

Collect and Evaluate Radiological Air Samples

A graphic on the right side of the slide featuring a blue rounded rectangle with a white background. Inside, the EPRI slogan is written in white text. The background of the slide shows a blurred image of two workers in safety gear.

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RP 02.03 – Revision 2 – 4/2025

Record of Revision

Rev 1 – 6/11/2018 -

1. Updated elements table using the knowledges and skills identified in NISP-RP-003
2. Developed new cognitive objectives that align with identified knowledges
3. Developed new performance objectives that align with identified skills
4. Developed new weighting of exam items based on new objectives.
5. Developed new performance objective table and performance levels for new objectives. .

Rev 2 – 4/2025

- Updated values from 250 to 150 and 1,000 to 1,400 reflecting changes to NISP-RP-003,
- slide 66 updated wording in 6.5.3

Standardized Task Evaluation Program

The Standardized Task Evaluation (STE) program promotes a work-ready workforce through the standardization of common tasks by defining the knowledge and skills required to perform a given task. Subject Matter Experts (SMEs) analyze the task and generate lesson plans, knowledge examination, and performance evaluation elements. These elements are combined to create an STE package.

The Electric Power Research Institute (EPRI) facilitates the development, oversees the quality, and programmatically implements each STE. EPRI STE members have access to these materials and permission to implement these STEs in accordance with their site training and qualification procedures.

Terminal Objective

Given a real or simulated contaminated area with potential airborne contamination and the proper tools and equipment, perform radioactive air sampling, in accordance with referenced procedures.

The STE Knowledge Examination requires a scoring grade of 80% or higher to pass the examination.

Enabling Objectives

From Memory and in accordance with NISP-RP-03 students will:

1. Given a work activity and radiological conditions, recognize if air sampling is required.
2. Define the three classifications of an air sample based on sampling location and the purpose of each.
3. State the purpose of a grab sample, a continuous sample, or using a remote pump.
4. Given a potentially explosive atmosphere, a noble gas atmosphere, or a work location with high contamination levels, state the precautions needed for sampling.

Enabling Objectives

5. Given a purpose and location for an air sample, state the minimum sample volume required.
6. Describe the three different methods to collect a noble gas sample.
7. Describe the common lights and alarms on a continuous air monitor and actions to take if an alarm occurs.
8. Define the terminology used for air sample calculations.

Enabling Objectives

9. Analyze air sample and identify the airborne concentration of potential intake that requires an area to be posted as an Airborne Radioactivity Area
10. State the definition of an Alpha Level 1, 2, or 3 Area with respect to the potential for internal dose.
11. Determine if an air sample from an Alpha Level 1 or 2 Area requires alpha analysis.
12. Determine when personal air samplers should be used in Alpha Level 2 & 3 Areas.

Definitions

Definitions are in accordance with
NISP-RP-13 Glossary.



Definitions

- **Airborne Radioactivity Area (ARA)** - A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations in excess of the values of 10CFR20, Appendix B, Table 1, Column 3 (i.e., DAC values) OR to such a degree that an individual without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 12 DAC-hours.
- **Annual Limit on Intake (ALI)** - means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue.

Definitions

- **Derived Air Concentration (DAC)** - The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work, results in an intake of 1 ALI. DACs are listed in 10 CFR 20, Appendix A, Table 1.
- **DAC-Hour** - The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. 2000 DAC-hours equals one ALI.
- **DAC Fraction (fDAC)** - The sum of each radionuclides (beta-gamma or alpha) emitting activity divided by its corresponding DAC value.

Definitions

- **Grab Sampling** - A general term used to denote air samples taken over a short time span (typically 10 to 15 minutes) to determine peak air concentrations. The technique is used to determine posting of area.
- **Intake** - Radioactivity that enters the body through the respiratory tract, the gastrointestinal tract, or the skin. Intake may be acute, meaning a single intake occurring over a very short time, usually taken to be instantaneous, or chronic, occurring over a specified time. Common units used in this guide for intake are microcuries (μCi) and kilobecquerel (kBq).

Given a work activity and radiological conditions, recognize if air sampling is required. EO-1



Purpose for taking air samples

- Air sampling is used to identify the Derived Air Concentration (DAC) values in order to establish controls necessary to protect the worker.
- Workers can be protected by:
 - Controlling access into airborne radioactivity areas
 - Limiting the exposure times
 - And the use of respiratory protection equipment.
- The results of airborne surveys are used to determine respiratory protection requirements.

Objective 1. State the purpose for taking air samples

Plant Conditions that would require air sampling

1. During any work or operation that is known to have a potential for causing airborne radioactivity
2. While grinding, welding, burning, cutting, hydrolasing, vacuuming, sweeping, or using compressed air on contaminated equipment
3. Using volatile substances on contaminated surfaces
4. When compacting radioactive waste
5. During any work or operation that involves the breach of a radioactive system for which the potential for measurable airborne radioactivity is known to exist

Objective 2. Identify plant conditions that would require air sampling

Plant Conditions that would require air sampling

6. Whenever respiratory protective equipment is worn
7. Prior to or during initial entry into a known or suspected airborne radioactivity area such as:
 - Steam leaks from a primary system
 - Steam leaks from a BWR secondary system
 - Leaks from a BWR off-gas systems
 - Leaks from a gaseous waste processing system

Objective 2. Identify plant conditions that would require air sampling

Plant Conditions that would require air sampling

8. When working in an area with levels of dry removable contamination that could become suspended in concentrations greater than 0.3 DAC such as:
 - Greater than 100,000 dpm/100 cm² of $\beta\gamma$ emitting nuclides
 - When aggressive work (e.g. cutting, grinding, welding, etc.) is performed in Alpha Level 2 areas or on systems with suspected but unknown amounts of transuranics
 - Work in Alpha Level 3 Areas

Objective 2. Identify plant conditions that would require air sampling

Plant Conditions that would require air sampling

9. Initial entry into a PWR containment or BWR drywell during power operation
10. Initial entry into a PWR containment or BWR drywell following shutdown as directed by RP supervision
11. Prior to or during initial entry into any high-risk area such as steam generators, reactor cavities, reactor vessels, or radioactive waste tanks, and periodically thereafter
12. When environmental factors such as heat, air flows, low humidity, etc. increase the potential for highly contaminated surfaces, components, and filters to dry and the contamination to become suspended in air
13. A significant spill or spread of contamination has occurred

Objective 2. Identify plant conditions that would require air sampling

Plant Conditions that would require air sampling

14. System leakage or work activities can result in airborne radioactivity and an area sample is needed to provide a timely alert of the changing condition
15. When DAC-Hour tracking is used to monitor worker intakes
16. When fuel leaks have occurred elevating noble gas, iodine, and transuranic nuclides in the RCS
17. A potential airborne pathway exists for a release to the environment

Objective 2. Identify plant conditions that would require air sampling

Define the three classifications of an air sample based on sampling location and the purpose of each. EO-2



Air Sample Locations

- **Breathing Zone Air Sample** – An air sample where the filter media is within approximately 12 inches of a worker's head.
 - A personal air sampler is set up with the filter media within a 25 cm (10 inches) radius of the worker's nose and mouth (Reference 5.1).
 - A lapel air sampler should be used if the results will be used to assign dose to a worker.

Objective 5. Given the type of air sample to be collected, state the location that an air sample should be taken

Air Sample Locations

- **Work Area Air Sample** – An air sample where the filter media is located to provide an average measurement of airborne radioactivity to which workers are exposed in a work area.
 - Either grab samples or continuous sampling may be used provided sample volumes are controlled to obtain an MDA less than 0.3 DAC for the nuclides being sampled
 - Place sampling media as close to the breathing zone as practicable without interfering with the work or the worker
 - Place the sampling media downstream of the airborne source if airflow patterns may affect dispersion

Objective 5. Given the type of air sample to be collected, state the location that an air sample should be taken

Air Sample Locations

- **General Area Air Sample** – An air sample located to accomplish one or more of the following:
 - Determine potential airborne hazards
 - Verify postings and boundaries
 - Determine the effectiveness of engineering controls
 - Measure general or average concentrations
 - Detect unexpected releases into a work place

Objective 5. Given the type of air sample to be collected, state the location that an air sample should be taken

State the purpose of a grab sample, a continuous sample, or using a remote pump. EO-3



Characteristics of air sampling equipment

- Select an appropriate sampling method considering the following:
 - Use a grab sampler (high volume air sampler) to obtain an air sample in a short period of time
 - Grab samples are used to quickly verify airborne concentrations during a system breach, monitor work area concentrations for short duration work, or in conjunction with low volume air samplers to determine peak airborne concentrations.

Objective 4. Identify the characteristics of air sampling equipment

Characteristics of air sampling equipment

- Collect grab samples using high volume air samplers during expected periods of actual or potentially highest airborne concentrations and evaluate them as quickly as practicable to determine the need for adjusting engineering controls, respirators, area evacuation, area posting, or worker relief from unnecessary respirator use
- For work that has the potential to generate airborne radioactivity for a longer period of time, e.g. over an hour, operate a low volume air sampler continuously while work is in progress
 - Change out filters with the objective to evaluate sample results from specific activities more likely to generate airborne radioactivity, e.g. a system breach, lapping of a valve seat, decontamination, etc.

Objective 4. Identify the characteristics of air sampling equipment

Characteristics of air sampling equipment

- Remote sample pumps allow samples to be collected near the work area or in highly contaminated area without the risk of the air discharge of the pump creating airborne.
- When using a hose and sample head in a highly contaminated area a sample head shield should be used.
(1 liter bottle with the bottom cut out)
- Verify that the air sampler is calibrated for the use of a hose and ant restrictions on its length.

Collect a Particulate and Iodine Air Sample

Always inspect air sampling equipment and sample media prior to use to ensure the following, as applicable:

1. Physical damage does not exist that could affect operation
2. Sample pumps have been calibrated within the required time frame
3. Any batteries that are required are charged for operation
4. Any AC power cords are not damaged and AC power is available where the sample will be taken

Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Particulate and Iodine Air Sample

Always inspect air sampling equipment and sample media prior to use to ensure the following, as applicable: [Continued](#)

5. Operability is checked by starting the sampler and observing expected parameters
6. Sample holders or Marinelli beakers are not damaged
7. Sample holders do not have any cracked or missing O-rings or screens
8. Threads and connectors are not damaged and function as expected
9. The age of filter media has not exceeded a required shelf-life, e.g. iodine cartridges

Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Particulate and Iodine Air Sample

- Load the particulate filter paper and iodine cartridge (charcoal) in the sample holder. Ensure filters are aligned or marked as needed to indicate the collection side that should face the detector during analysis.
- Silver zeolite cartridges may be used for iodine sampling in noble gas atmospheres when directed by RP supervision. Ensure that hydrogen is not present when using a silver zeolite cartridge.
- Site RP management may discontinue sampling for iodine when sample trends show that iodine is not a concern.

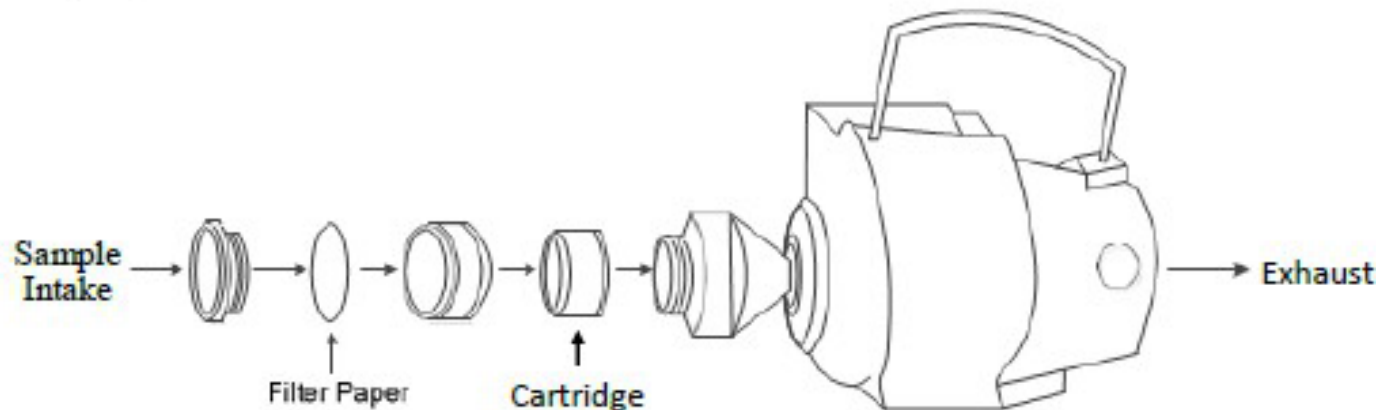
Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Particulate and Iodine Air Sample

- Check rubber O-rings on sampling head to ensure positive seals as required for the model of head being used
- Place filter paper into filter holder with collection side toward sample intake



Example Sample Head – Ensure O-rings are in good condition and placed as required.



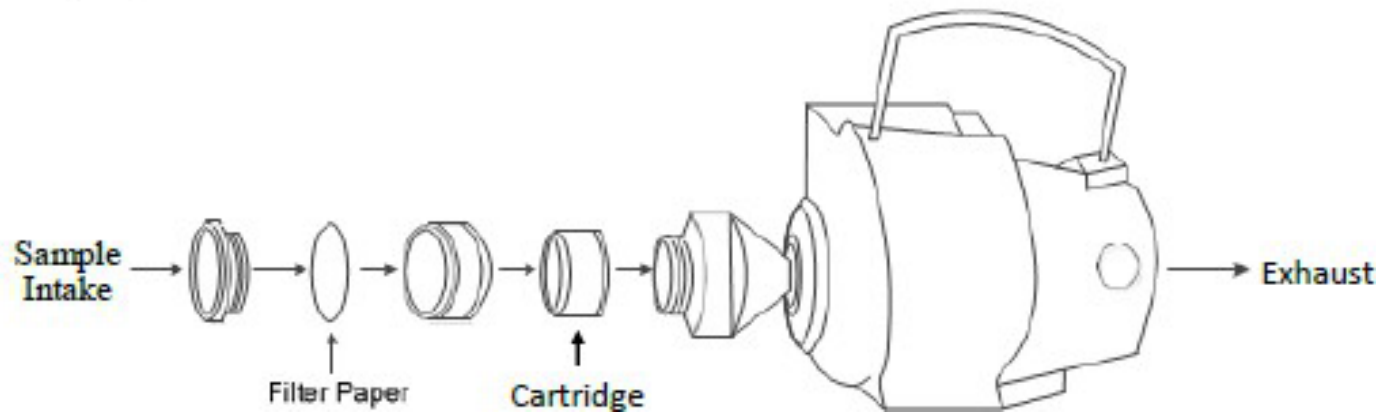
Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Particulate and Iodine Air Sample

- If iodine sampling is required, then place new iodine cartridge into holder with arrow pointing with direction of air flow. A dummy cartridge may be used if iodine sampling is not required and the air sampler has been calibrated with an iodine cartridge.



Example Sample Head – Ensure O-rings are in good condition and placed as required.



Objective 3. Identify the types of air samples collected and the methodology of sampling



Collect a Particulate and Iodine Air Sample

- Place sample inlet in a location representative of the desired sample; a location that is far enough from a contaminated surface to prevent pulling surface contamination into the sample media.
- Avoid placing sampler motors directly on contaminated surfaces (e.g. greater than 10,000 dpm/100 cm²) where the motor exhaust could create airborne radioactivity.
- Estimate the time needed to obtain the minimum volume as required by site procedures. This is calculated by dividing the required volume by the flow rate. Typical requirements for sample volume are 150 liters (5.3 ft³) for fission products and 1400 liters (49.5 ft³) for transuranics.

Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Particulate and Iodine Air Sample

CAUTION

Do not operate a sampler where hydrogen may be approaching the Lower Explosive Limit (e.g. 2% to 4% H₂)

- Turn on the sampler and verify, or adjust, the flow rate to be within 20% of the calibrated flow rate
- When the predetermined sample time or longer has passed, then stop the sampler and record the information
- If the sample was obtained in a noble gas atmosphere, consider purging the gas from the sample media by running the sampler 1 to 2 minutes in an area where noble gas, airborne particulates, or iodine are not present
- Remove sample collection media and place in a bag, exercising care to prevent cross contamination

Objective 3. Identify the types of air samples collected and the methodology of sampling

Given a potentially explosive atmosphere, a noble gas atmosphere, or a work location with high contamination levels, state the precautions needed for sampling. EO-4



Precautions

- Avoid placing sampler motors directly on contaminated surfaces (e.g. greater than 10,000 dpm/100 cm²) where the motor exhaust could create airborne radioactivity.
- Do not operate a sampler where hydrogen may be approaching the Lower Explosive Limit (e.g. 2% to 4% H₂)
- Silver zeolite cartridges may be used for iodine sampling in noble gas atmospheres when directed by RP supervision. Ensure that hydrogen is not present when using a silver zeolite cartridge.
- If the sample was obtained in a noble gas atmosphere, consider purging the gas from the sample media by running the sampler 1 to 2 minutes in an area where noble gas, airborne particulates, or iodine are not present



Minimum Sample Volumes

- Sample 150 liters (5.3 ft³) for corrosion and fission products.
 - A 150 liter sample can collect a sufficient amount of Co-60 to measure 0.3 DAC if the counting system has an MDA less than 1,000 dpm of Co-60.
- Sample 1,400 liters (49.5 ft³) for transuranics.
 - A 1,400 liter sample can collect a sufficient amount of Am-241 to measure 0.3 DAC if the counting system has an MDA of 2.8 dpm and there is negligible self-absorption within the sample filter.

There is no minimum sample volume for personal air samplers.

Describe the three different methods to collect a noble gas sample. EO-6



Collect a Noble Gas Air Sample

Three methods are discussed in NISP-RP-003 to obtain a noble gas sample.

1. One method is to open the lid of a Marinelli and wave the Marinelli in the atmosphere for 15 to 30 seconds to allow the Marinelli contents to equilibrate with the atmosphere. Place and seal the lid on the Marinelli prior to leaving the sampling area.

Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Noble Gas Air Sample

2. Another method is to use water displacement to collect noble gas.
 - a. Obtain a 1 liter or 4 liter Marinelli beaker approved for gamma spectroscopy that has a removable lid
 - b. Fill the container completely with demineralized water and seal the container
 - c. Proceed to the area where the sample is to be collected, open the container, pour the water into a floor drain or another container, and re-seal the sample container
 - d. Record important sample parameters for required analyses per Attachment 1 of NISP-RP-03 or the site equivalent form

Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Noble Gas Air Sample

3. The third method is to use a sample pump to collect noble gas per site procedures. Generic steps are listed below.
 - a. Obtain a 1 liter or 4 liter Marinelli beaker that has stopcocks and is approved for gamma spectroscopy
 - b. Obtain a low flow air pump
 - c. Perform an inspection to ensure the equipment is operable.
 - d. Connect the sample pump to the sample container with vacuum tubing
 - e. Open the valves on the container and start the sample pump

Objective 3. Identify the types of air samples collected and the methodology of sampling

Collect a Noble Gas Air Sample

3. The third method is to use a sample pump to collect noble gas per site procedures. Generic steps are listed below. **Continued**
 - f. Allow a sufficient purge time to totally displace the container volume with the sampled atmosphere (e.g., for a 4 liter container, a volume of at least 20 liters is needed)
 - g. Stop the pump and close the inlet and outlet valves.
 - h. Record important sample parameters for required analyses per Attachment 1 of NISP-RP-03 or the site equivalent form
 - i. Submit the sample for gamma spectroscopy analysis

Objective 3. Identify the types of air samples collected and the methodology of sampling

Describe the common lights and alarms on a continuous air monitor and actions to take if an alarm occurs. EO-7



Operate a Continuous Air Monitor (CAM)

Continuous Air Monitor (CAM) – A device for real-time monitoring of airborne radioactivity concentrations. It is designed to alert workers of significant increases in airborne radioactivity. A CAM has an automatic alarm that sounds at a predetermined radioactivity level or rate of collection of radioactivity on the collection medium.

Objective 3. Identify the types of air samples collected and the methodology of sampling

Operate a Continuous Air Monitor (CAM)

- When assigned responsibility to monitor or maintain a CAM, ensure prejob planning activities provide instructions for the following:
 - Identification of status lights that indicate normal operation
 - Identification of status lights and any alarms that indicate increased airborne concentrations
 - The proper sequence for manipulating the CAM to change out filters

Objective 3. Identify the types of air samples collected and the methodology of sampling

Operate a Continuous Air Monitor (CAM)

- Take the following actions if an unexpected alarm occurs from a continuous air monitor.
 - If a work activity is causing increased airborne radioactivity in the area, stop work and evacuate workers from the immediate area
 - Collect grab air samples for confirmation of airborne concentrations
 - If it is unlikely that a work activity is causing increased airborne radioactivity, survey the area to determine if an increase in background radiation levels caused the alarm
 - Notify RP supervision of the alarm and known conditions for further direction

Objective 3. Identify the types of air samples collected and the methodology of sampling

Define the terminology used for air sample calculations. EO-8



- **Beta-Gamma to Alpha Ratio** -The total activity of beta-gamma emitters divided by the total activity of transuranic alpha emitters as measured by counting systems. An increasing presence of transuranics is indicated by a decreasing ratio.
- **Beta-Gamma DAC Fraction** - $fDAC_{\beta\gamma}$ – The sum of each beta-gamma emitting nuclide's activity divided by its corresponding DAC value; the term is called the Beta-Gamma DAC Fraction. In some cases, the total beta-gamma activity may be divided by the most restrictive nuclide (e.g. Co-60 or Cs-137) for an approximation of the Beta-Gamma DAC Fraction.
- **Alpha DAC Fraction** - $fDAC_{\alpha}$ – The sum of each alpha emitting nuclide's activity divided by its corresponding DAC value; the term is called the Alpha DAC Fraction. In some cases, the total alpha activity may be divided by the most restrictive nuclide DAC value (e.g. Am-241) for an approximation of the Alpha DAC Fraction.

- Total DAC Fraction - $fDAC_{Total}$ – The sum of $fDAC_{\beta\gamma}$ and $fDAC_{\alpha}$
- DAC Fraction Ratio $DAC_{FractionRatio}$ – The ratio of $fDAC_{\alpha}/fDAC_{\beta\gamma}$; This ratio shows the relative significance of transuranics in contributing to potential internal dose to workers.-
- TRU Multiplier -A value equal to $1 + DAC_{FractionRatio}$ that can be multiplied by the $fDAC_{\beta\gamma}$ to estimate the $fDAC_{Total}$ in lieu of completing an alpha analysis. A graph showing TRU Multiplier values based on $\beta\gamma/\alpha$ Ratios, assuming Co-60 and Am-241, is provided in Attachment 3 of NISP-RP-03.

Analyze air sample and identify the airborne concentration of potential intake that requires an area to be posted as an Airborne Radioactivity Area. EO-9



Calculate Airborne Concentration

Evaluation of air sample results requires comparison of airborne concentrations to the Derived Air Concentration (DAC) values in 10 CFR 20, Appendix B.

Calculate Airborne Concentration

Beta-Gamma ($\beta\gamma$) Analysis of Particulate Air Sample

- A screening of the sample can be performed using a beta detector with either a scaler or ratemeter.
- A DAC fraction for beta-gamma emitters can be determined using a counting system and assuming the total activity is Co-60, or other nuclide(s) as directed by site procedures.
- This screening may not be required by the site if the sample has been submitted to a laboratory for gamma spectroscopy.

Objective 6. Calculate Airborne Concentration

Calculate Airborne Concentration

Beta-Gamma ($\beta\gamma$) Analysis of Particulate Air Sample

Use the following equation to calculate $fDAC_{\beta\gamma}$ (Beta Gamma DAC Fracton) if activity is detected above background. RP supervision may direct using a different DAC value based on the plant source term. Use an equation as directed by RP supervision.

$$fDAC_{\beta\gamma} = \frac{\text{Filter DPM}}{(\text{Sample Vol, ml})(0.0222)}$$

where:

$$0.0222 = (2.22e+6 \text{ dpm}/\mu\text{Ci}) \times (1e-8 \mu\text{Ci/ml})$$

$$1e-8 = \text{DAC value for Co-60}$$

Objective 6. Calculate Airborne Concentration

Calculate Airborne Concentration

Beta-Gamma ($\beta\gamma$) Analysis of Particulate Air Sample Example

NCPM from filter = 554

Counter Efficiency = 15%

Sample Volume = 1000 liters

Filter DPM = 554 NCPM / 0.15 efficiency

1000 liters x (1000ml / liter) = 1,000,000 ml

$$fDAC_{\beta\gamma} = \frac{3693 \text{ DPM}}{1,000,000 \text{ ml } (0.0222)}$$

$$fDAC_{\beta\gamma} = \frac{0.166}{}$$

$$fDAC_{\beta\gamma} = \frac{\text{Filter DPM}}{(\text{Sample Vol, ml})(0.0222)}$$

where:

0.0222= (2.22e+6 dpm/ μ Ci) X (1e-8 μ Ci/ml)

1e-8= DAC value for Co-60

*Human Performance Tool
Obtain a Peer Check for
these calculations*

Objective 6. Calculate Airborne Concentration

Indication of Airborne Radioactivity

If air sample results indicate airborne concentrations exceeded 0.3 DAC, or a personal air sampler indicates an intake could occur greater than 4 DAC-hours, in an area that is not posted and controlled as an Airborne Radioactivity Area, take the following actions:

1. If radon interference is suspected during field analysis, consult RP supervision to determine if follow-up actions should be delayed until a radon-discriminating analysis is completed.
2. Stop work, evacuate workers from the affected area, and collect grab samples to determine if airborne concentrations are sustained and to identify the source if unknown.

Indication of Airborne Radioactivity

3. Inform workers in the area without respiratory protection that airborne radioactivity was measured and potential exposures will be evaluated.
4. If the conditions causing the airborne radioactivity may still exist or are unknown, immediately post and control the area as an Airborne Radioactivity Area.
5. Notify RP supervision and ensure the occurrence is documented in the plant corrective action program to identify the cause of the conditions and any corrective actions, including an assessment of potential doses to workers.

Posting Requirements

- Particulates & Iodine \geq 0.3 DAC
- Noble Gas \geq 1.0 DAC

Standard Radiation Sign with the following:

- AIRBORNE RADIOACTIVITY AREA
- RP BRIEF REQUIRED FOR ENTRY

State the definition of an Alpha Level 1, 2, or 3 Area with respect to the potential for internal dose. EO-10



- Alpha Level 1 Area – The internal dose from alpha emitting transuranics is not likely to exceed 10% of the total internal dose from inhalation. Alpha Level 1 Areas have a $\beta\gamma/\alpha$ Ratio greater than 30,000 or alpha activity levels are less than 20 dpm/100 cm². An area not posted as an Alpha Level 2 or 3 Area is an Alpha Level 1 Area. Postings are not required for an Alpha Level 1 Area.

- Alpha Level 2 Area – Alpha emitting transuranics are likely to contribute between 10% and 90% of the total internal dose from inhalation. Alpha Level 2 Areas have a $\beta\gamma/\alpha$ Ratio between 300 and 30,000. Alpha Level 2 Areas are posted per NISP-RP-04, *Posting and Labeling of Radiological Areas*.
- Alpha Level 3 Area – The internal dose from alpha emitting transuranics is likely to exceed 90% of the total internal dose from inhalation. Alpha Level 3 Areas have a $\beta\gamma/\alpha$ Ratio less than 300. Alpha Level 3 Areas are posted per NISP-RP-04

Determine if an air sample from an Alpha Level 1 or 2 Area requires alpha analysis. EO-11



Alpha Analysis of Particulate Air Sample

Analyze a particulate air sample for alpha emitting transuranics using the following criteria:

1. An air sample measures a $fDAC_{\beta\gamma} \geq 1.0$ DAC
2. As required by the option used by the site as described in Attachment 4 of NISP-RP-03 for Alpha Level 2 Areas
3. An air sample was collected in an Alpha Level 3 Area

Utilize NISP-RP-03 or site procedures to perform alpha DAC analysis calculations.

Objective 6. Calculate Airborne Concentration

Determine when personal air samplers should be used in Alpha Level 2 & 3 Areas. EO-12



Set up and Operate a Personal Air Sampler

Personal Air Sample - Sample collected by a small, lightweight air sampler worn by the worker that draws an air sample from the breathing zone (also known as a Lapel Air Sample).

- Issue personal air samplers as required by the RWP
- Issue personal air samplers to each worker in an Alpha Level 2 or 3 Area based on the following criteria:
 - Work in Alpha Level 3 Areas
 - Aggressive work in Alpha Level 2 Areas or on systems with suspected but unknown amounts of transuranics
 - Examples of aggressive work include cutting, grinding, welding, etc.

Objective 3. Identify the types of air samples collected and the methodology of sampling

Set up and Operate a Personal Air Sampler

- Exceptions for the use of personal air samplers may be made for the following:
 - When air supplied suits are worn if the industrial hazards associated with the use of a personal air sampler outweigh the benefits
 - Where a periodic (non-incident based) alpha excreta sampling program is in place
 - During a specific task evolution where it is concluded that a personal air sampler is not necessary, because the potential for airborne alpha had been evaluated and is considered improbable, and appropriate stop work controls are in place and communicated to the workers
 - Where engineering controls, (e.g. a glove box) adequately contain the source term

Objective 3. Identify the types of air samples collected and the methodology of sampling



Set up and Operate a Personal Air Sampler

- Ensure work area sampling is also performed where personal air samplers are in use to provide a complete assessment of the airborne hazard.
 - Measurements from a personal air sampler are not reliable for a complete hazard assessment, including posting criteria, due to:
 - Personal air samplers often do not collect sufficient volume to measure 0.3 DAC.
 - Potential movement of the workers in and out of the area with the highest airborne radioactivity

Objective 3. Identify the types of air samples collected and the methodology of sampling

Set up and Operate a Personal Air Sampler

- Perform the following steps when setting up the personal air sampler for use:
 1. Attach the pump to the worker using the belt that is provided
 2. Secure the tygon tubing with the air sampler head over the worker's shoulder and neck
 3. Locate the sampler head within 10 inches of the workers nose and mouth
 4. Secure the air sample head to the worker by tape or other means making sure not to restrict air flow through the tube

Objective 3. Identify the types of air samples collected and the methodology of sampling

Set up and Operate a Personal Air Sampler

- Perform the following steps when setting up the personal air sampler for use: [Continued](#)
 5. Turn the pump on and verify the flow rate is within specification
 6. Inform the worker to leave the work area if they believe the pump is turned off for more than 30 seconds or is otherwise malfunctioning
 7. Document the person's name and any other identifying information on the site-specific document (e.g. air sample bag or an accompanying form) along with the time the pump was turned on and any other pertinent information such as flow rate, job location time, etc.

Objective 3. Identify the types of air samples collected and the methodology of sampling

Removing a Personal Air Sampler

- Perform the following steps when removing a personal air sampler:
 1. Turn off the sampler pump
 2. Remove the air sampler head, tygon tubing, and pump from the worker
 3. Remove the air sample from the air sample head and place in the air sample bag or petridish as required by site procedures
 4. Use site-specific procedures and forms to record parameters and analyses

Objective 3. Identify the types of air samples collected and the methodology of sampling

Operating Experience

Individual Dose Uptake >10 mRem Internal Exposure During Dry Cask Storage Campaign

While removing the hoses from the quick disconnect fittings at the vent and siphon ports of Dry Storage Cask following helium backfill, a small localized burst of airborne radioactivity was produced while trying to seat the seal in the port. This resulted in an internal exposure uptake of 31 mRem by the maintenance craft worker.

Operating Experience

Individual Dose Uptake >10 mRem Internal Exposure During Dry Cask Storage Campaign

The cause was Radiation Protection and Mechanical Maintenance personnel did not recognize the risk of airborne contamination during the reseating of the Hansen fitting on the dry storage cask.

Operating Experience

Individual Dose Uptake >10 mRem Internal Exposure During Dry Cask Storage Campaign

Corrective Actions

- Procedure revision will require use of HEPA filter during disconnect of siphon and vent lines, use of leak detect substance to detect for leaks, and adjusting fitting with a specific specialized tool.
- Changed ALARA plan to ensure full Anti-C's with Face Shield is required. Lapel and general area air monitors will be utilized.

Enabling Objectives

From Memory and in accordance with NISP-RP-03 students will:

1. Given a work activity and radiological conditions, recognize if air sampling is required.
2. Define the three classifications of an air sample based on sampling location and the purpose of each.
3. State the purpose of a grab sample, a continuous sample, or using a remote pump.
4. Given a potentially explosive atmosphere, a noble gas atmosphere, or a work location with high contamination levels, state the precautions needed for sampling.

Enabling Objectives

5. Given a purpose and location for an air sample, state the minimum sample volume required.
6. Describe the three different methods to collect a noble gas sample.
7. Describe the common lights and alarms on a continuous air monitor and actions to take if an alarm occurs.
8. Define the terminology used for air sample calculations.

Enabling Objectives

9. Analyze air sample and identify the airborne concentration of potential intake that requires an area to be posted as an Airborne Radioactivity Area
10. State the definition of an Alpha Level 1, 2, or 3 Area with respect to the potential for internal dose.
11. Determine if an air sample from an Alpha Level 1 or 2 Area requires alpha analysis.
12. Determine when personal air samplers should be used in Alpha Level 2 & 3 Areas.

Collect and Evaluate Radiological Air Samples

Training Conclusion:

- Questions:
- Feedback:
- Conclusions:



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