

# **Radionuclide Laboratory Procedure Manual**

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## General Laboratory Safety Rules

Each Permittee possesses a copy of the "Procedure Manual for the Use of Radioactive Materials". Please refer to this manual or contact the EHSD for additional information on any topic covered in this section.

1. Lab coats or equivalent shall be worn when unsealed radionuclides with activities greater than 50 microcuries are used. Laboratory 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. Monitor hands and clothing for contamination after each procedure or before leaving an area.
5. Monitor area where unsealed radioactive materials are used after each procedure and document the results. If contamination is found, decontaminate and resurvey. The decontamination goal is "indistinguishable from background".
6. Remote handling tools and shielded containers should be used whenever possible to minimize doses from gamma emitters and high energy beta emitters. Examples include tongs, forceps, or extension handles.
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, or cups and 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, EHSD approved containers. Segregate wastes by nuclide, half-life, and physical characteristics per instructions provided by the EHSD.
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, especially tritiated water or unbound I-125, in a fume hood.
12. Survey meters must be calibrated and fume hoods must be inspected annually by the EHSD or other organizations approved to perform these evaluations. Laboratory instruments like Liquid Scintillation Counters (LSC) and Gamma Counters must also be efficiency checked.
13. Do not dispose of empty shipping boxes or return Styrofoam inserts to the vendor without first surveying them to ensure that they are not contaminated. Remove or 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 the radioactive waste container.
15. If one or more radiation dosimeters have been issued to you, wear it (them) whenever working with or near radioactive material. Wear the dosimeter(s) according to instructions provided by the EHSD.
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 EHSD **before** the order is placed.

1. Prior to ordering or receiving radioactive materials, Permittees or designees shall obtain approval from the EHSD by one of the following means:
  - a. submit the purchase requisition for approval, or
  - b. telephone (979-845-1361) to receive verbal approval, or
  - c. fax (979-845-1348) to request approval.
  - d. via internet at (<https://rammgt.tamu.edu/>)
2. The EHSD will require the following information:
  - a. Permittee name and Permit number,
  - b. caller name and phone number,
  - c. radionuclide, compound, and activity (quantity in microcuries, millicuries, or curies),
  - d. vendor, and
  - e. any special delivery requests.
3. Persons located at remote sites must ask for an RSO Number at the time order approval is requested and granted.
4. If either the radionuclide or the activity to be ordered cannot be accommodated under the Permittee's existing authorizations, approval for the order shall be denied. The Permittee may not place the order.
5. When placing the order, specify your address as the "Bill to" address and give the following "Ship to" address:

***Environmental Health and Safety Dept.***  
***Attn: (enter Permittee's name)***  
***1111 Research Parkway***  
***Texas A&M University***  
***College Station, Texas 77845***

When ordering material from a remote site, provide the vendor with your "ship to" address instead of the EHSD address.

6. If the material is temperature sensitive, request that it be shipped in dry ice or reusable ice packs.
7. Shipments received by the EHSD shall normally be inspected, inventoried, and delivered to the lab on the same day.
8. Contact the EHSD if an order is changed or canceled after receiving approval from the EHSD.
9. Questions and special requests may be referred to the EHSD at 979-845-1361.

## Radioactive Material Package 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 permittee's radioactive material inventory.

### *Cautions*

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 the EHSD immediately and survey for secondary contamination in the package check-in area.

### *Instrumentation*

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

### *Ordering/Receiving Radioactive Material*

1. Before you order radioactive material, you must receive permission from the EHSD to place the order. Please refer to "Ordering Radioactive Material" for instructions.
2. If the order is approved, the order shall be assigned an RSO Number, or Ship Code. 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 Bureau of Radiation Control (BRC) 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 Permittee'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 attached EHSD form, "Texas A&M University Package Check-in and Delivery". Note: **All blanks on the form must be filled in.**

Permittees located off the main TAMU campus must maintain receipt forms for the life of their Permit. These records are among those that may be inspected by the Bureau of Radiation Control during facility inspections. Failure to maintain these records is a violation of BRC 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 EHSD to obtain the RSO Number. Be sure to tell the EHSD 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 Permittee's name, Permit number, and department. Enter the date the material is 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 ( $\mu\text{Ci}$ ) or millicuries (mCi).
6. Enter detector type (GM, ion chamber, etc.) and make/model/serial number of meter used for radiation exposure measurements.
7. Perform a radiation survey for external radiation exposure at the surface of the package and at a distance of one meter. 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 EHSD immediately.**

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 the EHSD 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 or piece of tissue and a liquid scintillation counter (LSC) or an end-window GM survey meter.

The liquid scintillation counter is the preferred method of counting wipes for removable contamination. A GM survey meter will not detect  $^3\text{H}$  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.

Wipe the exterior of the package with a filter paper or a piece of tissue, wiping an area of at least  $300\text{ cm}^2$ . This wipe must be counted on the appropriate, calibrated counting instrument:

End Window GM Survey Meter - Alphas, High Energy Betas ( $^{32}\text{P}$ ), Beta/Gamma  
Liquid Scintillation Counter - Low Energy ( $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{35}\text{S}$ ,  $^{33}\text{P}$ ), High Energy Betas,  
Low Energy Photons ( $^{125}\text{I}$ ), and Alphas

Thin Window Scint. Probe - High Energy Betas ( $^{32}\text{P}$ ), Low Energy Photons ( $^{125}\text{I}$ )  
Gamma Counter - Low Energy, 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.

\*\*\*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:

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

where:

MDA = activity level in disintegrations/minute

$B_R$  = background rate in counts/minute

t = counting time in minutes for sample and background counts

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):

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

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.

Example:

A package of  $^3\text{H}$  has been received. The LSC efficiency for  $^3\text{H}$  is 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:

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

The net wipe activity is:

$$\text{Net Wipe Activity (dpm)} = \frac{40 \text{ cpm} - 22 \text{ cpm}}{0.33} = 55 \text{ dpm} < 72 \text{ dpm}$$

The contamination level for the external surface of the package can then be entered as “< 72 dpm”. If the net wipe activity was greater than 72 dpm, the actual net wipe activity would have been entered on the form.

The permittee is responsible for establishing an efficiency for the LSC and the nuclide in question. Contact the EHSD 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:

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

where:

MDA = activity level in disintegrations/minute/cm<sup>2</sup>

B<sub>R</sub> = background rate in counts/minute

t<sub>c</sub> = meter time constant in minutes (Refer to Table 1)

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 Sulfur-35. The background rate of the meter is 40 counts per minute. The efficiency of the survey meter for <sup>35</sup>S 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:

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

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

$$\text{Net Wipe Activity (dpm)} = \frac{60 \text{ cpm} - 40 \text{ cpm}}{0.05} = 400 \text{ dpm} < 1610 \text{ dpm}$$

The contamination level for the external surface of the package can then be entered as “< 1610 dpm”. 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 EHSD 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 is attached. 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 the EHSD.

If the calculated MDA for the counting system is greater than 3300 dpm for beta-gamma counting systems or 330 dpm for alpha counting systems, contact the EHSD for instructions. The detector may be malfunctioning or contaminated, causing a high background count rate, or a more efficient detector may be required.

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 the EHSD immediately.

10. 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.
11. 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 the EHSD immediately.
12. 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 the EHSD if a replacement shipment will be sent.
13. 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.
14. The person who checked in the package must sign the form as Surveyor to indicate that the shipment was received and checked in.
15. Immediately send or fax (979-845-1348) a copy of the completed form to the EHSD.
16. The box that the material was shipped in may be discarded as non-radioactive waste as long as the permittee 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.

17. Some vendors participate in a Styrofoam container recycling program. It is a requirement of the vendor as well as the EHSD that a survey of the container for removable contamination be performed and documented before the Styrofoam package is sent back to the vendor.
18. Any questions regarding this procedure may be directed to the EHSD at 979-845-1361.

Table 1 - Time constants for common survey meters

1. Ludlum Models 2 and 3

Fast Response:  $t_c = 4 \text{ sec.} = 0.0667 \text{ min.}$

Slow Response:  $t_c = 22 \text{ sec.} = 0.3667 \text{ min.}$

2. Ludlum 2200

Fast Response:  $t_c = 4 \text{ sec} = 0.0667 \text{ min.}$

Slow Response:  $t_c = 22 \text{ sec} = 0.3667 \text{ min.}$

3. Rad Monitor 9000 GM-1 and GM-2

$t_c = 4 \text{ sec}$

4. Eberline E-120

Fastest Response (response knob to clockwise limit):  $t_c = 2 \text{ sec.} = 0.0333 \text{ min.}$

Slowest Response (response knob to counterclockwise limit):  $t_c = 10 \text{ sec.} = 0.1667 \text{ min.}$

**Texas A&M University**  
**Radioactive Material Check-In and Delivery Form**

1. RSO Number \_\_\_\_\_

***ADMINISTRATIVE***

- |                            |                        |
|----------------------------|------------------------|
| 2. Date Processed _____    | 7. Permittee _____     |
| 3. Radionuclide _____      | 8. Permit No. _____    |
| 4. Physical Form _____     | 9. Dept. _____         |
| 5. Chemical Compound _____ | 10. Use Location _____ |
| 6. Activity Received _____ |                        |

***MONITORING***

**EXPOSURE RATE**

11. Instrument(s): Type \_\_\_\_\_ Make/Model \_\_\_\_\_ Serial Number \_\_\_\_\_
12. Exposure rate at 1 meter from package surface mR/hr 13. Background \_\_\_\_\_
14. Exposure rate at package surface \_\_\_\_\_ mR/hr

**REMOVABLE CONTAMINATION**

15. Instrument(s): Type \_\_\_\_\_ Make/Model \_\_\_\_\_ Serial Number \_\_\_\_\_
16. Minimum Detectable Activity dpm 17. Background \_\_\_\_\_
18. Removable contamination on surface of package \_\_\_\_\_ dpm/300cm<sup>2</sup>
19. Removable contamination on primary container \_\_\_\_\_ dpm/wipe

\_\_\_\_\_  
Surveyor

\_\_\_\_\_  
Received by Laboratory

## Transfer of Radioactive Materials

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

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 the TAMU EHSD (such as transport of moisture gauges and some transport of waste), the Permittee shall contact the EHSD 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 TAMUS Permittees

The Permittee who transfers licensed material from his or her Permit to another **shall contact the EHSD for approval prior** to releasing the material, and complete and sign the appropriate section of the "Radioactive Material Transfer Form". The receiving Permittee shall then complete and sign the appropriate section of the form. The form shall then be forwarded to the EHSD.

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-TAMUS Permittees

Transfers involving non-TAMUS licensees (as receiver or transferor) shall also **require advance approval from the EHSD**. Transfer documentation shall be prepared by the TAMUS Permittee as described previously. For transfers from TAMUS to a non-TAMUS license, a copy of the receiver's license must be obtained and **provided to the EHSD prior to the transfer**.

# Radioactive Material Transfer Form

## **MATERIAL TRANSFERRED FROM:**

Permittee Name \_\_\_\_\_

Permit Number \_\_\_\_\_

Date of Transfer \_\_\_\_\_ RSO Number \_\_\_\_\_

Was this material originally transferred to you from another TAMUS Permittee? Yes \_\_\_\_\_ No \_\_\_\_\_  
If "Yes", please give the name of the Permittee from which the material was originally received and the date of receipt. \_\_\_\_\_

Radionuclide/Compound \_\_\_\_\_

Quantity of Material Transferred \_\_\_\_\_ (μCi, mCi)

**APPROVED BY:** \_\_\_\_\_  
Permittee "FROM"

## **MATERIAL TRANSFERRED TO:**

Permittee Name \_\_\_\_\_

Permit Number \_\_\_\_\_

RSO Number \_\_\_\_\_ (Office use only)

**APPROVED BY:** \_\_\_\_\_  
Permittee "TO"

## 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 the EHSD. This procedure includes instructions for filling out the "Waste Disposal Report Form".

### Liquid Waste

Liquid wastes are collected in 5 gallon plastic carboys (or other approved containers) provided by the EHSD. 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 the EHSD 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 the EHSD 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. Permittees 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 the EHSD. Treatment options include bleaching or other chemical neutralization. Contact the EHSD 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. Permittees 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 once contained hazardous liquid, the empty vials must be tightly capped and placed in a separate waste container for disposal. If the vials once 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 the EHSD. Contact the EHSD regarding treatment options. Examples of tissue that must be treated include:
  - small amounts of tissue on slides or products of other analyses
  - tissue in alcohol or formaldehyde
  - paper or labware contaminated with blood
3. Contact the EHSD 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 the EHSD.
5. Double bag and label carcass waste, indicating that the bag contains carcasses.
  - Indicate nuclide and total activity, or weight and specific activity.
  - Remove excess air from 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.

1. All solid waste containers must have a lid. The lid should only be removed when adding waste to the container.
2. Short half-life solid waste may be mixed in a single solid waste container.
3. 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.
4. Remove or deface 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).
5. No liquids should be placed in solid waste.
6. “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.
7. 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 the EHSD before disposing of this material. Possible treatment options may include autoclaving, bleaching, or other chemical neutralization.
8. 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.
9. Uncontaminated lead shields (pigs) or lead lined containers should be separated from other waste. Remove or cover radiation signs or symbols.
10. Limit weight of container to 50 pounds.
11. 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 the EHSD. Please make certain that the form is properly completed **before** you call for a waste pick-up. EHSD 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 he will leave a discrepancy notice indicating the nature of the problem. 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:
  - The nuclide, the name of the licensee, the license number, and the RSO number for the waste.
  - 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 in 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 the EHSD 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 EHSD web site.
8. When waste is ready to be picked up, call the EHSD at 979-845-1361. You will be asked:
  - The name of the permittee
  - Your name and a number at which you can be contacted
  - The building and room where the waste is physically located
  - The nuclide and how many bags, carboys, or boxes of vials of that nuclide you have to be picked up
  - How many carboys you need in exchange for the full one(s)

# Waste Disposal Report Form

Nuclide: \_\_\_\_\_ Permittee: \_\_\_\_\_ Permit No: \_\_\_\_\_ RSO#: \_\_\_\_\_

Rev. July 2004

Starting Amount (in mCi): \_\_\_\_\_

Entry No.	Date	Disposal Form (in mCi)						Amount Disposed (mCi)	Remaining inventory (mCi)
		Solid	Liquid	Vials	Primary Vial	Sharps	Animal Carcass		
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
Disposal:									

Certification of chemical composition for <b>bulk liquid</b> wastes and/or <b>vial</b> wastes listed above.	
Chemical Constituents	Concentration (specify units)

Licensee (or designated) signature
  Printed Name
  Date

Waste Pickup by EHSD: Date: _____	By: _____
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## Emergency Procedures

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

Emergency Fire & Medical	9-911
Duty Health Physicist	979-862-1111
Radiation Safety.	979-845-1361
Physical Plant Radio Room	979-845-4311
University Police Dispatcher	979-845-2345

### Accident/Spill Response

If an accident or spill involves personnel injury:

1. Provide first aid immediately for serious injuries
2. Call 9-911
3. Notify the EHSD
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 microcuries) or spills that are difficult to clean up, the work would be carried out under the supervision of the EHSD. Appropriate protective clothing shall be worn during decontamination activities.

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

\*\*\* If the spill involves millicurie quantities of iodine, exit and seal off room, notify the EHSD, 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 tepid water (note: some solution 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 the EHSD
6. Identify and decontaminate secondary contamination locations (floor, shoes, doorknobs, telephones), etc.), documenting all surveys
7. Notify EHSD (even if the decontamination was successful)
8. Write an account of the incident, signed by the author and the Permittee, and forward a copy to the EHSD

## **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.

Permittees are not required to maintain survey instruments for performing radiation surveys. The EHSD will perform a radiation survey at the request of the permittee.

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 the EHSD.

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 the EHSD for information regarding instrument calibration. 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.
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 the EHSD 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 the EHSD for evaluation. Excessive radiation levels may require additional shielding or a relocation of the sources.

# Contamination Surveys

## Introduction

Permittees 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 permittee 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 permittee 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 A&M campus are Geiger Mueller (GM) survey meters and thin window NaI(Tl) scintillation survey meters.

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

Wipe tests must be used to survey an area for  $^3\text{H}$  contamination. Due to their high efficiency, wipe test counters, such as LSC's and gamma counters are very effective tools for identifying removable contamination. Gamma counters are limited to counting wipe tests for photon emitters, such as  $^{125}\text{I}$  or  $^{51}\text{Cr}$ . 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 Radiological Safety 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 EHSD personnel.

### **Documentation**

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

1. Permittee 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
  - 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 EHSD instrument calibration/source check (contact EHSD 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 one or two 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 the EHSD immediately. If contaminated skin or clothing still reads more than twice background after repeated attempts to decontaminate, notify the EHSD. See "Emergency Procedures" for additional information regarding spill response and surface and personnel decontamination.

## Radioactive Contamination Survey Record

Permittee: \_\_\_\_\_ Building/Room(s): \_\_\_\_\_

Radionuclides used: \_\_\_\_\_

### Survey Instrument Response

	Bkgd. (cpm)	Instr. Response Check or Calibration Date
<u>Make, Model, Serial No.</u>		
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

### Contamination Survey Results

- [A] Enter “work area”, name of person surveyed, or location designation (number) per attached map.
- [B] Check “yes” if contamination found to be greater than two times background. If “yes”, be sure to document that decontamination results are less than two times background or call EHSD for assistance.
- [C] Check “See Attached” if results are contained on an attached printout.

		[A]	[B] [C]	
<u>Survey Date</u>	<u>Instr. Used</u>	<u>Location, Work Area, Object or Name of Person Surveyed</u>	<u>Contaminated ? Yes / No / See Attached</u>	<u>Surveyed By</u>
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____
_____	_____	_____	/ /	_____

