



# 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.

**Secondary** - Organizations responsible for the review of (1) radwaste system design and performance, (2) ventilation systems, and (3) hydrogen control.

#### I. AREAS OF REVIEW

The gaseous waste management system (GWMS) involves the gaseous radwaste system (GRS), which deals with the management of radioactive gases collected in the offgas system (this system contains charcoal delay beds) or the waste gas storage and decay tanks. In addition, it involves the management of a condenser air removal system, steam generator blowdown flash tank (if applicable), and containment purge exhausts for PWRs; hydrogen and oxygen recombiners and instrumentation to control hydrogen and oxygen levels; gland seal exhaust and mechanical vacuum pump operation exhaust for BWRs; and building ventilation system exhausts for both PWRs and BWRs. 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 from the above sources. The review of the GWMS includes the design, design objectives, design criteria, methods of treatment, expected releases, and methods and principal parameters used in calculating effluent source terms and releases of radioactive materials (noble gases, radioiodines, tritium, carbon-14, and particulates). SRP Section 12.3-12.4 considers the presence of N-16, as a noble gas, in assessing doses from external radiation from the turbine buildings of BWR plants. The review will include system piping and instrumentation diagrams (P&IDs) and process flow diagrams showing methods of operation and factors that influence waste treatment (e.g., system interfaces and potential bypass routes to nonradioactive systems).

Revision 3 - March 2007

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#### USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to [NRR\\_SRP@nrc.gov](mailto:NRR_SRP@nrc.gov).

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The specific areas of review are as follows:

1. Equipment and ventilation system design capacities, expected flows, source terms and radionuclide concentrations, expected decontamination factors or removal efficiencies for radionuclides, and holdup or decay time.
2. System design capacity relative to the design and expected input flows, the period of time the system is required to be in service to process normal waste flows, availability of standby equipment, alternate processing routes, and interconnections between subsystems. This information is used to evaluate the overall ability of the system to meet anticipated demands imposed by major processing equipment downtime and waste volume surges cause by anticipated operational occurrences.
3. Quality group classifications of piping and equipment, the bases governing the chosen design criteria, design and expected temperatures and pressures, and materials used to construct the system components.
4. Design provisions incorporated in the equipment and facility design to facilitate operation and maintenance in conformance with Regulatory Guide 1.143 for gaseous wastes produced during normal operation and anticipated operational occurrences.
5. Design features that would reduce the volumes of gaseous waste to 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.
6. 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, special design features, topical reports incorporated by reference, and data obtained from previous experience with similar systems as described in the SAR.
7. Design features to preclude the possibility of an explosion if the potential for hydrogen and oxygen explosive mixtures exist in system components.
8. For multi-unit stations, 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 subsystems.
9. 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.
10. 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 in accordance with Regulatory Guide 1.143 for gaseous wastes produced during normal operation and anticipated operational occurrences.

11. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this SRP section in accordance with 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 this portion of the application has 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 in accordance with SRP Section 14.3.
12. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).  
  
For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.
13. Early Site Permit (ESP) Application Reviews. For an ESP application, the review is limited to the information on potential radiological exposures to members of the public from gaseous effluents that would be generated as a normal byproduct of nuclear power operations. The estimates on the maximum doses to the public should be based on available data for the reactor designs being considered (e.g., a certified design or a plant parameter envelope (PPE) approach), in which the bounding gaseous radiological effluents are used in assessing potential exposures to the public by considering the probable pathways to individuals and populations near the proposed new unit(s). The staff should consider external exposure to the airborne plume, external exposure to contaminated ground, inhalation of airborne activity, and ingestion of agricultural products.

### Review Interfaces

Other SRP sections interface with this section as follows:

1. Review of the independent source term and dose calculations for the purpose of assessing the performance of the GWMS against the NRC requirements of 10 CFR 20.1302; Table 2, Column 1, of Appendix B to 10 CFR Part 20; and the dose objectives of Appendix I to 10 CFR Part 50, is conducted under SRP Section 11.1 and SRP Section 11.5.
2. Review of design provisions incorporated into the GWMS to control, sample, and monitor radioactive materials in gaseous processes and effluent streams is performed under SRP Section 11.5.
3. Review of the the dose calculation methods and parameters of the Standard Radiological Effluent Controls (SREC), as they relate to the ODCM is performed under SRP Section 11.5.
4. 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 under SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.

5. Review of the GWMS fire protection and prevention program is performed under SRP Section 9.5.1.
6. Review of the acceptability of the seismic and quality group classifications for structures and system components is performed under SRP Sections 3.2.1 and 3.2.2.
7. Review of technical specifications (TS) for the GWMS is performed under SRP Section 16.0.
8. Review of quality assurance is performed under SRP Section 17.5.
9. Review of design features of the GWMS process and post-accident sampling subsystems is conducted under SRP Sections 9.3.2 and 11.5.
10. Review of design features of building exhaust and ventilation systems servicing areas where radioactive materials are present (e.g., use of HEPA and charcoal filters) is conducted under SRP Section 9.4 and under SRP Section 11.5 for instrumentation used to monitor and control radioactive effluent releases.
11. The review of design features for the protection of potable and sanitary water systems is conducted under SRP Section 9.2.4.

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

## II. ACCEPTANCE CRITERIA

### Requirements

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

1. 10 CFR 20.1302, as it relates to radioactivity in gaseous effluents released to unrestricted areas.
2. 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.
3. 10 CFR 50.34a, as it relates to the provision of sufficient design information to demonstrate that design objectives for equipment necessary to control releases of radioactive effluents to the unrestricted areas are kept as low as reasonably achievable.
4. General Design Criterion 3 (GDC) 3, as it relates to the design of gaseous waste handling and treatment systems to minimize the effects of explosive mixtures of hydrogen and oxygen.

5. GDC 60, as it relates to the design of the GWMS to control releases of radioactive materials to the environment.
6. GDC 61, as it relates to radioactivity control in the GWMS associated with fuel storage and handling areas.
7. 10 CFR Part 50, Appendix I, Sections II.B, II.C, and II.D, as they relate to the numerical guides for design objectives and limiting conditions for operation to meet the “as low as is reasonably achievable” criterion.
8. 40 CFR Part 190 (EPA generally applicable environmental radiation standards), as implemented under 10 CFR 20.1301(e), as it relates to limits on total annual doses from all sources of radioactivity and external radiation from the site (with single or multiple units).
9. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (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, and the NRC's regulations;
10. 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 Atomic Energy Act, and the NRC's regulations.
11. For an ESP application, the relevant requirement is limited to Appendix I to 10 CFR Part 50, such that the guidelines in Sections II.B and II.C of Appendix I can be met.

#### SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for the review described in this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

1. The GWMS should have the capability to meet the dose design objectives and should include provisions to treat gaseous radioactive wastes such that the following is true:
  - A. The calculated annual total quantity of all radioactive materials released from each reactor to the atmosphere will not result in an estimated annual external dose from gaseous effluents to any individual in unrestricted areas in excess of

0.05 mSv (5 mrem) to the total body or 0.15 mSv (15 mrem) to the skin. Regulatory Guides 1.109, 1.111, and 1.112 provide acceptable methods for performing this analysis.

- B. The calculated annual total quantity of radioactive materials released from each reactor to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of 0.01 cGy (10 millirads) for gamma radiation or 0.02 cGy (20 millirads) for beta radiation. Regulatory Guides 1.109, 1.111, and 1.112 provide acceptable methods for performing this analysis.
  - C. The calculated annual total quantity of radioiodines, carbon-14, tritium, and all radioactive materials in particulate form released from each reactor at the site in effluents to the atmosphere will not result in an estimated annual dose or dose commitment from such releases for any individual in an unrestricted area from all pathways of exposure in excess of 0.15 mSv (15 mrem) to any organ. Regulatory Guides 1.109, 1.111, and 1.112 provide acceptable methods for performing this analysis.
  - D. In addition to 1.A, 1.B, and 1.C, above, the GWMS should include all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, for a favorable cost-benefit ratio, can effect reductions in dose to the population reasonably expected to be within 80 km (50 mi) of the reactor. Regulatory Guide 1.110 provides an acceptable method for performing this analysis.
  - E. The concentrations of radioactive materials in gaseous effluents released to an unrestricted area should not exceed the limits specified in Table 2, Column 1, of Appendix B to 10 CFR Part 20.
  - F. The regulatory position contained in Regulatory Guide 1.140 is met, as it relates to the design testing and maintenance of normal ventilation exhaust system air filtration and adsorption units at nuclear power plants.
  - G. The regulatory position contained in Regulatory Guide 1.143 is met, as it relates to the seismic design and quality group classification of components used in the structures housing the GRS and the provisions used to control leakages of gaseous wastes produced during normal operation and anticipated operational occurrences.
  - H. The regulatory position contained in Regulatory Guide 1.143 is met, as it relates to the definition of the boundary of the GWMS, beginning at the interface from plant systems to the point of controlled discharges to the environment as defined in the ODCM, or at the point of storage in holdup tanks or decay beds for gaseous wastes produced during normal operation and anticipated operational occurrences.
2. The GWMS should be designed to meet the anticipated processing requirements of the plant. Adequate capacity should be provided 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 anticipated operational occurrences, are acceptable. To meet these processing demands, the reviewer will consider shared systems, redundant equipment, mobile equipment, and reserve storage capacity.

3. The seismic design and quality group classification of components used in the GWMS and structures housing the system should conform to Regulatory Guide 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 anticipated operational occurrences.
4. System designs should describe features that will minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste in accordance with Regulatory Guide 1.143, for gaseous wastes produced during normal operation and anticipated operational occurrences, and the requirements of 10 CFR 20.1406 or the DC application, update in the SAR, or the COL application to the extent not addressed in a referenced certified design.
5. System designs should use the guidelines in Regulatory Guide 1.140 for the design testing and maintenance of HEPA filters and charcoal adsorbers installed in normal ventilation exhaust systems. If decontamination factors for radioiodines that differ from those specified in Regulatory Guide 1.140 are used for design purposes, they should be supported by test data under operating or simulated operating conditions (temperature, pressure, humidity, expected iodine concentrations, and flow rate). The test data should also support the effects of aging and poisoning by airborne contaminants.
6. 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 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 mixtures and annunciated both locally and in the control room.
  - D. For systems not designed to withstand a hydrogen explosion, dual gas analyzers (with dual being 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) with automatic control functions are required to preclude the formation or buildup of

explosive hydrogen/oxygen mixtures. 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 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 required 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 be in accordance with 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 is required between the compressor and the storage tanks. Dual gas analyzers set to sequentially measure concentrations both upstream and downstream of a recombiner are acceptable for a PWR. When two or more potentially explosive process streams are combined before entering a component, each stream or the combination thereof, is required to 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 is required. 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 shall be nonsparking.

7. Branch Technical Position (BTP) 11-5, as it relates to potential releases of radioactive materials (noble gases) as a result of postulated leakage or failure of a waste gas storage tank or offgas charcoal delay bed.
8. 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 Regulatory Guides 1.109 and 1.111, and appropriate computer codes, such as the GASPARD II computer code (NUREG/CR-4653) for gaseous effluents.

#### 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). 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 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 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 liquid effluent concentrations in unrestricted areas as an acceptance criterion; consequently, the ability of a facility to meet this criterion will be evaluated under Section 11.2.

2. Under the provisions of 10 CFR 20.1406, the NRC focuses on design features or operational procedures that would reduce the amount of gaseous wastes, reduce radioactivity levels and discharges of radioactive materials in effluents, minimize contamination of the facility and environment, and avoid or reduce the potential for uncontrolled and unmonitored releases to the environment. In the context of this SRP section, relevant and specific guidance to meet 10 CFR 20.1406 includes:
  - A. Gaseous waste processing systems (either as permanently installed systems or in combination with mobile equipment) with a potential for leakage should include the means to control and contain this leakage to prevent contamination of building floors and interconnected systems (e.g., curbing, floor sloping to local drains, floor-to-floor seals over floor expansion joints, wall-to-floor joint seals, sheathed hoses, drip pans or containment boxes, backflow preventers, siphon breakers, self-sealing quick-disconnects, and operational interlocks). See guidance given in IE Bulletin No. 80-10 as an example.
  - B. In minimizing the generation of waste, provisions should be made to clean contaminated equipment (e.g., system components) and to reuse charcoal adsorbent media via regeneration, when feasible.
  - C. Mobile gaseous waste processing systems with interconnections to a permanently installed plant GWMS and condensate drains connected to LWMS subsystems should include provisions that (1) avoid the contamination of nonradioactive systems, (2) prevent uncontrolled and unmonitored releases of radioactive materials in the environment, and (3) avoid interconnections with nonradioactive systems.

3. Acceptance Criterion II.3 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 nuclear power reactors will meet the criterion that controlled releases of radioactive materials in effluents to unrestricted areas in the vicinity of a nuclear facility will be kept as low as is reasonably achievable 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 Part 20, 10 CFR 20.1302, and 10 CFR 20.1301(e); Appendix I to 10 CFR Part 50; and GDC 60 and 61.

4. GDC 3 provides that SSCs important to safety shall be designed and located, consistent with other safety requirements, to minimize the probability and effect of fires and explosions.

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.

Meeting the requirements of GDC 3 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.

5. Compliance with GDC 60 requires that design provisions be included in the nuclear power unit to control releases of radioactive materials in gaseous effluents to the environment during normal reactor operation, including anticipated operational occurrences.

GDC 60 specifies that the radwaste processing 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 capacity also provides time to allow shorter lived radionuclides to decay before they are further processed or released to the atmosphere. The holdup or decay times are used in source term calculations based on the methods described in NUREG-0016 or NUREG-0017 and Regulatory Guide 1.112.

The review will evaluate the types and characteristics of filtration and adsorbent media proposed to treat gaseous process and effluent streams, including removal efficiencies and decontamination factors, taking into account the expected physical, chemical, and radiological properties of gaseous process and effluent streams. The review should determine whether performance meets or exceeds that noted in NRC guidance (Regulatory Guide 1.140 and NUREG-0016 or NUREG-0017), standard DCs, industry standards, or topical reports.

Meeting the requirements of GDC 60 provides assurance that releases of radioactive materials in gaseous effluents to unrestricted areas during normal plant operation and anticipated operational occurrences will not result in offsite radiation doses exceeding the dose 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, of Appendix B to 10 CFR Part 20.

6. Compliance with GDC 61 requires that the GWMS and other systems (either as permanently installed systems or in combination with mobile equipment) that may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident 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.

Regulatory Guide 1.140 provides design guidance acceptable to the NRC staff relating to design, testing, and maintenance criteria for air filtration and adsorption units, and Regulatory Guide 1.143 describes design guidance acceptable to the NRC staff relating to seismic and quality group classification and quality assurance provisions for the GRS portion of the GWMS structures and components, involving gaseous wastes produced during normal operation and anticipated operational occurrences.

Meeting the requirements of GDC 61 provides assurance that releases of radioactive materials during normal operation and during anticipated operational occurrences will not result in radiation doses that exceed the limits specified in 10 CFR 20.1302. In addition, meeting these requirements will help to assure that the GWMS will continue to perform its safety function(s) under postulated accident conditions, given the guidance of Regulatory Guide 1.52.

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 as low as is reasonably achievable. Section II of Appendix I

relates to the numerical guides for dose design objectives, limiting conditions for operation, and controls to meet the as low as is reasonably achievable criterion.

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

Regulatory Guide 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 levels as low as is reasonably achievable.

Regulatory Guide 1.140 presents methods acceptable to the NRC 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 adsorbers in filtration systems.

The requirements of Sections II.B, II.C, and II.D of Appendix I to 10 CFR Part 50 provide assurance that the limits for external radiation doses to a maximally exposed offsite individual, maximum offsite air doses from noble gases (as gamma and beta radiation), and radiation doses from carbon-14, tritium, particulates, and radioiodines to a maximally exposed offsite individual from gaseous effluents, specified in Sections II.B and II.C, and the acceptance criterion for cost-benefit analysis specified in Section II.D for meeting the as low as reasonably achievable objective will be met.

8. BTP 11-5 describes acceptable methods to evaluate doses associated with the postulated releases of radioactive gases resulting from the failure of a gas decay tank or bed or a leak from a GWMS component.

The BTP presents guidelines 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 PWR-GALE or BWR GALE code (NUREG-0016 or NUREG-0017) and Regulatory Guide 1.112.

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

10 CFR 20.1301(e) requires that all potential sources of external radiation and radioactivity be considered, 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 with single or multiple 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 source of radiation and external radiation exposures from buildings, storage tanks, radioactive waste storage areas, and N-16 skyshine from BWR turbine buildings.

Meeting the requirements of 10 CFR 20.1301(e) provides assurance that doses to an individual located in an unrestricted area will not exceed the EPA standards by taking into account all sources of radioactivity and radiation.

### III. REVIEW PROCEDURES

The reviewer will select material from the procedures described below, as may be appropriate for a particular case.

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 identified in Subsection II.

The NRC will review the description of the design features of the GWMS provided in the SAR, the DC application, the update of the FSAR, or the COL application to the extent not addressed in a referenced certified design, including SRP Sections 11.1, 11.2, 11.4, 11.5, and 12.3-12.4, for completeness in accordance with Regulatory Guide 1.206.

1. 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; flowpaths of gases through subsystems, including all potential bypasses to nonradioactive systems; treatment methods; expected decontamination factors or removal efficiencies and holdup or decay times; and points of release of gaseous effluents to the environment.

This information is used to calculate the quantity of radioactive materials (noble gases, radioiodines, tritium, carbon-14, and particulates) released annually in gaseous effluents during normal operations, including anticipated operational occurrences, using the given parameters and calculational techniques of NUREG-0016 or NUREG-0017 and Regulatory Guide 1.112. The results of this calculation will determine whether the proposed GWMS design meets the acceptance criterion of SRP Acceptance Criteria 1 of this SRP section and relevant sections of SRP Section 11.1.

Compliance with the acceptance criteria of SRP Acceptance Criteria 1.A, 1.B, and 1.C of this SRP section concerning exposures of the total body, skin, and thyroid will be determined based on dose and source term calculations performed by NRC staff using NUREG-0016 or NUREG-0017, Regulatory Guide 1.112, and NUREG/CR-4653 (GASPAR II code).

The NRC staff will determine conformance with the acceptance criterion given in SRP Acceptance Criteria 1.D of this SRP Section, concerning the cost-benefit analysis based on an analysis that includes population cumulative dose calculations (person-Sv (person-rem)) and cost-benefit studies. Regulatory Guide 1.110 describes methods for performing such cost-benefit analyses.

2. 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 capability of the GRS to process gaseous wastes at design-basis fission product levels (i.e., from 1 percent of the fuel-producing power in a PWR or in a BWR, consistent with a noble gas release rate of 3.7 MBq/s per MWt (100  $\mu$ Ci/s per MWt) with a 30-minute delay).
  - C. The operational flexibility designed into the GRS (e.g., cross-connections between subsystems, 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 bed dimensions, mass of charcoal, flow rate, temperatures, pressures, humidity, and dynamic adsorption coefficients are used to calculate the effective holdup times.
  - 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 and Regulatory Guide 1.140), standard design certifications, or topical reports, taking into account the expected physical, chemical, and radiological properties of gaseous process and effluent streams.
  - F. Analysis and results demonstrating compliance with BTP 11-5 for doses to any offsite individuals associated with the postulated failure of a waste gas system component or leak.
3. The quality group classification of piping and equipment in the GRS portion of the GWMS is compared to the guidelines of Regulatory Guide 1.143 for gaseous wastes produced during normal operation and anticipated operational occurrences. The seismic design criteria of equipment and of structures housing the GRS is also compared to the design guidance identified in Regulatory Guide 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. 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.

4. The GRS design, system layout, equipment design, method of operation, and provisions to reduce leakage and to facilitate operations and maintenance are compared to Regulatory Guide 1.143 for gaseous wastes produced during normal operation and anticipated operational occurrences. Special design features provided to control leakage from system components and topical reports on system designs will be evaluated on a case-by-case basis.

5. The review will compare the design, testing, and maintenance criteria for HEPA filters and charcoal adsorbers in filtration systems against the provisions of Regulatory Guide 1.140.
6. If a potential for explosive hydrogen and oxygen mixtures exist, 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 the required dual instrumentation and design features to annunciate and prevent the buildup of potentially explosive mixtures, respectively.
7. Part of the review identified in SRP Sections 11.5 and 16.0 will evaluate the SREC, ODCM, and Administrative Controls section of the TS proposed by the applicant for process and effluent controls. The reviewer will determine that 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, consistent with the plant design. The ODCM, SREC, and TS are reviewed with respect to the requirements of 10 CFR 50.36a using Generic Letter 89-01 and guidance contained in NUREG-1301 (PWR) or NUREG-1302 (BWR) or NUREG-0133 for either type of plant. (Note: Generic Letter 89-01 is included in NUREG-1301 and NUREG-1302.)
8. The review considers information describing design features that will minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste in accordance with the requirements of 10 CFR 20.1406 and Regulatory Guide 1.143 for gaseous wastes produced during normal operation and anticipated operational occurrences. The review may also consider the information contained in the DC application, the update in the SAR, or the COL application, to the extent not addressed in a referenced certified design. NRC guidance includes the following:
  - A. IE Bulletin No. 80-10
  - B. Memorandum from Larry W. Camper to David B. Matthews and Elmo E. Collins, dated October 10, 2006 (ADAMS Accession No. ML0619201830), and NUREG/CR-3587, as they relate to the design issues that need to be addressed to meet the requirements of 10 CFR 20.1406
  - C. "Liquid Radioactive Release Lessons Learned Task Force, Final Report," Sections 2.0 and 3.2.2, September 1, 2006 (ADAMS Accession No. ML062650312)
  - D. Regulatory Guides 1.143 and 1.11
  - E. Industry standards, e.g., ANSI/ANS-55.4-1993 (1999), ANSI/ANS-40.37-1993 (200x updated draft)
9. In determining compliance with 40 CFR Part 190, as implemented under 10 CFR 20.1301(e), the review considers all sources of radiation and radioactivity as a potential contributor to doses to members of the public from the site (which may have either single or multiple units). The review focuses on sources of radioactivity, as gaseous and liquid effluents, and external radiation exposures from buildings, storage

tanks, radioactive waste storage buildings, and N-16 skyshine from BWR turbine buildings. The source terms and associated doses from gaseous effluents are evaluated in this section of the SRP, while SRP Sections 11.2 and 11.4 evaluate source terms and doses from liquid effluents and solid wastes. In turn, SRP Section 11.5 addresses compliance with all sources of effluents. SRP Section 12.3-12.4 evaluates doses associated with external radiation from buildings and contained sources of radioactivity.

10. For 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 final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

For review 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 this section.

11. 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. The scope and level of detail of review of data parallel that used for a CP review.

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 (uCi/ml) are evaluated to determine whether they are consistent with the proposed type of reactor design and requested thermal power level. 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 SSAR.

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 the early site permit at the COL stage. Accordingly, the reviewer should ensure that all physical attributes of the site that could affect the design basis of SSCs important to safety are reflected in the site characteristics, design parameters, or terms and conditions on the early site permit.

#### IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

The staff concludes that the design of the GWMS (either as a permanently installed system or in combination with a mobile system) includes the necessary equipment to process and control releases of radioactive materials in gaseous effluents in accordance with GDC 3, 60, and 61 of Appendix A to 10 CFR Part 50 and 10 CFR 50.34a. The staff concludes that the design of the GWMS is acceptable and meets the requirements of 10 CFR Part 20, 10 CFR 20.1301 and 20.1302, 10 CFR 20.1301(e), and 10 CFR 20.1406; 10 CFR Part 50 and 10 CFR 50.34a; GDC 3, 60, and 61; and Appendix I to 10 CFR Part 50.

This conclusion is based on the following:

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 the release of radioactive materials in gaseous effluents.
2. The applicant has met the requirements of Appendix I to 10 CFR Part 50 by meeting the as low as is reasonably achievable criterion as follows:
  - A. Regarding Sections II.B and II.C of Appendix I, the staff has considered releases of radioactive material (noble gases, radioiodine, tritium, carbon-14, and particulates) in gaseous effluents for normal operation, including anticipated operational occurrences, 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 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-mi) radius of the reactor at a cost of less than \$1000 per man-rem or \$1000 per man-thyroid-rem.
3. The applicant has met the requirements of 10 CFR 20.1302 since the staff has considered the potential consequences resulting from reactor operation with "1% of the operating fission product inventory in the core being released to the primary coolant" for a PWR, or "a fission product release rate consistent with a noble gas release rate to the reactor coolant of 3.7 MBq/sec per MWt (100  $\mu$ Ci/ sec per MWt) after 30 minute decay" for a BWR. The staff has further determined that, under these conditions, the concentrations of radioactive materials in gaseous effluents in unrestricted areas will be a small fraction of the limits specified in Table 2, Column 1, of Appendix B to 10 CFR Part 20.

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 units), including liquid and gaseous effluents and external radiation exposures from buildings and storage tanks and N-16 skyshine from a BWR turbine building as a source 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).
5. The staff has considered the ability of the proposed GWMS to meet the anticipated demands of the plant resulting from anticipated operational occurrences and has concluded that the system capacity and design flexibility are adequate to meet the anticipated needs of the plant.
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. 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 classifications used for the GRS components, the seismic design applied to the design of the GRS, and the structures housing the GRS. The design of the GRS and the structures housing it meet the criteria set forth in Regulatory Guide 1.143 for gaseous wastes produced during normal operation and anticipated operational occurrences.
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 64, and guidance of Regulatory Guide 1.143 for gaseous wastes produced during normal operation and anticipated operational occurrences.
9. The staff has reviewed the provisions incorporated in the applicant's design to control releases from hydrogen explosions 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.

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.

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.

For an ESP application, the staff concludes that the applicant has provided an assessment that demonstrates its capability to comply with 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," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

## V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications submitted six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

## 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 50.34a, "Design Objective for Equipment to Control Releases of Radioactive Materials in Effluents—Nuclear Power Reactors."
6. 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."
7. 10 CFR Part 50, Appendix A, General Design Criterion 3, "Fire Protection."
8. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."
9. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."
10. 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."
11. Regulatory Guide 1.11, "Instrument Lines Penetrating Primary Reactor Containment."
12. Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)."

13. Regulatory Guide 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."
14. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."
15. Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I."
16. Regulatory Guide 1.110, "Cost Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors."
17. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."
18. Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluent from Light-Water-Cooled Power Reactors."
19. Regulatory Guide 1.140, "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."
20. Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light-Water-Cooled Nuclear Reactor Power Plants."
21. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."
22. NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWRs) (BWR GALE-Code)."
23. NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWRs) (PWR GALE Code)."
24. NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants."
25. NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors."
26. NUREG-1302, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors."
27. NUREG/CR-4653, "GASPAR II—Technical Reference and User Guide."
28. IE Bulletin No. 80-10, "Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment," May 6, 1980.

29. Memorandum from Larry W. Camper to David B. Matthews and Elmo E. Collins, dated October 10, 2006, "List of Decommissioning Lessons Learned in Support of the Development of a Standard Review Plan for New Reactor Licensing" (ADAMS Accession No. ML0619201830) and NUREG/CR-3587, "Identification and Evaluation of Facility Techniques for Decommissioning of Light Water Reactors."
30. Office of Nuclear Reactor Regulation, "Liquid Radioactive Release Lessons Learned Task Force, Final Report," Sections 2.0 and 3.2.2, September 1, 2006 (ADAMS Accession No. ML062650312)
31. ANSI/ANS-55.4-1993 (1999), "Gaseous Radioactive Waste Processing Systems for Light Water Reactor Plants." Reaffirmed in 1999.
32. ANSI/ANS-40.37-1993 (200x updated draft), "American National Standard For Mobile Low-Level Radioactive Waste Processing Systems." Proposed 2007 draft for public comments.
33. Branch Technical Position (BTP) 11-5, "Postulated Radioactive Releases Due to a Waste Gas System Leak or Failure."

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**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**

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