

NUCLEAR REACTOR EFFLUENT MONITORING

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Abstract - Radiological environmental monitoring and effluent monitoring at nuclear power plants 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 in the plant. Following an accident, it would be an additional mechanism for estimating doses to members of the general public. This paper identifies the U.S. Nuclear Regulatory Commission (NRC) regulatory basis for requiring radiological environmental and effluent monitoring, licensee conditions for effluent and environmental monitoring, NRC independent oversight activities, and NRC's program results.

REGULATORY BASIS FOR REQUIRING MONITORING

The principal regulatory basis for requiring environmental monitoring and effluent monitoring at nuclear power plants during the operational stage is contained in General Design Criteria 64 of Appendix A of Title 10 of CFR Part 50, and Section IV.B of Appendix I of 10 CFR 50. For example, 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 materials released in effluents and resultant radiation doses to individuals from principle [*sic*] pathways of exposure; and

Results from the environmental and effluent monitoring programs are reviewed, and if the data indicate that the relationship between the quantities of effluents and doses to individuals is significantly different than that assumed in the licensing calculations, then the NRC may modify the

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allowable quantities in the Technical Specifications for the nuclear power plant (Section IV.C of Appendix I of 10 CFR 50, Ref. 2).

The NRC, through the use of regulations and license conditions, requires licensees to develop programs and procedures to monitor and to minimize releases to unrestricted areas. Results of these programs are submitted to the NRC periodically for review. The NRC also sponsors programs that are independent from, but supplemental to, the monitoring programs conducted by the licensees. These programs provide a means of verifying licensee performance and assuring that releases to the environment and associated population are maintained as low as reasonably achievable (ALARA). The independent programs consist of the following elements:

- Radiological environmental monitoring
- Thermoluminescence dosimetry

Through the five regional offices, the NRC contracts with 34 states to carry out independent environmental monitoring. The purpose of these contracts is to provide independent measurements of the concentration of radioactive material and radiation levels in the environs of NRC-licensed facilities. These programs provide independent duplication of certain parts of the licensees' environmental monitoring efforts. The results of the states' monitoring program are also used to check the accuracy of licensees' monitoring programs and to aid in verifying the ability of the licensee to measure radioactivity in environmental media. The state provides the NRC with an annual report of all offsite analyses with comparisons to similar analysis by the respective licensee. In the future, results of the state's monitoring program will be available for distribution annually.

The NRC has contracted the U.S. Department of Energy, Idaho Operations Office (DOE/ID) Radiological and Environmental Sciences Laboratory (RESL) to provide the regions with a much broader base of radioisotopic measurement capability traceable to the National Institute of Standards and Technology (NIST). With RESL's support, the regional laboratories determine if licensee measurements are accurate and make independent radiological assessments of situations to provide or justify the basis for NRC action. It is through this program that the regions maintain their credibility with the licensee. RESL also provides analytical sample measurement expertise for samples requiring lengthy chemical separation or alpha spectroscopy that is beyond the capabilities of the regions. RESL has also provides analysis for state contractors when evaluation of unique samples is required.

NRC regional inspection activities relating to environmental areas are as follows. Approximately once per year the licensee's radioanalytical laboratory programs are inspected. The scope of the inspection encompasses organization, procedures records, quality control, laboratory facilities and confirmatory measurements. NRC conducts this inspection with the use of a mobile laboratory. Effluent stream samples are split with the licensee and analyzed in their laboratory and in the NRC mobile laboratory. A high level of quality control is maintained over the NRC mobile laboratory with traceability to NIST. Split sample results are intercompared and applied to an agreement/disagreement criteria. The purpose of this type of inspection is to assure that licensees are making valid radioanalytical measurements. Details of this inspection activity are discussed in NRC Inspection Procedure 84725.

The NRC also operates mobile laboratories which are used during plant inspections to confirm, using split samples, the accuracy of the licensee's radiological monitoring program. The mobile labs are deployed to licensee facilities every other year. The mobile labs also provide prompt and accurate

assessments during accidents situations. Licensees are also required to participate in an interlaboratory comparisons program which provides an independent check of the accuracy and the precision of the measurement of radioactive material in environmental samples.

The NRC is also able to utilize a state-of-the-art aerial radiation surveillance program operated under the DOE by EG&G/Las Vegas. The Aerial Measuring System (AMS) consists of rotary and fixed wing aircraft-equipped gamma ray and neutron detectors. In the East, the AMS is based at Andrews Air Force Base, Maryland, and in the West at Las Vegas, Nevada. The AMS program is directed toward obtaining surveys of gamma data (gross and spectral) that can be used to assess changes in environmental levels of radiation from nuclear tests and operation of nuclear facilities. Preoperational surveys are made at all nuclear power reactor sites, and these surveys are periodically updated at 3- to 5-year intervals for most facilities. A periodic update survey to measure environmental buildup of long-lived radionuclides is made for all nuclear facilities in order to determine the baseline for post-nuclear incident restoration.

The NRC has contracted with Brookhaven National Laboratory (BNL) to compile information obtained from the licensee in the semiannual report for all reactor facilities. The information presents principal radionuclides released in power plant effluents for all light-water reactors. This report is published annually as NUREG/CR-2907 and is widely distributed.

In response to the concerns expressed about the magnitude of the collective dose received by the general population residing near commercial power plants, the NRC contracted with Pacific Northwest Laboratory (PNL) to undertake a series of studies to estimate radiation dose commitments to the population produced by radionuclides releases from commercial light-water power reactors. Fifty-year dose commitments for a 1-year exposure from both liquid and atmosphere releases is calculated for four population groups (infant, child, teenagers, and adult) residing between 2 and 80 km from each of 71 sites. Data from NUREG/CR-2907 are used to carry out the calculation. This report is published annually as NUREG/CR-2850.

EG&G/Idaho, under contract to the NRC, supports licensing activities by providing technical reviews of licensees' revision to Offsite Dose Calculations Manual (ODCM) upon request from the Commission. These NRC-conducted programs, along with the licensees to provide monitoring of releases, yield accurate information for assessing the effect of nuclear power plants on the population and environment.

After the TMI accident, the NRC determined that relying solely on licensee estimates of population exposure during an accident situation was unacceptable. The NRC decided to develop its own program to provide the data needed to independently assess the radiological impacts of an accident. The Direct Radiation Monitoring Network is operated by the NRC through the Facilities Radiological Protection Branch in Region 1, which has implementation responsibility. All data processing and reporting of results is handled by the TLD Laboratory in Region 1. At most sites, deployment and collection of TLDs is performed by state personnel under contract with the NRC. The network provides continuous measurements of the ambient radiation levels around NRC-licensed power reactor facilities. The network also provides the NRC a means of identifying any deficiencies in the licensees' monitoring program. Results of this program are published quarterly in NUREG-0837.