

Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous, Radioactive, and Mixed Wastes at Berkeley Lab

Environment, Health and Safety Division
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Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous, Radioactive, and Mixed Wastes at Berkeley Lab

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May 15, 1996

TO: Berkeley Lab Employees
FROM: Charles V. Shank, Director
RE: Training for Generators of Hazardous Waste

The Berkeley Lab is committed to responsible management of hazardous and/or radioactive waste, and it is imperative that all waste generators be properly trained in the complexities of waste handling to assure that we comply with environmental laws and regulations.

The first step in waste disposal is to accurately and completely characterize our hazardous/radioactive waste. Waste that does not meet Berkeley Lab's waste acceptance criteria will not be accepted by the Hazardous Waste Handling Facility until it does. The main responsibility for characterizing this waste rests with the generator, who has the process knowledge appropriate for this task. When full confidence in process knowledge is not present the generator has an obligation to arrange for chemical analysis of the waste in question.

I further urge all generators of hazardous waste or effluents to work to reduce the generation of such materials through source reduction and other pollution prevention methodologies. In addition to supporting the above policy, such source reduction helps avoid future liability for waste disposal site cleanup. Another benefit of pollution prevention is to reduce waste management costs, which comprise a significant percentage of our EM program dollars.

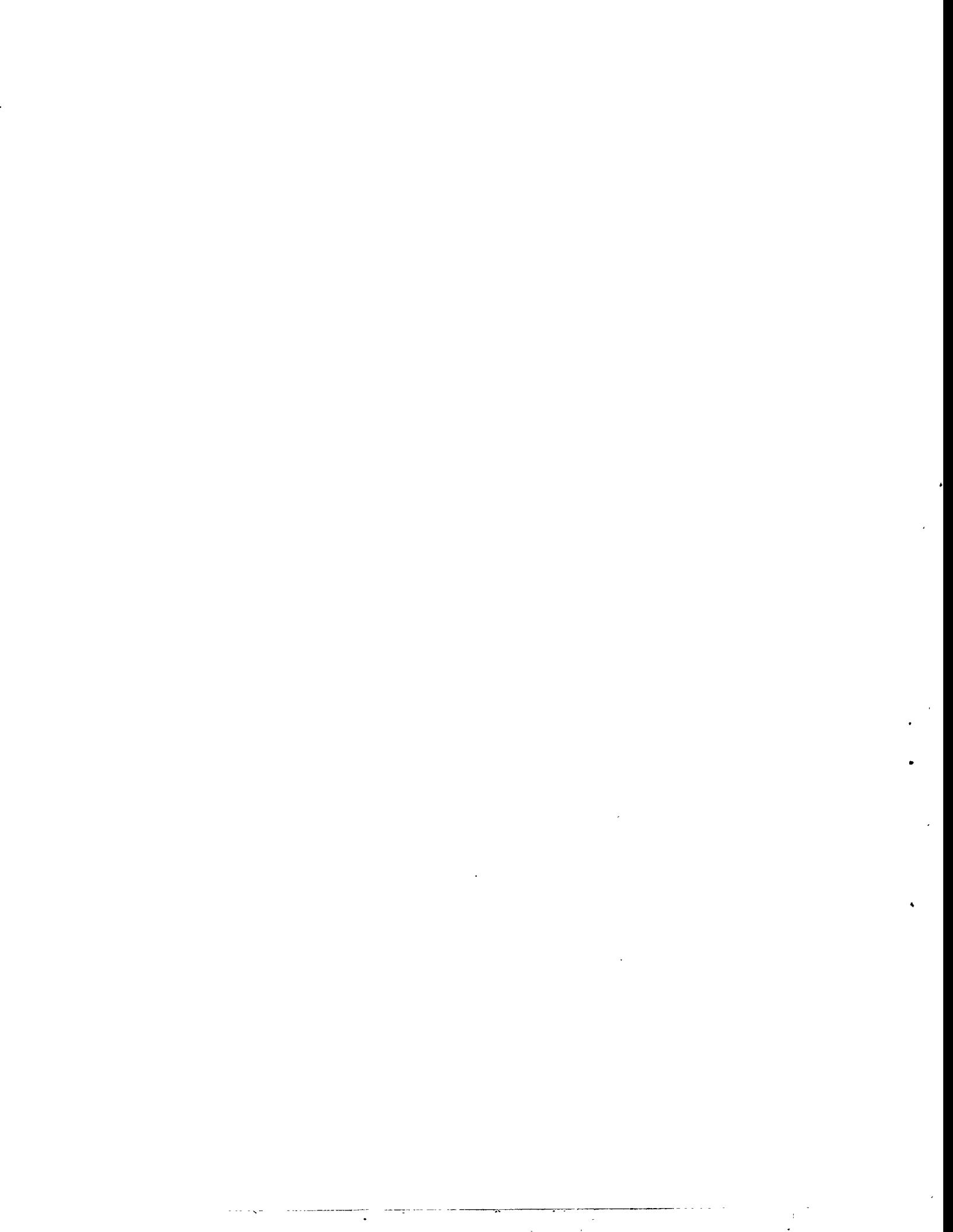
The Environment, Health & Safety (EH&S) Division has the responsibility of ensuring the waste has been properly characterized before accepting it for disposal, treatment or storage and for providing the generator with regulatory guidance. EH&S is also responsible for ensuring an appropriate level of quality assurance analysis is in place for Laboratory waste streams.

Responsible management of hazardous wastes is the responsibility of ALL generators. The attached Hazardous Waste Generator Guides, when used in conjunction with the required training, outline how to execute that responsibility.

Sincerely,



Charles V. Shank
Director



Contents

Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab

1. Introduction.....	Haz-1
2. Minimization of Hazardous Waste.....	Haz-5
3. Hazardous Waste Characterization.....	Haz-7
4. Guidelines for SAA Operation	Haz-9
5. Hazardous Waste Containers and Other SAA Items.....	Haz-11
6. Segregation of Incompatible Wastes.....	Haz-13
7. Separation of Incompatible Wastes.....	Haz-14
8. Labeling.....	Haz-15
9. Requesting Hazardous Waste Pickup	Haz-18
10. Compressed Gases and Pressurized Liquids.....	Haz-24
11. Empty Containers.....	Haz-25
12. Spill Cleanup and Reporting.....	Haz-26
13. Berkeley Lab Chemical Exchange Program.....	Haz-27
14. Closing Out an SAA	Haz-28

Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab

1. Introduction.....	Rad-1
2. Minimization of Radioactive Waste.....	Rad-4
3. Radioactive Waste Characterization.....	Rad-5
4. Segregation of Radioactive Wastes.....	Rad-9
5. Labeling of Radioactive Waste Containers	Rad-10
6. Guidelines for Radioactive Waste Accumulation.....	Rad-16
7. Requesting Radioactive Waste Pickup	Rad-17
8. Guidelines for Specific Radioactive Waste Streams.....	Rad-18

Guidelines for Generators to Meet HWHF Acceptance Requirements for Mixed Wastes at Berkeley Lab

1. Introduction.....	Mix-1
2. Mixed Waste Minimization	Mix-4
3. Mixed Waste Characterization.....	Mix-5
4. Segregation of Mixed Wastes.....	Mix-6
5. Separation of Mixed Wastes	Mix-6
6. Guidelines for Mixed Waste Accumulation.....	Mix-7
7. Mixed Waste Labeling	Mix-9
8. Requesting Mixed Waste Pickup	Mix-9

Appendices

Appendix 1. Additional Information for Berkeley Lab Waste Generators.....	App-1
A. Federal and State of California Toxicity Characteristics.....	App-1
B. Listed Hazardous Chemicals	App-4
C. List of Extremely Hazardous Chemicals.....	App-27
D. Chemical Compatibility Guide	App-35
Appendix 2. Waste Acceptance Criteria for Certification Team Review of	App-38
Radioactive Waste Tag Information	
Appendix 3. Abbreviations and Acronyms.....	App-39
Appendix 4. Definitions.....	App-40
Appendix 5. Compliance Framework for Waste Accumulation at Generator Sites ...	App-44
Appendix 6. Governing Documents and References.....	App-50

Figures

Hazardous Waste

Figure H-1. Flowchart for Hazardous Waste Management at Berkeley Lab.....	Haz-2
Figure H-2. Satellite Accumulation Area sign.....	Haz-9
Figure H-3. Hazardous Waste Label.....	Haz-16
Figure H-4. Hazardous Waste Accumulation Log	Haz-17
Figure H-5. Hazardous Waste Disposal Requisition	Haz-20
Figure H-6. RMA Waste Certification form.....	Haz-22
Figure H-7. Laboratory Waste Analysis Request form	Haz-23
Figure H-8. Process used for empty container disposal.....	Haz-25

Radioactive Waste

Figure R-1. Flowchart for Radioactive and Mixed Waste Management	Rad-2
at Berkeley Lab	
Figure R-2. Sample LBNL Daily Use Log (RWA Program).....	Rad-6
Figure R-3. Radioactive Waste Tag	Rad-11
Figure R-4. Radioactive Waste Tag Continuation Sheet.....	Rad-13
Figure R-5. Radioactive Waste Accumulation Log	Rad-15
Figure R-6. Radioactive/Mixed Waste Disposal Requisition.....	Rad-17

Mixed Waste

Figure M-1. Flowchart for Radioactive and Mixed Waste Management	Mix-2
at Berkeley Lab	
Figure M-2. Mixed Waste Satellite Accumulation Area (MWSAA) Sign	Mix-8
Figure M-3. Mixed Waste Accumulation Log	Mix-10
Figure M-4. Radioactive Waste Tag (front) filled out for mixed waste	Mix-11

Tables

Hazardous Waste

Table H-1. Approved Containers for Use in Satellite Accumulation Areas.....	Haz-11
Table H-2. Satellite Accumulation Area Materials and Equipment.....	Haz-12

Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab

1. Introduction

This document provides performance standards that you, as a generator of hazardous chemical waste at the Berkeley Lab, must manage your waste to

- protect Berkeley Lab staff and the environment,
- comply with hazardous waste regulations and ensure the continued safe operation of your workplace,
- have your waste transferred to the Hazardous Waste Handling Facility (HWHF), and
- enable the Environment, Health and Safety (EH&S) Division to properly pick up, manage, and ultimately send your waste off site for recycling, treatment, or disposal.

Figure H-1 is a flowchart that shows how hazardous waste is managed at Berkeley Lab.

If you use hazardous chemicals and generate hazardous wastes, you must establish a Satellite Accumulation Area (SAA) and follow the guidelines in this section of this document. Much of the information in this section also applies to hazardous waste that is accumulated in a Waste Accumulation Area (WAA); supplemental guidelines for WAA operation can be found in PUB-3093, *Guidelines for Waste Accumulation Areas (WAAs)* (see latest revision). To determine the most recent edition of PUB-3093 or any other document referenced in this manual, contact your EH&S Generator Assistance specialist.

The information in this section also applies to your operations if you generate mixed waste; i.e., waste that is both hazardous and radioactive. For more information on mixed waste management, see "Guidelines for Generators to Meet HWHF Acceptance Requirements for Mixed Wastes at Berkeley Lab" (part of this booklet).

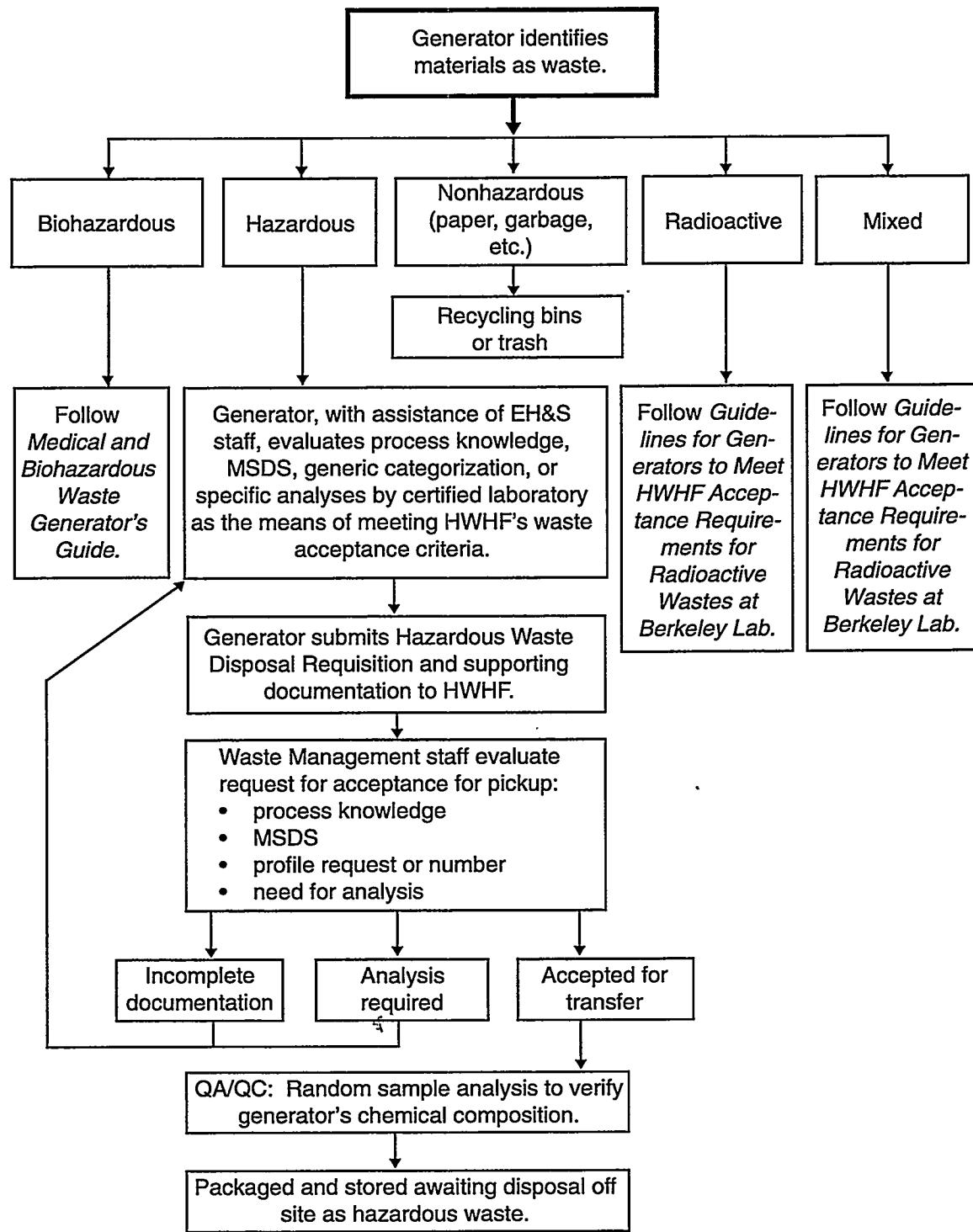


Figure H-1. Flowchart for hazardous waste management at Berkeley Lab

The performance standards in this section do not apply to

- radioactive wastes that are otherwise nonhazardous. For more information on radioactive waste management, see "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab" (part of this booklet).
- purely medical and biohazardous wastes. For information on proper management of medical and biohazardous wastes, see PUB-3095, *Medical and Biohazardous Waste Generator's Guide* (for the latest revision, contact your EH&S Generator Assistance specialist).

What Is a Hazardous Waste?

Hazardous waste is defined by both federal and state regulations. Waste falls into two regulatory categories: characteristic and listed. Regulatory designation of chemical components of waste as "characteristic" is based on specific hazardous properties, which may depend on their concentrations. (pH is a good example.) "Listed" waste is derived from chemicals that are specifically listed in the regulations (see last paragraph in this section).

The following general guidelines describe some of the more common characteristics of hazardous waste. If your waste has any of these characteristics, it is regulated and must be handled as hazardous waste.

Characteristics of Hazardous Waste

Under federal and state law, the four characteristics of a hazardous waste are

- **Ignitability.** A waste is classified as ignitable if it is
 - a liquid with a flash point of less than 140°F,
 - a solid that can ignite spontaneously through the absorption of moisture or through friction, or
 - any flammable gas or any oxidizer.
- **Corrosivity.** A waste is classified as a corrosive if it has a pH ≤ 2 or ≥ 12.5 . This applies to aqueous wastes as well as nonaqueous wastes that produce a solution with these pH values when mixed with an equivalent weight of water. Nonaqueous waste with an acid component and no designation of pH does not meet HWHF Acceptance Requirements.
- **Reactivity.** A waste is classified as reactive if it is
 - unstable or explosive,
 - reacts readily with water, or

- generates toxic vapors when mixed with water. For example, wastes with certain concentrations of cyanides or sulfides are regulated as hazardous based on generation of toxic vapors when mixed with water.
- **Toxicity.** A waste is classified as toxic if it poses a hazard to human health or the environment because of
 - carcinogenicity,
 - acute or chronic toxicity,
 - bioaccumulative properties, or
 - persistence in the environment.

For example, wastes with certain concentrations of heavy metals or solvents are toxic.

Listed Hazardous Waste

Although your waste may not exhibit any of the four characteristics listed above, it may be hazardous because one or more of the constituents is specifically listed in federal or state regulations (see Appendix 1). There are many chemicals and mixtures of chemical compounds on these lists that could cause your waste to be classified as hazardous, depending on how they are used. For example, if a "listed" chemical is a participant in a chemical reaction, i.e. a reactant, then the presence of that chemical in the byproduct of the reaction (waste) does not force designation of the waste as hazardous because of the listing. On the other hand, use of "listed" chemicals as solvents for reactants or as cleaning agents dictates designation of the waste as hazardous. Interpretation of the regulations has limited the treatment options, and thereby disposal options, for "listed" waste. Once a "listed" chemical used as a solvent enters a waste stream, it may carry that designation no matter what the fate of the original listed molecule. Furthermore, anything coming in contact with that waste (paper, column packing material, pipet tips), no matter what the final concentration, may also be designated as hazardous.

Avoiding "listed" chemicals is a good way to enhance waste minimization opportunities. For example, substituting ethanol for methanol in many chemical processes might cost more initially, but it could greatly reduce the complications and costs associated with disposal.

If, after reading this section, you are still unsure whether your waste is hazardous, contact your EH&S Generator Assistance specialist for assistance.

2. Minimization of Hazardous Waste

As a generator of hazardous waste at Berkeley Lab, you must develop and implement waste minimization techniques in your research or support activities. Berkeley Lab is required by federal and state laws enforced by various agencies, and is encouraged by the citizens and government of the City of Berkeley, to maintain an active waste minimization program. The Laboratory's success in this area depends on the contributions of all hazardous waste generators at the Laboratory.

The DOE office that currently supports hazardous waste management at Berkeley Lab (EM, or Environmental Management) will be re-engineered in the next few years. One component of the effort will be to return hazardous waste management costs to the waste-generating organization (principally ER, or Energy Research at Berkeley Lab). To help prepare for this transition, Berkeley Lab is committed to meeting specific waste minimization goals. To increase awareness of the need for minimization, the Waste Management Group will track disposal costs by account number and periodically inform you of the volume and estimated disposal cost of your hazardous waste. These estimated waste management and disposal costs will also be summarized for each Division to facilitate line management participation in waste minimization. In addition, your EH&S Generator Assistance specialist can provide specific advice and information on ways to reduce the volumes, quantities, and the costs of managing hazardous waste streams.

The major underlying principle of waste minimization is that it makes far more sense not to produce waste in the first place than to develop systems to ensure that generated waste is managed in an environmentally safe manner. What can you do personally? For example, by using chemicals that are not "listed" or by doing your part to reduce the generation of waste, you can help to use materials more effectively, improve the protection of your staff in the workplace, and reduce the impact on the public and the environment. Waste reduction at the source is an economically sensible approach in which you, as a generator, can directly help lower waste management and compliance costs, liabilities, and risks.

The following list highlights some of the things you can do to minimize the amount of hazardous waste you generate at Berkeley Lab:

- Take precautions to prevent contamination of nonhazardous materials with hazardous materials or waste.
- Centralize purchasing of chemicals through one person within your laboratory and purchase chemicals in the smallest quantities needed.
- Rigorously evaluate research procedures to identify less hazardous or nonhazardous reagents that are just as effective for your purposes. In particular, review the use of highly toxic, reactive, carcinogenic, or mutagenic materials to determine if safer alternatives could be used.
- Consider the quantity and type of waste produced when selecting new equipment, and investigate equipment that enables the use of procedures that produce less waste.

- Review your procedures at least annually to see if quantities of chemicals and/or chemical waste could be reduced.
- When researching a new or alternative procedure, consider the amount and type of waste produced as a factor. For example, practice microscale laboratory techniques whenever possible.
- Use secondary containment, such as dishpans, under bottles of chemicals to minimize the potential waste generated as a result of spills.
- When testing experimental products for private companies, request only the amount needed for research.
- Substitute red liquid (alcohol) thermometers (range up to 150°C) or digital thermometers for mercury thermometers where practicable.
- Substitute biodegradable water-based liquid scintillation fluid for solvent-based fluid, and reduce liquid scintillation fluid volume by using smaller vials.
- Substitute biodegradable water-based solvents for xylene / toluene used in cell preparation and tissue processing.
- Segregate halogenated from nonhalogenated spent solvents.
- Substitute specialty detergents for chromic-acid-based processing cleaners.
- Substitute biodegradable nontoxic detergents for cleaning solvents. When cleaning solvents can not be avoided, reuse spent solvents for initial rinses or general cleaning.
- Reuse gel staining or destaining solutions.
- Use the Laboratory's Chemical Exchange Program to publicize excess chemicals, making them available for transfer to another project. To advertise or locate chemicals and chemical products in good condition in their original container, refer to the Chemical Exchange section of the Chemical Management System database, or contact the EH&S Waste Minimization specialist at extension 6123 or your Divisional Chemical Inventory Coordinator for assistance.
- Ask your EH&S Generator Assistance specialist to recommend additional waste minimization techniques that would be practicable for your specific experiments or operations.

3. Hazardous Waste Characterization

Hazardous waste regulations dictate that you, as the generator, are responsible for the complete and accurate characterization of your waste. Precise characterization is also essential to ensure

- safe handling,
- protection of the environment,
- compliance with federal and state packaging requirements,
- compliance with conditions of Berkeley Lab's HWHF Permit,
- compliance with land-disposal restrictions, and
- acceptance of the wastes by appropriate recycling or disposal facilities.

All wastes must be characterized fully, as directed by the criteria in the next section, before they can be accepted for transport to the HWHF. This characterization is essential to ensure that your waste is safely managed through a process designed to enhance waste minimization, safety, and environmental protection.

Process Knowledge

Because most chemical waste is generated during specific processes in the course of your activities or experiments, you should know the chemical content of a unit of waste from your "knowledge of the process" used to generate that waste. In fact, the individual generating the waste is, in most cases, a more accurate source than certified analytical laboratories for specifying components and their concentrations in a given waste sample. Most hazardous waste generated at the Berkeley Lab can be characterized through process knowledge. However, for this approach to be considered the most reliable for accurate waste characterization, it must be supported by precise, documented information (see Hazardous Waste Characterization Criteria). To use and justify process knowledge for characterization, you must

- know the hazardous properties of all chemicals used,
- have a thorough understanding of how the chemicals were used,
- understand the chemistry of the reaction to determine if hazardous chemicals were produced where none existed before, and
- know whether the process converted hazardous chemicals to nonhazardous ones.

Hazardous Waste Characterization Criteria

The first step is to determine whether your waste is hazardous. If your waste is hazardous, it must be characterized by type of hazard, and all hazardous and nonhazardous components must be fully identified. It is important to account for 100% of the contents of each waste container, including trace amounts of known hazardous components. A common problem is the failure to recognize that water and hydrogen ion (pH), if present, must be listed as components. Hazardous waste characterization to meet performance requirements may be achieved in the following ways:

- By maintaining records (logs) of accumulations that draw upon knowledge of the procedures and processes that generated the wastes. The logs contain an entry each time a chemical is added to a container (see Figure H-4 in Section 8). To use and justify process knowledge, these entries must be based upon direct information transfer from written research techniques (DIRT), a materials balance (MB), direct assay (DA) and/or a predictable reaction product (Rx).
- By consulting an MSDS for each hazardous component, and listing quantitative information for all nonhazardous components.
- By developing a generic description when the material has a well-known standard composition (e.g., waste alkaline batteries or waste mercury-contaminated glassware).
- By using analytical results from a certified laboratory on known, unchanging waste streams (i.e., a waste profile), or by using complete analytical results from a certified laboratory for each waste. Analytical results from a noncertified laboratory may be used if adequate analytical records and procedures are documented and available to the EH&S Waste Certification Team.

When you submit your Hazardous Waste Disposal Requisition, each entry on the Requisition should be supported by documentation verifying the entry's composition (i.e., process knowledge, MSDS, standard composition, a waste profile number, or analytical results). If process knowledge is the basis for characterization, indicate the basis (DERT, MB, DA, Rx) under the Process Knowledge checkoff box.

Quality Assurance

As part of EH&S's Quality Assurance (QA) program for waste characterization, ten percent of all hazardous wastes, including mixed waste, passing through the Berkeley Lab HWHF are randomly sampled and assayed to verify the accuracy of characterization information on the Waste Disposal Requisitions. In addition, waste streams presenting high risk if characterization is not accurate and special challenges determining the correct characterization are sampled in the field. The performance of individual generators in meeting these QA checks is tracked, and Generator Assistance works with the generators who fail to meet performance standards. Those generators who consistently provide inadequate or incomplete waste-characterization information are placed on a higher sampling regimen until the cause(s) of the mischaracterization is understood and resolved. The cost of the chemical analyses in this situation is charged to the generator's research program. If the generator's characterization of waste targeted for sampling based on waste acceptance performance continues to fail validation for accuracy and integrity, the generator and his/her staff are subjected to process-specific training, and the research program is charged for further waste analyses on the waste in each container in the next two requests for transfer to the HWHF.

4. Guidelines for SAA Operation

A Satellite Accumulation Area (SAA) is an area in an individual laboratory, shop, or other facility designated by the generator for the accumulation of hazardous waste. Hazardous waste regulations require the SAA to be located at or near the point of waste generation and that it be managed by a responsible, trained generator. Even a single small bottle of a hazardous waste requires the establishment of an SAA in your laboratory or work area.

The Facility/Laboratory Supervisor (or designee) is responsible for enforcing proper waste accumulation at the SAA. The Waste Generator is responsible for maintaining the SAA and for keeping detailed records of waste accumulation. If your work area has a pre-existing SAA, ask the responsible person if you can use it. Details for setting up, using, and maintaining an SAA follow.

- Maximum storage allowed is 55 gallons of hazardous waste, including up to 1 quart of extremely hazardous waste.
- If you wish to accumulate more than 10 gallons (and fewer than 55 gallons) of liquid ignitable waste in an SAA, Fire Code requires that your SAA be located in a metal flammables cabinet.
- Waste may accumulate in SAAs for up to 275 days (nine months). A container must be removed from the SAA within three days after reaching the 55-gallon accumulation volume limit.
- The SAA area must be clearly designated using the yellow sign depicted in Figure H-2. If there is uncertainty regarding the boundaries of the SAA, the area should be clearly marked off with tape. Chemicals, empty bottles, or other items should not be stored in your SAA because these items may be mistaken for unlabeled hazardous waste. Good housekeeping practices should be implemented to provide for easy access to your SAA.

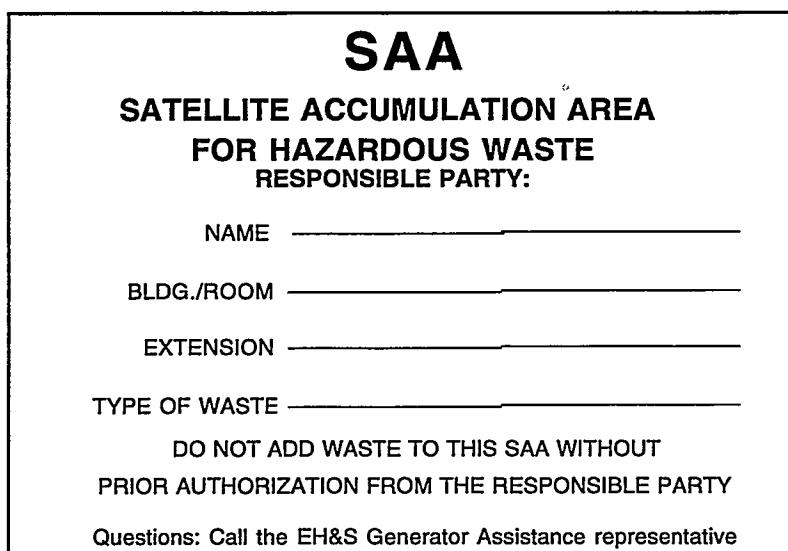


Figure H-2. Satellite Accumulation Area sign.

- The SAA must be at or near the site where the waste is generated so that the SAA can be controlled by staff while working. Current interpretation of the "at or near" requirement is that your SAA must be located in the room where the waste is generated, or in an immediately adjacent room (with no intervening hallway). The intent of this requirement is to provide virtually full-time monitoring of the SAA by the individual(s) generating the waste.
- Fire Code requires that the SAA be located away from all exit doors or areas where it could hamper exiting in the event of a fire or spill. Appropriate spill cleanup materials should be located near your SAA, especially if large amounts of wastes are accumulated.
- Applicable procedures and directions, including these guidelines, should be readily accessible at the site. Other information regarding the generation and management of your hazardous waste can be kept elsewhere in your laboratory or facility.
- To prevent accidents and injuries, liquid corrosive wastes should be accumulated in polyethylene or plastic containers that are known to be compatible with acids or bases.
- Secondary containment is required for all liquid hazardous wastes and all wastes accumulated in glass containers. The secondary containers must be compatible with the chemical they contain. Examples of secondary containers for SAAs include water troughs or photographic chemical trays. Pail skids make excellent secondary containment for five-gallon or smaller containers.
- Glass containers can be used to accumulate up to 1 pint of Class 1A liquid ignitable waste (flash point < 73°F and boiling point < 100°F—e.g., ethyl ether) or up to 1 quart of Class 1B ignitable waste (flash point < 73°F and boiling point > 100°F—e.g., acetone, alcohols). Larger quantities of such wastes (e.g., solvents) must be accumulated in red 2- or 5-gallon safety cans or other approved plastic or metal containers with self-closing lids.
- Primary waste containers must be tightly closed at all times except when you are adding waste. Fire Code requires that large containers (> 1 quart) for the accumulation of liquid and solid ignitable wastes (e.g., solvents or solvent-contaminated rags) have self-closing lids that are sufficiently tight to restrict the supply of oxygen.
- Add waste carefully to avoid spills. Any materials used to clean up small amounts of spilled liquid hazardous waste are also considered to be hazardous waste.
- Prepare and label all primary waste containers with red-and-white Hazardous Waste labels. Labels must be complete and correct at all times (See Section 10, "Labeling", for details).
- Tables H-1 and H-2 (next section) contain information on ordering items essential to the proper management and operation of your SAA.

Waste containers can be picked up by EH&S only if they are properly packaged and labeled and all other documentation is complete and correct.

5. Hazardous Waste Containers and Other SAA Items

You should set up your SAA and obtain waste containers and other items for SAA management based on the guidelines given in Table H-1.

Table H-1. Approved Containers for Use in Satellite Accumulation Areas

Waste Type	Approved Container	How to Obtain
Liquid wastes (large quantities)	55-gal DOT 17E drum	Contact EH&S
Solid wastes (large quantities)	55-gal DOT 17H drum	Contact EH&S
Small individual waste containers	Polypropylene tote box (useful for secondary containment)	Stores item 8115-66258
Liquid wastes, bulk, nonflammable	5-gallon plastic carboy	8125-45694
Liquid wastes, bulk, nonflammable	5-gallon glass carboy	8125-27825
Liquid wastes, bulk, flammable	Red metal or plastic safety can (used safety cans are available from EH&S)	7960-30361 (2-gallon) 7960-30344 (5-gallon)
Liquid wastes, bulk, halogenated solvents	Stainless steel 2- or 5-gallon can	Contact EH&S
Oily wastes, nonignitable, bulk	Protectoseal oily waste can	7960-30353 (6 gallons) 7960-30354 (14 gallons)
Asbestos and asbestos-containing materials	Double plastic bags labeled ASBESTOS	Stores item 8105 series (see Table H-2)
Mercury	Do not remove mercury from original device or equipment.	Call EH&S
PCB-containing wastes	Call EH&S for details.	
Water-reactive metals	Closed container filled with mineral oil	

The items listed in Table H-2 will also be useful in managing your SAA.

Table H-2. Satellite Accumulation Area Materials and Equipment

SAA Item	Comment	Berkeley Lab Stores No.
Hazardous Waste Label	Red and White, 6" x 6"	4280-72601
SAA sign	Yellow; see Figure H-2	4280-72514
Plastic developing tray	8" x 10"	6750-29165
Plastic developing tray	14" x 7"	6750-29166
Polyethylene plastic bag	6" x 8"	8105-27697
Polyethylene plastic bag	12" x 18"	8105-27699
Polyethylene plastic bag	16" x 20"	8105-47511
Polyethylene plastic bag	24" x 30"	8105-47512
Plastic trash container liner	12" x 8" x 22", 0.002 in.	8105-59166
Pail skid (for 2 5-gallon containers)	6" x 20" x 26", 0.002" Order Item #YB-13557- Small Pail Skid	Lab Safety Supply Janesville, WI 1-800-356-0783
Polyethylene bottle	16 oz, wide mouth	8125-42044
Polyethylene bottle	32 oz, narrow mouth	8125-27820
Polyethylene bottle	32 oz, wide mouth	8125-42045
Polyethylene bottle	1/2 gal, narrow mouth	8125-27821
Polyethylene jug	1 gal, integral handle	8125-27827
Glass bottle	1/2 gal, narrow mouth	8125-27777
Glass bottle	1 gal, narrow mouth	8125-27778

6. Segregation of Incompatible Wastes

Segregation means taking action to prevent the mixing of chemically unrelated or incompatible materials in the same container. Segregation is important for three reasons: safety, recyclability, and disposability.

- When chemicals are mixed without regard to compatibility, safety hazards can result. In some cases, the resulting mixture could explode or produce toxic gases. A safe rule for mixing chemicals is: When in doubt, don't mix.
- Certain chemicals can be recycled at great financial savings, but small amounts of contamination with other chemicals may render the original chemical unrecyclable. For example, waste oil is recyclable, but a few tablespoons of halogenated solvent in a 55-gallon barrel of waste oil will render that barrel of oil unrecyclable.
- Some chemicals can be managed and disposed of relatively inexpensively. Contamination with another chemical, however, may make the waste very difficult and expensive to manage. For example, some wastes can be sent to a landfill, while others require incineration. Mixing wastes together can limit disposal options and increase waste management costs.

A simple and effective way you can reduce waste management and disposal costs is to set up your operation to properly segregate your wastes as they are collected. The following guidelines will help you to properly segregate your hazardous waste.

- Segregate nonhalogenated waste solvents (acetone, alcohol, etc.) from halogenated (containing chlorine, fluorine, bromine, or iodine) solvents. This practice increases the recyclability of the wastes. It also helps the LBL maintain calculated offsite exposures for accident scenarios within limits that are acceptable to DOE.
- Keep waste oil free of contamination by halogenated solvents or water (for the reasons listed in the preceding bullet).
- Keep acids and acid plating solutions free of cyanides.
- Segregate acids and caustics contaminated with metals from those without metal contamination.
- Segregate radioactive wastes from hazardous wastes. Contamination of hazardous waste with even a small amount of radioactive materials can result in the generation of mixed waste. This results in very large increases in waste management costs (by a factor of more than 100).

7. Separation of Incompatible Wastes

In addition to segregation, physical separation will help you to prevent the inadvertent mixing of incompatible materials. Separation is achieved using distance or chemically resistant barriers such as secondary containers. To prevent accidents caused by inadvertent mixing, chemically incompatible wastes can not be accumulated in the same secondary containment bin. In addition, SAAs, MWSAAs (mixed waste SAAs), and Radioactive Waste Collection Areas should be physically separated to minimize chances of accidental cross-contamination.

Separate hazardous wastes using the following guidelines:

- Separate all spontaneously ignitable and explosive wastes from everything else. Package separately to contain and isolate any ignition that may occur. Explosives are not handled at the HWHF. Appendix 1 of this document provides several lists of potentially explosive chemicals.

Note: If you discover a potential explosive in your laboratory, contact the Fire Department at extension 7911 immediately.

- Separate strong oxidizers from all fuels and package separately.
- Separate all extremely hazardous chemical gases and compressed gases from potential fire hazards.
- Separate peroxide-forming chemicals from all other combustible materials and package separately.
- Separate acids from bases and package separately.
- Separate all water reactives from everything else. Package each group separately in a sealed container and protect from water. Place a WATER REACTIVE warning on the package. EH&S can not transport reactive wastes that are incorrectly packaged.
- Separate extremely hazardous noncorrosive materials from corrosive materials.
- Separate extremely toxic chemicals and poisons from all other wastes.

Appendix 1 of this booklet provides more detailed information on various categories of hazardous chemicals and chemical compatibility.

8. Labeling

When you determine that an item is hazardous waste, you must fill out and attach a Hazardous Waste label (Figure H-3, Berkeley Lab Stores Cat. # 4280-72601) to the waste container. The Hazardous Waste label identifies the waste generator and the contents of the container, provides information on the hazardous characteristic(s) of the waste, and establishes the waste generation date. Each primary waste container must have a label attached, indicating the composition of the material. A manufacturer's label does not serve this purpose, even if proper hazard information is on the label.

All entries on the Hazardous Waste label must be legible. It is recommended that entries be made with a permanent marker or a pen containing permanent ink. Pens with water-soluble ink or pencils should not be used to fill out Hazardous Waste labels. For large primary waste containers such as carboys, the Hazardous Waste label should be affixed to an area of the container that is easily visible for inspection and emergency response purposes. A waste container too small for a label can be placed in a zip-lock plastic bag with a Hazardous Waste label affixed to the bag.

Figure H-3 gives general instructions on filling out the Hazardous Waste label. The Contents section of the label can be completed using one of the following three approaches:

1. By chemical name. If the material is a mixture, provide concentrations of all constituents, including nonhazardous constituents. If this information will not fit on the Hazardous Waste label, provide a more generic description (see item 3 below) and attach a Hazardous Waste Accumulation Log (see Figure H-4).
2. By manufacturer and specific product (for example, trade name or number, catalog number, etc.), including all hazardous materials listed in the MSDS for the specific product. Chemical identification information of manufactured products may also be found in the *Aldrich Catalog of Fine Chemicals*, the *NIOSH Registry of Toxic Effects of Chemical Substances*, and *The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals*.
3. By complete generic description of the material, only if the material is a mixture with a well-known standard composition. The description should indicate whether the material is new, has exceeded its shelf life, is spent, etc. If the material is a process waste, such as a cleaning agent or an etching bath, list all of the potential contaminants from the process in addition to the known constituents—for example, "chromic acid dip-tank waste with copper." For machine coolants, identify the metals for which the coolants were used.

The generic description must be sufficiently complete to adequately characterize the waste material. For example, "photochemicals" is insufficient because a wide variety of chemicals is used in photoprocessing. The description must be more specific, such as "alkaline photo developer" or "photo fixer with chromate bleach."

Each waste container used for multiple types of wastes (e.g., more than one type of solvent) must have attached to it a record of waste accumulation (for example, a Hazardous Waste

Accumulation Log; see Figure H-4). Each time you place waste in a container, enter the date, your initials, and the type and amount of waste being added. This information is used to prepare a summary description of the container contents for the Hazardous Waste Disposal Requisition. For example, a solvent-collection container used to collect multiple solvents must have a supporting Hazardous Waste Accumulation Log and cannot be identified generically.

If you generate wastes such as oily paper towels while performing repetitive cleaning operations at your bench, you may accumulate your wastes in a large ziplock plastic bag with a Hazardous Waste Label attached. The Accumulation Start Date on the label must be filled in with the words "Daily Accumulation," and you must empty the contents into a nearby SAA at the end of each working shift.

**HAZARDOUS
WASTE**

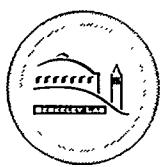
HANDLE WITH CARE!

<p>① Generator _____ Building # _____</p> <p>② Contents _____ _____</p> <p>③ SAA start date _____ WAA receipt or accumulation start date* _____</p> <p>④ HAZARDOUS WASTE HANDLING FACILITY USE ONLY</p> <p>HWHF receipt date _____ Disposal requisition# _____ Sample analysis# _____</p>	<p>Phone # _____ Room # _____</p> <p>⑤ Hazardous properties <i>Check all that apply</i></p> <p><input type="checkbox"/> Toxic <input type="checkbox"/> Corrosive <input type="checkbox"/> Ignitable <input type="checkbox"/> Reactive <input type="checkbox"/> Other _____</p> <p>⑥ Waste form</p> <p><input type="checkbox"/> Solid <input type="checkbox"/> Liquid <input type="checkbox"/> Gas</p>
---	---

* Receipt Date from SAA or Accumulation Start Date in the WAA
Berkeley Lab #1 Cyclotron Rd., Berkeley, CA 94720

- ① **Generator:** Enter name, building, phone number, and room number of person generating the waste.
- ② **Contents:** Give chemical name, material name, or waste stream description. Describe composition of waste.
- ③ **SAA start date:** Enter date waste is first placed in container (SAAs). Leave blank for WAAs.
- ④ **WAA receipt or accumulation start date:** Enter date waste from SAA is received at WAA, or date waste is first placed in a container at a WAA collection point.
- ⑤ **Hazardous properties:** Check appropriate boxes.
- ⑥ **Waste form:** Check appropriate box.

Figure H-3. Hazardous Waste Label



BERKELEY LAB

HAZARDOUS WASTE ACCUMULATION LOG

Container Description: _____

No. R

(HWHF 12/19/95 RA)

Figure H-4. Hazardous Waste Accumulation Log

9. Requesting Hazardous Waste Pickup

When you are approaching either the storage quantity or time limits (275 days) or when you wish to have your hazardous waste picked up by EH&S, fill out a Hazardous Waste Disposal Requisition (Figure H-5) and fax it, along with any supporting documentation, to EH&S at extension 4838. This fax number is dedicated to the transmission of Waste Disposal Requisitions. When faxing the Hazardous Waste Disposal Requisition, you must list each individual container on the requisition. Detailed instructions for filling out the Requisition appear on the second page of the Requisition. Please allow 5–7 business days for processing and pickup when determining the date to fax your Hazardous Waste Disposal Requisition. Waste that is not adequately characterized or that does not meet HWHF acceptance criteria can not be transferred to the HWHF.

After EH&S has received your faxed Hazardous Waste Disposal Requisition, Waste Management Group staff will check your documents to ensure that your waste meets the acceptance criteria described in this document. If the waste does not meet the criteria and discrepancies cannot be resolved through phone discussions with the EH&S Waste Certification Team, a Nonconformance and Corrective Action Report (NCAR) may be issued to your Division ES&H Coordinator, and your EH&S Generator Assistance representative may contact you to offer assistance.

Hazardous wastes generated in a Radiological Material Area (RMA) must be certified by the generator to be free of radioactive contamination before the waste can be removed. By signing the RMA Waste Certification form (see Figure H-6), you are certifying that your hazardous waste is free of radioactivity.

If you cannot certify that your waste is free of radioactivity (other than naturally occurring radioactive material, or NORM), additional testing and analysis of the waste will be needed. If your waste requires analysis, please allow an extra two to four weeks for pickup. That is, if you cannot certify that your waste is free of radioactivity, fax your Hazardous Waste Disposal Requisition to EH&S early enough to comply with the 275-day accumulation time limit and the 55-gallon (or 1-quart) volume limit.

Discovery of inaccurately characterized waste by a regulatory agency could result in fines and/or criminal penalties for the Laboratory and could jeopardize the operation of the HWHF and of the specific research project involved. Generators who make errors in characterization that could compromise the Laboratory's commitment to protect the environment, the safety of colleagues or EH&S staff may be required to pay for certified analytical information for all of their hazardous waste.

Information Required on the Hazardous Waste Disposal Requisition

A list of examples of waste types is given below, along with the information to be provided on the Hazardous Waste Disposal Requisition form (see Figure H-5). Also listed are laboratory analyses that may be needed for each waste type. Waste Management Group staff may request additional analysis for characterization of a particular waste.

- **Acids and Bases.** List acid or base strength in appropriate units (normality, molarity, percent by weight, or pH). Identify all metals present and give their concentrations.

- **Plating or Heavy Metal Solutions.** Identify all metals present and give their concentrations. List cyanide concentration if cyanide is present. Cyanide analysis is required for all aqueous solutions, acids, or bases generated in areas where cyanide is used.
- **Nonchlorinated or Mixed Organic Solvents.** List all constituents of the mixture. Analysis for halogenated hydrocarbon concentrations may be required. List flash point if known. The flash point should be determined if can be estimated from the flammability of the each solvent in the mixture is unknown.
- **Oils.** List all constituents, and flash point if known. Analyses for volatile halocarbon solvents, PCBs, percent oil, and flash point (if the oil has volatile components) may be required. All hydrocarbon-based oils with unknown constituents should must be analyzed.
- **Coolants.** List all constituents. Analyses may be required for volatile halocarbon solvents, percent oil, and / or metal contaminants (beryllium, uranium, nickel, etc.), depending on use.
- **Solid Wastes and Sludges.** Give composition of sludges and solid wastes. The composition of flocculants and sludges in liquid waste must be provided.
- **Unknowns.** Before hazardous waste can be transported to the HWHF, all hazardous and nonhazardous components must be identified by the generator, and all unknowns must be analyzed by a certified laboratory. A copy of the laboratory report should accompany the Hazardous Waste Disposal Requisition form when it is faxed to the Waste Management Group.

If you cannot characterize your waste properly from the original label or from your documented knowledge of the processes used to generate a given hazardous waste, you may need to resort to specific analyses for waste characterization. To initiate this process, fill out and submit a Laboratory Waste Analysis Request Form (see Figure H-7). Your EH&S Generator Assistance specialist can help you in this process, but the cost of analysis for unknown components may be charged to the research project.

LBL Hazardous Waste Disposal Requisition FAX 4838					
EH&S USE ONLY					
HWHF Requisition No. _____					
Date Received _____					
GENERATOR INFORMATION					
Date _____	Operating Account No. _____	SAA/WAA Location	Bldg. Room	Additional Description	
			Has this information been FAXED before? Y / N		
Name (printed) _____		Employee ID # _____		Div. _____	Phone _____
WASTE INFORMATION					
Waste Description (Use proper chemical name and provide concentration of each. Do not abbreviate chemical names.) Profile Number _____ Process knowledge <input type="checkbox"/> MSDS <input type="checkbox"/> Constituent / Concentration 1 _____ _____ _____ _____			Number of Containments Container Description eg., bag, drum, can _____ _____ _____ _____	Total Waste Quantity _____ _____ _____ _____	Waste Units _____ _____ _____ _____
Profile Number _____ Process knowledge <input type="checkbox"/> MSDS <input type="checkbox"/> Constituent / Concentration 2 _____ _____ _____ _____					
Profile Number _____ Process knowledge <input type="checkbox"/> MSDS <input type="checkbox"/> Constituent / Concentration 3 _____ _____ _____ _____					
EH&S USE ONLY					
Compliance Review Representative _____ Date _____		HWHF Representative _____ Date _____		Generator _____	
NTWKWORD:HAZARD WASTE: HWHF REQUISITION 3/05 Revised 3/2005					
I certify that to the best of my knowledge, the chemical composition provided for each item is correct.					

Figure H-5. Hazardous Waste Disposal Requisition

How to Fill Out This Form

Generator Information

Operating Account No: Fill in the account number you charge to for this project.

Has this information been FAXED before? Circle Y only if this is a second submission for the waste described in this requisition.

Name: Fill in your name.

Employee ID number: Fill in your 6-digit employee ID number.

Division: Fill in the Division responsible for the waste-generating project.

Phone: Fill in your phone number.

Date: Fill in the date that you FAX this requisition to EH&S.

Waste Location: List the building and room number where the waste is located. Use the "Additional Description" for waste that is not adequately located by building and room (for example, waste stored in a yard adjoining a building).

Waste Information

Waste Description: List one waste stream per line. Use the proper chemical name of the waste. Provide any additional information that may be helpful in describing the waste. List each constituent (hazardous and nonhazardous) and concentration.

Earliest Accumulation Start Date: List the first date waste was placed in any container described on this line.

Number of Containers: List the number of containers of this type of waste.

Container Description: Using this column, list (in either metric or English units) the container size and description.

Total Waste Quantity and Waste Units: Add up the volume of waste described under "Container Description" and list it here. Report solids by weight.

Liquid, Solid, or Gas: Fill in "L," "S," or "G," as appropriate.

Basis for waste characterization: If you check box for use of "Process Knowledge," mark beneath the box the source of that knowledge (DERT, MB, DA, Rx).

Supporting Documentation Requirements

Each waste container must have the contents described on the Hazardous Waste label, and *supporting documentation must be attached to the container in a plastic pouch OR be on file at the HWHF*. Supporting documentation can be one or more of the following: (A) Process knowledge of wastes whose composition is documented by the procedures generating them; (B) records of accumulation - a log that contains an entry each time waste is added to a container; (C) an MSDS for all chemicals/materials used in an experiment or process; (D) an MSDS for spent or unused materials; (E) a generic description when the material has a well-known standard composition (e.g., waste alkaline batteries or waste mercury contaminated glassware); (F) analytical results, or (G) Radioactive Waste Tag (for mixed waste only).

Waste Profiling: If the paperwork submitted adequately supports the description of the waste stream, and the waste stream will not change over time, HWHF staff will assign a waste stream profile number. If not, HWHF staff will contact the generator for clarification and/or to arrange for laboratory analysis of the waste stream. Once a profile number is assigned, the generator enters it under the supporting document code/profile number column on the requisition form.

Pickup and Transportation

A Berkeley Lab Hazardous Waste Disposal Requisition form must be FAXED to the HWHF. Ext. 4838 is dedicated to this purpose. Keep two copies of the requisition form; attach one copy to the containers to be picked up, and put the other copy in your file or work binder as a generator record..

Figure H-5 (continued). Hazardous Waste Disposal Requisition instructions

LAWRENCE BERKELEY LABORATORY
ENVIRONMENT, HEALTH & SAFETY DIVISION
RMA WASTE CERTIFICATION FORM

[Redacted]
Hazardous Waste Disposal Requisition
Number (for EH&S use only)

Generator able to certify waste as nonradioactive

Based on my process knowledge of the waste documented on the Hazardous Waste Disposal Requisition, I certify that the waste is neither radioactive nor radioactively contaminated.

Signature of Waste Generator

Payroll No.

Date

Generator unable to certify waste as nonradioactive:

(Analytical results will be required prior to pickup or disposal.)

Based on my process knowledge of the waste documented on the Hazardous Waste Disposal Requisition, I am unable to certify that the waste is not radioactive or radioactively contaminated for the following reason(s):

Signature of Waste Generator

Payroll No.

Date

Radiation Survey—EH&S use only

If the waste is from a RMA, survey the container and check the appropriate box ("Meets Release Criteria" or "Unreleasable" per EH&S Procedure 868). Analytical results will be required prior to pickup or disposal.

NORM

Meets Release Criteria

Unreleasable

Surveyed by: _____ Signature: _____ Date: _____

Instrument used: _____ Serial Number: _____ Background: _____ Result: _____

Instrument used: _____ Serial Number: _____ Background: _____ Result: _____

Comments: _____

Form No. WM 820-02, 5/96

Figure H-6. RMA (Radioactive Material Area) Waste Certification form



BERKELEY LAB
LABORATORY WASTE ANALYSIS REQUEST FORM

HWHF REQ. NO. _____

SAMPLE I.D. _____

OPERATING ACCOUNT NO. _____

DATE OF REQUEST / /

For EH&S use only

Sample Taken By: _____ Date Sampled: _____ / _____ / _____

Method of Sampling: _____ Date Sent to Lab: _____ / _____ / _____

Date Analysis Rec'd: _____ / _____ / _____

GENERATOR/SUBMITTER INFORMATION

NAME: _____ PAYROLL ACCT: _____ MAILSTOP: _____ EXT: _____

SAMPLE INFORMATION

LOCATION (Bldg., Room): _____ CONTACT PERSON: _____ EXT: _____

Type of Container _____ Liquid Solid Gas**SUSPECTED CHEMICAL COMPOSITION & DESCRIPTION OF PROCESS OR EXPERIMENT ORIGIN IN DETAIL.**
(E.G., PHOTOGRAPHIC, ETCHING, HUMAN GENOME, CHROMATOGRAPHY, ETC.)

(Attach additional sheet if necessary. Precise information minimizes the cost of analysis.)

INDICATE THE SUPPORTING DOCUMENT THAT IS ATTACHED:

- MSDS for each constituent
- Formulation(s)
- Chemical composition
- Record of how the waste was accumulated in the container (date, what was added, the amount and initials for each addition)
- Other _____

THE SAMPLE IS POTENTIALLY:

- carcinogenic
- corrosive
- explosive
- flammable
- an oxidizer
- poisonous
- radioactive
- reactive

RADIOACTIVE INFORMATION

Radionuclide(s): _____

Activity: _____

Methods of Assay: _____

Performed By: _____ Date: _____

(HWHF 6/23/93 RA)

Figure H-7. Laboratory Waste Analysis Request Form

10. Compressed Gases and Pressurized Liquids

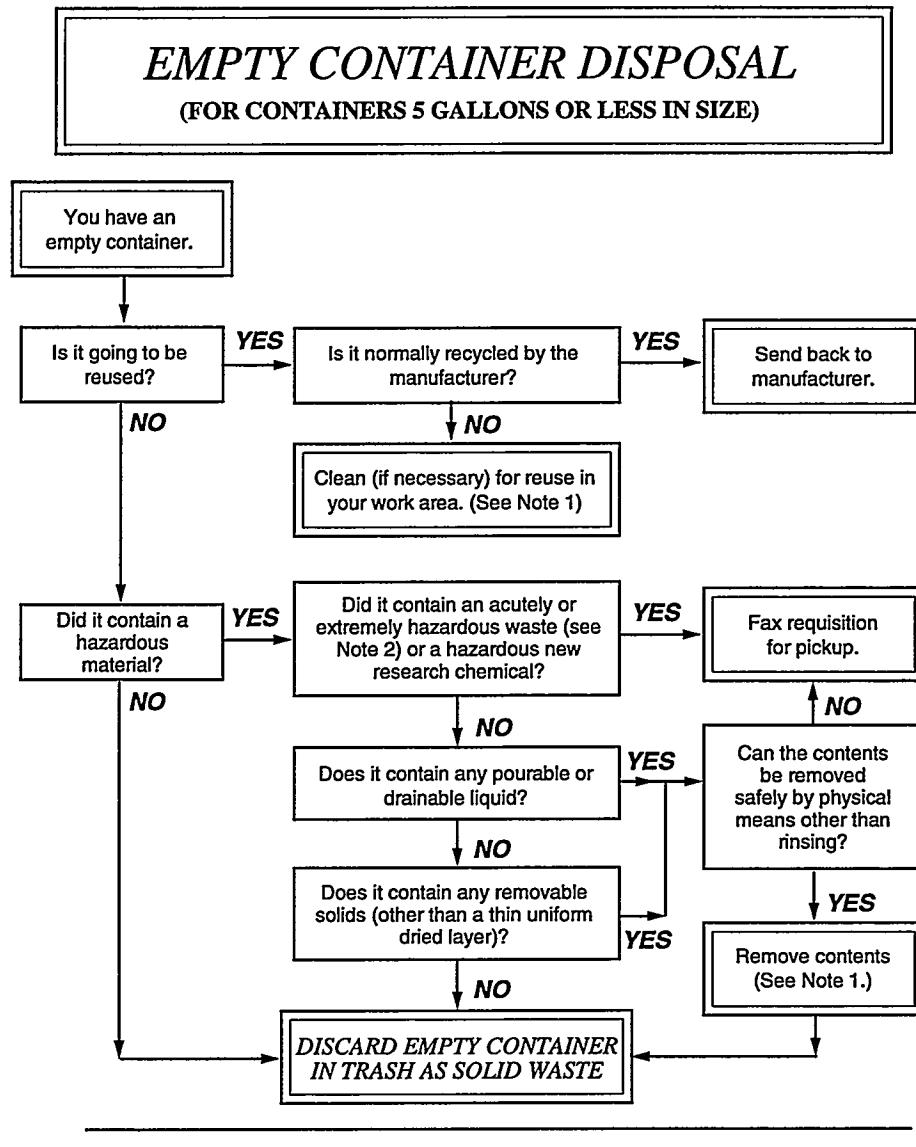
Compressed gas cylinders containing hazardous gases are not accepted at the HWHF for disposal. Depending on the type of gas contained in the cylinder, other disposal options are available for users of these materials.

When purchasing hazardous compressed gases, users should assure that the cylinders can be returned to the manufacturer once they are empty. All users should carefully evaluate their processes and order only as much gas as they will need. Users should attempt to use all gas in any cylinder where hazardous gases are involved, since a compressed gas cylinder is exempt from regulation as a hazardous waste when the pressure in the container approaches atmospheric pressure. Typical residual pressure that should remain in the cylinder at the end of its use is a positive pressure of at least 25 psig. Maintaining such residual pressure is important to keep the cylinder from becoming contaminated with atmospheric gases.

If you have a cylinder to be disposed of when it is not empty and cannot be returned to the supplier, the cylinder must be processed at the point of generation for shipment off site to an appropriate disposal facility. To start this process, fill out a Hazardous Waste Disposal Requisition and fax it to the Waste Management Group. For cylinders that cannot be returned to the manufacturer, the user is charged for disposal costs. If there is a question on whether a particular gas cylinder might pose a disposal problem, please call the Procurement specialist at extension 6220 or the EH&S Waste Management Group at extension 5877 before making a purchasing decision.

11. Empty Containers

Certain empty containers that previously contained hazardous materials are exempt from hazardous waste regulations and can be discarded as trash. If you are able to discard your container, please call extension 6571 to ensure that the container is deleted from the chemical inventory database. Figure H-8 shows the process used to determine if a container is considered "empty" and thus is exempt from regulation.



*UNCERTAIN? Contact your Generator Assistance Specialist.

Figure H-8. Process used for empty container disposal

12. Spill Cleanup and Reporting

If a hazardous material or hazardous waste spill occurs, the primary response should be to protect human health and the environment. Spills are categorized as either small spills or large spills.

A small spill is defined as one in which all of the following apply:

- The nature and hazards of the spilled material are known.
- The material is not a perceived threat to human health or the environment.
- The spill is small enough to be cleaned up safely by one or two people within one hour.
- All necessary personal protective equipment and cleanup equipment are available.

If a small spill occurs, the responsible program individual should immediately determine the source, type, and amount of spilled material and follow the procedure outlined in the relevant contingency plan for cleaning up a spill of that type of hazardous material or waste. If there is any uncertainty about safely managing the spill, the responsible individual must call the following number immediately:

From ICS phones: 7911 (LBNL Fire Department).	From Campus phones: 9-911.
---	----------------------------

All small spills should be reported immediately to the Divisional ES&H Coordinator and the Berkeley Lab Emergency Coordinator, who will determine whether the spill is reportable to DOE or regulatory agencies. If the spill is reportable, EH&S personnel will handle all notifications and reporting.

A large spill is defined as one in which any of the following apply:

- The nature of the material and the potential hazards are not known or are in question.
- The spill is perceived as an immediate actual or potential threat to public health or the environment.
- Necessary personal protective equipment or cleanup equipment is not available.
- More than two people would be required to clean up the spill safely within one hour.

In the event of a large spill or fire, the Fire Department must be called immediately:

From ICS phones: 7911 (LBNL Fire Department).	From Campus phones: 9-911.
---	----------------------------

Provide the Fire Department with the following information:

- Location of spill.
- Source of spill.
- Type of material.
- Amount of spilled material.
- Any exposure to personnel.

The Berkeley Lab Fire Department will contact all EH&S personnel necessary to respond to any large spill.

13. Berkeley Lab Chemical Exchange Program

Occasionally you will need to discard laboratory reagent chemicals because of excess inventory, expired shelf life, or lack of any further need for the chemical. It is a good idea to review the chemicals in your area at least annually to determine if you have chemicals that should be removed.

If you have identified excess chemicals, you should determine if they can be reused or if they must be disposed of as waste. If the chemicals appear to have further use by virtue of condition, amount, or age, you should consider using the Berkeley Lab Chemical Exchange Program to find a new user for your chemicals.

Surplus chemicals can be listed on the sitewide Chemical Management System (CMS) database. For information on CMS, call extension 4171 or 6571. In addition, you can call the EH&S Waste Minimization Specialist at extension 6123 for assistance. The Waste Minimization Specialist will assist in the listing of chemicals and provide information for exchange, storage, and disposal.

14. Closing Out an SAA

If you currently operate an SAA and will be leaving Berkeley Lab or relocating to another area of the Laboratory, you are responsible for assuring that any waste that has accumulated in your area is properly identified, characterized, and disposed of as part of your routine relocation or check-out process.

If you leave waste behind when you relocate, the next person to use the area will be unable to perform this identification and characterization. Managing your waste before your departure is especially important if you work in a Radiological Material Area (RMA), because subsequent occupants will not be able to certify the waste as being free of radioactivity. Extra time and cost will be involved in evaluating this waste.

If you know you are going to move, you should plan to process your waste for pickup prior to your departure. The following points are important to consider when closing out an SAA:

- If you are relocating to another part of Berkeley Lab, do the new occupants of your former area know where to locate you if necessary?
- Have you informed your Division ES&H Coordinator and your Building Manager that you are closing out an SAA?
- Have all wastes in your SAA been properly identified, characterized, and labeled?
- Are all wastes in your SAA properly segregated and stored?
- Have you filled out and submitted a Hazardous Waste Disposal Requisition for all wastes in your SAA?
- Is your SAA in an RMA? If so, has all waste that you have generated been certified *by you* to be free of known radioactive contamination?
- Have all wastes from your SAA been picked up by EH&S?
- Are there any hazardous materials you will leave behind or will not be moving? If so, have they been considered for reuse or recycling?
- If you are terminating your employment with Berkeley Lab, have you completed the employee/supervisor checkout list?

Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab

1. Introduction

This document provides performance standards that you, as a generator of radioactive waste at the Berkeley Lab, must meet to

- protect Berkeley Lab staff and the environment,
- comply with radioactive waste regulations and ensure the continued safe operation of your workplace,
- have your radioactive waste transferred to the Hazardous Waste Handling Facility (HWHF), and
- enable the Environment, Health and Safety (EH&S) Division to properly pick up, manage, and ultimately send your waste off site for reuse, recycling, treatment, or disposal.

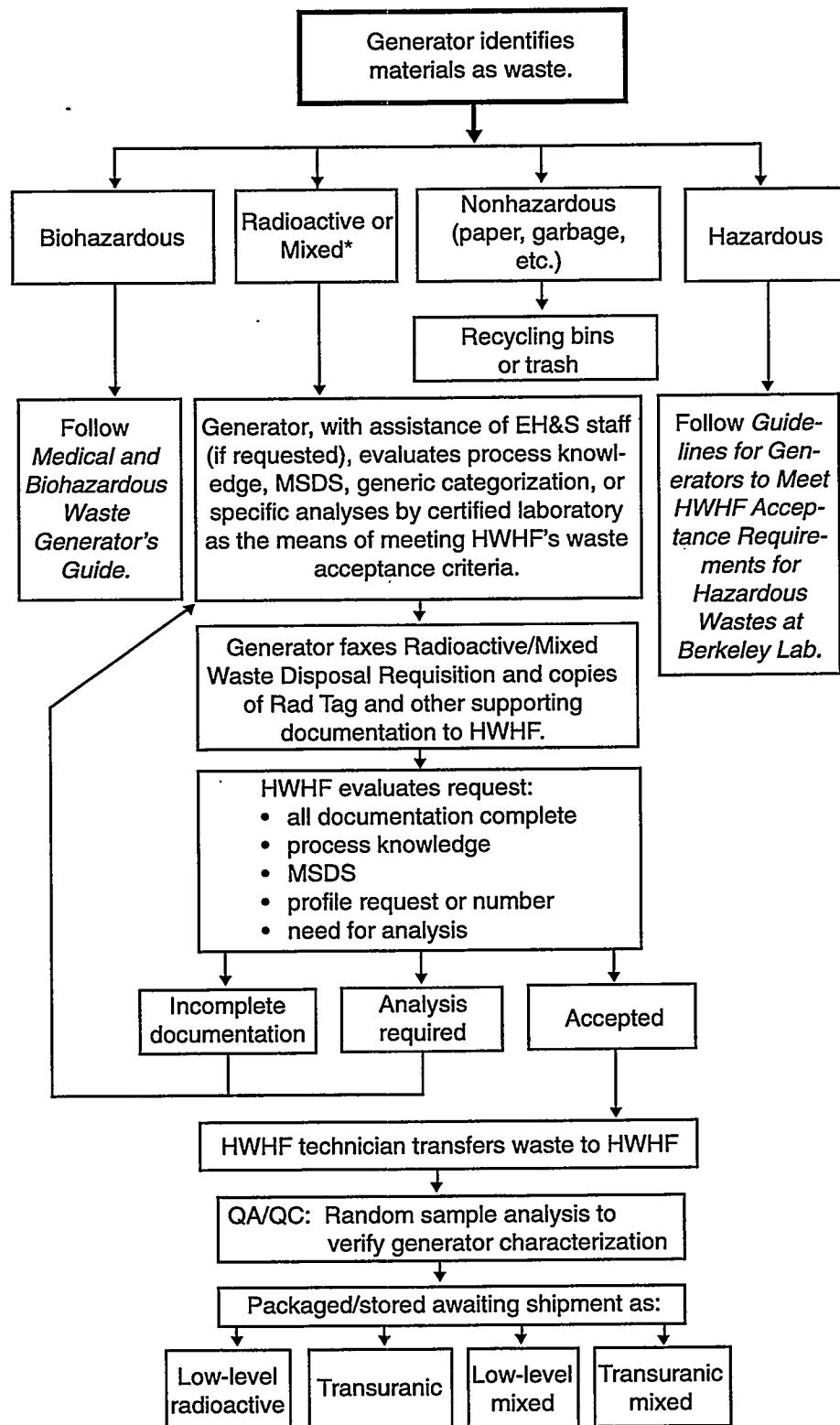
Figure R-1 is a flowchart that shows how radioactive and mixed waste is managed at the Berkeley Lab.

If you use radioactive materials and generate radioactive waste, you must establish a Radioactive Waste Collection Area and follow the guidelines in this section of this manual.

The information in this section also applies if you generate mixed waste; i.e., waste that is both hazardous and radioactive. For more information on mixed waste management, see "Guidelines for Generators to Meet HWHF Acceptance Requirements for Mixed Wastes at Berkeley Lab" (part of this manual).

The guidelines in this section do not apply to wastes that are hazardous, but are not radioactive. For more information on hazardous waste management, see "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" (part of this manual).

The guidelines in this section also do not apply to purely medical and biohazardous wastes. For information on proper management of medical and biohazardous wastes, see the most recent revision of PUB-3095, *Medical and Biohazardous Waste Generator's Guide*.



*Containers of mixed waste must have *Hazardous Waste* labels attached to them at all times.

Figure R-1. Flowchart for radioactive and mixed waste management at Berkeley Lab

Radioactive waste generated through the Berkeley Lab research and support activities is transferred to the Hazardous Waste Handling Facility (HWHF), managed by the Environment, Health and Safety (EH&S) Division. The waste is treated, if necessary, and packaged for shipment to one of several treatment, storage, and disposal facilities (TSDFs). Each of the TSDF operators establishes criteria (in conjunction with DOE) for acceptance of radioactive wastes. The performance standards provided in this section are designed to allow the Berkeley Lab to comply with the various waste acceptance criteria of TSDFs doing business with the Laboratory. These standards are also designed to promote compliance with all other regulations covering the management of radioactive wastes.

Further information on proper handling of radioactive wastes is presented in Chapter 20 ("Hazardous Waste Disposal") and in the Radiological Work Authorization (RWA) Section of Chapter 21 ("Radiation Safety") of the most recent version of PUB-3000, the Berkeley Lab *Health and Safety Manual*.

What Is a Radioactive Waste?

Radioactive waste is defined by both federal and state agencies. At the Berkeley Lab, a waste is characterized as radioactive if either process knowledge or monitoring and sampling show that radioactive material has been added to the waste. Wastes containing only naturally occurring radioactive material (NORM), such as potassium-bearing compounds with ^{40}K , as the sole radioactive constituent are not considered to be radioactive and should be managed as hazardous or nonhazardous waste, depending on chemical composition. If, after reading this section, you are still unsure whether your waste is radioactive, contact your EH&S Generator Assistance representative for assistance.

2. Minimization of Radioactive Waste

As a generator of radioactive waste at the Berkeley Lab, you must develop and implement waste minimization techniques in your research or support activities. Berkeley Lab is required by federal guidelines, and is encouraged by the citizens and government of the City of Berkeley, to maintain an aggressive radioactive waste minimization program. The Berkeley community is particularly concerned about radioactive waste production and storage. The Laboratory's success in this area depends on the contributions of all radioactive waste generators to the waste minimization effort at the Laboratory.

The DOE office that currently supports waste management at Berkeley Lab (EM, or Environmental Management) will be re-engineered in the next few years. One component of the effort will be to return radioactive waste management costs to the waste-generating organization (principally ER, or Energy Research at Berkeley Lab). To help prepare for this transition, the Berkeley Lab is committed to meeting specific waste minimization goals. To increase awareness of the need for minimization, the Waste Management Group will track disposal costs by account number and periodically inform you of the volume and estimated disposal cost of your radioactive waste. These estimated waste management and disposal costs will be summarized for each Division to facilitate line-management participation in waste minimization. In addition, your EH&S Generator Assistance specialist can provide specific advice and information that will allow you to reduce the volumes, quantity, and the costs of managing radioactive waste.

The major underlying principle of waste minimization is that it makes far more sense not to produce waste in the first place than to develop systems to ensure that generated waste is managed in an environmentally safe manner. What can you do personally? By doing your part to reduce the generation of waste, you can use radioactive materials more effectively. By means such as those described below, you can reduce the generation of radioactive waste and improve the protection of your staff in the workplace as well as reduce the impact on the public and the environment. Waste reduction at the source is an economically sensible approach in which you, as a generator, can directly help lower waste management and compliance costs, liabilities, and risks.

The following list highlights a few of the things you can do to minimize the amount of radioactive waste you generate.

- Minimize the gross volume of radioactive wastes by designing your experiments to use the minimum amount of radioactive materials and chemicals practicable.
- Order only the amount of radioactive materials and chemicals you will use.
- Search for nonradioactive substitutes (e.g., immuno-assay reagents, materials labeled with stable isotopes) for radioactive constituents in your experiments.
- Keep the amount of radioactive wastes accumulated in your Laboratory at a minimum.
- Store radioactive wastes separately from hazardous and nonhazardous wastes.
- Do not allow nonhazardous or hazardous materials to be contaminated with radioactive materials or waste.
- Do not add radioactive materials to unknown (uncharacterized) mixtures.
- Carefully segregate your radioactive wastes based on isotopic half life (see Section 4).
- Decontaminate items with surface contamination to meet release limits. (Contact the Radiation Protection Program for advice.)

3. Radioactive Waste Characterization

Radioactive waste characterization should be taken very seriously. The objective of accurate and complete radioactive characterization is to ensure

- safe waste handling,
- protection of the environment,
- compliance with DOE and U.S. DOT packaging requirements,
- compliance with conditions of Berkeley Lab's HWHF
- compliance with land disposal restrictions, and
- acceptance of the wastes by the relevant disposal or recycling facility.

The Hanford Waste Disposal Site requires that radioactive wastes be characterized in great detail. Characterization requirements continue to increase as disposal sites become more selective about the wastes they accept. It is your responsibility as a radioactive waste generator to fully characterize your waste both chemically and radiologically. Detailed guidelines for both radioactive and chemical characterization of radioactive wastes are presented in the following subsections. To ensure that your waste can be safely and reasonably managed by the Waste Management Group, your EH&S Generator Assistance specialist will advise you of any changes in radioactive waste acceptance criteria for disposal sites or the Berkeley Lab HWHF.

Radioactive Waste Characterization Criteria

The first step is to determine whether your waste is radioactive or mixed (a mixture of radioactive and hazardous waste). All the hazardous and nonhazardous components in each waste container must be fully identified. If radioactive waste contains a hazardous component, it must be characterized by type of hazard (see Hazardous Waste Characterization Criteria in this manual). It is important to account for 100% of the contents of each waste container, including trace amounts of known hazardous components, even though you may not consider the concentrations to be sufficient to warrant designation of the waste as hazardous. A common problem is the failure to recognize that water and hydrogen ion (pH), if present, must be listed as components. Radioactive waste characterization to meet performance requirements may be achieved in the following ways:

- By maintaining records (logs) of accumulations that draw upon knowledge of the procedures and processes that generated the wastes. The logs contain an entry each time radioactivity is added to a container (see Figure R-5 on page Rad-15). To use and justify process knowledge, these entries must be based on direct information transfer from written research techniques (DIRT), a materials balance (MB), direct assay (DA) and/or a predictable reaction product (Rx). The Daily Use Log (RWA program; see Figure R-2) may be used for this purpose.
- Use separate accumulation logs for mixed waste; in this case, the hazardous component must meet the characterization requirements for Hazardous Waste (see Hazardous Waste Characterization Criteria in this manual).

- By using analytical results from a certified laboratory on known, unchanging waste streams (i.e., a waste profile), or by using complete analytical results from a certified laboratory for each waste. Analytical results from a noncertified laboratory may be used if adequate analytical records and procedures are documented and available to the EH&S Waste Certification Team.

To provide auditable documentation of your characterization methodology, you should complete, sign, and date the Waste Characterization Certification section of the Radioactive/Mixed Waste Disposal Requisition. (See Figure R-6 in Section 7.)

LBNL Daily Use Log

RWA: 1067

Location: Bldg 94/3

Division: (5)

Principal Investigator: Jean Generatuer

Radioactive Material Received ³⁵S. Methionine

Cell Extract = 2% SDS
 1% Mercaptoethanol
 4 mM EDTA
 20% sucrose
 in 0.25 M Tris-HCl
 pH 6.8.

Date	Isotope	Chemical Form	Amount (mCi)	Transaction ID
4/7/96	^{35}S	l-methionine	0.1	A-6484

Usage

Disposal

Waste Type Codes: D = Dry Waste L = Liquid Waste A = Animal Waste
* A copy of this form is to accompany vial transfers to other authorized projects.

RAB WASTE TAG # R8103

Figure R-2. Sample LBNL Daily Use Log (RWA program)

Documentation of Experimental Process

Waste acceptance criteria from radioactive waste disposal sites require that all waste generators be able to validate the chemical and radioactive constituents of their waste by referring to pertinent written procedures, logs of activities, and results of analyses conducted in the course of their experiments. To achieve this requirement, Generator Support will assist generators in diagramming and briefly describing experimental processes and the associated waste streams from research activities involving radioactive materials. Your EH&S Generator Assistance specialist will assist you in preparing this documentation. This information should provide the basis for characterization of waste based on process knowledge (see below). This process information will be compiled by EH&S as part of the Berkeley Lab Radioactive Waste Reduction Plan and will be updated annually.

Process Knowledge

Because most radioactive waste is generated during specific processes in the course of your activities or experiments, you should know the radioactive and chemical content of a unit of waste from your "knowledge of the process" that generated that waste. In fact, the individual who generates the waste is, in most cases, the most accurate source, including certified analytical laboratories, for specifying the components and their concentration in a given waste sample. Most radioactive and mixed waste generated at the Berkeley Lab can be characterized through process knowledge. However, for this approach to be considered the most reliable for accurate waste characterization, it must be supported by precise, documented information. (See Radioactive Waste Characterization Criteria; and, for mixed waste, see Hazardous Waste Characterization Criteria as well.) To use and justify process knowledge for characterization of radioactive and mixed waste, you must

- be able to estimate, with some precision, the radioactive content of a unit of waste, if any;
- know whether the chemicals used in the process were hazardous;
- have a thorough understanding of how the chemicals were used;
- understand the chemistry of the reaction to determine if hazardous chemicals were produced where none existed before; and
- know whether the process converted unlabeled chemicals to radiolabeled ones.

Naturally Occurring Radioactive Material (NORM)

Wastes containing naturally occurring radioactive material (NORM) as the sole radioactive constituent are disposed of as radioactive waste only if they have been isotopically enriched during Berkeley Lab research or support activities. For example, photographic fixers and other chemical solutions containing ^{40}K as the only radioactive constituent (in its naturally occurring isotopic abundance) are managed only for hazardous characteristics, if any.

Quality Assurance

As part of EH&S's quality assurance (QA) program for waste characterization, Waste Management Group personnel sample waste at the HWHF to ensure that the generators have accurately and completely characterized their waste. On a routine basis, up to 40% of incoming waste may be sampled and analyzed under various QA programs. (There are seven different QA programs that require generator characterization to be validated. Some are driven by LBNL's Part B Permit, some are driven by the DOE low-level waste Moratorium procedures, and some are driven by low-level waste certification plans required by our offsite treatment and disposal facilities.) The Waste Management Group tracks performance of individual generators and issues NCARs where generators have made substantial errors. In all cases, Generator Assistance will discuss results of QA sampling and analysis with you.

The Deputy Director for Operations will require generators whose waste is consistently mischaracterized, as determined by QA programs, to provide analytical results from the certified analytical services laboratories under contract to LBL before the Waste Management Group picks up their waste. Sampling must be arranged well in advance of waste pickup and must take into account maximum residence times in the SAAs. This sampling and analysis must be funded by the division owning the waste.

If the generator's characterization continues to fail validation for accuracy and integrity, the Deputy Director for Operations may require the generator and his/her staff to complete process-specific training. Again, any related sampling and analysis required to fully characterize the waste must be funded by the division.

4. Segregation of Radioactive Wastes

To reduce the costs of radioactive waste management at Berkeley Lab, it is important for you to segregate your aqueous radioactive waste streams by half-life of the isotopes to allow yourself and the HWHF to maximize waste reduction in the future. Separate, clearly labeled collection containers should be established, as follows:

- Segregate wastes by half-life:
 - Segregate materials containing isotopes with half lives <3 hours from all other radionuclides; such materials must be allowed to decay in the workplace for at least 10 half lives (30 hours). After ten half-lives, the materials will be checked for contamination according to the governing RWA. This must be approved through the RWA process.
 - Segregate wastes containing radionuclides with half lives >3 hours and <15 days (such as ^{32}P).
 - Segregate wastes containing radionuclides with half lives >15 days and <90 days (including ^{35}S and ^{125}I).
 - Segregate wastes containing radionuclides with half lives >90 days from all other wastes.
- Segregate low-level and transuranic wastes in separate containers.
- Segregate your scintillation vials according to the type of scintillation fluid used and by isotope (see "Scintillation Vials" in Section 8 below).
- Segregate compactable and noncompactable dry radioactive waste.

If you are unclear on these requirements or the radioactive waste segregation as outlined above is not feasible in your laboratory, please contact your Generator Assistance specialist.

5. Labeling of Radioactive Waste Containers

Chemical Composition of Radioactive Waste

All radioactive wastes that contain chemicals should be considered potential mixed wastes until the chemical portion has been determined to be nonhazardous. To allow this level of characterization, quantitative information describing all hazardous and nonhazardous constituents must be listed on the Radioactive Waste Tag (Figure R-3), or on a supporting Radioactive/Mixed Waste Accumulation Log or Daily Use Log, keyed by number to the Radioactive Waste Tag. Important information regarding hazardous waste characterization can be found in "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" (part of this manual).

Radioactive Content of Radioactive Waste

The radioactive content of your waste must be known. You may determine the concentration of a radionuclide either by direct methods such as counting, or by indirect methods such as radionuclide material accountability or the use of scaling factors that relate the inferred concentration of one radionuclide to another that is measured, if there is reasonable assurance that the indirect methods can be correlated with actual measurements. For solid waste, make the best possible estimate of radioactive content. User knowledge is the favored approach, but it must be documented.

The Radioactive Waste Tag

The Radioactive Waste Tag must provide a summary of all chemical and radiological constituents in your waste, identified by name and concentration. All nonhazardous and potentially hazardous chemical constituents must be listed on the tag. Because the information on the Radioactive Waste Tag is a summary, only one entry for each chemical constituent or radionuclide must appear on the Radioactive Waste Tag; the information on the tag must account for 100% of the waste volume. In addition, one or more of the acronyms (DA, MB, Rx, and DIRT; see page Rad-5) must be entered to describe the characterization method used for each entry on the Radioactive Waste Tag. An example of a correctly prepared Radioactive Waste Tag is shown as Figure R-3.

Each Radioactive Waste Tag is reviewed by the Waste Management Group's Certification Team for correctness. Appendix 2 shows the acceptance criteria used by the Certification Team in reviewing Radioactive Waste Tags.

The Radioactive Waste Tag Continuation Sheet

In the event the summary chemical and radiological information will not fit on your Radioactive Waste Tag, you may complete your characterization summary using a Radioactive Waste Tag Continuation Sheet (Figure R-4). If you use a Continuation Sheet, check the box next to "D. Continued on Continuation Sheet?" on your Radioactive Waste Tag. Also, fill in the R-number from the Radioactive Waste Tag after the "R" on the Continuation sheet. If you are not sure that you are properly using the Radioactive Waste Tag Continuation Sheet, your EH&S Generator Assistance specialist is available for consultation.

INSTRUCTIONS

1. State and Federal waste disposal and transportation regulations require completion of this waste tag.
2. Minimize the gross volume of your waste; separate the noncontaminated materials from the hazardous or radioactive waste.
3. Separate radioactive waste into groupings: low level waste (LLW), transuranic waste (TRU), low level mixed waste (LLMW), and transuranic mixed waste (TRUM). Disposal of mixed waste is the most costly.
4. Keep radioactive waste free of other hazardous substances wherever practical. Identify the hazardous materials used in your research; you may be able to modify your procedure or substitute or neutralize these hazardous components in order to reduce their volume and toxicity. Attempt to keep oxidizers, flammables, poisons, and corrosive substances separate. Any of these substances added to low level waste will change it to the more costly mixed waste.
5. Scintillation vials are collected in a 10-gallon plastic container or in celled cardboard containers inside plastic bags; no metal, adsorbent, or other waste.
6. Segregate radioactive waste based on half-life, as follows:

Half-life
<3 hrs
>3 hrs and <15 days
>15 days and <90 days
>90 days

7. For consultation, especially on identifying hazardous materials, call your EH&S Generator Assistance specialist.

CAUTION



RADIOACTIVE WASTE



CONTINUATION SHEET

Total: _____ μ Ci

Additional Comments:

KEEP ALL THREE FORMS TOGETHER UNTIL WASTE IS PICKED UP.

No. R

SEE REVERSE SIDE FOR INSTRUCTIONS

Figure R-4. Radioactive Waste Tag Continuation Sheet

Radioactive Waste Accumulation Log

When wastes are accumulated in a radioactive waste container through two or more repetitive additions, a history of accumulation must be provided on a Radioactive Waste Accumulation Log or in the RWA notebook in the LBNL Daily Use Log (Figure R-2), and the integrated composition must be summarized on a Radioactive Waste Tag. Separate logs must be kept for radioactive and mixed wastes. For use of this form as a log for radioactive waste, cross off the word "Mixed" from the title of the log.

When a new accumulation container is started, the Radioactive Waste Tag must be attached with the following sections filled in:

- A ("Physical Form")
- F (all entries)
- G ("Generator's Name")

Examples of a Radioactive Waste Tag (Figure R-3) and its supporting Radioactive Waste Accumulation Log (Figure R-5) illustrate the fulfillment of this requirement.

CAUTION



RADIOACTIVE WASTE

BERKELEY LAB

RADIOACTIVE WASTE ACCUMULATION LOG

Container Description: 1 L bottle

Radioactive Waste Tag No. R-407 (HWHF 1/8/96 RA)

Figure R-5. Radioactive Waste Accumulation Log

6. Guidelines for Radioactive Waste Accumulation

Management of Your Radioactive Waste Collection Area

You should establish Radioactive Waste Collection Areas for the accumulation of radioactive wastes within your Radioactive Material Area (RMA). The Radioactive Waste Collection Area(s) should be clearly marked off with magenta and yellow tape, and all radioactive waste accumulation should take place within the marked area(s).

- Locate your Radioactive Waste Collection Area away from areas of high foot traffic or emergency equipment, and separated from areas where other types of wastes are accumulated.
- Be scrupulous about good housekeeping in hoods, glove boxes, and laboratories. Avoid overfilling and spills.
- When you are accumulating wastes, you may attach the Radioactive Waste Tag to the secondary containment.
- Do not pour liquid radioactive or mixed waste down the sanitary drain. If this should happen accidentally, immediately call EH&S Environmental Protection Group, extension 5251.
- Keep a copy of these guidelines near your Radioactive Waste Collection Area.

If you are unsure about guidelines for establishing or managing a Radioactive Waste Collection Area, call your EH&S Generator Assistance specialist for information or a site consultation.

Radioactive Waste Packaging

It is very important that you package your waste appropriately for transport to the Berkeley Lab HWHF. Radioactive waste that is not properly packaged will not be picked up by HWHF staff.

- Place all radioactive sharp objects (hypodermic needles, spitzers, scalpels, etc.) in protective containers. Ice cream cartons (available from Stores in pint [Item 8115-27762], quart [Item 8115-27763], and two-quart [Item 8115-27764] sizes) lined with plastic bags are acceptable.
- Do not place radioactive sharps in medical/biohazardous sharps containers.
- Do not overfill any radioactive or mixed waste container, liquid or dry.
- Make sure that the container is chemically compatible with the contents.
- Store all radioactive liquids in leak-tight containers inside rigid secondary containment. Seal the bottle with duct tape when you are ready to fax the Radioactive/Mixed Waste Requisition to the Waste Management Group.
- You should provide your primary waste containers (ice cream cartons, polyethylene bags, etc.). Most necessary items can be ordered from Berkeley Lab Stores (see Tables H-1 and H-2 of this manual). EH&S will supply some items, such as 30-gallon dry compactable waste containers and carboys.

7. Requesting Radioactive Waste Pickup

When your radioactive waste container is filled or when you wish to have your radioactive waste picked up, fax a completed Radioactive/Mixed Waste Requisition form (Figure R-6) to the HWHF (extension 4838), along with a copy of your signed and dated Radioactive Waste Tag and any supporting documentation, such as accumulation logs. If the EH&S Certification Specialist is satisfied that the tag is filled out completely and accurately, the HWHF will be directed to pick up your waste. You will be contacted by the HWHF if your tag and supporting documentation are not sufficient to adequately characterize your waste. If this phone call does not clarify all issues regarding the appropriate characterization of your waste, a Nonconformance and Corrective Action Report (NCAR) may be issued to your Division ES&H Coordinator, and your EH&S Generator Assistance representative may contact you to offer assistance.

LBNL Radioactive/Mixed Waste Disposal Requisition FAX 4838 • Questions: 5251		EH&S USE ONLY HWHF Requisition No. _____ Date Received _____					
INSTRUCTIONS: Please provide all information requested. List no more than one rad tag number per line. Your signature is required, and certifies that to the best of your knowledge, the chemical and radioactive composition provided for each item on the attached rad tag is correct. Please fax a copy of the radioactive waste tag and accumulation log for each item with this requisition form.							
GENERATOR INFORMATION							
Date _____	Operating Account No. _____	Bldg. _____	Room _____				
Additional Description _____		Has this information been FAXED before? <input type="checkbox"/> Y/N					
Name (printed) _____	Employee ID # _____	Div. _____	Phone _____				
WASTE INFORMATION							
Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____				
Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____				
Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____				
Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____	Radioactive Waste tag number _____				
							
I certify that to the best of my knowledge, the radioactive and chemical composition provided on the attached radioactive waste tag for each item is correct. The basis for process knowledge for each entry on the Radioactive Waste tag is either MB, DA, DIRT, or RX. In addition, I have taken EH&S Training Courses 601 and 621.							
Generator Signature _____							
EH&S USE ONLY							
Supporting documentation provided (list all): <div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div>							
Radwaste Tag number <input type="checkbox"/> Char. OK? <input type="checkbox"/> Char. sampling (list tests needed) <input type="checkbox"/> QA sampling (list tests needed) <input type="checkbox"/> Part B Waste Stream <input type="checkbox"/> EPA/State Codes <input type="checkbox"/> STP Waste Stream <input type="checkbox"/> Pickup? (Y/N) <input type="checkbox"/> Preassigned Storage Location	Compliance						
Generator training (Course numbers/dates taken): <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>				Will acceptance of these waste containers into the HWHF exceed threshold? <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>			
Signatures: _____ Certification Team Member _____ Date _____				Compliance Team Member _____ Date _____			
Samples taken by: _____ Operations Team Member _____ Date _____				Waste picked up by: _____ Operations Team Member: _____ Date _____			

Figure R-6. Radioactive/Mixed Waste Disposal Requisition

8. Guidelines for Specific Radioactive Waste Streams

Before radioactive wastes can be packaged at the HWHF, they must be separated into the proper waste streams. This section describes guidelines unique to each waste stream. If you are unsure about how to separate and package your radioactive waste, please call your EH&S Generator Assistance specialist.

Solid Compactable Dry Waste

By definition, dry waste is solid radioactive waste that has less than 1% free liquids. Keep these wastes inside a cement sack inside a 24" x 38" polyethylene bag, all placed inside a 15-gallon waste can. EH&S (extension 5251) provides the Dry Waste 15-gallon can. Cement sacks are available from Berkeley Lab Stores (Item 8105-27692), as are polyethylene bags (Item 8105-51456).

When your dry waste bag is full or ready for pickup, you should seal it with 2-inch duct tape and tie and tape your signed Radioactive Waste Tag and any supporting documentation to the neck of the sealed plastic bag. Double-bag the waste if there is suspected external contamination.

Solid Noncompactable Dry Waste (solid items > 4" x 4" x 4" with <1% liquid)

Keep these wastes inside a cement sack inside a 24" x 38" polyethylene bag and seal the plastic bag with 2-inch duct tape.

Induced Metals and Equipment

An EH&S representative will package large pieces. Place small pieces in DOT-approved drums or EH&S-approved polyethylene bags. Label all containers with Radioactive stickers (provided by EH&S).

Animal Carcasses and Tissues

Keep carcasses and tissues frozen, contained in double plastic bags. Fill out a separate Radioactive Waste Tag for each bag. Tape or otherwise protect any sharp items, such as claws.

Scintillation Vials

- Whenever possible, pack scintillation vials in their original celled cardboard containers to minimize the possibility of breakage prior to or during shipment to the HWHF. Place the celled containers in a secondary containment such as a photographic tray.
- If the original celled containers are not available, use 10-gallon plastic containers (provided by EH&S). Place a 2-mil (minimum thickness) plastic liner in the container. Stores Item 8105-59166 is acceptable. There should be no metal, absorbent, or other waste in the container.

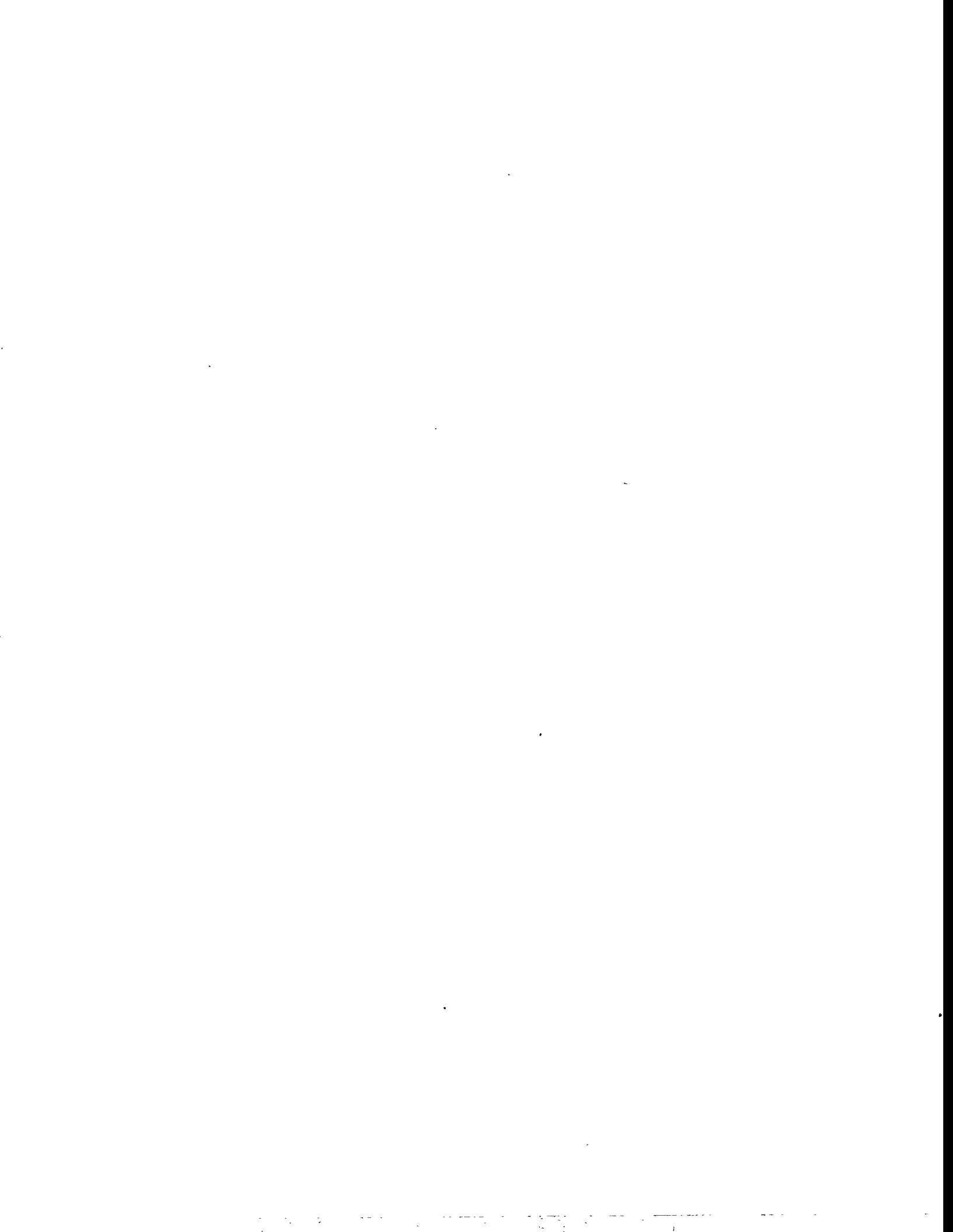
- A Radioactive Waste tag must be attached and filled out as specified in the preceding section entitled "Radioactive Waste Tag" to the container for scintillation vial disposal. The chemical characterization of scintillation vial waste must include the chemical in the counting sample and the final concentration; for example; 1% acetonitrile, 0.01 M NaOH, or 5% water.

Solid Transuranic Waste

- Package the waste in 1/2-gallon or smaller ice cream cartons, with lids sealed with 2-inch duct tape.
- Place the ice cream carton inside a polyethylene bag sealed with 2-inch duct tape.
- Identify all materials on the Radioactive Waste Tag by material composition (e.g., 50% paper, 25% glass, 25% rubber).
- Sign the Radioactive Waste Tag; tie and tape it (with 2-inch duct tape) to the sealed plastic bag.
- Place the plastic bag inside a 6"-diameter by 12"-high metal can (provided by EH&S).

Liquid Transuranic Waste

- Package the waste in LBL-certified glass containers. (Consult with EH&S on containers.)
- Place the glass containers in the ice cream cartons as described for solid transuranic waste, and follow the solid waste procedure.



Guidelines for Generators to Meet HWHF Acceptance Requirements for Mixed Wastes at Berkeley Lab

1. Introduction

This document provides performance standards that you, as a generator of mixed (hazardous and radioactive) waste at the Berkeley Lab, must meet to:

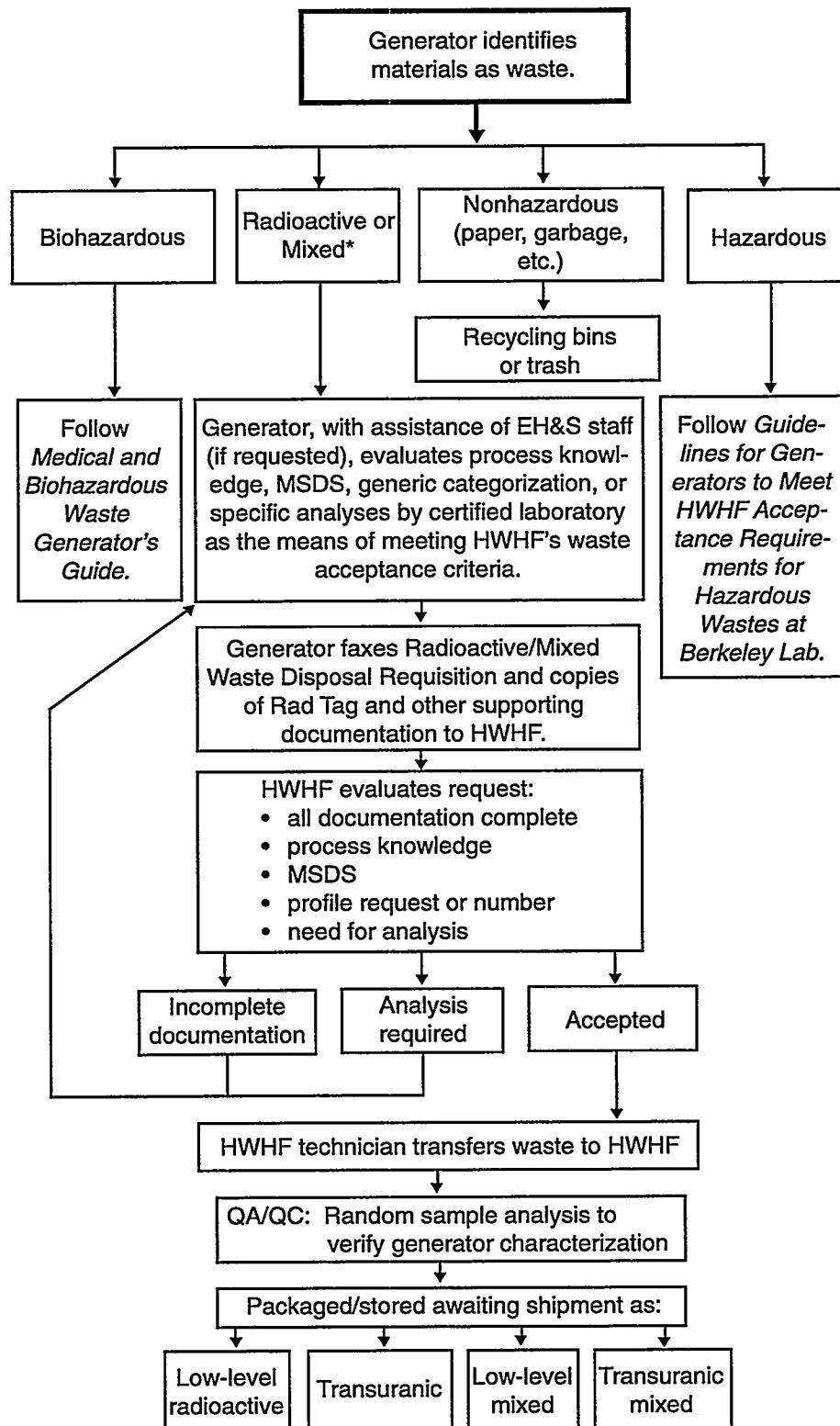
- protect Berkeley Lab staff and the environment,
- comply with hazardous waste regulations and ensure the continued safe operation of your workplace,
- have your waste transferred to the HWHF, and
- enable the Environment, Health and Safety (EH&S) Division to properly pick up, manage, and ultimately send your waste off site for recycling, treatment, or disposal.

If you use radioactive and hazardous materials and generate mixed wastes, you must establish a Mixed Waste Satellite Accumulation Area (MWSAA) and follow the guidelines listed in this section of the manual. Figure M-1 is a flowchart that shows how mixed (and radioactive) waste is managed at the Berkeley Lab.

Because mixed waste is both radioactive and hazardous, you must adhere to the requirements in the two other portions of this manual, entitled "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" and "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab." These requirements include characterization for both chemical and radioactive content and affixing a Hazardous Waste label and a Radioactive Waste tag to each waste container to make it clear that the waste added to the container was mixed. The intent of this section is to provide guidance on the rational integration of requirements for hazardous and radioactive wastes and to point out certain guidelines and requirements that are specific to mixed waste. This section is not meant to provide stand-alone standards for workplace management of mixed waste. It is designed as a supplement to the other sections to avoid redundancy.

Implementation of a mixed waste management system based solely on the information in this section will not meet the performance standards for disposal of mixed waste.

The guidelines in this section do not apply to wastes that are radioactive, but are not hazardous. For information on radioactive waste management, see the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab" (part of this manual).



*Containers of mixed waste must have *Hazardous Waste* labels attached to them at all times.

Figure M-1. Flowchart for Radioactive and Mixed Waste Management at Berkeley Lab

The guidelines in this section also do not apply to wastes that are hazardous, but are not radioactive. For information on hazardous waste management, see the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" (part of this manual).

The requirements in this section also do not apply to purely medical and biohazardous wastes. For information on proper management of medical and biohazardous wastes, see the most recent revision of PUB-3095, *Medical and Biohazardous Waste Generator's Guide*. To identify the most recent version of PUB-3095 or any other document referenced in this manual, contact your Generator Assistance specialist.

Mixed waste generated at the Berkeley Lab is transferred to the Hazardous Waste Handling Facility (HWHF), managed by the EH&S Division. The waste is treated, if necessary, and packaged for storage and ultimate shipment to one of several treatment, storage, and disposal facilities (TSDFs), as specified in the Laboratory's *Site Treatment Plan*. Each of the TSDFs establishes criteria (in conjunction with DOE) for acceptance of mixed wastes. The guidelines listed in this section are designed to ensure that individual generators of mixed waste comply with the waste acceptance criteria of TSDFs so that the Berkeley Lab can dispose of this waste in a responsible and timely manner. The performance standards in this manual are also designed to promote compliance with all other regulations covering the management of mixed wastes at the Berkeley Lab.

Further information on proper handling of mixed wastes is presented in Chapters 20 (Hazardous Waste Disposal) and in the Radiological Work Authorization (RWA) Section of Chapter 21 (Radiation Safety) of the most recent version of PUB-3000, the Berkeley Lab *Health and Safety Manual*.

What Is a Mixed Waste?

A waste is mixed if it is classified by federal and state agencies as being both radioactive and hazardous. At Berkeley Lab, a waste is characterized as radioactive if either process knowledge or monitoring and sampling show that radioactive material has been added to the waste. Wastes containing only naturally occurring radioactive material (NORM), such as potassium-bearing compounds with ^{40}K as the sole radioactive constituent, are not considered to be radioactive and should be managed as hazardous or nonhazardous waste, depending on chemical composition. More specific information on the proper classification of radioactive wastes can be found in another portion of this manual, entitled the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab."

Hazardous waste falls into two regulatory categories: characteristic and listed. Regulatory designation of chemical components of waste as "characteristic" is based on specific hazardous property characteristics (toxicity, reactivity, ignitability, or corrosivity) that may depend on their concentrations (pH is a good example). "Listed" waste is derived from chemicals that are specifically listed in the regulations. (See the paragraph entitled "Listed Hazardous Waste" in "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab.")

If, after reading this manual, you are still unsure whether your waste is mixed, contact your EH&S Generator Assistance representative for assistance.

2. Mixed Waste Minimization

It is absolutely essential that you minimize the amount of mixed waste you generate in your research. Because the regulations concerning mixed waste treatment and disposal are not yet fully mature, mixed waste management is both difficult and expensive. At the Berkeley Lab, for example, the addition of a small amount of radioactive material to a hazardous waste would increase waste management costs by more than two orders of magnitude! In addition, the total mixed waste storage capacity at the Berkeley Lab's HWHF is extremely limited, and much of the mixed waste must be stored for long periods of time before ultimate treatment and / or disposal will be allowed under a Federal Facilities Compliance Act that governs DOE facilities. The EH&S Division is doing what it can to alleviate the problems and reduce costs by establishing new treatment capabilities, such as neutralization, for some mixed waste streams, and by instituting "decay in place" policies for short-lived radioactive and mixed wastes. It is important that you also do your share by practicing mixed-waste source reduction in your research to the greatest extent practicable.

Mixed-waste source reduction refers to practices that eliminate the generation of mixed waste. Several ways to accomplish mixed waste source reduction are as follows.

- You can eliminate a mixed waste stream by replacing all radioactive constituents with nonradioactive constituents. For example, immuno-assay or chemical-fluorescence methods might be used in place of radioactive tracers in some applications, with little or no decrease in sensitivity.
- A mixed waste stream can be eliminated by replacing all hazardous constituents with nonhazardous constituents. For example, nonhazardous scintillation fluids can be used in some counting applications, greatly reducing the amount of mixed waste generated.
- You can minimize the volume of an existing mixed waste stream by using microscale chemical techniques and by designing your experiments to use the minimum amount of radioactive materials and chemicals practicable.

In addition, avoidance of "listed" chemicals (Appendix 1) in your research processes enhances opportunities for treatment of mixed waste and eventual disposal as radioactive. This strategy can reduce the volume of the waste, the impact on the environment, and the cost of disposal.

More information relevant to the minimization of mixed wastes can be found in the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" and the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab" (other sections of this manual). In addition, specific recommendations for source reduction in your experiment(s) can be found in the Berkeley Lab Mixed Waste Reduction Plan, prepared annually by EH&S based on input from all routine mixed-waste generators at the Berkeley Lab. Your Generator Assistance specialist will contact you annually to update the Berkeley Lab Mixed Waste Reduction Plan, and to discuss specific source reduction strategies that may be relevant to your research.

3. Mixed Waste Characterization

Proper characterization of mixed waste is mandatory and encompasses all of the challenges of both radioactive waste characterization and hazardous waste characterization. Hazardous waste characterization criteria can be found in the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" (part of this manual). Characterization of radioactive waste is described in detail in the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab" (part of this manual).

As with both hazardous and radioactive wastes generated at the Berkeley Lab, an EH&S Waste Certification specialist will evaluate your characterization information for completeness and accuracy. If questions concerning your characterization or documentation can not be cleared up through a phone conversation, a Nonconformance and Corrective Action Report may be issued to your Division ES&H Coordinator, and your EH&S Generator Assistance specialist may contact you to offer assistance.

If, after reading this booklet, you are unsure that you are properly characterizing your mixed waste, please call your EH&S Generators Assistance specialist for a consultation.

4. Segregation of Mixed Wastes

To avoid inadvertently creating mixed waste and to minimize the costs of mixed waste management at the Berkeley Lab:

- Mixed waste must be segregated from all other types of waste in your laboratory (nonhazardous, hazardous, radioactive, or biohazardous).
- Never add anything but mixed waste to any mixed waste container.
- Segregate mixed waste streams by isotopic half-life to allow the HWHF to maximize mixed waste reductions through "decay in place" practices.
- Established separate containers for low-level radioactive mixed waste and transuranic mixed waste, as indicated in the Segregation of Radioactive Wastes section of the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab" (another portion of this manual).

Mixed wastes must also be segregated on the basis of hazardous characteristic to prevent accidents due to the inadvertent mixing of incompatible materials and to maximize treatment and disposal options. Requirements for the segregation of chemically incompatible wastes can be found in the Segregation of Incompatible Wastes section of the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" (another portion of this manual).

If you are unclear on these requirements, or the radioactive waste segregation as outlined above is not feasible in your laboratory, please contact your Generator Assistance specialist.

5. Separation of Mixed Wastes

In addition to segregation, you must use physical separation to prevent the inadvertent mixing of incompatible mixed wastes. Separation is achieved using distance and/or chemically resistant barriers such as secondary containers. Chemically incompatible mixed wastes must not be placed within the same secondary containment bin. In addition, SAAs, MWSAAs, and Radioactive Waste Collection Areas must be physically separated to preclude accidental cross-contamination. More specific information on separation requirements for hazardous (and mixed) waste can be found in the Separation of Incompatible Wastes section of the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" (another portion of this manual).

6. Guidelines for Mixed Waste Accumulation

A Mixed Waste Satellite Accumulation Area (MWSAA) is an area in an individual laboratory, shop, or other facility designated by the generator for the temporary accumulation of mixed waste. You must establish a MWSAA for the accumulation of your mixed wastes within your Radioactive Material Area (RMA). The MWSAA must be clearly identified by a purple MWSAA sign, and all mixed waste accumulation must take place within the designated area. The area must be at or near the point of mixed waste generation and under the control of a responsible, trained generator. Even a single small bottle of mixed waste requires the establishment of a MWSAA.

- Locate your MWSAA away from areas of high foot traffic and emergency equipment, and separated from areas where other types of wastes are accumulated.
- Be scrupulous about good housekeeping in hoods, glove boxes, and laboratories.
- Do not pour liquid mixed waste down the sanitary drain. If this should happen accidentally, immediately call EH&S Environmental Protection Group, extension 5251.
- You must keep a copy of these *Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous, Radioactive, and Mixed Wastes at Berkeley Lab* near your MWSAA.

If you are unsure about requirements for establishing or managing a MWSAA, call your EH&S Generator Assistance specialist for information or a site consultation.

With two exceptions, the requirements for operation of a MWSAA are identical to those for operation of an SAA (see the Requirements for SAA Operation section of the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" (another portion of this manual). The two exceptions are as follows:

- The MWSAA must be designated using the purple MWSAA sign shown in Figure M-2.
- When you wish to have your mixed waste picked up, or you are approaching either the quantity or time limits (275 days), you must fax a Radioactive/Mixed Waste Disposal Requisition and supporting documentation to the HWHF at extension 4838.

MW-SAA

**SATELLITE ACCUMULATION AREA
FOR MIXED (HAZARDOUS/RADIOACTIVE)
WASTE**

RESPONSIBLE INDIVIDUAL:

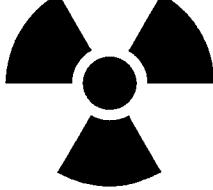
NAME _____

BLDG/ROOM _____

PHONE _____

TYPE OF WASTE _____

ISOTOPE(S) _____



DO NOT ADD WASTE TO THIS ACCUMULATION AREA WITHOUT
PRIOR AUTHORIZATION FROM THE RESPONSIBLE INDIVIDUAL

Questions: Call EH&S Generator Assistance

Figure M-2. Mixed Waste Satellite Accumulation Area (MWSAA) Sign

7. Mixed Waste Labeling

Because mixed waste is both hazardous and radioactive, you must affix both a Hazardous Waste Label and a Radioactive Waste Tag (Figures H-3 and R-3 of this manual, respectively) to each mixed waste container. The tags must be affixed at the time you declare a material to be mixed waste or when you begin to accumulate mixed waste in any container. Details on how to properly fill out these labels and on preparation of supporting documentation can be found in the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab" and the "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab" (other portions of this manual).

Record of Radioactive Mixed Waste Accumulation Log

When wastes are accumulated in a radioactive mixed waste container through two or more repetitive additions, a history of accumulation must be provided on a Mixed Waste Accumulation Log (see Figure M-3), and the integrated composition must be summarized on a Radioactive Waste Tag. Use of the RWA Materials Use does not suffice as a waste accumulation log in this case because it does not account for accumulation of the hazardous component. Separate logs must be kept for radioactive and mixed wastes. For use of this form as a log for mixed waste, cross off the word "Radioactive" from the title.

When a new mixed waste accumulation container is started, affix a Hazardous Waste tag with sections 1, 3, 4, 5, and 6 filled in (see "Labeling" in the hazardous waste section of this manual). Because the waste is also radioactive, attach the Radioactive Waste Tag with sections A ("Physical Form"), F (all entries), and G (Generator's Name) filled in. The Mixed Waste Accumulation Log or an indication to staff of which mixed waste stream is acceptable should also be attached to each mixed waste container. An example of a Radioactive Waste Tag filled out for mixed waste and a Hazardous Waste Label are shown, respectively, in Figures M-4 (below) and H-3 (in "Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous Wastes at Berkeley Lab").

8. Requesting Mixed Waste Pickup

When you wish to have your mixed waste picked up, or when you are approaching either the 55-gallon or 275-day (9-month) limits for accumulation of mixed waste in an MWSAA, you should fax a Radioactive/Mixed Waste Disposal Requisition (see Figure R-6 in "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab") and supporting documentation to the HWHF at extension 4838. See Sections 6 and 8 in "Guidelines for Generators to Meet HWHF Acceptance Requirements for Radioactive Wastes at Berkeley Lab" for details on packaging radioactive waste.

CAUTION



RADIOACTIVE WASTE



BERKELEY LAB

MIXED WASTE ACCUMULATION LOG - Solvents, Only !!

Container Description: Carboy

Date Added	Description of What Was Added	Amount	Isotope	Activity	Initials
6/7/96	Ethyl acetate/acetone 2:1	500 ml	^3H	<1 μCi	WL
6/7	Methanol	0.5 L	^3H	1 μCi	RAJ
6/8	Hexane	1.0 L	^{14}C	1.6 μCi	WL
6/10	Acetone	1.0 L	^3H	0.5 μCi	SBS
6/15	Acetone	0.2 L	^3H	<0.5 μCi	KMN
6/16	Ethyl acetate	0.1 L	^3H	<1.0 μCi	RAJ
6/20	Acetone 6/10 RAJ	1000 ml			RAJ
6/21	Methanol	200 ml	^3H	0.5 μCi	WL
6/23	Acetone	2.0 L	^3H	0.7 μCi	WL
7/1	Ethyl acetate	2.0 L	^3H	<1.0 μCi	WL
7/1	Acetone	0.5 L	^3H	0.5 μCi	SBS
7/2	Acetone	1000 ml	^3H	0.5 μCi	WL
7/3	Ethyl acetate/acetone 2:1	1.0 L	^3H	<1.0 μCi	SBS
7/10	Acetone	3.0 L	^3H	0.4 μCi	RAJ
7/12	Acetone (7/3) Methanol	0.2 L	^{14}C	10 μCi	KMN
	Summary				
	EtAc 1333, 100, 2000, 666	3.1 L	^3H	3 μCi	
	MeOH 500, 200, 200	0.9 L	$^3\text{H}/\text{E}$	11 μCi	
	Hexane 1000	1.0 L	^{14}C	1.6 μCi	
	Acetone 167, 1000, 333, 200, 2000, 500	8.2 L	^3H	3.7 μCi	

Radioactive Waste Tag No. R 8201

(HWHF 1/8/96 RA)

Figure M-3. Mixed Waste Accumulation Log

CAUTION



RADIOACTIVE WASTE



A. Physical form: Aqueous liquid Organic liquid Scintillation cocktail Dry
 Waste Container Size 15 L Actual Vol. of Waste 13.2 L pH N/A
 Accumulation log number R 8201

B. Radioactivity			C. Chemical Constituents of Waste (i.e., buffers, salts, etc.)	
			List all chemicals	
MP	3	μCi	Ethyl acetate - DIRT	23 v wt %
MB	0.9	11 μCi	Methanol - MB	7 v wt %
DA	1.0	1.6 μCi	Hexane - DIRT	8 v wt %
MB	3.7	μCi	Acetone - DIRT	62 v wt %
		μCi		wt %
		μCi		wt %
		μCi		wt %

Total: 19 μCi

D. Continued on continuation sheet?

E. Constituents Of Dry Waste (i.e., paper, plastic, metal, etc.)					
Item	Vol. %	Item	Vol. %	Item	Vol. %

F. Bldg/Rm 26/34 RWA 667 Div EH&S Acct 3073 Phone 4096

G. I certify I have adequate knowledge of the waste generating process to characterize this waste and, to the best of my knowledge, the information is accurate.

Gene Generator

Generator - PRINT NAME

Gene Generator

Generator's Signature

7/6/96

Date

WASTE MANAGEMENT GROUP USE ONLY

Radiation Dose/Rate @ Contact	mR/hour	Instrument serial #:
-------------------------------	---------	----------------------

Generator's portion of this tag has been reviewed IAW EH&S Procedure 827, Sec. 8.

EH&S Tech performing survey _____ Requisition No. _____

Compactable

Noncompactable

Waste Hauler's Signature

HWHF Receipt Date

CERTIFICATION TEAM WILL DETERMINE CLASSIFICATION

Low level Low level MIXED TRU TRU MIXED Induced metals

KEEP ALL THREE FORMS TOGETHER UNTIL WASTE IS PICKED UP.

No. R 8201

SEE REVERSE SIDE FOR INSTRUCTIONS

Figure M-4. Radioactive Waste Tag (front) filled out for mixed waste



Appendices

Appendix 1. Additional Information for Berkeley Laboratory Waste Generators

A. Federal and State of California Toxicity Characteristics

1. **Federal Toxicity Characteristic.** If your waste contains any of the following contaminants at or above the regulatory levels listed in the table below, when the waste is extracted (using the standard toxicity characteristic leaching procedure, or TCLP, test), then your waste is hazardous for the toxicity characteristic under federal regulations.

Table A-1. Federal Toxicity Regulatory Levels

Contaminant	Regulatory Level (Mg/L)	Contaminant	Regulatory Level (Mg/L)
Arsenic	5.0	Hexachlorobenzene	0.13
Barium	100.0	Hexachlorobutadiene	0.5
Benzene	0.5	Hexachloroethane	3.0
Cadmium	1.0	Lead	5.0
Carbon tetrachloride	0.5	Lindane	0.4
Chlordane	0.03	Mercury	0.2
Chlorobenzene	100.0	Methoxychlor	10.0
Chloroform	6.0	Methyl ethyl ketone	200.0
Chromium	5.0	Nitrobenzene	2.0
o-Cresol	200.0	Pentachlorophenol	100.0
m-Cresol	200.0	Pyridine	5.0
p-Cresol	200.0	Selenium	1.0
Cresol	200.0	Silver	5.0
2,4-D	10.0	Tetrachloroethylene	0.7
1,4-Dichlorobenzene	7.5	Toxaphene	0.5
1,2-Dichloroethane	0.5	Trichloroethylene	0.5
1,1-Dichlorethylene	0.7	2,4,5-Trichlorophenol	400.0
2,4-Dinitrotoluene	0.13	2,4,6-Trichlorophenol	2.0
Endrin	0.02	2,4,5-TP (Silvex)	1.0
Heptachlor (and its epoxide)	0.008	Vinyl Chloride	0.2

2. State of California Toxicity Characteristic

A material that has any of the following properties exhibits the California toxicity characteristic.

- An acute oral LD₅₀ less than 500 mg/kg
- An acute dermal LD₅₀ less than 4300 mg/kg
- An acute inhalation LD₅₀ less than 10,000 ppm
- An acute aquatic 96-hour LC₅₀ less than 500 mg/L
- Contains any of the Table A-2 substances exceeding 0.001% by weight
- Poses a hazard because of its carcinogenicity, acute toxicity, chronic toxicity, bioaccumulative properties, or persistence in the environment
- Is a federal listed waste
- Exceeds the soluble threshold limit concentration (STLC) or total threshold limit concentration (TTLC) given in Table A-3.

Table A-2
California Toxicity Characteristic Waste Exceeding 0.001% (Weight)

2-acetylaminofluorene	4-dimethylaminoazobenzene
acrylonitrile	ethyleneimine
4-aminodiphenyl	alpha-naphthylamine
benzidine and its salts	beta-naphthylamine
bis(chloromethyl)ether	4-nitrobiphenyl
methyl chloromethyl ether	N-nitrosodimethylamine
1,2-dibromo-3-chloropropane	beta-propiolactone
3,3'-dichlorobenzidine and its salts	vinyl chloride

Table A-3
California Toxicity Characteristic Waste
Persistent and Bioaccumulative Toxic Substances

	STLC mg/liter	TTLC mg/kg
antimony and/or antimony compounds	15	500
arsenic and/or arsenic compounds	5.0	500
asbestos		1.0%
barium and/or barium compounds*	100	10,000
beryllium and/or beryllium compounds	0.75	75
cadmium and/or cadmium compounds	1.0	1000
chromium (VI) compounds	5	500
chromium (III) and/or Cr+++ compounds	560	2,500
cobalt and/or cobalt compounds	80	8,000
copper and/or copper compounds	25	2,500
fluoride salts	180	18,000
lead and/or lead compounds	5.0	1,000
lead compounds, organic		13
mercury and/or mercury compounds	0.2	20
molybdenum and/or molybdenum compounds	350	3,500
nickel and/or nickel compounds	20	2,000
pentachlorophenol	1.7	17
selenium and/or selenium compounds	1.0	100
silver and/or silver compounds	5	500
thallium and/or thallium compounds	7.0	700
trichloroethylene	204	2040
vanadium and/or vanadium compounds	24	2,400
zinc and/or zinc compounds	250	5,000
polychlorinated biphenyls	5.0	50
numerous organic pesticides		

*Excluding some barium compounds (i.e., barite and solid barium sulfate).

B. Listed Hazardous Chemicals

Listed waste is considered hazardous regardless of the concentration of hazardous constituents in each batch.

Listed waste is legally hazardous unless it is "delisted" through a lengthy administrative procedure, as opposed to characteristic waste, which remains hazardous only as long as it is exhibits the characteristics for which it was listed.

A material is a listed waste if it is listed in any of the following:

- Hazardous waste from nonspecific sources (if wastes included in Table B-1)
- Hazardous waste from specific sources (K wastes)
- Acutely toxic wastes (P wastes included in Table B-2)
- Toxic wastes (U wastes included in Table B-3).

Definition of P-Listed Waste (from 40 CFR Section 261.33)

(d) Any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having the generic name listed in paragraph (e) or (f) of this section [Sec. 261.33], or any residue or contaminated soil, water, or other debris resulting from the cleanup of a spill, into or on any land or water, of any off-specification chemical product and manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in paragraph (e) or (f) of this section.

(e) The commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products or manufacturing chemical intermediates referred to in paragraphs (a) through (d) of this section, are identified as acute hazardous wastes (H) and are subject to be the small quantity exclusion defined in 261.5(e).

Definition of U-listed Waste (from 40 CFR Section 261.33)

(f) The commercial chemical products, manfacturing chemical intermediates, or off-specification commercial chemical products referred to in paragraphs (a) through (d) of this section, are identified as toxic wastes (T), unless otherwise designated and are subject to the small quantity generator exclusion defined in 261.5 (a) and (g).

Table B-1. Federal Listed Hazardous Waste*

F001 (degreasing)
tetrachlorethylene
trichloroethylene
methylene chloride
1,1,1-trichloroethane
carbon tetrachloride
chlorinated fluorocarbons
F002 (nondegreasing)
tetrachloroethylene
methylene chloride
trichloroethylene
1,1,1-trichloroethane
chlorobenzene
1,1,2-trichloro-1,2,2-trifluoroethane
o-dichlorobenzene
trichlorofluoromethane
1,1,2-trichloroethane
F003
xylene
acetone
ethyl acetate
ethyl benzene
ethyl ether
methyl isobutyl ketone
n-butyl alcohol
cyclohexanone
methanol
F004
cresols
cresylic acid
nitrobenzene
F005
toluene
methyl ethyl ketone
carbon disulvide
isobutanol
pyridine
benzene
2-ethoxyethanol
2-nitropropane

*This summary does not include listed waste from specific sources or industrial processes.

Table B-2. P-Listed Wastes

Hazardous Waste No.	Substance
P023	Acetaldehyde, chloro-
P002	Acetamide, N-(aminothioxomethyl)-
P057	Acetamide, 2-fluoro-
P058	Acetic acid, fluoro-, sodium salt
P002	1-Acetyl-2-thiourea
P003	Acrolein
P070	Aldicarb
P203	Aldicarb sulfone.
P004	Aldrin
P005	Allyl alcohol
P006	Aluminum phosphide (R,T)
P007	5-(Aminomethyl)-3-isoxazolol
P008	4-Aminopyridine
P009	Ammonium picrate (R)
P119	Ammonium vanadate
P099	Argentate(1-), bis(cyano-C)-, potassium
P010	Arsenic acid H_3AsO_4
P012	Arsenic oxide As_2O_3
P011	Arsenic oxide As_2O_5
P011	Arsenic pentoxide
P012	Arsenic trioxide
P038	Arsine, diethyl-
P036	Arsonous dichloride, phenyl-
P054	Aziridine
P067	Aziridine, 2-methyl-
P013	Barium cyanide
P024	Benzenamine, 4-chloro-
P077	Benzenamine, 4-nitro-
P028	Benzene, (chloromethyl)-
P042	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P046	Benzeneethanamine, alpha,alpha-dimethyl-
P014	Benzenethiol
P127	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P188	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)- 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo [2,3-b]indol-5-yl methylcarbamate ester (1:1).
P001	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1- phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	Benzyl chloride
P015	Beryllium powder

Table B-2. P-Listed Wastes (continued)

Hazardous Waste No.	Substance
P017	Bromoacetone
P018	Brucine
P045	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[methylamino)carbonyl] oxime
P021	Calcium cyanide Ca(CN) ₂
P189	Carbamic acid, [(dibutylamino)- thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7- benzofuranyl ester
P191	Carbamic acid, dimethyl-, 1-[(dimethyl-amino) carbonyl]- 5-methyl-1H- pyrazol-3-yl ester
P127	Carbofuran
P022	Carbon disulfide
P095	Carbonic dichloride
P189	Carbosulfan
P023	Chloroacetaldehyde
P024	p-Chloroaniline
P026	1-(o-Chlorophenyl)thiourea
P027	3-Chloropropionitrile
P029	Copper cyanide
P029	Copper cyanide Cu(CN)
P202	m-Cumanyl methylcarbamate.
P030	Cyanides (soluble cyanide salts), not otherwise specified
P031	Cyanogen
P033	Cyanogen chloride
P033	Cyanogen chloride (CN)Cl
P034	2-Cyclohexyl-4,6-dinitrophenol
P016	Dichloromethyl ether
P036	Dichlorophenylarsine
P037	Dieldrin
P038	Diethylarsine
P041	Diethyl-p-nitrophenyl phosphate
P040	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	Diisopropylfluorophosphate (DFP)
P004	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha, 4abeta,5alpha,8alpha,8abeta)-
P060	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha, 4abeta,5beta,8beta,8abeta)-
P037	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9- hexachloro-1a,2,2a,3,6,6a,7,7a- octahydro-, (1alpha,2beta,2alpha,3beta,6beta,6alpha,7beta, 7alpha)-
P051	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9 -hexachloro-1a,2,2a,3,6,6a,7,7a- octahydro-, (1alpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta, 7alpha)-, & metabolites
P044	Dimethoate

Table B-2. P-Listed Wastes (continued)

Hazardous Waste No.	Substance
P046	alpha,alpha-Dimethylphenethylamine
P191	Dimetilan.
P047	4,6-Dinitro-o-cresol, & salts
P048	2,4-Dinitrophenol
P020	Dinoseb
P185	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)- carbonyl]oxime.
P085	Diphosphoramido, octamethyl-
P111	Diphosphoric acid, tetraethyl ester
P039	Disulfoton
P049	Dithiobiuret
P050	Endosulfan
P088	Endothall
P051	Endrin
P051	Endrin, & metabolites
P192	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)- 1H-pyrazol-5-yl ester.
P190	Carbamic acid, methyl-, 3-methylphenyl ester.
P042	Epinephrine
P031	Ethanedinitrile
P194	Ethanimidothioc acid, 2-(dimethylamino)-N- [[(methylamino)carbonyl]oxy]-2-oxo-, methyl ester.
P066	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	Ethyl cyanide
P054	Ethyleneimine
P097	Famphur
P056	Fluorine
P057	Fluoroacetamide
P058	Fluoroacetic acid, sodium salt
P198	Formetanate hydrochloride.
P197	Formparanate
P065	Fulminic acid, mercury(2+) salt (R,T)
P059	Heptachlor
P062	Hexaethyl tetraphosphate
P116	Hydrazinecarbothioamide
P068	Hydrazine, methyl-
P063	Hydrocyanic acid
P063	Hydrogen cyanide
P096	Hydrogen phosphide
P060	Isodrin
P192	Isolan

Table B-2. P-Listed Wastes (continued)

Hazardous Waste No.	Substance
P202	3-Isopropylphenyl N-methylcarbamate.
P007	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	Manganese, bis(dimethylcarbamodithioato-S,S')-,
P196	Manganese dimethyldithiocarbamate.
P092	Mercury, (acetato-O)phenyl-
P065	Mercury fulminate (R,T)
P082	Methanamine, N-methyl-N-nitroso-
P064	Methane, isocyanato-
P016	Methane, oxybis[chloro-
P112	Methane, tetranitro- (R)
P118	Methanethiol, trichloro-
P198	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4- [(methylamino) carbonyloxy]phenyl]-
P050	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10- hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-
P199	Methiocarb
P190	Metolcarb
P066	Methomyl
P068	Methyl hydrazine
P064	Methyl isocyanate
P069	2-Methylacetonitrile
P071	Methyl parathion
P128	Mexacarbate
P072	alpha-Naphthylthiourea
P073	Nickel carbonyl
P073	Nickel carbonyl Ni(CO)4, (T-4)-
P074	Nickel cyanide
P074	Nickel cynaide Ni(CN)2
P075	Nicotine, & salts
P076	Nitric oxide
P077	p-Nitroaniline
P078	Nitrogen dioxide
P076	Nitrogen oxide NO
P078	Nitrogen oxide NO2
P081	Nitroglycerine (R)
P082	N-Nitrosodimethylamine
P084	N-Nitrosomethylvinylamine
P085	Octamethylpyrophosphoramide
P087	Osmium oxide OsO4, (T-4)-

Table B-2. P-Listed Wastes (continued)

Hazardous Waste No.	Substance
P087	Osmium tetroxide
P088	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P194	Oxamyl
P089	Parathion
P034	Phenol, 2-cyclohexyl-4,6-dinitro-
P128	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).
P199	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P048	Phenol, 2,4-dinitro-
P047	Phenol, 2-methyl-4,6-dinitro-, & salts
P202	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate.
P020	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P092	Phenylmercury acetate
P093	Phenylthiourea
P094	Phorate
P095	Phosgene
P096	Phosphine
P041	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	Phosphorodithioic acid, O,O-dimethyl S-[2- (methylamino)-2-oxoethyl] ester
P043	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester 3
P097	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	Phosphorothioic acid, O,O-dimethyl O-(4- nitrophenyl) ester
P204	Physostigmine.
P188	Physostigmine salicylate.
P110	Plumbane, tetraethyl-
P098	Potassium cyanide
P098	Potassium cyanide K(CN)
P099	Potassium silver cyanide
P201	Promecarb
P203	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime.
P070	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P101	Propanenitrile
P027	Propanenitrile, 3-chloro-
P069	Propanenitrile, 2-hydroxy-2-methyl-

Table B-2. P-Listed Wastes (continued)

Hazardous Waste No.	Substance
P081	1,2,3-Propanetriol, trinitrate (R)
P017	2-Propanone, 1-bromo-
P102	Propargyl alcohol
P003	2-Propenal
P005	2-Propen-1-ol
P067	1,2-Propylenimine
P102	2-Propyn-1-ol
P008	4-Pyridinamine
P075	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro- 1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-.
P114	Selenious acid, dithallium(1+) salt
P103	Selenourea
P104	Silver cyanide
P104	Silver cyanide Ag(CN)
P105	Sodium azide
P106	Sodium cyanide
P106	Sodium cyanide Na(CN)
P108	Strychnidin-10-one, & salts
P018	Strychnidin-10-one, 2,3-dimethoxy-
P108	Strychnine, & salts
P115	Sulfuric acid, dithallium(1+) salt
P109	Tetraethylthiopyrophosphate
P110	Tetraethyl lead
P111	Tetraethyl pyrophosphate
P112	Tetranitromethane (R)
P062	Tetraphosphoric acid, hexaethyl ester
P113	Thallic oxide
P113	Thallium oxide Tl ₂ O ₃
P114	Thallium(I) selenite
P115	Thallium(I) sulfate
P109	Thiodiphosphoric acid, tetraethyl ester
P045	Thiofanox
P049	Thioimidodicarbonic diamide [(H ₂ N)C(S)] ₂ NH
P014	Thiophenol
P116	Thiosemicarbazide
P026	Thiourea, (2-chlorophenyl)-
P072	Thiourea, 1-naphthalenyl-
P093	Thiourea, phenyl-

Table B-2. P-Listed Wastes (continued)

Hazardous Waste No.	Substance
P185	Tirpate.
P123	Toxaphene
P118	Trichloromethanethiol
P119	Vanadic acid, ammonium salt
P120	Vanadium oxide V ₂ O ₅
P120	Vanadium pentoxide
P084	Vinylamine, N-methyl-N-nitroso-
P001	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	Zinc, bis(dimethylcarbamodithioato-S,S')-,
P121	Zinc cyanide
P121	Zinc cyanide Zn(CN) ₂
P122	Zinc phosphide Zn ₃ P ₂ , when present at concentrations greater than 10% (R,T)
P205	Ziram.

Table B-3. U-Listed Wastes

Hazardous Waste No.	Substance
U394	A2213.
U001	Acetaldehyde (I)
U034	Acetaldehyde, trichloro-
U187	Acetamide, N-(4-ethoxyphenyl)-
U005	Acetamide, N-9H-fluoren-2-yl-
U240	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters 3
U112	Acetic acid ethyl ester (I)
U144	Acetic acid, lead(2+) salt
U214	Acetic acid, thallium(1+) salt
see F027	Acetic acid, (2,4,5-trichlorophenoxy)- 3
U002	Acetone (I)
U003	Acetonitrile (I,T)
U004	Acetophenone
U005	2-Acetylaminofluorene
U006	Acetyl chloride (C,R,T)
U007	Acrylamide
U008	Acrylic acid (I)
U009	Acrylonitrile
U011	Amitrole
U012	Aniline (I,T)
U136	Arsinic acid, dimethyl-
U014	Auramine
U015	Azaserine
U365	H-Azepine-1-carbothioic acid, hexahydro-, S-ethyl ester.
U010	Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione, 6 -amino-8-[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a, 8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1alpha, 8beta,8aalpha,8balpha)]-
U280	Barban.
U278	Bendiocarb.
U364	Bendiocarb phenol.
U271	Benomyl.
U157	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U016	Benz[c]acridine
U017	Benzal chloride
U192	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl) -
U018	Benz[a]anthracene
U094	Benz[a]anthracene, 7,12-dimethyl-
U012	Benzenamine (I,T)
U014	Benzenamine, 4,4'-carbonimidoylbis[N,N-dimethyl-
U049	Benzenamine, 4-chloro-2-methyl-, hydrochloride

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U093	Benzenamine, N,N-dimethyl-4-(phenylazo)-
U328	Benzenamine, 2-methyl-
U353	Benzenamine, 4-methyl-
U158	Benzenamine, 4,4'-methylenebis[2-chloro-
U222	Benzenamine, 2-methyl-, hydrochloride
U181	Benzenamine, 2-methyl-5-nitro-
U019	Benzene (I,T)
U038	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl) -alpha-hydroxy-, ethyl ester
U030	Benzene, 1-bromo-4-phenoxy-
U035	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-
U037	Benzene, chloro-
U221	Benzenediamine, ar-methyl-
U028	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U069	1,2-Benzenedicarboxylic acid, dibutyl ester
U088	1,2-Benzenedicarboxylic acid, diethyl ester
U102	1,2-Benzenedicarboxylic acid, dimethyl ester
U107	1,2-Benzenedicarboxylic acid, dioctyl ester
U070	Benzene, 1,2-dichloro-
U071	Benzene, 1,3-dichloro-
U072	Benzene, 1,4-dichloro-
U060	Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro-
U017	Benzene, (dichloromethyl)-
U223	Benzene, 1,3-diisocyanatomethyl- (R,T)
U239	Benzene, dimethyl- (I,T)
U201	1,3-Benzenediol
U127	Benzene, hexachloro-
U056	Benzene, hexahydro- (I)
U220	Benzene, methyl-
U105	Benzene, 1-methyl-2,4-dinitro-
U106	Benzene, 2-methyl-1,3-dinitro-
U055	Benzene, (1-methylethyl)- (I)
U169	Benzene, nitro-
U183	Benzene, pentachloro-
U185	Benzene, pentachloronitro-
U020	Benzenesulfonic acid chloride (C,R)
U020	Benzenesulfonyl chloride (C,R)
U207	Benzene, 1,2,4,5-tetrachloro-
U061	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4- chloro-
U247	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4- methoxy-
U023	Benzene, (trichloromethyl)-

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U234	Benzene, 1,3,5-trinitro-
U021	Benzidine
U202	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide, & salts
U203	1,3-Benzodioxole, 5-(2-propenyl)-
U141	1,3-Benzodioxole, 5-(1-propenyl)-
U090	1,3-Benzodioxole, 5-propyl-
U278	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate.
U364	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,
U367	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-
U064	Benzo[rst]pentaphene
U248	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl- butyl)-, & salts, when present at concentrations of 0.3% or less
U022	Benzo[a]pyrene
U197	p-Benzoquinone
U023	Benzotrichloride (C,R,T)
U085	2,2'-Bioxirane
U021	[1,1'-Biphenyl]-4,4'-diamine
U073	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-
U091	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-
U095	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-
U401	Bis(dimethylthiocarbamoyl) sulfide.
U400	Bis(pentamethylene)thiuram tetrasulfide.
U225	Bromoform
U030	4-Bromophenyl phenyl ether
U128	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	1-Butanamine, N-butyl-N-nitroso-
U031	1-Butanol (I)
U159	2-Butanone (I,T)
U160	2-Butanone, peroxide (R,T)
U053	2-Butenal
U074	2-Butene, 1,4-dichloro- (I,T)
U143	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy- 2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]- 2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*),7aalpha]]-
U031	n-Butyl alcohol (I)
U392	Butylate.
U136	Cacodylic acid
U032	Calcium chromate
U238	Carbamic acid, ethyl ester
U178	Carbamic acid, methylnitroso-, ethyl ester

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U372	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester.
U271	Carbamic acid, [1-[(butylamino)carbonyl]-1H- benzimidazol-2-yl]-, methyl ester.
U375	Carbamic acid, butyl-, 3-iodo-2-propynyl ester.
U280	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2- butynyl ester.
U373	Carbamic acid, phenyl-, 1-methylethyl ester.
U409	Carbamic acid, [1,2-phenylenebis (iminocarbonothiyl)] bis-, dimethyl ester.
U097	Carbamic chloride, dimethyl-
U379	Carbamodithioic acid, dibutyl, sodium salt.
U277	Carbamodithioic acid, diethyl-, 2-chloro-2-propenyl ester.
U381	Carbamodithioic acid, diethyl-, sodium salt.
U383	Carbamodithioic acid, dimethyl, potassium salt.
U382	Carbamodithioic acid, dimethyl-, sodium salt.
U376	Carbamodithioic acid, dimethyl-, tetraanhydrosulfide with orthothioselenious acid.
U114	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters
U378	Carbamodithioic acid, (hydroxymethyl)methyl-, monopotassium salt.
U384	Carbamodithioic acid, methyl-, monosodium salt.
U377	Carbamodithioic acid, methyl,- monopotassium salt.
U062	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3- dichloro-2-propenyl) ester
U389	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3- trichloro-2-propenyl) ester.
U392	Carbamothioic acid, bis(2-methylpropyl)-, S-ethyl ester.
U391	Carbamothioic acid, butylethyl-, S-propyl ester.
U386	Carbamothioic acid, cyclohexylethyl-, S-ethyl ester.
U390	Carbamothioic acid, dipropyl-, S-ethyl ester.
U387	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester.
U385	Carbamothioic acid, dipropyl-, S-propyl ester.
U279	Carbaryl.
U372	Carbendazim.
U367	Carbofuran phenol.
U215	Carbonic acid, dithallium(1+) salt
U033	Carbonic difluoride
U156	Carbonochloridic acid, methyl ester (I,T)
U033	Carbon oxyfluoride (R,T)
U211	Carbon tetrachloride
U034	Chloral
U035	Chlorambucil
U036	Chlordane, alpha & gamma isomers
U026	Chlornaphazin
U037	Chlorobenzene
U038	Chlorobenzilate
U039	p-Chloro-m-cresol

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U042	2-Chloroethyl vinyl ether
U044	Chloroform
U046	Chloromethyl methyl ether
U047	beta-Chloronaphthalene
U048	o-Chlorophenol
U049	4-Chloro-o-toluidine, hydrochloride
U032	Chromic acid H ₂ CrO ₄ , calcium salt
U050	Chrysene
U393	Copper, bis(dimethylcarbamodithioato-S,S')-,
U393	Copper dimethyldithiocarbamate.
U051	Creosote
U052	Cresol (Cresylic acid)
U053	Crotonaldehyde
U055	Cumene (I)
U246	Cyanogen bromide (CN)Br
U386	Cycloate.
U197	2,5-Cyclohexadiene-1,4-dione
U056	Cyclohexane (I)
U129	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-
U057	Cyclohexanone (I)
U130	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U058	Cyclophosphamide
U240	2,4-D, salts & esters
U059	Daunomycin
U366	Dazomet.
U060	DDD
U061	DDT
U062	Diallate
U063	Dibenz[a,h]anthracene
U064	Dibenzo[a,i]pyrene
U066	1,2-Dibromo-3-chloropropane
U069	Dibutyl phthalate
U070	o-Dichlorobenzene
U071	m-Dichlorobenzene
U072	p-Dichlorobenzene
U073	3,3'-Dichlorobenzidine
U074	1,4-Dichloro-2-butene (I,T)
U075	Dichlorodifluoromethane
U078	1,1-Dichloroethylene
U079	1,2-Dichloroethylene

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U025	Dichloroethyl ether
U027	Dichloroisopropyl ether
U024	Dichloromethoxy ethane
U081	2,4-Dichlorophenol
U082	2,6-Dichlorophenol
U084	1,3-Dichloropropene
U085	1,2:3,4-Diepoxybutane (I,T)
U395	Diethylene glycol, dicarbamate.
U108	1,4-Diethyleneoxide
U028	Diethylhexyl phthalate
U086	N,N'-Diethylhydrazine
U087	O,O-Diethyl S-methyl dithiophosphate
U088	Diethyl phthalate
U089	Diethylstilbestrol
U090	Dihydrosafrole
U091	3,3'-Dimethoxybenzidine
U092	Dimethylamine (I)
U093	p-Dimethylaminoazobenzene
U094	7,12-Dimethylbenz[a]anthracene
U095	3,3'-Dimethylbenzidine
U096	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U097	Dimethylcarbamoyl chloride
U098	1,1-Dimethylhydrazine
U099	1,2-Dimethylhydrazine
U101	2,4-Dimethylphenol
U102	Dimethyl phthalate
U103	Dimethyl sulfate
U105	2,4-Dinitrotoluene
U106	2,6-Dinitrotoluene
U107	Di-n-octyl phthalate
U108	1,4-Dioxane
U109	1,2-Diphenylhydrazine
U110	Dipropylamine (I)
U111	Di-n-propylnitrosamine
U403	Disulfiram.
U041	Epichlorohydrin
U390	EPTC.
U001	Ethanal (I)
U404	Ethanamine, N,N-diethyl-
U174	Ethanamine, N-ethyl-N-nitroso-

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U410	Ethanimidothioic acid, N,N'-[thiobis[(methylimino) carbonyloxy]]bis-, dimethyl ester
U394	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester.
U155	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'- (2-thienylmethyl)-
U067	Ethane, 1,2-dibromo-
U076	Ethane, 1,1-dichloro-
U077	Ethane, 1,2-dichloro-
U131	Ethane, hexachloro-
U024	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-
U117	Ethane, 1,1'-oxybis-(I)
U025	Ethane, 1,1'-oxybis[2-chloro-
U184	Ethane, pentachloro-
U208	Ethane, 1,1,1,2-tetrachloro-
U209	Ethane, 1,1,2,2-tetrachloro-
U218	Ethanethioamide
U226	Ethane, 1,1,1-trichloro-
U227	Ethane, 1,1,2-trichloro-
U359	Ethanol, 2-ethoxy-
U173	Ethanol, 2,2'-(nitrosoimino)bis-
U395	Ethanol, 2,2'-oxybis-, dicarbamate.
U004	Ethanone, 1-phenyl-
U043	Ethene, chloro-
U042	Ethene, (2-chloroethoxy)-
U078	Ethene, 1,1-dichloro-
U079	Ethene, 1,2-dichloro-, (E)-
U210	Ethene, tetrachloro-
U228	Ethene, trichloro-
U112	Ethyl acetate (I)
U113	Ethyl acrylate (I)
U238	Ethyl carbamate (urethane)
U117	Ethyl ether (I)
U407	Ethyl Ziram.
U114	Ethylenebisdithiocarbamic acid, salts & esters
U067	Ethylene dibromide
U077	Ethylene dichloride
U359	Ethylene glycol monoethyl ether
U115	Ethylene oxide (I,T)
U116	Ethylenethiourea
U076	Ethyldene dichloride
U118	Ethyl methacrylate
U119	Ethyl methanesulfonate

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U396	Ferbam
U120	Fluoranthene
U122	Formaldehyde
U123	Formic acid (C,T)
U124	Furan (I)
U125	2-Furancarboxaldehyde (I)
U147	2,5-Furandione
U213	Furan, tetrahydro-(I)
U125	Furfural (I)
U124	Furfuran (I)
U206	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido) -, D-
U206	D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)- carbonyl]amino]-
U126	Glycidylaldehyde
U163	Guanidine, N-methyl-N'-nitro-N-nitroso-
U127	Hexachlorobenzene
U128	Hexachlorobutadiene
U130	Hexachlorocyclopentadiene
U131	Hexachloroethane
U132	Hexachlorophene
U243	Hexachloropropene
U133	Hydrazine (R,T)
U086	Hydrazine, 1,2-diethyl-
U098	Hydrazine, 1,1-dimethyl-
U099	Hydrazine, 1,2-dimethyl-
U109	Hydrazine, 1,2-diphenyl-
U134	Hydrofluoric acid (C,T)
U134	Hydrogen fluoride (C,T)
U135	Hydrogen sulfide
U135	Hydrogen sulfide H ₂ S
U096	Hydroperoxide, 1-methyl-1-phenylethyl- (R)
U116	2-Imidazolidinethione
U137	Indeno[1,2,3-cd]pyrene
U375	3-Iodo-2-propynyl n-butylcarbamate.
U396	Iron, tris(dimethylcarbamodithioato-S,S')-,
U190	1,3-Isobenzofurandione
U140	Isobutyl alcohol (I,T)
U141	Isosafrole
U142	Kepone
U143	Lasiocarpine
U144	Lead acetate

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U146	Lead, bis(acetato-O)tetrahydroxytri-
U145	Lead phosphate
U146	Lead subacetate
U129	Lindane
U163	MNNG
U147	Maleic anhydride
U148	Maleic hydrazide
U149	Malononitrile
U150	Melphalan
U151	Mercury
U384	Metam Sodium.
U152	Methacrylonitrile (I, T)
U092	Methanamine, N-methyl- (I)
U029	Methane, bromo-
U045	Methane, chloro- (I, T)
U046	Methane, chloromethoxy-
U068	Methane, dibromo-
U080	Methane, dichloro-
U075	Methane, dichlorodifluoro-
U138	Methane, iodo-
U119	Methanesulfonic acid, ethyl ester
U211	Methane, tetrachloro-
U153	Methanethiol (I, T)
U225	Methane, tribromo-
U044	Methane, trichloro-
U121	Methane, trichlorofluoro-
U036	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2, 3,3a,4,7,7a-hexahydro-
U154	Methanol (I)
U155	Methapyrilene
U142	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a, 3,3a,4,5,5a,5b,6-decachlorooctahydro-
U247	Methoxychlor
U154	Methyl alcohol (I)
U029	Methyl bromide
U186	1-Methylbutadiene (I)
U045	Methyl chloride (I,T)
U156	Methyl chlorocarbonate (I,T)
U226	Methyl chloroform
U157	3-Methylcholanthrene
U158	4,4'-Methylenebis(2-chloroaniline)

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U068	Methylene bromide
U080	Methylene chloride
U159	Methyl ethyl ketone (MEK) (I,T)
U160	Methyl ethyl ketone peroxide (R,T)
U138	Methyl iodide
U161	Methyl isobutyl ketone (I)
U162	Methyl methacrylate (I,T)
U161	4-Methyl-2-pentanone (I)
U164	Methylthiouracil
U010	Mitomycin C
U365	Molinate.
U059	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6- trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10 -tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis) -
U167	1-Naphthalenamine
U168	2-Naphthalenamine
U026	Naphthalenamine, N,N'-bis(2-chloroethyl)-
U165	Naphthalene
U047	Naphthalene, 2-chloro-
U166	1,4-Naphthalenedione
U236	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'- dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)bis[5- amino-4-hydroxy]-, tetrasodium salt
U279	1-Naphthalenol, methylcarbamate.
U166	1,4-Naphthoquinone
U167	alpha-Naphthylamine
U168	beta-Naphthylamine
U217	Nitric acid, thallium(1+) salt
U169	Nitrobenzene (I,T)
U170	p-Nitrophenol
U171	2-Nitropropane (I,T)
U172	N-Nitrosodi-n-butylamine
U173	N-Nitrosodiethanolamine
U174	N-Nitrosodiethylamine
U176	N-Nitroso-N-ethylurea
U177	N-Nitroso-N-methylurea
U178	N-Nitroso-N-methylurethane
U179	N-Nitrosopiperidine
U180	N-Nitrosopyrrolidine
U181	5-Nitro-o-toluidine
U193	1,2-Oxathiolane, 2,2-dioxide
U058	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U115	Oxirane (I,T)
U126	Oxiranecarboxyaldehyde
U041	Oxirane, (chloromethyl)-
U182	Paraldehyde
U391	Pebulate.
U183	Pentachlorobenzene
U184	Pentachloroethane
U185	Pentachloronitrobenzene (PCNB)
See F027	Pentachlorophenol 3
U161	Pentanol, 4-methyl-
U186	1,3-Pentadiene (I)
U187	Phenacetin
U188	Phenol
U048	Phenol, 2-chloro-
U039	Phenol, 4-chloro-3-methyl-
U081	Phenol, 2,4-dichloro-
U082	Phenol, 2,6-dichloro-
U089	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U101	Phenol, 2,4-dimethyl-
U052	Phenol, methyl-
U132	Phenol, 2,2'-methylenebis[3,4,6-trichloro-
U411	Phenol, 2-(1-methylethoxy)-, methylcarbamate.
U170	Phenol, 4-nitro-
See F027	Phenol, pentachloro- 3
See F027	Phenol, 2,3,4,6-tetrachloro- 3
See F027	Phenol, 2,4,5-trichloro- 3
See F027	Phenol, 2,4,6-trichloro- 3
U150	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-
U145	Phosphoric acid, lead(2+) salt (2:3)
U087	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U189	Phosphorus sulfide (R)
U190	Phthalic anhydride
U191	2-Picoline
U179	Piperidine, 1-nitroso-
U400	Piperidine, 1,1'-(tetrathiodicarbonothioyl)-bis-
U383	Potassium dimethyldithiocarbamate.
U378	Potassium n-hydroxymethyl- n-methyldi-thiocarbamate.
U377	Potassium n-methyldithiocarbamate.
U192	Pronamide
U194	1-Propanamine (I,T)

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U111	1-Propanamine, N-nitroso-N-propyl-
U110	1-Propanamine, N-propyl- (I)
U066	Propane, 1,2-dibromo-3-chloro-
U083	Propane, 1,2-dichloro-
U149	Propanedinitrile
U171	Propane, 2-nitro- (I,T)
U027	Propane, 2,2'-oxybis[2-chloro-
U193	1,3-Propane sultone
See F027	Propanoic acid, 2-(2,4,5-trichlorophenoxy)- 3
U235	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U140	1-Propanol, 2-methyl- (I,T)
U002	2-Propanone (I)
U007	2-Propenamide
U084	1-Propene, 1,3-dichloro-
U243	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	2-Propenenitrile
U152	2-Propenenitrile, 2-methyl- (I,T)
U008	2-Propenoic acid (I)
U113	2-Propenoic acid, ethyl ester (I)
U118	2-Propenoic acid, 2-methyl-, ethyl ester
U162	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U373	Propham.
U411	Propoxur.
U194	n-Propylamine (I,T)
U083	Propylene dichloride
U387	Prosulfocarb.
U148	3,6-Pyridazinedione, 1,2-dihydro-
U196	Pyridine
U191	Pyridine, 2-methyl-
U237	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2- chloroethyl)amino]-
U164	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U180	Pyrrolidine, 1-nitroso-
U200	Reserpine
U201	Resorcinol
U202	Saccharin, & salts
U203	Safrole
U204	Selenious acid
U204	Selenium dioxide
U205	Selenium sulfide
U205	Selenium sulfide SeS ₂ (R,T)

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U376	Selenium, tetrakis(dimethyldithiocarbamate).
U015	L-Serine, diazoacetate (ester)
See F027	Silvex (2,4,5-TP) 3
U379	Sodium dibutyldithiocarbamate.
U381	Sodium diethyldithiocarbamate.
U382	Sodium dimethyldithiocarbamate.
U206	Streptozotocin
U277	Sulfallate.
U103	Sulfuric acid, dimethyl ester
U189	Sulfur phosphide (R)
See F027	2,4,5-T 3
U402	Tetrabutylthiuram disulfide.
U207	1,2,4,5-Tetrachlorobenzene
U208	1,1,1,2-Tetrachloroethane
U209	1,1,2,2-Tetrachloroethane
U210	Tetrachloroethylene
See F027	2,3,4,6-Tetrachlorophenol 3
U213	Tetrahydrofuran (I)
U401	Tetramethylthiuram monosulfide.
U366	2H-1,3,5-Thiadiazine- 2-thione, tetrahydro-3,5- dimethyl-
U214	Thallium(I) acetate
U215	Thallium(I) carbonate
U216	Thallium(I) chloride
U216	Thallium chloride TlCl
U217	Thallium(I) nitrate
U218	Thioacetamide
U410	Thiodicarb.
U153	Thiomethanol (I,T)
U402	Thioperoxydicarbonic diamide, tetrabutyl.
U403	Thioperoxydicarbonic diamide, tetraethyl.
U244	Thioperoxydicarbonic diamide $[(H_2N)C(S)]_2S_2$, tetramethyl-
U409	Thiophanate-methyl.
U219	Thiourea
U244	Thiram
U220	Toluene
U221	Toluenediamine
U223	Toluene diisocyanate (R,T)
U328	o-Toluidine
U353	p-Toluidine
U222	o-Toluidine hydrochloride

Table B-3. U-Listed Wastes (continued)

Hazardous Waste No.	Substance
U389	Triallate.
U011	1H-1,2,4-Triazol-3-amine
U227	1,1,2-Trichloroethane
U228	Trichloroethylene
U121	Trichloromonofluoromethane
See F027	2,4,5-Trichlorophenol 3
See F027	2,4,6-Trichlorophenol 3
U404	Triethylamine.
U234	1,3,5-Trinitrobenzene (R,T)
U182	1,3,5-Trioxane, 2,4,6-trimethyl-
U235	Tris(2,3-dibromopropyl) phosphate
U236	Trypan blue
U237	Uracil mustard
U176	Urea, N-ethyl-N-nitroso-
U177	Urea, N-methyl-N-nitroso-
U385	Vernolate.
U043	Vinyl chloride
U248	Warfarin, & salts, when present at concentrations of 0.3% or less
U239	Xylene (I)
U200	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3, 4,5-trimethoxybenzoyl)oxy]-, methyl ester, (3beta, 16beta,17alpha,18beta,20alpha)-
U407	Zinc, bis(diethylcarbamodithioato-S,S')
U249	Zinc phosphide Zn ₃ P ₂ , when present at concentrations of 10% or less

C. List of Extremely Hazardous Chemicals (from 22CCR 66261.126)

Hazard characteristics

- X: toxic
- C: corrosive
- I: ignitable
- R: reactive

Waste	Hazard Chars.
2-Acetylaminofluorene, 2-AAF	X
Acetyl chloride	X,C,R
Acrolein, Aqualin	X,I
Acrylonitrile	X,I
Adiponitrile	X
Aldrin; 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-endo-exodimethanonaphthalene	X
Alkyl aluminum chloride	C,I,R
Alkyl aluminum compounds	C,I,R
Allyl trichlorosilane	X,C,I,R
Aluminum chloride (anhydrous)	X,C,R
Aluminum phosphide, PHOSTOXIN	X,I,R
4-Aminodiphenyl, 4-ADP	X
2-Aminopyridine	X
Ammonium arsenate	X
Ammonium bifluoride	X,C
Amyl trichlorosilane (and isomers)	X,C,R
Antimony pentachloride	X,C,R
Antimony pentafluoride	X,C,R
Arsenic	X
Arsenic acid and salts	X
Arsenic compounds	X
Arsenic pentaselenide	X
Arsenic pentoxide, Arsenic oxide	X
Arsenic sulfide, Arsenic disulfide	X
Arsenic tribromide, Arsenic bromide	X
Arsenic trichloride, Arsenic chloride	X
Arsenic triiodide, Arsenic iodide	X
Arsenic trioxide, Arsenious oxide	X
Arsenious acid and salts	X
Arsines	X
AZODRIN, 3-Hydroxy-N-cis-crotonamide	X
Barium cyanide	X
Benzene hexachloride, BHC; 1,2,3,4,5,6-Hexachloro-cyclohexane	X
Benzene phosphorous dichloride	I,R
Benzidine and salts	X
Benzotrifluoride, Trifluoromethylbenzene	X,I
Benzoyl chloride	X,C,R
Benzyl chlorocarbonate, Benzyl chloroformate	X,C,R
Beryllium	X,I
Beryllium chloride	X

Appendices

Waste	Hazard Chars.
Beryllium compounds	X
Beryllium copper	X
Beryllium fluoride	X
Beryllium hydride	X,C,I,R
Beryllium hydroxide	X
Beryllium oxide	X
BIDRIN, Dicrotophos, 3-(Dimethylamino)-1-methyl-3-oxo-1-propenyldimethyl phosphate	X
bis (Chloromethyl) ether, Dichloromethylether, BCME	X
bis (Methylmercuric) sulfate, CEREWET, Ceresan liquid	X
BOMYL, Dimethyl 3-hydroxyglutaconate dimethyl phosphate	X
Boranes	X,I,R
Bordeaux arsenites	X
Boron trichloride, Trichloroborane	X,C,R
Boron trifluoride	X,C,R
Bromine	X,C,I
Bromine pentafluoride	X,C,I,R
Boron trifluoride	X,C,I,R
Brucine, Dimethoxystychnine	X
n-Butyllithium (and isomers)	X,C,I,R
n-Butyltrichlorosilane	C,I,R
Cacodylic acid, Dimethylarsinic acid	X
Cadmium (powder)	X,I
Cadmium compounds	X
Cadmium cyanide	X
Calcium	I,R
Calcium arsenate, PENSAL	X
Calcium arsenite	X
Calcium carbide	C,I,R
Calcium hydride	C,I,R
Calcium hypochlorite, Calcium oxychloride (dry)	X,C,I,R
Calcium phosphide	X,I,R
Carbanolate, BANOL, 2-Chloro-4,5-dimethylphenyl methylcarbamate	X
Carbophenothon, TRITHION, S{[(4-Chloro-phenyl)thio]methyl}0,0-diethyl phosphorodithioate	X
Chlordane; 1,2,4,5,6,7,8,8-Octachloro-4,7-methano-3a,4,7,7a-tetra- hydro- indane	X
Chlorfenvinphos, Compound 4072, 2-Chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate	X
Chlorine	X,C,I,R
Chlorine dioxide	X,C,I,R
Chlorine pentafluoride	X,C,I,R
Chlorine trifluoride	X,C,I,R
Chloroacetaldehyde	X,C
alpha-Chloroacetophenone, Phenyl chloromethyl ketone	X
Chloroacetyl chloride	X,C,R

Waste	Hazard Chars.
ortho-Chlorobenzylidene malonitrile, OCMB	X
Chloropicrin, Chloropicrin, Trichloronitromethane	X
Chlorosulfonic acid	X,C,I,R
Chromyl chloride, Chlorochromic anhydride	X,C,I,R
Copper acetoarsenite, Paris green	X
Copper arsenate, Cupric arsenate	X
Copper arsenite, Cupric arsenite	X
Copper cyanide, Cupric cyanide	X
Coroxon; ortho,ortho-Diethyl-ortho-(3-chloro-4-methylcoumarin-7-yl) phosphate	X
Coumafuryl, FUMARIN, 3-[1-(2-Furanyl)-3-oxobutyl]1-4-hydroxy-2H-1-benzopyran-2-one	X
Coumatetralyl, BAYER 25634, RACUMIN 57, 4-Hydroxy-3-(1,2,3,4-tetrahydro-1-naphthalenyl)-2H-1-benzopyran-2-one	X
Crimidine, CASTRIX, 2-Chloro-4-dimethylamino-6-methyl-pyrimidine	X
Crotonaldehyde, 2-Butenal	X
Cyanide salts	X
Cyanogen	X,I,R
Cyclohexenyltrichlorosilane	X,C,R
Cycloheximide, ACTIDIONE	X
Cyclohexyltrichlorosilane	X,C,R
DDVP, Dichlorvos, VAPONA, Dimethyl dichlorovinyl phosphate	X
Decaborane	X,I,R
Demeton, SYSTOX	X
Demeton-S-methyl sulfone, METAISOSYSTOX-SULFON, S-[2-(ethyl-sulfonyl)ethyl] O,O-dimethyl phosphorothioate	X
Diborane, Diboron hexahydride	I,R
1,2-Dibromo-3-chloropropane, DBCP, Fumazone, nemagon	X
3,3-Dichlorobenzidine and salts, DCB	X
2,4-Dichlorophenoxyacetic acid; 2,4-D	X
Dieldrin; 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,exo-5,8-dimethanonaphthalene	X
Diethylaluminum chloride, Aluminum diethyl monochloride, DEAC	I,R
Diethyl chlorovinyl phosphate, Compound 1836	X
Diethyldichlorosilane	X,C,I,R
O,O-Diethyl-S-(isopropylthiomethyl) phosphorodithioate	X
Diethylzinc, Zinc ethyl	C,I,R
Difluorophosphoric acid	X,C,R
Diglycidyl ether, bis(2,3-Epoxypropyl) ether	X
Dimefox, Hanane, Pextox 14, Tetramethylphosphorodiamidic fluoride	X
Dimethylaminoazobenzene, Methyl yellow	X
Dimethyldichlorosilane, Dichlorodimethylsilane	X,C,I,R
1,1-Dimethylhydrazine, UDMH	X,I
Dimethyl sulfate, Methyl sulfate	X
Dimethyl sulfide, Methyl sulfide	X,I,R
Dinitrobenzene (ortho, meta, para)	I,R

Waste	Hazard Chars.
4,6-Dinitro-ortho-cresol, DNPC, SINOX, E	
Dinitrophenol(2,3-;2,4-;2,6-isomers)	I,R
DINOSEB; 2,4-Dinitro-6-sec-butylphenol	X
Dioxathion, DELNAV; S,S-1,4-dioxane-2,3-diyl bis(O,O-diethyl phosphorodithioate)	X
Diphenyl, Biphenyl, Phenylbenzene	X
Diphenylamine chloroarsine, Phenarsazine chloride	X
Diphenyldichlorosilane	X,C,R
Disulfoton, DI-SYSTON; O,O-Diethyl S-[2-(ethylthio) ethyl] phosphorodithioate	X
Dodecyltrichlorosilane	X,C,R
DOWCO-139, ZECTRAM, Mexacarbate, 4-(Di-methylamino)-3,5-dimethylphenyl methylcarbamate	X
DYFONATE, Fonofos, O-Ethyl-S-phenylethyl phosphonodithioate	X
Endosulfan, THIODAN; 6,7,8,9,10,10-Hexachlor-1,5,5a,6,9,9a-hexa-hydro-6,9-methano-2,4,3-benzo-dioxathiepin-3-oxide	X
Endothal, 7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	X
Endothion, EXOTHION, S-[5-Methoxy-4-oxo-4H-pyran-2-yl]-methyl] O,O-dimethyl phosphorothioate	X
Endrin; 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-5,8-dimethanonaphthalene	X
EPN; O-Ethyl O-para-nitrophenyl phenylphosphonothioate	X
Ethion, NIALATE; O,O,O',O'-Tetraethyl-S,S-methylenediphosphorodithioate	X
Ethyl chloroformate, Ethyl chlorocarbonate	X,C,I,R
Ethyldichloroarsine, Dichloroethylarsine	I,R
Ethyldichlorosilane	X,C,I,R
Ethylene cyanohydrin, beta-Hydroxypropionitrile	I,R
Ethyleneimine, Aziridine, EI	X,I,R
Ethyl mercaptan, Ethanethiol	X,I,R
Ethylphenyldichlorosilane	X,C,R
Ethyltrichlorosilane	I,R
Fensulfothion, BAYER 25141, DASANIT, O,O-Di-ethyl-0-[4-(methylsulfinyl)phenyl] phosphorothioate	X
Ferric arsenate	X
Ferrous arsenate, Iron arsenate	X
Fluoboric acid, Fluoroboric acid	X,C
Fluorine	X,C,R
Fluoroacetanilide, AFL 1082	X
Fluoroacetic acid and salts, Compound 1080	X
Fluorosulfonic acid, Fluosulfonic acid	X,C,R
FURADAN, NIA 10,242, Carbofuran; 2,3-Dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate	X
GB, O-Isopropyl methyl phosphoryl fluoride	X
Guthion; O,O-Dimethyl-S-4-oxo-1,2,3-benzotriazin-3(4H)-ylmethyl phosphorodithioate	X
Heptachlor; 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene	X

Waste	Hazard Chars.
Hexadecyltrichlorosilane	X,C,R
Hexyltrichlorosilane	X,C,R
Hydrazine, Diamine	X,I
Hydriodic acid, Hydrogen iodide	X,C,R
Hydrobromic acid, Hydrogen bromide	X,C,R
Hydrochloric acid, Hydrogen chloride, Muriatic Acid	X,C,R
Hydrocyanic acid, Hydrogen cyanide	X,I,R
Hydrofluoric acid, Hydrogen fluoride	X,C,R
Hydrogen selenide	X,I
Hydrogen sulfide	X,I
Hypochlorite compounds	X,C,I,R
meta-Isopropylphenyl-N-methylcarbamate, Ac 5,727	X
Kepone; 1,1a,3,3a,4,5,5a,5b,6-Decachloroocta-hydro-1,2,4-metheno-2H-cyclobuta(cd) pentalen-2-one, Chlorecone	X
Lead arsenate, Lead orthoarsenate	X
Lead arsenite	X
Lead cyanide	X
Lewisite, beta-Chlorovinyldichloroarsine	X
Lithium	C,I,R
Lithium aluminum hydride, LAH	C,I,R
Lithium amide	C,I,R
Lithium ferrosilicon	I,R
Lithium hydride	C,I,R
Lithium hypochlorite	X,C,I,R
London purple, mixture of arsenic trioxide, aniline, lime, and ferrous oxide	X
Magnesium	I,R
Magnesium arsenate	X
Magnesium arsenite	X
Maleic anhydride	X
Manganese arsenate, Manganous arsenate	X
MECARBAM; O,O-Diethyl S-(N-ethoxycarbonyl N-methylcarba-moyl-methyl) phosphorodithioate	X
Medinoterb acetate, 2-tert-Butyl-5-methyl-4,6-dinitro-phenyl acetate	X
Mercuric chloride, Mercury chloride	X
Mercuric cyanide, Mercury cyanide	X
Mercury	X
Mercury compounds	X
Metal hydrides	I,R
Methomyl, LANNATE, S-Methyl-N-((methyl-carbamoyl)oxy) thioacetimidate	X
Methoxyclor; 1,1,1-Trichloro-2, -bis(p-meth- oxyphenyl) ethane, CHEMFLORM, MARLATE	X
Methoxyethylmercuric chloride, AGALLOL, ARETAN	X
Methylaluminum sesquibromide	I,R
Methylaluminum sesquichloride	I,R
Methyl bromide, Bromomethane	X

Appendices

Waste	Hazard Chars.
Methyl chloroformate, Methyl chlorocarbonate	X,I,R
Methyl chloromethyl ether, CMME	X,I
Methyldichloroarsine	X
Methyldichlorosilane	X,I,R
4,4-Methylene bis(2-chloroaniline), MOCA	X
Methyl hydrazine, Monomethyl hydrazine, MMH	X,I
Methyl isocyanate	X,I
Methylmagnesium bromide	C,I,R
Methylmagnesium chloride	C,I,R
Methylmagnesium iodide	C,I,R
Methyl parathion; O,O-Dimethyl-O-para-nitrophenyl-phosphorothioate	X
Methyltrichlorosilane	X,C,I,R
Mevinphos, PHOSDRIN, 2-Carbomethoxy-1-methylvinyl dimethylphosphate	X
Mirex; 1,1a,2,2,3,3a,4,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-metheno-1H-cyclobuta (cd) pentalene, Dechlorane	X
MOCAP, O-Ethyl-S,S-dipropyl phosphorodithioate	X
alpha-Naphthylamine, 1-NA	X
beta-Naphthylamine, 2-NA	X
Nickel arsenate, Nickelous arsenate	X
Nickel carbonyl, Nickel tetracarbonyl	X
Nickel cyanide	X
Nitrobenzol, Nitrobenzene	X
4-Nitrobiphenyl, 4-NBP	X
Nitrophenol (ortho, meta, para)	X
N-Nitrosodimethylamine, Dimethyl nitrosoamine	X
Nonyltrichlorosilane	I,R
Octadecyltrichlorosilane	I,R
Octyltrichlorosilane	I,R
Oleum, Fuming sulfuric acid	X,C,R
Oxygen difluoride	X,C,R
Para-oxon, MINTACOL; O,O-Diethyl-O-para-nitrophenyl phosphate	X
Parathion; O,O-Diethyl-O-para-nitrophenyl phosphorothioate	X
Pentaborane	X,I,R
Perchloromethyl mercaptan, Trichloromethylsulfenyl chloride	X
Phenyldichloroarsine	X
Phenylphenol, Orthozenol, DOWICIDE I	X
Phenyltrichlorosilane	I,R
Phorate, THIMET; O,O-Diethyl-S-[(Ethylthio)methyl] phosphorodithioate	X
Phosfolan, CYOLAN, 2-(Diethoxyphosphinylimino)-1,3-dithio-lane	X
Phosgene, Carbonyl chloride	I,R
Phosphamidon, DIMECRON, 2-Chloro-2-diethyl-carbamoyl-1-methylvinyl dimethyl phosphate	X
Phosphine, Hydrogen phosphide	X,I
Phosphorus (white or yellow)	X,I,R
Phosphorus oxybromide, Phosphoryl bromide	X,C,R

Waste	Hazard Chars.
Phosphorus oxychloride, Phosphoryl chloride	X,C,R
Phosphorus pentachloride, Phosphoric chloride	X,C,I,R
Phosphorus pentasulfide, Phosphoric sulfide	X,C,I,R
Phosphorus sesquisulfide, tetraphosphorus trisulfide	X,C,I,R
Phosphorus tribromide	X,C,R
Phosphorus trichloride	X,C,R
Platinum compounds	X
Polychlorinated biphenyls, PCB, Askarel, aroclor, chlorextol, interteen, pyranol	X
Potassium	C,I,R
Potassium arsenate	X
Potassium arsenite	X
Potassium bifluoride, Potassium acid fluoride	X,C
Potassium cyanide	X
Potassium hydride	C,I,R
Propargyl bromide, 3-Bromo-1-propyne	X,I
beta-Propiolactone, BPL	X
Propyleneimine, 2-Methylaziridine	X,I
n-Propyltrichlorosilane	X,C,I,R
Prothoate, FOSTION, FAC; O,O-Diethyl-S-carboethoxy-ethyl phosphorodithioate	X
Pyrosulfuryl chloride, Disulfuryl chloride	X,C,R
Quinone; 1,4-Benzoquinone	X
Schradan, Octamethyl pyrophosphoramido, OMPA	X
Selenium	X
Selenium compounds	X
Selenium fluoride	X
Selenous acid, Selenious acid and salts	X
Silicon tetrachloride, Silicon chloride	X,C,R
Silver acetylide	I,R
Sodium	C,I,R
Sodium aluminum hydride	C,I,R
Sodium amide, Sodaamide	C,I,R
Sodium arsenate	X
Sodium arsenite	X
Sodium bifluoride, sodium acid fluoride	X,C
Sodium cacodylate, Sodium dimethylarsenate	X
Sodium cyanide	X
Sodium hydride	X,C,I,R
Sodium hypochlorite	X,I,R
Sodium methylate, Sodium methoxide	C,I,R
Sodium peroxide	X,I,R
Sodium potassium alloy, NaK, Nack	C,I,R
Sodium selenate	X
Strontium arsenate	X
Strychnine and salts	X

Appendices

Waste	Hazard Chars.
Sulfotepp, DITHIONE, BLACAFUM, Tetraethylthio-pyrophosphate, TEDP	X
Sulfur chloride, Sulfur monochloride	X,C,R
Sulfur mustard	X,C,R
Sulfur pentafluoride	X,C
Sulfuryl chloride, Sulfonyl chloride	X,C,R
Sulfuryl fluoride, Sulfonyl fluoride	X,C,R
SUPRACIDE, ULTRACIDE, S-[5-Methoxy-2-oxo-1,3,4-thia-diazo13(2H)-yl)methyl]-O,O-dimethyl phosphorodithioate	X
SURECIDE, Cyanophenphos, O-para-Cyanophenyl-O-ethyl phenyl phosphonothioate	X
Tellurium hexafluoride	X,C
TELODRIN, Isobenzan; 1,3,4,5,6,7,8,8-Octachloro-1,3,3a,4,7,7a-hexahydro-4,7-methanoisobenzofuran	X
TEMIK, Aldicarb, 2-Methyl-2(methylthio) propionaldehyde-O-(methylcarbamoyl) oxime	X
2,3,7,8-Tetrachlorodibenzo-para-dioxin, TCDD, Dioxin	X
Tetraethyl lead, TEL (and other organic lead)	X,I
Tetraethyl pyrophosphate, TEPP	X
Tetramethyl succinonitrile	X
Tetranitromethane	X,I,R
Tetrasul, ANIMERT V-101, S-para-Chlorophenyl-2,4,5-trichlorophenyl sulfide	X
Thallium	X
Thallium compounds	X
Thallus sulfate, Thallium sulfate, RATOX	X
Thiocarbonylchloride, Thiophosgene	X,C,R
Thionazin, ZINOPHOS; O,O-Tetramethylthiuram monosulfide	X
Thionyl chloride, Sulfur oxychloride	X,C,R
Thiophosphoryl chloride	X,C,R
Titanium tetrachloride, Titanic chloride	X,C,R
Toluene-2,4-diisocyanate, TDI	I,R
Toxaphene, Polychlorocamphene	X
TRANID, exo-3-Chloro-endo-6-cyano-2-norbornanone-O-(methylcarbamoyl) oxime	X
2,4,5-Trichlorophenoxyacetic acid; 2,4,5-T	X
Trichlorosilane, Silicochloroform	X,C,I,R
tris(1-Aziridinyl) phosphine oxide, Triethylenephosphoramide, TEPA	X
Vanadium pentoxide, Vanadic acid anhydride	X
Vinyl chloride	X,I
Vinyltrichlorosilane	X,C,I,R
WEPSYN 155, WP 155, Triamiphos, para-(5-Amino-3-phenyl-1H-1,2,4-triazol-1-yl)-N,N,N', N'-tetramethyl phosphonic diamide	X
Zinc arsenate	X
Zinc arsenite	X
Zinc cyanide	X
Zinc phosphide	X,I,R
Zirconium chloride, Zirconium tetrachloride	X,C,R

D. Chemical Compatibility Guide

Separating chemicals into compatible groups can be a complicated procedure. There are several in-depth guides available. For the purposes of packaging chemicals for removal from the Laboratory, EH&S provides a simplified guide on the following page. The table below summarizes the categories you should use in the "Chemical Compatibility Code" column on the Requisition form. Additional information on proper segregation of chemicals can be found in references such as the Material Safety Data Sheets (MSDSs), Aldrich Catalog Handbook of Fine Chemicals, the NIOSH Registry of Toxic Effects of Chemical Substances, or the Merck Index. Laboratory personnel will be able to segregate most chemicals into safe, compatible groups for shipping or short-term storage. For potentially explosive chemicals, contact Industrial Hygiene at extension 5829 for assistance. Contact the HWHF for questions about separation and segregation of waste.

Chemical Compatibility Codes

I. Solvents: Flammable Liquids, Combustible Liquids, Halogenated Solvents	V. Poisons: Organics, Metallics, Inorganic Cyanides
II. Flammable Solids: Organics, Metals, Solids that are dangerous when wet, Sulfides, Phosphorous Allotropes, Organometallic Compounds, Inorganics	VI. Potential Reactives (Explosives): Trinitros, Azides, Amides, Monomeric Isocyanates
III. Oxidizers: Nitrates, Chlorates, Perchlorates, Oxides, Oxidizing Acids	VII. Other Chemical Waste: Separate organics from inorganics. Separate liquids from solids.
IV. Corrosives: <ul style="list-style-type: none"> • Acids (Mineral, Organic, Reactive Corrosives); • Bases (Inorganics, Organics, Hydrazine Solutions) 	VIII. Debris: Separate organics from inorganics and label packaging with all contaminants present.

Identifying and recognizing the hazards of each chemical is critical in order to handle these materials safely. To meet safety and environmental requirements, the following basic categories must be used for segregating and separating your waste.

I. Solvents

A. Flammable Liquids

1. Aliphatic: Acetone, Isopropanol, Methyl Ethyl Ketone, Methanol
2. Aromatic: Toluene, Xylene, Benzene, Propyl Benzene
3. Monohalogenated Solvents: Chlorobenzene, Ethyl Chloride, Acetyl Chloride
4. Monomers: Styrene, Ethylene, Vinyl Acetylene, Vinyl Pyridine
5. Reactives: Isopropyl Ether, Phenyl Manganese Chloride, Hydrazine Anhydrous, Ethyl Ether, Divinyl Ether

B. Combustible Liquids

1. Glycols: Ethylene Glycol Dibutyl Ether, Ethylene Glycol Monomethyl Ether

- 2. Mineral Spirits
- C. Halogenated Solvents: Carbon Tetrachloride, 1,1,1-Trichloroethane, Ethyl Chloroacetate
- II. Flammable Solids
 - A. Organic Flammable Solids: Cellulose Acetate, Nitrocellulose (At least 20% wet)
 - B. Flammable Metals: Manganese, Magnesium, Yttrium, Zirconium
 - C. Flammable Solids (Dangerous when wet): Sodium, Lithium, Calcium, Lithium Hydride
 - D. Flammable Sulfides: Sodium Sulfide, Potassium Sulfide, Ammonium Sulfide
 - E. Phosphorous Allotropes: Phosphorus (Yellow, Red, White), Aluminum Phosphide, Phosphorus Sulfide,
Phosphorus Pentasulfide
 - F. Organometallic Compounds: Lithium Butoxide, Lithium Metoxide, Sodium Ethoxy, Sodium Butylate,
Potassium Methylate
 - G. Inorganic Flammable Solids: Sodium Phosphide, Aluminum Hydride, Sodium Borohydride, Boron Lithium
Aluminum Alloy
- III. Oxidizers
 - A. Nitrates: Potassium Nitrate, Calcium Nitrate, Sodium Nitrate, Zinc Nitrate, Thallium Nitrate
 - B. Chlorates: Potassium Chlorate, Lithium Chlorate, Calcium Chlorate, Strontium Chlorate
 - C. Perchlorates: Lithium Perchlorate, Magnesium Perchlorate
 - D. Oxides: Manganese Dioxide, Magnesium Dioxide, Chromium Trioxide, Lead Oxide (Brown)
 - E. Oxidizing Acids: Nitric Acid (greater than 40%), Perchloric Acid, Periodic Acid
- IV. Corrosives
 - A. Acids
 - 1. Mineral Acids: Hydrochloric Acid, Sulfuric Acid, Nitric Acid (Less than 40%), Phosphoric Acid
 - 2. Organic Acids: Acetic Acid, Acetic Anhydride, Acetyl Bromide, Formic Acid, Isopentanoic Acid
 - 3. Reactive Corrosives: Phosphorus Trichloride, Phosphorus Pentachloride, Antimony Trichloride, Phosphoric Anhydride
 - B. Bases
 - 1. Inorganics: Sodium hydroxide, Potassium Hydroxide, Ammonium Hydroxide, Sodium Hypochlorite
 - 2. Organics: Amino Propyl Diethanolamine, Amino Ethyl Piperazine, Acetyl Iodide, Benzoyl Chloride, Dimethyl Sulfonyl Chloride

3. Hydrazine Solutions

V. Poisons

- A. Organics: Phenol, Acrylamide, Benzoin, Benzidine, Aniline
- B. Metallics: Arsenic, Lead, Beryllium, Mercury, Selenium
- C. Inorganic Cyanides: Potassium Cyanide, Sodium Cyanide, Cyanogen Bromide

VI. Potential Reactives (Explosive)

- A. Trinitros: Trinitrophenol (Picric Acid), Trinitrobenzene, Trinitrotoluene (TNT), Trinitromethane
- B. Azides: Hydrogen Azide, Ammonium Azide, Barium Azide, Chlorine Azide, Silver Azide
- C. Amides: Trinitroaniline (Picramide), Sodaamide, Potassium Amide
- D. Monomeric Isocyanates: Hydrocyanic Acid, Isothiocyanuric Acid

VII. Other Chemical Waste

- A. Separate Organics from Inorganics*
- B. Separate Liquids from Solids

VIII. Debris

- A. Separate Organics from Inorganics* and label packaging with all contaminants present.

*Inorganic materials contaminated with organic components should be segregated as organic.

Appendix 2. Waste Acceptance Criteria for Certification Team Review of Radioactive Waste Tag Information

- The generator must have completed Radioactive and Mixed Waste Generator Training.
- The tag must be legible, completely filled out, signed, and dated. Only one waste container is allowed on each waste tag.
- The tag must present a summary of the constituents of the waste, including radiological, physical, and chemical. Do not use the Radioactive Waste tag as an accumulation log.
- Each isotope must be listed with an activity. Total activity must be entered, based on a summation of the individual isotope entries.
- The basis for radioactive characterization must be indicated for each entry, i.e., DIRT (Direct Information transfer from Research Techniques), MB (Materials Balance), DA (Direct Assay), or Rx (predictable Reaction product).
- For dry compactable waste, an estimate of the physical components must be made, and the constituent percentages must total to 100%.
- For liquid waste, all constituents of the waste must be accounted for, including both hazardous and nonhazardous constituents. For aqueous waste, the percent water must be listed.
- 100% of the contents of the waste container must be accounted for. The preferred unit for constituent concentrations is wt%. List only one constituent per line. Use continuation sheet(s) if constituents exceed the number of lines on the tag.
- The pH must be reported for all aqueous waste.
- The basis for chemical characterization must be indicated for each entry (i.e., DIRT, MB, DA, or Rx).
- A copy of pertinent accumulation log(s) must be faxed with the Radioactive/Mixed Waste Disposal Requisition where waste is accumulated through multiple additions to a single waste container.
- Supporting documentation must be available for review by Waste Management on request.
- If the generator knows, or has strong reason to believe, that the waste is both hazardous and radioactive (that is, mixed waste), then a completed Hazardous Waste label must be affixed to each container of mixed waste at the start of accumulation in addition to the Radioactive Waste tag.
- When a generator signs a Radioactive Waste tag and a Radioactive/Mixed Waste Disposal Requisition, he/she is certifying that the waste is properly characterized, that training has been completed, and that documentation is available to support characterization information.
- Waste Certification will determine the classification of the waste based on the indicated constituent(s).

Appendix 3. Abbreviations and Acronyms

COB	City of Berkeley
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
DOT	U.S. Department of Transportation
HWHF	LBNL Hazardous Waste Handling Facility
LSAD	LBNL Self-Assessment Database
MSDS	Material Safety Data Sheet
MWSAA	Mixed Waste Satellite Accumulation Area
NCAR	Nonconformance and Corrective Action Report
NIOSH	National Institutes of Occupational Safety and Health
NORM	Naturally Occurring Radioactive Material
OAA	LBNL Office of Assessment and Assurance
RCRA	Resource Conservation and Recovery Act
RMA	Radioactive Material Area
RWCA	Radioactive Waste Collection Area
SAA	Satellite Accumulation Area
TCLP	Toxicity Characteristic Leaching Procedure
TSDF	Treatment, Storage, and Disposal Facility
WAA	Waste Accumulation Area

Appendix 4. Definitions

Acutely Hazardous Wastes. Any wastes defined as acutely hazardous by 22 CCR, Chapter 11, Article 4.

Certification. The person who signs his or her name on the Hazardous Waste Disposal Requisition and/or the Radioactive Waste Tag certifies that the contents of the hazardous, radioactive, or mixed waste package are described exactly and correctly by the Requisition/Tag. This description (and the signature) are legally binding.

Certify. To attest by signature, to the best of one's knowledge, that the information provided is correct.

Characterization. The detailed documentation necessary to certify that the waste is what it is claimed to be. Characterization can include process knowledge (see definition below), required analyses, or written documentation (log books, formulas, etc.).

Controlled Area (for Radiation Protection). An area where radioactive materials or elevated radiation fields may be present.

Corrosive Wastes. Aqueous wastes with $\text{pH} \leq 2$ or ≥ 12.5 (or nonaqueous wastes that produce a solution with these pH values when mixed with an equivalent weight of water). Corrosive wastes also include wastes that can corrode steel at a rate of 0.25 inch per year.

Cradle-to-Grave Tracking. The term for the system whereby carefully detailed records are maintained documenting the generation, storage, treatment, and disposal of all hazardous waste generated at a facility. These records essentially cover hazardous waste from the point of origin (generation) to its final offsite destination and disposal.

Discarded Material. Any material that is disposed of, burned, incinerated, accumulated, stored, treated, or recycled.

Dry Waste. Radioactive waste that has less than 1% free liquids.

Extremely Hazardous Waste. Any hazardous waste or mixture of hazardous wastes that, if human exposure should occur, may likely result in death, disabling personal injury, or serious illness caused by the hazardous waste or mixture of hazardous wastes because of its quantity, concentration, or chemical characteristics. (From 22 CCR 66260.10.)

Hazardous Wastes.

- Wastes that exhibit one or more of the criteria for identification of "hazardous waste" (22 CCR 66261.21–66261.24). These criteria are
 - toxicity
 - ignitability
 - reactivity
 - corrosivity

- Wastes listed in the California Code of Regulations (22 CCR 66261) and the Code of Federal Regulations (40 CFR Part 261). These wastes include certain discarded commercial chemical products, off-specification products, container residues, and spill residues.
- Wastes listed as “dangerous” or “extremely hazardous” in the Washington Administrative Code, Chapter 173-303.

High-Level Waste. The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Identification. The description of the waste in a container. When you fill out the Hazardous Waste Label and the Hazardous Waste Disposal Requisition, you identify your waste.

Ignitable Wastes. Material that has any of the following properties:

- A liquid with a flash point of less than 60°C (140°F). Exception: Aqueous solutions containing less than 24% alcohol when they are used
- Solids that are capable of causing fire through friction, absorption of moisture, or spontaneous changes
- A flammable compressed gas. Examples: carbon monoxide, ethylene, hydrogen, methane
- A material defined as an oxidizer. Examples: nitric acid, perchloric acid, potassium permanganate, hydrogen peroxide, silver nitrate, ammonium persulfate, potassium nitrate, sodium nitrate, chromic acid

Low-Level Waste. Waste containing radioactivity that is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material, as defined in DOE Orders 5820.2A and 5400.3. At Berkeley Lab, low-level waste is divided into the following categories for the purpose of safe handling:

- *Low-specific-activity (LSA) alpha waste, solid.* LSA solid alpha waste must have radioactivity levels below 100 nCi/g. Low-level solid waste with activity levels above 100 nCi/g should be kept separate from LSA waste.
- *Low-level alpha waste, liquid.* Low-level liquid alpha waste must have radioactivity levels below 100 nCi/ml.
- *Low-level beta and gamma waste, solid.* Low-level solid beta and gamma solid waste must have radioactivity levels below 0.3 mCi/g. The exception is ⁹⁰Sr, for which the beta and gamma levels must be below 0.005 mCi/g. Nonradioactive material contaminated with radioactivity less than 0.001 mCi/cm² (measured on the surface) is considered to be low-level beta or gamma solid waste.

- *Low-level beta and gamma waste, liquid.* Low-level liquid beta and gamma waste must have radioactivity levels below 0.3 mCi/ml. The exception is ^{90}Sr , for which the beta and gamma levels must not exceed 5 $\mu\text{Ci}/\text{ml}$.

Mixed Waste. Any radioactive waste that is also a hazardous waste.

Process Knowledge. The ability of the generator to characterize waste on the basis of knowing the chemical materials from which the waste was derived and the processes through which the waste was generated. Also includes the ability to verify the characterization with the documented procedures used and data accumulated during the waste-generation process.

Radioactive Material Area (RMA). An area where the potential exists for contamination from the presence of unencapsulated or unconfined radioactive materials or an area that is exposed to beams or other sources of particles (neutrons, protons, etc.) capable of causing activation.

Reactive Waste. A material that has the following properties:

- It is normally unstable and readily undergoes violent change.
- It reacts violently with water.
- It forms potentially explosive mixtures with water.
- It is a cyanide- or sulfide-bearing waste that is capable of generating toxic gases, vapors, or fumes
- It is capable of detonation or explosive reaction.
- It is defined as an explosive.

Satellite Accumulation Area (SAA). An area in an individual laboratory, shop, or other facility designated by the generator for the accumulation of waste, not to exceed 55 gallons of hazardous waste or 1 quart of extremely or acutely hazardous waste. The area must be at or near the point of waste generation. Waste can accumulate in SAAs for up to 275 days. Even a single small bottle of a hazardous waste is considered an SAA.

SAA Start Date. The date that waste is first placed in a container in the SAA.

Secondary Containment. A container designed to hold one or more containers for the collection of liquid waste in a laboratory or shop area. Examples of secondary containment include plastic tubs or buckets, photographic development trays, and pail skids.

Segregation. The practice of not placing chemically unrelated or incompatible materials in the same container.

Separation. The practice of keeping containers of incompatible wastes apart physically.

Solid Waste. Any discarded material (solid, liquid, or gas) that is not excluded.

Toxic Wastes. Wastes that pose a hazard to human health or the environment because of carcinogenicity, acute or chronic toxicity, bioaccumulative properties, or persistence in the environment.

Transuranic (TRU) Waste. Waste, without regard to source or form, that is contaminated with alpha-emitting transuranium radionuclides (elements 93 and higher) with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay. Radium sources and U-233 are also considered to be TRU waste. Radioactive waste with quantities of transuranic radionuclides in concentrations of 100 nCi/g of waste or less is considered low-level waste and not TRU waste. Transuranic waste generated at Berkeley Lab will be shipped to the Hanford site and placed in interim storage pending eventual shipment to the Waste Isolation Pilot Project (WIPP) in New Mexico. All transuranic waste must meet the criteria of WIPP-DOE-069, *Transuranic Waste Acceptance Criteria for the WIPP*.

Treatment. Any method, technique, or process designed to change the physical, chemical, or biological character or composition of any hazardous waste. (This definition is taken from 40 CFR 260.10 and 22 CCR 66260.10.) Neutralization and dilution are examples of processes that are considered treatments by federal and state regulations.

Waste Accumulation Area (WAA). An officially designated area for the accumulation and storage of large quantities of hazardous waste. Specific regulations apply to WAAs, including security, labeling and signage, contingency plans, and emergency equipment. Wastes can be accumulated in WAAs for up to 60 days.

WAA Receipt or Accumulation Start Date. The date that a container transferred from an SAA to a WAA is received by the manager of the WAA, or the date waste is first placed in a container at a WAA collection point.

Waste Container. Anything that collects waste. Waste containers include drums, carboys, cans, bottles, boxes, plastic bags, metal transport containers, and any other container approved as appropriate for the type of waste handled.

Waste-Generating Organization. A program, facility, or group that generates hazardous, radioactive, or mixed waste.

Waste Generator. The individual or operation responsible for actually generating the hazardous, radioactive, or mixed waste within an organization. Berkeley Lab as a whole is viewed as a waste generator by environmental regulatory agencies. Within Berkeley Lab, each researcher, laboratory, shop, and facility, as a potential point of origin for hazardous, radioactive, or mixed waste, is a waste generator.

Waste Stream. Waste generated from an industrial process or application, laboratory experiment, or routine laboratory procedure with roughly constant and unchanging radioactive, mixed, or hazardous characteristics.

Appendix 5. Berkeley Lab Compliance Framework for Waste Accumulation at Generator Sites

Introduction

Most of the hazardous, radioactive, and mixed wastes generated by Berkeley Lab scientific and support activities are accumulated in satellite areas until they are picked up and transported to the onsite Hazardous Waste Handling Facility (HWHF), where they are treated and/or packaged for transport to approved, offsite treatment, storage, and disposal facilities (TSDFs). The satellite areas include approximately 400 Satellite Accumulation Areas (SAAs), where small amounts of hazardous wastes are stored, approximately 120 Radioactive Waste Collection Areas, and approximately 25 Mixed Waste Satellite Accumulation Areas (MWSAAs).

Berkeley Lab has established policies for compliant accumulation of hazardous, radioactive, or mixed wastes at generator sites that minimize risks to the health and safety of Berkeley Lab staff and visitors, and greatly reduce the likelihood of accidental releases to the environment.

Noncompliance with laws and regulations regarding waste accumulation could result in fines or penalties to the Laboratory, with possible disciplinary actions to responsible parties. The purpose of this document is to briefly outline the responsibilities of Berkeley Lab scientists, managers, and support staff in the matter of waste accumulation at generator sites, and to familiarize Berkeley Lab staff with their roles in maintaining a workplace that is free from unnecessary hazards relating to waste storage.

Regulatory Framework

Regulations regarding the storage of hazardous wastes in SAAs are found in Title 22, Division 4.5, Chapter 12 of the California Code of Regulations. Because mixed wastes are hazardous as well as radioactive, these regulations also govern the accumulation of mixed wastes in satellite areas. The regulations make it clear that the point of responsibility for waste accumulation in satellite areas is as follows:

- The waste generator is responsible for the maintenance of the waste accumulation site and for keeping detailed records of waste accumulation, as necessary to adequately and accurately characterize all waste.
- The facility/laboratory supervisor (or designee) is responsible for enforcing proper waste accumulation at the SAA or MWSAA.

At Berkeley Lab, the compliance policies in this manual govern the accumulation of hazardous waste (in SAAs), mixed waste (in MWSAAs) and radioactive wastes (in Radioactive Waste Collection Areas). Areas where hazardous, radioactive, and mixed wastes are accumulated must be operated and maintained by the waste generators, and the accountability for compliance in these

areas is a clear line-management responsibility. The Berkeley Lab Environment, Health and Safety (EH&S) Division, the Office of Assessment and Assurance (OAA), DOE, and other groups play supporting roles in the management, operation, and oversight of these areas.

Enforcement Authority for Hazardous and Mixed Wastes

The responsibility and authority for enforcement of regulations regarding the storage of waste in Berkeley Lab's SAAs and MWSAAs resides with the State of California Department of Toxic Substances Control (DTSC) and also, should it choose to exercise its authority, the U.S. Environmental Protection Agency. DTSC has delegated to Alameda County, and Alameda County has redelegated to the City of Berkeley (COB) as the authority for local enforcement. Thus, the COB has the authority to make unannounced inspections of Berkeley Lab SAAs and MWSAAs and to prepare reports of violations to the Laboratory and its employees for any areas that are found to be out of compliance with the regulations.

For the purpose of determining administrative penalties, DTSC has divided violations into two types, Class I and Class II.

- **Class I violations** are significant deviations from statute or regulation that present a release or a significant threat of a release of hazardous waste to the environment and / or chronic nonconformance with the regulations. Fines for Class I violations can be as large as \$25,000 per day.
- Less significant **Class II violations** normally bring fines of up to \$10,000 per day for each violation, but fines as large as \$25,000 per day are possible.
- Noncompliant SAA or MWSAA operation can also lead to civil penalties of up to \$25,000 per day or criminal penalties involving fines and / or jail terms when responsible parties knowingly or willfully violate the statutes or regulations in accumulating or managing hazardous or mixed waste. Second or subsequent negligent violations can lead to civil penalties of up to \$25,000 per day or felony convictions involving large fines or jail terms, as can illegal treatment, storage, disposal, or transportation of hazardous waste by any person who knows or should reasonably know he or she was treating, storing, disposing, or transporting hazardous waste.

Enforcement Authority for Radioactive Wastes

Enforcement authority for the management of radioactive wastes at Berkeley Lab Radioactive Waste Collection Areas resides with the Department of Energy (DOE). Although DOE penalties do not include fines and / or criminal penalties, noncompliance with DOE orders and rules can result in the curtailment of research and support activities at the Laboratory.

The Compliance Hierarchy for Waste Accumulation at Generator Sites

To limit the institutional and individual liability in the case of noncompliance with regulations regarding waste accumulation at generator sites, Berkeley Lab has initiated a three-tiered hierarchy of violations, as depicted in Figure C-1. These three levels are described below.

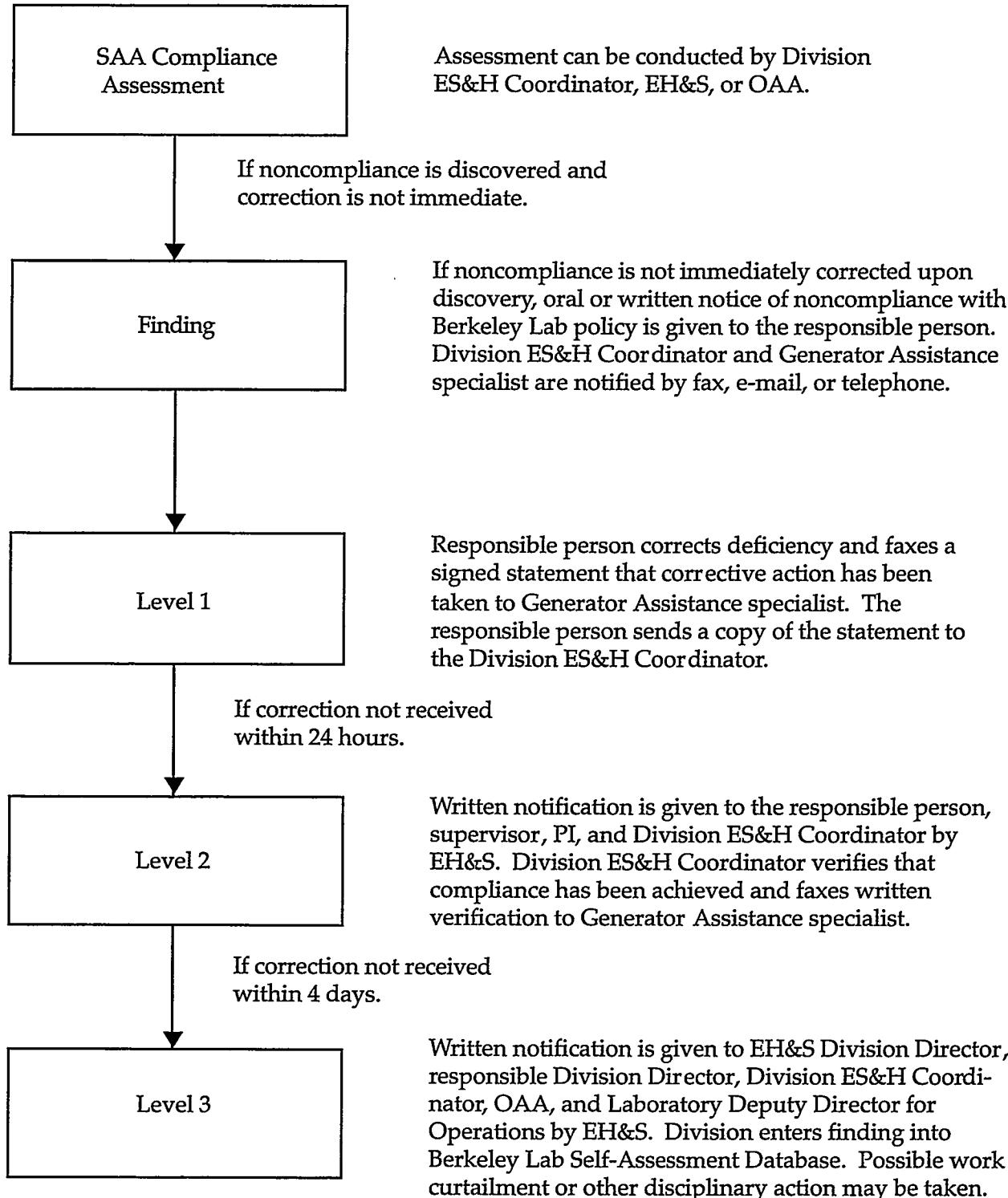


Figure C-1. Compliance hierarchy for waste accumulation at generator sites.

Level 1 When an assessment by the responsible Division, EH&S, or OAA reveals that a generator waste accumulation site is out of compliance with Berkeley Lab policy and the noncompliance is not immediately corrected, the person responsible for the accumulation site will be notified orally or in writing, and a notice will be faxed, telephoned, or e-mailed to both the EH&S Generator Assistance specialist and Environment, Safety, and Health (ES&H) Coordinator for the responsible division. This notice should be received on the day of discovery and should identify the generator site location, the date and time of the discovery of noncompliance, the responsible division, and the person responsible for the operation of the site of waste accumulation. The responsible person has 24 hours (one working day) to correct the deficiency and to fax a signed statement to the EH&S Generator Assistance specialist and the ES&H Coordinator for the responsible division that corrective actions have been taken

Level 2 If a fax confirming that compliance has been achieved is not received within 24 hours (one working day), the EH&S Generator Assistance specialist escalates the problem to Level 2. A written notice of the deficiency is faxed to the responsible person, his/her supervisor, the responsible Principal Investigator, and the ES&H Coordinator for the responsible division. In addition, an indication of noncompliance is entered into the Generator Assistance database for tracking. The responsible Division ES&H Coordinator has four working days to determine that compliance has been achieved, and to fax written verification of the correction to the EH&S Generator Assistance specialist.

Level 3 In the event that four working days pass without verification from the responsible Division ES&H Coordinator that a Level 2 infraction has been corrected, the EH&S Generator Assistance specialist escalates the problem to Level 3. After discussion with the responsible Division ES&H Coordinator, a written notice is faxed to the EH&S Division Director, detailing the nature of the problem. Copies are faxed to the responsible Division Director, the responsible Division ES&H Coordinator, and OAA, which informs the Laboratory Deputy Director for Operations. The responsible division enters the finding into the Berkeley Lab Self-Assessment Database (LSAD) for tracking. Ensuing discussions between the EH&S Division Director, the responsible Division Director, and the Laboratory Deputy Director for Operations focus on the need, if any, for work curtailment or other disciplinary action until compliance is achieved. It is anticipated that Level 3 will be reached only in the most extraordinary of conditions.

Oversight Responsibility at Berkeley Lab

EH&S is responsible for maintaining a current view of regulatory issues, formulating Berkeley Lab policy to assure regulatory compliance, and providing documentation, training materials, guidance, and assistance to the Laboratory's hazardous, radioactive, and mixed waste generators.

When the COB (or DOE) wishes to inspect generator waste accumulation sites at the Laboratory, an EH&S Division Generator Assistance specialist attends the inspection. The Generator Assistance specialist also takes part in scoping meetings prior to any inspection and in formal post-inspection close-outs, where any possible findings are discussed. This practice promotes factual accuracy in the findings and generates a full understanding of any outstanding issues by all

parties. A database of findings from COB, DOE, or EH&S inspections and all Level 2 or Level 3 violations is maintained by the Waste Minimization and Generator Assistance Team Leader to provide information for lessons learned analysis.

Berkeley Lab divisions routinely monitor their own performance in ES&H issues through the Berkeley Lab Self-Assessment Program. In addition, the EH&S Division and the DOE Site Office provide oversight of ES&H matters at Berkeley Lab through periodic functional appraisals. If not corrected immediately, these discoveries of nonconformance are treated in the same ways as violations discovered by COB. A notice reporting the noncompliance is sent to the EH&S Generator Assistance specialist, who enters the deficiency into the Compliance Hierarchy process, as described above.

EH&S Generator Assistance specialists conduct quarterly quality assurance walkarounds to establish the general level of compliance across the Laboratory's generator accumulation areas; these walkarounds also give the Generator Assistance specialists first-hand knowledge of the types of problems that may be contributing to any persistent noncompliance. The walkarounds cover at least 10% of Berkeley Lab's SAAs, MWSAAs, and Radioactive Waste Collection Areas in any quarter and are meant to provide a site-wide view of waste-accumulation compliance at Berkeley Lab generator sites.

EH&S Division Waste Generator Training Program

Generators of hazardous, radioactive, and / or mixed waste must be trained in proper handling procedures for waste to be accepted by the HWHF. All waste generators should complete Training for Hazardous Waste Generators (EHS-601) within 30 days of arriving at the Laboratory. Furthermore, generators of radioactive and / or mixed waste at the Laboratory should also complete Training for Radioactive / Mixed Waste Generators (EHS-621) within 30 days of arriving at Berkeley Lab. Training for Hazardous Waste Generators (EHS-601) is accomplished by watching a 12-minute video entitled "Environmental Compliance, Hazardous Waste, Part 1," studying this guidebook, *Guidelines for Generators to Meet HWHF Acceptance Requirements for Hazardous, Radioactive, and Mixed Wastes at Berkeley Lab* (PUB-3092), and passing a written test. Generators of radioactive and / or mixed waste view an additional 8-minute video, read the appropriate sections in PUB-3092, and answer additional examination questions. All materials have been distributed to each Division's ES&H Coordinator so generators can be trained at their convenience. Completed tests are forwarded to EH&S Training, where they are scored. The names and employee ID numbers of all Berkeley Lab staff who successfully pass the test are recorded in Berkeley Lab's training database, System for Training and Assessment Records.

After exams are scored, EH&S Training sends a memo to each trainee, listing any questions that were missed and the page in PUB-3092 where the correct information can be found. Any trainee who fails is given a second opportunity to pass the test, and credit for the course is not given until successful completion of the exam. The EH&S Training Unit also informs the appropriate Division Safety Coordinator of failures, so the information can be forwarded to the trainee's supervisor. Trainees who fail a second time should contact their EH&S Generator Assistance specialist for assistance.

Site-specific generator training is also available to supplement Training for Hazardous Waste Generators and Training for Radioactive / Mixed Waste Generators courses. This training is called Site-Specific Haz Waste Generator Training (EHS-602) and Site-Specific Rad / Mixed Waste Generator Training (EHS-622). Such special training sessions can always be arranged with the

EH&S Generator Assistance specialist at any time, and may include question-and-answer periods, site consultations, or follow-ups to resolve particularly difficult issues surrounding compliant operations.

Refresher training for hazardous, radioactive, and/or mixed waste generators is given to individuals or groups on an as-needed basis, as indicated from the compliance history for Berkeley Lab waste generators. In addition, refresher training will also be required when there are substantial changes in the generator guidelines or procedures. Refresher training may include formal classroom presentations by the EH&S Generator Assistance specialist and/or consultations at the generator waste accumulation site. Records on the refresher training are kept in the Berkeley Lab training database as well.

When revisions are made to PUB-3092, the new revision is distributed to everyone who has had waste generator training.

Berkeley Lab waste generators can get advice about their SAAs, MWSAAs, or Radioactive Waste Collection Areas by calling their EH&S Generator Assistance specialist. In most cases, questions can be answered directly over the phone, or by reference to one or more passages in PUB-3092. In cases where simple answers are not available, the EH&S Generator Assistance specialist will provide onsite consultations to resolve any further issues or give further assistance.

Appendix 6. Governing Documents and References

Governing Documents

United States Environmental Protection Agency, Title 40 of the Code of Federal Regulations (40 CFR)

United States Department of Transportation, 49 CFR

Occupational Safety and Health Administration, 29 CFR

United States Department of Energy Orders 5820.2A, 5400.3, and 5480.11

California Code of Regulations (CCR) Title 22

California Department of Health Services Hazardous Waste Control Law (excerpt from Health and Safety Code, Division 20)

EPA SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*

Washington Administrative Code, Chapter 173-303, *Dangerous Waste Regulations*

Health and Safety Manual, Berkeley Lab (PUB-3000)

Waste Analysis Plan (Section III of the Part B Permit)

Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements, WHC-EP-0063-3

Transuranic Waste Acceptance Criteria for the WIPP, WIPP-DOE-069

Master Emergency Plan, Berkeley Lab (PUB-237), revised

Waste Minimization and Pollution Prevention Awareness Plan, Berkeley Lab (PUB-3106), September 1995

Chemical Hygiene and Safety Plan, Berkeley Lab (PUB-5341)

References

Guidelines for Waste Accumulation Areas (WAAs), Berkeley Lab (PUB-3093)

Medical and Biohazardous Waste Generator's Guide, Berkeley Lab (PUB-3095)

Occurrence Reporting, Berkeley Lab (LBID-1694 Rev.)