During a recent laboratory decommissioning, the RSOf detected radioactive contamination in a vacuum line. Unfortunately, the contamination was carbon-14, so decay in place was not an option. Carbon-14 is a low energy beta emitter and even large amounts pose little external hazard. The major concern with carbon-14 is the possibility of an internal uptake. Such an exposure may occur if an individual contaminates bare skin, accidentally ingests the material, or inhales it in the form of a gas or vapor (e.g., $^{14}\text{CO}_2$).

Vacuum lines are vulnerable to contamination. When building/laboratory vacuum is used to manipulate compounds that contain radioactive materials (RAM), a suitable trap must be employed. Place the trap between the experimental apparatus and the vacuum source. The trap can be as simple as an additional vacuum flask connected in series to the collection flask as shown below.

(A) Collection flask, (B) Overflow flask, (C) in-line filter, (D) Building vacuum system

A suction flask is used to collect any contaminated fluids into a suitable collection solution. A second flask serves as a fluid overflow collection vessel. An in-line filter should also be used to protect the vacuum system from radioactive contamination.

To prevent contamination, all lines leading from the experimental apparatus to the vacuum source must be equipped with filtration or other trapping mechanism, as appropriate. Example trap mechanisms follow.
**PROTECTING BUILDING VACUUM LINES (CONT)**

- **Particulates**: use a filter capable of efficiently trapping the particles in the size range being generated.
- **Biological Material**: use a High Efficiency Particulate Air (HEPA) filter. Liquid disinfectant (e.g., bleach or other appropriate material) may also be required in the collection and overflow flask.
- **Aqueous or non-volatile liquids**: a filter flask at room temperature is generally adequate to prevent liquids from getting to the vacuum source.
- **Solvents and other volatile liquids**: use a cold trap of sufficient size and cold enough to condense vapors generated, followed by a filter flask capable of collecting fluid that could be aspirated out of the cold trap.
- **Highly reactive or gaseous**: (e.g., S-35 (SO₂) or C-14 (CO₂)) use a charcoal sorbent canister or scrubbing device capable of trapping the gas.

The RSOf recommends any vacuum line used during RAM procedures be surveyed at the completion of a procedure. The survey should include a direct survey (meter survey), if applicable for the radionuclide, and an indirect survey (wipe test) inside the end of the vacuum hose nozzle that attaches to the building/laboratory vacuum line. If any contamination is detected (i.e., exceeds 100 cpm above background), notify the RSOf immediately.

**CONDUCTING SURVEYS**

Contamination is radioactive material (RAM) in areas where it should not be. If contamination exists in a laboratory, the possibility also exists for the contamination to spread around the laboratory, as well as to contaminate an individual. Undetected contamination can result in serious problems such as ingestion of RAM, unnecessary radiation exposure, the spread of contamination into general public areas, and contamination into an experimental sample. The Radiation Protection Procedures Manual (Authorized User (AU) Manual) discusses the when, where, and how of surveying for contamination.

Under the Radiation Control & Safety Program (RCSP), documented surveys must be performed monthly in all rooms where unsealed RAM is used and stored, and weekly if greater than 200 micro-curies are used at any one time. This survey must include both a meter survey and a wipe test. Undocumented surveys must be performed prior to, during, and after each use of RAM. These undocumented surveys can be performed with a survey meter or a wipe test only. When using low to mid-energy beta emitting radionuclides (e.g., C-14, S-14), a wipe test is a more effective method, but a meter survey is allowable under the RCSP. If H-3 is used, a wipe test must be performed.

When conducting surveys, a meter survey should be performed first to identify areas of possible contamination. A survey meter can detect the presence of RAM contamination, but cannot determine if the contamination is removable or fixed. Following the meter survey, a wipe test must be performed and should always include locations where radiation was detected with the survey meter.

When conducting a wipe test survey, a piece of filter paper or cotton swab should be used and should cover at least the industry standard practice of an area of 100cm². The preferred method of performing a wipe test is to take the filter paper or cotton swab and while applying moderate pressure, swipe an area of about 12-14 inches (100cm²) in the shape of an “S” configuration. For a smaller area, swipe in a back and forth motion in an area about 4x4 inches (100cm²). Wipe test surveys should be conducted so that each wipe is used in one area only. This prevents the spreading of contamination to another area. After swiping a surface, the wipe should be considered contaminated and handled accordingly.

To conduct a wipe test survey:

1. Obtain a map that represents the floor diagram of the room to be surveyed. Number the specific survey area locations to be swiped. Emphasis
should be placed on RAM-use areas (e.g., fume hoods, bench tops, and RAM storage areas), as well as areas that should never be contaminated (e.g., drawer handles, telephones, and floor surfaces).

2. Pre-number the wipes to correspond with the specific locations identified on the survey map.

3. Don PPE. (A lab coat, gloves and dosimetry should always be worn while performing surveys.)

4. Begin by swiping areas where contamination is least suspected to be present and progress toward areas most likely to be contaminated. Also include any location where radiation was detected with the survey meter. (Ensure the wipes are kept separated to prevent cross contamination. This can be done by placing the wipes immediately within protective holders (e.g., envelopes, sample bags) or directly into liquid scintillation counter (LSC) or gamma counter vials.)

5. Analyze the wipes using a LSC or gamma counter, whichever is most appropriate for the radionuclide(s) of concern. (The LSC or gamma counter should have protocols established for counting wipe surveys. The protocol may use a wide open window or specified regions covering each radionuclide.)

6. Ensure to include a background wipe. This background wipe is also called a “blank”. The “blank” should be of the same material used for the wipe test survey, but must not have come in contact with any contaminated surface.

7. Review the wipe test results promptly. Focus on results indicating greater than 100 cpm above background.

8. Recount any wipes reading greater than 100 cpm above background to verify the counts were due to contamination, and not static or luminescence.

9. Decontaminate areas indicating greater than 100 cpm above background. (Also, refer to the contamination limits in Table 1 of the AU Manual. Removable contamination that exceed the values listed in Table 1 shall be decontaminated promptly.)

10. Wipe test again after decontamination to determine the effectiveness of the decontamination. Repeat the decontamination/re-wipe process until the area is less than 100 cpm above background.

Performing a survey is simple and provides assurance that areas within the laboratory are free of contamination. If there are any questions or concerns regarding meter surveys or wipe tests, contact the RSOf.

A list of general knowledge questions is included with each audit. The purpose of the questions is two-fold. One is to prepare individuals for an Ohio Department of Health (ODH) inspection. The other is to assure individuals have the knowledge to work safely and compliantly with radioactivity.

Occasionally knowledge deficiencies are noted. This article covers questions from recent audits that were missed and the correct answers.

Question: Is it necessary to perform a meter survey in the radioactive material (RAM) use area before beginning a RAM procedure? What is the purpose of performing a pre-work survey?

Answer: A pre-work survey is good radiation safety practice. The survey verifies the absence of contamination. If contamination is detected, someone did not perform an adequate survey or did not appropriately decontaminate. If contamination is detected during a pre-work survey, take the time to investigate, and discuss with the other
workers the importance of a post-use survey and associated decontamination.

**Question:** What conditions must be met in order to document “no use” for a commissioned RAM room? (i.e., a room listed on a radioactive material/authorized user authorization)?

**Answer:** To document “no use” in lieu of a survey, the room must have no storage of RAM and no RAM procedures performed for the month in question. Alternatively, if the room no longer has any value associated with RAM storage or use, the authorized user may want to decommission the room. To initiate the decommissioning process, submit a signed Decommissioning of RAM Use Room (RS Form 24). The form is available on the RSOf website (www.uc.edu/radsafety).

**Question:** What preparations need to be completed before a waste pickup is requested?

**Answer:** Before a waste pickup is requested, perform a wipe test on the waste containers and ensure you have compiled the appropriate documentation. Documentation includes a copy of the Radioisotope Use Record card, a completed waste tag, and the associated Radioactive Waste Log Sheet. Finally, ensure the container is appropriately labeled and sealed.

**Audit Questions and Answers (Cont)**

**Question:** What areas should be checked during a post-use survey?

**Answer:** A thorough post-use survey is necessary for contamination detection and control. Areas that should be checked include: (1) Yourself: hands, shoes (top and bottom), front of the body. (2) The entire RAM work area. (3) Equipment used in the procedure. (4) The floor adjacent to the RAM work area, and the floor spaces between RAM work areas where material may have been transported. In addition, it is good practice to also survey random areas adjacent to work areas and/or where you may have gone during the procedure (e.g., your desk or a computer work station).

**Question:** You discover that your survey meter is not working during or after completing a RAM procedure. What should you do?

**Answer:** Upon noticing your survey meter is not working, request another lab worker get a working survey meter for you. Requesting assistance minimizes the possibility of spreading contamination to other areas. Always keep in mind the possibility of spreading contamination. Perform a pre-operational check on your survey meter and ensure it is working before you begin your RAM procedure. Once you have surveyed yourself and the surrounding area, you may want to contact the Radiation Safety Office about the inoperable meter. The Radiation Safety Office may be able to supply you with a loaner meter and/or provide vendor contact information.

**Auditors:** Vicki Morris, Radiation Safety Officer  
Mark Cornelissen, Assistant Radiation Safety Officer  
Dramane Konate, Assistant Radiation Safety Officer  
Ken Egan, Senior Radiation Safety Specialist  
Beth Boston, Radiation Safety Specialist  
Jason Collier, Radiation Safety Specialist  
Chris Crawford, Radiation Safety Specialist  
Dave Root, Senior Health Physics Technician  
Mark Powers, Senior Health Physics Technician  
Dave Kobza, Senior Health Physics Technician  
Dick Henderer, Staff Health Physics Technician  
Janine Sumrall, Staff Health Physics Technician  
Debbie Kirkpatrik, Program Manager  
Carolyn Hurt, Business Manager

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**We are on the web:**  
www.uc.edu/radsafety  
Phone: 513-558-4110  
Fax: 513-558-9905

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**Radiation Safety Office**  
University of Cincinnati  
170 Panzeca Way  
P.O. Box 670591  
Cincinnati, OH 45267-0591