

In-scope all

Braidwood On November 30, 2005, the licensee informed the NRC Resident Inspectors of higher than expected tritium levels (~58,000 picoCuries per liter) measured in on-site monitoring wells at the norther edge of the owner controlled area. The licensee attributed the higher levels of tritium to historical vacuum breaker valve leakage in the circulating water blowdown line to the Kankakee River that occurred in 1998 and 2000. The licensee uses the blowdown line to perform liquid effluent releases to the river.

As of December 4, 2005, the licensee has detected measurable levels of tritium in offsite groundwater. Although nearby residential wells have not shown any tritium above normal background, the licensee detected elevated levels of tritium (as high as approximately 33,700 picoCuries per liter) in monitoring wells in a vacant development immediately offsite. The licensee continues to monitor and to develop plans for remediation.

Dresden In August of 2004, the licensee identified an underground leak of its condensate storage tank (CST) piping. The licensee detected levels of tritium in onsite groundwater monitoring wells as high as 1,700,000 picoCuries per liter. The licensee isolated the leakage and replaced the faulty section of piping (November 2004). Onsite monitoring well data confirm that the flow of groundwater is generally away from any residential areas and towards the River. In 2004 and 2005, the licensee sampled the private wells of nearby residents. One of the residents' wells had measurable levels of tritium above background (approximately 900 - 950 picoCuries per liter) and has shown positive results for tritium for a number of years. However, the licensee's other monitoring results and an independent hydrology study do not appear to support that the elevated levels of tritium in that well were from the 2004 CST pipe leakage. The licensee continues to evaluate the tritium in that well, which is a normal sample point for its radiological environmental monitoring program.

Related Historical Data

Point Beach Several years ago, the licensee measured tritium onsite in an old retention pond. Since that time, the pond has been closed, and the land has been encased in concrete. However, no offsite contamination appears to have occurred.

Prairie Island In the early 1990s, the licensee measured tritium in onsite monitoring wells from the leakage of the effluent discharge pipe. The licensee monitored the groundwater for a number of years, as the underground tritium plume migrated to the river. However, no offsite groundwater contamination appears to have occurred.

Davis Besse Approximately 15 - 18 years ago, the licensee identified leakage from the liquid effluent discharge pipe that transports effluents to the lake. However, no offsite contamination appears to have occurred.

Watts Bar The licensee identified on-site leakage from a radioactive waste pipe which discharges transports the liquid effluent. However, no offsite contamination has occurred.

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Background Information on NRC Effluent and Environmental Monitoring Requirements

This section identifies the NRC regulatory requirements for radiological effluent and environmental monitoring programs and radiation dose limits for protection against radiation.

Regulatory Requirements

Radiological environmental monitoring and effluent monitoring at nuclear power plants is required by U.S. Nuclear Regulatory Commission regulations. The monitoring of radioactive effluents and the environment around the nuclear power plant is important both for normal operations, as well as in the event of an accident. During normal operations, environmental monitoring verifies the effectiveness of in-plant measures for controlling the release of radioactive materials, and makes sure that the levels of radioactive materials in the environment do not exceed those originally anticipated prior to licensing the plant. For accidents, it allows an additional means for estimating doses to members of the general public.

The principal regulatory basis for requiring environmental monitoring and effluent monitoring at nuclear power plants is contained in General Design Criteria 64 of Appendix A of Title 10 of the Code of Federal Regulations Part 50 (i.e., 10 CFR Part 50), and Section IV.B of Appendix I of 10 CFR Part 50. Section IV.B states that:

"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."

Results from the environmental and effluent monitoring programs are reviewed by the NRC during routine inspections; and if the data indicate that the relationship between the quantities of effluents and the calculated doses to individuals is significantly different than that assumed in the licensing calculations, then the NRC may modify the allowable quantities in the Technical Specifications for the nuclear power plant.

Prior to licensing a nuclear power plant, the NRC staff review the applicant's proposed radiological environmental program. The applicant conducts a preoperational program at least two years prior to initial criticality of the reactor. The preoperational program documents the background levels of direct radiation and concentrations of radionuclides that exist in the environment. It also provides an opportunity for the licensee to train personnel, and to evaluate procedures, equipment, and techniques.

A licensee's preoperational environmental monitoring program is reviewed by NRC staff in regard to the criteria contained in the NRC's Radiological Assessment Branch Technical Position, Revision 1, November 1979, "An Acceptable Radiological Environmental Monitoring Program." The Branch Technical Position (BTP) contains an example of an acceptable

minimum radiological monitoring program. Highlights of the BTP include: monitoring of air at the offsite locations where the highest concentrations of radionuclides are expected; placement of dosimeters in two concentric rings around the plant; water samples (i.e., surface, ground, and drinking) upstream and downstream; milk samples at locations where the highest doses are expected; and various food samples. Lower limits of detection for the various types of samples and nuclides are specified.

The operational radiological environmental monitoring program is essentially a continuation of the preoperational program. The minimum requirements of the program are specified in the Radiological Effluent Technical Specifications (RETS) that are required pursuant to 10 CFR 50.36a. In addition, more detailed information about the program is contained in the licensee's Offsite Dose Calculational Manual, which is referenced in the plant's RETS. The RETS also require that the licensee submit: (1) an annual radiological environmental monitoring report which is designed to assess the impact of radiological effluent releases into the environment; and (2) a **Special Report within 30 days of discovery of the event if predetermined levels of radioactivity are exceeded**. The NRC also requires that the licensee participate in an Interlaboratory Comparison Program to ensure the accuracy and precision of the licensee's data.

The results of licensee's radiological environmental monitoring and effluent release programs are required to be reported annually to the NRC, and are available to the public.

Radiation Dose Limits

10 CFR Part 20, STANDARDS FOR PROTECTION AGAINST RADIATION

The regulations contained in 10 CFR Part 20, effective January 1, 1994, establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. The purpose is to control the receipt, possession, use, transfer, and disposal of licensed material to ensure that the standards of radiation protection are not exceeded.

10 CFR 20.1301, Dose limits for individual members of the public. This regulation requires licensees to conduct operation of their facility so that the total effective dose equivalent to a member of the public does not exceed 0.1 rem (100 mrems) in a year. It should be noted that prior to January 1, 1994, 10 CFR Part 20 had an annual dose limit of 500 mrems to a member of the public.

10 CFR 20.1301 (e), imposes an additional requirement on nuclear power reactors to comply with the Environmental Protection Agency's radiation protection standard in 40 CFR Part 190. This standard limits the annual dose to a member of the public to less than or equal to 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

For the release of radioactive effluents, the NRC imposes specific requirements for airborne and waterborne effluent releases that are contained in 10 CFR 50.36a and detailed in Appendix I to 10 CFR Part 50 (hereafter called Appendix I). These requirements are structured to maintain the dose to members of the public from all radioactive effluent releases to levels that are as low as reasonably achievable (ALARA). The controls imposed on licensees are not on the quantity of radioactive material released or the concentration or radioactivity in the effluents, but are on the doses to members of the public. The licensee's RETS contain the dose values

(obtained from Appendix I) to the maximally exposed member of the public living near a nuclear power plant. In essence, they are as follows:

1. Gaseous effluents shall not produce doses to offsite air of more than 10 mrad from gamma radiation and 20 mrad from beta radiation in a year.
 - 1a. Gaseous effluents shall not produce doses to members of the public of more than 5 mrems to the total body and 15 mrems to the skin in a year.
2. Radioiodine, tritium, and particulate radiation in gaseous effluents shall not produce doses to a member of the public of more than 15 mrems to the thyroid (or other organ) in a year.
3. Liquid effluents shall not produce doses to any member of the public of more than 3 mrems to the total body or 10 mrems to any organ in a year.
4. The licensee shall take other measures to reduce offsite doses that cost less than \$1000 per person-rem saved.

In addition to the annual doses listed above, the RETS impose controls on the maximum dose to a member of the public in a calendar quarter. They are as follows:

1. Gaseous effluents, during any calendar quarter, shall be less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation.
2. Radioiodine, tritium, and particulate radiation in gaseous effluents, during any calendar quarter, shall be less than or equal to 7.5 mrems to any organ.
3. Liquid effluents; during any calendar quarter, the dose shall be limited to less than or equal to 1.5 mrems to the total body and to less than or equal to 5 mrems to any organ.

In addition to the controls imposed by the RETS on the maximum dose to members of the public from radioactive effluents, there are controls on the rate at which radioactive material can be released. These controls, imposed on liquid and gaseous effluents, represent a defense in depth approach to further ensure that radioactive effluents and the resulting doses are ALARA. The release rate controls are as follows:

1. Gaseous effluent releases of noble gases shall be less than or equal to 500 mrem/year (0.06 mrem/hour) to the total body and less than or equal to 3000 mrem/year (0.3 mrem/hour) to the skin.
2. Radioiodine, tritium, and particulate radiation in gaseous effluents shall be less than or equal to 1500 mrem/year (0.2 mrem/hour) to any organ.
3. Liquid effluents shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B.

RADIOACTIVE EFFLUENT AND ENVIRONMENTAL MONITORING REQUIREMENTS

- 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 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. 1, 10/79)
- NUREG-0472, Radiological Effluent Technical Specifications for PWRs. (2/80)
- NUREG-0473, Radiological Effluent Technical Specifications for BWRs. (7/79)
- 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 64, Monitoring Radioactivity Releases.
- 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operations. (1/77)

NRC INSPECTION PROCEDURE

- NRC Inspection Procedure 71122 - Public Radiation Safety