



U.S. NUCLEAR REGULATORY COMMISSION  
**STANDARD REVIEW PLAN**  
 OFFICE OF NUCLEAR REACTOR REGULATION

SECTION 11.1

SOURCE TERMS

REVIEW RESPONSIBILITIES

Primary - Effluent Treatment Systems Branch (ETSB)

Secondary - None

I. AREAS OF REVIEW

ETSB reviews the sources of radioactivity that: (1) are input to the radioactive waste management systems employed for treatment of liquid, gaseous, and solid wastes, and (2) are used as the design bases for shielding and building ventilation systems.

1. Review of radioactive source terms includes consideration of parameters used to determine the concentration of each isotope in the reactor coolant; fraction of fission product activity released to the reactor coolant; concentrations of all non-fission product radioactive isotopes in the reactor coolant; leakage rates and associated fluid activity for all potentially radioactive water and steam systems; and potential sources of radioactive materials in effluents that are not considered in the applicant's safety analysis report (SAR) Section 11.2, "Liquid Waste Management Systems," and SAR Section 11.3, "Gaseous Waste Management Systems." The following release points are considered in the evaluations of effluent releases:

- a. Boiling water reactor (BWR) gaseous wastes (noble gases, radioiodine, and particulates), consisting of offgases from the main condenser vacuum system, offgases from the gland seal condenser, steam and liquid leakage to containment, radwaste, turbine, and auxiliary buildings, and ventilation air from buildings having the potential for containing radioactive materials.
- b. BWR liquid wastes, consisting of leakage to equipment and floor drains from buildings housing equipment and components that may contain radioactive fluids; contaminated liquids produced by plant operations, such as demineralizer regenerants and resin sluice water, filter backwashes, ultrasonic resin cleaning rinses, decontamination solutions, and laboratory samples and rinses; and detergent wastes.
- c. Pressurized water reactor (PWR) gaseous wastes (noble gases, radioiodine, and particulates), consisting of offgases from the steam generator blowdown flash tank; offgases from the main condenser vacuum system; leakage to containment,

---

 USNRC STANDARD REVIEW PLAN
 

---

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to Revision 2 of the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

---

11/24/75

9511020186 751124  
 PDR NUREG  
 75/087 R PDR

auxiliary, and turbine buildings; stripping of noble gases from the primary coolant during normal operation and at shutdown; and cover and vent gases from tanks and equipment containing radioactive material.

- d. PWR liquid wastes, consisting of primary coolant processed to control boron concentration (shim bleed); leakage collected in equipment and floor drains from buildings housing equipment and components that may contain radioactive fluids; steam generator blowdown; condensate demineralizer regenerant solutions; contaminated liquids from anticipated plant operations such as resin sluices, filter backwashes, decontamination solutions, and sample station drains; and detergent wastes.
2. The review of the radioactive material source terms used as the design bases for shielding and building ventilation systems includes, in addition to the applicable information from 1 above, the following areas:
    - a. The anticipated airborne radioactive concentrations generated during normal operation, purging, and refueling, together with the models and assumptions (leakage rates from closed systems) used to obtain these estimated concentrations.
    - b. The equipment layout, equipment design, and any special design features which may influence the concentrations of airborne radioactive materials, e.g., individually ventilated equipment cubicles, closed pump and valve seal leak-off systems, covered or ventilated liquid sumps and drains.
  3. The calculated releases of radioactive materials in liquid and gaseous effluents will be used in Standard Review Plans (SRP) 11.2 and 11.3 to evaluate the liquid and gaseous waste systems. ETSB will provide source terms to be used to evaluate shielding and occupational radiation exposures under the Chapter 12 standard review plans.

## II. ACCEPTANCE CRITERIA

1. ETSB will accept the source terms used as the design basis for expected releases if the following criteria are met:
  - a. The parameters used to calculate primary and secondary (PWR) coolant concentrations are consistent with those given in Regulatory Guides 1.BB, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Pressurized Water Reactors," and Regulatory Guide 1.CC, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Boiling Water Reactors."
  - b. All normal and potential release points of radioactive effluent delineated in Section I are considered.
  - c. For each source of liquid and gaseous waste considered in II.1.b, the volumes and radioactivity levels given for normal operation including anticipated operational occurrences are consistent with those given in Regulatory Guides 1.BB and 1.CC.

- d. Reduction factors for special design features used to reduce leakage, such as clean sealing steam for valve stems and turbine glands, are consistent with those given in Regulatory Guides 1.BB and 1.CC.
- e. Decontamination factors for inplant control measures used to reduce releases to the environment, such as iodine removal systems and high efficiency particulate air (HEPA), filters for building ventilation exhaust systems, are consistent with those given in Regulatory Guides 1.BB and 1.CC.

An acceptable method for satisfying the criteria of Section 11.1 consists of using the gaseous and liquid effluent (GALE) computer code and the source term parameters given in Regulatory Guides 1.BB and 1.CC. A complete Fortran listing of the PWR and BWR GALE computer code is given in these Regulatory Guides.

If the applicant's calculational technique or any source term parameter differs from that given in Regulatory Guide 1.BB or 1.CC, ETSB will review the justification for the calculations and parameters used and determine if they are reasonable and are consistent with operating experience.

- 2. ETSB will accept the source terms used as the design basis for shielding and ventilation exhaust systems if the following criteria are met:
  - a. Concentrations of radioactive materials in components and systems are based on the design value of the fraction of the reactor power produced in fuel with cladding defects, i.e., 1% fuel cladding defects for a PWR and an offgas rate of 100  $\mu\text{Ci/sec/MWt}$  after 30 minutes delay for a BWR.
  - b. Concentrations of airborne radioactive materials to be controlled by ventilation exhaust systems are based on design leakage values for equipment and components.
  - c. Decontamination factors for internal cleanup systems are consistent with the values given in Regulatory Guides 1.BB and 1.CC.

### III. REVIEW PROCEDURES

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

- d. In the review of the mathematical models and parameters given in the SAR to calculate primary coolant concentrations, and of the leakage rates to the radioactive waste management systems, ETSB compares parameters and calculations given in the SAR with the models and parameters given in Regulatory Guides 1.BB and 1.CC. If the SAR includes models or parameters to estimate primary coolant concentrations and leakage rates that differ from these guides, the parameters and calculations used need to be substantiated. The preferred method of substantiation is by presentation of operating data from similar reactors.

2. ETSB performs an independent calculation of the primary and secondary (PWR) coolant concentrations and of the release rates of radioactive materials using the GALE Computer Code and the "Principal Parameters for Source Term Calculations" given in Regulatory Guides 1.BB and 1.CC.
3. In the calculation, ETSB will use the applicant's values as given in the SAR for the following parameters: design core thermal power level, steam flow rate, coolant mass, and coolant purification rates.
4. ETSB will use the primary coolant concentrations and leakage rates calculated above as inputs for evaluation of the liquid waste system, under SRP 11.2, and the gaseous waste systems, under SRP 11.3, to determine if the radioactive waste management systems meets the dose design objectives of Appendix I to 10 CFR Part 50.
5. As design parameters for shielding and for building ventilation systems to be used in SAR Chapter 12, ETSB will base its source terms for PWRs on leakage from fuel rods producing 1% of the reactor power, and for BWRs, on an offgas rate of 100  $\mu\text{Ci/sec/MWt}$  at 30 minutes delay.
6. The ETSB source term calculations are used for both the review of the SAR and for the staff's Environmental Impact Statement.

#### IV. EVALUATION FINDINGS

The ETSB summary statement on the acceptability of source terms used as design parameters for the waste management systems will be made under SRP 11.2, "Liquid Waste Management Systems," and 11.3, "Gaseous Waste Management Systems."

#### V. REFERENCES

1. 10 CFR Part 20, Appendix B, "Concentrations in Air and Water Above Natural Background."
2. 10 CFR Part 50, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents, May 5, 1975.
3. Regulatory Guide 1.BB, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Pressurized Water Reactors (PWRs)."
4. Regulatory Guide 1.CC, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Boiling Water Reactors (BWRs)."