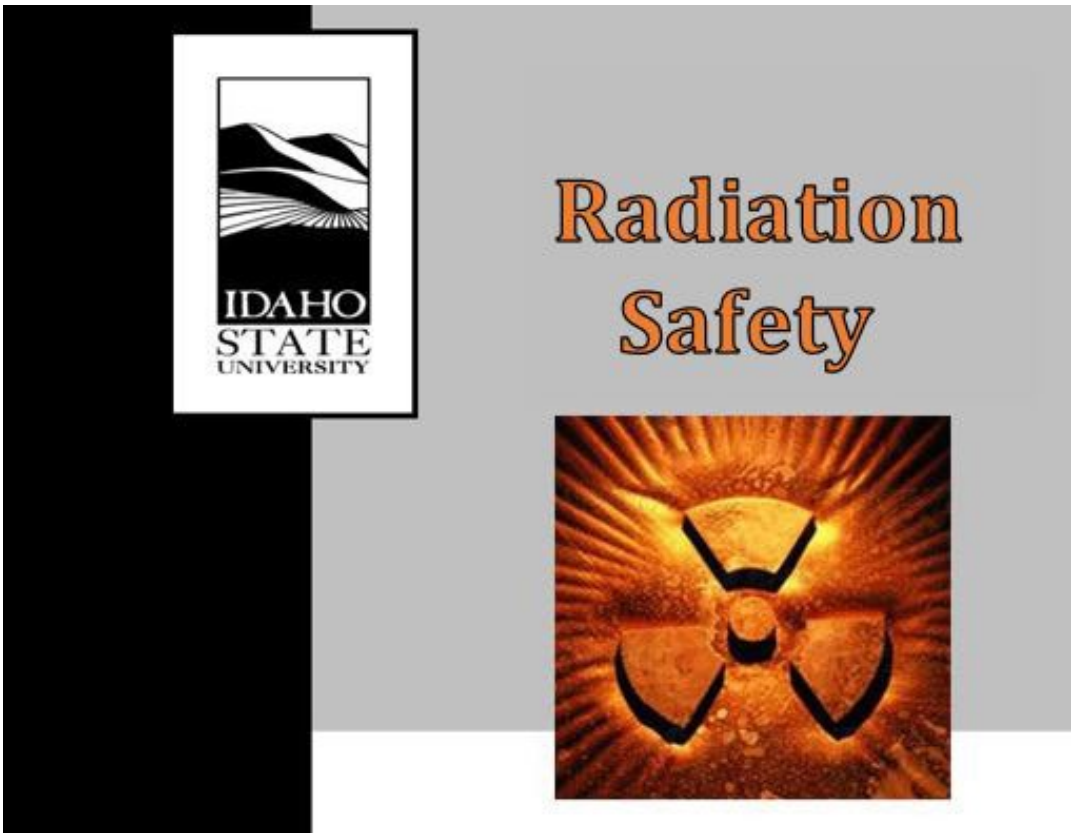


RADIATION PROCEDURES MANUAL

Procedure Cover Sheet

Procedure Title:	Emergency Response
Procedure Number:	RS-25 Rev.0
Effective Date:	08/31/2021

Approved By: Radiation Safety Committee Date: 08/12/2021

Revision History

Revision Number	Author Name	Date	Approved by/date
RS 25.0	Mason Jaussi & John Longley	08/12/21	RSC-08/12/21
RS 25.0	Kishor Paudel	09/14/23	RSC-08/12/21
RS 25.0	Miranda Kriner	09/03/25	RSC-08/12/21

Table of Contents

1. INTRODUCTION

Radiation Workers at Idaho State University are trained in basic emergency response as a part of general radiation safety training. In addition, Authorized User procedures address emergency response specific to their facilities and operations.

2. PURPOSE

This procedure provides instructions for radiation safety personnel for response to a general emergency involving radioactive materials or radiation producing machines at Idaho State University.

3. SCOPE

This procedure applies to all Radiation Safety Department personnel.

4. ROLES AND RESPONSIBILITIES

Radiation Safety Department personnel have the responsibility to read, understand, and follow this procedure. The Radiation Safety Department staff will perform an annual inventory of the Emergency Response kit.

The Radiation Safety Officer has the responsibility to oversee the radiation safety program.

5. ACRONYMS/DEFINITIONS

ALI: Annual Limit of Intake
ARSO: Assistant Radiation Safety Officer
DAC: Derived Air Concentration
DOE: Department of Energy
FCF: First Count Factor
ISU: Idaho State University
LSC: Liquid Scintillation Counter
PPE: Personnel Protective Equipment
REAC/TS: Radiation Emergency Assistance Center/Training Site
RSD: Radiation Safety Department
RSO: Radiation Safety Officer

6. REQUIRED MATERIAL(S)

- Whole-body dosimeter (as required)
- Emergency Response Kit (as required)
- Spill Kit (as required)
- PPE (as required)

7. REQUIRED TRAINING

• ISU Radiation Safety Training

8. PROCEDURE

8.1. Radioactive Material Spill

In the case of a spill involving radioactive material, Radiation Workers must respond in a timely manner to minimize exposures and the potential spread of radioactive contamination. Radiation Workers are expected to clean up, survey, and document their own spills if it is within their capability. In the event that a radioactive material spill is reported to the Radiation Safety Department, staff will respond as follows:

8.1.1. Collect and record the following information:

- Name of Caller
- Are there any serious injuries? – If Yes, call 911
- Location of spill.
- Contents of spill (radionuclides, hazardous materials, etc.)
- Extent of the spill.
- Time of spill,
- Potentially exposed/contaminated personnel.

8.1.2. Instruct the caller to perform the following if within their capacity:

S – Stop work and place in a safe configuration

W – Warn others in the area of the spill

I – Isolate the spill as much as possible

M – Minimize the spill as much as possible

S – Secure the area

8.1.3. Obtain the emergency response kit and emergency response instruments. Contact the ISU Environmental Health Safety and Sustainability Department if chemical or biological hazards are present.

8.1.4. Arrive at the spill, assess the area, don PPE (lab coat, gloves, and shoe covers), and perform any of the steps in 8.1.2 that have not been performed.

8.1.5. Have all personnel remain in the area until they have been surveyed for contamination.

8.1.6. Perform area dose rate measurements with the appropriate instrument(s) and establish Radiation Area/High Radiation Area boundaries as appropriate.

8.1.7. Use absorbent pads to soak up the spill.

8.1.8. Bag all potentially contaminated waste and label it as appropriate.

8.1.9. Perform large area wipe(s) of the area, frisk the wipe, record the results, and establish a contamination area boundary as appropriate.

8.1.10. Perform swipes of the area and count on an appropriate laboratory instrument. Record survey results.

8.1.11. Release the area from radiological controls when the survey results are as low as reasonably achievable and below the contamination limits of Table 7 in the Radiation Safety Manual, reproduced below.

Nuclide[1]	Average[2,3]	Maximum[2,4]	Removable[2,5]
U-nat, U-235, U-238, and associated decay products	5,000	15,000	1,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000	15,000	1,000

[1]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[2]As used in this table, disintegrations per minute (dpm) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[3]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[4]The maximum contamination level applies to an area of not more than 100 square centimeters (cm^2).

[5]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

8.2. Potential Over-Exposure

In the event the Radiation Safety Department is contacted with a potential over-exposure and the individual is not visibly injured or exhibiting symptoms of acute radiation sickness, personnel will respond as follows:

Note: It is very important to maintain a calm and collected attitude when responding to these emergencies. Calmly reassure the individual that the exposure is not likely to be life-threatening. Try to talk to the individual while performing the assessment to gain as much information about the incident as possible.

8.2.1. Collect and record the following information:

- Name and location of the individual
- Description of the incident, including all radioactive materials and radiation-producing machines in the area.
- Potential existing hazards

8.2.2. If the potential over-exposure involves dispersible radioactive material and an internal exposure is suspected, perform the following steps:

8.2.2.1. Instruct the individual to move to a safe location in the laboratory, or, if necessary, out of the laboratory, and minimize the potential spread of contamination.

8.2.2.2. Instruct the individual to warn people in the immediate area to prevent any further exposure. If multiple individuals are suspected to have been contaminated, and there are no significant injuries or danger of further exposure, instruct them to stay within the laboratory to prevent the spread of contamination.

8.2.2.3. Gather emergency response kit.

8.2.2.4. Respond to the incident. Don PPE (lab coat, gloves, shoe covers) outside of the contaminated area. If necessary, perform large area wipes, working your way inside to the contaminated individual.

8.2.2.5. Perform a full body survey of the individual with the appropriate survey instrument.

8.2.2.6. If contamination is found on clothing, provide the individual a set of scrubs or coveralls and bag the contaminated clothing. Ensure the individual can properly doff the contaminated clothing without further spread of contamination. Provide as much privacy as possible and assist the individual as best as you can while respecting their comfort levels.

8.2.2.7. Perform a superficial nasal swab or have the individual gently swab the opening of each nostril using a moistened sterile swab. Bag the swab for laboratory analysis.

8.2.2.8. If contamination is present on the individual's skin or hair, gently decontaminate using wet wipes. Bag and label all of the materials used to decontaminate the individual. Continue to decontaminate, taking care not to abrade the skin, until measurements are within background. As necessary, use soap and warm water for additional decontamination.

8.2.2.9. Release the individual, perform a survey of the area, decontaminate as necessary, record all information about the incident, count the nasal swipes on the LSC, and determine if the individual needs to be put on a bioassay schedule, using RS-11, Internal Dosimetry.

8.2.3. If the potential over-exposure involves external radiation only, perform the following steps:

8.2.3.1. Retrieve the individual's dosimeter. If the individual was not wearing a dosimeter, obtain the closest area monitor or dosimeter from personnel in the area.

8.2.3.2. Collect as much information as possible about the event (source of exposure, e.g. source or machine, duration of exposure, parts of the body exposed, others present, etc.).

8.2.4. If the exposure may exceed 25 rem to the whole body, seek medical assistance and have the medical personnel contact REAC/TS at 865-576-1005 as necessary. Radiation safety personnel will accompany the exposed person to the medical facility to provide detailed information to medical personnel.

8.3. Potentially Leaking Source

In the event the Radiation Safety Department is contacted with a potentially leaking source, personnel will respond as follows:

8.3.1. Collect and record the following information:

- Name and location of the individual and number of individuals present. Instruct the individual to secure the area and not let anyone enter or exit.
- Description of the incident. Including information about the source, possible extent of contamination, and area dose rates. If high dose rates are present, instruct the individual to move to an area away from the source field.
- If personnel contamination is found, perform the steps listed in 8.2.2.

8.3.2. Collect the necessary PPE, appropriate survey instrument(s) and materials, and containment for source.

8.3.3. Respond to the incident and don PPE (lab coat, shoe covers, and gloves). Measure dose rates and ensure the area is properly posted for the expected dose rates.

8.3.4. Perform large area wipes approaching the area where the source was dropped or damaged. Survey the entire area, including any individuals who were nearby when the source was dropped. Record all measurements.

8.3.5. If contamination is present, decontaminate the area to as low as reasonably achievable and below the contamination limits of Table 7 in the Radiation Safety Manual, see 8.1.11.

8.3.6. Retrieve the source, use long reach tools if the dose rate 30-cm from the source exceeds 100 mrem/hr, and place in a bag. J-seal the bag, label as Radioactive Materials, and indicate the source, activity, and dose rate on the bag.

8.3.7. Complete the survey of the area and remove the source.

8.3.8. Store the source in a designated radioactive materials area and consult with the RSO on how to properly dispose of the source.

8.3.9. Update the inventory and leak test records to indicate the source is out of service and to be disposed.

8.4. Large Emergency

For large emergencies, the Radiation Safety Department will respond and will coordinate with the public safety department, off-site responders from the City of Pocatello, the Idaho State Police, and medical personnel from Portneuf Medical Center. The Radiation Safety Department provides a support role to the incident commander, offering technical advice of the radiological hazards. For emergencies at the Reactor follow the Reactor Emergency Plan.

Any of the following scenarios are considered a Large Emergency:

8.4.1. Fire involving radioactive materials,

8.4.1.1. Contact Public Safety

8.4.1.2. Have Public Safety isolate and control the area.

8.4.1.3. Call 911 to obtain assistance from the local fire department.

8.4.1.4. Collect air samples, as specified in Appendix III, in the downwind direction, to obtain qualitative data on the airborne concentration. Appendix IV provides instructions for performing a quantitative analysis on the air sample filter.

8.4.1.5. Provide technical assistance to the incident commander.

8.4.2. Significant airborne release of radioactive materials

8.4.2.1. Contact Public Safety

8.4.2.2. Have Public Safety isolate and control the area.

8.4.2.3. Contact Idaho Radiological Emergency Personnel 208-846-7610.

8.4.2.4. Collect air samples, as specified in Appendix III, in the downwind direction, to obtain qualitative data on the airborne concentration. Appendix IV provides instructions for performing a quantitative analysis on the air sample filter.

8.4.2.5. Provide technical assistance to the incident commander if necessary.

8.4.3. Injury involving contamination with radioactive materials.

8.4.3.1. Call 911 for a significant or life-threatening injury. Treatment of the injury takes precedence over all radiological concerns.

8.4.3.2. In consultation with emergency medical personnel, decontaminate the injured person and perform radiological surveys of the person.

8.4.3.3. Record the survey data on the Patient Status Sheet

8.4.3.4. Radiation safety personnel will accompany the injured person to the medical facility with the status sheet and survey instrumentation.

8.4.3.5. Contact the Idaho Radiological Emergency Personnel 208-846-7610 as necessary. They will coordinate with the DOE Radiological Assistance Program if needed.

9. LIST OF FORMS

Radiological Emergency Kit Inventory (Appendix I)

Patient Status Sheet (Appendix II)

RS-25_Appendix_III_Workbook Rev0

RS-25_Appendix_IV_Workbook Rev0

10. REFERENCES

None.

11. CHANGE HISTORY

Revision 0 Reviews - Appendix IV was added to provide instructions for performing quantitative analyses on the air filter obtained from Appendix III. Minor grammar and reordering to improve clarity.

12. APPENDICES

APPENDIX I – Emergency Response Kit Inventory

APPENDIX II – Patient Status Sheet

APPENDIX III – High Volume Air Sampling Procedure for an Off-Normal Event

APPENDIX IV – Quantitative Analysis of High Volume Air Sample Filters

Emergency Response Kit Inventory

Item	Quantity	Notes
RS-25 Emergency Response Procedure	1	
Clipboard	1	
Patient Status Sheets	20	
RPR-11b Survey Forms	10	
Notepad	1	
Calculator	1	
Foaming Decontamination Spray	2 cans	
Empty Spray Bottles	2	
Heavy-duty Tape (Vinyl)	2 rolls	
Paper Towels	1 roll	
Nitrile Gloves (L and XL)	1 box each	
Gallon Bags	1 box	
Sandwich Bags	10	
Clear Drum Liners	5	
Clear Trash Bags	5	
Masslin Sheets	1 pkg	
Absorbent Pads	4	
EMR Guidebook	1	
High-Volume Air Sampler	1	
Extension Cord	1	
4” Air Filters	1 box	
Yellow & Magenta Rope	1 roll	
Yellow & Magenta Tape	1 roll	
Wet Wipes	1 pkg	
Sponges	4	
Shaving Cream	1 can	
Dish soap	1 bottle	
Scissors	1	
Razor	1	
Swipes	20	
Sterile cotton swabs	20	
Sharpies	4	
Pens	4	
PEN dosimeters	4	
Caution Radiation Area Postings	6	
Caution RAM stickers	1 pkg	
Hooded Coveralls	5 pairs	
Shoe Covers	5 pairs	
Forearm Gauntlets	5 pairs	

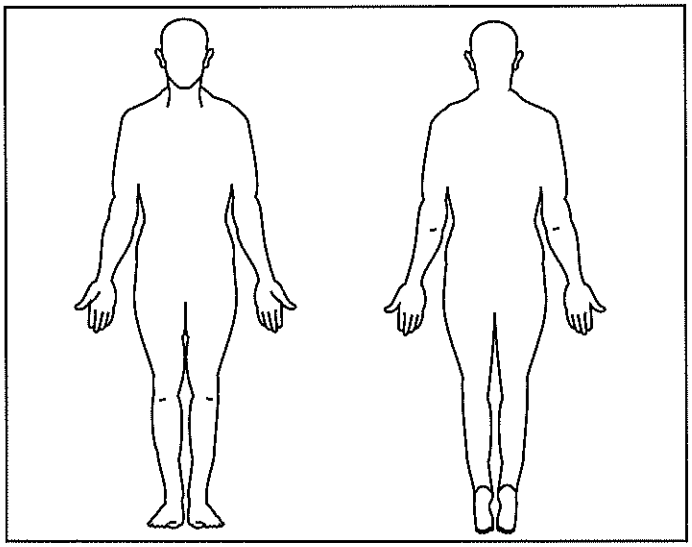
PATIENT STATUS SHEET

Contaminated Patient Information Sheets (present 2 copies to PMC radiation safety personnel once in PMC ER)

Patient Name		Age	
Institution		Accident Scene Location	
Contamination Location		Radionuclides Involved	
Maximum Radiation emanation rate at contamination location	Units: Maximum Value:	Medial Injury Location	Initial estimated patient dose in rads:
Accompanying Safety Personnel Name			
Completed by		Date	

Locations of identified radioactive contamination:

ANTERIOR POSTERIOR



RADIOLOGICAL PERSPECTIVE:

It is unlikely that radiological conditions will have any measurable impact on the patient, or care providers, but rather radioactive contamination is most likely to present a hygienic issue. The first priority should be the normal patient stabilization protocol. Be conscious about spreading radioactive materials unnecessarily; contamination control is a second priority after patient stabilization.

Decontamination in most instances can be accomplished with warm soapy water in non-aggressive washing. Save the wash water for future analysis and appropriate handling if feasible.

Avoid confusion with prefixes:

m = 1/1000	k = 1,000
μ = 1/1,000,000	M = 1,000,000

Remember radiation exposure control is accomplished by reducing time near sources, increasing distances between people and sources, and when convenient providing shielding between the source and personnel.

Guidelines: Radiation Emanation Rate

When expressed in cpm is a hygienic issue not life threatening.

If expressed in mRad/hr substantial contamination issue but not life threatening
If expressed in Rad/hr exposure consequences to personnel should be considered

Guidelines: Patient Dose

Radiation dose less than 25 rad: Not an immediate health consequence.

Radiation dose greater than 25 rad: Minor blood changes
Radiation dose greater than 450 rad LD 50/30

ASSESSMENT OF RADIOLOGICAL HAZARD:

Instrument used: Serial:

	Radiation Emanation rates Units:		Radiation Emanation rates Units:		Radiation Emanation rates Units:
BKG		4		10	
1		5		11	
2		6		12	
3		7		13	
4		8		14	
5		9		15	

PRECAUTIONS AND LIMITATIONS WITHIN THE RADIOLOGICAL HAZARD:

OTHER OBSERVATIONS/NOTES (DESCRIBE):

PERFORMED BY: _____

DATE: _____

Immediate contact information of person who performed survey:

Cellular number: _____

Telephone: _____

High Volume Air Sampling Procedure for an Off-Normal Event

Introduction

Appendix III is intended to provide qualitative information regarding airborne concentrations of radioactive material.to first responders in a large-scale emergency. Appendix IV is used to further quantify information obtained from the process outlined in this procedure and appendix.

High-volume air samplers are used to provide an estimate of the airborne radioactivity concentration in a given location in a short period of time. The sampler pulls air through a 4" diameter glass fiber filter at a volumetric flow rate of 0-70 cubic feet per minute (cfm). The filters are screened using a Geiger–Müller tube to provide rapid evaluation of potential airborne radioactive material. Additional analysis may be performed using laboratory equipment to more definitively quantify the release.

Procedure

Obtain a copy of the RS-25_Appendix III Workbook.

1. Determine the first count factor.

1.1. Collect an air sample as specified in Step 2 of this appendix. Air samples should be collected over a variety of conditions to assess the variability of measurements.

1.2. Measure the average gross background count rate with a Model 3 (set to slow response) equipped with a Model 44-9 probe. Record the background on the First Count Factor (FCF) Data tab of the RS-25_Appendix III_Workbook.

1.3. Count the filter as outlined in Step 2.5. Record the gross alpha and gross beta count rates (cpm) on the FCF Data tab.

1.4. The Excel sheet will calculate the first count factor (Γ) using the equation below.

$$\Gamma = \frac{B}{A}$$

Where: Γ is the first count factor,
B is the net beta count rate (cpm)
A is the net alpha count rate (cpm)

Where: $B = Gross\ Counts\ Rate\ (with\ paper) - Gross\ Background\ Count\ Rate$

$A = (Gross\ Counts\ Rate - Gross\ Background\ Count\ Rate) - Beta\ Net\ Count\ Rate$

1.5. Repeat this process at least 10 times, at varied locations and times of year, to determine the average and range of the first count factor.

1.6. The Excel sheet will calculate the mean, maximum, and minimum of all recorded FCF values on the FCF Data tab.

2. Collect a high-volume air sample.

2.1. Set up the high-volume air sampler. Ensure the rough (active) side of the filter is positioned out (so that air passes through it before entering the sampler).

2.2. Run the sampler approximately 5 ft above the ground to represent the height of the standard breathing zone and with the following parameters, for a target sample volume of 200 ft^3:

- Sample time: 10 minutes
- Flow rate: 20 cfm whenever possible*

  *if a different value is used, record the actual flow rate.

2.3. Record the applicable information on the High Volume Air Sampling Form (see the last page of this appendix) for transposition to the Sample Data tab of the RS-25_Appendix III_Workbook.

2.4. Measure the average background count rate with a Model 3 (set to slow response) equipped with a Model 44-9 probe. Record the background on the Sample Data tab.

2.5. Count the filter with the Model 3/44-9 probe (slow response) to establish a gross alpha beta measurement. Alpha and beta counts are differentiated by counting twice: First on the bare filter, then again with the filter covered by a sheet of paper. Record the gross alpha and gross beta count rates (cpm) on the Sample Data tab.

2.6. A, B, Γ, A_m, and B_m will automatically be calculated within the sheet.

- If Γ is greater than the maximum, the excel sheet will compute the beta count rate B_m (cpm) using the formula below:

$$B_m = A(\Gamma - \bar{\Gamma})$$

- If Γ is less than the minimum, compute the alpha count rate A_m (cpm).

$$A_m = B\left(\frac{1}{\Gamma} - \frac{1}{\bar{\Gamma}}\right)$$

2.7. If Γ is between the maximum and minimum, the activity is likely radon progeny. Recount in 30 minutes as specified in Step 4 below.

2.8. Compute the activity concentration (C) in μCi/ml using the equation below and record the results on the sample collection form.

$$C = \frac{A_m \; or \; B_m(cpm) * G}{F * t * \varepsilon * CF * CE * (AC \; or \; BC)}$$

Where: F is the flow rate (cfm)
t is the sample collection time (min)
ε is the detection efficiency for alpha or beta radioactivity
CF is a dimensional correction factor 6.29e10 = 2.22e+06 dpm/μCi * 28316.8 ml/ft^3
CE is the filter collection efficiency for 1 micron particle (0.95)

AC is the filter counting efficiency factor for alpha counts (0.7)
BC is the filter counting efficiency factor for beta counts (1)
G is a geometry correction factor for counting part of the filter (4), where:
Actual size of the filter = πr^2= 3.14 * (5.08 cm)^2 = 81.03 cm^2
Actual size of the adjusted filter (probe) = πr^2= 3.14 * (2.54 cm)^2 = 20.25 cm^2

3. Compare the alpha or beta concentration to the stochastic DAC values in the table below. If another nuclide is suspected or known, compare to stochastic DAC values in 10 CFR 20 Appendix B. One stochastic DAC-hr corresponds to roughly 2.5 mrem.

10 CFR 20, Appendix B – Stochastic Derived Air Concentration (DAC) Values		
Radionuclide	**Inhalation Class**	**Stochastic DAC [µCi/mL]**
U-238, U-235, U-234	Y	2.0E-11
Cs-137	D	6.0E-8
Sr-90	Y	2.0E-9

4. Recount the sample after 30 minutes. If the net count rate is approximately 0.5 of the initial, this indicates the activity is likely radon progeny.
5. If the counts do not drop in half, the results are most likely from “licensed materials” and should be further quantified following Appendix IV.
6. Save the air filter in a plastic bag for potential laboratory analysis. Label the bag with the sample number (MM/DD/YYYY- #).

References

Federal Radiological Monitoring and Assessment Center (FRMAC). Monitoring and Sampling Manual – Radiation Monitoring and Sampling; Volume III, Rev. 3; January 2021. DOE/NV/03624—1024.

U.S. Nuclear Regulatory Commission (NUREG). NUREG 1400. Air Sampling in the Workplace. Final Report; September 1993.

High Volume Air Sampler Data Sheet

Project/Facility: _____ Date: _____

Operator Name/Initials: _____

Sample Number (MM/DD/YYYY - #): _____

Sample Start Time: _____

Sample Stop Time: _____

Instrument Information

High Volume Air Sampler:

Model: _____ Flow Rate Data (CFM): _____

SN: _____ Outside Weather Conditions: _____

Cal. Due: _____

Model 3 - General Purpose Ratemeter

SN: _____

Cal. Due: _____

Model 44-9 - GM Pancake Probe

SN: _____

Filter Measurements

Gross Count - Background (CPM): _____

Gross Count - Bare Filter (CPM): _____

Gross Count - Filter + Paper (CPM): _____

Filter Counted on Proportional Counter (Circle One): YES / NO

Notes: _____

Quantitative Analysis of High Volume Air Sample Filters

Introduction

Appendix IV can be utilized if quantitative information regarding the airborne concentrations of radioactive materials is desired for first responders.

The secondary goal of Appendix IV is to estimate the Committed Effective Dose Equivalent of exposed personnel using the Annual Limit of Intake (ALI) values for personnel near the vicinity of a release of the airborne radioactive material. If the duration of time spent in a radioactive airborne area by personnel is unknown, use a conservative estimate of the duration.

Procedure

Obtain a copy of the RS-25_Appendix IV Workbook.

1. Obtain and analyze the same filter that was collected using Appendix III.

NOTE: The Radiation Safety Department (RSD) doesn't have the capability to count 4 inch filter paper. However, the diameter of the 4 inch filter can be reduced to 2 inches without any cross-contamination by using a 2 inch circular punch cutting tool, allowing it to fit on standard 2 inch planchettes. The area correction factor for the size adjustment will be applied when calculating the concentration of the filter. The two-inch filter, along with a background filter of the same geometry, will then be counted on the Proportional Counter for 4 Minutes. The usage and the frequency of steps outlined here in Appendix IV will be used at the discretion of the RSO.

2. Enter the net alpha and net beta counts (dpm) from the proportional counter results into the Template tab of the RS-25_Appendix IV Workbook. The Excel sheet will automatically calculate the activity concentration (C) in µCi/ml using the equations below:

2.1 Alpha concentration (µCi/ml)

$$C\ (Alpha\ ) = \frac{Activity(DPM) * G}{F * t * CF * CE * AC}$$

Where: F is the flow rate (cfm)
t is the sample collection time (min)
CF is dimensional correction factor 6.29e10 = 2.22e+06 dpm/µCi * 28316.8 ml/ft^3
CE is the filter collection efficiency for 1 micron particle (0.95)
AC is the filter counting efficiency factor for alpha counts (0.7)
G is a geometry correction factor (4), where:
Actual size of the filter = πr^2= 3.14 * (5.08cm)^2 = 81.03 cm^2
Actual size of the adjusted filter = πr^2= 3.14* (2.54cm)^2 = 20.25 cm^2

$$G = \frac{Actual\ size\ of\ the\ filter}{Total\ area\ of\ filter\ counted\ in\ the\ Proportional\ Counter} \qquad Therefore,\ G = \frac{81.03}{20.25} = 4$$

2.2 Beta concentration (µCi/ml)

$$C\ (Beta) = \frac{Activity(DPM) * G}{F * t * CF * CE * BC}$$

Where: F is the flow rate (cfm)
t is the sample collection time (min)
CF is dimensional correction factor 6.29e10 = 2.22e+06 dpm/µCi * 28316.8 ml/ft^3
CE is the filter collection efficiency for 1 micron particle (0.95)
BC is the filter counting efficiency factor for beta counts (1)
G is a geometry correction factor (4), see section 2.1 for the calculations

3. If radionuclides are unknown, conservatively estimate the dose using the DAC values of U-238 and Sr-90 from 10 CFR 20, Appendix B for alpha, and beta emitting radionuclides, respectively. Alternatively, for unknown radionuclides, the DAC values of the most probable radionuclides can also be used. One stochastic DAC-hr corresponds to roughly 2.5 mrem.
4. Return the filter to its labelled storage bag and retain or dispose of it as necessary.

References

Federal Radiological Monitoring and Assessment Center (FRMAC). Monitoring and Sampling Manual – Radiation Monitoring and Sampling; Volume II, Rev. 3; January 2021. DOE/NV/03624—1024.

U.S. Nuclear Regulatory Commission (NUREG). NUREG 1400. Air Sampling in the Workplace. Final Report; September 1993.