

IN-PLANT AIRBORNE RADIOACTIVITY CONTROL AND MITIGATION

INSPECTABLE AREAS: ALARA Planning and Controls
Radiation Monitoring Instrumentation

CORNERSTONE: Occupational Radiation Safety

EFFECTIVE DATE: January 1, 2016

INSPECTION BASIS: Title 10 of the Code of Federal Regulations (10 CFR) Part 20, "Standards for Protection against Radiation," Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas," requires licensees to use, to the extent practical, process or other engineering controls to control the concentration of radioactivity in air.

If engineering controls alone are not able to maintain airborne concentrations of radionuclides below those defined as an airborne radioactivity area (as defined in 10 CFR Part 20), then licensees must take other actions, consistent with the as low as is reasonably achievable (ALARA) principles, to limit the intake of these radionuclides. The use of a respiratory protection device is one of the optional measures to limit intake.

This inspectable area is partially covered by the Occupational Radiation Safety Performance Indicator (PI) in that the improper control of airborne radioactive materials, or ineffective measures to limit intake of these airborne materials, could result in unintended committed effective dose reportable per the definition of the PI. However, the risk associated with work activities that have significant potential for an acute intake may not be reflected in the resulting dose.

In addition, the use of a respiratory protection device can pose a risk to the health and safety of the wearer that is not a function of the resultant dose and is not covered by the PI. The regulation in 10 CFR 20.1703, "Use of Individual Respiratory Protection Equipment," provides several requirements for the use of respiratory protection devices to minimize the risk to the health of the wearer from the respiratory protection device itself.

LEVEL OF EFFORT: Inspect Biennially

PROGRAM APPLICABILITY: 2515 Appendix A

71124.03-01 INSPECTION OBJECTIVE

To verify that in-plant airborne concentrations are being controlled consistent with ALARA to the extent necessary to validate plant operations as reported by the PI and to verify that the practices and use of respiratory protection devices on site do not pose an undue risk to the wearer.

71124.03-02 INSPECTION REQUIREMENTS

02.01 Inspection Planning.

Inspectors should review the plant final safety analysis report (FSAR) to identify areas of the plant designed as potential airborne radioactivity areas and any associated ventilation systems or airborne monitoring instrumentation. Instrumentation may include continuous air monitors, particulate-iodine-noble-gas-type instruments, or other monitors used to identify changing airborne radiological conditions.

Inspectors should review the FSAR description of the respiratory protection program and the types of devices used.

Inspectors should review FSAR, technical specifications, and emergency planning documents to identify the locations and quantity of respiratory protection devices stored for emergency use.

Inspectors should review the licensee's procedures for maintenance, inspection, and use of respiratory protection equipment including self-contained breathing apparatus (SCBA). Additionally, review procedures for air quality maintenance.

Inspectors should review the reported PIs to identify any PIs related to unintended dose resulting from intakes of radioactive materials.

02.02 Engineering Controls. (1 sample)

- a. Ventilation, permanent and temporary—Verify that the licensee uses ventilation systems as part of its engineering controls (in lieu of respiratory protection devices) to control airborne radioactivity. Review procedural guidance for use of installed plant systems, such as containment purge, spent fuel pool ventilation, and auxiliary building ventilation, and verify that the systems are used, to the extent practicable, during high-risk activities (e.g., using containment purge during cavity flood-up).

Select, as available, one to two installed ventilation systems used to mitigate the potential for airborne radioactivity, and verify that ventilation airflow capacity, flow path (including the alignment of the suction and discharges), and filter/charcoal unit efficiencies are consistent with maintaining concentrations of airborne radioactivity in work areas below the concentrations of an airborne area to the extent practicable.

Select, as available, one to two temporary ventilation system setups high-efficiency particulate air (HEPA)/charcoal negative pressure units, downdraft tables, tents, metal “Kelly buildings,” and other enclosures) used to support work in contaminated areas. Verify that the use of these systems is consistent with licensee procedural guidance and ALARA.

- b. Airborne monitoring protocols - Select one to two portable (e.g., AMS-4s) or installed systems to monitor and warn of changing airborne concentrations in the plant. Verify that alarms and set points are sufficient to prompt licensee/worker action to ensure that doses are maintained within the limits of 10 CFR Part 20 and ALARA.

Verify that licensees have established trigger points (e.g., the Electric Power Research Institute’s “Alpha Monitoring Guidelines for Operating Nuclear Power Stations” (ML14083A535)) for evaluating levels of airborne beta-emitting (e.g., plutonium-241) and alpha-emitting radionuclides.

02.03 Use of Respiratory Protection Devices. (1 sample)

- a. Respiratory protection devices - For those situations where it is impractical to employ engineering controls to minimize airborne radioactivity, verify that the licensee provides respiratory protective devices such that occupational doses are ALARA.

As available, select one to two work activities where respiratory protection devices are used to limit the intake of radioactive materials, and verify that the licensee performed an evaluation concluding that further engineering controls are not practical and that the use of respirators is ALARA.

Verify that the licensee has established means (such as routine bioassay) to verify that the level of protection (protection factor) provided by the respiratory protection devices during use is at least as good as that assumed in the licensee’s work controls and dose assessment.

- b. Certified equipment - Verify that respiratory protection devices used to limit the intake of radioactive materials are certified by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) or have been approved by the NRC per 10 CFR 20.1703(b). As available, select one to two work activities where respiratory protection devices are used. Verify that the devices are used consistent with their NIOSH/MSHA certification or any conditions of their NRC approval.
- c. Air quality and quantity - Review records of air testing for supplied-air devices and SCBA bottles. Verify that air used in these devices meets or exceeds Grade D quality. Verify that plant breathing air supply systems meet the minimum pressure and airflow requirements for the devices in use.
- d. Medical determination - Select three to five individuals qualified to use respiratory protection devices, and verify that they have been deemed fit to use the device(s) by a physician. Do not request or review workers' personal medical records.
- e. User performance - As available, select three to five individuals assigned to wear a respiratory protection device and observe them donning, doffing, and functionally checking the device as appropriate. Verify through interviews with these individuals that they know how to safely use the device and how to properly respond to any device malfunction or unusual occurrence (loss of power, loss of air, etc.). If in-field observations are limited, review training curricula for users of the devices, and/or request a demonstration of device use from one to three selected individuals.
- f. Equipment storage, maintenance, and quality assurance - Choose **five to ten** respiratory protection devices staged and ready for use in the plant or stocked for issuance.

Observe the physical condition of the device components (mask or hood, harnesses, air lines, regulators, air bottles, etc.) and review records of routine inspection for each.

Select one to three of the devices, and review records of maintenance on the vital components (e.g., pressure regulators, inhalation/exhalation valves, hose couplings).

Verify that onsite personnel assigned to repair vital components have received vendor-provided training.

02.04 Self-Contained Breathing Apparatus for Emergency Use. (1 sample)

In addition to the inspection requirements of Section 02.03 above, verify the following for SCBAs designated for emergency use.

- a. Based on FSAR, technical specifications, and emergency operating procedure requirements, review the status and surveillance records of three to five SCBAs staged in-plant for use during emergencies.

Inspect the licensee's capability for refilling and transporting SCBA air bottles to and from the control room and operations support center during emergency conditions.

- b. Select at least three individuals on control room shift crews, and at least three individuals from designated departments currently assigned emergency duties (e.g., onsite search and rescue duties).

Determine if control room operators and other emergency response and radiation protection personnel (assigned in-plant search and rescue duties or as required by emergency operating procedures or the emergency plan) are trained and qualified in the use of SCBAs (including personal bottle change-out).

Determine if personnel assigned to refill bottles are trained and qualified for that task.

- c. Verify that appropriate mask sizes and types are available for use (in-field mask size and type should match what was used in fit-testing).

Select two to three on-shift operators, and verify that they have no facial hair that would interfere with the sealing of the mask to the face. Also, verify that vision correction that does not penetrate the face seal (e.g., glasses inserts or corrected lenses) is available as appropriate.

- d. In addition to the inspection in 02.03.f above, review the past 2 years of maintenance records for two to three SCBA units used to support operator activities during accident conditions and designated as “ready for service.”

Verify that any maintenance or repairs on an SCBA unit’s vital components were performed by an individual, or individuals, certified by the manufacturer of the device to perform the work. These vital components typically are the pressure-demand air regulator and the low-pressure alarm.

Review the onsite maintenance procedures governing vital component work, and identify any inconsistencies with the SCBA manufacturer’s recommended practices.

For those SCBAs designated as “ready for service,” **verify** that the required, periodic air cylinder hydrostatic testing is documented and up to date, and the retest air cylinder markings required by the U.S. Department of Transportation are in place.

02.05 Problem Identification and Resolution. (1 sample)

- a. Verify that problems associated with the control and mitigation of in-plant airborne radioactivity are being identified by the licensee at an appropriate threshold and are properly addressed for resolution in the licensee corrective action program.

In addition to the above, verify the appropriateness of the corrective actions for **three to five** problems involving airborne radioactivity documented by the licensee.

71124.03-03 INSPECTION GUIDANCE

03.01 Inspection Planning.

FSAR's are available on the NRC internal SharePoint site at <http://fusion.nrc.gov/nrr/team/dorl/FSARs/Forms/AllItems.aspx>

03.02 Engineering Controls.

- a. **Ventilation, permanent and temporary** - The focus of this inspection item is to verify that the licensee is using, to the extent practicable, engineering controls in lieu of respiratory protection. The effectiveness of the in-field use of temporary containment/ventilation is inspected according to Inspection Procedure 71124.01.

During plant tours, be alert to plant ventilation flow problems that may result in airborne radioactivity moved by incorrect flows from elevated airborne radioactivity areas to non-airborne radioactivity areas.

Improperly maintained and controlled vacuum cleaners have been the source of elevated airborne radioactivity events. Licensees should have a program to ensure that the vacuum cleaners are maintained and do not present an unevaluated source of airborne radioactivity.

- b. **Airborne monitoring protocols - Review the licensee's air monitoring instrument calibration and operational set-up procedures to determine the basis for the set points.**

The licensee's program for airborne radioactivity controls should consider alpha²²² emitters that have been incorporated into plant piping corrosion layers or other areas of the plant from a previous failed fuel event and may be released during grinding, welding, or other work activities generating airborne radioactivity.

03.03 Use of Respiratory Protection Devices.

- a. **Respiratory protection devices** - The level of detail and scope of the licensee's **TEDE ALARA evaluations** should be commensurate with the radiological hazards (both airborne and external, direct radiation exposure). These evaluations may also consider factors other than the exposure to radioactive materials (such as worker acceptance, contamination control, heat stress, and exposure to other Occupational Safety and Health Administration hazards).

- b. **Certified equipment** - Several licensees have obtained NRC approval to use non-NIOSH-approved respiratory protection devices. Examples of these include the Mine Safety Appliance GRM-I canister for radioiodine adsorption/filtration, and several models of the Delta Protection air-supplied and powered air purifying suits. The inspector should refer to the Office of Nuclear Reactor Regulation safety evaluations issued with these specific approvals for licensee commitments and conditions of use for these devices.

NIOSH certification (or NRC approval) is required for all respiratory protection devices used to limit intake of radioactive material (10 CFR 20.1703). It is the NRC's position that any respiratory protection device used in a contaminated area or potentially contaminated area (i.e., inside the radiation control area) is, by definition, being used to limit intake of radioactive material. This is true regardless of whether the licensee is taking credit for the respirators' applied protection factor.

A general Certified Equipment List is published by NIOSH on its [web site at http://www.cdc.gov/niosh/npptl/topics/respirators/cel/default.html](http://www.cdc.gov/niosh/npptl/topics/respirators/cel/default.html). Respirators and equipment (e.g., filter canisters) certified by NIOSH must have a label attached with a certification number (TC-#). The TC-# is unique to the specific configuration and application of the respirator. Use of replacement parts not listed under the NIOSH published TC-# voids the certification, even if those parts are certified for use for another respirator.

- c. **Air quality and quantity** - The air intake for compressors servicing breathing air supplies should be controlled and/or monitored by the licensee to ensure that fumes or other contaminants (e.g., toxic vapors from cleaning fluids, nitrogen/Halon fire suppression systems, or diesel engine exhaust) cannot be introduced into the breathing air.

Criteria for Grade D air are defined by the Compressed Gas Association in publication- G-7.1, "Commodity Specification for Air," issued in 1997, as referenced in 10 CFR 20.1703(g).

- d. **Medical determination - Medical** physicals and tests can be administered by a **non-physician** medical practitioner. The medical practitioner may even sign the documentation that the subject has passed the physical. However, the tests administered, their pass criteria, and the basis for judging the individual fit to use a respirator should be established by a licensed physician.
- e. **User performance** - Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," and NUREG-0041, "Manual of Respiratory Protection against Airborne Radioactive Material," Revision 1, issued January 2001, contain technical guidance on types of respiratory protection devices and all other aspects of a respiratory protection program. The inspector should determine to what extent deficiencies in this area indicate deficiencies in the licensee's respiratory protection training and cross-cutting issues in the human performance area.

- f. **Equipment storage, maintenance, and quality assurance** -The level of quality assurance should be commensurate with the safety significance of the respirator application. The inspector should verify that appropriate implementation of safety-significant elements of the respiratory program (e.g., fit-testing, training, providing a standby rescue person, and equipment configuration) is reviewed for SCBAs and respirators used in low-oxygen or other atmospheres immediately deleterious to life and health. Paint coatings on SCBA air bottles are designed to indicate potential damage to the bottle from overheating.

03.04 Self-Contained Breathing Apparatus for Emergency Use.

In general, the inspection should focus on use of SCBAs for radiological emergency response and not on fire brigade equipment. There may be some areas of overlap, however. For example, fire brigade procedures for inventory and maintenance of SCBAs may also include units staged for use in radiological emergencies. Any issues that arise regarding fire brigade equipment should be discussed with fire protection inspectors in the regional office.

- a. **It may be necessary to request that the licensee demonstrate SCBA bottle change-out to verify that the licensee's training program maintains this capability.**

For recent examples of licensee problems in **maintaining SCBAs**, refer to:

1. NRC Information Notice (IN) 98-20, "Problems with Emergency Preparedness Respiratory Protection Programs," dated June 3, 1998,
2. IN 99-05, "Inadvertent Discharge of Carbon Dioxide Fire Protection System and Gas Migration," dated March 8, 1999, and
3. **IN 14-15 "Inadequate Controls of Respiratory Protection Accessibility, Training, and Maintenance," dated December 1, 2014.**

The three INs summarize the recent industry problems with qualification of respirator users, shortcomings in training, inadequate evaluations of emergency conditions and impact on control room operators, and other problems. Inspection findings in this area note shortcomings in control room operator training, which focuses on lack of adequate hands-on training (e.g., no practice in changing air cylinders). Note that 10 CFR 20.1703(c)(4) requires respiratory training, and Regulatory Guide 8.15 (Revision 1), Section 5.2, describes the staff's position in this area (e.g., user training should include hands-on training and should demonstrate competency in donning, using, and removing the device).

- b. SCBA fit-testing is more safety significant than respirator fit-testing in general. Use of a poorly fitting SCBA can result in excessive air leakage from the face covering. Such leakage can significantly reduce the service life of the SCBA bottled air supply and jeopardize the mission of the wearer, as well as his or her personal safety.

- c. See pertinent sections of Regulatory Guide 8.15 (Revision 1) and NUREG-0041 (Revision 1) for current staff guidance on SCBA acceptable maintenance training, practices, and activities for vital respirator components.
- d. The respirator manufacturer (vendor) provides required written literature, as well as web sites on specific SCBA use and maintenance/repair, specifying required surveillances to ensure continued unit operability. Discuss any differences between the vendor's and the licensee's procedures and practices, and determine the potential impact of these differences on unit operability/NIOSH certification.

03.05 Problem Identification and Resolution.

See IP 71152, "Problem Identification and Resolution," for additional guidance.

71124.03-04 RESOURCE ESTIMATE

For planning purposes, it is estimated to take 16 hours, on average (with a range of 12 to 20 hours), to perform the requirements of this attachment.

71124.03-05 COMPLETION STATUS

Inspection of the minimum sample size will constitute completion of this procedure in the RPS. The minimum sample size for this attachment is **four**, defined as the sum of all the inspection requirements.

If any of the sample inspection requirements cannot be completed, the procedure should be closed in accordance with IMC 0306, "Planning, Tracking and Reporting of the Reactor Oversight Process (ROP)." For example, if certain steps could not be completed due to sample unavailability, the procedure should be declared "complete – full sample not available" with a comment addressing the specific steps or activities that could not be completed.

END

Attachment 1 – Revision History for IP 71124 Attachment 03

| Commitment Tracking Number | Accession Number Issue Date Change Notice | Description of Change | Description of Training Required and Completion Date | Comment and Feedback Resolution Accession Number (Pre-Decisional, Non-Public Information) |
|----------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------|
| N/A | 12/02/09 CN 09-030 | <p>Conducted four year search for commitments and found none.</p> <p>This new procedure is being issued as a result of the 2009 ROP IP Realignment. It supersedes inspection requirements in IP 71121 and 71122.</p> | 09/09/2009 | ML092810396 |
| N/A | ML15344A317 02/24/16 CN 16-008 | <p>Revisions to the IP 71124.03 procedure attachment were made in response to the 2013 ROP Enhancement Project.</p> <p>The revisions clarified the existing inspection requirements and enhanced the inspection guidance section.</p> <p>The revision also changed how samples are counted.</p> | N/A | ML15344A322 |