



# Performing Airborne Radioactivity Surveys

## ACADs (08-006) Covered

3.2.4.5.1 3.2.4.5.2 3.2.4.5.3 3.3.7.4

## Keywords

Sample analysis, gross particulate activity analysis, airborne radioactivity concentration.

## Description

This document provides information which can be used to establish a program for the performance and documentation of airborne radioactivity surveys, which are used to assess plant engineering control functions.

## Supporting Material

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# RP Procedure 5

# Performing Airborne Radioactivity Surveys



## **PERFORMING AIRBORNE RADIOACTIVITY SURVEYS**

### **1.0 PURPOSE**

To establish a program for the performance and documentation of airborne radioactivity surveys, which are used to assess plant engineering control functions.

### **2.0 SCOPE**

- 2.1. Provide appropriate methods and documentation for performing airborne radioactivity surveys.
- 2.2. Specifies the required sampling for alarms on continuous air monitoring equipment.

### **3.0 PRECAUTIONS AND LIMITATIONS**

- 3.1. High volume samples provide particulate survey data only and should be limited to emergencies and short duration (<10 minutes) jobs with little potential for the release of iodine or gaseous activity.
- 3.2. Marinelli beakers used to collect gaseous radioactivity samples should be checked by gamma spectroscopy to ensure decay of previous samples prior to use.
- 3.3. To prevent dilution, the sample should be terminated as soon after the work as reasonable. For some jobs, this may result in starting another sample to monitor the airborne radioactivity conditions for other phases of the work.
- 3.4. To prevent overloading, filter media used for low volume grab air samples should be changed about every six hours.
- 3.5. A filter change may be required more frequently in high dust areas or when grinding or welding is in progress.
- 3.6. During radiological emergencies, normal radioiodine sample techniques may produce overly conservative results due to interference from noble gases. This overly conservative estimation may result in plant personnel being required unnecessarily to wear respiratory protection equipment, which hampers communication and personnel performance.
- 3.7. To prevent loading of radioiodine cartridges (charcoal or silver zeolite) use a particulate pre-filter.



- 3.8. In areas where Foreign Material Exclusion (FME) controls are required, wrench tighten the sample head fittings and hose fittings.
- 3.9. During emergencies, sampling volumes for particulate and iodine may be less than minimum volumes when airborne activity is expected and the general area dose rate is greater than 1000 mrem/hr with no low background area near the sampling location.
- 3.10. For emergency field monitoring and plume tracking samples, the typical minimum volume is 10ft<sup>3</sup> for particulate and radioiodine. The RP Supervisor may give permission to reduce these to a minimum of 1 ft<sup>3</sup> to maintain RP Field Monitoring Team (FMT) exposures ALARA.
- 3.11. Early warning particulate monitoring is performed with continuous air monitors (CAMs). Results are qualitative.
- 3.12. Analyze the following samples by gamma spectroscopy, when gamma spectroscopy is available.
  - Particulate filters obtained when the sample volume is <100 ft<sup>3</sup> or when the particulate filter >7.5E-10 μCi / ml.
  - Low volume iodine cartridges and noble gas samples.

#### 4.0 PROCEDURE INSTRUCTIONS

##### 4.1. Airborne Radioactivity Survey Methods

### CAUTION

Starting air samplers in areas where hydrogen is present may cause an explosion

- 4.1.1. WHEN using a high volume air sampler to sample for particulate activity, OBTAIN a minimum sample volume of 100 ft<sup>3</sup>.
- 4.1.2. REMOVE a 47 mm circular section from the middle of the 4" high volume filter for sample analysis.
- 4.1.3. WHEN sampling for particulate or radioiodine activity, USE an air sampler operating at approximately 2 cubic feet per minute (cfm), OBTAIN a minimum sample volume of 20 ft<sup>3</sup>.



- 4.1.4. WHEN sampling for radioiodine activity during emergencies, USE a silver zeolite cartridge in an air sampler operating at approximately 2 cfm.
- 4.1.5. USE one of two methods for sampling noble gases:
- a. USE an air sampler operating at approximately 2 cfm with a gas Marinelli beaker connected to the sampler exhaust.
    1. When sampling for noble gas, use a 47 mm particulate filter on the inlet. A charcoal cartridge on the inlet is optional.
    2. RUN the air sampler for at least 2 minutes.
  - b. USE a 4 liter open-topped Marinelli beaker.
    1. WAVE Marinelli beaker in noble gas atmosphere.
    2. PLACE lid on Marinelli beaker.
    3. SEAL Marinelli beaker lid to beaker with vinyl tape.
- 4.1.6. COMPLETE an LSTC Airborne Radioactivity Concentration Worksheet as follows:
- a. RECORD "Sample No." as the date and time the sample is started. USE the format YYMMDD-HHMM (i.e., 090323-1000).
  - b. IF applicable, RECORD the "Radiation Work Permit" (RWP) number for the job being monitored.
  - c. IF the air sample is for some other reason (spill, CAM alarm, etc.), RECORD reason for sample.
  - d. RECORD the specific "location" of the sample.
  - e. CIRCLE appropriate type of sample. (More than one may apply.)
  - f. CIRCLE "Yes" or "No" for coin smear survey data Alpha  $\geq$  100 dpm/100 cm<sup>2</sup> or N/A when Alpha survey is not required.
  - g. CIRCLE "Yes" or "No" if area currently posted an ARA.
  - h. CIRCLE "Yes" or "No" if respiratory protection worn during air sample.
  - i. RECORD "Start Time" and "Flow", if applicable.



- j. RECORD "Sampler ID".
- k. INITIAL "Tech" block for having started the sample.
- l. WHEN adequate sample volume has been obtained, RECORD "Stop Time" and "Flow", if applicable.
- m. INITIAL "Tech" block for having stopped the sample.
- n. TURN OFF air sampler.

#### 4.2. Sample Analysis

##### 4.2.1. Radioiodine Sample Analysis During Plant Emergencies When Gamma Spectroscopy Is Not Available

- a. PERFORM radioiodine concentration estimate using portable instruments as follows:
  - 1. MOVE to an area where background count rate is low enough to count sample and an air sampler is available.
  - 2. PURGE sample to reduce noble gas interference by running the air sampler for at least one minute or 1 cubic ft.
  - 3. COUNT sample using a count rate meter with a pancake GM detector.
  - 4. IF >100,000 ncpm MULTIPLY ncpm by 1.3 to correct for detector resolving time.
  - 5. CALCULATE estimated radioiodine concentration in  $\mu\text{Ci/ml}$  on the LSTC Airborne Radioactivity Concentration Worksheet in the following equation:

$$\frac{\text{Net CPM} \times 8.0 \times 10^{-9}}{\text{Volume (ft}^3\text{)}} = \mu\text{Ci/ml Gross I}_2$$



4.2.2. Gross Particulate Activity Analysis

**NOTE**

Immediate access control and protective requirement decisions may be made based upon gross analysis results, prior to gamma spectroscopy results being available.

- a. WHEN immediate sample results are desired for a sample volume  $\geq 100 \text{ ft}^3$ , PERFORM gross counting of a particulate filter as follows:
1. MOVE to an area where background count rate is low enough to count sample.
  2. COUNT sample using a count rate meter with a pancake GM detector.
  3. Calculate the activity concentration in  $\mu\text{Ci/ml}$  using the following equation:

$$\frac{\text{Net CPM} \times 2.0 \times 10^{-10} \times \text{FCF}}{V (\text{ft}^3)} = \mu\text{Ci/ml}$$

Where:

FCF = filter correction factor = 4 (applicable only to 47 mm section removed from a 4" Hi Vol particulate sample filter.)

4.3. Documentation of Airborne Radioactivity Survey Results

**NOTE**

Airborne radioactivity surveys are calculated and recorded on LSTC Airborne Radioactivity Concentration Worksheet

- 4.3.1. ROUTE air sample and the LSTC Airborne Radioactivity Concentration Worksheet to Count Room for analysis by gamma spectroscopy, if applicable.
- 4.3.2. REVIEW the LSTC Airborne Radioactivity Concentration Worksheet and associated Count Room reports, if applicable, for completeness.



- 4.3.3. ENSURE RP survey data is complete.
- 4.3.4. IF Alpha results  $\geq 100$  dpm / 100 cm<sup>2</sup>, CHECK if TRU library was used to determine DAC values.
- 4.3.5. CHECK / COMPLETE Airborne Radioactivity Area postings.
- 4.3.6. IF air sample indicates an actual airborne radioactivity hazard is present, POST area.
- 4.3.7. CONTROL access as necessary.
- 4.3.8. ANNOTATE recording of air sample data by signing the LSTC Airborne Radioactivity Concentration Worksheet.
- 4.3.9. FORWARD LSTC Airborne Radioactivity Concentration Worksheet and associated Count Room reports, if applicable, to a RP Supervisor for review.

**End of Procedure**





**Attachment 1**

**LSTC AIRBORNE RADIOACTIVITY CONCENTRATION WORKSHEET**

**Airborne Sample Data**

|   |  |                   |  |
|---|--|-------------------|--|
| Sample No:<br>_____<br>YY MM DD HH MM (Start Time)  | Type of Sample Taken<br><input type="checkbox"/> Particulate <input type="checkbox"/> Iodine <input type="checkbox"/> Gas <input type="checkbox"/> H-3 |                   |  |
| RWP #:  | Reason:  | Location:         |  |
| Alpha Contamination: $\geq 100$ DPM/100 cm <sup>2</sup> Alpha <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A (None Required) |  |                   | If Yes for Alpha, send to Count Room for analysis.                 |
| Area currently posted as Airborne Radioactivity Area (ARA)? <input type="checkbox"/> Yes <input type="checkbox"/> No  |  |                   |  |
| Respiratory Protection worn during air sample? <input type="checkbox"/> Yes <input type="checkbox"/> No   |  |                   |  |
| Sample Start Time: _____  | Flow Rate: _____ ft <sup>3</sup> /min  | Technician: _____ |  |
| Sample Stop Time: _____   | Flow Rate: _____ ft <sup>3</sup> /min  | Technician: _____ |  |
| Air Sampler ID Number: _____  | <input type="checkbox"/> High Volume Flow Rate <input type="checkbox"/> Low Volume Flow Rate   |                   |  |
| Sample Volume: = (Sample Minutes) x (Sample Flow Rate*) = _____ ft <sup>3</sup>   |  |                   | *Use average flow rate if start and stop flow rates are different. |

**Airborne Activity Data**

Particulate Filter     Radioiodine Cartridge

Date/Time Air Sample Counted: \_\_\_\_\_ / \_\_\_\_\_    Count Rate Meter ID#: \_\_\_\_\_

Counted by: \_\_\_\_\_    Date/Time: \_\_\_\_\_ / \_\_\_\_\_

**Particulate Activity Calculation**

Gross CPM: \_\_\_\_\_    Background CPM: \_\_\_\_\_    Net CPM: \_\_\_\_\_

Activity =  $\frac{(\text{Net CPM}) \times (*) \times (2 \times 10^{-10})}{(\text{Sample Volume (ft}^3))}$  = Activity: \_\_\_\_\_  $\mu\text{Ci/ml}$

\* If Net CPM is >100,000, multiply by 1.3 to correct for detector resolving time.

**Iodine Activity Calculation**

Gross CPM: \_\_\_\_\_    Background CPM: \_\_\_\_\_    Net CPM: \_\_\_\_\_

Activity =  $\frac{(\text{Net CPM}) \times (*) \times (8 \times 10^{-9})}{(\text{Sample Volume (ft}^3))}$  = Activity: \_\_\_\_\_  $\mu\text{Ci/ml}$

\* If Net CPM is >100,000, multiply by 1.3 to correct for detector resolving time.

**Gross Airborne Activity:** \_\_\_\_\_  $\mu\text{Ci/ml}$

If Gross Airborne Activity is > 7.5 E-10  $\mu\text{Ci/ml}$ , or Alpha  $\geq 100$  DPM/100 cm<sup>2</sup>, send to Count Room for Gamma-Spectroscopy Analysis and DAC determination.

Reviewed/Recorded By: \_\_\_\_\_    Date/Time: \_\_\_\_\_ / \_\_\_\_\_  
RP Technician

Reviewed/Approved By: \_\_\_\_\_    Date/Time: \_\_\_\_\_ / \_\_\_\_\_  
RP Supervisor



### Derived Airborne Concentration (DAC) Determination

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#### Count Room Data:

Count Request #: \_\_\_\_\_ (From Count Room Log)

Particulate: \_\_\_\_\_ DAC

Iodine: \_\_\_\_\_ DAC     Check if TRU Library used

H-3 \_\_\_\_\_ DAC

**Total** \_\_\_\_\_ DAC (if  $\geq 0.3$ , Check ARA)

Gaseous \_\_\_\_\_ DAC

**Total + Gaseous** \_\_\_\_\_ DAC (if  $\geq 1.0$ , Check ARA)

Counted by: \_\_\_\_\_ Date/Time: \_\_\_\_\_ / \_\_\_\_\_

**ARA**  
**If ARA, Notify**  
**RP Supervisor**  
**Immediately**

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#### ARA Posting Changes: (When required, based on this air sample)

Date/Time Posted: \_\_\_\_\_ / \_\_\_\_\_

Date/Time De-posted: \_\_\_\_\_ / \_\_\_\_\_

Remarks:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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Reviewed/Recorded By: \_\_\_\_\_ Date/Time: \_\_\_\_\_ / \_\_\_\_\_

RP Technician

Reviewed/Approved By: \_\_\_\_\_ Date/Time: \_\_\_\_\_ / \_\_\_\_\_

RP Supervisor