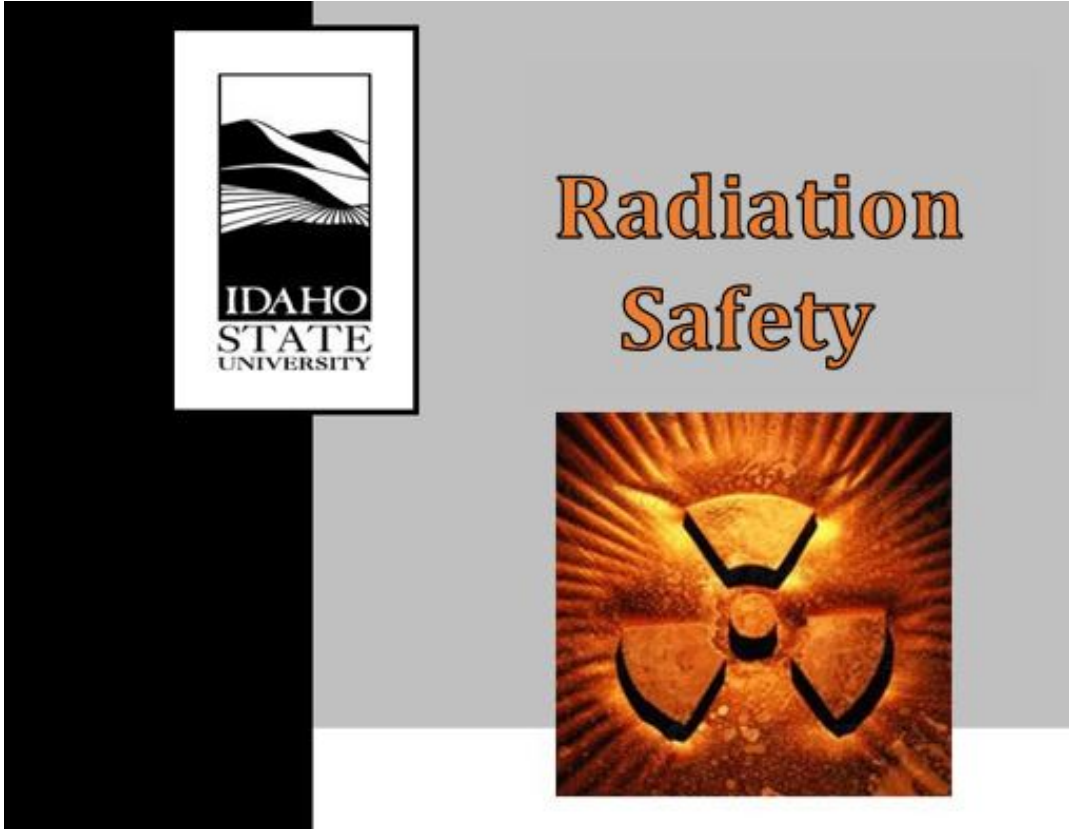


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RADIATION PROCEDURES MANUAL

Procedure Cover Sheet

Procedure Title: Radioactive Waste Management

Procedure Number: RS-09, Rev0

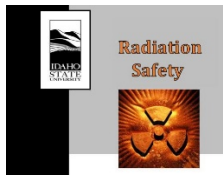
Effective Date: August 1, 2020

Reviewed By: Mason Jaussi
Assistant Radiation Safety Officer

Date: 22-Jun-2020

Approved By: John Longley
Radiation Safety Officer

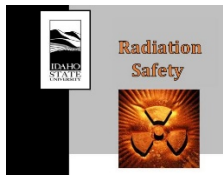
Date: 22-Jun-2020



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1. INTRODUCTION

This procedure specifies instructions for managing radioactive waste generated from ISU research and academic operations. Instructions are provided for Authorized Users and Radiation Safety Department staff who perform waste management functions. In addition, this procedure specifies instructions for managing mixed waste consisting of radioactive waste combined with hazardous waste and for managing biological waste (e.g. animal carcasses and food products) that contain radioactive material.

2. PURPOSE

The purpose of this procedure is to ensure safe and compliant management of radioactive and mixed waste at ISU facilities.

3. SCOPE

This procedure addresses the following activities:

- Waste generation, segregation, and storage at individual laboratories and facilities.
- Characterization and documentation of waste for radioactive and chemical constituents.
- Pickup, storage and tracking of radioactive waste by the Radiation Safety Department.
- Disposal of waste using the designated waste broker.
- Disposal of waste by discharge to the sanitary sewer.
- Disposal of waste as ordinary trash after decay in storage.

4. ROLES AND RESPONSIBILITIES

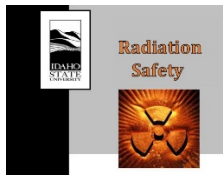
Responsibility for radioactive waste management is shared by authorized users and the Radiation Safety Department.

Authorized users are responsible for the following activities.

- Segregating radioactive waste into appropriate waste streams.
- Characterizing the waste for radioactive material content (radionuclides and activities)
- Characterizing the waste for chemical content (pH, metals, solvents, etc.)
- Documenting waste characterization on a waste tag form with sufficient attachments to justify the radiological and chemical characterization.
- Storing radioactive waste in a safe manner.
- Generating and storing mixed waste in compliance with the Hazardous Waste Management Plan and the Radiation Safety Manual.
- Requesting formal permission to generate mixed waste from the Radiation Safety Officer prior to generation.
- Contacting the Radiation Safety Department when radioactive waste is ready for pickup.

The Radiation Safety Department is responsible for the following activities.

- Picking up waste from generators and transferring it to the waste storage facility.



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- Tracking the radioactive material content of waste materials in the HPAssist database.
- Storing radioactive waste materials in the waste storage facility.
- Transferring waste to the designated waste broker including the following actions.
 - Maintaining licenses and permits for disposal of waste at the US Ecology site in Richland Washington.
 - Preparing waste profiles for the designated waste broker.
 - Reviewing and signing waste manifests and shipping documents.
- Discharging aqueous liquid waste to the sanitary sewer in accordance with NRC requirements and the City of Pocatello discharge permit.
- Storing waste for decay in accordance with NRC requirements.
- Assisting Authorized Users with waste characterization using gamma spectroscopy or sampling and analysis.

5. REQUIRED MATERIAL(S)

The following materials are used by Authorized Users generating waste.

- White plastic radioactive waste containers issued by the Radiation Safety Department.
- Clear plastic liners provided by the Radiation Safety Department.
- Secondary containment trays for liquids.
- Waste tag forms or spreadsheets.
- Strong screw top containers for liquid waste.

The following materials are used by the Radiation Safety Department.

- 55-gallon drums (1A2 and Type A), 1H2 plastic buckets, 1H1 carboys.
- Clear plastic drum liners and waste can liners.
- Secondary containment trays for liquids.
- Scale for weighing containers.
- Drum handling equipment (hand trucks, pallet jacks, etc.)
- Labels (Caution Radioactive Material, Radioactive Waste Labels, etc.)

6. PROCEDURE

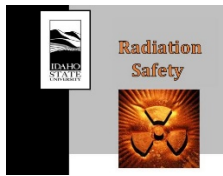
6.1. Waste Generation (Authorized Users)

Authorized Users must complete the following actions to properly generate radioactive waste. For routine PPE waste, if the material does not have detectable radioactive material by frisking with a GM detector and does not have known H-3 contamination, it may be disposed in the ordinary trash.

6.1.1. Segregate Radioactive Waste

Authorized Users shall segregate their radioactive waste into the following waste streams.

- Dry active waste is general solid radioactive waste. Liquids, hazardous waste (40 CFR 261), biological materials and sources greater than 100 μ Ci are prohibited from this



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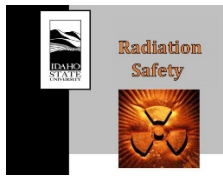
waste stream. Ensure all sharps are contained in puncture proof containers to protect personnel handling the waste.

- Aqueous liquid waste is water based liquid with radionuclides but no hazardous waste and pH greater than 2 and less than 12.5.
- Liquid scintillation waste with non-hazardous fluid containing only H-3 and C-14 with activity concentration less than or equal to 0.05 $\mu\text{Ci/g}$.
- Liquid scintillation waste with non-hazardous fluid and other radionuclides or H-3 and C-14 with activity concentration greater than 0.05 $\mu\text{Ci/g}$.
- Animal carcasses with only H-3 and C-14 with activity concentration less than or equal to 0.05 $\mu\text{Ci/g}$.
- Biological waste includes milk, food products, and carcasses not described above.
- Sources with activity greater than 100 μCi . If the source is tracked by mass the Authorized User will convert to activity to comply with this requirement. Specific activity values are available in 49 CFR 173.435. Sources greater than 100 μCi require stabilization at the waste disposal facility to meet waste classification requirements.
- Radioactive waste containing radionuclides with half-lives less than 120 days. Solids should be separated from liquids and these waste materials should be segregated from longer lived radioactive materials. Ensure no radioactive labels or markings are present in the waste. These wastes can be disposed by decay in storage by the Radiation Safety Department.
- Mixed waste is waste that contains radioactive material and hazardous waste. Common materials that are often hazardous waste include toxic metals (As, Ba, Cd, Cr, Pb, Hg, Se, and Ag), acids and bases, certain organic solvents, flammable liquids, and water reactive materials. Full definitions are given in 40 CFR 261. If waste contains unusual chemicals or you have questions regarding potential hazardous waste contact the RSO or Environmental Programs Manager in the EHS Department.
- Other wastes by written permission from the RSO.
- Greater than Class C (10 CFR 61.55) wastes may not be generated in any circumstances.

6.1.2. Waste Characterization and Documentation

Authorized users must determine and document the radioactive and chemical content of their waste.

- 6.1.2.1. Record all additions to waste containers on a Waste Addition Log Form (Available on Radiation Safety website <https://www.isu.edu/ehs/radiation-safety/>). For routine waste, the description can be generic (e.g. PPE, plastic, wipes, decon debris, etc). The Radiation Safety Department uses this information to verify the waste is in the proper waste stream and will meet the requirements of the disposal facilities.
- 6.1.2.2. Determine the radioactive content by knowledge of your operation and the material used. If the material does not have known activity, such as



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activated metals, contact the Radiation Safety Department for assistance with characterization.

6.1.2.3. Determine the chemical content of your waste by knowledge of the materials used in your operation. Common chemicals that may cause waste to be hazardous are listed below. See the Hazardous Waste Manual and 40 CFR 261 for more information.

- Toxic metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)
- Acids and bases (pH < 2 or > 12.5)
- Flammable liquids
- Reactive chemicals
- Organic solvents

6.1.2.4. Once a waste item (e.g. bag of solid waste taped closed, carboy of liquid waste, group of sources, etc.) is complete, fill out the waste tag form to document the waste characterization. Attach supporting documents (source certificates, waste addition logs, etc.) as necessary to give complete information. Note all applicable HPAssist numbers on the waste tag or in the supporting information.

6.1.3. Waste Storage

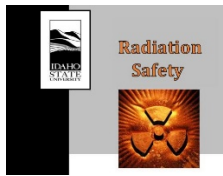
6.1.3.1. Store dry active waste in waste containers and clear plastic bags provided by the Radiation Safety Department. When bags are full tape the bag closed and contact the Radiation Safety Department for pick up as specified in Step [6.1.5](#) below.

6.1.3.2. For liquid wastes store in strong containers with screw top lids. Containers must be less than 4 liters for glass and less than 20 liters for plastic and metal. All liquid containers must be stored in secondary containment to capture the liquid if the primary container leaks.

6.1.3.3. Mixed waste must be stored and labeled in accordance with the ISU Hazardous Waste Management Plan (<https://www.isu.edu/media/libraries/research/ehs/plan-documents/hazardous-waste-management-plan/ENV-HW-Hazardous-Waste-Management-Plan.pdf>). Requirements differ for main campus locations and very small quantity generator locations.

6.1.4. Permission to Generate Mixed Waste

Contact the Radiation Safety Officer to obtain written approval prior to generating mixed waste. This is necessary to ensure no waste is generated unless a specific disposal pathway exists and is required in the ISU Broad Scope license 11-27380-01.



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6.1.5. Schedule Pick Up of Waste

Once the waste item is ready for pickup, scan or electronically transfer the waste tag form and supporting information to the Radiation Safety Department. They will review the information and schedule a time to pick up the waste. For mixed waste, the waste may need to remain at the generator location until a shipment is scheduled because the Radiation Safety Department is not authorized to store hazardous waste for more than 90 days at their waste storage facility.

6.2. Waste Operations (Radiation Safety Department)

6.2.1. Picking Up Waste

6.2.1.1. Radiation Safety Department staff members will review the information submitted by the Authorized User to ensure it is complete and that characterization information is accurate. They also will determine if the waste is regulated for transportation and identify the appropriate storage location for the waste.

6.2.1.2. Radiation Safety Department staff members will enter the waste tag in HPAssist and virtually dispose all HPAssist items associated with the waste tag. See procedure RS-16, Radioactive Material Inventory.

6.2.1.3. Radiation Safety Department technicians will collect the waste from the authorized user laboratory and move it to the radioactive waste storage facility. This may involve hand carrying the waste or moving it in a state vehicle as directed by the staff member. In some cases, waste may be stored at the Authorized User facility.

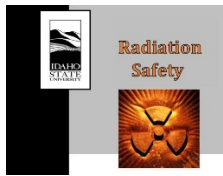
6.2.1.4. The technician will record their name, the acceptance date, and the storage location (TAA 1 or TAA 2) or container number on the bottom of the waste tag. If the waste is placed in a container, the technician will add the waste tag number to the Waste Addition Log for the container.

6.2.2. Disposing Waste Using the Waste Broker

6.2.2.1. Radiation Safety Department staff members will complete paperwork necessary to obtain the State of Washington Use Permit, to pay the US Ecology site use fee, and to complete the US Ecology annual volume projection each year.

6.2.2.2. Radiation Safety Department staff members will contact the waste broker to schedule the waste shipment, typically in May or June of each year.

6.2.2.3. Radiation Safety Department personnel will package waste into appropriate containers based upon characterization information. Some containers may already be packaged at Authorized User facilities. See packaging instructions for certain waste streams in Appendix A. The hierarchy of packaging for solid radioactive materials is listed below.



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- Non-regulated in general design package 49 CFR 173.410 or higher.
- Excepted package (UN2910, UN2911, etc.) in general design package or higher.
- LSA-I exclusive use in a general design package or higher.
- LSA-II exclusive use in a general design package or higher.
- Type A package for non-LSA material (e.g. sources) in a DOT-7A Type A container.
- Non Class 7 material in an appropriate lab pack (49 CFR 173.412(b)) or packaging for the applicable hazard class.

6.2.2.4. Radiation Safety Department staff members will complete the waste broker profile form and transfer it and any supporting information to the waste broker at least one month prior to the proposed shipping date.

6.2.2.5. Radiation Safety Department staff members will review the waste manifest forms 540 and 541 and any Uniform Hazardous Waste Manifest forms generated by the waste broker and make a list of required markings and labels for each package.

6.2.2.6. On the day of shipment, a Radiation Safety staff member will verify all markings and labeling applied to containers by the waste broker based on the list from above and the waste manifest forms.

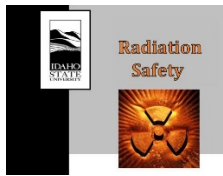
6.2.2.7. On the day of shipment, a Radiation Safety Staff Member with appropriate transportation training will sign all of the waste manifest forms and make copies for records. Note: the staff member must be trained for mixed waste shipment in order to sign a Uniform Hazardous Waste Manifest or a low-level waste manifest with subsidiary hazard classes.

6.2.3. Discharging Waste to the Sanitary Sewer

6.2.3.1. Radiation Safety Department staff members will verify that the waste material is readily soluble and will complete the RPR 54J spreadsheet to evaluate the radioactive content against the NRC and Pocatello limits. If there have been more than three discharges in the calendar year, copy the latest discharge tab to a new tab and update the summation formulas in the Annual Discharge to Date (μCi) column. After entering the data, the staff member will sign the form as prepared by.

6.2.3.2. A second Radiation Safety staff member will review the form to verify that all meets limits cells are Y and will sign the form as approved by.

6.2.3.3. A Radiation Safety Department technician will discharge the material to the sewer typically in the fume hood sink in Room 102 of the Physical Sciences



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Building. The technician will sign as disposed by and will scan the final form into the box folder under Sewage Disposal (240).

6.2.3.4. The technician will perform a daily use survey of the sink and immediate work area and document it in the lab logbook.

6.2.4. Disposing Waste by Decay in Storage

6.2.4.1. A Radiation Safety Department staff member will evaluate the waste tag by entering the data in the Decay in Storage spreadsheet and will thus determine the date when the activity will have decayed to less than 0.1 μCi .

6.2.4.2. On the date when the activity has decayed, a Radiation Safety Department technician will survey the waste item with the instrument recommended by the staff member on the lowest scale and will document the survey.

6.2.4.3. A radiation safety staff member will write a memo authorizing disposal of the material and will attach the spreadsheet and the waste survey. The memo will be saved in Box under Radioactive Waste Disposal (280)\Radioactive Waste Decay in Storage.

6.2.4.4. A radiation safety technician will dispose the waste material as ordinary trash in a dumpster.

6.2.5. Performing Waste Characterization Measurements

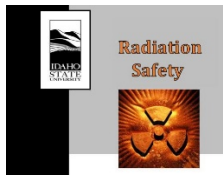
The Radiation Safety Department can assist Authorized Users with waste characterization for materials that cannot be characterized by process knowledge such as activated materials or legacy materials. Characterization measurements performed by the Radiation Safety Department include gamma spectroscopy measurements, sampling of liquid materials for analysis by liquid scintillation, and sampling materials for analysis at off-site analytical laboratories.

6.2.5.1. Perform the following steps to collect a sample of aqueous liquids.

- For aqueous liquids, collect 4 ml of liquid and 16 ml of Ecoscint A.
- Create a background sample using 4 ml of tap water and 16 ml of Ecoscint A.
- Analyze the samples on the Radiation Safety Department liquid scintillation counter using protocol 6 (30 minute count time and two beta windows).

6.2.5.2. Perform the following steps to collect a sample of oils.

- For oils, collect 4 ml of liquid and 16 ml of Ultima Gold LLT (from the EML).
- Create a background sample using 4 ml of clean oil and 16 ml of Ultima Gold LLT.
- Analyze the samples on the Radiation Safety Department liquid scintillation counter using protocol 6.



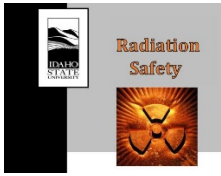
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6.2.5.3. Perform the following steps to measure a waste item by gamma spectroscopy

- Tape Cs-137 source 124840 on the top front of the ORTEC Detective with front edge at the bevel and lettering up.
- Select Advanced/Calibrate from the main menu.
- Adjust energy calibration as necessary and note the adjustment in the project log.
- Select Identify and let the instrument count for 600 seconds.
- Press pause and then save.
- Record the source check count in the project log.
- Count the waste item as directed by the radiation safety staff member.
- For drums, standard counting conditions are two feet from the center of the drum for one hour. Pause every 15 minutes and rotate the drum 90°.
- Record the waste count in the project log. Note count time and counting geometry.
- Move the waste item away from the detector. Count background for the same time as the waste item with the detector in the same position.
- Record the background count with count time in the project log.
- For carboys, the standard count distance is one foot from the center of the carboy and the standard count time is 30 minutes.
- For other waste items, count as directed by the radiation safety staff member.

6.2.5.4. Perform the following steps to analyze the gamma spectroscopy measurement.

- Develop a MicroShield model for the count geometry and waste contents. Standard models are available for drums with compactable waste and carboys with liquids. Use standard energy points and 1 Bq source term.
- Analyze the measurement control Cs-137 check and enter the data in the control chart spreadsheet. If the measurement is beyond three sigma, the measurements will have to be repeated.
- Analyze the gamma spectrum after subtracting the background spectrum live time normalized to determine net counts in peaks of interest.
- Enter the waste item, file name for the gamma spec measurement, the live time, and the Microshield unattenuated fluence rate in the gamma spectroscopy spreadsheet. Enter the Nuclide, energy, yield (from decay data



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search), and net counts in the spreadsheet. Activity results will be given in the uniform source estimated activity (Ci) column.

- Save the spreadsheet file on Box under current radioactive waste for the container or waste tag.

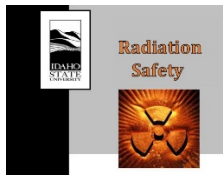
7. LIST OF FORMS

Waste Tag

Waste Addition Log

Sewer Discharge Spreadsheet

Decay in Storage Spreadsheet



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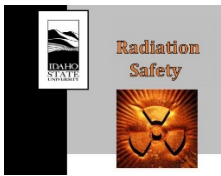
Appendix A - Waste Packaging Instructions

LSC Vial Waste

- Place a clear drum liner in the waste drum and tape the edge to the side of the drum.
- Place approximately four inches of vermiculite in the waste liner.
- Place a second liner in the drum and tape to the side of the drum.
- Place LSC vials in the drum until full. Record waste tag numbers on the Waste Addition Log.
- When drum is full, tape the two liners closed and close the drum according to the manufacturer instructions.
- Scan the waste addition log into the container folder on Box under Current Radioactive Waste.

Lab Pack Containers

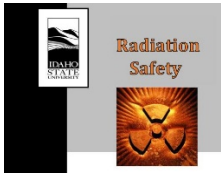
- Ensure the waste drum is rated for liquids. It will have a UN identifier line like UN1A2/X 1.5/ 400/ 19/ USA/ LM000 where 1.5 is the specific gravity and 400 is the maximum gross mass in kilograms. There will probably be a second line in the form UN1A2 /X 400/S/ 19/ USA/ LM000 where S indicates solids. If only one line is present and it contains S, the drum is not rated for liquids.
- Place a clear drum liner in the waste drum and tape the edge to the side of the drum.
- Place approximately four inches of vermiculite in the waste liner.
- Ensure all liquid waste materials are in strong containers with screw top lids.
- Ensure all liquid waste containers are in the same hazard class and are compatible (e.g Class 8 for corrosive acids)
- Tape each liquid waste container closed.
- Place a layer of liquid containers in the drum.
- Surround the liquid containers with vermiculite and cover with another four inch layer.
- Repeat the process until the drum is full.
- Tape the liner closed and close the drum according to the manufacturer instructions.
- Scan the waste addition log into the container folder on Box under Current Radioactive Waste.



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Solid Radioactive Waste in Drums

- Place a clear drum liner in the waste drum and tape the edge to the side of the drum.
- Load solid waste until the drum is full. Record all items and waste tags on the waste addition log.
- When the drum is full, tape the liner closed and close the drum according to the manufacturer instructions.
- Scan the waste addition log into the container folder on Box under Current Radioactive Waste.



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Example Forms

CAUTION - RADIOACTIVE WASTE

ONLY ONE MATERIAL CATEGORY ALLOWED PER PACKAGE!
KEEP LEAD CONTAINERS SEPARATE FROM WASTES!

1957

- DRY, SOLID WASTE
- SHARPS (NEEDLES, PIPETS, ETC.)
- ANIMAL OR OTHER BIOLOGICAL WASTE
- NON-HAZARDOUS, NON-TOXIC AQUEOUS LIQUID
- FLAMMABLE, HAZARDOUS OR TOXIC LIQUID
- OTHER MATERIALS

FOR LIQUIDS:

Circle vial size:

Mini Standard

Bulk Liquids:

_____ Gallons

DESCRIBE MATERIAL - give names of chemicals and fluors:

If any constituent is a "HAZARDOUS MATERIAL",
i.e. ignitable, corrosive, reactive or toxic (40 CFR 261),
complete and attach a HAZARDOUS MATERIAL DISPOSAL REQUEST.

NUCLIDES

ACTIVITY

CHECK ONE CATEGORY:

- H-3 and/or C-14
- Half-life <65 days
- Other BETA-GAMMA Emitters
- ALPHA Emitters or Mass>204

**DOES THIS PACKAGE CONTAIN ANY
"RADIOACTIVE MATERIAL" LABELS?**

Circle one: Yes No

WASTE GENERATOR CERTIFIES THAT THE CONTENTS ARE DESCRIBED ACCURATELY!

Responsible User (Waste Generator): _____

Prepared by: _____

Ready/Call-in Date: _____

TECHNICAL SAFETY OFFICE USE ONLY:

Accepted by: _____

Acceptance Date: _____

Storage Location: _____

Inv #: _____

Dry Waste Prepackaged drum

Assay Date: _____

Absorbed Biostabilized

Process Date: _____

Container #: _____

Released Liquid Released Solid Other

Exposure rate at contact: _____ mrem/hr

Disposal Date: _____

By: _____

RPR 13E (2/92)

RPR 54J SEWAGE DISPOSAL PERMIT					
CALENDAR YEAR					
	Discharge Date				
	Waste Tag No.				
	Volume (ml)				
	Soluble or dispersible biological material (Y/N)				
Waste Tague Evaluation					
Nuclide	Activity (uCi)	Concentration (uCi/ml)	Pocatello Concentration Limit (uCi/ml)	Concentration Fraction	
H-3			1.00E-02		
C-14			3.00E-04		
Waste Tag Total				0.00E+00	
Meets Pocatello License (Y/N)			Y		
Annual Discharge Summary					
Nuclide	Annual Limit (uCi)	Annual Discharge to Date (uCi)	Annual Fraction	Meets 10 CFR 20.2003(a)(4)	
H-3	5.00E+06	0.00E+00	0.00E+00	Y	
C-14	1.00E+06	0.00E+00	0.00E+00	Y	
Other	1.00E+06	0.00E+00	0.00E+00	Y	
	Print		Signature		Date
Prepared By					
Approved By					
Disposed By					

	A	B	C	D	E	F	G	H
1	Decay in Storage							
2								
3		Waste Tag Number						
4								
5		Permit Number						
6								
7	Nuclide	T1/2 (d)	Start Date	Start Act (uCi)	Decay Time (d)	Disposal Date		
8								
9								
10		Activity Limit for Exempt Consignment (uCi)						
11		Exempt Quantity (uCi)						
12		Labeling threshold (uCi)						
13								
14	Instructions:							
15	Enter Waste Tag and Permit Numbers							
16	Enter Nuclide							
17	Enter Start Date							
18	Enter Start Activity							
19	ALEC, Exempt Quantity, and Labeling Threshold are given to assist in labeling and inventory.							