Radionuclide Laboratory Procedures Manual

Radiological Safety

Environmental Health and Safety

Texas A&M University

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General Laboratory Safety Rules

Each Permit Holder possesses a copy of the "Procedure Manual for the Use of Radioactive Materials." which is part of the Radiological Safety Program Manual. Please refer to this manual, and if necessary, contact the EHS Radiological Safety Staff (RSS) for additional information on any of the topics covered.

1. Lab coats or equivalent shall be worn when unsealed radionuclides with activities greater than 50 microcuries are used. Lab coats and eye protection are recommended when working with any unsealed radioactive materials.

2. Gloves shall be worn when working with unsealed radioactive materials.

3. Closed-toe shoes shall be worn when working in a radioactive material laboratory to protect feet. Long lab coats or long pants shall be worn to protect legs.

4. Survey hands and clothing for contamination with an appropriate survey meter after each procedure or before leaving an area where radioactive material was used.

5. Survey area where unsealed radioactive materials are used with an appropriate survey technique after each procedure and document the results. Document model, serial number, and calibration date of the instrument used in the analysis. If contamination is found, decontaminate and resurvey. The decontamination goal is "indistinguishable from background."

6. Remote handling tools (e.g., tongs, forceps, or extension handles) and shielded containers should be used whenever possible to minimize doses from gamma emitters and high- energy beta emitters.

7. Do not eat, drink, smoke, use tobacco products, or apply cosmetics in any area where radioactive materials are used or stored. Do not store food, drinks, eating utensils, cups, or other food and drink containers in laboratories or refrigerators where radioactive material use or storage is authorized. Do not use ice from a laboratory ice machine for personal use. Do not use a laboratory microwave oven to heat food.

8. Dispose of radioactive materials only in conspicuously labeled, "EHS-RSS" approved containers. Segregate wastes by nuclide, half-life, and physical characteristics per instructions provided by the EHS-RSS. Mark all containers containing organic solvents.

9. Carboys are required to be placed in spill trays to confine radioactive liquids that may spill. Absorbent paper and bench top spill trays should be used as appropriate.

10. Store radioactive materials in shielded containers or storage areas to minimize dose rates.

11. Use volatile materials, such as, tritiated water (3H2O), unbound I-125, or S-35 methionine in an externally exhausted chemical fume hood.

12. Survey meters must be calibrated and fume hoods must be inspected annually by the EHS-RSS or other organizations approved to perform these evaluations. Laboratory instruments

like Liquid Scintillation Counters (LSC) and Gamma Counters must undergo efficiency checks by the Permit Holder.

13. Do not dispose of empty shipping boxes or return Styrofoam inserts to the vendor without first surveying them with an appropriate meter to ensure they are not contaminated. *Note that even though a container may be empty, the shipment may be subject to US Department of Transportation regulations.* Remove or completely obliterate all radioactive signs and symbols before discarding a shipping box.

14. Remove or obliterate all radioactive signs and symbols before placing any material in a radioactive waste container.

15. If radiation dosimeters have been issued to your lab, they must be worn whenever work is done with or near radioactive material. Wear the dosimeter(s) according to instructions provided by the EHS-RSS. Make sure to store dosimeters away from radioactive material when not in use.

16. Keep any radioactive materials secure from unauthorized access or removal.

Ordering Radioactive Materials

All radioactive materials to be purchased (or otherwise obtained) must be approved by the EHS-RSS before the order is placed.

1. Prior to ordering or receiving radioactive materials, Permit Holders or designees shall obtain approval from the EHS-RSS by one of the following means:

    a. submitting the purchase requisition for approval,

    b. calling (979) 845-2132 to receive verbal approval,

    c. via internet at https://rammgt.tamu.edu/.

2. The EHS-RSS will require the following information:

    a. Permit Holder name and permit number,

    b. caller name and phone number,

    c. radionuclide, compound, and activity (quantity in microcuries (μCi), millicuries (mCi), or curies (Ci)),

    d. vendor, and

    e. any special delivery requests.

3. For persons located at remote sites, RSO numbers must be requested from EHS-RSS at the time the request is approved.

4. If either the radionuclide or the activity to be ordered cannot be accommodated under the Permit Holder's existing authorizations, approval shall be denied. The Permit Holder may not place the order.

5. When placing an order, specify your address as the "Bill to" address and give the following "Ship to" address:

Environmental Health and Safety

Attn: *(enter Permit Holder's name)*

1111 Research Parkway, Rm 130

Texas A&M University

College Station, Texas 77845

Note: If ordering material from a remote site, provide the vendor with your "ship to" address instead of the EHS address.

6. If the material is temperature sensitive, request that it be shipped in dry ice or reusable ice packs.

7. Shipments received by EHS shall normally be inspected, inventoried, and delivered to the lab on the same day.

8. Deliveries of radioactive materials to EHS is prohibited on weekends and TAMU holidays unless prior approval has been granted by EHS-RSS.

9. Contact the EHS if an order is changed or canceled after receiving approval.

10. Questions and special requests may be referred to EHS-RSS at (979) 845-2132.

Radioactive Material Check In at Remote Facilities

This procedure is designed to assist personnel at remote sites performing check-in of shipments of radioactive material. This check-in process ensures that the integrity of the package has been maintained during transport, that the material received is the material ordered, and that the material is properly entered into the Permit Holder's radioactive material inventory.

Precautions:

1. As with all exposure to radiation and radioactive material, it is important to keep your exposure as low as reasonably achievable (ALARA).

2. Gloves should be worn at all times while checking in radioactive material shipments.

3. A leaking or contaminated primary vial may result in personnel and surface contamination. If a shipping container appears damaged or wet, survey the package for contamination immediately and take extra care to prevent contamination from spreading. If a leaking package is identified, notify EHS-RSS immediately and survey for secondary contamination in the package check-in area. Also perform survey on the driver and the vehicle and decontaminate if necessary.

Instrumentation

To accurately measure radioactive contamination and radiation levels, you must use appropriate and calibrated instruments. Contact the EHS-RSS for information regarding annual calibration of these instruments.

Ordering/Receiving Radioactive Material

1. Before you order radioactive material, you must receive permission from EHS-RSS to place the order. Please refer to "Ordering Radioactive Material" for instructions. If the order is approved, the order shall be assigned an RSO number, or Ship Code.

2. If the order is denied, you will receive instructions regarding reducing your present inventory or amending your Permit to allow possession of a greater activity of the nuclide you are ordering.

3. The Texas Department of State Health Service, Radiation Control Program (DSHS, RCP) requires that the shipment of radioactive material be processed as soon as is practicable, but not later than three hours after receipt of the package at the Permit Holder's facility if it is received during working hours. If the order is received after normal working hours (or during holidays), the shipment must be checked in no later than 3 hours after the

beginning of the next regular business day. Crushed, wet, or damaged packages shall be inspected immediately.

Check-in Documentation

Document the package check-in on the EHS-RSS form, "Texas A&M University Radioactive Material Check-in and Delivery". All blanks on the form must be filled in.

Permit Holders located off the main Texas A&M University (TAMU) campus must maintain receipt forms for the life of their permit. These records are among those that may be inspected by the DSHS, RCP during facility inspections. Failure to maintain these records is a violation of bureau regulations.

1. Enter the RSO number on the check-in form. If the RSO number has been misplaced since approval for the order was obtained, contact the EHS-RSS to obtain the RSO number. Be sure to tell the EHS-RSS representative that an RSO number has already been assigned to the shipment. This will prevent two RSO numbers from being assigned to the same shipment.

2. Enter the Permit Holder's name, permit number, and department. Enter the date the material being checked in.

3. Enter the building and room number(s) in which the material is to be used or stored.

4. Enter the radionuclide and form. Typically, the compound (Bovine Growth Hormone, dATP, thymidine, etc.) should be entered here. If the material is a sealed source, that should be noted.

5. Enter the activity received. Specify microcuries (μCi) or millicuries (mCi).

6. Enter detector type (Geiger-Mueller (GM), ion chamber, etc.) and make/model/serial number of meter used for radiation exposure measurements.

7. Perform a radiation dose survey for external radiation exposure at the surface of the package and at a distance of one meter from the package. If the exposure rates at the surface of the package and at a distance of 1 meter from the package are less than 0.5 mrem/hr and 0.05 mrem/hr, respectively, these values can be recorded as simply <0.5 mrem/hr and <0.05 mrem/hr. If the radiation levels are above those values, the actual readings need to be recorded. If the exposure rate exceeds 10 mR/hr at one meter from the package or 200 mR/hr at the surface of the package, contact the EHS-RSS immediately.

Note: This survey must be performed using a meter calibrated in mR/hr or mrem/hr. The calibration sticker affixed to the instrument will indicate what units the instrument is calibrated in. If this is not indicated, contact EHS-RSS regarding instrument calibration.

8. Enter make/model/serial number and detector type of the instrument used to count contamination survey wipes.

9. Survey the exterior of the package for removable contamination. This will be the first indication that the primary container is leaking. This measurement can be accomplished using a filter paper, a piece of tissue analyzed using an LSC, or an end-window GM survey meter.

   Note: The liquid scintillation counter is the preferred method of counting wipes for removable contamination. A GM survey meter will not detect 3H and the detection efficiency of the LSC for all nuclides typically found in the laboratory is higher than that of the GM survey meter. The GM should be used only if a liquid scintillation counter is not available.

10. Wipe the exterior of the package with a filter paper or a piece of tissue, wiping an area of at least 300 cm2. This wipe must be counted on the appropriate, calibrated counting instrument.
    a. End Window GM Survey Meter - Alphas, high energy betas (P-32), beta/gammas
    b. Liquid Scintillation Counter - Low energy (H-3, C-14, S-35, P-33), high energy betas, low energy photons (I-125), and alphas
    c. Thin Window Scintillation Probe - High energy betas (P-32), low energy photons (I-125)
    d. Gamma Counter - Low and high energy photons

    The Minimum Detectable Activity (MDA) is an indication of the minimum level of contamination that a counting system can practically measure above background. A "blank" is counted to determine the background count rate. The MDA must be calculated and entered on the receipt form. The package is then surveyed, with the results entered on the receipt form. See the end of this section for additional information and MDA calculation examples.

    <u>If there is evidence that the vial is leaking (i.e., an elevated contamination level is found on the exterior of the package) take precautions to limit the spread of the contamination and notify EHS-RSS immediately.</u>

11. Open the package and visually verify that the interior packaging is intact. If the interior packaging is damaged, the vial may be damaged and leaking. Take extra care to prevent surface and personnel contamination when handling the primary vial.

12. Survey the primary vial for removable contamination (using the appropriate counting instrument) and compare the reading to the MDA. If the surface of the primary vial is contaminated, other personnel who may use that radioactive material need to be made aware of the condition of the vial. If the level of removable contamination is such that you suspect that the vial is cracked or broken, contact EHS-RSS immediately.

13. Check the primary vial label to ensure that it matches the entry on the shipping invoice. If the wrong material was shipped, you must inform EHS-RSS if a replacement shipment will be sent.

14. Transcribe the RSO number to the primary and secondary containers. This allows the shipment to be identified for radioisotope inventory verification and helps ensure proper completion of waste disposal forms.

15. The person who checked in the package must sign the form as surveyor to indicate that the shipment was received and checked in.

16. Immediately send a copy of the completed form to EHS-RSS.

17. The box that the material was shipped in may be discarded as non-radioactive waste as long as the Permit Holder ensures that the box is not contaminated (by performing and documenting a contamination survey) and obliterates any radioactive signs or symbols. The signs and symbols can be obliterated by covering them with duct tape or marking them out with a black marker. The container may then be discarded as normal solid waste. All material used during the package check-in procedure (gloves, wipes, etc.) should be considered contaminated and discarded in a radioactive waste container.

18. Some vendors participate in a Styrofoam container recycling program. It is a requirement of the EHS-RSS that a survey of the container for removable contamination be performed and documented before the Styrofoam package is sent back to the vendor. Remember that an empty package may also be a regulated shipment.

19. Any questions regarding this procedure may be directed to EHS-RSS at (979) 845-2132.

Additional MDA Information and Examples

For a system that integrates counts over a preset time, such as an LSC, gamma counter or any counting system with a scaler (assuming that background and wipe count times are equal), the MDA for removable surface activity can be approximated by:

$$MDA = \frac{3 + 4.65\sqrt{(B_R)(t)}}{(t)(E)}$$

where:

MDA = activity level in disintegrations/minute (dpm)

B_R = background rate in counts/minute (cpm)

t = counting time for sample and background counts in minutes

E = detector efficiency in counts/disintegration

Note: If the instrument used to count the wipe displays a total number of counts, the value indicated for the background count can be substituted for the value $(B_R)(t)$.

Compare the wipe activity with the MDA. If the net wipe activity (dpm) is less than the calculated MDA for that system, indicate as such by entering **"< MDA"** in the blank provided for the contamination level on the surface of the package. If the sample activity is greater than the MDA, indicate the calculated wipe activity.

$$Net\ Wipe\ Activity\ (dpm) = \frac{Wipe\ Count\ Rate\ (cpm) - Background\ Count\ Rate\ (cpm)}{Detector\ Efficiency\ \left(\frac{counts}{disintegration}\right)}$$

Example:

A package of H-3 has been received. The H-3 efficiency of this LSC has previously been determined to be 33%. The background count rate for the blank is 20 cpm. The wipe count rate is 40 cpm. The counting time for both is one minute. The MDA for this system is:

$$MDA = \frac{3 + 4.65\sqrt{(20\ cpm)(1\ \text{min})}}{(1\ min)(0.33)} = 72\ dpm$$

The net wipe activity is:

$$Net\ Wipe\ Activity = \frac{40\ cpm - 20\ cpm}{0.33} = 61\ dpm$$

The contamination level for the external surface of the package is less than the calculated MDA (72 dpm), so the contamination level can then be entered as "< 72 dpm" or "< MDA". If the net wipe activity was greater than 72 dpm, the actual net wipe activity would have been entered on the form.

The Permit Holder is responsible for establishing an efficiency for the LSC and the nuclide in question. Contact EHS-RSS for assistance, if necessary.

If a ratemeter instrument (such as a GM survey meter) is used to measure the removable contamination, the MDA can be estimated by taking twice the time constant (which may be referred to as the response time in the meter instruction manual) of the meter as the counting time and using the relationship:

$$MDA\ (dpm) = \frac{4.65\sqrt{\frac{B_R}{2t_c}}}{E}$$

where:

MDA = activity level in disintegrations/minute

B_R = background rate in counts/minute

t_c = meter time constant in minutes

E = detector efficiency in counts per disintegration

Note: For meters that display the count rate in counts per second, the time constant must be in units of seconds. For meters that display the count rate in counts per minute, the response time must be in units of minutes.

Example:

A Ludlum Model 3 meter is used to count a smear from a package receipt survey on a package containing S-35. The background rate of the meter is 40 counts per minute. The efficiency of the survey meter for S-35 is 5%. With the response switch in the fast position, the time constant of the meter is 4 seconds. The minimum detectable activity for that meter is:

$$MDA = \frac{4.65\sqrt{\frac{40\ cpm}{(2)(0.0667\ \text{min})}}}{0.05} = 1610\ dpm$$

The meter reads 60 cpm when the wipe from the external surface of the package is counted. The net wipe activity is:

$$Net\ Wipe\ Activity = \frac{60\ cpm - 40\ cpm}{0.05} = 400\ dpm$$

The contamination level for the external surface of the package can then be entered as "< 1610 dpm" or "< MDA". If the net wipe activity was greater than 1610 dpm, the actual net wipe activity would have been entered on the form.

The efficiency of the survey meter for the nuclide in question can be found on the calibration sticker affixed to the survey instrument. If this is not indicated, contact the EHS-RSS regarding instrument calibration.

The meter time constant, also referred to in operator's manuals as the response time, is most often defined as the time required for the meter to read 90% of full scale. A list of meter time constants can be found at the end of this section. If the time constant for your meter is not on this list, consult the operator's manual, contact the manufacturer's technical support department, or contact EHS-RSS for assistance.

If the calculated MDA for the counting system is greater than 3,300 dpm for beta-gamma counting systems or 330 dpm for alpha counting systems, contact EHS-RSS for instructions. The detector may be malfunctioning or contaminated, causing a high background count rate, or a more efficient detector may be required.

Detector	Time Constant(s)
Ludlum Models 2 and 3	Fast: $t_c = 4\ sec = 0.0667\ min$ Slow: $t_c = 22\ sec = 0.3667\ min$
Ludlum 2200	Fast: $t_c = 4\ sec = 0.0667\ min$ Slow: $t_c = 22\ sec = 0.3667\ min$
Rad Monitor 9000 GM-1 and GM-2	$t_c = 2\ sec = 0.0333\ min$
Eberline E-120 *Note: Fast is the fastest response which occurs when response knob is turned to the clockwise limit. Slow is the slowest response which occurs when the response know is turned to the counterclockwise limit.*	Fast: $t_c = 2\ sec = 0.0333\ min$ Slow: $t_c = 10\ sec = 0.1667\ min$

Transfer of Radioactive Materials

This procedure describes the requirements for the transfer of radioactive material between TAMU Permit Holders and the transfer of material to or from non-TAMU Permit Holders. This procedure does not apply to the disposal/transfer of radioactive waste to EHS-RSS.

If the transfer of radioactive material involves transporting material on public roadways (including campus streets), the material must be packaged and transported in accordance with state and federal regulations. Except for those instances where the packaging, labeling, documentation and transport are performed in accordance with a specific procedure written or approved by EHS-RSS (such as transport of moisture gauges and some transport of waste), the Permit Holder shall contact the EHS-RSS prior to transportation of radioactive material.

Radioactive material which is hand carried or transferred on a moveable cart between laboratories or buildings does not require special packaging other than that used to ensure that the material is packaged in such a way to prevent spillage or the spread of contamination.

Transfers Between TAMU Permit Holders

Transfer of radioactive material between one Permit Holder and another shall be facilitated through EHS-RSS. The Permit Holders shall complete and sign the "Radioactive Material Transfer Form" and submit the form to EHS-RSS for review and approval prior to the transfer of radioactive material. Under no circumstances shall a transfer of radioactive material occur before written authorization to conduct the transfer is given by the RSO. The receiving Permit Holder shall notify EHS-RSS after the transfer of material is completed.

If the entire inventory item is transferred, the RSO number will remain the same. If only part of the inventory item is transferred, a new RSO number will be assigned to the transferred portion.

Transfers Involving Non-TAMU Permit Holders

Transfers involving non-TAMU licensees (as receiver or transferor) shall also require advanced approval from EHS-RSS. Transfer documentation shall be prepared by the TAMU Permit Holder as described previously. For transfers from TAMU to a non-TAMU license, a copy of the receiver's license must be obtained and provided to the EHS-RSS prior to the transfer.

Waste Segregation and Disposal

Laboratory personnel are required to segregate (or separate) radioactive material for proper disposal. Segregation of waste at its origin allows for the most economical disposal of the final waste product. Radioactive waste is categorized by its form (solid, liquid, etc.), nuclide content, activity, and the presence of chemical or biological hazard.

A "Waste Disposal Report Form" must be completed for each RSO number prior to requesting a waste collection by EHS-RSS. This procedure includes instructions for filling out the "Waste Disposal Report Form."

Liquid Waste

Liquid waste is collected in 5 gallon plastic carboys (or other approved containers) provided by EHS-RSS. If high activity waste is generated (greater than 5 mCi in a single container), or materials are used that could not be safely stored in a plastic container, please contact EHS-RSS for special instructions.

1. Liquid waste containers must be capped at all times, except when the container is being filled or emptied.
2. Liquid waste must be segregated by nuclide. If mixing nuclides is required by protocol, contact EHS-RSS prior to mixing.
3. Liquid waste is classified by hazard (non-hazardous vs. hazardous). Waste classified as non- toxic/biodegradable should not contain hazardous chemicals (toluene, chloroform, benzene, etc.). As a test, ask yourself, "Is it legal to dispose of the waste through the sanitary sewer system if it were not radioactive? Does it meet pH and hazardous materials restrictions?" Radioactive hazardous waste (mixed waste) must be disposed of according to referenced regulations including any municipal rules or university policies in effect. To minimize the production of mixed waste, use a biodegradable liquid scintillation cocktail, if possible. Permit Holders disposing of mixed waste may be assessed significant disposal fees.
4. Biohazardous liquid waste must be treated to remove the biohazard before it can be collected by EHS-RSS. Treatment options include bleaching or other chemical neutralization. Contact EHS-RSS with questions regarding the removal of biohazards from liquid waste.
5. No solids shall be placed in the liquid waste containers (for example caps, pipettes, vials, and test tubes).
6. Chemical constituents must be delineated on the "Waste Disposal Report Form."

Vials

Vials are defined as glass or plastic containers used for liquid scintillation counting that contain radioactive materials in liquid form. The procedures for handling vial waste will depend on the vial size and chemical characteristics of the liquid. Use a biodegradable liquid scintillation cocktail, if possible. Permit Holders disposing of vials containing hazardous/non-biodegradable cocktail may be assessed significant disposal fees. Ensure that no other materials (gloves, paper towels, or other solids) are placed in the vial waste containers.

1. Greater than 20 ml. – These vials must be emptied before disposal. The liquid contents must be poured into a carboy designated for the appropriate nuclide and waste type (non-toxic/biodegradable or hazardous/non-biodegradable) as defined by the previously stated rules for liquid disposal. If the empty vials at one point contained hazardous liquid, the empty vials must be tightly capped and placed in a separate waste container for disposal. If the vials at one point contained non-hazardous liquid, they must be capped and can be discarded in a separate waste container or may be added to the solid waste can designated for that nuclide.
2. Less than or equal to 20 ml. – These vials are not required to be emptied. After separating non-toxic/biodegradable vs. hazardous/non-biodegradable, place these vials, tightly capped, in a plastic-bag and place the bag inside of a sturdy box.
3. Primary Vials – Place these vials in a separate bag and indicate "Primary Vial" on the waste form.

Carcasses

Carcasses are defined as animals, animal tissue, or blood products that contain radioactive material.

1. Carcasses that are frozen will be accepted, provided all labeling and other requirements are met.
2. Tissue that is not frozen must be sterilized (rendered a non-biohazard) prior to collection by EHS-RSS. Contact EHS-RSS regarding treatment options. Examples of tissue that must be treated include:
    a. small amounts of tissue on slides or products of other analyses
    b. tissue in alcohol or formaldehyde
    c. paper or lab ware contaminated with blood
3. Contact EHS-RSS before beginning a new series of experiments that will produce carcass waste. There may be options available that reduce both waste volume and disposal cost.
4. Because freezer space may be at a premium, individual laboratories may be required to store carcasses for extended periods of time before collection by EHS-RSS.
5. Double bag and label carcass waste, indicating that the bag contains carcasses. Indicate nuclide and total activity, or weight and specific activity. Remember to remove excess air from the bag.

Solid Waste

Solid waste is generally classified into two categories: waste containing radionuclides with a short half-life (almost any nuclide with a half-life of less than 300 days) and waste containing radionuclides with a long half-life (nuclides with a half-life greater than 300 days). Nuclides with a short half-life include P-32, P-33, S-35, Ca-45, I-125, and I-131. Radionuclides with a long half-life include H-3, C-14, Mn-54.

All solid waste containers must have a lid. The lid should only be removed when adding waste to the container.

1. Short half-life solid waste may be mixed in a single solid waste container.
2. H-3 and C-14 solid waste may be mixed in a single solid waste container. Other long half- life nuclides should be collected in a separate waste container.
3. Remove or obliterate all radioactive material tags and markings (stickers, tape, etc.) before placing material in the solid waste container. (Masking or duct tape may be used to cover markings).
4. No liquids should be placed in solid waste.
5. "Sharps" (syringes, Pasteur pipettes, broken glass, and razor and scalpel blades) must be placed in sturdy boxes or plastic containers and identified as radioactive sharps. Even a capped syringe must be placed in the "sharps" container.
6. Biohazardous and pathological waste requires special handling. This waste must be treated to remove the biohazard before it can be placed in the radioactive waste container. Notify EHS-RSS before disposing of this material. Possible treatment options may include autoclaving, bleaching, or other chemical neutralization.
7. Empty biohazard bags contaminated with radioactive material may be disposed of in the radioactive waste container provided they have an additional label that indicates that there is no biohazard.
8. Uncontaminated lead shields (pigs) or lead lined containers should be separated from other waste. Remove or obliterate radiation signs or symbols.
9. Limit weight of container to 50 pounds.
10. Chemical constituents must be delineated on the form. See the following "Waste Pick-up" section for additional information.

Waste Pick-up

A completed "Waste Disposal Report Form" must accompany all radioactive waste collected by EHS-RSS. Please make certain that the form is properly completed before you call for a waste pick-up. EHS-RSS technicians are instructed not to pick up waste unless a properly completed form is available when they arrive to collect the waste. If the waste or the form is not ready when the technician arrives, a discrepancy notice indicating the nature of the problem will be left. The technician will not wait for the form to be completed. The waste pick-up will need to be rescheduled.

1. Information on the form must include:
    a. The nuclide, the name of the Permit Holder, the Permit number, and the RSO number for the waste.
    b. The starting amount of the nuclide - This may be the original activity when the nuclide is first received or the balance of the activity after disposal of part of the material.
2. All activities must be stated in millicuries (mCi).
3. Each entry should be dated and you must indicate in millicuries how much of that disposal is in each form (solid, liquid, vials, carcass). Do not use percent or volumes. If you have no other information, you may estimate that 90% of the activity is in the liquid waste and 10% is in solid waste. Sharps may be estimated to contain about 1%-5% of the activity. If the activity is any waste stream is less than 1%, that stream may be estimated as ~ 0%.
4. Total the amount disposed and calculate the remaining activity. You do not need to decay correct this number.
5. You must also indicate the chemical constituents and concentration of any hazardous chemicals contained in the bulked liquid and vials. This may include the type or brand of liquid scintillation cocktail and anything you added in the course of the research
6. Sign the document, print your name, and date it on the day you call EHS-RSS for pick up.
7. A copy of the "Waste Disposal Report Form" is included with the package when it is delivered to the laboratory. An additional form is included with this procedure and may also be found on the EHS web site.
8. When waste is ready to be picked up, enter waste information via
    a. https://rammgt.tamu.edu/
    b. OR call EHS-RSS at (979) 845-2132.

    You will be asked:
        1. The name of the Permit Holder
        2. Your name and a phone number at which you can be contacted
        3. The building and room where the waste is physically located
        4. The nuclide and how many bags, carboys, or boxes of vials of that nuclide that must be picked up
        5. How many empty carboys you need in exchange for the full one(s)

Emergency Procedures

A designated EHS-RSS staff member is on call 24-hours a day, seven days a week to respond to emergencies involving radioactive materials. In the event of any spill or accident, EHS- RSS should be notified immediately. Remember, personnel safety comes first.

Emergency Contact Numbers

Emergency Fire & Medical	911
EHS Emergency Assistance	(979) 862-1111
EHS Main Office	(979) 845-2132
University Communications Center	(979) 845-4311
University Police Dispatch	(979) 845-2345

Accident/Spill Response

If an accident or spill involves personnel injury:

1. Provide first aid immediately for serious injuries
2. Call 911
3. Notify EHS-RSS
4. As possible, without doing harm to the victim, monitor the injured individual and remove contaminated clothing and gross personal contamination.

Decontamination shall be the responsibility of the group that caused the spill. For large spills (i.e., greater than 10 μCi) or spills that are difficult to clean up, the work should be carried out under the supervision of the EHS-RSS. Appropriate protective clothing shall be worn during all decontamination activities.

1. The following steps should be followed when dealing with a spill.
2. Stop the source and confine the spill
3. Immediately notify EHS-RSS for assistance
4. Warn others and isolate the area
5. Soak up any free-standing liquid
6. Wash area with soap and water or commercial decontamination solution
7. Survey area (portable instrument and/or smear survey). Document all surveys.
8. Repeat wash and survey, if necessary
9. Identify and decontaminate any secondary contamination locations
10. Monitor personnel for contamination during and after cleanup
11. Remove and bag any contaminated clothing
12. Discard all refuse as radioactive waste
13. Write an account of the incident and forward a copy to EHS-RSS

Note: If the spill involves mCi quantities of volatiles such as iodine, exit and seal off room, notify EHS-RSS, and isolate personnel involved in spill for cleanup and bioassay.

Decontamination of Personnel

1. Remove and bag all contaminated clothing
2. Use mild soap or commercial decontamination solution and lukewarm water. *Note: some solutions must be highly diluted before use on skin; read direction carefully*
3. If contamination is in a wound (e.g., a cut from contaminated glassware), wash with copious amounts of water
4. Survey affected area and repeat cleaning and survey as necessary
5. If skin becomes irritated, discontinue decontamination and notify EHS-RSS
6. Identify and decontaminate secondary contamination locations (floor, shoes, doorknobs, telephones), etc.), documenting all surveys
7. Notify EHS-RSS (even if the decontamination was successful)
8. Write an account of the incident, signed by the author and the Permit Holder, and forward a copy to EHS-RSS.

Radiation Surveys

Radiation surveys are performed to measure external exposure or dose rates from sources of radiation that are in storage, in waste, or in use. Radiation survey results may be used to evaluate exposure controls, indicate posting and access control requirements, and verify compliance with regulatory limits for radiation exposure to personnel and the public.

Radiation surveys are required to be performed in laboratories using 10 millicuries or more of photon or neutron emitting radionuclides or radioactive sources. These surveys are required to be performed when:

1. new and significantly higher activity sources are received,
2. radioactive material storage areas are relocated,
3. radioactive waste containers are relocated, or
4. activity levels of radioactive material are changed significantly.

Permit Holders are not required to maintain survey instruments for performing radiation surveys. EHS-RSS will perform a radiation survey at the request of the Permit Holder.

Radiation surveys that measure an exposure rate due to photons must be performed with a survey instrument that is calibrated in milliroentgens per hour (mR/hr) or millirem per hour (mrem/hr). Neutron surveys must be performed using a meter calibrated specifically for neutron dose measurements.

The selection of a proper survey instrument is critical to ensure that a radiation survey is performed correctly. If you are unsure if your survey meter is appropriate for the radiation to be measured, contact EHS-RSS.

Radiation survey instruments are calibrated to ensure that the radiation level registered by the instrument is an accurate indication of the actual radiation field being measured when the instrument is used properly. If your survey instrument is not calibrated to read out in mR/hr or mrem/hr, contact EHS-RSS for information regarding instrument calibration.

Note: Meters calibrated to read out in cpm are inappropriate for radiation surveys.

Performing a Radiation Survey

Before performing a radiation survey, the following steps should be performed to ensure that the survey instrument is operating properly:

1. Perform a physical inspection of the instrument, checking for obvious physical damage.
2. Verify that the instrument has been calibrated in the last twelve months.

3. Perform a battery check to verify that the condition of the batteries is within acceptable limits.
4. Perform a response check if a check source is available to verify the meter is responding at all to a known radiation source.
5. Ensure that the audio is working if the meter has audio capability.

If the instrument does not satisfactorily complete the pre-operational inspection, contact EHS-RSS for repair/calibration information.

Documenting a Survey

The following information should be recorded on the area radiation survey record:

1. Date performed
2. Survey location
3. Survey instrument information (make, model, and serial number)
4. Name of person performing survey
5. Description of conditions under which the survey is performed which may affect the radiation level being measured.

Radiation levels are normally taken at a height of one meter and at varying distances from the source. Radiation fields through a surface (e.g. beyond a wall or a shield) are taken at a distance of one foot beyond that surface. Readings should be taken at locations representing potential locations for personnel exposure in and around the facility.

Forward a copy of all radiation surveys to EHS-RSS for evaluation. Excessive radiation levels may require additional shielding or a relocation of the sources.

Contamination Surveys

Permit Holders are required, as a condition of their permit, to perform post-operational contamination surveys. Contamination surveys are used to identify and quantify radioactive contamination on surfaces or personnel. This guide is provided to assist you in performing contamination surveys and documenting routine contamination surveys.

Surveys are required to be performed by the Permit Holder in all labs under a permit that allows use of unencapsulated radioactive material (liquids, powders, etc.). This includes common equipment areas where several labs are using radioactive material. One Permit Holder is generally responsible for ensuring that the area is surveyed for radioactive contamination on a routine basis.

Types of Contamination

There are two categories of contamination that may be present in a lab, removable and fixed. Fixed contamination does not present a significant hazard unless the material should come loose or there is such a high level of contamination that it presents an external hazard. Removable contamination presents an external personnel contamination hazard and also an internal hazard due to ingestion. Contaminated areas generally have removable contamination, but may have a combination of the two types.

Types of Surveys

There are two types of surveys that can be performed by laboratory personnel: surveys using survey meters, and surveys using "wipes" counted on a liquid scintillation counter (LSC) or a gamma counter. Survey meter surveys can identify gross contamination (removable plus fixed) while wipe tests identify only removable contamination.

Survey Instrumentation

One key to an effective contamination survey program is the selection of the proper instrument. The two most common survey meters found on the TAMU campus are Geiger Mueller (GM) survey meters and thin window NaI(Tl) scintillation survey meters.

The GM meter is best used for P-32, a high energy beta emitter, but can also identify areas heavily contaminated with lower energy betas, such as S-35 or C-14, for which the GM has a relatively low efficiency. Thin window NaI(Tl) scintillation survey meters are used to identify I-125 contamination. GM survey meters are poor detectors of I-125, having a very low efficiency. *Note that no common survey meter can detect H-3.*

Wipe tests must be used to survey an area for H-3 contamination. Due to their high efficiency, wipe test counters such as LSCs and gamma counters are very effective tools for identifying removable contamination. Gamma counters are limited to counting wipe tests for photon emitters, such as I-125 or Cr-51. The most versatile instrument is the LSC. Its efficiency is high for a wide range of nuclides. It is the best choice for removable contamination surveys in radioactive material laboratories.

Frequency

Routine laboratory surveys will be performed by EHS-RSS on a monthly basis unless otherwise indicated.

Post-operational surveys are required each time an individual leaves the laboratory for a significant period of time or, as a minimum, once per day during material use. A post operational survey is a brief survey of the user's immediate work area including, hands, feet, face, and other suspect areas. Post-operational surveys must be conspicuously posted in the laboratory in a location readily visible to EHS-RSS personnel.

Documentation

Permit Holders are required to document post-operational contamination surveys as well as routine surveys. An EHS-RSS form for documenting contamination surveys is attached, but Permit Holders may generate an equivalent form. The following information must be included on every contamination survey report:

1. Permit Holder name and permit number
2. Date of survey
3. Building and room number
4. Radionuclides in use
5. Make, model, and serial number of survey/counting instrument
6. Name of person performing survey
7. Map of survey area with locations marked
8. Background reading of instrument
9. Survey results (including identification of contaminated areas, subsequent action, and results of re-survey)

Survey Locations

Survey locations should be chosen to reflect both areas where there is a likelihood of detecting contamination and also where contamination might be spread were an individual to become contaminated without knowing it.

1. Countertops, including the edges
2. Fume hoods (aprons, sashes, sash handles)
3. Beta shields
4. Refrigerator and freezer door handles
5. Sinks designated for radioactive material
6. Floor around:
a. working areas
b. lab entrances (including the floor in front of access points to office spaces within a lab)
c. waste containers
d. fume hoods
7. Designated "clean" areas:
a. offices
b. desks
c. food areas
d. doorknobs
e. telephones
8. Equipment used with radioactive material, especially common equipment

Survey Instructions

Contamination survey using a survey meter

1. Perform meter examination
a. Check physical condition of instrument
b. Check EHS-RSS instrument calibration/source check (contact EHS-RSS for calibration if calibration is greater than one year old)
c. Check batteries
d. Perform source check, if available - Expose meter to known radioactive material to verify that the instrument is operating
e. Determine and record background reading by holding the meter over an area that is not contaminated
f. Turn on the audio, if available
2. Record the date of the survey and indicate the instrument used for the survey (choose from instruments listed in the "Survey Instrument Response" section)
3. If performing a laboratory-wide routine contamination survey, obtain a map of the laboratory to indicate areas surveyed
4. If performing a post-operation survey, indicate that you are surveying a work area
5. Slowly move the probe over designated areas in a zigzag pattern, listening for an increase in the audible pulse rate survey instrument as an indication of increased activity
6. If an area with a count rate more than two times background is identified, record the location, determine the extent of the contaminated area and decontaminate
7. After decontaminating any area, resurvey to verify that the area is clean

Wipe tests counted on a LSC or a gamma counter

1. Wear gloves
2. Obtain map of laboratory
3. Using numbered filter papers or pieces of laboratory tissue paper, wipe areas in the laboratory and note location on map
4. Count the wipes on an appropriate counter, including two or more backgrounds (include a piece of clean wipe material) for comparison
5. If an area of removable contamination is identified (counts greater than twice background), clean and re-survey the area
6. Repeat the decontamination and re-survey until the area has removable contamination less than two times background. *Note: While not always achievable, the goal for decontamination is a contamination level which is "indistinguishable from background"*
7. Record counting results, identified contamination, subsequent actions and resurvey results

Personnel Contamination Survey

Use a portable survey meter to survey personnel for contaminated skin or clothing. Be sure to document any survey performed. See "Emergency Procedures."

Action Level

Any location in which the count rate is more than twice the background should be considered contaminated. Clean the area with soap and water, a commercial cleaning solution (such as 409 or Dow bathroom cleaner) or a commercial decontamination solution specifically designed for radioactive contamination. Resurvey the area to verify that the contamination has been removed.

If high level contamination is discovered and assistance in decontaminating the area is required, contact EHS-RSS immediately. If contaminated skin or clothing still reads more than twice background after repeated attempts to decontaminate, notify EHS-RSS. See "Emergency Procedures" for additional information regarding spill response and surface and personnel decontamination.