations of RG 1.143.

Meeting the guidance of RG 1.143 provides reasonable assurance that the assigned safety classifications for structures housing the GWMS and its components comply with the requirements of GDC 2 and 61 and the guidance of RG 1.143 for natural phenomena and man-induced hazards. Meeting the guidance of SRP Section 11.3 and BTP 11-5 (as referenced herein), and using the analysis of RG 1.143 in assigning the safety classifications to SSCs of the GWMS for design purposes, provide reasonable assurance that the necessary information is available to identify the amounts of radioactive materials contained in the GWMS and assess the radiological impacts during postulated accidents.

7. Appendix I to 10 CFR Part 50 provides numerical guidance for design objectives to meet the requirements that radiation doses from radioactive materials in effluents released to unrestricted areas be kept ALARA. Sections II.B, II.C, and II.D of Appendix I relate to the numerical guides for dose design objectives, limiting conditions for operation, and controls to meet the ALARA criterion for gaseous effluents.

   RG 1.109 and 1.111 provide acceptable methods in performing dose analyses that comply with the Appendix I design objectives to demonstrate that the GWMS design results in doses from releases of radioactive materials from each reactor.

   RG 1.110 provides an acceptable method of performing cost-benefit analysis to demonstrate that the GWMS design includes all items of reasonably demonstrated technology capable of reducing cumulative population doses from releases of radioactive materials in effluents from each reactor to ALARA levels within an 80 km (50 mile) radius of the reactor and to demonstrate compliance with the cost-benefit ratio of Section II.D of Appendix I.

RG 1.140 presents methods acceptable to the staff for implementing the regulations in Appendix I to 10 CFR Part 50 by providing guidance on the design, testing, and maintenance criteria for HEPA filters and charcoal absorbers in filtration systems.

Using the guidance of RG 1.109, 1.111 and 1.140 provides reasonable assurance that the requirements of Sections II.B, II.C, and II.D, of Appendix I to 10 CFR Part 50 are met with respect to exposures to radioactive materials and doses to the maximally exposed offsite individual. The criteria include dose limits from noble gases (as gamma and beta radiation air dose rates), radiation doses from carbon-14, tritium, particulates, and radioiodines, and the criterion in evaluating the results of a cost-benefit analysis in complying with ALARA provisions.

8. BTP 11-5 describes acceptable methods to evaluate doses at the EAB associated with the postulated releases of radioactive gases and radioiodines (as warranted) resulting from the failure of a gas storage tank or charcoal decay tank or a leak from a GWMS component.

   The BTP presents guidance for selecting the type of failure and model assumptions that provide reasonable assurance that the radiological consequences of a single failure of an active component will not result in doses exceeding a small fraction (10 percent) of the 10 CFR Part 100 dose limits for the whole body to any offsite individuals for the postulated event of systems designed to withstand explosions and earthquakes, or 1 mSv (0.1 rem) for systems not designed to withstand explosions and earthquakes. The analysis assumes that the waste gas system fails to meet its design bases, as required by 10 CFR 50.34a and GDC 60 and 61. The analysis relies on methods described in BTP 11-5 and the use of the BWR-GALE Code (NUREG-0016) or PWR-GALE Code (NUREG-0017) and RG 1.112, with model parameters modified to reflect design features. If the results of a plant- and site-specific analysis do not meet BTP 11- acceptance criteria, the applicant should propose TS limiting the total amount of radioactivity in such components, as described in SRP Chapter 16, Section 5.5, Programs and Manuals, as adopted from standard technical specifications (NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433, and NUREG-1434).

9. 10 CFR 20.1301(e) requires that certain NRC-licensed facilities comply with the EPA generally applicable environmental radiation standards of 40 CFR Part 190 for facilities that are part of the fuel cycle. The EPA annual dose limits are 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ.

   Meeting the requirements of 10 CFR 20.1301(e) requires the consideration of all potential sources of external radiation and radioactivity, including liquid and gaseous effluents and external radiation exposures from buildings, storage tanks, radioactive waste storage areas, and N-16 skyshine from BWR turbine buildings. The EPA standards apply to the entire site or facility, whether it has single or multiple reactor units. SRP Sections 11.2 and 11.4, address the sources of radioactivity and doses associated with liquid effluents and solid wastes, respectively. SRP Section 12.3-12.4 addresses the sources of radiation and external radiation exposures from buildings, storage tanks, radioactive waste storage areas, and N-16 skyshine from BWR turbine buildings.

   For OL and COL applicants with site-specific information on the locations of offsite dose receptors, compliance with the EPA standards should include consideration of whether doses due to gaseous and liquid effluent releases and external radiation are additive or

need to be addressed separately given actual exposure pathways. The location of offsite dose receptors and the determination of actual exposure pathways should be based on the results of a current land use census for the site. If there is no site-specific information, the applicant may assume that all exposures occur at one location or in one sector in bounding dose estimates, where doses from liquid and gaseous effluent releases and external radiation are summed up and compared to the EPA standards. In such instances, the applicant should provide a commitment, as part of the ODCM, to reassess compliance with the EPA standards by appropriately assigning doses with actual exposure pathways once site-specific information becomes available on their locations within the vicinity of the site.

III. REVIEW PROCEDURES

These review procedures are based on the identified SRP acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements and guidance identified in Subsection II. The review should confirm that the applicant has submitted sufficient information for the staff to conduct an independent evaluation of any proposed alternative method and demonstration of compliance with NRC regulations and SRP acceptance criteria and supporting regulatory guidance.

While the GWMS has been categorized as nonsafety-related and nonrisk-significant, the failure of specific systems or components may have impacts on the means to control and monitor gaseous effluent releases and in complying with NRC regulations under 10 CFR Part 20 and 10 CFR Part 50, Appendix I. As such, the review of the GWMS must be sufficiently detailed systems to assess whether a failure of any GWMS systems may have an impact on demonstrating compliance with the requirements of 10 CFR Part 20, Appendix B, Table 2, Effluent Concentration Limits (ECLs) and dose limits to members of the public and design objectives and ALARA provisions of 10 CFR Part 50, Appendix I. The applicant's FSAR will be reviewed to confirm that sufficient information has been provided demonstrating that the failure of essential systems will not result in plant or operating conditions in noncompliance with NRC regulations on exposure to workers and members of the public and that the FSAR and failure analysis are consistent with SRP acceptance criteria.

The NRC will review the description of the design features of the GWMS provided in the FSAR, including SRP Sections 9.1, 9.2, 9.3, 9.4, 10.4, 11.1, 11.2, 11.3, 11.4, 11.5, and 12.3-12.4, for completeness in accordance with RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," or 1.206. While the SRP references RG 1.70 and 1.206, not all sections of RG 1.70 have a corresponding review plan section. The SRP sections applicable to a COL application for a new light-water reactor (LWR), submitted under 10 CFR Part 52, are based on RG 1.206.

1. Programmatic requirements. Commission regulations and policy mandate "programs" applicable to SSCs that include:

   A. Technical specifications, Section 5 Administrative Controls, as they relate to administrative programs on radioactive effluent controls and monitoring via the ODCM, SREC, and radiological environmental monitoring program (REMP). The associated TS are discussed in NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433, and NUREG-1434. The review of the SREC, ODCM, and REMP may be conducted as part of the review of SRP Section 11.4 or 11.5, depending on where the applicant has located the procedural details and programmatic

controls, consistent with the provisions of GL 89-01 and NUREG-1301 or NUREG-1302.

B. Startup initial testing plan, as described in SRP Section 14.2, using RG 1.68 and 1.33.

C. Implementation of these programs will be inspected in accordance with NRC Inspection Manual Chapter (IMC)-2504, "Construction Inspection Program – Non- ITAAC Inspections."

D. If applicable, the staff reviews the proposed augmentation of programmatic elements in assessing the adequacy of the GWMS design and resulting effects on the development of the radioactive gaseous effluent source terms. The staff's evaluation and conclusion of the acceptability of the augmented programmatic elements is addressed in Safety Evaluation Report (SER) Section 13.4, "Operational Programs," and relevant requirements and guidance identified in this SER section for the systems and components identified in the supplemental or new programmatic elements.

2. For new reactor license applications submitted under 10 CFR 52.47(a)(8) and 52.79(a)(17) and (20), the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority GSIs that are identified in the version of NUREG-0933 current on the date 6 months before the submission of the application and that are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and (3) provide information necessary to demonstrate compliance with the technically relevant portions of the TMI requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v), as referenced in 10 CFR 52.47(a)(21), 10 CFR 52.47(a)(22), and 10 CFR 52.47(a)(8), respectively. With respect to NUREG-0933, TMI Action Plan Items, Task III.D (Radiation Protection) and Task III.D.2 (Public Radiation Protection Improvement), the applicant should describe design features of the GWMS that are used to control and reduce potential exposures to offsite populations following an accident. With respect to GSIs, the applicant should present an evaluation of the issues listed in NUREG-0933 and, depending upon their applicability to the design, present information that demonstrates the implementation of acceptance criteria. These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions should be documented in the corresponding sections of the SER.

3. The review of the GWMS will evaluate P&IDs and system process flow diagrams to identify all sources and amounts of gaseous waste; points of collection of gaseous wastes; flow paths of gases through systems, including all potential bypasses to nonradioactive systems; treatment methods and expected decontamination factors or removal efficiencies and holdup or decay times; and points of release of gaseous effluents to the environment. With respect to potential bypasses, the review considers improper connection to nonradioactive systems and the possibility of uncontrolled and unmonitored gaseous releases and liquid releases from collection of GWMS water vapor condensates.

   This information is used to calculate the quantity of radioactive materials released annually in gaseous effluents during normal operations, including AOOs, using parameters and calculation techniques discussed in NUREG-0016 or NUREG-0017 and

RG 1.112, as modified to reflect design-specific features. In such instances, the evaluation should confirm that the applicant has submitted sufficient information for the staff to conduct an independent evaluation of proposed modifications or alternative methods for estimating yearly releases of radioactive materials in gaseous effluents and for demonstrating compliance with NRC regulations using the SRP acceptance criteria and supporting regulatory guides. The results of this calculation will determine whether the proposed GWMS design meets SRP acceptance criteria 1 through 6 in Subsection II of this SRP section and relevant elements of SRP Section 11.1, on the basis of the source terms.

Conformance with Subsection II, Acceptance Criteria 1.A, 1.B, 1.C, and 1.D of this SRP section concerning exposures of the total body, skin, and thyroid will be determined using dose and source term calculations performed by the staff using methods described in NUREG-0016 or NUREG-0017, RG 1.112 and 1.111, and NUREG/CR-4653 (GASPAR II code). In calculating offsite gaseous effluent concentrations and doses to members of the public, the acceptability of the proposed short and long-term atmospheric dispersion and deposition parameters is determined as part of the review of the information discussed in SRP Section 2.3.5.

The staff will determine conformance with Subsection II, Acceptance Criterion 1.E of this SRP section, concerning cost-benefit analysis using population cumulative dose calculations (person-Sv (person-rem)) and cost benefit analyses. In its review, the staff has considered the potential effectiveness of augmenting the proposed GWMS using items of reasonably demonstrated technology and should confirm that further effluent treatment will not effect reductions in cumulative population doses reasonably expected within an 80 km (50 mile) radius of the reactor, nor is it necessary to augment the design of the system for compliance with the cost-benefit ratio of Section II.D of Appendix I. RG 1.110 describes methods for performing such cost-benefit analyses.

With respect to the types and locations of exhaust ventilation discharge points (e.g., plant stacks and building vents), the review should confirm that the information in FSAR Section 9.4 properly characterizes release heights, exhaust flow and velocity rates, and exit temperatures in determining compliance with ECLs of Part 20, Appendix B and doses to members of the public.

4. The review of the GWMS design capacity will encompass the following major areas:

   A. The capability of the GRS to process gaseous wastes in the event of a single major equipment item failure. For nonredundant equipment or components, a 3-week downtime every other year will be assumed (10 days per year average).

   B. The total system capability to process gaseous wastes at design-basis source term levels is evaluated based on information discussed in SRP Section 11.1, and in this SRP section. The source term is based on a combination of assumptions of failed fuel fractions, BWR offgas release rates, TS limits for halogens and noble gases, presence of activation and corrosion products, and steam generator TS limits on allowable primary-to-secondary leakage rates. The design basis of the reactor coolant and reactor steam source terms is based on:

      1) an offgas system noble gas release rate of 3.7 megabecquerels per second per megawatt thermal (MBq/s per MWt) (100 microcuries (μCi)/s per MWt) measured or estimated after a 30-minute delay for BWRs;

2) an assumed 1 percent fuel cladding defects for PWRs; and

3) technical specification limits for halogens (I-131 dose equivalent) and noble gases (Xe-133 dose equivalent), as defined in plant-specific TS.

C. The operational flexibility designed into the GRS (e.g., cross-connections between systems, redundant or reserve processing equipment, and reserve storage capacity, including the use of mobile processing and treatment systems).

D. In the evaluation of charcoal delay systems for radioactive gas decay, the number of beds or tanks, bed or tank volumes and dimensions, mass of charcoal in each bed or tank, charcoal mesh size and bulk density, processing flow rates, temperatures, pressures, humidity, and dynamic adsorption coefficients are used to calculate the effective holdup times meeting or exceeding the performance criteria of RG 1.112 and guidance of NUREG-0016 or NUREG-0017, as modified to reflect specific design features and DC/COL-ISG-05 in the use of GALE86. The above information may be drawn from standard DCs or topical reports, taking into account the expected processing flow rates and volumes, and the physical, chemical, and radiological properties of gaseous process and effluent streams.

E. Types and characteristics of filtration and adsorbent media to treat gaseous process and effluent streams, with removal efficiencies and decontamination factors meeting or exceeding the performance of NRC generic guidance NUREG-0016 or NUREG-0017 (as modified) and RG 1.112 and 1.140, standard DCs, or topical reports, taking into account the expected physical, chemical, and radiological properties of gaseous process and effluent streams.

F. For processing systems equipped with automatic control features, the design should provide the justification for the placement of isolation valves and radiation detectors on process piping and effluent exhaust vents and stacks to ensure the timely closure of such dampers/valves upon the detection of elevated radioactivity levels, and, if part of the design, controls in monitoring deviations of in-plant exhaust flow rates and terminating releases or isolating process flows when deviations exceed preset limits. Other considerations may include determining whether system logic demands that a valve or damper should fail in the closed position in protecting the system from further contamination, terminating releases to the environment, or diverting process streams or effluents to appropriate treatment systems. Acceptable guidance is discussed in SRP Section 11.5 and ANS N42.18-2004.

The average input flow rates and volumes are compared with the design flows to determine the fraction of time individual systems must be online to process normal waste inputs. The review considers the operational flexibility designed into the system (i.e., cross-connections between systems, redundant or reserve processing equipment, reserve storage capacity, and reliance on mobile processing systems). Based on the usage factors and operational flexibilities, an evaluation of the overall system capability to process and control wastes as related to items A through F above, is performed by comparing design flows with the potential process routes and equipment capacities. System capabilities to treat and hold for decay will be evaluated using the guidance and methods described in NUREG-0016 or NUREG-0017 and RG 1.112, as modified to reflect design features. If an alternate method includes the use of mobile processing

systems connected to permanently installed GWMS systems, the staff will conduct a parallel review and evaluation using the above guidance and acceptance criteria.

5. The quality group and safety classifications of piping and equipment in the GRS portion of the GWMS are compared to the guidance of RG 1.143 and 4.21 for gaseous wastes produced during normal operation and AOOs. The seismic design criteria of equipment and structures housing the GRS are also compared to the design guidance identified in RG 1.143. When applicable, SRP Sections 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5 will be used to evaluate exceptions.

   The applicant's design is reviewed to ensure that it includes adequate provisions to stop continuous leakage paths after an explosion of combustible gas mixtures. The areas of concern are (1) process streams where water decomposition gases (hydrogen and oxygen) exist in a BWR, (2) cover gas streams where air in-leakage can occur in a PWR, and (3) areas where there is a possibility of liquid hydrocarbons and ozone collecting in a cryogenic distillation system.

6. The GRS design, system layout, equipment design, method of operation, and provisions to reduce leakage and to facilitate operations and maintenance are compared to RG 1.143 and 4.21 for gaseous wastes produced during normal operation and AOOs, including adverse vacuum conditions. Special design features provided to control leakage from system components and/or topical reports on system designs will be evaluated on a case-by-case basis.

   The applicant's design is compared to RG 1.143, as acceptable guidance related to seismic, safety, and quality group classifications and quality assurance provisions for SSCs systems of the GWMS in treating gaseous wastes and effluents produced during normal operation and AOOs. RG 1.143 provides guidance in assigning safety classifications to structures and radioactive waste management systems in protecting SSCs against natural phenomena and man-induced hazards. For unmitigated releases of radioactive materials, the acceptance criterion of RG 1.143 is 1 mSv (100 mrem) for members of the public assumed to be located at or beyond the restricted area or in unrestricted areas (whichever is most limiting). For unmitigated radiation exposures to site personnel, the acceptance criterion is 5 rem (50 mSv) for a plant worker assumed to be located in the restricted area. In classifying system components, the radioactivity inventories of components are compared to the acceptance criteria in determining the appropriate safety classification. In addition, RG 1.206, Part I, C.I.3, Sections 3.2.1 and 3.2.2, and SRP Section 3.8.4, identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the recommendations of RG 1.143.

7. The review will compare the design, testing, and maintenance criteria for HEPA filters and charcoal absorbers in filtration systems against the provisions of RG 1.140.

8. If a potential for explosive hydrogen and oxygen mixtures exists, it will be determined, using the system description and P&IDs, whether the applicant has designed the GRS to withstand the effects of such an explosion or has provided dual instrumentation and design features to annunciate and prevent the buildup of potentially explosive mixtures.

   The applicant's design is reviewed to ensure that it includes adequate provisions to stop continuous leakage paths after an explosion. The areas of concern are: (a) process streams where water decomposition gases (hydrogen and oxygen) exist, (b) cover gas

streams where air in-leakage can occur, and (c) areas where there is a possibility of liquid hydrocarbons and ozone collecting in a cryogenic distillation system.

9. The SREC, ODCM, and TS Administrative Controls, Section 5.5, , proposed by the applicant for process and effluent controls will be evaluated as part of the review identified in SRP Section 11.5, and SRP Chapter 16, as adopted from standard technical specifications (NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433, and NUREG-1434). The reviewer will determine whether the content of the SREC and ODCM, calculation methods, and scope of the programs identified in the Administrative Controls section of the TS are in agreement with the requirements identified as a result of the staff's review. The review will include the evaluation or development of appropriate controls and the limiting conditions for operation and their bases as being consistent with the plant design. The ODCM, SREC, and TS are reviewed with respect to the requirements of 10 CFR 50.36a using GL 89-01 and guidance contained in NUREG-1301 (BWR) or NUREG-1302 (BWR) and NUREG-0133 for either type of plant. Alternatively, a COL applicant may incorporate by reference NEI 07-09A as the basis of the ODCM until a plant and site-specific ODCM is developed before fuel load as described in SRP Section 13.4.

10. BTP 11-5 describes acceptable methods to evaluate the consequences associated with the postulated release of radioactive noble gases and radioiodines following the failure of a waste gas system component. The associated exposure pathways include direct radiation exposures and inhalation for a receptor assumed to be located at the EAB. Supporting information on the staff's evaluation of the site's atmospheric dispersion characteristics in transporting radioactivity into unrestricted areas is discussed in SRP Section 2.3.4. The use of proposed short-term EAB atmospheric dispersion parameters in support of dose calculation is based on the acceptability of the information evaluated as part of the review of SRP Section 2.3.4.

    The reviewer will evaluate the type of event leading to the assumed component failure and release; the assumed radioactive source term; the process by which the radioactivity is assumed to be released in the environment from the plant; the use of system design features and credit assumed in mitigating the amounts of radioactivity released; the duration of the release; the selection of proper atmospheric dispersion parameters; the basis for the selection of the EAB sector as the location of the dose receptor; and dose results and comparison of doses against BTP 11-5 acceptance criteria.

    The reviewer will determine whether the analytical approach, assumptions, and model parameters used in assessing the radiological impacts are adequately conservative, consistent with the guidance of BTP 11-5, and confirm whether the acceptance criteria of BTP 11-5 are met for a dose receptor assumed to be located at the EAB. Alternatively, for plant system features and site characteristics incapable of meeting the acceptance criteria of BTP 11-5, the reviewer will evaluate proposed special design features applied in mitigating the effects of a postulated failure and determine whether such design features are adequate and acceptable consistent with the objectives of BTP 11-5. If the results of a plant- and site-specific analysis do not demonstrate meeting BTP 11-5 acceptance criteria, the applicant should propose TS limiting the total amount of radioactivity contained in GWMS components. The staff will evaluate the proposed TS limiting the radioactivity content of GWMS components to ensure that the TS are consistent with the results of the consequence analysis. The staff will confirm that DC/COL FSAR Chapter 16, Section 5.5, "Programs and Manuals," identifies the requirements for this technical specification.

11. The proposed GWMS is reviewed to ensure that the design includes provisions to meet the requirements of 10 CFR 20.1406. The review will confirm that:

A. Adequate design features exist, supplemented with operating programs, processes and procedures (as necessary), which will provide reasonable assurance that leaks and inadvertent discharges of radioactive effluents will be prevented or minimized to the extent practicable.

B. There is reasonable assurance that a leak or inadvertent discharge will be detected in a timely manner in the event one does occur. For those SSCs that are typically inaccessible for routine inspection or observation, leak detection capability should allow for the identification and measurement of relatively small leak rates, to the extent practical and depending on the concentration of radioactive materials and leak rates.

C. Design features are supplemented, as necessary, by operating programs, processes and procedures to monitor leaks and evaluate their impact to the environment.

D. Design features that facilitate decommissioning, including their role in the decommissioning process. These should include both design features (such as modular components and adequate space for equipment removal) and operating procedures to minimize the amount of residual radioactivity that will require remediation at the time of decommissioning.

E. The site has been designed and will be operated to minimize the generation and volume of radioactive waste; both during operation and decommissioning (e.g., charcoal adsorbent media will be regenerated and reused when feasible).

F. Description of design features and applications of surface protective coatings on concrete floor surfaces in areas where process equipment is located and exposed surfaces in sumps and drain channels collecting water vapor condensates in following the guidance of RG 1.54 and 4.21 in facilitating the decontamination of radioactivity.

In addressing the above, NRC guidance includes the following:

A. IE Bulletin No. 80-10; GL 99-02; IE Circulars 79-21 and 80-18; and IE Information Notices 82-43, 82-49, 91-40, and 99-01.

B. DC/COL-ISG-06, as incorporated in SRP Section 12.3-12.4.

C. RGs 1.11, 1.143, and 4.21 for system process streams, gaseous wastes, and gaseous effluents produced during normal operation and AOOs; and NUREG/CR-3587 as it relates to techniques used in decommissioning light-water reactors.

D. SRP Sections 5.2.5, 5.4.8, 5.4.13, 6.5, 9.1.2, 9.1.3, 9.2.4, 9.2.6, 9.3.2, 9.3.3, 9.3.4, and 10.4.

E. NRC endorsed industry guidance and standards: NEI 08-08A, ANSI/ANS-40.37-2009, and ANSI/ANS-18.1-1999.

12. In determining compliance with EPA generally applicable environmental standards of 40 CFR Part 190, as required under 10 CFR 20.1301(e), the review considers all sources of radiation and radioactivity as potential contributors to doses to members of the public from the site, which may have either single or multiple reactor units. The review focuses on sources of radioactivity, as gaseous and liquid effluents, and external radiation exposures from buildings, storage tanks, and radioactive waste storage buildings. This section of the SRP provides guidance for the staff 's evaluation of the source terms and associated doses from gaseous effluents, while SRP Sections 11.2 and 11.4 provide guidance in evaluating source terms and doses from liquid effluents and solid wastes. SRP Section 11.5 addresses the means of demonstrating compliance with all sources of effluents. SRP Section 12.3-12.4 provide guidance in evaluating doses associated with external radiation from buildings and sources of radioactivity contained in systems and components and N-16 skyshine from BWR turbine buildings.

    For OL and COL applicants with site-specific information on the locations of offsite dose receptors, compliance with the EPA standards requires consideration of whether doses due to gaseous and liquid effluent releases and external radiation are additive or need to be addressed separately given actual exposure pathways. The location of offsite dose receptors and the determination of actual exposure pathways should be based on the results of a current land use census for the site. The reviewer should determine whether the applicant has applied site-specific information in assigning doses for all identified exposure pathways, or instead has assumed that all exposures occur at one location in bounding dose estimates, where doses from gaseous and liquid effluent releases and external radiation are summed up and compared to the EPA standards. In such instances, the applicant should provide a commitment to reassess compliance with the EPA standards, as implemented under 10 CFR 20.1301(e), by appropriately assigning doses with actual exposure pathways once site-specific information becomes available on their locations within the vicinity of the site.

13. For the review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the FSAR meets NRC regulations, guidance, and acceptance criteria. The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure that these COL action items are addressed in a COL application, they should be added to FSAR Sections 1.8 and 1.9.

    For the review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an ESP, other NRC approvals (e.g., manufacturing license, site suitability report or topical report), or proposes other reactor technology. The staff will confirm that the applicant has properly incorporated the relevant information from the DC or that of another design into the COL application, addressed all COL action items associated with specific design aspects of SSCs (e.g., balance of plant topics not covered in the design) left to the COL applicant, and considerations driven by site-specific features.

    For reviews of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of the review conducted using the guidance of this SRP section and related others, as warranted by design features.

For reviews of a COL application referencing on a DC, 10 CFR 52.63 precludes the staff from imposing new requirements on DCs unless it is deemed necessary to bring the certification in compliance with NRC regulations, provide adequate protection of public health and safety, or preserve common defense and security. A DC has finality for issues resolved at the DC stage, and the staff can only make changes to this information if it meets one of the standards in 10 CFR 52.63. If a COL applicant seeks to make changes to information within the scope of a design certification (as Tier 1, 2, or Tier 2* information), then it must also follow the appropriate change process in Section VIII of the design certification. Accordingly, the reviewer should ensure that plant design features of the certified design are maintained in the COL application and that, if requested, the 10 CFR Part 52 process for seeking exemptions, changes, and departures is observed in changing Tier 1, Tier 2, and Tier 2* information. These provisions apply only to those portions of the DC that are incorporated by reference in the COL and do not apply to site-specific design features that are within the scope of the COL.

In instances where an applicant has submitted conceptual design information for portions of the plant for which the application does not seek certification, the review should confirm that the applicant has submitted sufficient details for the staff to conduct its evaluation of the associated SSCs, assess the adequacy of interface requirements with other SSCs that are included in the DC, ensure that the application continues to include an essentially complete design, and confirm the adequacy of proposed ITAAC and methods used in verifying that all interface requirements have been met by a COL applicant under the requirements of 10 CFR 52.47(a)(24) through 52.47(a)(26), 10 CFR 52.79(d)(2), and 10 CFR 52.80(a).

14. Subpart A to 10 CFR Part 52 specifies the requirements applicable to the Commission's review of an ESP application. Information required in an ESP application includes a description of the site characteristics and design parameters of the proposed site. For an ESP application, the staff reviews the estimates of the source terms for gaseous radioactive effluents and radionuclide concentration levels at the site boundary, identified points of discharge or release into the environment, and at all appropriate offsite dose receptor locations and potential exposure pathways. The estimates of the effluent source terms (Ci/yr) and effluent concentrations (μCi/ml) are evaluated to determine whether they are consistent with the range of possible requested thermal power levels. For gaseous effluents, the staff confirms that atmospheric dispersion characteristics and deposition parameters used in calculating offsite doses are consistent with the information presented in Section 2.3.5 of the applicant's technical submittal.

The staff should confirm the approach used by the applicant in developing the annual average gaseous effluent source terms from all release points (e.g., plant stack, building vents, etc.). For a source term based on a single type of reactor design, the staff will confirm that the applied source term is consistent with that presented in the current revision of the DC for the selected reactor technology. For a source term based on two or more types of reactor designs, the staff will confirm that the source term, as a plant parameter envelope, is consistent with that presented in the current revision of each design certification, or other reactor technology, and conservatively bounding over all expected radionuclides.

In the absence of certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on issues that were resolved as part of the ESP at the COL stage. The applicant should provide enough information for the staff to conclude that the ESP application provides a bounding assessment in demonstrating the

capability to comply with the regulatory requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I design objectives. Accordingly, the reviewer should ensure that physical attributes (relevant to the review conducted under this SRP section) of the site that could affect the design basis of SSCs that are important to safety or risk significant are reflected in the site characteristics, design parameters, and conditions stipulated in the ESP, including COL action items.

The staff should confirm that exposure pathways are based on site-specific or regional land-use information and include all appropriate dose receptors and populations near the proposed new unit(s) for all expected activities. Exposure pathways should include external exposures to airborne plumes, external exposure to contaminated ground, inhalation of airborne activity, and ingestion of agricultural products, and consumption of meat and milk products from grazing livestock. The staff's conclusion of acceptability is based on site-specific data and assumptions presented by the applicant as to the types of exposure pathways and locations of dose receptors. However, should future local land-use information reveal that new and different exposure pathways and dose receptors exist from that described in the ESP, ESP applicants should identify this possibility and flag it as a COL action item in a COL application. The COL action item should flag the necessity to consider new exposure pathways, when different than those described in the ESP, and conduct a new dose assessment and confirm that associated doses are in compliance with NRC regulations and applicable guidance.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the staff's safety review and analysis, conducted in accordance with the staff's review approach described in the SRP Introduction, support conclusions of the following types to be included in the staff's SER. The reviewer also states the bases for those conclusions. When programmatic elements are used to assess design adequacy and effects on the development of new or modifications of existing operational programs, the reviewer confirms that the applicant has properly identified those elements of the program in DC and COL FSAR Section 13.4 (Table 13.4-x), as supplemental elements to an existing program or as the addition of a new program.

The staff concludes that the design of the GWMS (as a permanently installed system or in combination with mobile systems) includes the equipment necessary to process and control releases of radioactive materials in gaseous effluents in accordance with GDC 2, 3, 60, and 61 of Appendix A to 10 CFR Part 50 and 10 CFR 50.34a. The staff concludes that the design of the GWMS is acceptable and meets the requirements of 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 20.1406, 10 CFR 50.34(f), 10 CFR 50.34a, and 10 CFR 50.36a;; GDC 2, 3, 60, and 61; and the design objectives and ALARA provisions of Appendix I to 10 CFR Part 50.

The reviewer states the bases for those conclusions, as listed below:

1. The applicant has met the requirements of GDC 60 and 61 with respect to controlling releases of radioactive materials to the environment by assuring that the design of the GWMS includes the equipment and instruments necessary to detect and control releases of radioactive materials in gaseous effluents from the plant stack and building exhaust vents.

2. The applicant has met the requirements of Appendix I to 10 CFR Part 50 by meeting the ALARA criterion as follows:

A. Regarding Sections II.B and II.C of Appendix I, the staff has considered releases of radioactive material in gaseous effluents for normal operation, including AOOs, based on expected amounts and concentrations of gaseous wastes over the life of the plant for each reactor on the site. The staff has determined that the proposed GWMS is capable of maintaining releases of radioactive materials in gaseous effluents such that the calculated individual doses in an unrestricted area from all pathways of exposure are less than 0.05 mSv (5 mrem) to the total body or 0.15 mSv (15 mrem) to the skin and less than 0.15 mSv (15 mrem) to any organ from releases of radioiodines, tritium, carbon-14, and radioactive materials in particulate form.

B. The staff has determined that the calculated air doses from gaseous effluents at any location near ground level that could be occupied by individuals in unrestricted areas will be less than 0.01 cGy (10 millirads) for gamma radiation and 0.02 cGy (20 millirads) for beta radiation.

C. Regarding the ALARA provisions of Section II.D of Appendix I, the staff has considered the potential effectiveness of augmenting the proposed GWMS using reasonably demonstrated technology, and determined that further gaseous effluent treatment will not effect reductions in cumulative population doses within an 80-km (50-mile) radius of the reactor, and the proposed GWMS complies with the cost-benefit ratio of Section II.D of Appendix I.

3. The applicant has met the requirements of 10 CFR 20.1301 and 10 CFR 20.1302, as the staff has considered the potential consequences resulting from reactor operation with design basis fuel defect, TS limits for dose equivalent halogens and noble gases, and core inventories of fission products inventory PWRs. For BWRs, the offgas noble gas release rate should be determined assuming 30-minute decay within the offgas system. The design basis fuel defect level for PWRs and noble gases release rate for BWRs were reviewed using the guidance in SRP Sections 11.1 and 11.3, as radioactive source terms to the primary and secondary coolant and reactor steam. The staff has determined that under these conditions, the concentrations of radioactive materials in gaseous effluents released in unrestricted areas will comply with the concentration limits specified in Table 2, Column 1, and Note 4 of Appendix B to 10 CFR Part 20. In making the above determination for radioiodines and noble gases, the staff has considered TS limits for I-131 and Xe-133 dose equivalent concentrations in the primary and secondary coolants, as defined in the plant TS.

4. The staff has reviewed the sources of radiation and radioactivity and associated doses to members of the public and concludes that annual doses from all sources of radioactivity and radiation from the site (which may have either single or multiple reactor units), including liquid and gaseous effluents and external radiation exposures from buildings and storage tanks, and N-16 skyshine from BWR turbine buildings as sources of external radiation, will not exceed the EPA generally applicable environmental radiation standards of 40 CFR Part 190 as implemented under 10 CFR Part 20.1301(e). SER Section 12.3-12.4 evaluates the doses associated with external radiation from buildings and sources of radioactivity contained in systems and components, including N-16 skyshine from BWR turbine buildings.

5. The applicant has met the requirements of GDC 60 and 61 with respect to controlling releases of radioactive materials to the environment through the use of automatic control features in terminating gaseous effluent discharges or diverting process flows to systems for storage and decay or further processing, as needed. In controlling releases to the environment, the staff has found the design of automatic control features acceptable in

terminating gaseous effluent discharges or diverting process flows to systems for filtration. Supplemental information on instrumentation monitoring and controls is presented and evaluated using the guidance in SER Section 11.5.

6. The staff has reviewed the design features and operational programs and procedures to 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, with supplemental information presented in FSAR Section 12.3-12.4. The staff concludes that the proposed design features and operational programs and procedures are consistent with NRC guidance and the requirements of 10 CFR 20.1406.

7. The staff has reviewed the applicant's quality assurance provisions for the GRS portion of the GWMS, the quality group and safety classifications used for the GRS components, and the seismic design applied to the design of the GRS and the structures housing the GRS. The design of the GRS and structures housing it meet the criteria set forth in RG 1.143 for gaseous wastes produced during normal operation and AOOs. Meeting the guidance of RG 1.143 provides reasonable assurance that the assigned safety classifications for structures housing the GWMS and its components comply with the requirements of GDC 2 and 61 and the guidance of RG 1.143 for natural phenomena and man-induced hazards. Meeting the guidance of SRP Sections 11.3 and BTP 11-5 (as referenced in SRP Section 11.3), and using the analysis of RG 1.143 in assigning the safety classifications to SSCs of the GWMS, provide reasonable assurance that the design meets the requirements of GDC 2 and 61.

8. The staff has reviewed the provisions incorporated in the applicant's design to control the release of radioactive materials in gaseous wastes from inadvertent releases, avoid the contamination of nonradioactive systems, prevent uncontrolled and unmonitored releases of radioactive materials in the environment, and avoid interconnections with nonradioactive systems, and concludes that the measures proposed by the applicant are consistent with the requirements of GDC 60 and 61, and as describe in the guidance of DC/COL-ISG-06, and RG 1.143 and RG 4.21 for gaseous wastes produced during normal operation and AOOs.

9. The staff has reviewed the provisions incorporated in the applicant's design to control releases of radioactive materials following the explosion of combustible gas mixtures in the GRS, and concludes that the measures proposed by the applicant are adequate to prevent the occurrence of an explosion or to withstand the effects of an explosion, in accordance with GDC 3 using the guidance of RG 1.189 and 1.205 and the method described in BTP 11-5.

10. Based on the staff's review of the GWMS fire protection program on the management of flammable and combustible radioactive wastes (e.g., spent HEPA filters and bulk quantities of spent activated charcoals) discussed in this section of the SRP and in SER Sections 9.5 and 11.4, the staff finds the scope of the fire protection program and operational safeguards adequate as they relate to system design features and commitment to conduct fire hazards analyses involving the presence of combustible or flammable materials. The inclusion of facility and system design features and elements of the fire protection program in managing radioactive materials provides reasonable assurance that the facility design and proposed operations comply with 10 CFR Part 20 using the guidance of RG 1.189 and 1.205 in protecting workers and members of the public.

11. There are no specific operational programs required for the operation of the GWMS. All gaseous effluent releases associated with the operation of the GWMS are controlled by the ODCM. The applicant has committed, given FSAR Sections 11.5, 13.4, and 13.5, to develop a plant- and site-specific ODCM before fuel load based on NEI ODCM Template 07-09A, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description." The staff has endorsed NEI ODCM Template 07-09A. The staff's evaluation of the ODCM and acceptability of NEI ODCM Template 07-09A are discussed in SRP Section 11.5.

12. If applicable, the staff has reviewed the proposed augmentation of programmatic elements in assessing the adequacy of the GWMS design and resulting effects on the development of the radioactive gaseous effluent source terms. The staff's evaluation and conclusion of the acceptability of the augmented programmatic elements is addressed in SER Section 13.4, and the relevant requirements and guidance are identified in the appropriate SER sections for the systems and components identified in the supplemental or new programmatic elements. The staff concludes that the proposed augmentation of programmatic elements is acceptable and consistent with the ALARA principle described in 10 CFR 20.1101(b) and 10 CFR Part 50, Appendix I design objectives. (Note: Staff to provide a summary description and identify other SER sections presenting the staff's evaluation.)

13. With respect to the consequence analysis addressing the radiological impact from an assumed waste gas system component failure or leak, the applicant has provided the results of a site-specific analysis meeting the acceptance criteria of SRP Section 11.3 and BTP 11-5. If the results of a plant- and site-specific analysis do not meet BTP 11-5 acceptance criteria, the applicant should propose TS limiting the total amount of radioactivity in such a tank and components in accordance with SRP Chapter 16, Section 5.5, Programs and Manuals. Supporting information on the staff's evaluation of the site's atmospheric dispersion characteristics in transporting radioactivity into unrestricted areas is discussed in SRP Section 2.3.4. The staff concludes that the analysis provided by the applicant is consistent with the guidance of BTP 11-5 and meets the dose acceptance criteria defined in BTP 11-5 for an individual located at the EAB. The applicant has considered whether the waste gas system is designed to withstand the effects of an internal hydrogen explosion and earthquakes; justified the use of special design features to mitigate the consequences of a GWMS component failure; and, if warranted, proposed TS limiting the total amount of radioactivity in components when BTP 11-5 criteria cannot be met using site specific information. The specific conclusions and evaluation findings of the staff will be drawn from those listed in BTP 11-5. The staff will introduce the appropriate evaluation findings and summarize the results of its independent evaluation, based on the information presented by the applicant.

14. For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this SRP section and confirm that the applicant has met NRC requirements and guidance described in the application. If requested by the COL applicant, the findings will confirm whether the 10 CFR Part 52 licensing process for seeking exemptions, changes, and departures in the COL application was observed in changing specific features of the design certification in Tier 1, Tier 2, and Tier 2* information, and that resulting changes in plant design features and operations will ensure compliance with NRC regulations and guidance once the facility is constructed and operating in conformity with the COL.

In instances where an applicant has submitted conceptual design information for portions of the plant for which the application does not seek certification, the findings will summarize the staff's evaluation in confirming that the applicant has submitted supplemental design details for the associated SSCs, adequately addressed interface requirements with other SSCs that are included in the design certification, and determined the adequacy of the proposed ITAAC and methods used in verifying that all interface requirements have been met by the COL applicant under the requirements of 10 CFR 52.47(a)(24) through 52.47(a)(26), 10 CFR 52.79(d)(2), and 10 CFR 52.80(a).

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

15. For an ESP application, the staff confirms that the applicant has provided enough information for the staff to conclude that the application provides a bounding assessment in demonstrating the capability to comply with the regulatory requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I design objectives. The staff's evaluation confirmed that physical attributes of the site that could affect the design basis of SSCs (in the context of SRP Sections 11.1 and 11.2) that are important to safety or risk significant are reflected in the site characteristics, design parameters, and conditions stipulated in the ESP, including COL action items. The staff confirms that the applicant has identified the appropriate COL action item, as warranted, in recognition that future local land-use information may reveal that new and different exposure pathways and dose receptors exist from that described in the ESP. The COL action item flags the necessity to consider new exposure pathways, when different than those described in the ESP, and conduct a new dose assessment and confirm that associated doses are in compliance with NRC regulations and applicable guidance.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of ESP, CP, DC, OL or COL applications submitted by applicants pursuant to 10 CFR Part 50 and 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations as noted below. With respect to demonstrating conformance with the SRP, NRC regulations state, in part, that applications must contain "an evaluation of the standard plant design against the SRP revision in effect 6 months before the docket date of the application." However, an applicant is required to identify differences between this SRP section and design features, analytical techniques, and procedural measures proposed for the facility, and discuss how the proposed alternatives to the SRP acceptance criteria provide acceptable methods in complying with regulations that underlie SRP acceptance criteria and meet NRC regulatory requirements under 10 CFR 50.34(h), 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), and 10 CFR 52.79(a)(41) for ESP, CP, DC, OL and COL applications.

VI. REFERENCES

1. 10 CFR 20.1301, "Dose Limits for Individual Members of the Public."

2. 10 CFR 20.1302, "Compliance with Dose Limits for Individual Members of the Public."

3. 10 CFR 20.1406, "Minimization of Contamination."

4. 10 CFR Part 20, Appendix B, “Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage.”

5. 10 CFR 50.34, “Contents of Applications; Technical Information.”

6. 10 CFR 50.34a, “Design Objective for Equipment to Control Releases of Radioactive Materials in Effluents—Nuclear Power Reactors.”

7. 10 CFR 50.36a, “Technical Specifications on Effluents from Nuclear Power Reactors.”

8. 10 CFR 50.34(f), “Additional TMI-related requirements.”

9. 10 CFR 50.59, "Changes, Tests, and Experiments."

10. 10 CFR Part 50, Appendix A, General Design Criterion 2, “Design bases for protection against natural phenomena.”

11. 10 CFR Part 50, Appendix A, General Design Criterion 3, “Fire Protection.”

12. 10 CFR Part 50, Appendix A, General Design Criterion 60, “Control of Releases of Radioactive Materials to the Environment.”

13. 10 CFR Part 50, Appendix A, General Design Criterion 61, “Fuel Storage and Handling and Radioactivity Control.”

14. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.”

15. 10 CFR Part 50, Appendix I, “Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion ‘As Low As Is Reasonably Achievable’ for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.”

16. 10 CFR 52.39, “Finality of Early Site Permit Determinations.”

17. 10 CFR 52.47, “Contents of Applications; Technical Information.”

18. 10 CFR 52.63, “Finality of Standard Design Certifications.”

19. 10 CFR 52.80, “Contents of Applications; Additional Technical Information.”

20. 10 CFR Part 100, “Reactor Site Criteria.”

21. 40 CFR Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.”

22. ANSI/ANS-55.4-1993 (R2007), “Gaseous Radioactive Waste Processing Systems for Light Water Reactor Plants,” Reaffirmed in 2007.

23. ANSI/ANS-40.37-2009, “American National Standard, Mobile Low-Level Radioactive Waste Processing Systems,” 2009..

24. ANSI N42.18-2004, “Specification and Performance of On Site Instrumentation for Continuously Monitoring Radioactivity in Effluents,” 2004.

25. ANSI/HPS N13.1-2011, “Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities,” Approved March 30, 2011.

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

27. DC/COL-ISG-05, “Interim Staff Guidance on the use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents from Boiling-Water-Reactors and Pressurized-Water-Reactors to Support Design Certification and Combined License Applications,” July 2008.

28. DC/COL-ISG-06, “Final Interim Staff Guidance Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications,” as incorporated in SRP Section 12.3-12.4.

29 GL 89-01, “Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program (GL 89-01).”

29. GL 99-02, “Laboratory Testing of Nuclear-Grade Activated Charcoal.”

30. IE Circular No. 79-21, “Prevention of Unplanned Releases of Radioactivity,” October 17, 1979.

31. IE Bulletin No. 80-10, “Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment,” May 6, 1980.

32. IE Circular No. 80-18, “10 CFR 50.59 Safety Evaluations for Changes to Radioactive Waste Treatment Systems,” August 22, 1980, implemented using RG 1.187.

33. IE Information Notice No. 82-43, “Deficiencies in LWR Air Filtration/Ventilation Systems,” November 16, 1982.

34. IE Information Notice No. 82-49, “Correction for Sample Conditions for Air and Gas Monitor,” December 16, 1982.

35. IE Information Notice No. 91-40, “Contamination of NonRadioactive System and Resulting Possibility for Unmonitored, Uncontrolled Release to the Environment,” June 19, 1991.

36. IE Information Notice No. 99-01, “Deterioration of High-Efficiency Particulate Air Filters in a Pressurized Water Reactor Containment Fan Cooler Unit,” January 20, 1999.

37. NEI 08-08A, “Generic FSAR Template Guidance for Life Cycle Minimization of Contamination,” Revision 0, October 2009.

38. NEI 07-09A, “Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description,” Revision 0, March 2009.

39. NEI 97-06, “Steam Generator Program Guidelines,” 1997.

40. NUREG-0016, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWRs).”

41. NUREG-0017, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWRs) (PWR GALE Code).”

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

43. NUREG-0800, Section 5, Branch Technical Position (BTP) 5-1 “Monitoring of Secondary Side Water Chemistry in PWR Steam Generators.”

44. NUREG-0800, BTP 11-5, “Postulated Radioactive Releases Due to a Waste Gas System Leak or Failure.”

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

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

47. NUREG-1430, "Standard Technical Specifications - Babcock and Wilcox Plants."

48. NUREG-1431, "Standard Technical Specifications - Westinghouse Plants."

49. NUREG-1432, "Standard Technical Specifications - Combustion Engineering Plants."

50. NUREG-1433, "Standard Technical Specifications - General Electric Plants (BWR/4)."

51. NUREG-1434, "Standard Technical Specifications - General Electric Plants (BWR/6)."

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

53. NUREG/CR-3587, “Identification and Evaluation of Facility Techniques for Decommissioning of Light Water Reactors.”

54. RG 1.11, “Instrument Lines Penetrating Primary Reactor Containment.”

55. RG 1.33, “Quality Assurance Program Requirements (Operation).”

56. RG 1.52, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants.”

57. RG 1.54, “Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants.”

58. RG 1.68, “Initial Test Programs for Water-Cooled Nuclear Power Plants.”

59. RG 1.70, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition).”

60. RG 1.97, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants.”

61. RG 1.109, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I.”

62. RG 1.110, “Cost Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors.”

63. RG 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors.”

64. RG 1.112, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluent from Light-Water-Cooled Power Reactors.”

65. RG 1.140, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants.”

66. RG 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Reactor Power Plants.”

67. RG 1.187, “Guidance for Implementation of 10 CFR 50.59 Changes, Tests, and Experiments.”

68. RG 1.189, “Fire Protection for Nuclear Power Plants.”

69. RG 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants.

70. RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition).”

71. RG 1.215, “Guidance for ITAAC Closure Under 10 CFR Part 52.”

72. RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning.”

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

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

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

SRP Section 11.3
Description of Changes

Section 11.3 "Gaseous Waste Management System"

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in Section 11.3, Revision 3, dated March 2007, of this SRP. See ADAMS Accession No. ML070710366.

Editorial changes included adding new abbreviations in several places throughout this section and correcting grammatical errors. Other changes reflect the removal of redundant information.

Technical changes incorporated in this revision include:

I. AREAS OF REVIEW

The areas of review section was revised by identifying additional technical areas which warrant staff reviews and evaluations in assessing the design and performance characteristics of the GWMS in recognition of existing guidance and regulatory requirements. In part, the additional technical topics identified here also support the expanded topics listed in review interfaces. The additional areas of review address:

1. Quality assurance provisions for GWMS systems not covered by the requirements of 10 CFR Part 50, Appendix B, based on the guidance of RG 1.143.

2. Expanded discussions on design features to prevent, control, and collect radioactive materials, as condensate, from building ventilation systems and ductwork, and gases vented from tanks and components. The discussions now also refer to RG 1.54 and 4.21 and industry guidance under NEI 08-08A in meeting the requirements of 10 CFR 20.1406.

3. For processing systems equipped with automatic control features, justification for the placement of isolation dampers/valves and radiation detectors on process piping, ductwork, and effluent discharge lines to ensure the timely closure of valves and dampers upon the detection of elevated radioactivity levels, and, if part of the design, controls in monitoring deviations of exhaust flow rates and terminating releases or isolating process flows when deviations exceed preset limits.

4. Design features and operational safeguards to prevent the introduction and mixing of chemical additives with adsorption media to avoid the generation of exothermic reactions and explosive gas mixtures in GWMS components.

5. The listing of plant systems identified in review interfaces has been expanded to ensure that the staff's review of radiological considerations is properly integrated with parallel and complementary evaluations conducted by other technical disciplines. For systems that contribute potential input gaseous wastes to process streams and effluents managed by the GWMS, the following SRP sections were identified with technical and regulatory interfaces. The SRP Sections are 1.8, 1.9, 2.1.2, 2.3, 5.2.5, 5.4.8, 5.4.13, 6.5 7.1, 7.5, 7.6, 7.7, 9.1.2, 9.1.3, 9.2.3, 9.2.4, 9.2.6, 9.3.3, 9.3.4, 10.4, 11.2, 11.4, 12.3-12.4, 13.3, 13.4, 13.5, 14.2, and 14.3 and associated BTPs as noted in each SRP section.

II. ACCEPTANCE CRITERIA

The acceptance criteria section was revised by including citations of existing regulatory requirements not cited in the prior SRP and providing clarification on methods used in calculating radioactive source terms and doses to members of the public in demonstrating compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I. The major revisions include:

1. Addition of a discussion on 10 CFR Part 20.1101(b), as it relates to the use of procedures and engineering controls in maintaining doses to members of the public ALARA.

2. Addition of a discussion on 10 CFR Part 50, Appendix A, GDC 2, as it relates to the design bases of structures housing GWMS and its components using the guidance of RG 1.143 in assigning seismic and quality group classifications, and safety classifications for natural phenomena and man-induced hazards as defined in RG 1.143 in assigning safety classifications to GWMS SSCs for design purposes.

3. Addition of a discussion on 10 CFR Part 50, Appendix A, GDC 3, as it relates to the design of GWMS systems and operational safeguards to avoid the generation of explosive gas mixtures and exothermic reactions through the inadvertent introduction and mixing of chemical agents with adsorption media using RG 1.189 and 1.205 in conducting fire hazards analyses involving the presence of radioactivity in combustible or flammable materials. Using GDC 3, provides assurance that radioactive materials are protected from the effects of fires and that the function of plant systems and components will not be compromised in meeting effluent discharge concentration limits of 10 CFR Part 20 associated with releases of contaminated fire protection water and combustion gases and smoke.

4. Addition of a discussion on 10 CFR Part 50, Appendix A, GDC 61, as it relates to the ability of the GWMS design to ensure adequate safety under normal and postulated accident conditions, as noted in SRP Section 11.3 and consequence analysis described in BTP 11-5 for design purposes.

5. Addition of a discussion on 40 CFR Part 190 (the U.S. Environmental Protection Agency's (EPA) generally applicable environmental radiation standards), as implemented under 10 CFR 20.1301(e), as it relates to limits on annual doses from all sources of radioactivity contained in gaseous effluents and external radiation from site buildings and facilities (with single or multiple reactor units). The SRP guidance has been expanded in evaluating compliance with the standards for sites that have site-specific information on the locations of offsite dose receptors, and those that do not.

6. Addition of a discussion on 10 CFR 52.17(a)(ii), for ESP applications as relevant requirement to releases and doses under 10 CFR Part 20 and Appendix I, to 10 CFR Part 50, such that the design objectives of Sections II.B and II.C can be met based on anticipated levels of radioactive effluents released in plant environs.

7. Revised staff guidance discussed in: DC/COL-ISG-05, Interim Staff Guidance on NUREG-0800, Standard Review Plan, Section 11.1, "GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents to Support Design Certification and Combined License Applications." The clarification notes that

the calculation methods discussed in NUREG-0016 or NUREG-0017 and ANSI/ANS 8.1 1999 have been updated in a newer version of the associated computer GALE code, as GALE86 – see ADAMS Accession ML081710264.

8. Clarification in developing design basis reactor coolant and reactor steam source terms when considering technical specification limits for halogens (I-131 dose equivalent) and noble gases (Xe-133 dose equivalent), as applied in analyses conducted in SRP Sections 11.1 and 11.3 .

9. Clarification on the application of RG 1.143 acceptance criteria related to seismic, safety, and quality group classifications and quality assurance provisions for structures, systems, and components of the GWMS produced during normal operation and AOOs. RG 1.143 provides guidance in assigning safety classifications to structures and GWMSs in protecting SSCs against natural phenomena and man-induced hazards. The acceptance criteria are revised to conform with 10 CFR Part 20 dose limits for members of the public and plant workers and their assumed locations in restricted areas for workers and unrestricted areas for members of the public. Also, the revised guidance refers to RG 1.206, Part I, C.I.3, Sections 3.2.1 and 3.2.2, and SRP Section 3.8.4, in identifying applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and differences from the recommendations of RG 1.143.

10. Additional clarification is provided on the use of automatic control features and placement of isolation valves and radiation detectors on process piping, ductwork, and effluent vents and stacks to ensure the timely closure of valves and dampers upon the detection of elevated radioactivity levels, and, if part of the design, controls in monitoring deviations in exhaust flow rates in terminating releases or isolating process flows when deviations exceed preset limits. Other considerations include determining whether system logic demands that a valve or damper should fail in the closed position in protecting the system from further contamination, terminating releases to the environment, or diverting process streams or effluents to appropriate treatment systems.

11. For ESP applications, clarification is provided in reviewing the estimates of the source terms of gaseous radioactive effluents and radionuclide concentration levels at the site boundary. For a source term based on a single type of reactor design, the staff will confirm that the applied source term is consistent with that presented in the current revision of the DC for the selected reactor technology. For a source term based on two or more types of reactor designs, the staff will confirm that the source term, as a plant parameter envelope, is consistent with that presented in the current revision of each DC and conservatively bounding over all expected radionuclides and estimate of releases.

12. For ESP applications, clarification is provided for the staff in reviewing the results of a bounding dose assessment and demonstrate the capability to comply with 10 CFR Part 20 dose limits and 10 CFR Part 50, Appendix I design objectives. The staff's conclusion of acceptability is based on site-specific data assumptions presented by the applicant as to the types of exposure pathways and locations of dose receptors. However, should future local land-use information reveal that new and different exposure pathways and dose receptors exist from that described in the ESP, ESP applicants should identify this possibility and note it as a COL action item for consideration in a COL application. The COL action item should flag the necessity to consider new exposure pathways, when different than those described in the ESP, and conduct a new

dose assessment and confirm that associated doses are in compliance with NRC regulations and applicable guidance.

13. The revision provides guidance on the review of the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues (GSIs) identified in the version of NUREG-0933 current on the date 6 months before application and that are technically relevant to the design; how operating experience insights have been incorporated into the plant design; and information necessary to demonstrate compliance with technically relevant portions of the Three Mile Island requirements.

14. Updated listing of NRC and industry guidance reflecting operating experience – see updated reference list below.

15. The SRP guidance endorses NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," (Revision 0, October 2009) in describing acceptable methods in complying with 10 CFR 20.1406 and guidance of RG 4.21.

16. The SRP guidance endorses NEI 07-09A, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," (Revision 0, March 2009) as an acceptable commitment in developing a plant and site-specific ODCM before fuel load, as specified in SRP Sections 11.5 an 13.4.

III. REVIEW PROCEDURES

The review procedures section was updated in recognition of the revisions identified in the areas of review and acceptance criteria sections, as noted in explanations above.

IV. EVALUATION FINDINGS

The evaluation findings section was revised by expanding the discussions on the results of the staff's evaluation and conclusion of acceptability against cited regulations and guidance. The revisions address:

1. Compliance with 10 CFR Part 50, Appendix A, GDC 61, as it relates to the consequence analyses conducted under SRP Section 11.3, using the guidance in BTP 11-5.

2. Using RG 1.143, compliance with 10 CFR Part 50, Appendix A, GDC 2 and 61, as they relate to acceptance criteria related to seismic, safety, and quality group classifications and quality assurance provisions for SSCs of the GWMS for gaseous wastes produced during normal operation and AOOs. The acceptance criteria are revised to conform with 10 CFR Part 20 dose limits for members of the public and plant workers, given assumed locations in restricted areas for workers and unrestricted areas for members of the public.

3. Development of radioactive source terms using RG 1.112, NUREG-0016, NUREG-0017, DC/COL-ISG-05 in using GALE86 and ANSI/ANS 18.1-1999, and whether specific adjustments are made in consideration of specific design and operating features of the proposed reactor design.

4. If applicable, proposed augmentation of programmatic elements in assessing the adequacy of the design and resulting effects on the development of associated

radioactive gaseous effluent source terms and compliance with 10 CFR Part 20 effluent concentration and dose limits and 10 CFR Part 50, Appendix I design objectives and ALARA provisions.

5. Confirmation that the approach used in an ESP application in developing effluent source terms, as a plant parameter envelope, is consistent with the identified type of reactor design and conservatively bounding over all expected radionuclides and releases.

6. Confirmation that the applicant has committed, given SRP Sections 11.5, 13.4, and 13.5, to develop a plant and site-specific ODCM before fuel load, based on NEI ODCM Template 07-09A.

V. IMPLEMENTATION

The implementation section was revised by expanding the discussions on the evaluation of ESP, DC, COL applications. The expanded discussion address differences between standard plant design features, COL applications, and SRP acceptance criteria, and provide guidance on the acceptability of alternative methods in complying with cited regulations and SRP acceptance criteria.

VI. REFERENCES

The following references were added in support of the expanded discussions in areas of review, acceptance criteria, and review procedures. The added references are:

1. 10 CFR 50.34, “Contents of Applications; Technical Information.”

2. 10 CFR 50.59, "Changes, Tests, and Experiments.”

3. 10 CFR Part 50, Appendix A, GDC 2, “Design Bases for Protection Against Natural Phenomena.”

4. 10 CFR Part 50, Appendix A, GDC 3, “Fire Protection.”

5. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria For Nuclear Power Plants And Fuel Reprocessing Plants.”

6. 10 CFR 52.39, “Finality of Early Site Permit Determinations.”

7. 10 CFR 52.47, “Contents of Applications; Technical Information.”

8. 10 CFR 52.63, “Finality of Standard Design Certifications.”

9. 10 CFR 52.80, “Contents of Applications; Additional Technical Information.”

10. 40 CFR Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.”

11. ANSI/ANS-55.4-1993 (R2007), “Gaseous Radioactive Waste Processing Systems for Light Water Reactor Plants,” Reaffirmed in 2007.

12. ANSI/ANS-40.37-2009, “American National Standard, Mobile Low-Level Radioactive Waste Processing Systems,” 2009.

13. ANSI N42.18-2004, “Specification and Performance of On Site Instrumentation for Continuously Monitoring Radioactivity in Effluents,” 2004.

14. ANSI/HPS N13.1-2011, “Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities,” Approved March 30, 2011.

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

16. DC/COL-ISG-05, “Interim Staff Guidance on the use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents from Boiling-Water-Reactors and Pressurized-Water-Reactors to Support Design Certification and Combined License Applications,” July 2008.

17. DC/COL-ISG-06, “Final Interim Staff Guidance Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications,” as incorporated in SRP Section 12.3-12.4.

18. GL 89-01, “Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program (GL 89-01).”

19. GL 99-02, “Laboratory Testing of Nuclear-Grade Activated Charcoal.”

20. IE Circular No. 80-18, “10 CFR 50.59 Safety Evaluations for Changes to Radioactive Waste Treatment Systems,” August 22, 1980.

21. IE Information Notice No. 82-43, “Deficiencies in LWR Air Filtration/Ventilation Systems,” November 16, 1982.

22. IE Information Notice No. 82-49, “Correction for Sample Conditions for Air and Gas Monitor,” December 16, 1982.

23. IE Information Notice No. 91-40, “Contamination of NonRadioactive System and Resulting Possibility for Unmonitored, Uncontrolled Release to the Environment,” June 19, 1991.

24. IE Information Notice No. 99-01, “Deterioration of High-Efficiency Particulate Air Filters in a Pressurized Water Reactor Containment Fan Cooler Unit,” January 20, 1999.

25. NEI 08-08A, “Generic FSAR Template Guidance for Life Cycle Minimization of Contamination,” Revision 0, October 2009.

26. NEI 07-09A, “Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description,” Revision 0, March 2009.

27. NEI 97-06, “Steam Generator Program Guidelines,” 1997. Nuclear Energy Institute Washington, DC.

28. NUREG-0800, Section 5, Branch Technical Position (BTP) 5-1 “Monitoring of Secondary Side Water Chemistry in PWR Steam Generators.”

29. NUREG-1430, "Standard Technical Specifications - Babcock and Wilcox Plants."

30. NUREG-1431, "Standard Technical Specifications - Westinghouse Plants."

31. NUREG-1432, "Standard Technical Specifications - Combustion Engineering Plants."

32. NUREG-1433, "Standard Technical Specifications - General Electric Plants (BWR/4)."

33. NUREG-1434, "Standard Technical Specifications - General Electric Plants (BWR/6)."

34. RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning.”

35. RG 1.54, “Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants.”

36. RG 1.68, “Initial Test Programs for Water-Cooled Nuclear Power Plants.”

37. RG 1.97, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants.”

38. RG 1.187, "Guidance for Implementation of 10 CFR 50.59 Changes, Tests, and Experiments."

39. RG 1.189, “Fire Protection for Nuclear Power Plants.”

40. RG 1.205, “Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants.”

41. RG 1.215, “Guidance for ITAAC Closure under 10 CFR Part 52.”

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

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