

OBJECTIVE 8: FIELD RADIOLOGICAL MONITORING - AIRBORNE RADIOIODINE AND PARTICULATE ACTIVITY MONITORING

OBJECTIVE

Demonstrate the appropriate use of equipment and procedures for the measurement of airborne radioiodine concentrations as low as 10^{-7} (0.0000001) microcuries per cubic centimeter in the presence of noble gases and obtain samples of particulate activity in the airborne plume.

INTENT

This objective is derived from NUREG-0564 which provides that each offsite response organization should have the capability to use field monitoring teams within the plume exposure pathway emergency planning zone (EPZ) to detect and measure airborne radioiodine concentrations as low as 10^{-7} (0.0000001) microcuries per cubic centimeter in the presence of noble gases and to detect and measure the presence of radioactive particulate material in the airborne plume. (See evaluation criteria in Planning Standards I. and N.)

Specific equipment and procedural provisions for successful demonstration of this objective are described in greater detail in Appendix D of FEMA REP-2, Rev. 2. While this document is being revised, the information referred to in Appendix D is applicable to the field monitoring functions addressed for this objective. Demonstration of this objective focuses on both equipment and procedures used by field monitoring teams.

Measurement of the concentration of airborne radioiodine is necessary because it is the basis for determining the thyroid dose commitment which is necessary for plume dose projections and for protective action decision making. Thyroid dose is likely to be the leading exposure pathway for reactor accidents.

The detection of particulates provides an indication of ground deposition that will likely result from the airborne plume. Airborne particulates also may contaminate an individuals clothing and skin and, in significant enough quantities, may add to an individuals dose through inhalation. Early detection of airborne particulates in a radiological release will be an indication of the seriousness of the accident and the need for early protective action decision making for relocation and for the ingestion exposure pathway. It may also provide an insight in the recovery and re-entry problems that should be anticipated.

The procedure entails the collection of samples on both a particulate filter positioned in front of an iodine adsorbent cartridge in the air sampling apparatus, field measurement of the radioiodine activity and the gross particulate activity, and prompt delivery of the

samples collected to a designated location or laboratory for more detailed analysis. Demonstration of this objective focuses on the taking of samples within the plume for both airborne radioiodine and airborne particulates in the plume pathway EPZ, early field measurement of these samples outside of the plume, and prompt verbal reporting of the field monitoring data to the Field Team Coordinator (FTC) with delivery to a designated location, in accordance with the plan. This objective is closely related to Objective 5, Emergency Worker Exposure Control which provides for continuously monitoring and controlling the radiation exposure of the monitors, Objective 6, Field Radiological Monitoring - Ambient Radiation Monitoring, which addresses the determination of appropriate locations for taking the air samples; Objective 7, Plume Dose Projection, which describes the use of field monitoring data for dose projections; and Objective 25, Laboratory Operations, which focuses on the analyses, by an appropriate laboratory, of the samples collected.

DEMONSTRATION CRITERIA

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CRITERION

- H.10.,I.9. 1. Each field team has the equipment for field monitoring of airborne particulates and radioiodines in the presence of noble gases.**

Explanation

In addition to the equipment required in Objective 6, Field Radiological Monitoring - Ambient Radiation Monitoring, an airborne radioiodine and particulate sampling system that includes the following should be demonstrated by field monitoring teams:

- o air sampler with flow rate indicator; [(sampling rate: 1 to 5 cubic feet per minute ($\text{ft}^3/\text{min.}$))]
- o adsorbent filter media cartridges for collection of radioiodines (silver zeolite, silver alumina, or silver silica gel)
- o particulate filters
- o power supply capable of operating the air sampler pump
- o count rate instrumentation [e.g., portable Geiger-Mueller counter with a thin window [i.e., 1.4 to 2.0 milligrams per centimeter squared (mg/cm^2)] pancake-type detector or a portable sodium iodide (NaI) scintillation counter]

Each field team should inventory the equipment and replace missing items with spare equipment.

When the ORO uses a mobile laboratory with appropriate counting equipment that is available to provide rapid analysis of the iodine samples as well as an indication of the particulate activity, then this is acceptable in lieu of having portable instruments for the field team to perform the early assessment.

Extent of Play

Under this criterion, all equipment used by the field team for the completion of sampling activities and the measurement of the samples (or the mobile laboratory) should be available for inspection by evaluators. A mobile laboratory is not required for demonstration of this objective unless indicated in ORO plans for the measurement of samples in the field.

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CRITERION

H.10 2. Each field team performs appropriate operational checks of their equipment and instruments before deployment. The survey instruments are calibrated within 12 months of the exercise date.

Explanation

Responsible ORO field teams should demonstrate the operative procedures that adequate equipment is operational. Checks should be performed to confirm proper operation before the teams are deployed.

Evidence should be available to document that the calibration date for each item of equipment that requires periodic calibration is within 12 months of the exercise date. The calibration data should be identified on the exterior of each item, although this is not essential. Documentation, or exterior labels, should show the following information:

- o date of most recent calibration or date that next calibration is due

- o the appropriate reading (or range of readings) for an identified check source for instruments with check sources,

- o calibration curve or exposure rate correction factors to be used, if needed

If the calibration data is contained on other than the item itself, the item, serial number of the item, and date of calibration should be clearly listed.

Some portable survey instruments may have either an internal battery, circuit, or an operability check. Low range survey instruments with Geiger-Mueller detectors or NAI detectors should be checked for proper response to normal background radiation. In addition, a small radioactive sealed source (calibration check source) that has a long radioactive half life should be used in confirming the instruments proper response to beta-gamma radiation. Inoperative items should be replaced with spare equipment.

Appropriate radioactive check sources (e.g., Cs-137) should be used for checking the proper operational response of the survey instruments, when they are available. If the reading on the label is expressed as a single value, the instrument response (as adjusted by any correction factors identified on the label) should be within 25 percent of this value. If the reading is expressed as a range of values, the adjusted reading should be within the range. Any survey instrument that is not properly operating should be replaced with backup equipment.

Extent of Play

Under this criterion, all procedures should be completed as in an actual emergency.

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3. Airborne radioiodine and particulate sampling procedures are followed and samples obtained.

Explanation

After demonstrating the capability to perform operational and calibration checks of equipment specified in Demonstration Criterion 2, to ensure that it is in proper working order prior to taking measurements, field monitoring teams should demonstrate the capability to proceed to the sampling location specified by the FTC. Field teams should demonstrate the capability to determine whether the designated location within the plume pathway is suitable for taking an air sample by taking open and closed window exposure rate measurements.

The field teams should demonstrate the capability to determine suitable locations where the exposure rate is sufficient to take an air sample. Although the air sample would be preferable if taken near a peak exposure rate reading while transverse the plume, any location where the exposure rate is 100 milliroentgens per hour (mR/h) or greater will be acceptable.

Field teams should demonstrate attaching a filter holder, containing a particulate filter and adsorber media cartridge, to a calibrated air sampler. The air sampler should be positioned upwind from any engine exhaust, preferably off the ground far enough to avoid extraneous sources of particulate matter. A minimum sample volume of 10 cubic feet should be collected. Open and closed measurements should be taken and recorded near the beginning, the middle and the end of the sample collection period to assure constant plume presence during the sampling period.

Extent of Play

Except as indicated below, all sampling activities addressed in this criterion should be conducted as they would be in an actual emergency in accordance with the plan. A representative number of air samples, including one or more per team from near the plume centerline, should be taken. However, for those States that object to taking extensive measurements inside the plume, the air samples may be taken in any area where the exposure rate at the sampling location is 100 mR/h or greater. Data for the measurement of these samples should be provided through controller injects. The scenario should provide these data.

Unless needed for other operations at the time of the exercise, field activities should be conducted in vehicles that would be used in an actual emergency.

Exceptions to the demonstration sampling in exercises are as follows. Radiation sources should not be used to simulate released material in the context of radioiodine monitoring. Supplies such as charcoal adsorbers may be substituted for cartridges such as silver zeolite cartridges. Also, cartridges may be reused during exercises. All substitutions should be agreed upon by responsible parties with the FEMA Regional Assistance Committee (RAC) Chair in advance of the exercise and documented in pre-exercise agreements.

All field teams specified in the plan are encouraged to participate in the exercise, unless a fewer number of teams is determined by mutual agreement between the RAC Chair and the ORO as acceptable for the exercise. Two teams, at a minimum, should be used for field monitoring. A combination of State and licensee field teams is sufficient for obtaining field measurements, provided that: appropriate coordination of functions between the two teams is effected, this arrangement is documented in the ORO plans, and a written agreement supporting this coordination is made.

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CRITERION

- I.9. 4. Procedures for the measurement of the airborne radioiodine and particulate activity are followed.**

Explanation

After demonstration of the collection of air samples, each field monitoring team should demonstrate the capability to move immediately to a low background location outside of the radioactive plume. At this location, the field team should demonstrate the capability to purge the adsorber media cartridge and to count separately the radioactivity from the adsorber cartridge and from the particulate filter. Each field team should demonstrate the use of a reproducible geometry in which the sample being counted is held at a fixed distance from the detector of the measurement instrument.

Field teams should demonstrate, as a minimum, the capability to sample and measure airborne radioiodine concentrations as low as 10^{-7} (0.0000001) microcuries per cubic centimeter in the presence of noble gases. If a field laboratory is available, their staff may demonstrate the capability to make iodine and particulate measurements in lieu of the field teams.

Extent of Play

Under this criterion, all measurement activities should be completed as they would be in an actual emergency.

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CRITERION

- I.8.,11. 5. Data pertaining to the field measurements of radioiodine in air and particulates are promptly and accurately transmitted in accordance with the organizations plan.**

Explanation

Field teams should demonstrate the capability to promptly and accurately transmit, preferably by radio, or alternate means if necessary, field data pertaining to the

measurement of radioiodine and particulates to the FTC for relay to the dose assessment group. The accuracy of the communicated data received should be confirmed.

After measurement, each team should either calculate the radioiodine concentration in air at the sampling location, or provide the necessary data to the FTC for calculation by the dose assessment group. Necessary data includes the sample count rate data for the radioiodine cartridge and the particulate filter, the measured air flow through the cartridge, and the open and closed exposure rate measurements made near the beginning, middle and end of the sample collection. In this process, previously determined information on the efficiency of the counting system for radioiodines should be used.

Extent of Play

Under this criterion, all activities should be completed as they would be in an actual emergency.

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CRITERION

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6. Particulate filter and iodine cartridge samples are properly bagged and labeled and promptly delivered to a designated location.

Explanation

Field teams should demonstrate the capability to use procedures to ensure that the particulate filter and adsorber media cartridge are enclosed in separate plastic bags, labeled, and transported to a laboratory. A chain-of-custody form should be available for the transfer of samples to an intermediate location or collection point.

Extent of Play

Under this criterion, demonstration of transportation of samples to a laboratory for analysis may be accomplished by delivery of the particulate filter and iodine cartridge samples together with the measured air flow through the samples, along with appropriate

documentation, to an intermediate location or courier. Objective 25, Laboratory Operations, covers the transport of samples from a intermediate location or courier to the laboratory.

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CRITERION

- N.1.a. 7. All activities described in the demonstration criteria for this objective are carried out in accordance with the plan, unless deviations are provided for in the extent-of-play agreement.

Explanation

Responsible OROs should demonstrate the capability to follow policies, implement procedures, and utilize equipment and facilities contained in their plans and procedures. OROs should demonstrate that they can follow sequences outlined in the various procedures and perform specified activities, as necessary.

Extent of Play

Under this criterion, all activities should be carried out as specified in the plan, unless deviation from the plan is provided for in the extent-of-play agreement.

CLARIFICATION OF TERMS

The following definitions describe the limited meaning of terms in the context of the Exercise Evaluation Methodology and may vary from the technical definition for all circumstances.

Chain-of-custody form refers to the documentation of the transfer of samples from one organization/individual to another with respect to the name of the organization/individual and dates of acceptance and/or transfer of samples.

Check source refers to a radioisotope with a relatively fixed activity level used to determine the responsiveness of survey instruments.

Counting refers to using an instrument to detect individual particles or gamma rays which interact with the detector on the instrument. For example, ambient radiation can be counted, or, alternatively, the radiation emitted by specific samples can be counted.

Exposure rate refers to the amount of gamma radiation that a individual would receive in one hour as measured in air (typically expressed in units of milliroentgens per hour or Roentgens per hour).

Field Team Coordinator refers to the individual who manages the functions of field teams and coordinates data with the dose assessment group located in emergency operation centers and facilities.

Fixed (reproducible) geometry refers to a method of measuring levels of radioactivity in samples by using a standard size or volume of sample held at a fixed distance from the measuring instrument.

Half-life refers to the time required for a particular quantity of a radionuclide to reduce the rate at which it emits radiation by one half.

Measuring refers to counting to detect radiation levels or determining other parameters, such as the energy of radiation or physical characteristics, such as the volume, of an air sample.

Monitoring refers to checking radiation levels, usually by counting ambient radiation.

Noble gases refer to the chemically inert radioactive gases that are released during an accident at a nuclear power plant.

Recovery refers to the process of reducing radiation exposure rates and concentrations in the environment to acceptable levels for unconditional occupancy or use after the emergency phase of a radiological emergency.

Re-entry refers to temporary entry of individuals into a restricted zone under controlled conditions.

Relocation refers to a protective action, taken in the post-emergency phase, through which individuals not evacuated during the emergency phase are asked to vacate a contaminated area to avoid chronic radiation exposure from deposited radioactive material.

Sampling refers to collecting specimens of materials (e.g. particles or radioiodine in the air) at field locations.