

Western Michigan University

Radiation Safety

Radioactive Waste Program

Purpose

NOTE: WMU is not authorized to dispose of radioactive materials via the sanitary sewage system. The local sanitary sewage system operator would place additional requirements and constraints on WMU that do not make this a feasible option.

- A. To provide requirements for the storage and disposal of radioactive waste generated at WMU. [10CFR20.2001]
- B. To provide guidance and safe handling techniques to minimize radioactive waste generation.

Table of Contents

Section	Title	Page
I.	Responsibilities	1
II.	Definitions	1
III.	Methods for the Disposal and Storage of Radioactive Waste	1
IV.	Requirements for Handling Radioactive Waste	2
V.	Documentation of the Radioactive Waste Program	3
VI.	Final Conditions for Waste in Storage	3
VII.	Final Conditions for Waste Being Disposed	3

Appendix

- A. Process for Storing Radioactive Waste
- B. Process for Disposal of Radioactive Waste

I. Responsibilities

A. Executive Manager

1. Support the RSO and AUs in complying with the requirements of this program.

B. Radiation Safety Officer (RSO)

1. Direct/guide the waste program, including waste minimization efforts.
2. Maintain the Waste Inventory and Disposal Log.
3. Controls access, additions, and removals from the waste storage area.
4. Perform surveys as necessary.
5. Transport radioactive waste from the labs to the storage area.
6. Perform or evaluate isotopic analysis reports.
7. Determine the disposal method best suited for the type, volume, and other characteristics of radioactive waste.
8. Dispose of, or contract with a vendor the disposal of, waste as necessary.
9. Maintain the completed records required by this program.

C. Authorized User (AUs) / Radiation Workers (RWs)

1. Evaluate protocols and practices for waste minimization opportunities.
2. Perform surveys, as necessary.
3. Notify the RSO when waste containers are ready to be transported to the waste storage area.
4. Separate radioactive waste as required.

II. Definitions

Waste	An unwanted by-product of a process or product.
Specific Activity	The total radioactivity of a given nuclide per gram of substance.
Half-life	The time required for the activity of a radioactive substance to decay by 50%. Each radionuclide has a unique half-life.

III. Methods for the Disposal and Storage of Radioactive Waste

A. Authorized Methods at Western Michigan University

1. Burial in a facility licensed by the NRC. [10CFR20.2001 and 2008]
 - a. Transfer to a vendor licensed to receive waste by the Nuclear Regulatory Commission.
2. Extended Interim Storage. [10CFR20.2008 / License]
 - a. Interim storage refers to the storage of radioactive waste until shipment to a vendor for processing and/or burial.
3. Decay in Storage (DIS). [10CFR20.2001 and 2005]
 - a. Waste that is stored until considered non-radioactive and then disposed of as ordinary trash.
 - b. Only radioactive material with half-lives \leq 120 days can be considered for this method.
 - c. Waste must be stored a minimum of 10 half-lives of the longest-lived isotope identified in the waste.

- d. Waste can be disposed of as ordinary trash if it meets the following criteria.
 1. The unshielded radiation levels from all surfaces of the material are indistinguishable from background.
 2. The radiation survey is performed in a low background area.
 3. All radiation labels and markings are removed or defaced.
4. Disposal of waste as if it was not radioactive. [10CFR20.2005 / License]
 - a. Liquid scintillation fluid containing < 0.05 mCi/ml of H-3 or C-14
 - b. Animal carcasses or tissue containing < 0.05 mCi/gram of H-3 or C-14 averaged over the weight of the entire animal.

NOTE: Disposal via the sanitary sewage system is **NOT** authorized by the local sanitary sewage system operator.

5. Disposal of liquid waste into the sanitary sewerage. [10CFR20.2003]
 - a. The sewer system must be a public system.
 - b. The liquid waste must be readily soluble in water.
 - c. The monthly volume of non-radioactive water released into the sewer is known.
 - d. The quantity of licensed or other radioactive material released in one month divided by the average monthly sewage does not exceed the limits of 10 CFR 20. Appendix B, Table 3.
 1. If more than one isotope is being released, the sum of their ratios as calculated above must not exceed unity (1).
 - e. The quantity in one year of material from liquid waste must not exceed:
 1. 5 Ci H-3
 2. 1 Ci C-14
 3. 1 Ci All other isotopes combined.

B. Campus Storage Facility

1. Located to prohibit the unnecessary exposure to the general public and WMU AUs/RWs.
2. Area must remain locked except for normal egress and ingress.
3. Area must be posted in accordance with the Radiological Controls Program.
4. The area layout must be such that the integrity of the containers can be determined easily and in keeping with the ALARA concept.
5. Every container shall be appropriately marked.
6. The environmental conditions should not allow the waste in storage to be subjected to extreme temperatures, such as freezing or boiling.

IV. Requirements for Handling Radioactive Waste

A. General requirements for all Radioactive Waste.

1. Liquid and solid waste is contained separately.
2. Radioactive waste should be segregated by the isotopes' half-lives.
 - a. Less than or equal to (\leq) 120 days may be placed together.
 - b. Greater than ($>$) 120 days may be placed together.
3. The RSO will move all radioactive waste to the storage area.
4. Waste placed in storage will be logged and tracked.

5. Radiation surveys should be performed after additions to the waste containers to ensure radiation exposure levels are maintained ALARA.
6. Provide shielding for the containers as necessary to keep exposure ALARA.
7. Solid waste should be in marked bags or containers.
8. Liquid waste should be in marked suitable containers.
9. All labels/markings must be defaced or removed before disposal as non-radioactive waste. [10CFR20.1904]

B. Waste Minimization Techniques

1. Survey the area and equipment frequently.
2. Promptly wipe up minor spills.
3. Separate radioactive material from non-radioactive material, i.e. leftover reagents, boxes, etc.
4. Only allow equipment needed to perform the work to come into contact with the radioactive material.
5. Mark equipment as radioactive for reuse.
6. Review protocols for waste reduction aspects.
7. Use proper contamination control practices.

V. Documentation for the Radioactive Waste Program

- A. Waste Inventory and Disposal Log [10CFR20.2108]

VI. Final Conditions for Waste in Storage

- A. Waste is identified, marked, and in storage.
- B. The Waste Inventory and Disposal Log has been updated. [10CFR20.2108]
- C. All documentation is maintained in accordance with the Administrative Controls Program.

VII. Final Conditions for Waste Being Disposed

- A. The waste has been processed for shipment in accordance with the Transportation Program requirements and transferred to a licensed vendor for disposal.
- B. All radioactive labels and markings have been removed or defaced from waste being disposed of as ordinary trash. [10CFR20.1904]
- C. The Waste Inventory and Disposal Log has been updated and maintained in accordance with the Administrative Controls Program. [10CFR20.2108]

Appendix A Process for Storing Radioactive Waste

I. Generating Radioactive Waste

- A. The following steps will be performed by the AU or RW using the RAM:
1. Handle the waste with appropriate ALARA precautions and contamination control measures.
 2. Place the material in the appropriate container.
 - a. Separate solids from liquids, and
 - b. Long-lived (>120 days $T_{1/2}$) from short lived isotopes (≤ 120 days $T_{1/2}$).
 3. Survey the container, in accordance with the Radiological Controls Program.
 4. Evaluate the survey results.
 5. Determine if the waste container will need additional shielding and shield if necessary.
 6. Notify the RSO when the container is:
 - a. Full
 - b. ≥ 2 mR/hr 30 cm from any surface of the waste container.
 - c. ≥ 5 mR/hr on contact to any surface of the waste container.
- B. The following steps will be performed by the RSO to move waste to the central storage area:
1. Gather necessary equipment.
 2. Proceed to the lab/area where the waste is currently stored.
 3. Survey the container.
 4. Verify the container integrity is intact.
 5. Verify that the container is marked appropriately.
 - a. Isotope(s)
 - b. Lab generating the waste
 - c. Date of Addition
 - d. Comments, i.e. survey results were high and shielding was added.
 6. Transport the waste to the approved storage area.
 7. Place the waste in to the storage area.
 8. Update the Waste Inventory and Disposal Log.
 9. Survey the waste storage area.
 10. Document the results of the survey if different from last routine survey.
 11. File all paperwork.

Appendix B Process for Disposing of Radioactive Waste

NOTE: All of the steps in this Appendix will be performed by the RSO.

I. Disposal as Ordinary Trash [10CFR20.2005 / License]

NOTE: Only items that have been Decayed in Storage for a minimum of 10 Half-Lives and survey results in levels indistinguishable from background can be disposed of as ordinary trash.

NOTE: Liquid scintillation fluid containing less than 0.05 mCi/ml of H-3 or C-14 and animal carcasses or tissue containing less than 0.05 mCi/gram of H-3 or C-14 averaged over the weight of the entire animal are not consider to be radioactive and may be disposed of as ordinary trash.

A. Verify the container has been in storage for a minimum of ten half-lives from the last addition to the container.

B. Survey the container.

1. Move the container to an area of low background.
2. Survey all sides of the container.
3. Record the survey.
4. Evaluate the results of the survey.

NOTE: The disposal process STOPS, if survey readings were GREATER THAN THE BACKGROUND levels. The container and its contents are returned to storage for further evaluation.

C. Survey the contents of the container.

1. Remove the contents and survey the materials
2. Deface all markings and labels that communicate a radioactive hazard. [10CFR20.1904]
3. Dispose of the material in the ordinary trash.
4. Update the Waste Inventory and Disposal Log. [10CFR20.2008]
5. File the documentation.

II. Disposal by transfer to a licensed vendor for further processing or to a burial facility. [10CFR20.2001 and 2008]

A. Determine the containers that are to be transported for disposal.

1. Verify the contents of the container.

NOTE:	It may be necessary to perform an isotopic analysis of the contents to determine type and quantity of the container's activity.
--------------	--

2. Determine the activity of the container.

3. Survey all sides of the container.
4. Evaluate the results of the survey.

NOTE: The remaining steps are performed in conjunction with the Transportation Program Requirements.

B. Package the waste in accordance with the NRC, Department of Transportation, and Transportation Program requirements.

1. Complete the Waste Manifest.
2. Offer the waste packages to the vendor for transport to the processing facility or the burial site.
3. Update the Waste Inventory and Disposal Log. [10CFR20.2008]
4. File the documentation.

III. Disposal of liquid waste in the sanitary system.

NOTE: WMU is not authorized to dispose of radioactive materials via the sanitary sewage system. The local sanitary sewage system operator would place additional requirements and constraints on WMU that do not make this a feasible option.