

NRC Radiological Effluent and Environmental Monitoring Programs

Regulatory References

The principal regulatory basis for requiring effluent and environmental monitoring at nuclear power plants is contained in General Design Criteria 60, 61, and 64 of Appendix A of Title 10 of the Code of Federal Regulations Part 50. The criteria require that a licensee control, monitor, perform radiological evaluations of all releases, document and report all radiological effluents discharged into the environment.

The NRC also has specific criteria that requires power reactor licensees to keep the public dose from radioactive effluents as low as it reasonably achievable (ALARA). The ALARA criteria is contained in Appendix I of 10 CFR Part 50. This criteria is very clear what the NRC expects of power reactors concerning their effluent discharges.

“The licensee shall establish an appropriate surveillance and monitoring program to:

1. Provide data on quantities of radioactive material released in liquid and gaseous effluents...;
2. Provide data on measurable levels of radiation and radioactive materials in the environment to evaluate the relationship between quantities of radioactive material released in effluents and resultant radiation doses to individuals from principal pathways of exposure; and 3. Identify changes in the use of unrestricted areas (e.g., for agricultural purposes) to permit modifications in monitoring programs for evaluating doses to individuals from principal pathways of exposure.”

Specific regulations and regulatory guidance

- 10 CFR 50.34a, Design objectives for equipment to control releases of radioactive material in effluents - nuclear power reactors.
- 10 CFR 50.36a, Technical specifications on effluents from nuclear power reactors.
- 10 CFR Part 20, Standards for Protection Against Radiation.
- 10 CFR 50.72, Immediate notification requirements for operating nuclear power reactors.
- 10 CFR 50.73, Licensee event report system.
- 10 CFR 50.75(g), Reporting and recordkeeping for decommissioning planning.
- 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. (40 FR 19437 as an effective rule on May 5, 1975)
- 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 (Rev. 1, 10/75).
- Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants. (1/73)
- Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations. (Rev. 2, 7/76)

- Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants (12/75) and Branch Technical Position (Rev. 1, 11/79; specific to environmental monitoring program).
- Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Program (Normal Operation) - Effluent Streams and the Environment.
- Regulatory Guide 1.21, Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants. (Rev. 1, 6/74)
- Regulatory Guide 1.143, Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants. (Rev. 2, 11/01)
- NUREG-0472, Radiological Effluent Technical Specifications for PWRs. (2/80)
- NUREG-0473, Radiological Effluent Technical Specifications for BWRs. (7/79)
- NUREG-1430, Technical Specifications for Babcock and Wilcox Plants. Rev 3.
- NUREG-1431, Technical Specifications for Westinghouse Plants. Rev 3.
- NUREG-1432, Technical Specifications for Combustion Engineering Plants. Rev 3.
- NUREG-1433, Technical Specifications for General Electric BWR/4 Plants. Rev 3.
- NUREG-1434, Technical Specifications for General Electric BWR/6 Plants. Rev 3.
- 10 CFR Part 50, Appendix A; Design Criteria 60, Control of Releases of Radioactive Materials to the Environment.
- 10 CFR Part 50, Appendix A; Design Criteria 61, Fuel storage and handling and radioactivity control.
- 10 CFR Part 50, Appendix A; Design Criteria 64, Monitoring Radioactivity Releases.
- 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operations. (1/77)

NRC Dose Limits from Radioactive Effluents

10 CFR Part 20 requires that each licensee shall conduct operations so that the total effective dose equivalent to individual members of the public from the licensed operations does not exceed 0.1 rem in a year, which the licensee can demonstrate by not exceeding the concentration values specified in table 2 of Appendix B to 10 CFR Part 20 when averaged over the course of a year. For tritium, the table 2 concentration value is 1×10^{-3} micocuries per milliliter (1×10^6 picocuries per liter).

Furthermore, 10 CFR Part 20 requires that power reactor licensees comply with EPA's environmental radiation standards contained in 40 CFR Part 190, i.e., 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public from the uranium fuel cycle.

The NRC also has design objectives in Appendix I to 10 CFR Part 50 to meet the criterion of As-Low-As-Reasonably-Achievable (ALARA) for reactor effluents. The design objectives for liquid effluent releases is to maintain offsite annual doses below 3 millirem to the whole body and 10 millirem to any organ. In power reactor Technical Specifications, if half of those radiation dose levels are exceeded in any calendar quarter, licensees are to investigate the cause(s), initiate a corrective action program, and report the actions within 30 days from the end of the quarter to the NRC.

EPA drinking water limit

The EPA has a maximum contamination level (MCL) of 4 millirem per year for beta particle and photon radioactivity from man-made radionuclides in drinking water. If contamination is exclusively tritium, this EPA drinking water standard corresponds to a concentration of 20,000 picocuries per liter of tritium, which is based on an annual dose of 4 millirem.

Regulatory Event Reporting

10 CFR Part 20, "Standards for Protection Against Radiation," provide many of the reporting and notification requirements for radiological issues. These requirements are contained in Subpart M, "Reports," which provides the reports of most radiological issues that NRC licensees are required to make to the NRC. In addition, 10 CFR Part 50 in section 50.72, "Immediate Notification Requirements for Operating Nuclear Power Plants," and 50.73, "Licensee Event Reporting System," provide emergency notification requirements and those for reporting events that relate primarily to reactor operating conditions.

While the regulations in 10 CFR Part 20 include NRC notification requirements for releases of radioactive material above prescribed limits and for radiation doses to the public in excess of specified limits, the licensee is also required by their operating license to implement a program for radioactive effluent controls and for monitoring the potential impact of radioactive effluents on the environment through a radiological environmental monitoring program (REMP). The REMP requires sampling of various environmental pathways including waterborne pathways at required intervals, which are to be analyzed for the presence of specified radiological constituents. Reporting levels for radioactivity concentrations in environmental samples are specified in the REMP and include reporting levels for tritium in water.

If the "reporting levels" specified in the REMP are exceeded, the licensee is required to prepare and submit a report to the NRC that identifies the problem and defines its corrective actions. The problem would also be required to be reported to the NRC in the licensee's Annual Radiological Environmental Operating Report. These reports are publically available.

NRC Inspection

The NRC conducts periodic Health Physics inspections of each licensee's radiological effluent and environmental monitoring programs once every two years, to ensure compliance with NRC requirements. The Inspection Procedure is IP 71122, Public Radiation Safety. In addition to the Health Physics inspectors, each plant has full time Resident Inspectors stationed at the site. The NRC documents the status of licensee programs in inspection reports that are available to the public.