

Section 14

Radioactive Waste

Contents

A. Proper Collection, Disposal, and Packaging	14-2
1. Dry Waste	14-2
a. Acceptable	14-2
b. Unacceptable	14-3
c. Disposal:	14-3
2. Liquid Waste	14-3
a. Sewer Allowance	14-3
b. Aqueous Liquid	14-4
3. Liquid Scintillation Counting (LSC) Waste	14-6
a. Bulk LSC Waste	14-6
b. Vials and Contents	14-6
c. Safe Handling of LSC Waste	14-7
4. Animal Carcasses and Putrescible Animal Waste	14-8
a. Non-Radioactive Animal Waste	14-8
b. Radioactive Animal Waste	14-8
c. Animal Carcasses Containing Short Half-Lived Materials	14-9
5. Possible Infectious Wastes	14-9
a. Type of Infectious Wastes	14-9
b. Processing	14-9
6. Fumes and Vapors	14-10
a. Atmospheric Releases	14-10
7. Incineration	14-10
8. Storage for Decay	14-10
a. Waste That Can Be Stored for Decay	14-10
b. Criteria for Determining Material has Decayed	14-11
c. Prior to Disposal of Decayed Materials into Normal Trash	14-11
d. Record Keeping	14-12
9. Mixed Waste	14-12
a. Definition	14-12
b. Characteristics and Examples of Mixed Waste	14-12
c. Neutralization and Deactivation	14-12
d. Lead	14-12
10. Lead	14-13

- 11. Uranium and Thorium Compounds..... 14-13
 - a. Separation..... 14-13
 - b. Disposal..... 14-13
- B. Records and Labeling 14-14
 - 1. Waste Disposal Records 14-14
 - a. Radioactive Material Delivery and Usage Record (Form 160)..... 14-14
 - b. Disposal Log..... 14-14
 - 2. Marking Packages for Collection 14-14
- C. Other Items of Importance 14-15
 - 1. Designation of Radioactive Waste Containers 14-15
 - 2. Radioactive Material Labels..... 14-15
 - a. Purpose of Labels 14-15
 - b. Removal of Labels..... 14-15
 - 3. Security..... 14-15
 - 4. High Exposure Level Waste 14-15
 - a. "Hot Project" Waste..... 14-15
 - b. Disposition..... 14-15
 - 5. Waste Containers 14-16
 - 6. Ventilation of Containers..... 14-16
 - a. Proper Ventilation..... 14-16
 - b. Adding Waste..... 14-16
 - 7. Radioactive Material Waste Fees 14-16
 - a. Determination of Waste Fees..... 14-16
 - b. Changing Rates..... 14-16
 - c. University Costs 14-16

Tables

- Table 14-1 Characteristics of Hazardous Waste 14-13
- Table 14-2 Catalog Numbers for Ordering Waste Supplies..... 14-17

A. Proper Collection, Disposal, and Packaging

1. Dry Waste

a. Acceptable

Dry waste consists of paper, gloves, glass, plastics, and other forms of solid waste.

b. Unacceptable

It is forbidden to put the following items in dry waste

- 1) Uranium and thorium compounds.
- 2) Liquid in any form.
- 3) Lead.
- 4) Animal carcasses.
- 5) Putrescible waste.
- 6) Human blood or tissue.

c. Disposal:

- 1) Dry Waste

Dry waste is collected in the standard Low Specific Activity (LSA) box that has been lined with a plastic bag. See Table 2, at the end of Section 14, for catalog numbers for ordering LSA boxes and plastic bags.

- 2) Sharps

Sharps include glass pipettes, broken glass, and needles. They should be placed in a strong inner package, which is placed in the LSA box.

2. Liquid Waste**a. Sewer Allowance**

The UW is allowed to dispose of material that is soluble or readily dispersible in water into the sanitary sewer, as long as quantities are restricted. A portion of the UW's allowance for sewer disposal is allocated to each lab. Each registered radioactive materials (RAM) laboratory may have a sink or drain designated for liquid radioactive waste disposal.

- 1) Single Laboratory

The single laboratory allowance for each calendar quarter is as follows:

H-3	1000 μCi
C-14	200 μCi
I-125	100 μCi
All other radionuclides combined	200 μCi

2) Multiple Laboratories

When a group of RAM laboratories are assigned to one Authorized Investigator, the allowance for the group is the sum of the allowance for each lab. For example, if you have six labs assigned to your use, you may dispose of a total of six times the limit given above. **Records of all sink disposals must be maintained by each Authorized Investigator** to show compliance within the limits. Radiation Safety Office (RSO) Form 170, Quarterly Sink Disposal Record for Radioactive Material, is available for this purpose.

3) Release

The soluble or readily dispersible material must be released into a strong flow of water to allow complete purge of traps. Consult the UW Environmental Health and Safety (EH&S) website or call the Radiation Safety Office at 543-6328 for the current list of approved sewer disposable liquid scintillation fluids.

4) Restricted or Not Allowed

a) Restricted Liquid Scintillation Fluids

This restriction includes soluble liquid scintillation fluids that are not approved for sewer disposal.

b) Not Sewer Disposable

Organic solvents or other hazardous materials are not to be disposed of into the sewer.

5) Special Projects

A portion of the University's licensed sewer disposal allowance is held in reserve for special projects, which generate unusual quantities of liquid waste. Permission to make these non-routine disposals should be requested from the RSO.

b. Aqueous Liquid

Aqueous liquids that exceed the sewer allowance are not candidates for sewer disposal and must be absorbed and transferred to Radiation Safety (RS) staff for disposal.

1) Waste Collection Procedures

Only properly packaged aqueous waste will be accepted for disposal by the RS staff.

- a) Use plastic pails and lids, which are available from Radiation Safety. Call Radiation Safety for information and for catalog numbers for these supplies.
 - b) Pails should be labeled with a radiation label and filled only **half-full** with diatomaceous earth, an absorbent. See Table 2 for the catalog number for diatomaceous earth.
 - c) The lid can be secured and liquid added through the bung hole, or the lid can be left loose.
 - d) Add liquid waste until it will no longer "soak in."
 - e) Fill the remaining half volume with diatomaceous earth. **Do not add more liquid.** This will assure the legal disposal of approximately 1.5 gallons of aqueous solution in a 5-gallon pail. Fill the bucket as full as possible with dry absorbent to minimize the void space in the pail.
 - f) Secure the lid and the bung hole plug.
 - g) Wipe any spilled waste from the top, sides and bottom of the pail.
 - h) **No items other than aqueous liquid and diatomaceous earth are allowed in pails.**
- 2) Maximum Allowed Pail Weight:
- a) 5-Gallon Pail - maximum pail weight is 38 lbs.
 - b) 3.5-Gallon Pail - maximum pail weight is 26 lbs.
 - c) Pails over the appropriate weight or that contain materials other than absorbed aqueous liquid and diatomaceous earth will be returned to the lab of origin for repackaging.

3) Removing Lid

It is not possible to remove the lid from a plastic pail once it has been secured without breaking the binding ring. If a secured lid is removed, it must be replaced with a new lid.

4) Cautions

a) Inhibit Biological Growth

A pail of absorbed liquid waste can serve as an ideal growth chamber and may generate gas when cell culture media or other nutrients decompose. Waste may need to be treated prior to

disposal by adding an appropriate growth inhibitor.

b) Biohazard Control, Decontamination

Consult the UW Biohazard Safety Manual, Chapter IV Procedures for Biohazard Control, Part C Decontamination.

c) Possible Side Reactions

An example of a possible side reaction is chlorine bleach releasing chlorine gas or stimulating the volatilization of radioactive iodine.

5) Liquid Scintillation Fluid

This is not considered aqueous liquid, and must be handled separately. See Item 3 - Liquid Scintillation Counting Waste below.

3. Liquid Scintillation Counting (LSC) Waste

a. Bulk LSC Waste

1) Cost

The most economical method of disposing LSC waste is in bulk form.

2) Bulking

LSC waste can be emptied from vials and consolidated into tight-lidded, labeled containers.

3) LSC Bottles

The original LSC bottles in the original cardboard carton are recommended for packaging waste LSC fluid.

b. Vials and Contents

1) Disposal

Vials containing LSC fluid can be accepted by the RS staff for disposal; however, the cost is greater than for disposal of bulk LSC waste.

2) Packaging

LSC vials and contents should be packaged in the original "egg crate" cartons, because loose vials in boxes are prone to leakage. Also, do not use LSA boxes to package vials. An LSA box full of scintillation vials is too heavy for pickup.

c. Safe Handling of LSC Waste

- 1) Caution During Handling
 - a) LSC waste may contain several solvents, including toluene, dioxane, xylene, and/or trimethylbenzene.
 - b) Many LSC fluids contain chemicals that are suspected carcinogens.
 - c) Inhalation, skin contamination, and fire hazards must be considered in handling LSC waste.
- 2) Protection during Handling
 - a) Filling and emptying LSC vials may require the use of an operating fume hood.
 - b) During work individuals should wear gloves, eye protection, and a lab coat.
- 3) Handling Empty Vials
 - a) Empty vials can be re-used or properly disposed.
 - b) If vials are to be disposed, they should either be evaporated to dryness or rinsed in a pail of warm detergent water within a ventilated space to eliminate residual solvent vapors, and checked for contamination.
 - c) Empty glass vials should be discarded with lab glassware. Empty plastic vials may be discarded in normal trash.
- 4) Storing Bulk LSC Waste

Bottles of LSC waste should be stored until collected in cabinets approved for flammable materials.
- 5) Exceptions
 - a) Some newer types of LSC fluid may be safer to use and, therefore, require fewer precautions.
 - b) Be sure to consult manufacturer's recommendations before you deviate from the above procedures.

4. Animal Carcasses and Putrescible Animal Waste

a. Non-Radioactive Animal Waste

1) Below Regulatory Limits

Animals contaminated with H-3 or C-14 at a concentration less than 0.05 $\mu\text{Ci}/\text{gram}$, or other radionuclides at a concentration below 0.005 $\mu\text{Ci}/\text{gram}$ can be disposed as non-radioactive waste.

2) Specific Organs

Organs with concentrated radioactivity may be removed and treated separately as radioactive waste if the remainder of the animal is below regulatory limits. See Item b.1) for handling of those specific organs.

b. Radioactive Animal Waste

1) Organs with Higher Levels

If certain organs with H-3 or C-14 concentrated radioactivity at or above 0.05 $\mu\text{Ci}/\text{gram}$ or other radionuclides at or above 0.005 $\mu\text{Ci}/\text{gram}$, these parts can be removed for radioactive waste disposal.

2) Animal Waste above Limits

Putrescible animal waste containing radionuclides greater than the levels listed in Item a.1) above must also be treated as radioactive waste. This includes blood, excreta, tissue samples, animal bedding, and similar materials.

3) Disposal

Animal carcasses, animal organs, or putrescible animal waste containing long-lived radionuclides above the exempt limits **must be transferred to RS staff** for disposal.

4) Packaging for Disposal

To package radioactive animal carcasses, animal organs, and putrescible animal waste, do the following. Waste presented in an incorrect form or which becomes putrid will jeopardize the authorization to use radioactive materials. Putrid packages will be returned to the originating laboratory for proper packaging.

a) Seal into two layers of plastic bags.

b) Take to Comparative Medicine, Health Sciences D607 (freezer section).

- c) Label with a RAM tag provided in HSB D607. The tag should be filled out with all information required for disposal.
- d) Large Animals

When the disposal of large animals is anticipated, arrange with RS staff to have a 30-gallon drum delivered to your work area. The carcass can then be placed in the drum before it becomes rigid. When notified, the RS staff will pick up the drum and take it directly to the freezer in Health Sciences B122.

c. Animal Carcasses Containing Short Half-Lived Materials

- 1) Holding for Decay

Animals containing only radionuclides with short half-lives can be held for radioactive decay, provided the average activity concentration will be less than $0.005 \mu\text{Ci}/\text{gram}$ within six months, to prevent long term storage.

- 2) Storage

These animals are stored without charge. Make arrangements with the Radiation Safety Office.

- 3) Labeling

This waste **must be labeled** by the researcher to indicate the date at which the activity of the waste will be below $0.005 \mu\text{Ci}/\text{gram}$.

5. Possible Infectious Wastes

a. Type of Infectious Wastes

- 1) Human blood.
- 2) Human tissues.
- 3) Human wastes of any kind.
- 4) Animal carcasses or wastes that contain active pathogens.

b. Processing

- 1) Sterilization

These materials need to be processed in an appropriate manner to sterilize any biological agent.

2) Autoclaving

Autoclaving biological waste that contains radioactive material requires the pre-authorization and written approval of the Radiation Safety Office. Using an autoclave to sterilize radioactive material has been known to cause extensive contamination of the equipment and laboratory spaces if the material is not properly prepared.

3) Incompatible Processing

Some sterilization procedures, such as treatment with chlorine bleach, may be incompatible with control of radioactive materials. Contact the RSO for special review, if you have questions or are uncertain about the appropriate procedure.

6. Fumes and Vapors

a. Atmospheric Releases

The UW is allowed to emit small quantities of radioactive materials to the atmosphere. An evaluation of the potential release, the exhaust stacks, and the exhaust rates must be made and included with other University releases.

- 1) The Radiation Safety office will assist with this evaluation.
- 2) Atmospheric release, as part of ongoing research projects, needs to be evaluated by Radiation Safety staff. You must present a detailed discussion of your plans in the application to use radioactive materials or in an application for amendment to your authorization.

7. Incineration

At present, there is no provision in the University license or local pollution prevention laws to permit incineration of radioactive materials.

8. Storage for Decay

a. Waste That Can Be Stored for Decay

1) Short-Lived Radionuclides

Short-lived radionuclide waste can include almost all radionuclides on campus with a half-life of 100 days or less. Radionuclides, such as tritium and carbon-14, have a half-life greater than 100 days, and, therefore, cannot be held in storage for decay.

2) Acceptable Locations for Storage

Short-lived radioactive materials may be stored for decay in the User's facilities or transferred to RS staff for a storage and handling fee.

Putrescible material is not allowed and should not be included.

b. Criteria for Determining Material Has Decayed

1) Hold for 10 Half-Lives

Waste must be held for at least 10 half-lives prior to disposal, but in some situations this may still not be enough time to decay some high activity sources to background levels.

2) Determine Materials have Actually Decayed

The ultimate determination of decay to background levels usually comes from using a survey instrument that is appropriate for the type and energy of radiation being measured. Also, a survey will assure that no long-lived contaminants are present.

3) Alternatively – Decay to Activity Limit

Solid or liquid short half-lived wastes that cannot be readily measured with a survey instrument (like low energy beta emitters, e.g. S-35) and of known activity, must be decayed to 0.000001uCi/gram (1pCi/gram) prior to disposal.

c. Prior to Disposal of Decayed Materials into Normal Trash

1) Measurement Method

Check the radiation detection survey meter for proper operation and current calibration status prior to use. Monitor waste with the survey instrument in a low-level radiation area away from all sources of radioactive material. Remove any shielding from around the materials being surveyed. Monitor at contact on all surfaces and discard only those wastes that cannot be distinguished from background radiation.

2) Decay Calculation Method

The activity at time of disposal must be determined using appropriate decay equations or tables. Packages must be weighed to enable calculation of final concentrations of solid or liquid wastes.

3) Labels

All radionuclide labels and radiation symbols must be removed or defaced.

4) Internal Labels

Waste given to the RS staff for decay must be properly labeled on the outside, but internal labels and radiation symbols must have been removed or marked out.

d. Record Keeping

1) Required Data

Careful records must be kept of original activity, time of decay, final concentration of radionuclides, and the radiation survey prior to disposal.

2) Records Retention

You must keep these records for three years.

9. Mixed Waste

The University currently does not have a means of disposal for mixed waste. Review laboratory procedures to eliminate the production of mixed wastes. Processes that use or generate materials that could potentially become mixed wastes will not be authorized.

a. Definition

Mixed waste is radioactive waste that has a hazardous waste component.

b. Characteristics and Examples of Mixed Waste

Table 1 is a list of characteristics and examples to help you avoid generating mixed waste. Contact the RSO, 206-543-6328, to assist in researching questions concerning this issue.

Hazardous waste disposal must be consistent with the University's Hazardous Waste Program. Call 206-685-2848 for questions concerning disposal of hazardous waste.

c. Neutralization and Deactivation

In some cases, the hazardous aspect can be neutralized and/or deactivated. The generating laboratory, if appropriate, must do this process.

d. Lead

Lead in any form is not permitted in radioactive waste, since its inclusion with radioactive materials constitutes mixed waste. This includes lead

shielding.

10. Lead

Disposal - A laboratory wishing to dispose of lead must segregate it from their radioactive waste, and the RS staff will collect it at no charge.

Table 14-1
Characteristics of Hazardous Waste

Characteristic	Description	Examples
Flammable	Liquids with a flash point less than 140° Solids which spontaneously ignite in air or can ignite through friction or absorption of moisture	Methanol, xylene, other solvents Zinc dust, pyrophoric organometallic compounds
Oxidizer	Compounds which promote combustion	Potassium, permanganates, chromic acid
Corrosive	Liquid with a pH less than 2 or greater than 12.5 Solids which, when mixed with an equal part water, will form solutions with a pH less than 2 or greater than 12.5	Sulfuric acid, ammonium hydroxide Ferric Chloride
Reactive	Unstable compounds which may explode Compounds which react violently with water Compounds which may produce toxic gases when in contact with water or acids	Picric acid, perchloric acid, lead azide Metallic sodium and potassium Acetyl chloride, sodium cyanide
Toxic	High acute toxicity to mammals by ingestion, inhalation, or skin absorption (measured by median lethal doses in laboratory animals) High toxicity to fish (measured by laboratory aquatic toxicity tests) Compounds possessing high organ-specific toxicity	Phenol, mercury salts, lead, organophosphates Chromic acid, silver salts Carbon tetrachloride
Environmentally Persistent	Halogenated hydrocarbons 4-, 5-, and 6-ring polycyclic aromatic hydrocarbons	Trichlorethylene Benzo (a) pyrene, 3-methylcholanthrene

11. Uranium and Thorium Compounds

a. Separation

Uranium and thorium compounds may **not** be mixed with other radioactive waste forms.

b. Disposal

Uranium and thorium waste must be collected separately by the RS staff.

B. Records and Labeling

The University's license requires that we maintain records of inventory and control on all aspects of work with radioactive materials.

1. Waste Disposal Records

a. Radioactive Material Delivery and Usage Record (Form 160)

A Form 160 is provided with each shipment of radioactive material. Indicating the disposal methods of the radionuclide on the Form 160 and returning it to the RSO reduces your inventory. The Authorized Investigator should retain copies of these records, for at least three years, to be available for inspection and to verify disposal of inventory.

b. Disposal Log

To establish how much radioactive waste is involved in the following processes, the Authorized Investigator should maintain a log for each mode of disposal.

- 1) You may use RSO Form 150 to record how much activity is in each container. This form is optional and available from the Radiation Safety Office. Form 150-type records should be totaled to determine the approximate values for labeling the contents of each filled waste container. This information should be consistent with that on Form 160, but scrupulous correlation is not necessary.
- 2) Use RSO Form 170 to record the amount of radioactive waste released to the sewer.
- 3) You must also keep track of the amount of radioactive materials released to the atmosphere. This may be recorded on RSO Form 160.

2. Marking Packages for Collection

Packages that are full and ready for collection must be securely closed and marked or labeled to show the following information:

- Authorized Investigator's name
- Phone #
- Budget #
- Mail Box #
- Radionuclide(s)
- Total activity of each radionuclide
- Laboratory of origin

- RAM tape or label (see C.2.b. - Marking Waste Containers)

C. Other Items of Importance

1. Designation of Radioactive Waste Containers

Clearly label each waste container with a sign to indicate radioactive waste. Use the standard radiation sign or a strip of radioactive tape.

Since custodians occasionally collect radioactive waste by mistake, handmade hazard signs and handwritten messages are not adequate. Some custodians may not be able to read or interpret them correctly. Also, do not use “Laboratory Glassware” tape to secure radioactive waste boxes closed.

2. Radioactive Material Labels

a. Purpose of Labels

Do not misuse RAM labels. RAM labels are intended as a warning. Improper use of labels causes unnecessary alarm and leads to disregard for the proper warning.

b. Removal of Labels

A container that once contained radioactive material should have labels or signs removed or marked out before the container is discarded or placed in storage.

3. Security

Radioactive waste containers **should not** be placed in hallways or unsecured areas.

4. High Exposure Level Waste

a. “Hot Project” Waste

Waste from a special project that involves high radiation activity (hot project) should be sealed up immediately for early removal from the work area. Smaller packages can be used if normal packages are too large.

b. Disposition

Prior arrangements may be made to schedule the early collection of “hot” packages. However, researchers must be prepared to store it in their laboratory until collection is possible.

5. Waste Containers

Standard radioactive waste containers should be used **only** for radioactive materials.

6. Ventilation of Containers

a. Proper Ventilation

Vapor and fumes may accumulate above waste containers. Therefore, waste receptacles should be in or near a fume hood or other ventilated space.

b. Adding Waste

Partially full containers should be allowed to ventilate "down wind" when opened to add more waste.

7. Radioactive Material Waste Fees

a. Determination of Waste Fees

The Washington Utilities and Transportation Commission determines the fees for radioactive waste disposal in our state.

b. Changing Rates

In general, disposal rates can be expected to rise. Waste disposal costs fluctuate depending on market factors such as:

- 1) Broker costs.
- 2) Total disposal volumes from the entire northwest region.
- 3) Taxes.
- 4) State and waste-site license fees.

c. University Costs

The disposal prices charged to individual researchers are equal to University of Washington costs. Call the RSO for specific price information (206-543-0463).

Table 14-2
Catalog Numbers for Ordering Waste Supplies
Contact Radiation Safety For Information

#	Item	Catalog #
Section – Food Services & Janitorial Supplies		
1	LSA Box	0737042
2	Plastic Liner	0060132
3	5-Gallon Plastic Pail	0737237
4	3.5-Gallon Plastic Pail	0737240
5	Diatomaceous Earth	0737236
Section – Hardware, Electrical, Plumbing		
	Lead	6451030