U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

11.3 GASEOUS WASTE MANAGEMENT SYSTEMS~~[1]~~

REVIEW RESPONSIBILITIES

Primary - ~~Effluent Treatment~~ Plant Systems Branch ~~(ETSB)~~ (SPLB)[2]

Secondary - ~~Radiological Assessment Branch (RAB)~~ Emergency Preparedness and Radiation Protection Branch (PERB)[3]

I. AREAS OF REVIEW

At the construction permit (CP) or standard design certification[4] stage of review, ~~ETSB~~ SPLB[5] reviews the information in the applicant's safety analysis report (SAR) in the specific areas that follow. At the operating license (OL) or combined license (COL)[6] stage of review, ~~ETSB~~ SPLB review consists of confirming the design accepted at the CP or standard design certification[7] stage and evaluating the adequacy of the applicant's technical specifications in these areas. The ~~ETSB~~ SPLB review includes:

1. The gaseous waste management ~~(treatment and ventilation)~~ system~~s~~[8] design, design objectives, design criteria, methods of treatment, expected releases, and principal parameters used in calculating the releases of radioactive materials (noble gases, radioiodine, tritium, carbon-14,[9] and particulates) in gaseous effluents. The gaseous waste management system involves the gaseous radwaste system (GRS), which deals with the management of radioactive gases collected in offgas system (this system contains charcoal delay beds) or waste gas storage and decay tanks. In addition, it involves the management of condenser air removal system, steam generator blowdown flash tank (if applicable), and containment purge exhausts for PWRs; 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

environment from the above sources may, in turn, involve treatment systems to reduce releases of radioactive material in the effluents from the above sources.[10] The ~~ETSB~~ SPLB review will include the system piping and instrumentation diagrams (P&IDs), and the process flow diagrams showing methods of operation and factors that influence waste treatment, e.g., system interfaces and potential bypass routes.

2. Equipment and ventilation system design capacities, expected flows and radionuclide concentrations, expected decontamination factors for radionuclides, and available holdup time. The 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 system capability to meet anticipated demands imposed by major processing equipment downtime and waste volume surges due to anticipated operational occurrences.

3. The quality group classifications of piping and equipment, and the bases governing the design criteria chosen. Design and expected temperatures and pressures, and materials of construction of the components of the system.

4. Design provisions incorporated in the equipment and facility design to facilitate operation and maintenance in conformance with the guidelines of Regulatory Guide 1.143.[11] ~~(Ref. 8)~~[12]

5. Special design features to reduce leakage of gaseous waste or discharge of radioactive material in gaseous effluents. Special design features, topical reports incorporated by reference, and data obtained from previous experience with similar systems which are submitted with the SAR.

6. Design features to preclude the possibility of an explosion if the potential for explosive mixtures exist.

Review Interfaces[13]

1. The SPLB performs the following reviews as part of its primary review responsibility under the SRP sections indicated:[14]

   Design provisions incorporated to sample and monitor radioactive materials in gaseous process and effluent streams are reviewed under SRP Section 11.5 by ~~ETSB~~ SPLB.

2. The SPLB will coordinate evaluations performed by other branches that interface with the overall evaluation of the system as follows:[15]

   a. A secondary review is performed by the ~~Radiological Assessment Branch (RAB)~~ (PERB).[16]

1. ~~RAB~~ PERB[17] calculates the doses based on the gaseous source term provided by ~~ETSB~~ SPLB and transmits the results to ~~ETSB~~ SPLB for their use in evaluating the gaseous waste management systems.

2. ~~RAB~~ PERB also reviews the dose calculational portions of the radiological effluent technical specifications (TS), i.e., offsite dose calculation manual (ODCM),[18] for input into SRP Section 16.0.

~~In addition, ETSB will coordinate other branches' evaluations that interface with the overall review of the system as follows:~~[19]

b. The ~~Structural Engineering~~ Civil Engineering and Geosciences Branch (~~SEB~~ ECGB[20]) determines the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the systems and supporting systems to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), probable maximum flood (PMF), and tornado missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5. Upon request from ~~ETSB~~ SPLB, the ~~SEB~~ ECGB[21] will also review non-seismic Category I structures housing radwaste management systems to determine their ability to withstand the effects of the design ~~Operating B~~basis E~~e~~arthquake ~~(OBE)~~ [22]in accordance with Regulatory Guide 1.143.

c. The Mechanical Engineering Branch (EMEB) determines the acceptability of the seismic and quality group classifications for structures and system components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2.

d. The Technical Specifications Branch (TSB) coordinates and performs reviews of the proposed technical specifications as part of its primary review responsibility for SRP Section 16.0.[23]

e. The Quality Assurance and Maintenance Branch (HQMB) coordinates and performs reviews of quality assurance programs as part of its primary review responsibility for SRP Chapter 17.[24]

~~The reviews for Technical Specifications and Quality Assurance are coordinated and performed by the Licensing Guidance Branch and the Quality Assurance Branch (QAB) as part of their primary review responsibility for SRP Sections 16.0 and 17.0, respectively.~~[25]

For those areas of review identified as part of the primary responsibility of other branches, the acceptance criteria and methods of application are contained in the referenced SRP section.

II. ACCEPTANCE CRITERIA

A. ~~ETSB~~ SPLB acceptance criteria are based on meeting the relevant requirements of the following regulations:

1. 10 CFR Part 20, ~~§20.106~~ § 20.1302[26], as it relates to radioactivity in effluents to unrestricted areas.

2. 10 CFR Part 50, § 50.34a, as it relates to sufficient design information being provided to demonstrate that design objectives for equipment necessary to control releases of radioactive effluents to the environment have been met.

3. General Design Criterion 3 (GDC 3)[27] as it relates to providing protection to gaseous waste handling and treatment systems from the effects of an explosive mixture of hydrogen and oxygen.

4. General Design Criterion 60 (GDC 60)[28] as it relates to the ~~radioactive~~ gaseous waste management system~~s~~ being designed to control releases of radioactive materials to the environment.

5. General Design Criterion 61 (GDC 61)[29] as it relates to radioactivity control in gaseous waste management system~~s and ventilation systems~~ associated with fuel storage and handling areas.

6. 10 CFR Part 50 Appendix I, Sections II.B., II.C., and II.D., as it relates to the numerical guides for design objectives and limiting conditions for operation to meet the "as low as is reasonably achievable" criterion. The requirements of the Commission regulations identified above are met by using the regulatory positions contained in the following regulatory guides:

   a. Regulatory Guide 1.140[30] as it relates to the design testing and maintenance of normal ventilation exhaust system~~s~~ air filtration and adsorption units at nuclear power plants.

   b. Regulatory Guide 1.143 as it relates to the seismic design and quality group classification of components used in the ~~gaseous waste treatment system~~ GRS and structures housing the ~~systems~~ GRS[31] and the provisions used to control leakages.

7. Branch Technical Position (BTP) ETSB 11-5 as it relates to potential releases of radioactive materials as a result of postulated leakage or failure of a waste gas storage tank or offgas system.[32]

B. Specific criteria necessary to meet the relevant requirements of the Commission regulations are as follows:

1. The gaseous waste management system~~s~~ should have the capability to meet the dose design objectives and include provisions to treat gaseous radioactive wastes such that:

a. The calculated annual total quantity of all radioactive material released from each reactor at the site 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 millirems)[33] to the total body or 0.15 mSv (15 millirems)[34] to the skin.

b. The calculated annual total quantity of all radioactive material released from each reactor at the site 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)[35] for gamma radiation or 0.02 cGy (20 millirads)[36] for beta radiation.[37]

~~b~~c. The calculated annual total quantity of all radioactive iodine, carbon-14, tritium, and radioactive material 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 ~~radioactive iodine and radioactive material in particulate form~~ releases[38] for any individual in an unrestricted area from all pathways of exposure in excess of 0.15 mSv (15 millirems)[39] to any organ.

~~c~~d. In addition to a~~.~~, b, and ~~b~~ c, above, the gaseous waste management systems should include all items of reasonably demonstrated technology that when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio effect reductions in dose to the population reasonably expected to be within 80 km (50 miles)[40] of the reactor. Regulatory Guide 1.110 provides an acceptable method for performing this analysis.[41]

~~d~~e. The concentrations of radioactive materials in gaseous effluents released to an unrestricted area should not exceed the limits specified in 10 CFR Part 20, Appendix B, Table~~II~~ 2,[42] Column 1.

2. The gaseous waste management system 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. ~~ETSB~~ SPLB will accept 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. To meet these processing demands, ~~ETSB~~ SPLB will consider shared systems, redundant equipment, and reserve storage capacity.

3. The seismic design and quality group classification of components used in the gaseous waste management system~~s~~ and structures housing the~~se~~ system~~s~~ should conform to the guidelines of 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.

4. ~~ETSB~~ SPLB will accept system designs that contain provisions to control leakage and to facilitate operation and maintenance in accordance with the guidelines of Regulatory Guide 1.143.

5. ~~ETSB~~ SPLB will 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 iodine different 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 effects of aging and poisoning by airborne contaminants should also be supported by test data.

6. If the potential for an explosive mixture of hydrogen and oxygen exists, the GRS portion of the gaseous waste management system~~s~~ 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.[43]

   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).

      Small allowances should be made to conform to standard design pressures for off-the-shelf components; i.e., if the system operating pressure is nominally 103 kPa (15 psia)[44] but could approach 138 kPa (20 psia),[45] by design, piping could be designed to 2413 kPa (350 psia),[46], since the next higher standard pressure rating is 4137 kPa (600 psia).[47]

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

   b. 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. "high alarm" should be set approximately 2% and "High-high alarm" should be set at a maximum of 4% hydrogen or oxygen.

Control features to reduce potential for explosion should be automatically initiated at "high-high alarm" setting. The automatic control features should be as follows: (1) for systems designed to preclude explosions by maintaining either hydrogen or oxygen below 4%, the source of hydrogen or oxygen (as appropriate) should be automatically isolated from the system (valve should fail in closed position); (2) for systems using recombiners, if the downstream hydrogen and/or oxygen concentration exceeds 4% (as appropriate), acceptable control features include automatically switching to an alternate recombiner train; and (3) injection of diluents to reduce concentrations below the limits specified herein.

Systems designed to operate below 4% hydrogen and below 4% oxygen may be analyzed for either hydrogen or oxygen; systems designed to operate below 4% hydrogen only (no oxygen restrictions), should be analyzed for hydrogen; and systems designed to operate above 4% 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 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 at a point common to streams measured sequentially; i.e., 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 also 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 analyzers shall be nonsparking.

Technical Rationale[48]

The technical rationale for application of these acceptance criteria to reviewing the gaseous waste management system is discussed in the following paragraphs:[49]

1. 10 CFR Part 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 Part 20, § 20.1301.

   10 CFR Part 20, § 20.1302, identifies two approaches, either of which can demonstrate compliance with the dose limits of 10 CFR Part 20, § 1301. The requirements for one of these approaches are the following:

   a. Demonstrate that the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the effluent concentration limits specified in Table 2 of Appendix B to 10 CFR Part 20; and

   b. Demonstrate 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)[50] and 0.02 mSv (0.002 rem),[51] respectively.

   Meeting the requirement on gaseous effluent concentration limits in unrestricted areas is identified as an acceptance criterion in this SRP section. Meeting the requirement on offsite doses identified above will be reviewed by PERB as part of its primary review responsibility for SRP Section 12.1 material. Meeting both requirements provide assurance that the dose limits to individual members of the public, specified in 10 CFR Part 20, § 1301, will not be exceeded.[52]

2. Acceptance Criterion II.2 gives the technical rationale for 10 CFR Part 50, § 50.34a, requirement.

   Meeting the requirement of 10 CFR Part 50, § 50.34a, as it relates to the gaseous waste management system provides assurance that the nuclear power reactors will meet the requirement that controlled releases of radioactive material in effluents to the

environment of unrestricted areas in the vicinity of a nuclear facility will be kept as low as is reasonably achievable and that the gaseous waste management system 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, § 1302; 10 CFR Part 50, Appendix I; and GDC 60 and 61.[53]

3. General Design Criterion 3 provides that structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions.

With regard to the GRS portion of the Gaseous Waste Management System, this GDC requires that if a potential for explosive hydrogen/oxygen mixtures exist, then the GRS must be designed to withstand the effects of such an explosion, or be provided with dual instrumentation and design features to annunciate and prevent the buildup of potentially explosive mixtures, respectively.

Meeting the requirements of GDC 3 provide assurance that the GRS is protected from the effects of an explosive mixture of hydrogen and oxygen and that the safety functions of other structures, systems, and components will not be compromised.[54]

4. Compliance with GDC 60 requires that design provisions be included in the nuclear power unit to control suitably the release 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 the radioactive waste particularly where unfavorable site environmental conditions may impose unusual operational limitations upon the release of the effluent. The holdup capacity also provides time to allow the shorter lived isotopes a chance to decay before they are further processed or released to the atmosphere.

Meeting the requirement 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 limits specified in 10 CFR Part 50, Appendix I, and concentrations of radioactive material in gaseous effluents in any unrestricted area exceeding the limits specified in 10 CFR 20, Appendix B, Table 2, Column 1.[55]

5. Compliance with GDC 61 requires that the gaseous waste management system and other systems which 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.

RG 1.140 furnishes design guidance acceptable to the NRC staff relating to design, testing, and maintenance criteria for air filtration and adsorption units and RG 1.143 furnishes design guidance acceptable to the NRC staff relating to seismic and quality

group classification and quality assurance provisions for the GRS portion of the gaseous waste management system, structures, and components.

Meeting the requirement 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 Part 20. In addition, meeting the requirement will help assure that the system will continue to perform its safety function(s) under postulated accident conditions.[56]

6. Appendix I to 10 CFR Part 50 provides numerical guidance for design objectives to meet the requirements that radiation doses due to radioactive material in effluents released to unrestricted areas be kept as low as is reasonable achievable. Section II of Appendix I relates to the numerical guides for dose design objectives and limiting conditions for operation to meet the "as low as is reasonably achievable" criterion.

Regulatory Guide 1.140 presents methods acceptable to the staff for implementing the regulations in Appendix I by providing guidance on the design, testing and maintenance criteria for HEPA filters and charcoal adsorbers in filtration systems.

Meeting 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 due to gamma radiation and beta radiation, and radiation doses due to carbon-14, tritium, particulates and iodine to a maximally exposed offsite individual due to 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.[57]

7. Branch Technical Position (BTP) ETSB 11-5 contains system design guidelines and failure assumptions that provide adequate and acceptable design solutions for meeting the requirements of 10 CFR Part 50, § 50.34a, and General Design Criteria 60 and 61 of Appendix A.

The purpose of BTP ETSB 11-5 is to provide guidelines on postulated radioactive releases due to a GRS leak or failure. The intent is to minimize potential radiation and to minimize the radiological consequences of a single failure of an active component in the waste gas system.

Following the assumptions and guidelines of BTP ETSB 11-5 provide assurance that releases of radioactive materials would not result in doses that would exceed a small fraction (i.e., 10%) the guidelines of 10 CFR Part 100 for a postulated failure of the GRS or postulated leak from the GRS.[58]

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from this SRP section, as may be appropriate for a particular case.

1. In the ~~ETSB~~ SPLB review of the gaseous waste management systems, the P&IDs and system process flow diagrams are reviewed to determine all sources of gaseous waste, the points of collection of gaseous wastes, the flow paths of gases through the systems, including all bypasses, the treatment provided and the points of release of gaseous effluents to the environment. This information is used to calculate the quantity of radioactive material (noble gases, radioiodine, and particulates) released annually in gaseous effluents during normal operations, including anticipated operational occurrences, using the given parameters, the GALE Code, and the calculational techniques given in NUREG Reports 0016 and 0017. A complete Fortran listing of the GALE computer code is given in these reports. The results of this calculation will be used to determine whether the proposed gaseous waste management systems design meets the acceptance criterion of subsection II.B.1.d of this SRP section. Compliance with the acceptance criteria of subsection II.B.1.a and b of this SRP section concerning exposures of the total body, skin, and thyroid will be determined based on ~~RAB~~ PERB dose calculations using the ~~ETSB~~ SPLB calculated source term. Conformance with the acceptance criterion given in subsection II.B.1.c of this SRP section concerning the cost-benefit analysis will be determined based on ~~RAB~~ PERB man-Sv (rem)[59] dose calculations in conjunction with ~~ETSB~~ SPLB cost-benefit studies.

2. The ~~ETSB~~ SPLB review of the gaseous waste management systems design capacity will encompass two major areas:

   a. The capability of the GRS portion of the[60] system to process gaseous wastes in the event of a single major equipment item failure. For nonredundant equipment or components, ~~ETSB~~ SPLB will assume a 3-week downtime every other year (10 days per year average).

   b. The capability of the GRS portion of the[61] system to process gaseous wastes at design basis fission product levels, i.e., from 1% of the fuel producing power in a PWR or, in a BWR, consistent with a noble gas release rate of 3.7 MBq/sec/MWt (100 µCi/sec/MWt)[62] at 30 minutes delay.

      ~~ETSB~~ SPLB will review the operational flexibilities designed into the ~~system~~ GRS,[63] e.g., cross connections between subsystems, redundant or reserve processing equipment, and reserve storage capacity.

      In the evaluation of charcoal delay systems for radioactive gas decay, ~~ETSB~~ SPLB considers the bed dimensions, mass of charcoal, flow rate, temperatures, pressures, humidity, and dynamic adsorption coefficients to calculate the effective holdup times.

   c. SPLB will review the analyses for the whole body dose at the exclusion area boundary using the assumptions given in BTP ETSB 11-5.[64]

3. ~~ETSB~~ SPLB compares the quality group classification of piping and equipment in the GRS portion of the[65] gaseous waste management system with the guidelines of Regulatory Guide 1.143. ~~ETSB~~ SPLB also compares the seismic design criteria of

equipment and of structures housing the GRS with the design guidance identified in Regulatory Guide 1.143. The exceptions are transmitted to EMEB, which has primary responsibility under SRP Sections 3.2.1 and 3.2.2 and to SEB, which has primary responsibility under SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1, 3.7.2, 3.7.3, 3.7.4, 3.8.4, and 3.8.5. ~~ETSB~~ SPLB also determines if the applicant's design includes adequate provisions to stop continuous leakage paths after an explosion. The areas of concern are (1) streams where water decomposition gases (hydrogen and oxygen) exist in a BWR, (2) cover gas streams where air inleakage can occur in a PWR, and (3) where there is a possibility of liquid hydrocarbons and ozone collecting in a cryogenic distillation system.

4. ~~ETSB~~ SPLB will compare the system design, system layout, equipment design, method of operation, and provisions to reduce leakage and to facilitate operations and maintenance of the GRS[66] to the guidelines of Regulatory Guide 1.143. ~~ETSB~~ SPLB will evaluate special design features provided to control leakage from system components and topical reports on system designs on a case-by-case basis.

5. ~~ETSB~~ SPLB will compare the design, testing and maintenance criteria for HEPA filters and charcoal adsorbers in filtration systems with the guidelines of Regulatory Guide 1.140.

6. If there is a potential that explosive hydrogen/oxygen mixtures exist, ~~ETSB~~ SPLB will determine, using the system description and P&IDs, whether the applicant has designed the ~~gaseous waste management system~~ 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.[67]

7. At the OL or COL[68] stage ~~ETSB~~ SPLB will review the ~~technical specifications~~ TS, i.e., administrative control section, proposed by the applicant for process and effluent control for input into SRP Section 16.0. The reviewer will determine that the content, ~~and~~ intent, and scope of the programs identified in the administrative controls section of the ~~technical specifications~~ TS prepared by the applicant are in agreement with the requirements developed as a result of the staff's review. The review will include the evaluation or development of appropriate limiting conditions for operation and their bases consistent with the plant design and the requirement of 10 CFR Part 50, § 50.36a. The programs identified in the administrative controls section of the TS are reviewed with respect to the requirements of 10 CFR Part 50, § 50.36a.[69]

8. ~~ETSB~~ SPLB reviews the quality assurance provisions for the ~~gaseous waste management systems~~ GRS[70] in accordance with Regulatory Guide 1.143. The exceptions are transmitted to ~~QAB~~ HQMB,[71] which has the primary responsibility under SRP Sections 17.1 and 17.2.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains

procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[72]

IV. EVALUATION FINDINGS

~~ETSB~~ SPLB verifies that sufficient information has been provided and that the review is adequate to support conclusions of the following type, to be included in the staff's safety evaluation report (SER):

> The staff concludes that the design of the gaseous waste management systems is acceptable and meets the requirements of 10 CFR Part 20, ~~§20.106~~ § 20.1302;[73] 10 CFR Part 50, § 50.34a; General Design Criteria 3, 60, and 61; and 10 CFR Part 50, Appendix I. 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 material to the environment by assuring that the design of the gaseous waste management systems include the equipment and instruments necessary to detect and to control the release of radioactive materials in gaseous effluents.
>
> 2. The applicant has met the requirements of Appendix I of 10 CFR Part 50 by meeting "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, and carbon-14[74] and particulates) in gaseous effluents for normal operation including anticipated operational occurrences based on expected radwaste inputs over the life of the plant for each reactor on the ( ) site. The staff has determined that the proposed gaseous waste management systems are 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)[75] to the total body or 0.15 mSv (15 mrem),[76] to the skin and less than 0.15 mSv (15 mrem)[77] to any organ from releases of radioiodine, tritium, carbon-14,[78] and radioactive material in particulate form.
>
>   b. The staff has further determined that the calculated air doses from the 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.[79]
>
>   ~~b~~c. Regarding Section II.D of Appendix I, the staff has considered the potential effectiveness of augmenting the proposed gaseous waste management system~~s~~ using items of reasonably demonstrated technology and have determined that further effluent treatment will not effect reductions in the cumulative population dose within a 80 km (50-mile)[80]

radius of the reactor at a cost of less than $1,000 per man-rem or $1,000 per man-thyroid-rem.[81]

3. The applicant has met the requirements of 10 CFR Part 20 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/MWt-sec (100 μCi/MWt-sec)[82] at 30 minutes decay" for a BWR and 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 10 CFR Part 20, Appendix B, Table ~~II~~ 2,[83] column 1.

4. The staff has considered the capabilities of the proposed gaseous waste management system~~s~~ to meet the anticipated demands of the plant due to anticipated operational occurrences and have concluded that the system capacity and design flexibility are adequate to meet the anticipated needs of the plant.

5. The staff has reviewed the applicant's quality assurance provisions for the GRS portion of the gaseous waste management systems, the quality group classifications used for ~~systems~~ the GRS components, the seismic design applied to the design of the ~~systems~~ GRS, and of structures housing the ~~radwaste systems~~ GRS. The design of the ~~system~~ GRS and structures housing ~~these systems~~ the GRS meet the criteria as set forth in Regulatory Guide 1.143.[84]

6. The staff has reviewed the provisions incorporated in the applicant's design to control releases due to hydrogen explosions in the ~~gaseous waste management systems~~ GRS[85] and concluded 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 General Design Criterion 3 of Appendix A to 10 CFR Part 50.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[86]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licenses regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[87] Except in those cases in which the applicant proposes an acceptable alternative method for complying with

specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[88]

~~Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides and NUREGs.~~[89]

VI. REFERENCES

1. 10 CFR Part 20, "Standards for Protection Against Radiation."

2. 10 CFR Part 50, § 50.34a, "Design Objective for Equipment to Control Releases of Radioactive Materials in Effluents - Nuclear Power Reactors."

3. 10 CFR Part 50, § 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors.

4. 10 CFR Part 50, Appendix A, General Design Criterion 3, "Fire Protection," General Design Criterion 60," Control of Releases of Radioactive Materials to the Environment," and General Design Criterion 61 "Fuel Storage and Handling and Radioactivity Control."

5. 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."

6. NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWRs)," current revision.[90]

7. NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWRs)," current revision.[91]

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

9. 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."

BRANCH TECHNICAL POSITION ETSB 11-5
(Currently the responsibility of the SPLB)[92]
Postulated Radioactive Releases Due to a Waste Gas
System Leak or Failure

A. BACKGROUND

During normal operation of a nuclear power plant, radioactive fission and activation gases and gases that are the result of radiolytic decomposition of water are generated in the reactor and are continuously removed from the reactor coolant. After separation, the gases may be treated for volume reduction of the nonradioactive species before the radioactive gases are stored for radioactive decay prior to release to the environment. The system to accomplish this separation, reduction, and decay process is called the waste gas system.

The waste gas system at BWRs may include steam air ejectors, vacuum pumps, decay pipes, moisture separators, condensers, cryogenic distillation, tanks, ambient or chilled charcoal adsorbers, filters, process sampling, instrumentation and radiation monitoring, and control features. The waste gas system at PWRs may include volume control tank, letdown or shim bleed gas separation, gas stripping, cover gas collection, compressors, recombiners, surge and storage tanks, ambient or chilled charcoal adsorbers, moisture separators, condensers, filters, process sampling, instrumentation and radiation monitoring, and control features. In all cases, the waste gas system is a radioactive gaseous waste management system and information on the system is considered as part of the design information required by 10 CFR Part 50, § 50.34a. ~~, with s~~System operation is required to be in accordance with § 50.36a. The design acceptance criteria for waste gas systems (i.e*., Gaseous Waste Management Systems has been given in SRP Section 11.3.[93]

The basic criterion for reactor accidents, including waste gas system failures, is that offsite doses shall not exceed 25 rem to the whole body (10 CFR Part 100). However, that criterion is predicated on the assumption that the probability of occurrence is very small. At least since 1972, it has been recognized that the probability of an accidental release from the waste gas system is relatively high and that lower dose criteria are appropriate.

Generally two kinds of waste gas system failures have been designated as warranting evaluation. These are (1) gross system failures, such as rupture of a decay tank (Regulatory Guide 1.24, Rev. 0, March 1972) or rupture of a line (Regulatory Guide 1.98, For Comment, March 1976) and (2) malfunctions, such as operator errors, valve misalignments, malfunction of attendant equipment and active component failures. Both the probabilities and the consequences of a waste gas system leak or failure depend on the kind of accident considered and the characteristics of the system (Regulatory Guide 1.70 Section 15.7.1, Rev. 3, November 1978).

Waste gas systems characteristics differ between plants, particularly between BWRs and PWRs, but for present purposes the most important difference is between those systems designed to withstand the effects of a hydrogen explosion and earthquakes (Regulatory Guide 1.143) and those systems not so designed. Gross failure of the system is considered much less likely if the system is designed to withstand explosions and earthquakes. Therefore, Initially, a higher dose

criterion was considered for evaluating gross failures of the fortified systems. ~~Accordingly, higher dose criteria have been considered appropriate for evaluating gross failure of these fortified systems. Initially, a 5-rem criterion was used, but more recently the value has been 2.5 rem. For systems not designed to withstand explosions and earthquakes, the criterion has been 0.5 rem.~~[94]

This dichotomy in having different dose criteria for systems designed to withstand explosions and earthquakes and systems not designed to withstand such events had led to a problem in that system malfunctions appear to be the controlling failure mode and resistance to explosions and earthquakes provide no protection against operator error and system malfunction. No system-malfunction type failures have been designated as representative. However it appears that an event, such as valve misalignment or overpressure could give a release approximating that from the rupture of a tank or pipe. Therefore, it was considered that for future safety evaluations the waste gas system failures analyzed could be limited to tank or pipe ruptures but that the dose criterion in every case should be ~~0.5 rem~~ 25 mSv (2.5 rem) at the exclusion boundary.[95]

The purpose of this BTP is to provide guidelines on postulated radioactive releases due to a radioactive waste gas system leak or failure. The goal is to minimize potential radiation exposures to ~~workers and~~ the public, and to provide reasonable assurance that the radiological consequences of a single failure of an active component in the waste gas system would not result in exceeding ~~the guidelines of 10 CFR Part 20 for a unique unplanned release and would, therefore, be substantially below the guidelines~~ a small fraction (i.e., 10%) of 10 CFR Part 100 limit for whole body dose to any offsite individual for a postulated event.[96]

The criteria in Section B, below, provide adequate and acceptable design solutions for the concerns outlined above. This position paper sets forth minimum branch requirements and is not intended to prohibit the implementation of more rigorous design codes, standards, or quality assurance measures than those indicated nor reevaluate waste gas systems with limiting conditions for operation based on more conservative calculational assumptions.

B. BRANCH TECHNICAL POSITION

I. Waste Gas System Leak or Failure Analysis

a) Criteria: The SAR (Section 15.7.1) should provide an analysis of the radiological consequences of a single failure of an active component in the waste gas system. The analysis should provide reasonable assurance that in the event of a ~~unique unplanned release of radioactive gas from~~ a postulated failure or leak of the waste gas system, the resulting total body exposure to an individual at the nearest exclusion area boundary will not exceed 25 mSv (25 rem) ~~0.5 rem~~. This is consistent with the dose criterion for the event ~~guidelines of 10 CFR Part 20~~ and is a small fraction ~~substantially below the guidelines~~ of 10 CFR Part 100 limit.[97] The bases for the analysis should include the assumption that the waste gas system fails to meet its design intent as required by 10 CFR Part 50, § 50.34a(c), and Appendix A, GDC 60.

b) Source Term: The safety analysis on the radiological consequences of a single failure of an active component in the waste gas system should use a system design basis source term for light-water-cooled nuclear power plants. The NRC staff method of calculation for this analysis is based on ~~a~~ conservative assumption~~s that the waste gas system maximum~~ to maximize the design capacity source term (sustained power operation). ~~is 7 times greater than the source term considered for normal operation, including anticipated operational occurrences, as given in SRP Section 11.1. This assumption is in good agreement with previous design basis analysis which used:~~ These assumptions are given below:[98]

1) For a PWR: 1% of the operating fission product inventory in the core being released to the primary coolant, or

2) For a BWR: A fission product release rate consistent with the noble gas release to the reactor coolant of 100 µCI/sec/MWt (after 30 min. decay).

The analysis should assume principle parameters and conditions typical of the equipment designed to remove radioactive gases from the coolant and process and treat these gases during normal operation, including anticipated operational occurrences by the waste gas system. The NRC staff considers that there would be no major alteration in the use or performance of gas separation, reduction, and decay equipment prior to and immediately following this unique unplanned release affected by the waste gas system maximum design capacity source term.

~~c) Release: The safety analysis on the radiological consequences of a single failure of an active component in the waste gas system involves a release method having the consequence of being a unique unplanned release. Such releases are less frequent than those considered by anticipated operational occurrences and cannot be included in a meaningful annual average for routine releases applicable to plant effluents in 10 CFR Part 50, Appendix I. At the same time, the radiological impact due to such a unique unplanned release has the characteristics of an accident and is important to the health and safety of workers and the public. Waste gas systems designed to acceptance criteria of SRP Section 11.3 have low probability of passive failure, excluding events required by the guidelines of 10 CFR Part 100. All principal release points are to be monitored and controlled according to the requirements of 10 CFR Part 50, Appendix A, GDC 60 and 64, and SRP Section 11.5 provides the acceptance criteria for release point instrumentation to assure that setpoints are established on gaseous effluent lines prior to exceeding the limits of 10 CFR Part 20.[99]~~

~~Therefore, the most credible unique unplanned release would be a major leak or a single active failure of a waste gas system component releasing gas by a~~ The NRC staff considers that the release to the environment resulting from the postulated event will be via a pathway not normally used for planned releases and ~~requiring~~ the release will

require a reasonable time to detect and take remedial action to terminate the release. The NRC staff considers that the release of a compressed gas storage tank of a batch-type waste gas system or the inadvertent bypass of the main decay portion of a continuous-type waste gas system (such as charcoal delay beds in a BWR augmented off-gas system) would provide a conservative assumption for ~~any unique unplanned~~ the release while the input to the waste gas system is at the system design basis source term. Only the radioactive noble gases (Xe, Kr, Ar) are to be considered since the assumed transit time is great enough to permit major radioactive decay of oxygen and nitrogen isotopes. Particulates and radioiodines are assumed to be removed by pretreatment, gas separation, and intermediate radwaste treatment equipment. The release should be assumed to occur within the building structure housing the waste gas system storage tank or main decay position of the system.~~, and~~ It should further be assumed that the effluent resulting from the postulated event will be released to the environs without continuous effluent radiation monitoring to automatically isolate and/or terminate the effluent release. Also, g~~G~~round-level release without credit for a building wake factor should be assumed, and a conservative (5%) short-term diffusion estimate for the Value (X/Q) determined by a method outlined in the acceptance criteria in SRP Section 2.3.4, should be assumed. No deposition is assumed to occur during downwind transport.[100]

II. Staff Method for Analysis

a) Pressurized Storage Tanks: The safety analysis for the radiological consequences, of a single failure of an active component in a waste gas system, with compressed gas storage (holdup or decay) tanks or cover gas tanks assumes that the tank being filled has a major leak to the environs. The radioactive noble gas inventory in the tank, at 100% capacity, should be determined based on the system design capacity source term using the parameters and principal components considered for pretreatment and collection of waste gas to the waste gas system tanks during normal operation, including anticipated operational occurrences.

To determine the pressurized storage tank noble gas inventory, the staff method of calculation alters the PWR-GALE Code (NUREG-0017) and requires manual calculations to determine the radiological impact.

1) Enter a value of zero for the "Holdup Time, in days, for Xe."

2) Enter a value of zero for the "Holdup Time, in days, for ~~Y~~Kr."

3) Check the value entered for "Fill Time, in days." This should be the average volume for all storage or cover gas tanks. If this is a cover gas system, calculate the effective fill time based on 20% of the liquid tank volumes. (Charcoal delay systems are not applicable.) The PWR-GALE Code limits the minimum fill time to 0.01 days.

4) Rerun the computer program for this analysis only.

5) Multiply each noble gas printout given, under "Gas Stripping - Continuous" by ~~7~~ the ratio of the noble gas concentration in the reactor coolant corresponding to 1% failed fuel to that noble gas concentration in the coolant given by GALE printout. This adjustment is to account for the design capacity source term correction.[101]

6) Divide the values in step 5 above by the number of tanks filled per year (equal to 365/value in step 3 above). This gives ~~to~~ the tank inventory A_i for each nuclide.

7) Calculate the radiological impact by the following equation:

Dose (mrem) = E $K_i A_i$ (X/Q)(10^{12} pCi/Ci)/3.15X10^7 sec/year
where,

A_i = The noble gas nuclide activity determined in step 6 above, in curies/event.

K_i = The total-body dose factor given as DFB_i in Table B-1 of Regulatory Guide 1.109, mrem-m^3/pCi/yr.

(X/Q) = The relative concentration at the nearest exclusion boundary given in Figure 1 of Regulatory Guide 1.24 for ground-level releases, in sec/m^3.

8) The sum dose shall be less than 25 mSv (2.5 rem) ~~500 mrem~~. Using the same parameters, the technical specifications will set a curie limit on a tank, based on the maximum of 25 mSv (2.5 rem) ~~500 mrem~~ at the nearest exclusion boundary and using the same noble gas mixture.[102]

b) Charcoal Delay Units: The safety analysis for the radiological consequences of a single failure of an active component in a waste gas system with charcoal delay units assumes that the charcoal unit is bypassed with a 1-hour release to the environs. The staff considers that either a line bypass valve malfunction, control error, or bed bypass would require the remedial action by isolation, and that starting an alternate charcoal unit, if available, or reducing reactor power could take up to 2 hours. The radioactive noble gas concentration should be determined based on the system design capacity source term using the parameters and principal components considered for pretreatment and collection of waste gas to the waste gas system charcoal delay units during normal operation, including anticipated operational occurrences. To determine the releases without the charcoal delay unit, the staff method of calculation uses the BWR-GALE Code (NUREG-0016) and requires manual calculations to determine the radiological impact. Alterations to the PWR-GALE Code (NUREG-0017) are also included.

1) Enter a value of 0.02 for the "Holdup Time, in days, for Xe." (BWR- or PWR-GALE Code)

2) Enter a value of 0.02 for the "Holdup time, in days, for Kr." (BWR or PWR GALE Code)

(This time, about 30 minutes, is considered for gases to travel through the components in the waste gas system via the release point to the nearest exclusion boundary.)

3) Rerun the computer program for this analysis only.

4) Multiply each noble gas printout given under "Air Ejector" by ~~7~~ 0.002 MWE where MWE represents the reactor power level to account for the design capacity source term correction.[103]

5) Add to each noble gas value determined in step 4, above, the applicable value for the nuclide given in the source term for normal operation. This step will account for noble gases which have been delayed in the charcoal unit being released during the event.

6) Calculate the radiological impact by the following equation:

Dose (mrem) = $E\ K_i Q_i (X/Q)(10^{12}\ pCi/Ci)(7.25 \times 10^{-12} yr^2/event\text{-}sec)$
where,

Q_i = The noble gas nuclide release rate determined in steps 4 and 5, above, in curies/yr rate for 2 hrs.

K_i = The total-body dose factor given as DFB_i in Table B-1 of Regulatory Guide 1.109, in mrem-m^3/pCi/yr.

(X/Q) = The relative concentration at the nearest exclusion boundary given in Figure 1 of Regulatory Guide 1.24 for ground-level releases, in sec/m^3

7) The sum dose shall be less than 25 mSv (2.5 rem) ~~500 mrem~~. Using the same parameters, the technical specifications will set a maximum release rate to the waste gas system of 100 µCi/sec/MWt (after 30 min. decay) or use the value of Q_i (in µCi/sec) determined above, whichever is less, to assure that the BTP criteria of 25 mSv (2.5 rem) ~~500 mrem~~ individual exposure for 2 hrs at the nearest exclusion boundary is met.[104]

SRP Draft Section 11.3
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	PRB Comment C1 (attached)	Changed "systems" to system. (Global change for this section where appropriate.)
2.	Current PRB name and acronym	Changed PRB to Plant Systems Branch (SPLB).
3.	Current SRB name and acronym	Changed SRB to Emergency Preparedness and Radiation Protection Branch (PERB).
4.	SRP-UDP format item	Added reference to standard design certification stage of review.
5.	Current PRB acronym	Changed PRB to SPLB. (Global change for this section.)
6.	SRP-UDP format item	Added reference to combined license (COL) stage of review.
7.	SRP-UDP format item	Added reference to standard design certification stage of review.
8.	PRB comment C1	Standardized on "gaseous waste management system" (global for this section.)
9.	PRB comment C4	Added "tritium, carbon-14."
10.	PRB comment C2	Added a description of the scope (provided by the PRB) of the gaseous waste management system.
11.	SRP-UDP format item	Editorial comment to indicate that RG 1.143 should be updated in accordance with IPD Form # 11.2-1.
12.	SRP-UDP Format Item	Deleted parenthetical reference identification for Regulatory Guide 1.143 in accordance with SRP-UDP guidance.
13.	SRP-UDP format item	Added "Review Interfaces" to facilitate grouping the secondary review branches and the other SRP sections that support the review of SRP Section 11.3.
14.	SRP-UDP format item	Relocated review tasks to the PRB's area of responsibility - SPLB.
15.	SRP-UDP format item	Added a sentence to indicate coordinating review branches.
16.	Current SRB name and acronym	Changed SRB to PERB.
17.	Current SRB acronym	Changed SRB to PERB. (Global change for this section.)

Item	Source	Description
18.	Integrated Impact No. 459 and PRB comment C13A	Added reference to "offsite dose calculation manual (ODCM)" based on Generic Letter 89-01, Supplement No. 1, which allows OL applicants to relocate Radiological Effluent Technical Specification (RETS) to the ODCM, a controlled document.
19.	SRP-UDP format item	Deleted redundant statement.
20.	Current review branch name and acronym	Changed review branch for selected sections of SRP Chapter 3 - Civil Engineering and Geosciences Branch (ECGB).
21.	Current review branch	Changed review branch to ECGB.
22.	SECY 93-087	Deleted reference to the OBE to reflect the provisions of SECY 93-087 (see IPD-7.0 Form No. 11.2-1).
23.	SRP-UDP format item and current review branch name and acronym	Changed review branch for SRP Section 16.0 - Technical Specifications Branch (TSB).
24.	SRP-UDP format item and current review branch name and acronym	Changed review branch for SRP Chapter 17 - Quality Assurance and Maintenance Branch (HQMB).
25.	SRP-UDP format item	Deleted redundant statement.
26.	Integrated Impact No. 461	Changed to indicate the new Part 20 section number - §20.1302.
27.	SRP-UDP format item	Introduced initialism for GDC 3.
28.	SRP-UDP format item	Introduced initialism for GDC 60.
29.	SRP-UDP format item	Introduced initialism for GDC 61.
30.	SRP-UDP format item	Editorial comment to indicate that RG 1.140 should be updated.
31.	PRB comment C3	Revised sentence for added clarity.
32.	Integrated Impact No. 460	Modified to include BTP ETSB 11-5 as review criteria.
33.	Conversion of 5 millirems to SI units	Converted 5 millirems to 0.05 mSv.
34.	Conversion of 15 millirems to SI units	Converted 15 millirems to 0.15 mSv.
35.	SRP-UDP format item	Checked the conversion of 10 millirads to the metric system (0.01 cGy) and included results in the metrication documentation for SRP Section 11.3.
36.	SRP-UDP format item	Checked the conversion of 20 millirads to the metric system (0.02 cGy) and included results in the metrication documentation for SRP Section 11.3.
37.	PRB comment C4	Added new paragraph b. at the direction of the PRB and relettered subsequent paragraphs.
38.	PRB comment C4	Revised sentence at the direction of the PRB reviewer.

Item	Source	Description
39.	Conversion of 15 millirems to SI units	Converted 15 millirems to 0.15 mSv.
40.	Conversion of 50 miles to SI units	Converted 50 miles to 80 km.
41.	PRB comment	Included guidance based on Regulatory Guide 1.110 at the direction of the PRB reviewer.
42.	Editorial	Corrected "Table II" to "Table 2."
43.	PRB comment	Revised paragraph for added clarification.
44.	Conversion of 15 psia to SI units	Converted 15 psia to 103 kPa.
45.	Conversion of 20 psia to SI units	Converted 20 psia to 138 kPa.
46.	Conversion of 350 psia to SI units	Converted 350 psia to 2413 kPa.
47.	Conversion of 600 psia to SI units	Converted 600 psia to 4137 kPa.
48.	SRP-UDP format item	Added "Technical Rationale" to ACCEPTANCE CRITERIA and organized in numbered form to incorporate the bases for the acceptance criteria.
49.	SRP-UDP format item	Added the lead-in statement for the "Technical Rationale."
50.	SRP-UDP format item	Checked the conversion of 0.05 rem to the metric system (0.5 mSv) and included results in the metrication documentation for SRP Section 11.3.
51.	SRP-UDP format item	Checked the conversion of 0.002 rem to the metric system (0.02 mSv) and included results in the metrication documentation for SRP Section 11.3.
52.	SRP-UDP format item and PRB comment C5	Revised draft technical rationale for the 10 CFR Part 20, § 1302 criterion in accordance with instructions from the PRB reviewer.
53.	SRP-UDP format item and PRB comment C6	Revised draft technical rationale for the 10 CFR Part 50, § 50.34a criterion in accordance with instructions from the PRB reviewer.
54.	SRP-UDP format item and PRB comment C7	Revised draft technical rationale for GDC 3 in accordance with instructions from the PRB reviewer.
55.	SRP-UDP format item and PRB comment C8	Revised draft technical rationale for GDC 60 in accordance with instructions from the PRB reviewer.
56.	SRP-UDP format item and PRB comments C9 and C10	Added the technical rationale for GDC 61, RG 1.140, and RG 1.143 as revised by the PRB reviewer.
57.	SRP-UDP format item and PRB comment C11	Added the technical rationale for 10 CFR Part 50, Appendix I, and RG 1.140.
58.	SRP-UDP format item and PRB comment C12	Added the technical rationale for BTP ETSB 11-5, as revised by the PRB reviewer.

Item	Source	Description
59.	Conversion of man-rem to SI units	Converted man-rem to man-Sv.
60.	PRB comment C13	Added "GRS portion of the" at the direction of the PRB reviewer.
61.	PRB comment C13	Added "GRS portion of the" at the direction of the PRB reviewer.
62.	Conversion of 100 µCi/sec/MWt to SI units	Converted 100 µCi/sec/MWt to 3.7 MBq/sec/MWt.
63.	PRB comment	Replaced "system" with "GRS" at the direction of the PRB reviewer.
64.	Integrated Impact No. 460	SRP modification to include BTP ETSB 11-5 as review criteria.
65.	PRB comment C13	Added "GRS portion of the" at the direction of the PRB reviewer.
66.	PRB comment	Specified the GRS.
67.	PRB comment	Revised sentence at the direction of the PRB reviewer.
68.	SRP-UDP format item	Added reference to combined license stage of review.
69.	Integrated Impact No. 459 and PRB comment C13a	Revised paragraph at the direction of the PRB reviewer. Generic Letter 89-01, Supplement 1, SUBJECT: NUREG-1301 - "OFFSITE DOSE CALCULATION MANUAL GUIDANCE: STANDARD RADIOLOGICAL EFFLUENT CONTROLS FOR PRESSURIZED WATER REACTORS" allows PWR OL applicants to relocate RETS to the ODCM, a controlled document (NUREG-1302 provides similar guidance for BWRs.)
70.	PRB comment	Replaced "gaseous waste management systems" with "GRS."
71.	Current review branch acronym	Changed review branch to HQMB.
72.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
73.	Integrated Impact No. 461	Editorial change to indicate the new Part 20 section number - § 20.1302.
74.	PRB comment C14	Added "tritium and carbon-14."
75.	Conversion of 5 mrem to SI units	Converted 5 mrem to 0.05 mSv.
76.	Conversion of 15 mrem to SI units	Converted 15 mrem to 0.15 mSv.
77.	Conversion of 15 mrem to SI units	Converted 15 mrem to 0.15 mSv.
78.	PRB comment C14	Added "tritium and carbon-14."

Item	Source	Description
79.	PRB comment C14	Added a new paragraph b addressing gamma and beta air doses in unrestricted areas.
80.	Conversion of 50 miles to SI units	Converted 50 miles to 80 km.
81.	SRP-UDP format item	The metric conversion of rem to Sv should be postponed pending metrication of the source document, 10 CFR Part 50, Appendix I.
82.	Conversion of 100 µCi/sec/MWt to SI units	Converted 100 µCi/sec/MWt to 3.7 MBq/sec/MWt.
83.	Editorial	Corrected "Table II" to "Table 2."
84.	PRB comment C14	Substituted "GRS" for various "systems" throughout the paragraph.
85.	PRB comment	Replaced "gaseous waste management systems" with "GRS."
86.	SRP-UDP format item	Added reference to the design certification reviews .
87.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
88.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
89.	SRP-UDP format item	Deleted outdated guidance.
90.	SRP-UDP format item	Editorial change to indicate current revision is to be used.
91.	SRP-UDP format item	Editorial change to indicate current revision is to be used.
92.	SRP-UDP Format Item	Revised the BTP title to reflect the current PRB responsibility for the reviews performed in accordance with the BTP guidance. This change is made in accordance with SRP-UDP guidance.
93.	PRB comment C16	Revised paragraph for clarification (at the direction of the PRB reviewer).
94.	Integrated Impact No. 1421 and PRB comment C16	Revised paragraph for clarification (at the direction of the PRB reviewer).
95.	PRB comment C16	Revised paragraph for clarification (at the direction of the PRB reviewer).
96.	PRB comment C16	Revised paragraph for clarification (at the direction of the PRB reviewer).
97.	PRB comment C17	Revised paragraph for clarification (at the direction of the PRB reviewer).

Item	Source	Description
98.	PRB comment C17	Revised paragraph for clarification (at the direction of the PRB reviewer).
99.	PRB comment C18	Deleted paragraph at the direction of the PRB reviewer.
100.	PRB comment C18	Revised paragraph for clarification (at the direction of the PRB reviewer).
101.	PRB comment C19	Revised paragraph because of its incorrect guidance (at the direction of the PRB reviewer).
102.	PRB comment C12	Revised dose criteria at the direction of the PRB reviewer.
103.	PRB comment C20.	Revised guidance as directed by the PRB reviewer.
104.	PRB comment C12	Revised dose criteria at the direction of the PRB reviewer.

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SRP Draft Section 11.3
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
458	Consider adding Reg. Guides 1.109, 1.110, and 1.111 to ACCEPTANCE CRITERIA as specific guidance for assessing compliance with the guidelines of Appendix I to 10 CFR Part 50. In addition, consider revising REVIEW PROCEDURES based upon this guidance.	Not incorporated in the SRP as RG 1.109, RG 1.110 and RG 1.111 do not address the source terms used in the design of the system.
459	Consider modifying REVIEW PROCEDURES to address the content of the Offsite Dose Calculation Manual as it relates to control of radioactive gaseous effluents.	Incorporated in the SRP in Sections I (Review Interface 2.a.2) and III.7.
460	Consider revising ACCEPTANCE CRITERIA and REVIEW PROCEDURES to evaluate postulated radioactive releases due to a waste gas system leak or failure as identified in BTP ETSB 11-5.	Incorporated in the SRP in Sections II.A and III.2.
461	Consider revising the ACCEPTANCE CRITERIA, REVIEW PROCEDURES, and EVALUATION FINDINGS to replace citations of superseded sections in 10 CFR Part 20.	Incorporated in the SRP in Sections II.A.1 and IV, 2nd ¶.
462	Developing a revision to Reg. Guide 1.143 to provide an alternate method for defining seismic criteria should be considered a candidate for future work.	Not incorporated in the SRP.
1420	Consider reviewing the revised standards for applicability as SRP 11.3 review criteria and update RG 1.143 to endorse the latest version of the standards.	Not incorporated in the SRP.
1421	Update Branch Technical Position ETSB 11-5 to comply with the current revision of the GALE code, revised staff practices, SI unit nomenclature, and RG 1.170 changes.	Revised "BACKGROUND," 5th paragraph
1422	Consider reviewing the revised standards for applicability as SRP 11.3 review criteria and update RG 1.140 to endorse the latest version of the standards.	Not incorporated in the SRP.