

Guide to
Hazardous Waste Management

THE UNIVERSITY OF
MEMPHIS[®]

NOTICE TO USERS

This Guide to Hazardous Waste Management is provided to assist departments which generate hazardous waste. It is designed to clarify the maze of regulations which govern hazardous waste; however, the regulations should always be consulted for complete information.

Since information in this guide is based directly on regulatory requirements promulgated by the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation - Division of Solid Waste Management, deviations from recommendations may result in serious legal ramifications, both civil and criminal. These legal ramifications include personal criminal liability under the Resource Conservation and Recovery Act (RCRA) and related regulations.

A Guide to Hazardous Waste Management was originally approved by the Chemical Hygiene Committee on September 28, 1993; this updated Guide was approved on July 13, 2006.

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Table of Contents

Determining If a Material is a Hazardous Waste	1
The Hazardous Waste Lists	1
Characteristics of a Hazardous Waste	2
Some Common Wastes Which May Fail the TCLP Test	3
What to Do With Your Hazardous Waste	5
Satellite Accumulation Areas	6
Generator Status	6
Drain Disposal	7
Mixed Waste	8
Potentially Infectious Materials	8
Polychlorinated Biphenyls (PCB's)	8
Chemical Spills	8
Releases to the Environment	9
Empty Containers	9
Waste Minimization	10
The Waste Reduction Plan	11
Decommissioning Chemical Use and Storage Areas	11
The Contingency Plan	11
Shipment of Hazardous Waste	13
Important Documents	13
Disposing of Unwanted Equipment	13
Glossary	14
Appendices	14

The University of Memphis Guide to Hazardous Waste Management

Each department at The University of Memphis has responsibility for assuring proper disposal of its chemical wastes. Each department chair or director is accountable for compliance with University policy and with federal, state, and local regulations governing chemical waste generated within the department.

With the exception of chemicals which can be legally treated and then disposed of as non-hazardous waste, even hazardous chemicals which are not legally classified as hazardous waste may often be disposed of in the same manner as hazardous waste in order to avoid any detrimental effects on people or the environment and to avoid any future legal liability for the University. Contact Environmental Health and Safety (EH&S) for guidance in these matters.

Determining If a Material is a Hazardous Waste

It is the responsibility of the generating department to determine if a waste is a hazardous waste prior to its disposal. The waste determination must be made at the point of generation (e.g., in the lab for spent materials). **A chemical must never be placed in the building solid waste (trash) or dumped down a drain unless it has been determined that the chemical is not a hazardous waste and is acceptable for disposal through such means.** Liquids should never be placed in the building solid waste; liquids are not acceptable for landfill because they can migrate into the ground water.

For chemicals or products of unknown composition, expensive laboratory analysis is often required before disposal. However, knowledge of the generating process and the chemicals involved may be sufficient to make a determination for other materials. Consulting the Material Safety Data Sheet (MSDS) provided by the chemical manufacturer can provide a wealth of information.

Chemical wastes are classified as hazardous waste by being specifically listed as a hazardous waste in federal and/or state hazardous waste regulations, or based on characteristics of ignitability, reactivity, corrosivity, or toxicity. Each hazardous waste is assigned an EPA Hazardous Waste Code consisting of a letter and three numbers. A flowchart of the waste determination processes for spent and unused chemicals is contained in the on-line appendices to this manual.

The Hazardous Waste Lists

Federal regulations found in 40 CFR 261 and state regulations found in Tennessee Rule Chapter 1200-1-11 contain lists of specific materials which are hazardous wastes. Listed wastes are grouped by EPA Waste Codes on four lists: the "F" list, which applies primarily to spent solvents, sludges, etc.; the "K" list which includes wastes from specific sources such as distillation bottoms, wastewater treatment sludges, etc.; the "P" list of unused chemicals that are acutely hazardous wastes; and the "U" list containing various unused chemicals. Wastes found in the first list are assigned waste codes which begin with "F" (e.g., F001); wastes from the second list have waste codes beginning with "K" (e.g., K136), etc. **Be careful to apply the correct list to your situation.**

One example of the need for care in using these lists is the list of acutely hazardous wastes (the "P" list). The "P" list only applies to unused commercial chemical products, manufacturing chemical intermediates, or off-specification commercial chemical products or their intermediates; a spent product, even if found in the "P" list, will not carry a "P" waste code.

Characteristics of a Hazardous Waste

Ignitability

A waste exhibits the characteristic of ignitability and is assigned the Hazardous Waste Code D001 if it meets any of the following criteria:

- (a) It is a liquid, other than an aqueous solution containing less than 24% alcohol by volume, and has a flash point less than 60°C (140°F), as determined by methods approved by the Tennessee Department of Environment and Conservation (TDEC);
- (b) It is not a liquid and is capable, under standard temperature and pressure, of causing fire through spontaneous chemical changes and, once ignited, burns so vigorously and persistently that it creates a hazard;
- (c) It is an ignitable compressed gas as defined in federal regulations or as determined by approved test methods;
- (d) It is an oxidizer as defined in federal regulations.

Corrosivity

A waste exhibits the characteristic of corrosivity, and has a Hazardous Waste Code of D002, if it meets any of the following criteria:

- (a) It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by a pH meter using a test method approved by TDEC;
- (b) It is a liquid and corrodes steel at a rate greater than 6.35 mm per year at a temperature of 55°C (130°F) as determined by approved methods.

Reactivity

A waste exhibits the characteristic of reactivity, and has a Hazardous Waste Code of D003, if it meets any of the following criteria:

- (a) It is normally unstable and readily undergoes violent change without detonating;
- (b) Reacts violently with water;
- (c) Forms potentially explosive mixtures with water;
- (d) When mixed with water, it generates toxic gases, vapors, or fumes in a quantity sufficient to present a danger to public health or the environment;
- (e) It is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to public health or the environment;
- (f) It is capable of detonation or explosive reaction if subjected to a strong initiating source or is heated under confinement;
- (g) It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure;
- (h) It is a forbidden explosive, Class A explosive, or Class B explosive (Explosives 1.1, 1.2, or 1.3) as defined by U.S. Department of Transportation (DOT) regulations found in Title 49 of the Code of Federal Regulations.

Toxicity Characteristics

A waste exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure (TCLP) or other approved procedure, the extract from a representative sample contains any of the contaminants listed below in concentrations equal to or greater than the noted levels. Hazardous waste codes assigned to these wastes are also listed below:

<u>HW CODE</u>	<u>CONTAMINANT</u>	<u>CAS NUMBER</u>	<u>LEVEL (mg/L)</u>
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	Cresol, o-	95-48-7	200.0
D024	Cresol, m-	108-39-4	200.0
D025	Cresol, p-	106-44-5	200.0
D026	Cresol		200.0
D016	2,4-D	94-75-7	10.0
D027	Dichlorobenzene, 1,4-	106-46-7	7.5
D028	Dichloroethane, 1,2-	107-06-2	0.5
D029	Dichloroethylene, 1,1-	75-35-4	0.7
D030	Dinitrotoluene, 2,4-	121-14-2	0.13
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone (MEK)	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	Trichlorophenol, 2,4,5-	95-95-4	400.0
D042	Trichlorophenol, 2,4,6-	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	Vinyl chloride	75-01-4	0.2

Some Common Wastes Which May Fail the TCLP Test

Photographic Chemicals

Used photographic chemicals containing silver in excess of 5 milligrams per liter (e.g., spent black and white fixers) are examples of a hazardous waste under the TCLP rule. The indiscriminate dumping of these chemicals, as with other hazardous wastes, could result in severe civil and criminal penalties, and damage the environment. Therefore, spent black and white fixers and related materials should not be dumped down drains unless tested and found to be non-hazardous.

If your operations generate such materials, you may choose from several methods to handle the resulting hazardous waste, including:

- Accumulating waste in containers for recovery or disposal by a hazardous waste contractor, or
- Recovering silver from waste by use of a chemical recovery cartridge or other approved system.

Departments recovering silver on-site with approved methods are not considered to be generators of hazardous waste, and recovering significant quantities of silver may also negate a portion of the treatment cost. Recovery cartridge systems for this purpose are reasonably priced, requiring a one-time investment for the system, plus periodic maintenance costs.

Used Oils and Filters

When properly recycled, used oil from vacuum pumps and other sources is not currently classified as a hazardous waste unless combined with a hazardous waste. Uncontaminated oil should be collected and shipped via an approved contractor for recycling. Since contaminated oil must be disposed of as a hazardous waste, it is essential that vacuum pumps (and the pump oil) be protected from contamination. Uncontaminated used oil should never be consolidated with contaminated waste oil. Uncontaminated used oil should be labeled with the words "Used Oil."

Oil filters such as those removed from vehicles should be drained and crushed to remove all free flowing oil for recycling; the crushed filter may then be recycled or disposed as a special waste. Used engine oils and fully drained oil filters that are not recycled must be handled under waste management standards for used oil.

Spent Solvents

Waste petroleum based solvents will almost always be a hazardous waste based on ignitability (D001); however, contaminants in waste solvents may add additional hazards and EPA Waste Codes. Examples include paint solvents from art studios and maintenance operations which may contain lead, chromium, or other heavy metals noted in the TCLP list.

Fluorescent Tubes and Other Mercury Containing Lamps

The presence of mercury within fluorescent tubes and certain other lamps will generally make these items a hazardous waste. Unless there is laboratory evidence to show that a lamp type is not a hazardous waste under the TCLP rule, these should not be indiscriminately placed in the solid waste. Physical Plant can generally recycle these items under Universal Waste rules.

Thermometers, Barometers, and Manometers

Mercury-filled thermometers, barometers, and manometers constitute a hazardous waste when broken or disposed of. Due to the health hazards presented and the high cost for disposal of mercury spill debris, mercury-filled devices should be purchased only when no cost-effective alternative is available. Those departments which purchase mercury-filled devices must be prepared to pay all associated disposal costs unless prior arrangements are made with EH&S.

Batteries

Batteries of various types may contain lead, mercury, and cadmium from the TCLP list, plus other materials such as lithium and nickel. While old lead-acid batteries are easily returned to recyclers and are not a hazardous waste when treated in this manner, other types of batteries may present problems. Small batteries like those found in computers and other electronic devices can cost

many times their original value when disposed of as hazardous waste, and they present a great temptation for improper disposal. Departments should avoid the expense and potential legal ramifications by dealing only with vendors who will accept the return of old batteries. Where batteries cannot be returned to the vendor, Physical Plant can send many types of batteries for recycling under Universal Waste rules.

Electronic Devices

Computer monitors, printed circuit boards, and other electronic devices typically contain significant amounts of lead and other contaminants. Since electronic devices are known to contain significant quantities of heavy metals, some of which are listed hazardous wastes, unwanted electronic devices such as printed circuit boards, monitors, etc., should be routed through Central Receiving for recycling or resale. **Do not dispose of these items in the dumpster.**

What to Do With Your Hazardous Waste

Departments that generate hazardous wastes must have an EPA ID Number for the generating location, comply with all applicable hazardous waste regulations, file reports with various regulatory agencies, pay applicable fees, and be prepared to pay disposal costs.

Once your department has determined that a waste is hazardous, it is important to do the following:

- Store the waste properly.
 - ▶ Accumulate waste in containers that are clean, in good condition, chemically compatible, and appropriate for the quantity accumulated - quantities greater than one (1) gallon should be in unbreakable containers, metal safety cans are recommended for flammables suitable for storage in metal;
 - ▶ If small quantities are accumulated in larger containers, **do not combine different kinds of waste unless you know that they are compatible and are acceptable for disposal in the combined form;**
 - ▶ Flammables must be stored away from oxidizers, water reactives away from moisture, acids away from bases, etc.;
 - ▶ Containers must be within a secure area where any leak will not cause harm to the environment;
 - ▶ Containers must be closed at all times unless waste is being actively added to or removed from the containers.
- Label the waste container with the date accumulation started, identity of the contents, quantity of each constituent, and the words "HAZARDOUS WASTE."
- Schedule removal of the waste by the University hazardous waste contractor by notifying Environmental Health and Safety that a pick-up is needed. This may be accomplished by submitting an Unwanted Chemical Declaration Form.
- Inspect the hazardous waste on a weekly basis and keep a log (see online appendices for form) showing: date and time of each inspection, name of the inspector, observations, and any remedial action taken to correct problems.
- Install and maintain emergency equipment to be used in case of a spill.
- Post a Chemical Spill Procedure by the nearest phone and in the storage area. Be certain to designate an emergency coordinator who will respond to any emergency situation involving the waste. Fill in the appropriate phone numbers and other information on the Chemical Spill Procedure.
- Keep complete records of all hazardous waste, including generation date, quantities, and kinds of materials.
- Provide appropriate training on at least an annual basis for personnel who handle or might otherwise be in proximity to the hazardous waste.

Satellite Accumulation Areas

Hazardous wastes may be accumulated in a Satellite Accumulation Area (SAA) at or near the point of waste generation. Quantities of waste stored in the (SAA) are limited to 55 gallons of non-acute hazardous waste or 1 quart (1 kg.) of acutely hazardous waste; once the limit is reached, containers must be marked with the accumulation start date and moved to a central hazardous waste storage area within 72 hours. Container labeling, storage, and weekly inspection requirements must be complied with in the SAA. Waste must not be moved from one SAA to another SAA.

Generator Status

Your generating location will be classified under environmental regulations as a Conditionally Exempt Small Quantity Generator (CESQG), Small Quantity Generator (SQG), or Large Quantity Generator (LQG) based on the following criteria:

Conditionally Exempt Small Quantity Generator

- Total monthly generation is less than 100 kilograms (kg), and
- Accumulation or generation of acutely hazardous waste is less than 1 kg, and
- Waste is accumulated in quantities less than 1,000 kg before shipping off-site.

Small Quantity Generator

- Total monthly generation is greater than 100 kg, but less than 1,000 kg, and
- Accumulation or generation of acutely hazardous waste is less than 1 kg, and
- Waste is accumulated in quantities less than 1,000 kg before shipping off-site.

Large Quantity Generator

- Total monthly generation is equal to or greater than 1,000 kg, or
- Accumulation or generation of acutely hazardous waste equal to or greater than 1 kg, or
- Waste is accumulated in quantities equal to or greater than 1,000 kg before shipping off-site.

Generator status is important: Large Quantity Generators are more highly regulated, must ship wastes off-site every 90 days, and must pay the maximum annual maintenance fees to regulatory agencies; Small Quantity Generators may hold hazardous wastes for up to 180 days (270 days if wastes are shipped more than 200 miles for treatment or disposal), and pay an annual maintenance fee which is about half that of the LQG; and Conditionally Exempt Small Quantity Generators pay no fee and have no storage time limit until certain quantities of waste are generated or accumulated.

It is very important to observe the time and quantity limits for storage. **Exceeding these limits can result in serious legal consequences, and reclassify your location as a storage facility.** A storage facility must have a special EPA permit and falls under very stringent regulatory constraints which present major administrative and financial burdens. Departments are responsible for notifying TDEC of new waste streams, changes in generation rates, etc., within ninety (90) days to assure proper generator classification.

Since departments generating 1 kg or more of an acutely hazardous waste become Large Quantity Generators, **it is imperative that EH&S be notified immediately when 1 kg or more of acutely hazardous waste is generated.** Upon notification, EH&S will schedule removal of the waste by the hazardous waste contractor prior to expiration of the 90 day time limit.

Drain Disposal

Because limited quantities of non-hazardous chemicals may be introduced into the sanitary sewer for disposal, Section 33-104 of the Memphis Sewer Use Ordinance should be consulted before discharge of chemicals into the sanitary sewer. EH&S can also offer guidance in these matters.

No chemical should ever be discharged into storm sewers.

Some Chemicals Prohibited from Drain Disposal

Based on the above ordinance, no person shall discharge wastewater containing any of the materials listed below into the municipal sewer system without obtaining written permission from the City of Memphis.

Acrylonitrile	Dichloropropane, 1,1-
Aldrin	Dichloropropene, 1,3-
Aluminum	Diieldrin
Barium	Diisobutylenes
Benzene	Dimethylnitrosamine
Benzo (a) pyrene	Dinitroluene, 2,4-
Benzotrichloride	Dinitrophenol, 2,4-
Beryllium	Ethyl benzene
Bis (2-ethylexyl) phthalate (DEHP)	Heptachlor
Bromobenzene	Heptachlorodibenzo-p-dioxins, total
Bromodichloromethane	Heptachlorodibenzo-p-dioxins, 1,2,3,4,6,7,8-
Bromoform	Heptachlorodibenzofurans, total
Carbon tetrachloride	Heptachlorodibenzofuran, 1,2,3,4,7,8,9-
Chlordane	Heptachlorodibenzofuran, 1,2,3,4,6,7,8-
Chlorobenzene	Hexachlorobenzene
Chlorodibromomethane	Hexachlorobutadiene
Chloroethane	Hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9-
Chloroform	Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-
Chlorophenol, 2-	Hexachlorodibenzo-p-dioxins, total
Chlorotoluene, p-	Hexachlorodibenzofuran, 1,2,3,4,7,8-
Chlorotoluene, o-	Hexachlorodibenzofurans, total
Cumene	Hexachlorodibenzofuran, 1,2,3,6,7,8-
DDT/DDE/DDD	Hexachlorodibenzofuran, 1,2,3,7,8,9-
Dibromo-3-chloropropane, 1,2-	Hexachlorodibenzofuran, 2,3,4,6,7,8-
Dibutylphthalate	Isopropylbenzene
Dichlorobenzene, p-	Lindane
Dichlorobenzene, m-	Methyl chloride (Chloromethane)
Dichlorobenzene, o-	Molybdenum
Dichlorobenzene, 1,4-	Octachlorodibenzo-p-dioxin
Dichlorobenzidene, 3,3-	Octachlorodibenzofuran
Dichloroethane, 1,2-	PCB-1260
Dichloroethane, 1,1-	Pentachlorodibenzo-p-dioxin, 2,3,4,7,8-
Dichloroethyl ether (bis (2-chloroethyl))	Pentachlorodibenzo-p-dioxin, 1,2,3,7,8-
Dichloroethylene, trans-1,2-	Pentachlorodibenzo-p-dioxins, total
Dichloroethylene, cis-1,2-	Pentachlorodibenzofuran, 1,2,3,7,8,-
Dichloroethylene, 1,1-	Pentachlorodibenzofuran, 2,3,4,7,8,-
Dichloropropane, 2,2-	Pentachlorodibenzofurans, total
Dichloropropane, 1,3-	Phenols
Dichloropropane, 1,2-	Pyrene

Tetrachlorodibenzo-p-dioxins, total
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-
Tetrachlorodibenzofuran, total
Tetrachloroethane, 1,1,1,2-
Tetrahalorodibenzofuran, 2,3,7,8-
Tin
Titanium

Toluene
Toxaphene (chlorinated camphene)
Trichloroethane, 1,1,2-
Trichloroethylene
Trichloropropane, 1,2,3-
Vinyl chloride
Xylenes, o,m,p-

Neutralization

Chemicals with a pH less than 5.5 or greater than 10 must not be introduced into the sanitary sewer. Where a chemical would otherwise be acceptable for sewer disposal, neutralize corrosive solutions to acceptable levels before disposal down the drain. Contaminants such as heavy metals or hazardous reaction products will make the neutralized solution unacceptable for drain disposal. In all cases of neutralization, **be careful** - perform the procedure in an approved fume hood with a safety shield, wear the proper personal protective equipment, and work slowly to prevent splattering and container damage due to the exothermic reaction.

Mixed Waste

Regulatory complexities treat different types of waste in distinctly different ways. In addition, there are few facilities authorized to transport, treat, and/or dispose of materials falling under multiple regulatory constraints. Therefore, it is essential that personnel exercise great care in not mixing hazardous waste with materials which are radioactive or infectious. These combinations, called Mixed Waste, may be virtually impossible to dispose of at the present time and represent a significant liability to the University and generating departments.

Potentially Infectious Materials

Potentially infectious items, including cultures, pathogenic waste, human blood and blood products, sharps, and certain body fluids, must be accumulated, handled, and disposed of in accordance with University exposure control plans, the OSHA Bloodborne Pathogens Standard, and related regulations. In order to avoid the potential liability associated with the appearance of improper disposal, University personnel are urged to dispose of all hypodermic needles, syringes, scalpel blades, needles with tubing attached, culture dishes, etc., through the medical waste contractor. Sharps must be accumulated in properly labeled, puncture resistant, leak proof containers. Call EH&S at 678-2740 for guidance on proper handling and disposal of potentially infectious materials.

Polychlorinated Biphenyls (PCB's)

PCB's, once commonly used in transformers, capacitors, and other electrical devices, are now virtually banned from common applications. Regulated under the Toxic Substances Control Act (TSCA), PCB's must be possessed and handled in accordance with very detailed requirements found in 40 CFR 761. Because of the great liability that is created by the presence of PCB's, all departments are urged to contact EH&S for disposal of old electrical devices known or thought to contain these chemicals. If you are unsure of the presence of PCB's in any device, contact the manufacturer with the model number, serial number, and other identifying information about the device; the manufacturer will then confirm the presence or absence of these chemicals.

Chemical Spills

When any hazardous material is spilled, follow the Chemical Spill Procedure found in the on-line appendices. This procedure is designed to safeguard health and safety of personnel, as well as

facilities and the environment. For small spills which present minimal risk to personal safety, clean up the spill under the supervisor's guidance, and in accordance with instructions in the MSDS. EH&S can supply a basic spill kit at no cost. **Be sure to contain the waste, label it, and hold for proper disposal.**

If you need help with a spill that is too large or too hazardous for clean-up by laboratory personnel or others familiar with the substance, call Police Services at 678-4357 (678-HELP) to request assistance from the Memphis Fire Department or the spill response contractor. During normal business hours, EH&S may be contacted at 678-4672 or 678-2044 to report a spill.

When notifying Police Services or EH&S of a spill, report at least the following items:

- Location of the Spill
- Chemical Name (spell it)
- Quantity Released
- When the Spill Occurred
- What Kind of Assistance is Needed
- Your Name and Phone Number

Releases to the Environment

When spilled hazardous materials enter the soil, sewers, bodies of water, or the atmosphere, **the release must be reported to Police Services at 678-4357 immediately.** Police Services or EH&S will notify appropriate government agencies when necessary to comply with federal and/or state regulations.

Empty Containers

When accepting or disposing of drums or other containers, it is wise to confirm that they are empty. A container is legally empty based on the following criteria:

Compressed Gases

A container which has held a compressed gas which is a hazardous waste may be considered empty when the pressure within the container is equal to atmospheric pressure.

Acutely Hazardous Waste

A container which has held an acutely hazardous waste must be triple rinsed using a solvent capable of removing the chemical contained therein, or cleaned by another method that is legally acceptable, or by removing and properly handling any inner liner which prevented contact with the container. **Materials rinsed out of the container and any liner must be properly handled and disposed of as acutely hazardous waste.**

Other Hazardous Waste

All waste must be removed from the container to the extent possible through commonly employed methods of removal for the type of container (e.g., pouring, pumping, etc.). When residue remains, contact EH&S for guidance before disposing of the container or residue.

Obliterate the labels and other markings before disposing of an empty container which held a hazardous chemical. Render glass containers useless by safely breaking them; plastic and small metal containers may be carefully punctured with a non-sparking tool before disposal to prevent further use. Some empty metal drums and glass containers may be recycled through a reputable recycler; check with EH&S for guidance.

Pipettes and Pipette Tips

Pipettes and their tips, like other containers, are legally empty once all liquid is removed using the practices commonly employed. Pipette tips that have been used to transfer hazardous chemicals can, therefore, legally be disposed in the trash. Follow the guidance above for tips used with a chemical that would have been an acutely hazardous waste. In situations where personnel have concerns that legally empty pipette tips could pose a threat to people or the environment, these items may be held for disposal as non-RCRA regulated waste; contact EH&S for guidance.

Waste Minimization

The most effective method of reducing disposal costs, quantity and toxicity of waste, and the associated safety and administrative problems is to never generate hazardous waste. Some methods for reducing waste are listed below:

- Centralize the purchase of hazardous materials within the department by processing all orders through one person or one office.
- Order only what is needed now, not what you might need for future processes.
- Maintain an up-to-date inventory and check for in-house availability before ordering new materials (EH&S can assist in setting up an electronic database).
- Use materials on a first-in, first-out basis to prevent degradation in storage.
- Reduce the scale of laboratory processes.
- Substitute less hazardous materials in processes (e.g., special detergents in place of chromic acid solution to clean glassware).
- Reuse materials by making the product of one process the raw material for a later process.
- Reduce the hazardous properties of waste as the final step in experiments.
- Train personnel in waste reduction techniques.
- Centralize waste management within each building.

Inventory Control for Waste Reduction

In addition to potentially serious safety problems and storage difficulties, uncontrolled inventories of hazardous materials eventually lead to increased hazardous waste generation. Department chairs and directors should avoid these difficulties by following guidance found above and in the *Laboratory Chemical Hygiene Plan*.

It is especially important to date all chemical containers to indicate when the containers are received and when they are opened. Those chemicals known to form potentially explosive peroxides must carry a peroxide former label. This label, available from EH&S, should be completed appropriately and affixed by laboratory personnel upon receipt of peroxide formers; a list of potential peroxide formers and recommended shelf life is contained in the on-line appendices to this manual. Disposal of unused peroxide formers by the times suggested in the list will decrease the probability of an explosion and reduce disposal costs by thousands of dollars. **Never drop, shake, or attempt to remove the cap from old picric acid or peroxide former containers.**

Departments allowing chemicals to deteriorate to the point of becoming unstable must be prepared to pay costs for bomb disposal technicians, disposal charges, and fees to various regulatory agencies. Departments must also be prepared for the inconvenience of temporary building evacuation and losing the use of laboratories and storage rooms containing potentially shock sensitive explosives until the materials are properly stabilized and removed.

The Waste Reduction Plan

The Tennessee Hazardous Waste Reduction Act of 1990 (TCA 68-46-301 et seq) mandates that **generators of hazardous waste must develop a comprehensive waste reduction plan**. The University has adopted such a plan in University Policy UM1622, known as the Hazardous Waste Reduction Policy and Plan. That policy requires each department generating hazardous waste to prepare a departmental hazardous waste reduction plan which must be updated annually.

At a minimum, waste reduction plans must include the following items:

- A written policy supporting the hazardous waste reduction plan which is signed by top level management (i.e., the department chair for the departmental plan);
- The scope and objectives of the plan;
- A description of technically and economically practical hazardous waste reduction options, and a schedule of implementing these options;
- A description of a hazardous waste cost accounting system;
- A description of employee awareness and training programs; and
- A description of how the plan has been or will be incorporated into management practices and procedures so as to insure an ongoing effort.

A generator or person failing to comply with the above act is subject to a civil penalty of up to \$10,000 per day. If your department has not developed a plan, please call EH&S at 678-4672 or 678-2044 for more information and assistance in writing your plan. EH&S must have current copies of departmental plans on file in order to assure that a department will qualify for financial assistance in disposal of hazardous wastes. Remember that federal law also requires generators of hazardous waste to have a program in place to reduce the volume and toxicity of hazardous waste. The person signing your hazardous waste manifests must certify that you have a program.

Decommissioning Chemical Use and Storage Areas

Prior to the closing of a laboratory or other area where hazardous chemicals have been used or stored, departments must certify that the area has been decommissioned. Principal Investigators (PIs) are fully responsible for complying with all decommissioning requirements. In the event of death, disability, abrupt termination of employment, or other unplanned event where the PI is unavailable, the department chair becomes responsible for implementing the decommissioning procedure. Department chairs are additionally responsible for oversight of the decommissioning procedure and for certifying that a vacated laboratory space or storage area has been properly decommissioned. Researchers who vacate shared spaces must ensure that this procedure is implemented for their portion of the lab space.

Departments may incur significant costs as a result of laboratories that have not been properly decommissioned; departments are responsible for any deficiencies not corrected by the Principal Investigator. Any regulatory actions or fines resulting from improper management or disposal of any regulated material may also accrue to the department. The Laboratory Decommissioning Form is found in the on-line appendices.

The Contingency Plan

Contingency Plans are required under 40 CFR 265.50 and Tennessee Rule 1200-1-11-.05 (4)(a) through (f). LQGs operating 90-day accumulation areas under 40 CFR 262.34 must write and implement a contingency plan, assign an Emergency Coordinator, and implement specific procedures to minimize hazards to human health or the environment from fires, explosions, or unplanned release of hazardous waste or hazardous constituents from their facilities to air, surface water, or soil.

While departments with LQG status must have a Contingency Plan, Small Quantity Generators must only have an Emergency Coordinator and an Emergency Response Procedure. Under Tennessee regulations, the Contingency Plan must contain the following information:

- Describe the actions departmental personnel must take to comply in response to fire, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water at the facility. (If a Spill Prevention, Control, and Countermeasures (SPCC) Plan in accordance with 40 CFR 112 or 40 CFR 1510, or some other emergency or contingency plan has been prepared, the department may amend the plan to incorporate hazardous waste management provisions that are sufficient to comply with these requirements.)
- Describe arrangement agreed to by local police departments, fire departments, hospitals, contractors, and State and local emergency response teams to coordinate emergency services.
- List names, address, and phone numbers (office and home) of all persons qualified to act as emergency coordinator and this list must be kept up to date. Where more than one person is listed, one must be named as the primary emergency coordinator and others must be listed in the order in which they will assume responsibility as alternates.
- Include a list of all emergency equipment at the facility [such as fire extinguishing systems, spill control equipment, communications and alarm systems (internal and external), and decontamination equipment], where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.
- Include an evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of hazardous waste or fires).

A copy of the contingency plan and all revisions to the plan must be maintained within the department and submitted to all police departments, fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services. Don't forget to send a copy to EH&S as well. The plan must be reviewed and immediately amended, if necessary, whenever applicable regulations are revised; the plan fails in an emergency; the facility changes in design, construction, operation, maintenance, or other circumstances in a way that materially increase the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes the response necessary in an emergency; the list of emergency coordinators changes; or the list of emergency equipment changes.

There must be at least one employee available at all times either on site or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility of coordinating all emergency response measures. This emergency coordinator must be thoroughly familiar with all aspects of the contingency plan, all operations and activities at the facility, the location and characteristics of waste handled, the location of all records within the facility, and the facility layout. In addition, this person must have the authority to commit the resources needed to carry out the contingency plan.

A template is available from EH&S which covers the major requirements listed above. Once the Contingency Plan is written, it should be reviewed at least annually and updated in response to any changes in personnel, hazards, etc.

Shipment of Hazardous Waste

Since hazardous wastes must be transported in commerce by DOT permitted haulers, movement of hazardous waste in commerce by University personnel is prohibited. Personnel wishing to transport hazardous waste for short distances between contiguous sites on campus should call EH&S for guidance. When necessary to transport chemicals on University property, it is important to maintain a spill control kit suitable for the substance and to provide adequate training for personnel who might have to control a spill. When shipping waste off-site through a permitted transporter, a signed hazardous waste manifest must accompany each shipment. Only personnel who have been appropriately trained and certified may be involved in shipping hazardous materials; this includes personnel signing hazardous waste manifests. University Policy UM1296 makes the Director of Environmental Health and Safety responsible for certifying University employees.

Transportation Security Plans

Each department holding hazardous waste for shipment must implement appropriate security measures. These measures must be included in a written departmental transportation security plan which addresses who will have access to the waste and how access will be limited to those who are trained and authorized. Methods of restricting access include (1) installing or replacing locks to limit access to specific individuals, (2) installing alarms to limit access to specific individuals, and (3) performing background checks on all faculty, staff, and students who have access to the area. Each employee involved in the hazardous waste program must receive training in the security plan at appropriate intervals. Contact EH&S for assistance.

Important Documents

The hazardous waste manifest, hazardous waste disposal certificates, and related documents such as drum packing lists are important legal documents. Copies of these documents must be retained by each generating department. For departments participating in the hazardous waste disposal program coordinated by EH&S, originals must be forwarded to EH&S.

Disposing of Unwanted Equipment

Unwanted equipment destined for disposal poses a potentially serious liability. It is essential that all hazardous materials associated with equipment destined for disposal be removed and properly disposed. Some items to check for are noted below:

- Coolants, including ethylene glycol antifreeze
- Oil, including pump oil
- Refrigerants, including freon and ammonia
- Batteries
- Fluorescent lamps and ballasts
- Lead, including that found in electronic devices
- Mercury, including that found in switches and thermostats

It is the responsibility of your department to ensure that all unwanted equipment is acceptable for disposal. An Equipment Release Form must be completed and attached to equipment destined for removal by Physical Plant; a copy of the form is found in the on-line appendices.

Glossary of Terms Not Defined Elsewhere

Accumulation Start Date	The date when a waste container is full. Containers must be moved to a central waste storage area within 72 hours of becoming full.
Spent	A material is spent if it has been used for its intended purpose. Spent materials will not carry a "P" or "U" waste code; however, they may carry "D," "F," and/or "K" waste codes.
Universal Waste	Universal wastes are specific hazardous wastes that are subject to streamlined collection, storage, and processing rules when appropriately recycled. These items include batteries, mercury-containing thermostats, and mercury-containing lamps.
Unused	A material is consider unused if it has not been used for its intended purpose even if some of the material has been removed from the container and used.
Waste Determination	Waste determination is the process whereby a waste is evaluated to determine if the waste is a hazardous waste. Waste determination process flowcharts are included in the on-line appendices to this manual.

On-line Appendices to this Manual

Chemical Spill Procedure

Equipment Release Form

Laboratory Decommissioning Form

Lists of Hazardous Wastes

Peroxide Former List

Unwanted Chemical Declaration Form

Waste Determination Process for Spent Chemicals

Waste Determination Process for Unused Chemicals

Weekly Inspection Log