

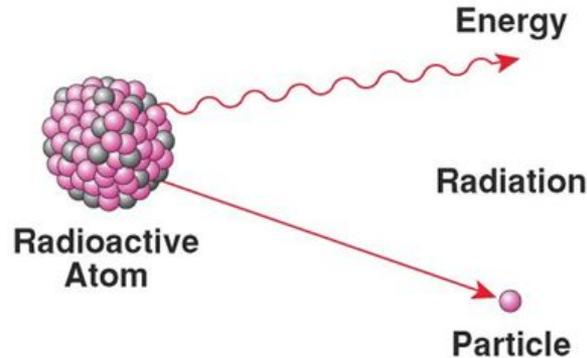
# **Saint Louis University**

## **Radiation Safety Awareness**



# What is Radioactivity?

- Radioactivity is the spontaneous emission of particles or rays from unstable atoms.
- Radioactivity can be found in natural sources such as air, soil, the sun, or from man made sources such as the radionuclides used for medical procedures and research.



# Radioactive Materials Use

- Radioactive materials may only be used:
  - Under the supervision of a Permit Holder who has been approved by the Radiation Safety Committee (RSC).
  - In RSC approved locations.
  - By personnel who have completed the Radiation Safety Orientation and passed the associated test.
- For more information visit: [SLU Radiation Safety](#)

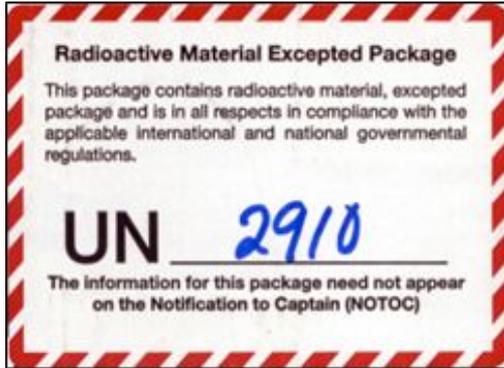






# Recognizing the Presence of Radioactive Materials Boxes Used to Ship Radioactive Materials

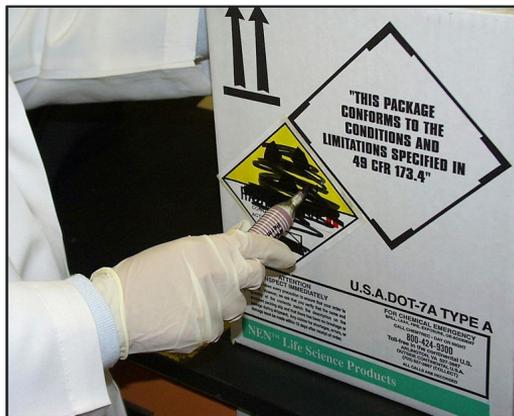
- Examples of common labels on shipping boxes used for radioactive materials are shown below.



# Recognizing the Presence of Radioactive Materials

## Boxes Used to Ship Radioactive Materials

- Containers used to ship radioactive materials must be tested and verified to be free of radioactivity prior to disposal in the regular trash.
- To show that this has been done, the federal government requires that radioactive materials labels be removed or marked through (as shown below) prior to disposal in the regular trash.



# Recognizing the Presence of Radioactive Materials

## Radioactive Materials Appearance

- The innermost container that the radioactivity comes in is known as the stock vial. Examples are shown below.
- The material inside the stock vial is usually a clear liquid.
- This material cannot be easily seen when spilled, and can easily spread. It is concentrated, so a little can go a long way!



Perkin-Elmer

# Recognizing the Presence of Radioactive Materials

## Radioactive Waste Containers

- Radioactive waste at SLU is typically stored in standard containers like the ones shown below.



- Some labs may store waste in non-standard containers. These containers must have labels which are red or magenta on yellow.

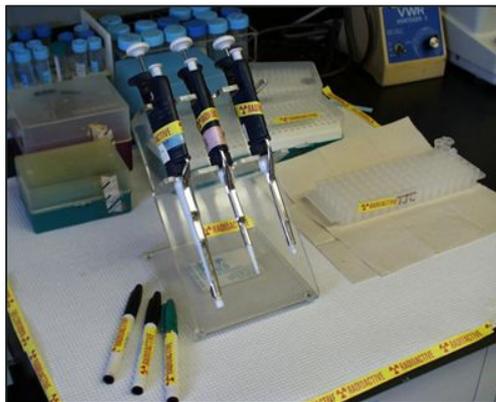


- *Radioactive* Sometimes, the word “Radioactive” may be written on a waste container with a marker, even though this does not comply with the NRC regulations.

# Recognizing the Presence of Radioactive Materials

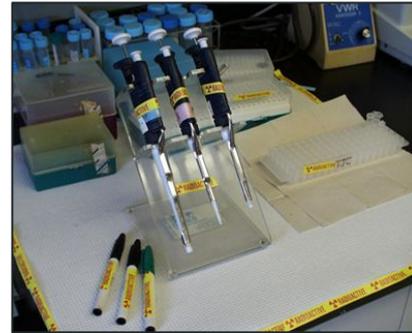
## Radioactive Lab Areas and Equipment

- Lab areas and equipment used for radioactive materials are identified using specific labels and tape.
- There are different sizes and shapes of these labels. These labels should always be red or magenta on yellow (as shown below).

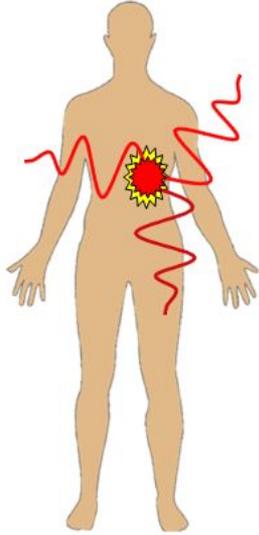


# Precautions to Take When in Restricted Areas

- Avoid touching any container, box, trash can, etc. labeled with the words “Radioactive” or “Radioactive Materials” (even if only hand-written).
- Do not touch any of the bench tops in the designated radioactive areas, or any equipment in those areas.

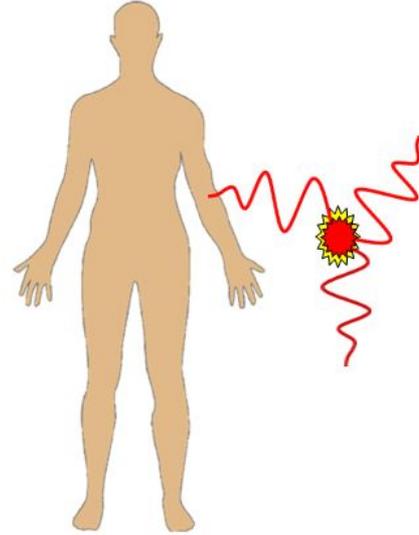


# Types of Radiation Dose



## Internal Dose

- An internal dose of radiation is received when an individual is exposed to radiation internally.
- Radioactive materials may be ingested, inhaled, or absorbed through the skin.

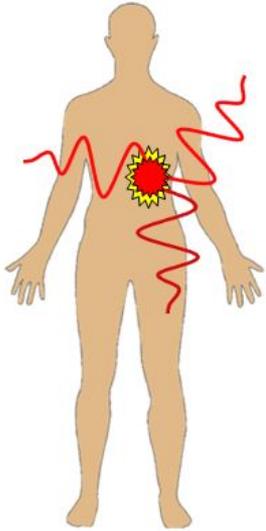


## External Dose

- An external dose of radiation is received when an individual is exposed to radiation outside of the body.
- Standing in close proximity to an unshielded stock vial of P-32 for an extended period of time will result in an external dose of radiation.

# Internal Dose

- **Internal exposure is irradiation of body tissues by a radioactive material deposited within the body.**
  - This can occur only if the individual has ingested, inhaled, or by some other route absorbed some radioactive material into the body.
- **In research labs, the most likely cause is poor lab hygiene.**
  - Poor lab hygiene can result in radioactive contamination being transferred to an individual's hands and from hands to mouth possibly via a pen or pencil, eating or drinking, etc.

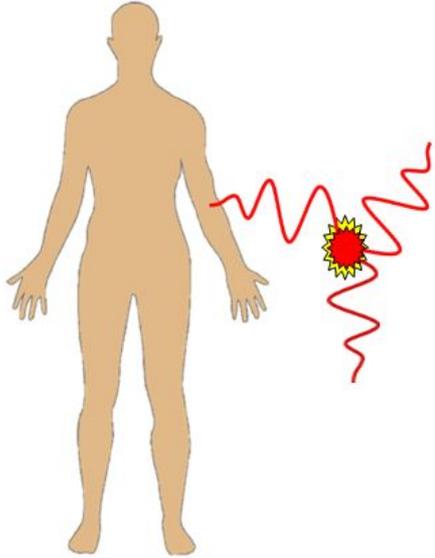


## Internal Dose - Inhalation

- Fortunately, few radionuclides at SLU evaporate readily into the air.
- These materials are required to be used in fume hoods that are routinely measured and approved by Radiation Safety staff.
- Each of these hoods is required to be posted with the sign shown below:

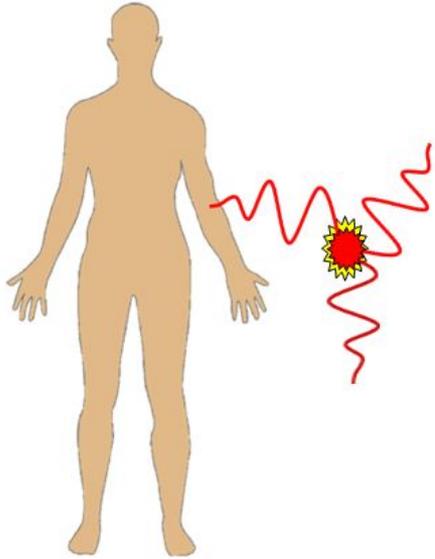


# External Dose



- External exposure is irradiation of tissue from a source of radiation outside the body.
- External exposure occurs when radioactive material is in close proximity to the body or in contact with it.
  - There are a few exceptions to this (e.g., H-3 and C-14 which are too weak to penetrate the dead layer of skin).
- For stronger, more energetic radiation sources, exposure can occur when the source is several feet away.

## External Dose *(continued)*



- In most restricted areas (e.g., research labs) at our institution, the radioactive materials do not cause significant exposure at distances of a few feet away.
- In those cases where significant exposure is detected, shielding is employed to store the materials safely (lead for x-rays and gamma rays, Plexiglas or plastic for strong/energetic beta emitters).



# Eating, Drinking, Etc. in Restricted Areas

- No eating, drinking, smoking, or application of cosmetics or contact lenses is allowed in any laboratory where biological, chemical, or radioactive materials may be present.
- Food and drink may not be stored in any laboratory in which hazardous chemicals are used (applies to cold rooms, freezer rooms, refrigerators, etc.)
- No research oven or microwave shall be used for heating or cooking of any food or beverage.



# Eating, Drinking, Etc. in Restricted Areas *(continued)*

- Eating and drinking is permitted in unrestricted areas where no hazardous materials are used or stored.
- Clean areas can only be set up in areas that have a physical barrier (such as a door) between the restricted and unrestricted areas.
- Examples:
  - Lunch Rooms & Break Rooms
  - Cafeterias
  - Offices





# Survey Instruments

- A survey meter is required to be on the bench and turned on when radioactive materials are in use.
- The meter/detector should be appropriate for the type of radiation in use.



- Wipe tests are assayed on a liquid scintillation counter.



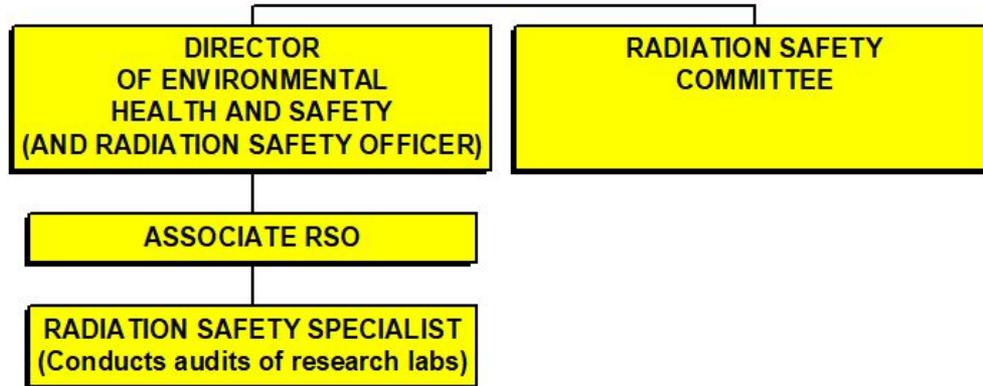
# Laboratory Inspections

- Radiation Safety staff inspect labs quarterly, including contamination survey records.

<b>RADIATION SAFETY LABORATORY INSPECTION</b>		INSPECTION DATE: _____
(Revision Date: 11/1/2019)		(Mo/Da/Yr)
MEMORANDUM TO: _____		LABORATORY: _____
(Permit Holder) (Department/Division) (Building) (Room Nos.)		
<p>This Radiation Safety Laboratory Inspection is a constructive appraisal of the radiation safety program in your laboratory. Its purpose is to evaluate your laboratory's compliance with the Nuclear Regulatory Commission (NRC) &amp; Radiation Safety Committee (RSC) requirements for the safe use and control of radioactive materials (RAM) at Saint Louis University, to which you committed in your permit application. This inspection form provides a mechanism for identifying weaknesses in your radiation safety program and an opportunity for you to correct deficiencies in order to avert potential incidents involving radioactive materials obtained under your</p>		<p>permit. It is <b>extremely important</b> that the deficiencies identified be promptly addressed and corrected. An excessive number of deficiencies, or uncorrected repeat deficiencies, may result in withholding of radionuclide shipments, referral to the RSC and suspension or revocation of your radionuclide use permit. Changes in regulations, NRC license, or University policies may necessitate occasional revision of the inspection form. Questions or comments regarding the inspection should be directed to the Radiation Safety Officer at 977-8609.</p>
LABORATORY STAFF/PERSONNEL CHANGES: <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> JRSO Database		LABORATORY LOCATION CHANGES: _____ <input type="checkbox"/> JRSO Database
SUMMARY OF INSPECTION FINDINGS		
<p>A. <input type="checkbox"/> No items of noncompliance or unsafe conditions were identified.</p> <p>B. <input type="checkbox"/> Items of noncompliance or unsafe conditions were identified: <b>SEE BELOW.</b></p>		<p>C. <input type="checkbox"/> Inactive - No radioactive materials used this quarter; storage only.</p> <p>D. <input type="checkbox"/> Inactive; No radioactive materials in use or storage.</p>
		<p><input type="checkbox"/> Logbook <input type="checkbox"/> Database Total Pts: _____</p> <p><b>RSO REVIEW:</b> _____</p> <p><input type="checkbox"/> Repeat Def. <input type="checkbox"/> Excessive Def. <input type="checkbox"/> Letter Sent</p>
<p><b>POSTING &amp; RECORDS ACCESSIBILITY</b></p> <ul style="list-style-type: none"> <li>___ 1. NRC-3 form not posted.</li> <li>___ 2. Radioactive materials sign not posted</li> <li>___ 3. Radiation area sign not posted</li> <li>___ 4. High radiation area sign not posted</li> <li>___ 5. Airborne radioactivity area sign not posted</li> <li>___ 6. Low Level Exposure Zone (&lt;0.2 mR/hr) not posted</li> <li>___ 7. Emergency instructions not posted</li> <li>___ 8. Permit not posted</li> <li>___ 9. Permit application (copy) not accessible</li> <li>___ 10. Previous RSO inspection not logged or posted</li> <li>___ 11. Radiation Safety Manual or required records inaccessible</li> </ul> <p><b>TRAINING REQUIREMENTS</b> (see comments for specification of individuals)</p> <ul style="list-style-type: none"> <li>___ 12. Personnel working with RAM have not attended Radiation Safety Orientation Course and passed exam</li> <li>___ 13. Personnel have not attended the annual refresher course</li> <li>___ 14. Permit Holder has not provided/certified laboratory specific instruction to workers</li> </ul> <p><b>RADIONUCLIDE RECEIPT, INVENTORY &amp; TRANSFER</b></p> <ul style="list-style-type: none"> <li>___ 15. Radionuclide Shipment Receipt Log incomplete                             <ul style="list-style-type: none"> <li>___ A. &lt; 10% of shipments received</li> <li>___ B. &lt; 25% of shipments received</li> <li>___ C. &gt; 25% of shipments received</li> <li>___ D. other; see comments</li> </ul> </li> <li>___ 16. Inventory Log - Radionuclide Stock Vial Inventory Ledger incomplete                             <ul style="list-style-type: none"> <li>___ A. &lt; 10% of shipments received</li> <li>___ B. &lt; 25% of shipments received</li> <li>___ C. &gt; 25% of shipments received</li> <li>___ D. other; see comments</li> </ul> </li> <li>___ 17. Online radionuclide inventory database not updated</li> <li>___ 18. Radionuclide shipment received directly; RSO not notified</li> <li>___ 19. Radioactive material provided to unauthorized staff</li> <li>___ 20. Unauthorized removal of RAM from SLU-affiliated facilities</li> </ul>	<p><b>SAFETY PRACTICES, SURVEYS &amp; SUPPLIES</b></p> <ul style="list-style-type: none"> <li>___ 21. Staff do not adequately survey during &amp; after each use of radionuclides</li> <li>___ 22. Area survey documentation lacking (specify dates of missing surveys in comments section):                             <ul style="list-style-type: none"> <li>___ A. 1 weekly survey</li> <li>___ B. 2 weekly surveys</li> <li>___ C. 3 or more weekly/1 or more monthly surveys</li> <li>___ D. survey meter readings not documented</li> <li>___ E. Other; specify in comments section</li> </ul> </li> <li>___ 23. Appropriate survey instrument not used or unavailable</li> <li>___ 24. Survey instrument not operational, has depleted batteries, or lacks check source</li> <li>___ 25. Survey instrument calibration not current within 1 year; comments: _____</li> <li>___ 26. Evidence of personnel eating or drinking in areas designated for radioactive materials use or storage</li> <li>___ 27. Staff not wearing gloves, lab coat, or other protective clothing while working with radionuclides</li> <li>___ 28. Staff wearing open toed shoes (sandals, etc.) or shorts while working with radionuclides</li> <li>___ 29. Laboratory surfaces (bench tops, etc.) inadequately covered</li> <li>___ 30. Fume hood, glove box, or charcoal filtered mini-hood not used as required</li> <li>___ 31. Essential spill response supplies not maintained within laboratory (see itemized list below):                             <ul style="list-style-type: none"> <li style="width: 50%;">___ absorbent pads</li> <li style="width: 50%;">___ absorbent towels</li> <li style="width: 50%;">___ decontamination solution</li> <li style="width: 50%;">___ mild hand soap (e.g., Joy)</li> <li style="width: 50%;">___ scouring pads</li> <li style="width: 50%;">___ soft brush (for skin)</li> <li style="width: 50%;">___ scrub brush</li> <li style="width: 50%;">___ shoe covers (disposable)</li> <li style="width: 50%;">___ heavy duty plastic bags</li> <li style="width: 50%;">___ gloves (disposable)</li> <li style="width: 50%;">___ tape (caution: RAM)</li> <li style="width: 50%;">___ spare clothing/shoes</li> </ul> </li> </ul> <p><b>RADIONUCLIDE USE &amp; STORAGE</b></p> <ul style="list-style-type: none"> <li>___ 32. Use or storage of radionuclides in an unauthorized area</li> <li>___ 33. Radionuclides improperly stored or inadequately shielded</li> <li>___ 34. Unmarked and unattended labware containing radionuclides</li> </ul>	<ul style="list-style-type: none"> <li>___ 35. Radionuclides not secured against unauthorized access or removal                             <ul style="list-style-type: none"> <li>___ A. unattended laboratory not locked</li> <li>___ B. unlocked refrigerator/freezer in unrestricted area</li> <li>___ C. unattended radioactive waste in unrestricted area</li> <li>___ D. other; see comments</li> </ul> </li> <li>___ 36. Food/drink stored in area designated for RAM</li> </ul> <p><b>RADIONUCLIDE WASTE DISPOSAL</b></p> <ul style="list-style-type: none"> <li>___ 37. Waste disposal records inadequate</li> <li>___ 38. Improper packaging/labeling of radioactive waste</li> <li>___ 39. Improper segregation of radioactive waste</li> <li>___ 40. Improper disposal of radioactive waste</li> </ul> <p><b>INTERNAL &amp; EXTERNAL DOSIMETRY</b></p> <ul style="list-style-type: none"> <li>___ 41. Personnel bioassay not submitted as required</li> <li>___ 42. Personnel dosimeter (badge) not timely returned; specify individual(s): _____</li> <li>___ 43. Location of personnel exposure records unknown</li> <li>___ 44. Staff not wearing required dosimeter while handling radionuclides</li> <li>___ 45. Staff wearing dosimeter assigned to another person</li> <li>___ 46. Dosimeter (badge) stored in radiation work/storage area</li> </ul> <p><b>OTHER ITEMS OF NONCOMPLIANCE</b></p> <ul style="list-style-type: none"> <li>___ 47. _____</li> <li>___ 48. _____</li> </ul> <p><b>COMMENTS</b></p> <p><input type="checkbox"/> See attached comments <input type="checkbox"/> No comments necessary</p> <p style="text-align: center;">(Signature of Laboratory Inspector)</p> <p style="text-align: center;">(Signature of Laboratory Staff Member)</p>

# Laboratory Inspections *(continued)*

- Any significant safety or compliance issues are reported to the SLU Radiation Safety Committee (RSC) and the Administration of Saint Louis University.
- The Radiation Safety Officer (RSO) has the authority to shut the lab down if it is deemed necessary.



# Laboratory Decommissioning

## **1. Contact the Associate Radiation Safety Officer as soon as a laboratory move is known. (NOTE: Do NOT dispose of ANY past Lab Radiation Safety Records\*\*.)**

- a. This needs to be done prior to terminating your Radioactive Materials Permit and/or well in advance of the PI relocating to another laboratory with the University or leaving the University.
- b. Prior to a relocation within the University, termination of your radioactive materials permit, and/or relocating to another institution, all applicable steps below must be completed.
- c. Prior to moving to another location within the University, complete and submit an "[Application for Approved Location Change](#)".

## **2. Transfer radioactive materials (excluding waste) to another SLU Permit Holder.**

- a. Must be done through the SLU Radiation Safety Office.
- b. The transferee permit holder must be approved in advance for the radionuclides(s) and activities to be transferred.
- c. If the radioactive materials must be moved elsewhere on campus by vehicle, contact Radiation Safety staff to perform this transfer for you.
- d. Radioactive materials are not generally allowed to be transferred to another institution except under unusual circumstances.

## **3. Dispose of all radioactive waste prior to the move.**

- a. Pack all waste properly and request a radioactive waste pick up.

# Laboratory Decommissioning *(continued)*

## **4. Complete thorough contamination surveys of all laboratory surfaces and equipment that has been used in conjunction with radioactive materials.**

- a. Both wipe tests and meter surveys are required. Only wipe tests are required for H-3 (tritium).
- b. Decontaminate any laboratory surfaces and equipment surfaces found to be contaminated.
- c. Document all wipe test and meter survey results, decontamination efforts, and follow-up wipe tests and meter survey results demonstrating successful decontamination.

## **5. Remove “Radioactive Materials” labels, etc.**

- a. Remove radioactive materials labels, stickers and tape from laboratory surfaces, equipment, instruments, and other items confirmed to be free of radioactive contamination after completing no. 4 above.
- b. Do NOT remove postings on the doors or rooms.

## **6. Contact Radiation Safety Staff to arrange for decommissioning confirmatory surveys.**

- a. \*\*Retention/transfer of radiation safety records will also be discussed.

# Response to a Spilled Container of Radioactive Material

- In the event that there is a spill of radioactive material stay out of the area, and notify the Saint Louis University Department of Public Safety immediately at:



**314-977-3000**

**The dispatcher will notify the appropriate response team. This procedure applies 24 hours a day, 7 days a week.**

- If a water leak or other leak develops in any area, always assume that it is contaminated (chemically or radioactively) until the source and pathway of the leak has been determined, and it is confirmed to not contain radioactive or other hazardous materials.

# Radioactive Spills (continued)

If you accidentally walk through an area that is believed to be contaminated with radioactive materials, take the following precautions:

- **Do not leave the area!**
- Remain at the scene and keep movement within the area to a minimum!
- Wait to be tested (surveyed) by a qualified spill team member.
- **Leave the area only after you have been surveyed and are told by a qualified spill team member that you may leave the area.**
- More detailed instructions are posted in labs authorized for radioactive materials.



## Emergency Procedures for Radionuclides



(Page 1 of 2)



### FIRE

*In the event of a general fire in the laboratory:*

1. Follow the general fire alarm and/or notification procedures for your facility. Be sure to report that radioactive materials are present in the lab.
2. Utilize available fire fighting equipment to control or extinguish small fires that can be safely handled prior to arrival of the fire department, if you have been trained to do so.



### MAJOR RADIOACTIVE SPILL

*A spill of greater than 100  $\mu\text{Ci}$  of any radionuclide or involving the floor or contaminated personnel.*

1. Do not leave the immediate area.
2. Immediately notify all persons in the area that you have just had a spill of radioactive material.
3. Prevent the spread of contamination by limiting the movement of all personnel who may be contaminated. Place an absorbent pad or bench paper on the floor near any potentially contaminated persons for them to stand on. If the spill involves significant activity, several sheets of bench paper may be placed on the floor to create a path to allow the person to move several feet away from the spill area without the risk of spreading contamination to other areas of the floor.
4. Immediately survey all individuals who have been in the vicinity of the spill location. Especially important is to survey the soles of the shoes worn by these individuals to assure that the spill has been contained. Also survey hands, lab coats, and other clothing.
5. Decontaminate personnel immediately if individuals are contaminated, following procedures for personnel decontamination on page 2.
6. Notify all persons not involved in the spill to vacate the room. Be sure to survey all individuals as they leave the room. Especially important is to survey the soles of the shoes worn by these individuals to assure that the spill has been contained within the room and is not spread outside of the room. Also survey hands, lab coats, and other clothing.
7. Do not attempt to clean up the spill. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
8. Shield the source if possible. This should be done only if it can be done without further spread of contamination or a significant increase in radiation exposure.
9. Prevent unauthorized entry by closing the door and placing a "Caution: Contaminated Area" sign or warning tape across the entrance. If possible, an individual who is not contaminated should be stationed outside of the door to prevent unauthorized entry until the spill team arrives.

### EMERGENCY CONTACTS

#### Quick Reference

- ✓ Spill Team – SLU Buildings ..... 73000  
(314) 977-3000 if calling from an outside line or cell phone
- ✓ Spill Team – SSM Health SLU Hospital ... 4444  
(314) 257-4444 if calling from an outside line or cell phone
- ✓ Radiation Safety Office..... 78609  
(314) 977-8609 if calling from an outside line or cell phone

10. Notify the Radioactive Spill Response Team immediately via the Saint Louis University Public Safety Dispatcher by dialing (314) 977-3000. (If dialing from within SSM Health SLU Hospital, dial the Hospital Operator at ext. 4444). These procedures apply 24 hours a day, 7 days a week.



### MINOR RADIOACTIVE SPILL

*A spill of 100  $\mu\text{Ci}$  or less of any radionuclide confined to a bench top or other laboratory surface, and not involving the floor or contaminated personnel.*

1. Immediately notify all persons in the area that a spill has occurred.
2. Prevent the spread of contamination by covering the spill with absorbent paper.
3. Immediately survey individuals who have been in the vicinity of the spill location. Especially important is to survey the soles of the shoes worn by these individuals to assure that the spill has been contained. Also survey hands, lab coats and other clothing. If personnel are contaminated, including soles of shoes, immediately follow procedures for personnel decontamination on page 2 and procedures for a major spill on this page.
4. Clean up the spill using disposable gloves and absorbent paper. Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Also put contaminated gloves and any other contaminated disposable material in the bag.
5. Survey the area with an appropriate radiation detector with a low range survey meter. Check the area around the spill. Also check your hands, clothing, and shoes for contamination.
6. Report the incident to the Radiation Safety Office at (314) 977-8609. If after hours or on a weekend, contact the Radiation Safety Officer through the Saint Louis University Public Safety Dispatcher by dialing (314) 977-3000. (If dialing from within SSM Health SLU Hospital, dial the Hospital Operator at ext. 4444). This applies 24 hours a day, 7 days a week.
7. Document all survey results and cleanup efforts in a written report. Forward a copy of the written report to the Radiation Safety Officer. Keep a copy of the written report on file with the laboratory Radiation Safety Survey Records.

## Summary

- Please complete the Safety Awareness Quiz on Radiation Safety by July 31, 2023.
- Please contact [ehs@slu.edu](mailto:ehs@slu.edu) for any questions.