United States
Environmental Protection
Agency

EPA/600/R-19/116
December 2019

Laboratory Analytical Waste Management and Disposal Information Document

Companion to Selected Analytical Methods for Environmental Remediation and Recovery (SAM) 2017

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Companion to *Selected Analytical Methods for Environmental Remediation and Recovery* (SAM)

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EPA Contract No. EP-C-10-060 and EP-C-15-012.

December 2019

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Disclaimer

This document is intended to provide general guidelines for use by the U.S. Environmental Protection Agency (EPA) and EPA-contracted laboratories when managing and disposing of analytical waste following use of the methods listed in EPA's *Selected Analytical Methods for Environmental Remediation and Recovery* (SAM) 2017. It includes information regarding laboratory waste management responsibilities; waste minimization; federal and state regulations; and waste treatment, storage, packaging, disposal and decontamination procedures. This document is not intended to be a complete compilation of all the regulatory requirements with which the laboratory may have to comply to meet local, state and federal mandates. It is the laboratory's responsibility to ensure that their programs and procedures are in full compliance with the applicable regulations. It should also not be used as a substitute for the actual requirements. EPA hazardous waste regulations are located in Title 40 of the Code of Federal Regulations (CFR) Parts 260 to 299. While the document mentions state regulations generally, many states have their own hazardous waste regulations based on the federal hazardous waste regulations. In some of these states, the requirements are the same as the federal standards and definitions. Other states, however, have developed more stringent requirements than the federal program. If this is the case in your state, you must comply with the state regulations. To become familiar with your state's requirements, consult your state hazardous waste agency. This document has been reviewed by the EPA Office of Research and Development and approved for publication. Mention of trade names, products, or services does not convey EPA approval, endorsement or recommendation.

Questions concerning this document, or its application should be addressed to:

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Acronyms and Abbreviations

AEA	Atomic Energy Act
ALARA	As Low as Reasonably Achievable
APHIS	Animal and Plant Health Inspection Service (USDA)
BSL	Biosafety Level
CAA	Clean Air Act
CDC	U.S. Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESER	Center for Environmental Solutions and Emergency Response (EPA)
CFR	Code of Federal Regulations
CG	phosgene
Cl	chlorine
CWA	Clean Water Act
DAC	derived air concentration
DDESB	Department of Defense Explosives Safety Board
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
g	gram(s)
GA	tabun
GB	sarin
GD	soman
GF	cyclohexylsarin
HAZMAT	hazardous materials
HD	sulfur mustard
HDPE	high density polyethylene
HN-1	nitrogen mustard (bis(2-chloroethyl)ethylamine)
HN-2	nitrogen mustard (bis(2-chloroethyl)methylamine)
HN-3	nitrogen mustard (tris(2-chloroethyl)amine)
HSRP	Homeland Security Research Program
IAEA	International Atomic Energy Agency
IATA	International Air Transport Association
ICS	Incident Command System
L-1	lewisite 1
L-2	lewisite 2
L-3	lewisite 3
LLRW	low-level radioactive waste
LLRWPA	Low-Level Radioactive Waste Policy Act
LMW	low molecular weight
LQG	Large Quantity Generator
mCi	millicurie(s)
mg	milligram(s)
mm	millimeter(s)
mR	milliroentgen(s)

mrem	millirem(s)
mSv	millisievert(s)
MTRU	mixed transuranic
N	normal – 1 equivalent weight per liter
NARM	naturally occurring, and/or accelerator-produced radioactive material
NaOCl	sodium hypochlorite
nCi	nanocurie(s)
NIMS	National Incident Management System
nm	nanometer(s)
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act
OSC	On-Scene Coordinator
OSHA	U.S. Occupational Safety and Health Administration
PCB(s)	polychlorinated biphenyl(s)
PPE	personal protective equipment
ppm	parts per million
POTW	publicly owned treatment works
PSN	Proper Shipping Name
RCRA	Resource Conservation and Recovery Act
SAM	*Selected Analytical Methods for Environmental Remediation and Recovery*
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety Data Sheet
SHEM	Safety, Health, and Environmental Management
SOP	Standard Operating Procedure
spp.	Several species
SQG	Small Quantity Generator
TBq	terabecquerel(s)
TNT	trinitrotoluene
TRU	transuranic
TSCA	Toxic Substances Control Act
TSDF	treatment, storage and disposal facility
µCi	microcurie(s)
µm	micrometer(s)
UN	United Nations
UN ID	United Nations identification number
µR	microroentgen(s)
URL	Uniform Resource Locator
UV	ultraviolet
VSQG	Very Small Quantity Generator
VX	O-ethyl-S-[2-diisopropylaminoethyl]methyl-phosphonothiolate
WHO	World Health Organization
WMP	Waste Management Plan

Acknowledgments

This document was developed by the U.S. Environmental Protection Agency's (EPA) Center for Environmental Solutions and Emergency Response (CESER) within EPA's Office of Research and Development, as a companion to NHSRC's *Selected Analytical Methods for Environmental Remediation and Recovery* (SAM). We wish to acknowledge the peer reviews conducted by Paul Lemieux (EPA CESER) and Mario Ierardi (EPA Office of Resource Conservation and Recovery, retired) whose thoughtful comments contributed greatly to the quality of the information. We also wish to acknowledge Eric Boring, Yildiz Chambers, Joan Cuddeback, Marti Sinclair and Larry Umbaugh (of CSRA) for technical and editorial support. The document was prepared by CSRA under EPA Contract No. EP-C-10-060 and EP-C-15-012.

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1.0 Background

The U.S. Environmental Protection Agency's (EPA) Homeland Security Research Program (HSRP) has been working with experts from across EPA and its sister agencies since 2004 to develop a compendium of procedures to be used when EPA is tasked with environmental remediation following national homeland security related incidents, such as an attack or natural disaster resulting in contamination. Analytical methods have been selected for chemical, radiochemical, pathogen, and biotoxin analytes of concern for the environmental sample types that are anticipated in such incidents. These sample types include water, soil, surface wipes, air particulate filters and building materials. The most recent result of this effort is published in EPA's *Selected Analytical Methods for Environmental Remediation and Recovery* (SAM).

During development of SAM, EPA recognized the need for companion documents, including a document to provide guidelines regarding management and disposal of wastes resulting from samples that have been analyzed by the methods listed in SAM.

This document addresses management of laboratory analytical waste unique to remediation activities following a homeland security incident when SAM methods would be applied, and assumes that specific environmental sample types (i.e., water, soil, surfaces wipes, air particulates and building materials) will be analyzed by laboratories using the methods listed in SAM.

2.0 Scope and Application

This document is intended to provide general guidelines for use by EPA and EPA-contracted laboratories when managing and disposing of analytical waste following use of the methods listed in SAM.

The document includes information regarding laboratory waste management responsibilities; waste minimization; federal and state regulations; and waste treatment, storage, packaging, disposal and decontamination procedures. This document is not intended to be a complete compilation of all the regulatory requirements with which the laboratory may have to comply to meet local, state and federal mandates. It is the laboratory's responsibility to ensure that their programs and procedures are in full compliance with the applicable regulations. The internet Uniform Resource Locators (URLs) found throughout this document provide the most currently available information at the time of document preparation. Please note that these links will be reviewed and updated periodically, following publication of updated SAM documents.

It is assumed that laboratories using this document will be handling environmental samples (e.g., water, soil, surfaces wipes, air particulate filters, outdoor building and infrastructure materials) containing one or more of the chemical, biological, or radiochemical analytes listed in SAM at levels that would be expected to be found in samples collected in support of site remediation and clearance. It is also assumed that these samples and the corresponding analytical waste are thoroughly characterized, and the hazardous components and concentration levels understood. Guidelines are provided for management and disposal of waste samples that may contain SAM chemical (Section 4), radiochemical

(Section 5), and biological hazards (Section 6), as well as mixed and multiple-hazards sample waste (Section 7).

Although samples received by laboratories are not considered to be regulated waste while awaiting testing, while stored after testing, or while being transported back to the sample collector (40 Code of Federal Regulations (CFR) 261.4(d)), all samples should be treated as potentially hazardous. Once samples are analyzed, the concentration of contaminants determines appropriate disposal procedures. Samples designated for waste treatment, disposal or decontamination should be treated as a regulated waste, and sample handling should meet all federal and state requirements. Although the U.S. Department of Transportation (DOT) provides information regarding the packaging, labeling and transport of biological waste at 49 CFR, it should be noted that there is no federal framework for management of bio-incident waste, potentially including laboratory-generated waste; these activities fall under the purview of state regulatory programs.

The information provided in this document is intended only as a guide and is based on the current federal and state regulations cited. Laboratories must consult and comply with these regulations prior to initiating analytical waste management and disposal activities. This document is not intended to be a complete compilation of all the regulatory requirements with which laboratories may have to comply to meet local, state and federal mandates. It is the laboratory's responsibility to ensure that their programs and procedures are in full compliance with the applicable regulations.

3.0 Overview of Laboratory Responsibilities

This section summarizes laboratory responsibilities and strategies for management and disposal of analytical waste resulting from analysis of samples containing chemical, radiological or biological contaminants. In some cases, multiple management strategies may be required, such as when a biological laboratory uses an analytical technique with a chemical component, thus requiring a chemical disposal plan.

3.1 Waste Management

3.1.1 Waste Management Plan

Laboratories managing and disposing of analytical waste are responsible for complying with all federal, state, and local regulations governing waste management. A Waste Management Plan (WMP) will help laboratories ensure compliance with all applicable regulations. Laboratories also should be able to demonstrate that this plan is being followed by personnel for the safe handling and disposal of all waste materials generated. A laboratory's WMP should include information and instructions regarding:

- Plan implementation
  - Types of wastes expected to be generated at the laboratory
  - Responsibilities of laboratory personnel
  - Management authorization (signatures)
  - Information accessibility by staff
  - Laboratory accountability

- Permit and reporting requirements
- Decontamination materials (storage)
- Health and safety for storage and transportation areas
- Training requirements
- Personal protective equipment (PPE)
- Exposure monitoring
- Requirement for review and updates (e.g., at least annually)
- Audits
- Record keeping requirements
- Contingency plan(s) with alternatives to decontamination, storage and off-site treatment and disposal

- Waste storage
  - Primary containment
  - Requirements for satellite waste accumulation areas (e.g., decontamination and spill kits, power source, fresh water source)
  - Accumulation and storage of spent decontamination materials
  - Waste classification and segregation
  - Identification and inspection of waste storage areas
  - Waste neutralization requirements
  - Maximum amount of time that waste can be stored

  > For the purposes of this document, it is assumed that laboratory storage of analytical waste will be only temporary, until further disposition is determined or addressed.

- Treatment options
  - Neutralization/decontamination (Section 4.3)
  - Solidification, compaction, storage (Section 5.3)
  - Sterilization/deactivation (Section 6.2.1)

- Disposal options
  - Identification of key waste disposal regulatory agencies and contacts
  - Publicly-owned treatment works (POTW) disposal
  - Landfill (land-ban restrictions, acceptable wastes, packing requirements)
  - Incineration (acceptable wastes, packing requirements)

- Waste shipment
  - Federal and state regulations
  - Waste container packaging and labeling
  - Packaging requirements
  - Arranging for shipment and preparation of shipment papers

- Requirements for review and updates

3.1.2 Waste Management Administrator

In addition to a WMP, laboratories should have a Waste Management Administrator with knowledge of all regulations concerning waste handling, shipping, treatment and disposal. As

laws and statutes are periodically updated and modified with respect to hazardous waste identification, shipment, treatment and disposal, the administrator must periodically review regulations concerning contaminants and different levels of contamination, packaging, markings, shipping regulations, and safety requirements as prescribed by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA). In most states, Waste Management Administrators are required to attend and pass a one to two-day training course, and are responsible for the following:

- Plan implementation
  - Maintaining a Waste Management Plan and/or a Chemical Hygiene Plan, Radiological Safety Plan, and/or Biological Safety Plan
  - Identifying waste-generating processes, type of waste generated, expected contaminant concentrations, and expected amounts generated during a specified time period
  - Reviewing laboratory procedures for waste minimization and reduction
  - Completing annual reports for regulatory agencies (see Appendices A and B for appropriate agency contact information)

- Waste storage
  - Identifying proper storage containers for each waste type
  - Completing labels for each waste storage container
  - Completing required waste treatment or neutralization
  - Tracking opening and closing dates for each storage container at satellite locations and in bulk waste storage location
  - Tracking the duration of waste storage, and ensuring it does not exceed the allowable storage time

- Disposal options
  - Identifying the local POTW and ensuring proper communication and permit requirements
  - Receiving and maintaining copies of waste hauler identification documents and certified driver's licenses; and treatment, storage and disposal facility (TSDF) permits as required for each waste type. Also maintaining copies of hauler and TSDF insurance and any manifests or tracking forms that are required.
  - Coordinating with waste brokers; waste haulers; and TSDFs approved to handle each waste identified and ensuring that such entities have the appropriately trained personnel, capacity and resources to manage the waste
  - Visiting TSDFs
  - Verifying that TSDFs (both the actual facility and its owners) are willing to accept the waste materials (i.e., the government cannot force a facility to accept waste), have the appropriate authorizations to accept the waste and that the local government where the facility is located, is aware and in agreement with receipt of the waste

- Waste shipment
  - Completing waste profiles with the waste broker, and receiving TSDF acceptance for each waste prior to shipment
  - Ensuring wastes are properly packaged and labeled for transportation using Packing Groups and Proper Shipping Names (PSNs)
  - Completing the waste manifest and bill of lading for each waste shipment (see Appendix D for example waste manifest and bill of lading)

- Submitting copies of the waste manifest to each required government office (see Appendices A and B for appropriate agency contact information)
- Ensuring transportation vehicles are appropriate for the waste and meet placard requirements; wastes are properly segregated and secured; and vehicles are in good working condition and, if necessary, are decontaminated following each shipment
- Ensuring waste shipments arrive as specified and are accepted at the approved TSDF
- Receiving and maintaining treatment and/or disposal certificates documenting that the TSDF has completed treatment (if applicable) and disposal, and containing dates, batch identification, and disposal location

3.1.3 Generator Status

Laboratories with chemical and/or radiological waste must have a waste generator status, an understanding of the required limits, and documentation to maintain this status (see Resource Conservation and Recovery Act and Table 3-1). Unlike processors and manufacturers, which generate large amounts of consistent waste types, most laboratories typically generate small amounts of varying wastes and therefore face challenges in costs and planning. Although laboratories likely will be small quantity generators, management and disposal of highly contaminated sample wastes might alter this status for a specific period. The Waste Management Administrator must review the appropriate regulations carefully to ensure records and reporting is completed properly. Subpart K of the Resource Conservation and Recovery Act (RCRA) hazardous waste generator regulatory requirements in Part 262 apply to colleges, universities, and teaching hospitals and to nonprofit research institutes that are either owned by or affiliated with a college or university. This subpart allows eligible academic entities the flexibility to make hazardous waste determinations in the laboratory, at an on-site central accumulation area, or at an on-site TSDF.

3.1.4 Waste Broker

Laboratories with chemical waste can use the services of a waste broker. Laboratories seeking to dispose of radiological waste must use the services of a licensed waste broker. The Nuclear Regulatory Commission (NRC) provides information about waste brokers who can assist in profiling, manifesting, and inspecting laboratory waste prior to shipment; and low-level radioactive waste disposal facilities that can receive the waste that can be expected following analysis of samples containing the SAM analytes. Many states require waste brokers to attend and pass a hazardous materials disposal training course for chemical wastes. In most states a waste broker may not be needed for disposal of treated, non-infectious biological waste. Depending on state and local regulations, a waste broker also might not be required for disposal of biological waste.

3.1.5 Documentation

RCRA subtitle C (40 CFR Parts 261 and 262) requires laboratories to maintain accurate, up-to-date and easily retrievable records of sample and waste handling. The documentation is required to meet state regulations, for planning and tracking sample disposition, for reducing liability, for facilitating inspections, and for responding to inquiries and information requests. Many regulations and regulatory authorities require comprehensive documentation of these waste handling activities to assure compliance. Each agency has unique and specific reporting periods and submission dates, data reporting formats, and record retention times.

Documentation requirements and procedures must be included in the laboratory's WMP. These requirements typically include:

- Preliminary documentation of sample or site characterization
- Waste profile acceptance
- Open/close dates for storage containers
- Shipping container purchase records
- Waste manifests and bill of lading
- Disposal certificate
- Waste minimization review findings

3.2 Guidelines for Waste Minimization

Waste avoidance and pollution prevention can significantly reduce the amount of waste a laboratory handles, and are a critical part of any laboratory WMP. The following guidelines are suggested for waste minimization.

3.3 Waste Categorization and Segregation

Proper waste categorization can help avoid unnecessary, inappropriate, and costly waste handling, treatment, storage and disposal. For example, the processes and definitions that the laboratory uses to determine that a waste is radioactive or non-radioactive will have a great influence on the amount of radioactive waste that the laboratory must manage. Once a waste has been properly categorized, the laboratory can prioritize the waste options for elimination, reduction or modification.

Laboratory waste can typically be segregated into the following categories: radioactive solid waste, radioactive liquid waste, RCRA waste, Toxic Substances Control Act (TSCA) waste, mixed waste, polychlorinated biphenyl (PCB) waste and biological hazards. Depending on individual state requirements, biological waste can be classified as medical waste, infectious waste (Categories A or B), or biohazardous waste; in general, these three classifications require that the waste be sterilized prior to disposal, unless incinerated. Segregating wastes by the appropriate category allows them to be managed by the most cost-effective option. Combining highly regulated waste streams with less stringently regulated waste streams usually requires the total waste stream to meet the most stringent waste management requirements. For example:

- Non-hazardous waste mixed with hazardous waste is managed as hazardous waste.
- Non-radioactive waste mixed with radioactive waste is managed as radioactive waste.
- Hazardous waste mixed with radioactive waste (referred to as mixed waste) is managed in compliance with requirements of the Atomic Energy Act (AEA), RCRA and TSCA.
- Biohazardous waste mixed with solid waste is managed as biohazardous waste.

3.3.1 Regulatory Exemptions

Some wastes may be exempt from regulations because of the production process, level of contaminants, volume of waste, or the waste management option chosen. For example:

- In cases where contaminants are regulated and are below regulatory levels (see 40 CFR parts 136 and 403), wastes can be incorporated into a laboratory's wastewater stream

- A hazardous waste generator that produces less than 100 kg of waste in a month may be a conditionally exempt small quantity generator and thus be exempt from many of the requirements of the RCRA
- Some radioactive waste may be managed as non-radioactive if the total level of radioactivity is below exempted quantities (10 CFR 30.70), or if the activity for specific radionuclides is below established levels as described in 10 CFR Part 61. Certain states have entered into agreements with NRC that give them the authority to license and inspect byproduct, source, or special nuclear materials used or possessed within their borders. In some cases, states with these agreements might have more restrictive requirements. The NRC website should be reviewed to determine which states have agreements.

3.3.2 Method Selection

The analytical method selected for sample analysis or handling determines the type and volume of waste generated. If two methods will achieve the required measurement quality objectives, the laboratory might select the method that produces the least amount or most easily managed waste. For example, biological laboratories can minimize the use of chemical disinfectants that require management and disposal as hazardous substances waste by considering alternative disinfection procedures, such as autoclaving. Current laboratory guidelines for working with infectious microorganisms at Biosafety Level 3 (BSL-3) laboratories recommend that waste be decontaminated before disposal and that select agents be destroyed using a steam autoclave. Method selection for disposal of analytical waste containing biological hazards is discussed in greater detail in Section 6.0.

It also may be possible to replace hazardous analytical reagents with non-hazardous reagents and still meet method requirements and data quality objectives (refer to analytical methods listed in SAM for information regarding alternative reagents and materials). Laboratories should consult with analytical service requestors regarding whether methods can be adjusted. EPA also recommends that the contacts identified in Section 4.0 of SAM be consulted before implementing method modifications or deviations. In addition, substituting a short-lived radionuclide for a long-lived radionuclide may ultimately result in reducing radioactive waste. Methods that are recommended for analysis of environmental samples for confirmatory identification and measurement of SAM analytes are listed in the SAM document. Guidance regarding analytical methods and discharge limitations corresponding to analytes regulated by EPA in wastewater discharges is provided in 40 CFR Part 136.

3.3.3 Sample Amounts

If possible, laboratories can request that excess sample material not be collected or received. To minimize the amount of sample waste, laboratories should receive only the amount of sample needed for sample analysis and analytical quality control, and a limited amount of excess in case of sample loss or other unforeseen problems or uses. For example, laboratories might request approximately two times the amount of sample required by the analytical method. Approximately four times the amount required may be needed if the laboratory will be analyzing matrix spikes and matrix spike duplicates. Reserve sample amounts should be minimized with up-front planning. It may also be possible to convert a method to a micro-scale method that uses significantly less sample and reagents. Laboratories should consult with analytical service requestors regarding whether sample sizes can be adjusted. EPA also recommends that the contacts identified in Section 4.0 of SAM be consulted before adjusting

sample sizes. For example, to optimize method sensitivity in the situation of evaluating the effectiveness of decontamination, it may be necessary to use large quantities of sample material.

3.3.4 Reagent Procurement Controls

Amounts of reagents and materials purchased by a laboratory often are determined by price discounts available on large quantities, instead of the amount required. The real cost of purchasing these materials should include the initial purchase price plus disposal costs (lifetime costs). Procurement of hazardous material should be initiated only if a non-hazardous substitute is not available. Rotating chemical stock (first in, first out) also can help avoid expiration.

3.3.5 Re-Use of Materials

Some materials may be recovered from the analytical process and re-used in subsequent analyses. For example, distillation of certain used organic solvents may purify them sufficiently for reuse. Glassware and some disposable equipment can often be decontaminated and re-used or disposed of as non-hazardous waste. Pre-use of materials is discussed further in the Treatment subsections of Sections 4.0, 5.0 and 6.0.

3.4 Packaging

Each hazardous compound is grouped into a common characteristic hazardous class (49 CFR 172.101) for shipment. Samples and sample wastes must be packaged for shipment according to the packing group criteria for the hazard class (49 CFR 173.2). Small quantities of material (as defined at 49 CFR 173.4) that meet the definition of one or more of the following hazard classes are not subject to any special requirements:

- Class 3: Flammable and combustible liquid (see 49 CFR 173.120)
- Class 4, Division 1 (Division 4.1): Flammable solid (see 49 CFR 173.124)
- Class 4, Division 2 (Division 4.2): Packing Groups II and III: Spontaneously combustible material (see 49 CFR 173.124)
- Class 5, Division 1 (Division 5.1): Oxidizer (see 49 CFR 173.127)
- Class 5, Division 2 (Division 5.2): Organic peroxide (see 49 CFR 173.128)
- Class 6, Division 1 (Division 6.1): Poisonous materials (see 49 CFR 173.132)
- Class 6, Division 2 (Division 6.2): Infectious substances (see 49 CFR 173.134)
- Class 7: Radioactive material (see 49 CFR 173.403)
- Class 8: Corrosive material (see 49 CFR 173.136)
- Class 9: Miscellaneous hazardous material (see 49 CFR 173.140)

The requirements for these exceptions are strictly monitored and many transporters will not accept packages for shipment. Each hazard class is divided into three packing groups with Level 1 (I) being greatest degree of danger and Level 3 (III) being least degree of danger.

3.5 Safety

Laboratories must have a Chemical Hygiene Plan, Radiological Safety Plan or Biological Safety Plan, as appropriate, covering all aspects of sample and waste management specific to the target contaminants. This plan must encompass personnel responsibilities, engineering controls, monitoring, emergency response, spills or releases and special handling criteria for samples containing significantly elevated

contaminant levels. Many of the contaminants included in SAM are not routinely handled by laboratories, and hygiene and safety plans must address samples and analytical materials containing these contaminants.[1] These plans provide guidelines for the protection of employees from health effects associated with hazardous chemicals and biological agents used in the laboratory, and include information regarding:

- Responsibilities of laboratory personnel
- Avoidance of routine exposures
- Housekeeping
- Chemical procurement and storage
- Chemical inventory
- Staff training
- Hazards identification and monitoring
- Environmental maintenance and monitoring
- Maintenance and inspections
- Medical monitoring of personnel
- Safety Data Sheets (SDSs)
- PPE
- Emergency equipment
- Standard operating procedures (SOPs) for health and safety
- Employee training, including dry runs for handling hazardous samples
- Waste handling, treatment and disposal procedures (included in the WMP)
- Chemical or biological handling procedures (e.g., flammable, corrosive, reactive chemicals; compressed gases; radioactivity; carcinogens, mutagens, reproductive toxins)
- Working with moderate to highly chronic toxic substances
- Working with highly acute toxic substances
- Autoclave validation and routine testing with biological indicators and preventative maintenance
- Laboratory and surface decontamination
- Security

All laboratory staff requires training related to the tasks that they perform in relation to hazardous substances. This training will vary greatly by the tasks performed, the type(s) of hazardous substance(s), and the intensity of the hazard (e.g., low-level vs. high-level). Regardless of these factors, OSHA regulations at 29 CFR 1910.132(f) require that staff be trained in the use of PPE. (EPA conducts internal initial 24-hour training with annual 4-hour refresher courses for its laboratory personnel to meet these requirements.) Training should be completed in a non-hazardous environment prior to PPE use, and should be repeated at the frequency required in OSHA and Superfund Amendments and Authorization Act (SARA), Title III. At a minimum, the training must include:

- Proper use and maintenance of selected protective clothing
- Nature of hazards and the consequences of not using the protective clothing
- Instructions in inspecting, donning, checking, fitting, and using protective clothing
- PPE user's responsibility (if any) for decontamination, cleaning, maintenance, and repair of protective clothing

[1] OSHA requirements for chemical hygiene and safety plans can be found at 29 CFR 1910.1450 Appendix A, Part D

- Emergency procedures and self-rescue in the event of protective clothing/equipment failure
- The buddy system

3.6 Primary Organizations and Acts that Dictate Waste Management and Disposal

The guidelines provided in this document are not intended to be used without knowledge and comprehension of applicable federal, state, or local regulations. These regulations must be consulted prior to development and implementation of a laboratory's waste management activities. Summary information regarding general waste management regulations is provided in this subsection. Summary information regarding regulations applying to chemical, radiological, biological, and multi-hazardous wastes is provided in Sections 4.0, 5.0, 6.0, and 7.0, respectively. In preparing this document, the U.S. CFR and U.S. DOT directives were reviewed for regulations having provisions that pertain to laboratory management and disposal of analytical waste expected to be generated by laboratories analyzing samples during remediation activities following homeland security events. Wastes generated from samples and sample analysis must comply with EPA regulations at 40 CFR Part 260 and with DOT regulations at 49 CFR Parts 171 – 199 which regulate packaging, handling, labeling, marking, placarding, and routing of all hazardous shipments within the U.S. The location of this information in the CFR is provided in Table 3-2. A condensed summary of these regulations and of U.S. Department of Defense (DoD) directives is provided below. This section provides only summary information; it is the laboratory's responsibility to have a Waste Management Administrator (see Section 3.1, Waste Management) who is fully aware of and familiar with federal, state, and local regulations affecting management and disposal of hazardous waste.

3.6.1 U.S. Occupational Safety and Health Administration (OSHA)

OSHA regulations (29 CFR Part 1960) provide for the safety of personnel working with hazardous materials and wastes. Training requirements for handling sample wastes and for general safety also are covered. Laboratories using this document must have an approved Health and Safety Plan and laboratory staff must be trained in procedures and requirements for handling hazardous materials, samples and waste. The health and well-being of laboratory staff is paramount in handling and disposing of these potentially hazardous environmental samples and associated analytical waste. Accordingly, OSHA regulations pertaining to PPE must be reviewed in Sections 132 – 138 of 29 CFR 1910, as well as Section 22 for general "housekeeping" and Section 141 for general environmental controls.

Regulations involving safety and emergency response under the Incident Command System (ICS) and National Incident Management System (NIMS) are covered in 29 CFR 1910.120 and 1926.65. OSHA does not provide blanket exemptions or waivers to regulations involving personal safety, even during emergency conditions and operations. However, as part of the ICS, the Incident Commander must consider the risks associated with operations that have the potential to result in exposures exceeding permissible exposure limits and manage the response accordingly.

3.6.2 Clean Water Act (CWA)

The Clean Water Act (CWA) provides for the protection and maintenance of the chemical, physical, and biological integrity of the nation's water. CWA regulations (40 CFR Parts 112 – 503) address the control of discharges into U.S. waterways, including direct and indirect discharges, as well as the injection of wastewater into the ground. Direct discharges into surface waters are regulated by National Pollutant Discharge Elimination System (NPDES) permit conditions.

Indirect discharges to a POTW is controlled under the National Pretreatment Standards (Part 403).

3.6.3 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA)

Regulations under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (40 CFR Subchapter J) provide a mechanism for the federal government to respond to hazards posed by uncontrolled release of hazardous substances. As a laboratory may be held responsible for the entire costs associated with a cleanup of a hazardous material, all aspects of processing, handling and disposal (e.g., selecting the proper waste transporter and disposal facility) should be undertaken with great care.

3.7 Resource Conservation and Recovery Act (RCRA)

RCRA provides for tracking of all hazardous substances from "cradle to grave" (generation to final disposal), and provides regulations at 40 CFR Parts 239 – 299. This Act is intended not only to protect human health and the environment by prohibiting open dumping, but also to conserve materials and energy resources by encouraging waste recycling, reuse and treatment. Pursuant to RCRA, EPA developed hazardous waste management regulations for generators and for TSDFs. In 1984, Congress expanded the scope of RCRA with passage of the Hazardous and Solid Waste Amendments, which directed EPA to adopt regulations governing small quantity generators (SQGs) of hazardous waste, such as many small laboratories. Most laboratories routinely generate hazardous waste and, therefore, are subject to RCRA hazardous waste management regulations at 40 CFR Parts 260 – 270. These regulations include requirements governing waste classification, accumulation, treatment, disposal, recordkeeping and emergency preparedness. This Act addresses sample wastes by regulating the identification of the hazardous constituent, storage of the sample waste, and proper shipment and disposal of the sample waste. Although RCRA and the implementing federal regulations at 40 CFR govern hazardous waste management, many states also have their own regulations, which will be equal to or more stringent than federal regulations, and can vary from state to state.

Under RCRA regulations, there are three classes of generators: (1) Very Small Quantity Generator (VSQG); (2) SQG; and (3) Large Quantity Generator (LQG). Each level has specific accumulation levels, holding times, disposal options, and reporting criteria. Information regarding these criteria, including changes needed when status is increased, is provided in Table 3-1. Laboratories accepting samples in large quantities might change generator status, requiring an increase in both reporting requirements and training of staff. Many states have modified these requirements and often have removed the lowest level (VSQG).

Table 3-1. RCRA Waste Generator Status Requirements

Requirement (40 CFR)	Very Small Quantity Generator (VSQG)	Small Quantity Generator (SQG)	Large Quantity Generator (LQG)
Waste Determination (262.11)	Applicable	Applicable	Applicable
Generation Rate Limits (262.13)	<100 kg/month	100–1,000 kg/month	1,000 kg/month or greater

Requirement (40 CFR)	Very Small Quantity Generator (VSQG)	Small Quantity Generator (SQG)	Large Quantity Generator (LQG)
Accumulation Quantity Limit at or near the point of generation (262.15)	Waste collected at or near any point of generation where initially accumulated may not exceed 55 gallons of hazardous waste or 1 quart of acutely hazardous or extremely hazardous waste.		
Accumulation Quantity Limit w/o permit (262.14, 262.16, 262.17)	Total waste may not exceed 1,000 kg hazardous waste or 1 kg acutely hazardous waste at any time.	Total waste may not exceed 6,000 kg at any time.	May accumulate any quantity of waste in containers, tanks, drip pads, and containment buildings for up to 90 days.
Accumulation Time (262.14, 262.16, 262.17)	No limit	180 days (or 270 days if waste is to be transported over 200 miles)	90 days
EPA ID Number (262.18)	Not required (possible state requirement)	Required	Required
Mark Containers with Start Date (262.14, 262.16, 262.17)	Not applicable	Applicable	Applicable
Mark Containers "Hazardous Waste" 262.14, 262.16, 262.17)	Applicable	Applicable	Applicable
Air Emission Standards (265, Subpart CC)	Not applicable	Not applicable	Applicable
Satellite Accumulation (262.15)	Not applicable	Applicable	Applicable
Use Manifests (262, Subpart B)	Not required, possible state requirement	Required	Required
Exception Reporting (262.42)	Not required	Required after 45 days	Required after 35 days
Biennial Report (262.41)	Not required	Not required; possible state requirement	Required
Contingency Plan (262.16, 262.17, 265, Subpart D)	Not required, but OSHA (29 CFR 1910.38) requires emergency planning	Basic planning required in accordance with 262.16b(8) and 265, Subpart C as well as OSHA regulations	Full written plan, in accordance with 262.17a(6) and 265, Subpart D, is required by OSHA regulations
RCRA Personnel Training (265.16)	Not required, but recommended	Basic training required	Full compliance with training requirements in 265.16

Requirement (40 CFR)	Very Small Quantity Generator (VSQG)	Small Quantity Generator (SQG)	Large Quantity Generator (LQG)
Storage Requirements (without permit) (265 and 262)	None, but OSHA regulations under 29 CFR 1910, Subparts H and N, apply, particularly 29 CFR 1910.106. Exemption in 40 CFR 262.14.	Compliance with technical standards in Part 265, Subparts I and J for containers and tanks, is required by OSHA regulations. Exemption in 40 CFR 262.16.	Compliance with technical standards, in Part 265, Subparts I, J, W and DD, is required by OSHA regulations. Exemption in 40 CFR 262.17.
Recordkeeping Requirements (262.40)	Waste determinations and generation log required (notification of regulated waste activity, training records, manifests, and land disposal restriction notifications recommended)	Notification of regulated waste activity, waste determinations, generation log, manifests, land disposal restriction notifications, exception reports, and correspondence with local emergency responders	Notification of regulated waste determinations, activity, generation, manifests, land disposal restrictions, exception reports, biennial reports, correspondence with local responders, RCRA training records, and contingency plan; weekly container inspection is required; equipment maintenance logs recommended.
Waste "Designated Facility" (264 and 172)	State-approved or RCRA permitted facility or legitimate recycler	RCRA-permitted facility or legitimate recycler	RCRA-permitted facility or legitimate recycler
Land Disposal Restrictions (268)	Possible state requirement	Applicable	Applicable

3.7.1 RCRA Laboratory Wastewater

Under 40 CFR 261.3(E), wastewater that is generated by laboratory operations, and that contains toxic wastes listed in Subpart D of 40 CFR Part 261, is not considered a hazardous waste if it meets the following conditions: the annualized average flow of laboratory wastewater does not exceed one percent of total wastewater flow into the head works of the facility's wastewater treatment or pre-treatment system, or the wastes combined annualized average concentration does not exceed one part per million in the head works of the facility's wastewater treatment or pre-treatment facility. Toxic wastes used in laboratories that are demonstrated not to be discharged to wastewater are not to be included in this calculation.

3.7.2 U.S. Department of Defense (DoD) Directives

The DoD has been implementing an Installation Restoration Program since the mid-1970's, which was formalized by statute with the passage of SARA in 1986, amending CERCLA. Section 211 of SARA established the Defense Environmental Restoration Program to be carried out in

consultation with the Administrator of the EPA and the states. The program has three goals: (1) identification and cleanup of contamination from hazardous substances consistent with CERCLA cleanup requirements; (2) correction of environmental damage, such as detection and disposal of unexploded ordnance, that creates an imminent and a substantial endangerment to public health and the environment; and (3) demolition and removal of unsafe buildings and structures, including those at Formerly Used Defense Sites.

The DoD Explosives Safety Board (DDESB) provides an objective expert to advise the Secretary of Defense and the Service Secretaries on matters concerning explosives safety, as well as to prevent hazardous conditions for life and property (both on and off DoD installations) that result from the presence of explosives and the environmental effects of DoD munitions. The roles and responsibilities of the DDESB were expanded in 1996 with the issuance of DoD Directive 6055.9 on July 29, 1996, and modified in 2004. The directive provides the DDESB with responsibility for serving as the DoD advocate for resolving issues between explosive safety standards (DoD-Directives) and environmental standards (EPA-RCRA regulations). DDESB is responsible for promulgating safety requirements and overseeing their implementation as necessary to protect human welfare and the environment. These requirements provide for extensive management of explosive materials.

3.7.3 Hazardous Materials (HAZMAT) Transportation Act

Wastes generated from samples and sample analysis must comply with EPA regulations at 40 CFR Part 260 and with DOT regulations at 49 CFR Parts 171 – 199, which regulate packaging, handling, labeling, marking, placarding, and routing of all hazardous shipments within the U.S. The location of this information in the CFR is provided in Table 3-2.

Waste Management Administrators and other staff responsible for preparing waste for shipment must be trained in waste handling, packaging, and corresponding regulations (49 CFR 172.704). Training must be repeated every three years. Many states offer a course and/or have a certification process. DOT regulations also require that each shipment must be certified by the person offering hazardous material for transportation (49 CFR Part 172), to certify that the materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to DOT. Many laboratories have a certified TSDF pick up their hazardous waste. Thus, often laboratory staff are not certified to ship hazardous waste. In this scenario, hazardous waste shipments are certified by the shipper who picks up the waste, not a laboratory employee. Some states require certification for laboratories that store waste, but this requirement can only be detailed on a state-by-state basis. In this case, the state offers a course and/or has a certification process for the laboratory waste management administrator. The following general practices provide a summary of DOT requirements (at 49 CFR 173.24) for packaging wastes for disposal:

- Except as otherwise provided in this subchapter, there will be no identifiable (without the use of instruments) release of hazardous materials to the environment
- The effectiveness of the package will not be substantially reduced; for example, impact resistance, strength, and packaging compatibility must be maintained for the minimum and maximum temperatures, changes in humidity and pressure, and shocks, loadings, and vibrations normally encountered during transportation

- There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, significantly reduce the effectiveness of the packaging
- There will be no hazardous material residue adhering to the outside of the package during transport
- In certain situations, a USDOT special permit may be required that requires alternative packaging, labeling and transport

Table 3-2: EPA and DOT Shipping Regulations

Topics	EPA 40 CFR Regulations	DOT 49 CFR Regulations
Definitions	Section 260.10	Section 171.8
Identification and listing of hazardous materials	Part 261	Section 172.1
Characteristic of hazardous materials	Sections 261.20 to 261.24	Sections 171.8, Part 173
Compliance with manifesting	Sections 262.20 to 262.23 and 263.20 to 263.21	Section 172.205
Packaging and containers	Section 262.30	Parts 173 , 178 and 179
Labeling requirements	Section 262.31	Section 172.400
Marking requirements	Section 262.32	Sections 172.300 to 172.330
Placarding requirements	Section 262.33	Sections 172.500 to 172.558, and 172.560
Hazardous material and waste discharge incidents	Sections 263.30 and 263.31	Sections 171.15 and 171.16
Storage	Part 370 - reporting requirements to local and state government	Section 171.1 for storage while in transit

3.7.4 State Regulations

State regulators can incorporate, and even increase, the level of compliance needed in the federal regulations. RCRA regulations in 40 CFR Parts 256 and 271 provide guidelines to states for producing acceptable WMPs. In addition to complying with federal regulations, laboratories must comply with all pertinent state regulations impacting laboratory waste management and disposal. EPA listings of state Internet sites and regulation sources are provided in Appendix A for chemicals, Appendix B for radiologicals, and Appendix C for biologicals. Information also can be found at:

- Chemicals (http://www.epa.gov/osw/hazard/wastetypes/universal/statespf.htm)
- Radiologicals (https://scp.nrc.gov/rulemaking.html)
- Biologicals (http://www.epa.gov/osw/nonhaz/industrial/medical/programs.htm)

4.0 Management and Disposal of Analytical Waste Containing Chemical Hazards

Hazardous waste contains properties that make it dangerous or potentially harmful to human health or the environment, and is regulated under RCRA Subtitle C. A RCRA hazardous waste is a waste that appears on one of four hazardous wastes lists (F-list, K-list, P-list or U-list), or exhibits at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity). RCRA lists are organized into three categories:

- **The F-list** (non-specific source wastes) identifies wastes from common manufacturing and industrial processes, such as solvents that have been used in cleaning or degreasing operations. Because the processes producing these wastes can occur in different sectors of industry, the F-listed wastes are known as wastes from non-specific sources. Wastes included on the F-list can be found in the regulations at 40 CFR 261.31.

- **The K-list** (source-specific wastes) includes certain wastes from specific industries, such as petroleum refining or pesticide manufacturing. Certain sludges and wastewaters from treatment and production processes in these industries are examples of source-specific wastes. Wastes included on the K-list can be found in the regulations at 40 CFR 261.32.

- **The P-list and the U-list** (discarded commercial chemical products) include specific commercial chemical products in an unused form. Some pesticides and pharmaceutical products become hazardous waste when discarded. Wastes included on the P- (acute hazardous waste) and U- (non-acute) lists can be found in the regulations at 40 CFR 261.33.

Waste that does not meet any of the lists above may still be considered a hazardous waste if it exhibits one of the four characteristics defined in 40 CFR Part 261, Subpart C (commonly referred to as the RCRA D List).

- **Ignitability** (D001) – Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents. For more details, see 40 CFR 261.21. Many military munitions are hazardous via this characteristic, even without a detonation source being present.

- **Corrosivity** (D002) – Corrosive wastes include acids or bases (pH ≤ 2 or ≥ 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels. Battery acid is an example. For more details, see 40 CFR 261.22.

- **Reactivity** (D003) – Reactive wastes are unstable under "normal" conditions, and can cause explosions, toxic fumes, gases, or vapors when heated, compressed, or mixed with water. Examples include lithium-sulfur batteries and explosives. For more details, see 40 CFR 261.23. There are currently no test methods available.

- **Toxicity** (D004 through D043) – Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead). When toxic wastes are disposed of on land, contaminated liquid can leach from the waste and pollute ground water. For more details, see 40 CFR 261.24.

The United Nations (UN) Chemical Weapons Convention defines a chemical warfare agent as "any chemical which, through its chemical effect on living processes, may cause death, temporary loss of performance, or permanent injury to people and animals." Nerve and blister agents are the two classes of chemical warfare agents that have been most widely manufactured and used for military purposes. Common blistering agents include sulfur mustard (HD), nitrogen mustards (HN-1, HN-2, HN-3) and lewisites (L-1, L-2, L-3). Common choking agents include chloropicrin, chlorine (Cl_2), phosgene (CG) and diphosgene. Common organo-phosphorous nerve agents are GA (tabun), GB (sarin), GD (soman), GF (cyclohexylsarin) and VX (O-ethyl-S-[2-diisopropylaminoethyl]methyl-phosphonothiolate).

Note: Laboratory waste containing chemical warfare agents must be handled only by trained personnel, using appropriate safety precautions. In all cases, laboratories must contact appropriate authorities identified by the EPA On-Scene Coordinator (OSC) or project manager and should follow procedures that have been approved specifically for handling these wastes and that are included in the laboratory's WMP. Small-scale treatment of waste containing dilute chemical warfare agent is discussed in Section 4.3.

4.1 Regulations

In addition to the regulations summarized in Primary Organizations and Acts that Dictate Waste Management and Disposal subsection (Section 3.6), the laboratory must be aware of requirements included in Title III of SARA for notification of municipalities. The Emergency Planning and Community Right-to-Know Act (EPCRA or Title III of SARA) requires all facilities storing or producing hazardous materials to inform local and state communities. This requirement is necessary if the laboratory meets the quantities of any one or more chemicals on the list of "extremely hazardous substances" at 40 CFR Part 372. The owner of the laboratory must report the chemical to the state and local emergency response commission and must have prepared action plans to respond to a release.

4.2 Storage

The operator of a hazardous waste storage area must inspect areas in which waste containers are stored, at least weekly, looking for leaks and deterioration caused by corrosion or other factors (40 CFR 265.174). Requirements for prevention and preparedness, contingency plans, and emergency procedures that may apply to a laboratory that stores RCRA waste are addressed in 40 CFR 262.16, 262.17 and 262, Subpart M. Laboratory management should review 40 CFR Part 262 prior to storing these wastes.

Samples and analytical wastes containing reportable levels of RCRA hazardous chemical analytes (RCRA List D) must be stored between 4°C and 6°C and must be segregated from lower level contaminated samples and from non-environmental samples. However, once designated for management and disposal by the laboratory, the samples must be treated as a regulated waste, meeting all RCRA and generator status requirements. Table 3-1 lists quantity storage limitations and reporting information for each level of generation status. A generator may store hazardous waste up to 90 days, 180 days, or 270 days depending on its status as defined by the regulations or the distance the generator is from the disposal facility (40 CFR 262.15). A generator may accumulate as much as 55 gallons of hazardous waste or one quart of acutely hazardous waste in containers at or near the point of generation where wastes initially accumulate, which is under the control of the operator of the process generating the waste (40 CFR 262.15). The storage time clock (90, 180, or 270 days) does not begin until the waste volume reaches 55

gallons (or one quart, in the case of acutely hazardous waste), or whenever waste is stored in a 90-day accumulation area. A small laboratory may require additional training, reporting, and time management if large amounts of contaminated wastes are generated during a short time period. A summary of requirements for storage of these waste materials is provided below.

All sample and sample preparation (extraction) wastes should be segregated according to chemical class. Acidic wastes should be stored separately from basic wastes, oxidizers should be stored separately from organics, and cyanide positive wastes should be stored separately from acids to reduce the possibility of inadvertent potentially dangerous releases/exposures, fires, or increased hazardous status.

Each type of waste (based on the specific chemical contamination, level, and initial generation site) must be stored in a separate, labeled container to help reduce multi-hazardous wastes and to assist in source reduction. The label must identify the chemical contaminant, the waste generation point, the date of generation, and the initials of the technician responsible for the initial generation of the waste.

The laboratory must use proper storage containers, limiting the container size to properly reflect the amount of sample and sample waste expected to be generated. The storage container must be properly designed, meeting Packing Group I, II, or III criteria (49 CFR Part 173, Subpart D), to double as the correct transport/disposal container (e.g., drum, Packing Group) to reduce handling of the waste materials. Storage containers must be made of proper materials with sealable lids.

Once analytical wastes are designated for waste management by the laboratory, all waste locations that have not been identified as the main storage location must meet the satellite location rules (40 CFR Part 262) and waste holding times determined by the generator status. Storage locations should be properly labeled and documented. Storage precautions are also provided in the Safety Data Sheets (SDS) for each compound component of the waste.

Special storage precautions must be taken for analytical waste containing military ordnance[2] or chemical warfare agents. These storage precautions include:

- Limiting potential contact and increased secondary containment. The secondary containment must contain an excess of absorbent that would absorb all of the liquid if spilled from the primary container.
- Wearing protective covering, such as lab-coats, safety goggles/glasses, appropriate gloves (e.g., nitrile gloves, and a pair of butyl rubber gloves over the nitrile gloves when handling waste containing chemical warfare agents)
- Limiting volumes of samples and all related wastes, if possible, to those deemed non-explosive by contact or impact
- Familiarizing all employees with SDSs and special handing requirements. For example,

> soils with a 12 percent or greater concentration of secondary explosives [such as trinitrotoluene (TNT)] are capable of propagating (transmitting) a detonation if initiated by flame. Soils containing more than 15 percent secondary explosives by weight are susceptible to initiation by shock. To be safe, the U.S. Army Environmental Center

[2] EPA's *Handbook on the Management of Munitions Response Actions* (Interim Final. EPA 505-B-01-001) defines military munitions and their constituents

considers all soils containing 10 percent or more of secondary explosives or mixtures of secondary explosives to be reactive or ignitable soil.[2]

The laboratory must designate a labeled container for wastes containing RCRA List D levels of hazardous materials. This container must be labeled with all information necessary to completely identify the original sample or site location (e.g., the accumulation start date; location information, including room number where the container is located; substances in the container and their estimated proportions; the physical state of the waste; and the primary hazard category of the waste). All solid wastes generated during the sample preparation phase of analysis must be placed in this container, and the container must be stored with the original sample(s) to reduce the amount of waste needing to comply with increased levels of sample handling requirements and disposal criteria. Sample extract waste must be contained and maintained with the original sample or, if appropriate (see Section 4.3.1, Aqueous and Water Soluble Waste), discharged to the municipal water treatment system.

To minimize sample extract waste, the laboratory may, in some cases, evaporate solvents in a hood with appropriate safety considerations, leaving only a residue. This container should be placed with the solid sample waste or liquid sample for disposal (40 CFR 264.1030). Evaporation is not always a legal form of treatment. Consult 40 CFR 264.1030 before using this waste minimization technique.

4.3 Treatment

4.3.1 Aqueous and Water Soluble Waste

It may be possible to treat aqueous and water-soluble wastes for disposal through discharge to a POTW. The laboratory must notify the POTW of potential discharges prior to using this option and must have gained a permit, if applicable, that meets municipality requirements. If the laboratory disposes of more than 15 kg of hazardous waste (or any acute wastes) per month to a POTW, the EPA, state waste authority, and POTW must be notified (40 CFR 403.12). Discharges to storm drains or septic systems are prohibited.

To effectively manage its wastewater program, the laboratory must develop a wastewater management system that includes:

- An inventory of wastewater (samples and contaminants) discharges
- Programs and practices for minimizing wastewater
- Operating and maintenance procedures for wastewater discharge systems (collection and treatment, if required by permit)
- Monitoring to check operations (as required by permit)
- Recordkeeping to document compliance with permits
- Procedures to respond to emergencies
- A training program to ensure operators meet regulatory requirements and operational requirements
- Procedures to assess planned changes
- Procedures for hold and haul contingencies, if necessary

4.3.2 Non-Aqueous Liquid Waste

The treatment of non-aqueous liquid wastes is strictly regulated by RCRA regulations (40 CFR Part 260). The fine for violations is significant, and laboratory personnel must be familiar with

the correct procedure for pretreatment and disposal. Liquid sample preparation wastes must be neutralized prior to disposal. Evaporation of liquid waste solvents is not considered a treatment option.

Hazardous Waste Mixed with Domestic Sewage. EPA's hazardous waste management regulations exclude from the definition of hazardous waste any wastes mixed with domestic sewage that enters a POTW (40 CFR 261.4(a)(1)). In most cases, laboratories must avoid discharging regulated hazardous waste down the drain. Generally, any laboratory that discharges down the drain more than 15 kg of hazardous waste per month (40 CFR 403.12(p)(2)), or acutely hazardous waste in any amount, is required to notify the EPA regional office, the state hazardous waste authorities, and the POTW of such discharges.

Neutralization. Prior to use of this treatment option, it is important to consider that, in some cases, neutralization can result in an increase in the amount of waste. In most states, it is acceptable to neutralize acidic and caustic liquid sample wastes and to dispose of the neutralized solution down the drain if it has no other hazardous characteristics. Where permissible, it is important that only elementary neutralization occurs and that it is under a RCRA exemption for hazardous waste treatment without a permit. Non-exempted treatment, without a RCRA permit, is a serious RCRA violation. The local POTW can assist with this action and provide additional resources or necessary permits.

4.3.3 Air Sample Waste

Some air samples with elevated contamination can be forced through carbon media to absorb contaminants. The carbon material is disposed of as a solid. Air filters also can be disposed of as solids with other samples of the same hazard class.

4.3.4 Solid Waste

Solid wastes should be collected and segregated. Most solid wastes cannot be treated at the laboratory and should be properly characterized and disposed of at an approved disposal facility. All free liquids should be removed prior to disposal and treated according to the information in Sections 4.3.1 and 4.3.2, as appropriate.

4.3.5 Re-useable and Disposable Containers and Equipment

Empty containers that once held hazardous materials are not regulated as hazardous waste if they meet the definition of “empty.” Empty means that all hazardous materials have been removed from the container and, for containers of 110 gallons or less, residue is no more than 3% by weight of the total capacity; for containers greater than 110 gallons, residue is no greater than 0.3% by weight of the total capacity. Containers that held acutely hazardous waste are considered empty only after being triple rinsed with a solvent capable of removing the acutely hazardous waste residue. Disposable laboratory equipment also can be decontaminated by triple rinsing with a solvent capable of removing residue. The solvent rinse then must be managed as acutely hazardous waste.

Laboratory glassware and other re-useable equipment can be decontaminated using the same procedures used to decontaminate empty containers and cleaned in the same manner used to clean glassware for laboratory use. Cleaning solvents and procedures for these materials are somewhat dependent on the intended use. Glassware intended for use during analysis of

metals, for example, is cleaned differently than glassware intended for use in analyzing organic compounds.

4.3.6 Wastes Containing Chemical Warfare Agents

Small amounts of chemical warfare agents and glassware contaminated with chemical warfare agents can be neutralized prior to disposal, using a solution of 5–10% sodium hypochlorite (NaOCl). Reactions between NaOCl and waste, particularly solvents, can be highly exothermic and the bleach must be added to and mixed with the waste slowly in a hood while wearing proper PPE. Complete neutralization may require mixing times from several hours to overnight. Approximately 200 mL 5 – 10% NaOCl solutions can be added to small amounts of waste (≤4 liters or ≤200 g solids) to result in a waste stream that is primarily an aqueous solution of NaOCl. When neutralizing waste containing chemical warfare agents, the resulting waste should be analyzed and handled as hazardous waste as defined by the results of analysis.

4.3.7 Decontamination Waste

Most decontamination wastes are solvents or aqueous solutions that have been used to rinse or wash contaminated materials. This rinse material should be treated as contaminated waste. Waste that the laboratory cannot treat should be stored and segregated by contaminant (see Section 4.2, Storage), and disposed of by a licensed TSDF and hauler.

4.3.8 Recycling

Wastes that meet specific requirements can be sent for recycling within the laboratory or off-site. For example, some solvents can be purified and reused for sample extraction; mercury can be sent for recycling. Material to be recycled is no longer considered waste. According to 40 CFR 261.6(a)(1), it is considered to be recyclable materials. Although no longer waste, it may still be considered hazardous material if shipped off site for recycling, depending on the substance. This disposal option is not easily completed and often requires individual approval from permitting agencies.

4.4 Packaging

The laboratory should apply for a waste profile from the selected TSDF. Waste profiles typically cover a period of one year. However, other periods may be used depending on TSDF requirements. The waste profile lists the contaminant concentration, contaminant by shipping name, frequency in shipping, generator ID, disposal method, land ban information, and selected other information. This profile helps to ensure the TSDF is capable of proper disposal. The TSDF will provide the generator with a Profile ID (Approval Code) to be listed on the shipping manifest for the specific waste. Additional waste types cannot be shipped for disposal without modifying or preparing a new profile.

Individuals involved in packaging hazardous laboratory waste for shipment must have successfully completed DOT HAZMAT training. Applicable regulations include 49 CFR Part 172, Subpart H regarding DOT training regulations, 49 CFR 173.12b regarding regulations governing "lab-packs," and 49 CFR Part 173, Subpart B regarding regulations governing packaging of hazardous materials. Many laboratories contract hazardous material disposal companies that have completed DOT HAZMAT training. Laboratory waste brokers (discussed in the Waste Management subsection of Section 3.0) that work in the laboratory often are required to pass a state training course; EPA employees should contact their Safety, Health, and Environmental Management (SHEM) program contact for appropriate training. This requirement is state-specific. A summary of information provided in these regulations is provided below.

Sample wastes must be separated by hazard class and then by analyte of concern for disposal (see Section 3.4).

Packing materials and containers are manufactured to meet performance standards described in 49 CFR 173.4. The laboratory must determine that the packaging or container is consistent with the requirements for the respective packing group, and that the package has been manufactured, assembled, and marked in accordance. The manufacturer's marking requirement is contained in 49 CFR 178.503 and consists of the following:

- UN symbol
- Packaging identification code designating:
  - Type of packaging
  - Material of construction
  - Category of packaging (when appropriate)
- A letter identifying the performance standard under which the packaging design has been tested:
  - X: Packages meeting Packing Group I, II, and III tests (great danger, medium danger and minor danger, respectively)
  - Y: Packages meeting Packing Group II and III tests
  - Z: Packages meeting only Packing Group III tests
- Specific gravity or mass for which the packaging design type has been tested
- Test pressure (for packaging intended to contain liquids); the letter "S" for packaging intended to contain solids
- Last two digits of the year of manufacture, and (in some cases) the month of manufacture
- Authorizing state
- Name and address, or symbol, of manufacturer or approval agency
- Packaging thickness (for metal or plastic drums or jerrycans intended for reuse)
- Rated capacity

For example, most laboratory waste drums will be UN1A1 (Liquids) or UN1A2 (Solids) steel or stainless steel drums that resist impact and corrosion damage, with these codes indicating first the United Nations standard symbol (UN), followed by the type of packaging (1 for drum), the package material (A for steel), and the category of packaging (1 for closed head and 2 for open head packaging). High density polyethylene (HDPE) should be labeled UN1H2 (Solids) or UN1H1 (Liquids), and can be incinerated without removing wastes. Overpack drums might be required for DOT Shipments and should be sized to most closely secure the original shipping container.

> **Note**: Although lab packs eliminate the need to transfer wastes and reduce the occurrence of dangerous reactions resulting from mixing incompatible materials, this packing procedure is also often the most expensive.

Most laboratory hazardous sample wastes can be packaged in "lab packs" due to the small quantity. This process uses smaller shipping containers (30 gallons or less) that meet the specified packaging requirements (49 CFR 173.2). The initial sample containers are placed in the shipping container and surrounded with absorbent materials, and the outside container is sealed. Each lab pack must be labeled with the proper Hazard Chemical name, the UN ID, the total weight, and the closing date. An inventory

containing the weight of each internal container, and the Proper Shipping Name (PSN) and level of contamination of each internal container, must be attached to the shipping container and shipping manifest. Each lab pack containing aqueous materials must be enclosed in a plastic bag, and contain twice the amount of absorbent material necessary to absorb the entire liquid content in the event of leakage.

If larger containers are used, the laboratory should limit the size to 55 gallons. A solid 55-gallon drum can weigh more than 350 pounds, requiring a forklift to load it onto a truck.

Solid material requires passing a paint filter test (EPA SW-846 Method 9095B) specifying no "free liquid" is present. If the waste material fails the paint filter test, additional absorption materials should be added.

4.5 Off-Site Disposal

Prior to disposal or transfer to a waste hauler, laboratories must identify whether the waste is (1) a solid waste and/or (2) a hazardous waste. The term solid waste is used broadly in RCRA and refers to both nonhazardous and hazardous waste including solids, liquids, semi-solids, sludges and compressed gases. EPA defines hazardous waste in 40 CFR Part 261 as consisting of or partially containing a "listed" waste or if it demonstrates any one or more of the following characteristics: ignitability, corrosivity, reactivity or toxicity (see introduction to Section 4.0). The laboratory should use either documented analytical results or manufacturer's certifications of reagents to determine the hazard characteristics of samples and related waste.

The selection of a proper waste hauler is important. The laboratory is responsible for waste shipments and should expect proper documentation from the transporter for all shipments. The waste hauler should assist in properly completing the documentation for shipment, manifest, or bill of lading, and in outfitting the truck in accordance with the correct hazard class.

The selection of a proper TSDF is also important. The TSDF must forward a copy of the approved Part A or B permits (see Section 9.0) to the laboratory. The facility must be willing to accept the waste, and must be capable of completing the required disposal activities and associated requirements. Waste packed in a lab pack will be unpacked, checked against the manifest/bill of lading, and then placed into a disposal stream. When the waste is disposed of, the TSDF will issue a disposal certificate to the laboratory. The laboratory must maintain this documentation indefinitely.

4.5.1 Incineration

Waste is removed to a certified incinerator (typically in bulk shipping containers) and destroyed by burning. Each incinerator operator is certified to accept specific wastes in composition, quantity, and concentration. The laboratory will need to ensure proper disposal can be met and that the shipped material meets the requirements of the incinerator permit.

4.5.2 Land Disposal

Waste is removed to a certified landfill facility (typically in bulk shipping containers) and buried in a matrix system. Each landfill operator is certified to accept specific wastes in composition, quantity, and concentration. The laboratory will need to ensure proper disposal requirements can be met and that the shipped material meets the requirements of the landfill permit. Most hazardous wastes have been designated under RCRA's list of compounds that cannot be

landfilled (i.e., the Land Disposal Restrictions at 40 CFR Part 268) and cannot be buried.

4.5.3 Military Return

Wastes that are identified as military wastes or military explosives may need to be sent to a military facility for final disposal. The EPA on-scene coordinator or project manager must provide additional information if this disposal option is required. Information is also provided by the EPA in the *Handbook on the Management of Munitions Response Action* (see Resources for Wastes Containing Chemical Hazards in Section 10.0).

4.5.4 Transfer to Origin

In some specific incidences, samples and sample wastes will be returned to the point of origin. This return will require interfacing with the EPA On-Scene Coordinator or project manager.

5.0 Management and Disposal of Analytical Waste Containing Radiological Hazards

Any activity that uses or produces radioactive materials generates radioactive waste. This waste can exist in gas, liquid, or solid form with varying levels of radioactivity, and can remain radioactive for a few hours, several months, or hundreds of thousands of years. The NRC separates radioactive wastes into two broad classifications: high-level or low-level. High-level waste includes (1) irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted. Low-level waste includes items that have become contaminated with radioactive material or have become radioactive through exposure to neutron radiation. This waste typically consists of contaminated protective shoe covers and clothing, wiping rags, mops, filters, reactor water treatment residues, equipment and tools, luminous dials, medical tubes, swabs, injection needles, syringes, and laboratory animal carcasses and tissues. The radioactivity can range from just above background levels found in nature to very highly radioactive. Low-level waste is typically stored on-site by licensees, either until it has decayed away and can be disposed of as ordinary trash, or until amounts are large enough for shipment to a low-level waste disposal site in containers approved by DOT.

It is assumed that samples analyzed by laboratories supporting EPA remediation activities will not include high-level radiation, therefore, this document provides guidelines for handling samples containing low-level radioactive contamination and associated analytical waste. A radioactive sample is defined by NRC as either:

- Any sample with activity concentrations greater than the “Exemption Concentration” limits specified: 10 CFR 30.70, Schedule A
- Any sample containing a quantity of activity greater than the “Exempt Quantity” limits specified in 10 CFR 30.71, Schedule B

Laboratory samples containing radiation levels that are greater than background (i.e., ambient level of radioactivity occurring at a site or in the laboratory) must be treated as radioactive. Waste material

containing licensable quantities of radioactivity (as indicated in the laboratory's radioactive materials license) must be disposed of in accordance with applicable federal and/or state regulations.

5.1 Regulations

Any person or laboratory possessing, using, storing, or transporting quantities of radioactive materials must have a radioactive materials license in accordance with applicable state and/or NRC regulations (http://www.nrc.gov/materials/miau/regs-guides-comm.html, contact number 1-800-368-5642, or 301-415-7000). Laboratories disposing of radioactive waste must have a Radiation Safety Officer on staff, as required by their radioactive materials license, with knowledge of all regulations concerning radioactivity. To obtain a license, laboratories must submit an application to NRC and/or the applicable state. This application must demonstrate how the handling of these materials will meet the safety requirements in NRC regulations found in 10 CFR Parts 19–21 and 30–39, or applicable state regulations. Guidelines for obtaining a state license can be found using the state Web site sources listed in Appendix B. Items typically addressed in a radioactive materials license include:

- Types and quantities of licensable radioactive materials
- Waste storage volume and time constraints
- Waste survey requirements
- Personnel monitoring requirements

Management and disposal of radioactive waste is a complex issue, not only because of the nature of the waste, but also because of the complicated regulatory structure and the limited number of facilities permitted to manage this type of waste. There are a variety of stakeholders affected, and a number of regulatory entities involved. Government agencies involved in radioactive waste management include the U.S. EPA, NRC, Department of Energy (DOE) and DOT; states and affected tribes. Responsibilities of these agencies include the following:

5.1.1 Nuclear Regulatory Commission (NRC)

The NRC has regulatory authority over storage and disposal of radiological wastes generated in the United States. Part 61 of the NRC regulations (10 CFR) sets forth the procedures, criteria, terms and conditions for licensing sites for land disposal of low-level waste. The requirements also provide the basis for agreement with state regulations, since state rules must be compatible with NRC requirements. Additionally, 10 CFR 20.2002 is available for use by licensees for disposal of low-level wastes for which the extensive controls in Part 61 are not needed to ensure protection of public health and safety and the environment. Regulations require conformance with criteria for waste management activities. NRC's regulations are found in 10 CFR Chapter I, which is divided into Parts 1 through 199. The following are the principal requirements governing the licensing of laboratory handling and use of nuclear materials:

- Part 19 - Notices, Instructions and Reports to Workers: Inspection and Investigations
- Part 20 - Standards for Protection Against Radiation
- Part 21 - Reporting of Defects and Noncompliance
- Part 30 - Rules of General Applicability to Domestic Licensing of Byproduct Material
- Part 32 - Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material
- Part 33 - Specific Domestic Licenses of Broad Scope for Byproduct Material
- Part 40 - Domestic Licensing of Source Material

- Part 70 - Domestic Licensing of Special Nuclear Material
- Part 71 - Packaging and Transportation of Radioactive Material
- Section 150.20 - Recognition of Agreement State Licenses (Reciprocity)

Additional NRC requirements in 10 CFR that are pertinent to laboratories disposing of radioactive waste include:

- Part 2 - Specifies the licensing process and requires an electronic record-keeping system to preserve data needed for licensing
- Section 20.2002 - General provision that allows for alternative disposal methods, provided that doses are maintained As Low As Reasonably Achievable (ALARA) and within the dose limits of Part 20 see 10 CFR Part 20, Subpart D for radiation dose limits for individual members of the public
- Part 61 - Licensing requirements for land disposal of radioactive waste
- Part 62 - Criteria and procedures for emergency access to non-federal and regional low-level waste disposal facilities
- Part 74 - Establishes requirements for control and accounting of special nuclear material, including documentation of transfer of material

NRC also provides guidance to licensees and other stakeholders regarding transportation of packages containing radioactive material in its Standard Review Plan for Transportation Packages for Radioactive Material (NUREG-1609).

5.1.2 The U.S. Environmental Protection Agency (EPA)

Under Section 121(a) of the Nuclear Waste Policy Act (NWPA), EPA is required to promulgate generally applicable standards for protection of the environment from off-site releases of radioactive materials in repositories. The standards are intended to limit the amount of radioactivity entering the biosphere outside the boundaries of a facility and the radiation exposure to the public from management of waste prior to disposal, and provide criteria to be followed for disposal of these wastes. These standards are found at 40 CFR Part 191 (Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes).

5.1.3 The U.S. Department of Transportation (DOT)

DOT regulates packaging and transport of all hazardous materials including nuclear waste. Packaging must meet NRC regulations, which are compatible with and generally derived from internationally developed standards (e.g., International Atomic Energy Agency [IAEA]), and the package design must be reviewed and certified by NRC. DOT prescribes limits for external radiation levels and contamination, and controls the mechanical condition of carrier equipment and qualifications of carrier personnel. The maximum external radiation limits are listed at 10 CFR 71.47, based on the type of transport. On October 2018, these limits were listed as described in Table 5-1.

Table 5-1: External Radiation Standards for Packages

Reading Location	Common carrier non-exclusive use: Open or closed transport	Contract carrier exclusive use: Closed transport	Contract carrier exclusive use: Open transport
Reading on surface of the package	2mSv /hour (200 mrem/hour)	10 mSv/hour (1000 mrem/hour)	2 mSv/hour (200 mrem/hour)
Reading at 1 meter from any surface of the package	0.1mSv/hour (10 mrem/hour)	Not Applicable (NA)	NA
Reading at the surface of the vehicle or any imaginary surface of the vehicle for open transport	NA	2mSv/hour (200 mrem/hour)	2 mSv/hour (200 mrem/hour)
Reading 2 meters from any surface of the vehicle or any imaginary surface of the vehicle for open transport	NA	0.1 mSv/hour (10 mrem/hour)	0.1 mSv/hour (10 mrem/hour)
Reading in the vehicle cab	NA	0.02 mSv/hour (2 mrem/hour)	0.02 mSv/hour (2 mrem/hour)

DOT regulations at 49 CFR Parts 171 – 179 (Hazardous Materials Regulations) specify requirements for the transportation of radioactive materials.

Although the type of package required for transporting radioactive material is based on the activity inside the package, the required label is based on the radiation hazard outside the package. For radioactive material there are three possible labels, depending on the external levels of radiation. The three labels are commonly called White I, Yellow II and Yellow III. The required label is determined by radiation readings at the surface of the package and at 1 meter from the surface of the package:

- White I: Surface radiation level does not exceed 0.5 mrem/hour
- Yellow II: Surface radiation level does not exceed 50 mrem/hour, and the radiation level at 1 m does not exceed 1 mrem/hour
- Yellow III: Surface radiation level exceeds 50 mrem/hour or radiation level at 1 m exceeds 1 mrem/hour

Most laboratory waste will fall into the categories needing White I or Yellow II labels.

5.1.4 The U.S. Department of Energy (DOE)

DOE Order 435.1 (Radioactive Waste Management) describes requirements and procedures to ensure that DOE radioactive waste is managed in a manner that is protective of worker and

public health, worker and public safety, and the environment. The Order applies to all high-level waste, transuranic waste, and low-level waste, including the radioactive component of mixed waste, for which DOE is responsible. Attachment 1 of the Order sets forth requirements that are applicable to contractors performing work that involves management of DOE radioactive waste at DOE-owned or leased facilities. The Order requires that radioactive waste shall be managed to:

- Protect the public from exposure to radiation from radioactive materials (DOE 5400.5, Radiation Protection of the Public and the Environment)
- Protect the environment (DOE 5400.1, General Environmental Protection Program and DOE 5400.5, Radiation Protection of the Public and the Environment)
- Protect workers (10 CFR Part 835, Occupational Radiation Protection)
- Comply with applicable federal, state, and local laws and regulations

5.2 Storage

Storage of low-level radioactive waste (LLRW) requires an NRC or agreement state license. NRC or agreement state regulations generally require that waste be stored in a manner that keeps radiation doses to workers and the public below NRC-specified levels. Licensees must further reduce these doses to levels that are ALARA. Actual doses, in most cases, are a small fraction of the NRC limits.

5.2.1 Waste Containers

LLRW is packaged in containers appropriate to its level of hazard. Some LLRWs require shielding with lead, concrete, or other materials to protect workers and the public. Laboratory staff must be trained to maintain a safe distance from more highly radioactive materials, to limit the amount of time near the materials, and to monitor the waste to detect any releases. Radioactive waste storage areas are posted to identify the waste so that workers and the public will not inadvertently enter the area. Low-level waste may be stored to allow short-lived radionuclides to decay to innocuous levels and to provide safe-keeping when access to disposal sites is not available. The NRC believes storage can be safe over the short term as an interim measure, but favors disposal rather than storage over the long term. Waste must be stored in an appropriate container (e.g., 55-gallon drum; carboy; or DOT-approved B-12, B-25 or B-52 container) that complies with the laboratory's radioactive materials license.

In addition to DOT requirements summarized in the Hazardous Material Transportation Act subsection of Section 3.0, radiological waste containers must be labeled in accordance with requirements at 10 CFR Part 61.

5.2.2 Storage Areas

According to NRC regulations at 10 CFR 20.1801 and 1802, all samples containing radioactive contamination and all licensed material possessed by the laboratory must be stored in a designated storage location that is secure from unauthorized access or removal. The storage location must, at a minimum, be posted as described in the Storage Area Posting Requirements subsection in Section 5.0. General storage requirements include:

- Waste containing gamma exposure rates > 5,000 µR/hour (hr) or with individual radioisotope activity levels > 1 µCi/gram must be segregated from waste with lesser gamma

exposure rates (≤ 5,000 µR/hr or activity levels ≤ 1 µCi/gram), and must be stored in an area posted or otherwise identified for "High Activity Sample Storage."
- Radioactive and mixed wastes awaiting disposal must be segregated from non-radioactive process wastes. Liquid waste must be stored in closed containers.
- The total used volume of these containers must not exceed 55 gallons.

Time constraints for storing radioactive waste are contained in the laboratory's radioactive material license, which generally contain language similar to the following:

> Waste generated during sample preparation, analysis, and cleanup operations containing licensable quantities of radioactive material shall be returned to the client submitting the sample as soon as practicable, or shall be shipped to a licensed disposal facility. Waste material containing licensable quantities of radioactive material, which is to be shipped to a disposal facility, must be stored in closed containers. The activity of waste material awaiting shipment shall not exceed 100 mCi per single radionuclide (mass number 3 through 247) or a total of 2,000 mCi for all radionuclides combined.

5.2.3 Storage Area Posting Requirements

Areas or rooms where contamination exists due to handling of radioactive material must be posted with appropriate caution signs in accordance with 10 CFR 20.1902 and containers labelled in accordance with 10 CFR 20.1904. The signs must bear the conventional radiation colors (magenta, purple, or black on a yellow background) and the three-blade tri-foil design. Postings must be the size and quantity needed to properly alert personnel of the radiological hazards. All radiological postings must be conspicuously posted so that personnel engaged in work activities in the area can readily view them. When possible, the size of the posted area will be limited to the immediate area of concern, rather than posting large non-specific areas, to provide more specific worker guidelines while limiting the chance of causing undue worker or public alarm. Table 5-2 provides a summary of area posting requirements. The following exceptions may apply to the requirements listed in Table 5-2:

Caution signs are not required in areas or rooms containing sources of radiation for periods of less than eight hours if each of the following conditions are met:

- sources of radiation are constantly attended by an individual who takes precautions to prevent exposure of individuals to radiation in excess of limits established in 10 CFR Part 20
- the area or room is under the control of the laboratory

A room or area containing a sealed source is not required to be posted with a caution sign provided that the radiation level at 30 centimeters from the surface of the sealed source container or housing does not exceed 5 mrem/hour.

Table 5-2: Posting Requirements for Storage of Radioactive Samples and Waste

Area	Area Posting Requirements
Restricted Area	A Restricted Area is defined as "any area, access to which is controlled by the licensee for the purpose of protection of individuals from exposure to radiation and radioactive materials." The immediate area in which radiological activities are taking place (i.e., areas where contaminated land is being remediated or where decontamination is taking place) shall be considered a restricted area. The maximum dose rate allowed at the boundary of a restricted area is 2 millirem per hour (mrem/hr), or an exposure rate that could result in more than 100 millirem per year (mrem/yr), whichever is more restrictive.
Radiation Area	Areas, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates, or in any 5 consecutive days a dose in excess of 100 mrem, shall be posted "Caution: Radiation Area."
High Radiation Areas	Areas accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 100 mrem in 1 hour at 30 centimeters from the source or 30 centimeters from any surface that the radiation penetrates shall be posted “Caution: High Radiation Area.”
Very High Radiation Areas	Areas, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 5 mR in 1 hour at 1 meter from a source of radiation or from any surface that radiation penetrates shall be posted “Grave Danger: Very High Radiation Area.”
Airborne Radioactive Materials	An area, room, or enclosure shall be posted “Caution: Airborne Radioactive Materials” when airborne radioactive materials exist in concentrations that are: – in excess of the derived air concentrations (DACs) specified in 10 CFR Part 20, Appendix B, or – to such a degree that an individual without respiratory protective equipment could exceed, when an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours
Radioactive Materials Areas	Each area or room in which there is used or stored an amount of licensed or registered source of radiation exceeding 10 times the quantity of such source of radiation specified in 10 CFR Part 20, Appendix C shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words “Caution: Radioactive Material(s).”
Hot Particle Areas	Each area, room, or enclosure that contains hot particles shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words “Caution: Hot Particles” or “Caution: Hot Particle Area.”
Temporary Storage Areas	In the event the laboratory designates an area as a temporary "Radioactive Material Storage Area," the storage area shall be posted with a conspicuous sign or signs bearing the radiation symbol and, at a minimum, the words "Caution: Radioactive Materials, Restricted Area."

5.2.4 Monitoring and Documentation

Radioactive waste storage areas must be surveyed, and personnel monitored in accordance with the laboratory's radioactive material license which must specify requirements for surveys, personnel monitoring, and storage of radioactive material.

An inventory of analytical sources and radioactive tracers must be performed in accordance with the laboratory's radioactive material license, at least semi-annually, and a written inventory must be maintained. A written inventory also must be maintained of all radioactive samples received by the laboratory for analysis. This inventory must, at a minimum, include the following information:

- Date of sample receipt
- Sample origin
- Date samples returned to sample owner or shipped for disposal

Inventory records of analytical source standards, tracers, and samples received must be maintained by the laboratory for a minimum of three years.

5.3 Treatment

Both radioactive and mixed waste may require treatment to meet one or more objectives prior to final disposal (see Section 7.0 regarding mixed waste). Treatment involves physical or chemical processes that result in a waste form that is acceptable for disposal or further treatment. Treatment objectives include:

- Producing a waste form acceptable for land disposal
- Volume/mobility reduction through possible solidification or sizing
- Producing a waste more amenable for further treatment
- Separating radioactive components from RCRA or TSCA components

Another treatment objective is to convert a radioactive RCRA regulated waste to a radioactive non-RCRA waste. Laboratory management should determine if special permits or licenses are required from various regulatory agencies prior to the treatment of waste.

Radioactive wastes may require treatment to meet the waste characteristics provided in 10 CFR 61.56 prior to disposal. The following types of treatment may be used to meet those requirements:

- Non-solid radioactive waste may be treated with various solidification agents (such as cement, asphalt, or polymers) to immobilize waste or sludge not otherwise acceptable for disposal. LLRW may be absorbed onto a porous material, such as silica, vermiculite, or organic materials to reduce the liquid volume.
- Dry radioactive waste may be treated with compaction or super-compaction to reduce the waste volume. Compaction is a concern only when there is uncertainty regarding the effectiveness of decontamination and the potential for release of air-borne contamination.
- Glassware, disposable laboratory equipment, and other radioactive waste may be decontaminated for unrestricted release by removal of surface radioactivity through chemical (e.g., weak nitric acid rinse) or physical means. The residue from the decontamination of a surface may require disposal as a radioactive waste.

- Since the level of radioactivity decreases with time, it may be possible to store samples or materials containing a short-lived radionuclide (e.g., Se-75, Ru-103, Ru-106, Ir-192, Po-210) until the natural-decay process reduces the radioactivity to a level at which the waste can be considered non-radioactive for waste management purposes.

5.4 Packaging

Packaging of LLRW for disposal must be in accordance with 10 CFR 20.2006(d) requirements. Each container of low radioactive waste must be clearly labeled to identify whether the waste is Class A, Class B or Class C, as defined at 10 CFR 61.55. Containers must be labeled in accordance with requirements at 10 CFR Part 71 and 49 CFR Part 172. The following minimum requirements for all classes of LLRW are intended to facilitate handling and to provide health and safety protection of personnel at a disposal site:

- Wastes must be packaged in conformance with the conditions of the disposal site license. Where conditions of the laboratory license are more restrictive than the disposal site license, the laboratory license conditions must be followed.
- Wastes must not be packaged for disposal in cardboard or fiberboard boxes.
- Liquid waste must be packaged in sufficient absorbent material to absorb twice the volume of the liquid.
- Solid waste containing liquid must contain as little free-standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed one percent of the volume.
- Waste shall not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reactions with water.
- Waste shall not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste.
- Waste must not be pyrophoric.
- Waste in a gaseous form shall be packaged at an absolute pressure that does not exceed 1.5 atmospheres at 20^{o}C. Total activity shall not exceed 3.7 TBq (100 Ci) per container.
- Wastes containing hazardous, biological, pathogenic, or infectious material shall be treated to reduce, to the maximum extent practicable, the potential hazard from the non-radiological materials.
- Package must be sufficiently stable to ensure that the waste does not degrade and affect overall stability of the disposal site through slumping, collapse, or other failure and thereby lead to water infiltration. The following requirements should be followed to provide stability of the waste at the disposal site:
  - Waste packaging must have structural stability, allowing it to maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.
  - Wastes containing liquid should be converted to a form that contains as little freestanding liquid as is reasonably achievable, but in no case shall the liquid exceed one percent of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5 percent of the volume of the waste for waste processed to a stable form.
  - Void spaces within the waste and between the waste and its package should be reduced to the extent practicable.

5.5 Disposal

Disposal of radioactive wastes generated by the laboratory is regulated by the NRC, regulating state, and/or other agreement state. Records of all waste disposed of must be maintained in accordance with 10 CFR 20.2108 until termination of the laboratory's license.

Sample and analytical waste generated during sample preparation, analysis, and cleanup operations containing licensable quantities of radioactive material must either be returned to the client submitting the sample (or site of sample origination) as soon as practicable or shipped to a licensed disposal facility that is willing to accept the waste. Wastes containing licensable quantities of radioactive material, which is to be shipped to a disposal facility, must be stored in closed containers. The requirements of Waste Disposal (10 CFR Part 20, Subpart K) must be followed, when applicable, when solid waste material cannot be returned to a client and must be disposed of. A sample of all liquid waste must be taken and analyzed for radioactive contents and activity prior to disposal. In general:

- Radioactive Solid Waste - Radioactive solid waste shall be disposed of at a facility licensed by the regulatory state for such disposal, another agreement state, or the NRC.
- Radioactive Liquid Waste - Certain water-soluble liquid wastes may be disposed of by release into sanitary sewage systems in accordance with the laboratory's radioactive material license. Sewage disposal is commonly used for low-level radioactive liquid waste (usually in the form of pH-neutralized waste) as long as it is readily soluble in water and meets requirements and limits set forth in 10 CFR 20.2003.

6.0 Management and Disposal of Analytical Waste Containing Biological Hazards

Microorganisms are a natural part of the environment and are found in soil, water, air, and on plants and animals. Most organisms are harmless or may be beneficial to humans or the environment; however, some microorganisms can cause disease (pathogens) and their dissemination in the environment and disease transmission to human and animal populations must be either reduced or eliminated. Samples and waste containing pathogenic microorganisms require treatment either with chemicals such as bleach or with the use of non-chemical procedures, such as autoclaving or ultraviolet radiation, to render them non-infectious prior to disposal.

EPA's SAM recognizes the following categories of pathogens for remediation:

- Bacteria (vegetative and spores): (1 – 10 µm) single cells lacking complex internal structures (prokaryotes)
- Viruses: (0.005 – 0.300 µm) particles incapable of replicating except within a host cell
- Protozoa: (1 – 300 µm) single cells with complex internal structures (eukaryotes)
- Helminths: parasitic worms (20 µm – greater than 50 mm)

Some microorganisms produce metabolic products (biotoxins) that can cause disease even if the microorganism is not present or is no longer viable (e.g., botulinum neurotoxin). Biotoxins also can be produced by plants (e.g., ricin from castor beans) as well as animals (α-conotoxin from snails). Biotoxins

can be proteins that are readily destroyed by addition of bleach, or they can be small molecules that may require an extreme treatment such as incineration.

The management of waste resulting from analysis of samples containing biological contamination can be complex, due to the limited number of facilities that are able to handle it. Some states have state-specific regulations pertaining to this waste, and these regulations should be consulted. In most states, biological contaminants and the associated analytical waste are regulated as infectious or biomedical waste. Specific federal regulations and procedures are summarized below.

6.1 Regulations

In 1988, Congress passed the Medical Waste Tracking Act of 1988, which resulted in Standards for the Tracking and Management of Medical Waste and was in effect for two years. At its expiration, individual states and localities implemented a variety of similar rules and regulations applying to non-household-generated (e.g., laboratory and hospital) biomedical waste. Currently, there are no federal biomedical waste tracking and management regulations in effect. As state and local requirements vary considerably, laboratories must consult individual agencies governing their locality. A list of the agencies governing medical and biological waste management and disposal for each state and supporting documents can be found at https://www.epa.gov/rcra/medical-waste and https://www.epa.gov/home/health-and-environmental-agencies-us-states-and-territories. Guidance on regulations is also provided by the World Health Organization (WHO) in its "Guidance on Regulations for the Transport of Infectious Substances 2017–2018" (WHO, 2017, in Section 10.5). In addition to the regulations summarized in Section 3.4, the regulations summarized below must be considered by laboratories generating biological waste.

- Employee safety while handling and disposing of biological samples is addressed under OSHA regulations 29 CFR Part 1910. These regulations include general hazardous materials sections on employee training (29 CFR 1910.1200(h)), written hazard communication (29 CFR 1910.1200(e)), and SDS requirements (29 CFR 1910.1200(g)). The bloodborne pathogens regulations (29 CFR 1910.1030) are specific for exposure to blood or other potentially infectious materials containing pathogens and do not apply to environmental samples.
- While medical and biological waste is not regulated under current federal RCRA regulations, there are federal requirements for incineration of medical waste under the Clean Air Act (CAA Sections 129 and 130). Incineration is the method of choice for large amounts of infectious waste, and incinerator operators must comply with EPA standards for clean air and emissions. If chemicals or pesticides are used in the treatment of medical waste, the appropriate Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulations must be followed. Section 18 of FIFRA provides procedures and authorizes the EPA Administrator to exempt state and federal agencies from provisions of the Act if it is determined that emergency conditions exist that require an exemption. Many states have specific requirements for the chemical treatment of medical waste as an alternative treatment technology.
- 42 CFR Part 73 describes the possession, use and transfer of select agents and toxins (see Resources for Waste Containing Biological Hazards in Section 10.0; Richmond and Nesby-O'Dell, 2002, in Section 10.5). Select agent pathogens are handled and disposed of under BSL-2, BSL-3 or BSL-4 conditions (see Resources for Waste Containing Biological Hazards in Section 10.0; National Committee on Clinical Laboratory Standards, 2002 and Richmond and Nesby-O'Dell, 2002, in Section 10.5). Clinical or diagnostic laboratories that possess, use, or transfer a select agent or toxin that is contained in a specimen presented for diagnosis or verification are exempt from the requirements

provided that within seven calendar days after identification, the select agent or toxin is transferred in accordance with 42 CFR 73.16 or destroyed on-site by a recognized sterilization or inactivation process. If exempted, the select agent or toxin is reported to the U.S. Centers for Disease Control and Prevention (CDC) or other appropriate agencies using Animal and Plant Health Inspection Service (APHIS)/CDC Form 4) within seven calendar days after identification and a copy of the form maintained for three years. Under extraordinary circumstances, such as a widespread outbreak, less stringent reporting may be required. Laboratories performing regular testing and using control stocks containing a select agent or toxin must conform to all regulations for select agents. These regulations should be consulted for the proper accounting and record keeping requirements. The following select agent pathogens are listed in SAM:

- *Bacillus anthracis*
- *Brucella* spp.
- *Burkholderia mallei*
- *Burkholderia pseudomallei*
- *Coxiella burnetii*
- *Francisella tularensis*
- *Yersinia pestis*

Biotoxins are regulated as select agents only if the aggregate amount of the biotoxin exceeds a threshold level. Select agent toxins are handled and disposed of under BSL-2 or BSL-3 conditions (e.g., see Richmond and Nesby-O'Dell, 2002, in Section 10.5). The following select agent biotoxins and associated threshold are listed in SAM:

- Abrin (100 mg)
- Botulinum neurotoxins (0.5 mg)
- Diacetoxyscirpenol (1000 mg)
- Ricin (100 mg)
- Saxitoxin (100 mg)
- Staphylococcal enterotoxins (5 mg)
- Tetrodotoxin (100 mg)
- T-2 toxin (1000 mg)

6.2 Storage

Prior to storage, samples and associated waste must be clearly identified and segregated by placement in leak-proof bags or containers. Disposable, puncture-resistant containers and leak-proof bags are commercially available, as well as reusable plastic and metal pans. Many states require that biological waste have a primary and secondary container (e.g., either a bag within a box, or double-bagged).

Biological waste storage facilities or areas must have appropriate state and local permits, and must be fully enclosed, secured to prevent entry of unauthorized persons, not used for other purposes, and operated in such a manner as to minimize odor and entry by rodent and insect vectors. These areas must be conspicuously identified with signs containing the International Biological Hazard Symbol or phrases such as "Infectious Waste" or "Biohazard." Waste storage containers must be handled in a manner that does not affect the integrity of the packaging. Containers or packaging must remain intact without signs of leakage. Damaged or leaking containers may be over packed into appropriately labeled and constructed containers. Waste held for more than seven days must be maintained at temperatures

below 10 °C. Records should contain the name and location of the waste generator, quantity of waste generated, date accepted, contact person for waste, and quantity removed.

Containerized treated solid waste can be mixed with other solid waste for storage prior to transport and disposal. Relevant health department or environmental agency requirements must be met for solid waste storage.

Note: The terms decontamination, disinfection and treatment, as discussed in this document, are consistent with the CDC. Definitions of these terms, however, can vary across different organizations and agencies. The State of New York (6 CRR-NY 360.2 Definitions; Subchapter B, Solid Wastes), for example, defines decontamination as a method that results in the reduction in the concentration of microorganisms or toxins of concern to a level that is considered safe for the intended use, handling or disposal; disinfection as a procedure involving application of an antimicrobial agent; and treatment as a method, technology or process designed to change the character or composition of medical or infectious waste.

6.2.1 Treatment

Laboratories can meet waste decontamination objectives by selecting acceptable treatment techniques approved by their state and applying them diligently. Prior to decontamination, samples and associated waste (e.g., glassware or disposable equipment such as micro-pipette tips) must be clearly identified and segregated by placement in leak-proof bags or containers. Disposable, puncture-resistant containers and leak-proof bags are commercially available, as well as reusable plastic and metal pans. If samples are not decontaminated within 48 hours, consideration must be given to storage in appropriate containers at reduced temperatures (i.e., below 10^{o}C). In many states, decontaminated materials can be disposed of along with associated solid hazardous waste; decontaminated re-useable equipment can be cleaned as required for its intended use. Information regarding the effectiveness of procedures for decontamination of laboratory waste containing specific pathogens and biotoxins (i.e., listed in SAM) is provided in Tables 6-1 and 6-2.

Category A and Category B infectious substances are not subject to dangerous goods regulations in cases where they are present in a form that has been neutralized or inactivated such that they no longer pose a health risk, unless they meet criteria for inclusion in another class. Environmental samples, which are not considered to pose a significant risk of infection, also are not subject to dangerous goods regulations, unless they meet criteria for inclusion in another class. (WHO, 2017, in Section 10.5)

6.2.2 Pathogens

Sterilization and inactivation techniques and their applicability to various pathogens, protein biotoxins and equipment (see Resources for Waste Containing Biological Hazards in Section 10.5) are provided in Table 6-1. Autoclave conditions are provided as guidance and may need to be adjusted to account for challenges posed by waste conditions, such as porous or dense materials.

Table 6-1: Comparison of Decontamination Procedures

Source: *Adapted from information in Biosafety in Microbiological and Biomedical Laboratories (BMBL), 5th Edition.*

Parameter	Autoclave (121–132°C 15 lb/in^2)	Dry-heat Oven (160–180°C)	Incinerator	UV (253.7 nm)	Chlorine (5% NaOCl or 52,500 ppm Cl_2)	Phenolic Compounds	Alcohol (70–85%)
Duration of Treatment	50–90 minutes	180–240 minutes	NA	10–30 minutes	10–30 minutes	10–30 minutes	10–30 minutes
Vegetative Bacteria	+	+	+	+	+	+	+
Bacterial Spores	+	+	+	–	±	–	–
Protein-Capsid Viruses	+	+	+	±	+	±	±
Lipid-Enveloped Viruses	+	+	+	–	+	+	+

+ Effective treatment
– Non-effective or not applicable treatment
± Somewhat effective treatment

6.2.3 Biotoxins

Decontamination parameters for non-protein (low molecular weight [LMW]) biotoxins are provided in Table 6-2. Do not use steam sterilization (autoclave) for destruction of non-protein (LMW) biotoxins. Unless otherwise stated, contact time for chemical inactivation is 30 minutes. Some non-protein biotoxins are extremely resistant to inactivation and should be treated only by incineration (see Resources for Waste Containing Biological Hazards in Section 10.0).

Table 6-2: Comparison of Decontamination Procedures for Biotoxins

Source: *Biosafety in Microbiological and Biomedical Laboratories (BMBL), 5th Edition.*

Parameter	Incinerator (> 815°C)	Autoclave	Dry-heat Oven (160–180°C)	2.5% NaOCl with 0.25 N NaOH	2.5% NaOCl
Duration of Treatment	NA	60–120 minutes	10–60 minutes	30 minutes	30 minutes
Botulinum neurotoxin	+	+	+	+	+
Staphylococcal enterotoxin	+	+	–	+	+
Ricin	+	+	+	+	+
Brevetoxin	+	–	–	+ (4 hr)	+
Microcystins	+	–	–	+	+
Picrotoxin	+	–	–	–	–
Saxitoxin	+	–	–	+	+
T-2 Mycotoxin	+	–	–	+ (4 hr)	–
Tetrodotoxin	+	–	–	+	+

NA = Not applicable
+ Effective treatment
– Non-effective or not applicable treatment / Treatment results unknown

6.2.4 Non-Chemical Treatment

- **Steam sterilization** – All laboratories handling moderate- to high-risk agents (BSL-3 and BSL-4) must have a steam autoclave within the restricted area. For low-risk agents (BSL-2), an autoclave must be available, preferably on the same floor and in the general vicinity of the laboratory. The processing time will depend upon the type of autoclave, the number of vacuum pulls, loading factors such as the type of waste and autoclave pan (metal versus polypropylene), the use of autoclavable waste bags, the amount of water in the waste, and the weight of the waste load. The moisture content of saturated steam at 121°C – 132°C is responsible for the rapid destruction of microbes. Thus, if sufficient water is not present, water should be added. Steam sterilizers must be equipped to continuously monitor and record temperature and pressure. Alternative methods of evaluating effectiveness, such as the use of biological indicators placed in "cold spots" (areas where the temperature is the lowest during sterilization) of the autoclave, temperature-sensitive tape affixed to each container, may also be used. Sterilizers must be periodically evaluated for effectiveness.
- **Dry heat** – Dry-heat ovens are used for glassware, instruments, and anhydrous materials such as oils, greases, and powders, as the moisture component of saturated steam will not adequately penetrate anhydrous materials and closed containers. Temperatures of 160 – 180 °C can be selected. Contact time of 180 – 240 minutes takes into account the lag time for certain materials to reach the temperature in the oven and may or may not be applicable to all situations. Good examples of the times required to decontaminate various materials are presented in Rutala *et al*., 1982 (see Resources for Waste Containing Biological Hazards, subsection in Section 10.5).
- **Incineration** – Incineration is the method of choice for large amounts of infectious waste. Non-protein toxins that are resistant to other methods of decontamination can be disposed of by incineration. Difficulty in building, running, and meeting regulatory guidelines for incinerators prevents many laboratories from using this method. Where available, however, samples and waste can be outsourced to commercial facilities with approved incinerators. The Preparation of Untreated Waste for Off-site Treatment and Disposal section below (Section 6.3.1), describes the storage conditions, containers, and labeling of untreated waste prior to pick up by the waste transport facility.
- **Ultraviolet radiation** – Germicidal ultraviolet (UV) radiation at 253.7 nm is effective against most vegetative microbial cells and some bacterial spores, but has limited penetrating power. It is used primarily with vegetative cells on exposed surfaces or in the air. Germicidal UV will not penetrate accumulated organic material, opaque liquids, packaging material, soil, dust, or other solids. The intensity, or destructive power, of the lamp decreases by the square of the distance from the lamp; thus, effectiveness is related to exposure time and distance from the UV source. The intensity of the lamp will also decrease with time and should be checked yearly with a UV meter. The intensity of the lamp also is drastically affected by the accumulation of dust and dirt; the surface of the lamp should be wiped weekly with alcohol. UV lights are not intended to replace routine decontamination processes for the interior of a biosafety cabinet and must be used in conjunction with established disinfection procedures. This restriction is especially important to note when working with unknown and/or possibly resistant microorganisms such as spores. Due to the short time for UV overexposure (e.g., 1.3 – 6.7 minutes at the face of a biological safety cabinet), it is recommended that neither laboratory nor maintenance personnel work in a room with UV lighting.

6.2.5 Chemical Treatment

- **Chlorine compounds** – Inexpensive treatments can be made from commercial products such as Clorox® (NaOCl, 5% or 52,500 ppm Cl_2). Non-protein biotoxins are more readily inactivated by the addition of NaOH (final concentration 0.25 N) to the chlorine solution. These compounds are quickly inactivated by organic matter, work best at pH 6.0 – 8.0, and perform most rapidly at higher temperatures. Chlorine solutions are skin irritants and corrosive to metal. Hence, they should be used with caution and in well-ventilated areas.
- **Phenolic and phenolic-detergent based compounds** – These compounds have a broad microbicidal spectrum and are less affected by organic matter than are other chemical treatments. However, phenolic and phenolic-detergent based compounds can corrode some plastics and very high concentrations are needed to inactivate hydrophilic viruses. Commercially available products include Lysol® and Pine-Sol®.
- **Alcohol** – Ethyl or isopropyl alcohol (70 – 85%) is used to disinfect contaminated surfaces. Paper towels and wipes that have been used to apply and remove alcohol solutions should be decontaminated prior to disposal. As alcohol is combustible, make sure that it has evaporated if a heat treatment is used for decontaminating used towels and wipes. Alcohols are ineffective against spores, hydrophilic viruses, parasite cysts and ova and toxins.
- **Other compounds** – Various other chemicals also are available and used for decontamination. Quaternary ammonium compounds (e.g., benzalkonium chloride) are odorless and non-irritating, but some formulations are inactivated by soap and soap residues. Glutaraldehyde is used as a 2% solution for re-usable instruments that cannot be autoclaved. Glutaraldehyde has been implicated as an occupational hazard due to sensitivity problems in workers using it as a high-level disinfectant. Iodine compounds are available as iodophors, which are combinations of elemental iodine and a substance that makes the iodine soluble in water. Iodine compounds are effective against many microbes, but do not work well in the presence of organic material and can stain clothing and surfaces. Bromine also is a known biocide and can be used for disinfection, sometimes as a substitute for chlorine. Stabilized bromine biocide is used for industrial water treatment to control microbiological activity. Chlorine dioxide is often used to decontaminate medical waste. Ozone has been used for treatment of both sludge and water.

6.3 Packaging

During and following analytical procedures in the laboratory, analytical solid waste and residual samples are accumulated in red leak-proof bags with identifying markings such as “Biohazard.” Markings must be indelible and permanent. Many states require that biological wastes have a primary and secondary container such as a second bag (double-bagging), or a labeled, puncture-resistant cardboard container. Specific requirements for labeling biological wastes are regulated and vary by state. An example general biohazard waste label is provided below.

Containers holding sharp objects must also be rigid and puncture-resistant. Liquid waste is accumulated in leak-proof plastic, metal, or glass containers. Waste can either be decontaminated on-site or transported off-site for treatment. Disposal is the same whether the material has been treated on- or off-site. Select agents must be handled separately from other biological wastes, and handling procedures must comply with requirements at 42 CFR Part 73.

6.3.1 Preparation of Treated Waste for Off-site Disposal

Treated waste can be mixed with other solid waste for landfilling. Decontaminated biological waste containing free liquids that would prevent blade mixing at the disposal facility must be further processed to eliminate the liquids. Treated waste containers that have identifying phrases such as "Infectious Waste" or "Biohazard," are red in color, or display the International Biological Hazard Symbol, must be processed by grinding (post treatment), incineration, or other method to remove such markings.

6.3.2 Preparation of Untreated Waste for Off-site Treatment and Disposal

Small containers may be combined and placed inside larger containers as long as the identifiable markings are repeated on the exterior of the larger container. The outermost packaging must have the International Biological Hazard Symbol and an identifying phrase such as "Infectious Waste" or "Biohazard," the date of packaging, and the name and address of the packager.

Single-use containers must be burnable if destined for incineration. Multiple-use containers must be smooth, cleanable, and resistant to corrosion. After pickup, emptied containers must be cleaned at a site next to the pickup area with a disinfectant-detergent, such as a phenolic or iodophor compound, followed by steam, if compatible.

6.4 Disposal

Waste disposal regulations vary from locality to locality, and laboratories must understand the applicable state and local requirements for proper disposal (Appendix C). Common procedures for disposal of treated and untreated waste are described in Treated Waste and Untreated Waste subsections, respectively.

6.4.1 Treated Waste

- **Transportation** – Decontaminated biological waste may be transported with other solid waste. State or local regulations may require that written certification (stating that the waste has been rendered non-infectious or inactivated) be given to the transporter on a per load, annual, or other basis. In some states, a waste transporter and the disposal facility may need to be authorized to accept the waste.
- **Disposal** – Solid waste can be disposed of either by incineration or by landfilling. As with transportation, state or local regulations may require written certification that the waste has been rendered non-infectious or inactivated. Most sewer authorities allow appropriately treated biological wastes resulting in water-soluble liquids to be disposed of in the sanitary sewer system, with the permission of the system authorities.

6.4.2 Untreated Waste

- **Transportation** – Untreated biological waste must not be transported with solid waste, and must be transported to an approved storage or disposal facility that is willing to accept it. Vehicles must be enclosed to prevent escape of waste into the environment, with

notification of authorities if a spill occurs. Transport vehicle surfaces must be capable of being easily cleaned and decontaminated if they come in contact with untreated waste. The vehicle must be identified with the name of the transporter, name and telephone number of a contact person, and the International Biological Hazard Symbol and/or phrase such as "Infectious Waste." Transport personnel must wear impermeable gloves and protective clothing. Transporters also must have the appropriate state and local permits and maintain applicable records. If waste is shipped to a disposal facility, shipping regulations must be followed. Select agents must be handled separately from other biological waste, and handling procedures must comply with requirements at 42 CFR Part 73.

- Disposal – Untreated biological waste must be treated before disposal. Biological waste not treated at the point of generation can be treated by incineration or steam sterilization at an authorized off-site facility. After incineration, all combustible waste must be reduced to ash and non-combustible waste such as metal must be processed by grinding or shredding to render the waste unrecognizable as biological waste. If steam sterilization is used, similar additional processing also may be required to render the waste unrecognizable as biological waste. After treatment, incineration ash or treated waste may be disposed of in a landfill.

7.0 Management and Disposal of Samples and Analytical Waste Containing Mixed Hazards

Multi-hazardous waste is waste that contains two or more of the following: radioactive, infectious agent(s) or hazardous chemical(s). Mixed waste is one type of multi-hazardous waste, and contains both a chemical component (regulated by the EPA as a hazardous waste) and radioactive material (regulated by the NRC). Mixed transuranic waste (MTRU or mixed TRU) is waste that has a hazardous component and contains radioactive elements that are heavier than uranium. The radioactivity in the MTRU must be greater than 100 nCi/g, and the waste must include RCRA hazardous constituents. These wastes typically are classified according to the highest applicable hazard type, which are listed below in descending order of hazard:

- Radioactive materials, other than limited quantities (Class 7)
- Poisonous gases (Class 2, Division 3)
- Flammable gases (Class 2, Division 1)
- Nonflammable gases (Class 2, Division 2)
- Poisonous liquids (Division 6.1, Packing Group I, poisonous-by-inhalation only)
- Waste meeting the definition of a pyrophoric material in 49 CFR 173.124(b)(1) (Class 4, Division 2, Packing Group 1, liquids only)
- Waste meeting the definition of a self-reactive material in 49 CFR 173.124(a)(2) (Class 4, Division 1)
- Flammable liquids (Class 3), corrosive materials (Class 8), flammable solids (Class 4, Division 1), spontaneously combustible materials (Class 4, Division 2), dangerous materials when wet (Class 4, Division 3), oxidizers (Class 5, Division 1) or poisonous liquids or solids other than Packing Group I, poisonous-by-inhalation (Class 6, Division 1). The hazard class and packing group for a material meeting more than one of these hazards is determined using the precedence table in 49 CFR 173.2.
- Combustible liquids
- Class 9 (miscellaneous hazardous materials)

The NRC and DOE regulate the radioactive portion of mixed waste under Atomic Energy Act (AEA) authority, while EPA regulates the hazardous waste portion of mixed waste under RCRA authority. Therefore, all AEA and RCRA requirements for waste generation, storage and disposal must be met for each sample or waste defined as a "mixed waste." In cases where this waste contains chemical warfare agents, laboratories must contact the EPA coordinator for instructions.

7.1 Multi-hazardous Samples and Wastes

Multi-hazardous waste typically contains two or more RCRA contaminants and/or infectious agents and is regulated as a hazardous waste based on the higher applicable hazard class listed above. EPA regulates multi-hazardous wastes under RCRA requirements for generation, storage and disposal for each waste component.

7.1.1 Handling

Samples and analytical materials designated as multi-hazardous waste must be handled as a RCRA-contaminated waste and handling procedures must follow requirements noted in Section 4.0 for each waste component. Each compound contained in the waste must be documented, and special notice must be made if the two (or more) chemical compounds are incompatible or if degradation products can increase the hazard or instability of the waste. This waste must be treated only with careful consideration of the impact on all components of the waste, including potential byproducts. Procedures for handling this type of waste must be included in the laboratory's WMP. Recommended general practices include:

- If possible, generation of multi-hazardous wastes should be avoided; management and disposal can be difficult and expensive.
- If generation cannot be avoided, minimize volumes generated.
- If multi-hazardous waste contains an infectious agent(s), inactivation of the agent may be possible with proper consideration of other hazardous components of the waste.
- Segregate the waste as much as possible, for example: liquid from solid waste; non-water-soluble waste from aqueous waste; by isotope half-life – short (≤ 120 days) or long (> 120 days); oxidizers from organic compounds, flammable, combustible, and reducing agents (e.g., zinc, alkaline metals).

7.1.2 Disposal

Multi-hazardous waste is disposed of using technologies that are compatible with the destruction or containment of all contaminants without increasing the hazard of the waste. Some multi-hazardous wastes may require multiple steps or increased environmental monitoring for complete disposal. Table 7-1 presents information provided by the National Institutes of Health (NIH) for disposal of multi-hazardous waste (http://orf.od.nih.gov/EnvironmentalProtection/WasteDisposal/Pages/multiwaste.aspx).

Table 7-1: Guidelines for Disposal of Multi-Hazardous Laboratory Wastes

Waste Description	Disposal Method	
Hazardous chemical(s) and Radioactive material	"Mixed Waste" Use the smallest non-glass container possible. Complete and attach to container: ・A chemical waste label ・A radioactive waste pickup receipt ・A radioactive material label	
Infectious agent(s) and Hazardous chemical(s) and Radioactive material	Infectious agent inactivated	"Mixed Waste" Use the smallest non-glass container possible. Complete and attach to container: ・A chemical waste label ・A radioactive waste pickup receipt ・A radioactive material label
	Infectious agent not inactivated	Contact regulatory authority.
Infectious agent(s) and Hazardous chemical(s)	Infectious agent not inactivated	Contact regulatory authority.
	Infectious agent inactivated	Treat as chemical waste. Follow chemical waste procedures.
Infectious agent(s) and Radioactive material	Infectious agent inactivated	Treat as radioactive waste. Follow radioactive waste procedures.
	Infectious agent not inactivated	Treat as radioactive biological waste. Follow radioactive biological waste disposal procedures included in Waste Management Plan.

7.2 Mixed Waste Samples and Waste

Mixed waste is composed of radioactive waste defined under the AEA and hazardous waste as defined under RCRA. As a result, treatment and regulation of these wastes is complex. In general, the requirements of RCRA and AEA are consistent and compatible. However, in cases where requirements of the two acts are found to be inconsistent, the AEA takes precedence. Laboratories should contact the NRC to develop the information that should be included in a plan to store mixed waste.

EPA's Mixed Waste Rule, finalized on May 16, 2001, provides increased flexibility to generators and facilities that manage low-level mixed waste (LLMW) and technologically-enhanced, naturally-occurring, and/or accelerator-produced radioactive material (NARM) containing hazardous waste. LLMW is exempt from some RCRA storage and treatment regulations, and LLMW or eligible NARM are exempt from RCRA hazardous waste transportation and disposal regulations. These wastes are exempt from RCRA Subtitle C requirements, including permitting, provided they meet specific conditions (e.g., see U.S. Army Corps of Engineers Management Guidelines for Working with Radioactive and Mixed Waste). The exempt wastes must then be managed as radioactive waste in accordance with NRC or NRC agreement state regulations.

7.2.1 Regulations

To remain in compliance with regulatory requirements for mixed-waste storage, the laboratory may need to obtain an EPA (or authorized state) storage permit and/or amend their NRC (or agreement state) license. Examples of instances where an NRC license amendment may be needed include:

- If the total activity of the radioactive material at the facility (in use, in storage, or in waste) would exceed the activity authorized by the facility license
- If the laboratory intends to store the waste in a portion of the facility not authorized by the license
- If the chemical or physical form of the waste is not authorized by the license
- If the storage program is not specifically included within the scope of the authorization

If a laboratory is required to amend its radioactive materials license, NRC will require the laboratory to provide sufficient information to evaluate the request and determine if the proposed amendment impacts the level of protection afforded by the existing license. If a laboratory stores mixed-waste containing special nuclear material, it must address the special properties of the fissile radioisotopes in the waste. The laboratory's mixed-waste storage program must address the spatial distribution, geometry, volume, and the concentration of this waste at the storage facility. Strict controls must be implemented and documented to assure the safe storage of mixed-waste containing special nuclear material. Appropriate security measures are to be taken, and documented, to ensure the physical security of special nuclear material at the storage facility. The laboratory must comply with all requirements stipulated in their license and with the requirements in 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

7.2.2 Handling and Storage

Procedures for handling and storing mixed wastes must follow requirements for labeling, storing, packaging, and monitoring noted in Sections 4.0 and 5.0 of this document. Container

labels must indicate the RCRA chemical contaminant(s) and list the associated UN ID(s). All safety concerns specific to both the radiological and RCRA chemical compounds must be observed. In general, mixed-waste must be stored in a manner that ensures the waste does not create a radiological hazard to surrounding areas, increase the potential for a release of radioactive materials to unrestricted areas, or pose an increased hazard to facility personnel. The physical, chemical, and radiological characteristics of the waste, as well as any other characteristics that could pose a potential health and safety problem in the storage area, must be identified and evaluated.

The NRC generally allows facilities to store waste containing radionuclides with half-lives of less than 65 days until 10 half-lives have elapsed and the radiation emitted from the unshielded surface of the waste (as measured with an appropriate survey instrument) is indistinguishable from background levels. The waste may then be disposed of as non-radioactive, but still RCRA waste, after ensuring that all radioactive material labels are rendered unrecognizable (see 10 CFR 35.92). Radioactive waste may also be stored for decay under certain circumstances in accordance with 10 CFR 20.2001. For mixed waste, storage for decay is particularly advantageous, since the waste may be managed solely as a hazardous waste after the radionuclides decay to background levels. Thus, the management and regulation of these mixed wastes are greatly simplified.

Before disposing of this waste after decay, the licensee must survey the waste using an appropriate survey instrument and technique, and demonstrate that any radiation emitted is indistinguishable from background levels. Laboratories that are not already authorized to hold wastes for decay-in-storage, but that wish to hold mixed waste for decay-in-storage, may need to obtain a license amendment from NRC prior to storing the mixed waste. Many licensees in possession of mixed waste and using decay-in-storage options will be required to obtain an amendment to store the mixed waste as hazardous waste.

The following must be included in a license amendment request to NRC:

- a description of the survey procedures to be used during storage and prior to release of the waste to a hazardous waste-only facility
- a description of the procedures for segregating and tracking waste, from storage to release to a hazardous waste-only facility
- a commitment that waste will be held for a minimum of ten half-lives prior to performing the final radiation survey before release to a hazardous waste-only facility
- a statement that the decayed radioactive waste will not be released to a hazardous waste-only facility unless the radiation emitted from the waste is indistinguishable from background radiation

While NRC licensing amendments address the management of the radioactive component of these wastes, they generally have no effect on the applicable RCRA storage provisions. Storage requirements under RCRA should be implemented in a manner that provides appropriate protection of health and the environment, without setting up undue impediments to well-conducted decay programs.

7.2.3 Disposal

Mixed waste and mixed transuranic wastes are disposed of in a limited number of facilities in the U.S. It is typically the responsibility of the laboratory's waste broker (see the Waste Broker subsection in Section 3.0) to identify appropriate disposal sites or facilities that are willing to accept these waste types.

If a laboratory generates a quantity of low-level mixed waste that, combined with on-site RCRA non-mixed hazardous waste generation, does not exceed 100 kg/month (or one kilogram of acutely hazardous waste as defined in 40 CFR 261.11(a)(2) and listed in 40 CFR 261.31-33), it qualifies as a conditionally-exempt SQG. As a result, it can dispose of the low-level mixed waste as LLRW, if these materials meet the disposal site's waste acceptance criteria (40 CFR 262.13).

RCRA disposal permit requirements are unit-specific (i.e., dependent on compound and concentration) and are described in 40 CFR Part 264 for permitted facilities and 40 CFR Part 265 for interim status facilities. Interim status requirements are self-implementing waste management requirements that are limited to facilities that were already in existence on the date that a new regulation or statutory requirement took effect, and that subjected the facility to RCRA. For mixed-waste facilities in authorized states, this date generally corresponds to the date that the state received authorization for a mixed-waste program, although state requirements may differ.

Mixed waste is sent to a limited number of facilities that are licensed under both of the appropriate laws. For example, radioactive RCRA waste cannot go to a RCRA landfill that is not licensed under the Low-Level Radioactive Waste Policy Act (LLRWPA) nor can it be disposed of at a LLRW site that is not licensed. No treatment or disposal options exist for certain classes of mixed waste, such as a mixture of radiation and PCB wastes or radiation and long-lived warfare agents. Indefinite storage is the only option for these waste streams with no treatment or disposal capacity.

8.0 Shipping

Shippers are responsible for ensuring compliance with DOT, UN, and International Air Transport Association (IATA) regulations regarding the transfer of hazardous substances and environmental samples. These regulations (49 CFR Parts 171 through 180 for DOT, 49 CFR Part 172 specific for the UN, and the Dangerous Goods Regulations for IATA), provide specific details regarding proper marking, labeling, placarding, packaging, and shipment of hazardous materials, substances and wastes, and regulatory exceptions, and must be consulted prior to preparation of or planning for sample shipment.

IATA and DOT both require specific training for anyone directly involved in the shipping of dangerous goods (IATA 1.5, 49 CFR 172.700). IATA requires training and re-certification every two years, while DOT requires training and re-certification every three years. Recent changes in DOT shipping regulations (October 1, 2006) and United Nations (January 1, 2007) require retraining of personnel as of these dates under 49 CFR 172.702 and 49 CFR 172.704.

The laboratory is responsible for ensuring that transport drivers are properly licensed and that the route selected is correct for the type of hazard being shipped. Laboratories should obtain and keep copies of

all driver endorsement licenses, and most haulers will provide this information when asked. All waste shipments must be properly documented with a manifest and bill of lading. Laboratories should file the correct manifesting forms with the appropriate state and disposal agencies.

9.0 Disposal Sites

Laboratories are responsible for the proper transport and disposal of its solid waste. If using a private hauler, laboratory staff must make sure the vehicles being used are enclosed or can otherwise prevent spills, and that they are adequately maintained. Laboratory staff also must make sure that the waste is being disposed of at a permitted facility.

9.1 Treatment, Storage and Disposal Facilities (TSDFs)

RCRA provides direction and requirements that must be followed by chemical TSDFs. U.S. Army guidelines (based on 50 U.S.C. Chapter 32 Sec. 1512-1521) express a preference for on-site treatment of chemical warfare munitions. A military fixed treatment and disposal facility differs from commercial TSDF, as commercial TSDFs cannot be used to treat these munitions. Commercial TSDFs, however, can accept secondary waste generated by either mobile systems or individual treatment technologies if the waste no longer contains agent (except at *de minimis* levels). It must be noted that the TSDF must be willing to accept the waste (i.e., the government cannot force a facility to accept a given waste, even if the facility is allowed to accept that waste by their regulatory decision makers).

9.1.1 TSDF Permits

Owners and operators of hazardous waste management units must have permits (40 CFR Part 264) during the active life (including the closure period) of the unit. Each TSDF site requires an EPA ID and a Part A or Part B permit. TSDFs are authorized to accept and dispose of wastes as indicated by the facility's permit. If a TSDF does not have an applicable permit in place, the permitting process should be initiated as soon as possible. General information on hazardous waste permitting can be found on the EPA Web page: https://www.epa.gov/hwpermitting. A Type A permit requires specification of the hazardous wastes listed or designated under 40 CFR Part 261 to be treated, stored, or disposed of at the facility; an estimate of the quantity of such wastes to be treated, stored, or disposed of annually; and a general description of the processes to be used for such wastes, along with location of facility, owner information, obtained permits, and building/construction designs for the facility. The TSDF can modify permit acceptances (quantity and concentration of chemicals accepted) with EPA approval (40 CFR 270.42).

A Type B permit requires specification of the hazardous wastes listed or designated under 40 CFR Part 261 to be treated, stored, or disposed of at the facility; an estimate of the quantity of such wastes to be treated, stored, or disposed of annually; a general description of the processes to be used for such wastes; and the location of the facility, including a full geologic assessment, plans for release prevention and containment, structural engineering studies for plant development and containment, responses to cover 100-year environmental events, groundwater evaluation and monitoring plans, owner information, and obtained permits. The TSDF can modify their permit acceptances with the approval of EPA (40 CFR 270.42).

The TSDF must maintain the ability to properly dispose of the individual waste in an EPA approved manner with completed disposal actions certified. The TSDF can apply to modify their

permit with EPA when necessary. The laboratory will be responsible to meet all generator status requirements even if the selected TSDF fails to gain the modification.

9.1.2 TSDF Waste Acceptance Criteria

Each TSDF has criteria and limits for acceptance of wastes as delineated by the facility's EPA Part A or Part B permit. Waste profiles are approved by the TSDF prior to acceptance of the laboratory's waste for disposal at the facility. Waste profiles typically include information regarding the following:

- Waste generator (laboratory) by proper company name, address, phone, and EPA ID
- Generator contact information, including a 24-hour phone number
- Type of waste (solid, liquid, aqueous, mixed material, etc.)
- Amount expected to be disposed of and frequency of shipment
- Chemical composition, including all UN IDs and Proper Shipping Names (PSNs)
- Land ban notification
- Hazard class and shipping container regulations
- Any other information considered critical to disposal

9.2 Radiological Waste Disposal Sites

Low-level radiological wastes are commonly disposed of in a limited number of near-surface facilities rather than in geologic repositories, such are those required for high-level wastes. Once disposed of, there is no intent to recover these wastes. The waste must meet site waste acceptance criteria prior to disposal. Burial of transuranic waste is limited at all sites. In 2000, low-level waste disposal facilities received approximately 3.3 million cubic feet of commercially-generated radioactive waste. Of this, 8.2% came from nuclear reactors, 83.8% from industrial users, 7.6% from government sources (other than nuclear weapons sites), 0.2% from academic users, and the rest (0.2%) was undefined.

9.3 Biological Waste Disposal Sites

Laboratory biological wastes must be rendered non-infectious (pathogens) or inactivated (biotoxins) prior to disposal at a landfill or in a sanitary sewer. Waste must also be de-identified as infectious/ medical waste. This de-identification includes using processes such as shredding and grinding to obliterate the International Biohazard Sign, intact red biohazard bags, and phrases on waste such as "Biohazard" or "Medical Waste." Generators of biological waste may be asked to provide transporters and site authorities with written certification for these steps.

10.0 References and Resources

The resources listed in this section were used in preparing this document and/or are recommended for additional information and guidelines regarding laboratory waste handling and disposal.

10.1 General Resources

- Clinical and Laboratory Standards Institute (CLSI). 2012. *Clinical Laboratory Safety; Approved Guideline—Third Edition.* Wayne, PA: National Committee for Clinical Laboratory Standards.
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10.2 Regulatory Resources

Code of Federal Regulations: Title 10

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- U.S. Nuclear Regulatory Commission. 10 CFR Part 20: *Appendix C to Part 20-Quantities of Licensed Material Requiring Labeling*. https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-appc.html (accessed 12/2019).
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- U.S. Nuclear Regulatory Commission. 10 CFR Part 35: *Medical Use of Byproduct Material.* https://www.ecfr.gov/cgi-bin/text-idx?SID=fa98a0681489e2a2edfd177a3c1a5ce9&mc=true&node=pt10.1.35&rgn=div5 (accessed 12/2019).
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- U.S. Nuclear Regulatory Commission. 10 CFR Part 71: *Packaging and Transportation of Radioactive Material.* https://www.nrc.gov/reading-rm/doc-collections/cfr/part071/index.html (accessed 12/2019).
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Code of Federal Regulations: Title 29

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Code of Federal Regulations: Title 40

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- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 40 Part 261: *Identification and Listing of Hazardous Waste.* https://www.ecfr.gov/cgi-bin/text-idx?SID=a123e42a907091e860ecd2d6b851d1d8&mc=true&node=pt40.28.261&rgn=div5 (accessed 12/2019).
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- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 40 Part 372: *Toxic Chemical Release Reporting: Community Right-To-Know*. https://www.ecfr.gov/cgi-bin/text-idx?SID=eecd79317b040b1344c81ec7d48007ab&mc=true&node=pt40.30.372&rgn=div5 (accessed 12/2019).
- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 40 Part 403: *General Pretreatment Regulations for Existing and New Sources of Pollution.* https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr403_main_02.tpl (accessed 12/2019).

Code of Federal Regulations: Title 42

- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 42 Part 73: *Select Agents and Toxins.* https://www.ecfr.gov/cgi-bin/text-idx?SID=c91b4be6c4044b86347a27641759f59e&mc=true&node=pt42.1.73&rgn=div5 (accessed 12/2019).

Code of Federal Regulations: Title 49

- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 49: *Transportation.* https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title49/49tab_02.tpl (accessed 12/2019).
- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 49 Part 171: *General Information, Regulations, and Definitions*. https://www.ecfr.gov/cgi-bin/text-idx?SID=c7698ce6f4009eabd0e001b7ef6449eb&mc=true&node=pt49.2.171&rgn=div5 (accessed 12/2019).
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- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 49 Part 175: *Carriage by Aircraft.* https://www.ecfr.gov/cgi-bin/text-idx?SID=91df7191edc57006ab5ef732430aa4bd&mc=true&node=pt49.2.175&rgn=div5 (accessed 12/2019).
- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 49 Part 176: *Carriage by Vessel. https://www.ecfr.gov/cgi-bin/text-idx?SID=91df7191edc57006ab5ef732430aa4bd&mc=true&node=pt49.2.176&rgn=*div5 (accessed 12/2019).
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idx?SID=c7698ce6f4009eabd0e001b7ef6449eb&mc=true&node=pt49.3.178&rgn=div5 (accessed 12/2019).

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- U.S. Government Publishing Office. Electronic Code of Federal Regulations Title 49 Part 180: *Continuing Qualification and Maintenance of Packagings.* https://www.ecfr.gov/cgi-bin/text-idx?SID=5aaa06ef06125412bedcbcca6f836de8&mc=true&node=pt49.3.180&rgn=div5 (accessed 12/2019).
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10.3 Resources for Wastes Containing Chemical Hazards

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10.4 Resources for Wastes Containing Radiological Hazards

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10.5 Resources for Wastes Containing Biological Hazards

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Appendix A

State Regulatory Information Sources for Management and Disposal of Waste Containing Chemical Contamination

State	State Web Address – Chemistry	State Admin. Code Location
Alabama	http://adem.alabama.gov/programs/land/default.cnt (accessed 12/2019)	Division 14; Code §§22-30-1 to 22-30-24
Alaska	https://dec.alaska.gov/media/1043/18-aac-62.pdf (accessed 12/2019)	Title 18; 18 AAC 62.010 – 18 AAC 62.990)
Arizona	https://www.azleg.gov/arsDetail/?title=49 (accessed 12/2019)	Chapter 5; 49-901 to 49-944
Arkansas	https://www.adeq.state.ar.us/regs/files/reg23_final_151018.pdf (accessed 12/2019)	Regulation 23
California	http://www.dtsc.ca.gov/LawsRegsPolicies/Title22/index.cfm https://dtsc.ca.gov/wp-content/uploads/sites/31/2018/04/2014-Health-and-Safety-Code-FINAL.pdf (accessed 12/2019)	Title 22, Division 4.5 and HSC-2014
Colorado	https://www.colorado.gov/pacific/cdphe/hazardous-waste-regulations (accessed 12/2019)	Title 6, 1007-3
Connecticut	https://eregulations.ct.gov/eRegsPortal/Browse/RCSA (accessed 12/2019)	Title 22a
Delaware	http://delcode.delaware.gov/title7/c063/sc01/index.shtml (accessed 12/2019)	Title 7 > Chapter 63
District of Columbia	https://www.dcregs.dc.gov/Common/DCMR/RuleList.aspx?ChapterNum=20-42&ChapterId=483 (12/2019)	Title 20; Chapter: 20–42
Florida	https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-730 (accessed 12/2019)	FAC, Chapters 62–730
Georgia	http://rules.sos.ga.gov/gac/391-3-11 (accessed 12/2019)	Chapter 391-3-11
Hawaii	http://health.hawaii.gov/shwb/hazwaste/ (accessed 12/2019)	HAR Chapter 11
Idaho	https://adminrules.idaho.gov/rules/current/58/580105.pdf (accessed 12/2019)	IDAPA 58; Chapter 05; 58.01.05
Illinois	https://pcb.illinois.gov/SLR/IPCBandIEPAEnvironmentalRegulationsTitle35 (accessed 12/2019)	Title 35 Ill. Adm. Code, Parts 700–739
Indiana	http://www.in.gov/legislative/iac/title329.html (accessed 12/2019)	Title 329
Iowa	http://www.iowadnr.gov/InsideDNR/RegulatoryLand/SolidWaste/SolidWastePolicyRules.aspx (accessed 12/2019)	Solid Waste Policy & Rules
Kansas	http://www.kdheks.gov/waste/regsstatutes/sw_laws.pdf (accessed 12/2019)	KSA Chapter 65 Article 34 and KAR Article 29
Kentucky	https://apps.legislature.ky.gov/law/kar/TITLE401.HTM (accessed 12/2019)	Title 401, Chapters 31–39
Louisiana	http://deq.louisiana.gov/page/hazardous-waste (accessed 12/2019)	LAC Title 33 Part V

State	State Web Address – Chemistry	State Admin. Code Location
Maine	http://www.maine.gov/sos/cec/rules/06/chaps06.htm (accessed 12/2019)	Chapters 850–857
Maryland	http://www.dsd.state.md.us/comar/subtitle_chapters/26_Chapters.aspx (accessed 12/2019)	Title 26; Part 3 - Subtitles 13–15
Massachusetts	https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter21c (accessed 12/2019)	General Laws, Part I, Title II, Chapter 21C
Michigan	https://www.michigan.gov/documents/deq/deq-whm-hwp-Part111Rules_248146_7.pdf (accessed 12/2019)	Rules 299.9101–299.11107
Minnesota	https://www.revisor.mn.gov/rules/?id=7045 (accessed 12/2019)	MAR: Chapter 7045
Mississippi	http://www.mdeq.ms.gov/wp-content/uploads/2018/02/Title-11-Part-3-Ch.-1-Final-Filing.pdf (accessed 12/2019)	Title 11; Part 3, Chapter 1
Missouri	https://www.sos.mo.gov/adrules/csr/current/10csr/10csr.asp#10-25 (accessed 12/2019)	Title 10, Division 25
Montana	http://deq.mt.gov/DEQAdmin/dir/legal/Chapters/ch53-toc (accessed 12/2019)	Title 17; Chapter 53
Nebraska	http://deq.ne.gov/RuleAndR.nsf/Title_128.xsp (accessed 12/2019)	Title 128
Nevada	https://www.leg.state.nv.us/nac/nac-444.html (accessed 12/2019)	Chapter 444; 842–848 and 850–8746
New Hampshire	https://www.des.nh.gov/organization/commissioner/legal/rules/index.htm#waste (accessed 12/2019)	Env-Hw Chapters 100–1000
New Jersey	http://www.state.nj.us/dep/dshw/resource/rules.html#rules (accessed 12/2019)	Title 7; N.J.A.C. 7:26G
New Mexico	https://www.env.nm.gov/waste/ http://164.64.110.239/nmac/parts/title20/20.004.0001.htm (accessed 12/2019)	Title 20; Chapter 4
New York	http://www.dec.ny.gov/chemical/100401.html (accessed 12/2019)	6 NYCRR
North Carolina	https://files.nc.gov/ncdeq/WasteManagement/DWM/HW/Proposed_Rules/RulesListwithStateandFederal.pdf (accessed 12/2019)	Title 15A; Chapter 13; Subchapter 13A
North Dakota	http://www.legis.nd.gov/information/acdata/html/33-24.html (accessed 12/2019)	NDAC Article 33–24
Ohio	http://codes.ohio.gov/oac/3745-51 (accessed 12/2019)	Chapter 3745–51
Oklahoma	http://www.deq.state.ok.us/rules/205.pdf (accessed 12/2019)	Title 252; Chapter 205
Oregon	https://secure.sos.state.or.us/oard/displayChapterRules.action?selectedChapter=80 (accessed 12/2019)	Chapter 340; Divisions 100–104
Pennsylvania	https://www.pacode.com/secure/data/025/025toc.html (accessed 12/2019)	Title 25; Subpart D; Article VII; Chapters 260–270
Rhode Island	http://www.dem.ri.gov/pubs/regs/regs/waste/hwregs14.pdf (accessed 12/2019)	DEM OWM-HW-01-14

State	State Web Address – Chemistry	State Admin. Code Location
South Carolina	http://www.scstatehouse.gov/coderegs/Chapter61Word.php (accessed 12/2019)	Chapter 61–79 (Parts I and 2)
South Dakota	http://www.sdlegislature.gov/Rules/DisplayRule.aspx?Rule=74:28 (accessed 12/2019)	Rule 74: Article 74:28
Tennessee	http://publications.tnsosfiles.com/rules/0400/0400-12/0400-12.htm (accessed 12/2019)	Chapter 0400-12-01
Texas	http://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=30&pt=1&ch=335 (accessed 12/2019)	Title 30, Part 1, Chapter 335
Utah	https://rules.utah.gov/publicat/code/r315/r315.htm (accessed 12/2019)	R315
Vermont	http://dec.vermont.gov/waste-management/hazardous/regulations (accessed 12/2019)	Chapter 7
Virginia	https://law.lis.virginia.gov/admincode/title9/agency20/chapter60/ (accessed 12/2019)	Title 9; Agency 20; Chapter 60
Washington	http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303 (accessed 12/2019)	Title 173; Chapter 173–303
West Virginia	http://apps.sos.wv.gov/adlaw/csr/rule.aspx?rule=33-20 (accessed 12/2019)	33 CSR 20
Wisconsin	https://docs.legis.wisconsin.gov/code/admin_code/nr/600/662.pdf (accessed 12/2019)	Chapter NR 662; NR 662.010
Wyoming	https://rules.wyo.gov/Search.aspx?mode=4 (accessed 12/2019)	Reference Number: 020.0003.1.03182015

Note: Links to hazardous waste programs and environmental agencies for U.S. Territories can be accessed using: https://www.epa.gov/hwgenerators/links-hazardous-waste-programs-and-us-state-environmental-agencies. Links are provided for: American Samoa, Guam, Northern Mariana Islands, Marshall Islands, Micronesia, Puerto Rico and Trust Territories. Information is not available for the U.S. Virgin Islands.

Appendix B

State Regulatory Information Sources for Management and Disposal of Waste Containing Radioactive Contamination

State	State Addresses & Website URLs (if available)	
Alabama	Department of Environmental Management 1400 Coliseum Boulevard Montgomery, AL 36110-2400 Mailing address: P.O. Box 301463 Montgomery, AL 36130-1463 http://www.adem.state.al.us/alEnviroRegLaws/files/Division14.pdf (accessed 12/2019)	Office of Radiation Control Alabama Department of Public Health The RSA Tower 201 Monroe Street Montgomery, AL 36104 Mailing address: P.O. Box 303017 Montgomery, AL 36130-3017 http://www.alabamapublichealth.gov/radiation/index.html (accessed 12/2019)
Alaska	Department of Environmental Conservation Division of Environmental Health Solid Waste Program 555 Cordova St, Anchorage, AK 99501 https://dec.alaska.gov/ (accessed 12/2019)	Radiological Health Program Alaska Department of Health and Social Services Division of Public Health, State Public Health Laboratories Anchorage Laboratory 5455 Dr. Martin Luther King Jr. Avenue PO Box 196093 Anchorage, AK 99507 http://dhss.alaska.gov/dph/Labs/Pages/radiological/default.aspx (accessed 12/2019)
Arizona	Department of Environmental Quality Waste Programs Division 1110 West Washington Street Phoenix, Arizona 85007 https://azdeq.gov/HazWaste (accessed 12/2019)	Arizona Department of Health Services Bureau of Radiation Control 150 North 18th Avenue Phoenix, Arizona 85007 https://arra.az.gov/ (accessed 12/2019)
Arkansas	Department of Environmental Quality Hazardous Waste Division 5301 Northshore Drive North Little Rock, AR 72118-5317 https://azdeq.gov/HazWaste (accessed 12/2019)	Department of Health Division of Radiation Control and Emergency Management 4815 West Markham Street, Slot 30 Little Rock, AR 72205 http://www.healthy.arkansas.gov/programs-services/topics/radiation-control (accessed 12/2019)

California	California Department of Toxic Substances Control 1001 I Street Sacramento, CA 95814-2828 Mailing Address: P.O. Box 806 Sacramento, CA 95812-0806 https://dtsc.ca.gov/managing-hazardous-waste/ (accessed 12/2019)	California Department of Public Health Radiation Safety and Environmental Management Division Radiologic Health Branch 1500 Capitol Avenue, 5th Floor, Building 172 Sacramento, CA 95814-5006 Mailing Address: PO Box 997377, MS 0500 Sacramento, CA 95899-7377 https://www.cdph.ca.gov/Programs/CEH/DRSEM/Pages/RHB.aspx (accessed 12/2019)
Colorado	Department of Public Health and Environment Hazardous Materials and Waste Management Division 4300 Cherry Creek Drive South Denver, CO 80246 https://www.colorado.gov/pacific/cdphe/hm (accessed 12/2019)	Department of Public Health and Environment Radiation Management Division 4300 Cherry Creek Drive South Denver, CO 80246 https://www.colorado.gov/pacific/cdphe/categories/services-and-information/environment/radiation-management (accessed 12/2019)
Connecticut	Department of Energy and Environmental Protection 79 Elm Street Hartford, CT 06106-5127 http://www.ct.gov/dep/cwp/view.asp?a=2713&q=324812&depNav_GID=1639 (accessed 12/2019) Hazardous Waste Program: http://www.ct.gov/deep/cwp/view.asp?a=2718&q=325420&deepNav_GID=1967 (accessed 12/2019)	Department of Energy and Environmental Protection Radiation Division 79 Elm Street Hartford, CT 06106-5127 http://www.ct.gov/deep/cwp/view.asp?a=2713&q=324824&deepNav_GID=1639 (accessed 12/2019)
Delaware	Department of Natural Resources and Environmental Control Division of Air and Waste Management Solid & Hazardous Waste 89 Kings Highway Dover, DE 19901 https://dnrec.alpha.delaware.gov/waste-hazardous-substances/ (accessed 12/2019)	Department of Health & Social Services Division of Public Health Office of Radiation Control Jesse S. Cooper Building 417 Federal Street Dover, DE 19901 http://www.dhss.delaware.gov/dhss/dph/hsp/orc.html (accessed 12/2019)
District of Columbia	Department of Energy and Environment 1200 First Street NE, Washington, DC 20002 http://ddoe.dc.gov/service/hazardous-waste (accessed 12/2019) Association of State and Territorial Solid Waste Management Officials 1101 17th St NW #707, Washington, DC 20036 http://www.astswmo.org/ (accessed 12/2019)	Department of Health Radiation Protection Division 899 North Capitol Street, NE, Washington, DC 20002 https://dchealth.dc.gov/service/radiation-protection (accessed 12/2019)

Florida	Department of Environmental Protection Division of Waste Management 2600 Blair Stone Road, MS #4500 Tallahassee, FL 32399 http://www.dep.state.fl.us/waste/default.htm (accessed 12/2019)	Department of Health Bureau of Radiation Control 4052 Bald Cypress Way Tallahassee, FL 32399-1741 http://www.doh.state.fl.us/environment/radiation/index.html (accessed 12/2019)
Georgia	Department of Natural Resources Environmental Protection Land Protection Branch Industrial and Hazardous Waste Management Program 2 Martin Luther King, Jr. Dr. Atlanta, GA 30334 https://epd.georgia.gov/hazardous-waste (accessed 12/2019)	Department of Natural Resources Air Protection Branch; Environmental Protection Division Radioactive Materials Program 4244 International Parkway, Suite 120, Atlanta, GA 30354 https://epd.georgia.gov/air/radioactive-materials-program (accessed 12/2019)
Hawaii	Department of Health Environmental Health Division Solid and Hazardous Waste Branch 2827 Waimano Home Road Pearl City, HI 96782 http://health.hawaii.gov/shwb/ (accessed 12/2019)	Department of Health Indoor and Radiological Health Branch Radiation Section 99-945 Halawa Valley Street Aiea, HI 96701 http://health.hawaii.gov/irhb/radiation/ (accessed 12/2019)
Idaho	Department of Environmental Quality Waste Management & Remediation 1410 N. Hilton Boise, ID 83706 http://www.deq.idaho.gov/waste-mgmt-remediation/hazardous-waste.aspx (accessed 12/2019)	Department of Environmental Quality INL Oversight; Radiation 900 N. Skyline Drive, Suite B Idaho Falls, ID 83402 http://www.deq.idaho.gov/inl-oversight/radiation/ (accessed 12/2019)
Illinois	Illinois Environmental Protection Agency Hazardous Waste 1021 North Grand Avenue East Springfield, IL 62702 **Mailing Address** P.O. Box 19276 Springfield, IL 62794-9276 http://www.epa.state.il.us/land/hazardous-waste/reports/summary/index.html (accessed 12/2019)	Illinois Emergency Management Agency Nuclear & Radiation Safety 2200 South Dirksen Parkway Springfield, Illinois 62703 https://www2.illinois.gov/iema/NRS/RadSafety/Pages/default.aspx (accessed 12/2019)
Indiana	Department of Environmental Management Indiana Government Center North 100 N. Senate Indianapolis, IN 46206 Mailing Address P.O. Box 6015 Indianapolis, IN 46206-6015 http://www.in.gov/idem/ (accessed 12/2019)	State Department of Health Health Care Quality & Regulatory Medical Radiology Services 2 N. Meridian Street Indianapolis, IN 46204-3003 http://www.in.gov/isdh/23279.htm (accessed 12/2019)

Iowa	Department of Natural Resources Environmental Protection Division Land Quality, Contaminated Sites Wallace State Office Building 502 East 9th Street, 4th Floor Des Moines, IA 50319-0034 http://www.iowadnr.gov/Environmental-Protection/Land-Quality/Contaminated-Sites (accessed 12/2019)	Bureau of Radiological Health Iowa Department of Public Health Lucas State Office Building, 5th Floor Des Moines, IA 50319-6075 http://idph.iowa.gov/radiological-health (accessed 12/2019)
Kansas	Department of Health and Environment Bureau of Waste Management Curtis State Office Building 1000 SW Jackson, Suite 320 Topeka, KS 66612-1366 http://www.kdheks.gov/waste/ (accessed 12/2019)	Kansas Department of Health & Environment Bureau of Community Health Systems Radiation Control Program Curtis State Office Building 1000 SW Jackson, Suite 330 Topeka, KS 66612-1366 http://www.kdheks.gov/radiation/index.html (accessed 12/2019)
Kentucky	Energy and Environment Cabinet Department for Environmental Protection Division of Waste Management 300 Sower Blvd., 2nd Floor Frankfort, KY 40601 https://eec.ky.gov/Environmental-Protection/Waste/Pages/default.aspx (accessed 12/2019)	Cabinet for Health and Family Services Department for Public Health Radiation Health Branch 275 East Main Street Mailstop HS1C-A Frankfort, KY 40621 https://chfs.ky.gov/agencies/dph/dphps/rhb/Pages/default.aspx (accessed 12/2019)
Louisiana	Department of Environmental Quality Office of Land Hazardous Waste 602 N. Fifth Street Baton Rouge, LA 70802 http://deq.louisiana.gov/page/hazardous-waste (accessed 12/2019)	Department of Environmental Quality Office of Radiation Response Emergency & Radiological Services Division 602 N. Fifth Street Baton Rouge, LA 70802 http://deq.louisiana.gov/page/emergency-radiological-services-division (accessed 12/2019)
Maine	Department of Environmental Protection Waste Management 17 State House Station Augusta, Maine 04333-0017 http://www.maine.gov/dep/waste/index.html (accessed 12/2019)	Department of Health and Human Services Division of Environmental Health Radiation Control Program Key Plaza Building 286 Water St. 3rd Floor 11 State House Station Augusta, Maine 04333-0011 http://www.maine.gov/dhhs/mecdc/environmental-health/rad/rules.htm (accessed 12/2019)

Maryland	Department of the Environment Hazardous Waste Program 1800 Washington Boulevard, Baltimore, MD 21230 http://mde.maryland.gov/programs/LAND/HazardousWaste/Pages/index.aspx (accessed 12/2019)	Department of the Environment Radiological Health Program 1800 Washington Boulevard Baltimore, MD 21230 http://mde.maryland.gov/programs/Air/RadiologicalHealth/Pages/index.aspx (accessed 12/2019)
Massachusetts	Department of Environmental Quality Engineering Division of Solid and Hazardous Waste 1 Winter Street Boston, MA 02108 https://www.mass.gov/hazardous-waste-management (accessed 12/2019)	Massachusetts Department of Public Health Radiation Control Program Schrafft Center, Suite 1M2A 529 Main Street, Charlestown, MA, 02129 http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/radiation/ (accessed 12/2019)
Michigan	Department of Environmental Quality Waste Management and Radiological Protection Division (WMRPD) Constitution Hall 525 West Allegan Street P.O. Box 30473 Lansing, MI 48909-7973 http://www.michigan.gov/deq (accessed 12/2019)	Department of Environmental Quality Waste Management and Radiological Protection Division Constitution Hall 525 West Allegan Street P.O. Box 30473 Lansing, MI 48909-7973 http://www.michigan.gov/deq/0,4561,7-135-3312_4120---,00.html (accessed 12/2019)
Minnesota	Minnesota Pollution Control Agency Solid and Hazardous Waste Division 520 Lafayette Road St. Paul, MN 55155 https://www.pca.state.mn.us/waste/hazardous-waste-and-problem-materials (accessed 12/2019)	Minnesota Department of Health Radiation Control Freeman Building 625 Robert St. N PO Box 64975 St. Paul, MN 55164-0975 http://www.health.state.mn.us/divs/eh/radiation/index.html (accessed 12/2019)
Mississippi	Department of Environmental Quality Office of Pollution Control, Waste Division P. O. Box 2261 Jackson, MS 39225 **Street Address** Office of Pollution Control, Waste Division 515 Amite St Jackson, MS 39201 http://www.mdeq.ms.gov/land/waste-division/ (accessed 12/2019)	Division of Radiological Health State Department of Health 3150 Lawson Street, P.O. Box 1700 Jackson, MS 39215-1700 http://msdh.ms.gov/msdhsite/_static/30,0,102.html (accessed 12/2019)

Missouri	Department of Natural Resources, Division of Environmental Quality, Solid Waste Management Program 205 Jefferson Street, P.O. Box 176 Jefferson City, MO 65102 http://www.dnr.mo.gov/env/index.html (accessed 12/2019)	Department of Health and Senior Services Radiation Control P.O. Box 570 Jefferson City, MO 65102-0570 http://health.mo.gov/safety/radprotection/index.php (accessed 12/2019)
Montana	Department of Environmental Quality Sciences Waste Management & Remediation Division Hazardous Materials Section 1225 Cedar Street Helena, MT 59620-0901 **Mailing Address** P.O. Box 200901 Helena, MT 59620-0901 http://deq.mt.gov/Land/hazwaste (accessed 12/2019)	Radiological Health Program Department of Public Health & Human Services P. O. Box. 202953, Helena, MT 59620-2953 http://leg.mt.gov/bills/mca/title_0500/chapter_0790/parts_index.html (accessed 12/2019)
Nebraska	Department of Environmental Quality Air & Waste Management Division 1200 N Street, Suite 400, P.O. Box 98922 Lincoln, NE 68509 http://www.deq.state.ne.us/ (accessed 12/2019)	Department of Health and Human Services Office of Radiological Health 301 Centennial Mall South Lincoln, Nebraska 68509 http://dhhs.ne.gov/publichealth/Pages/puh_enh_rad_overview.aspx (accessed 12/2019)
Nevada	Division of Environmental Protection Bureau of Waste Management **Carson City** 901 S. Stewart Street, Suite 4001 Carson City, Nevada 89701 **Las Vegas** 2030 E. Flamingo Rd. Suite 230 Las Vegas NV 89119 https://ndep.nv.gov/land/waste/hazardous-waste-management (accessed 12/2019)	Department of Health and Human Services Nevada Division of Public and Behavioral Health (DPBH) Radiation Control Program **Carson City** 675 Fairview Drive, Suite 218 Carson City, Nevada 89701 **Las Vegas** 2080 E. Flamingo Road, Suite 319 Las Vegas, Nevada 89119 http://dpbh.nv.gov/Reg/Radiation_Control_Programs/ (accessed 12/2019)
New Hampshire	Department of Environmental Services Waste Management Division 29 Hazen Drive PO Box 95 Concord, NH 03302-0095 http://des.nh.gov/organization/divisions/waste/index.htm (accessed 12/2019)	Department of Health and Human Services Division of Public Health Services Radiological Health Section 129 Pleasant Street Concord, NH 03301-3852 https://www.dhhs.nh.gov/dphs/radiological/ (accessed 12/2019)
New Jersey	Department of Environmental Protection Division of Solid & Hazardous Waste 401 E. State Street Trenton, NJ 08625 http://www.state.nj.us/dep/dshw/ (accessed 12/2019)	Department of Environmental Protection Radiation Protection Element 25 Arctic Parkway Trenton, New Jersey 08625-0415 http://www.state.nj.us/dep/rpp/index.htm (accessed 12/2019)

New Mexico	Environment Department Waste Management 2905 Rodeo Park Dr. E., Bldg.1 Santa Fe, NM 87505 https://www.env.nm.gov/waste/ (accessed 12/2019)	Environment Department Radiation Control Bureau Montoya Building 1100 St. Francis Drive, Suite 1211 Santa Fe, NM 87505 **Mailing Address** PO Box 5469 Santa Fe, NM 87502-5469 https://www.env.nm.gov/rcb/ (accessed 12/2019)
New York	Department of Environmental Conservation Division of Environmental Remediation Chemical and Pollution Control Waste Management 625 Broadway Albany, NY 12233-7015 http://www.dec.ny.gov/chemical/292.html (accessed 12/2019)	Department of Environmental Conservation Division of Environmental Remediation Chemical and Pollution Control Radiation 625 Broadway Albany, NY 12233-7015 http://www.dec.ny.gov/chemical/296.html (accessed 12/2019)
North Carolina	Department of Environmental Quality Division of Waste Management 217 West Jones Street Raleigh, NC 27603 https://deq.nc.gov/about/divisions/waste-management/about-waste-management (accessed 12/2019)	Department of Health and Human Services Division of Health Service Regulations Radiation Protection Section 1645 Mail Service Center, Raleigh, NC 27699-1600 http://www.ncradiation.net/ (accessed 12/2019)
North Dakota	Department of Health Environmental Health Section Division of Waste Management 918 E. Divide Ave, 3rd Floor Bismarck, ND 58501 https://deq.nd.gov/WM/ (accessed 12/2019)	Department of Health Environmental Health Section Division of Air Quality Radiation Control 918 E. Divide Ave Bismarck, ND 58501 https://deq.nd.gov/AQ/Radiation/ (accessed 12/2019)
Ohio	Ohio EPA Division of Materials and Waste Management Lazarus Government Center 50 W. Town St., Suite 700 Columbus, OH 43215 **Mailing address** Ohio EPA - DMWM Lazarus Government Center P.O. Box 1049 Columbus, OH 43216-1049 http://epa.ohio.gov/dmwm/Home.aspx (accessed 12/2019)	Ohio Department of Health Bureau of Environmental Health and Radiation Protection Radiation Protection Programs 246 North High Street Columbus, Ohio 43215 https://odh.ohio.gov/wps/portal/gov/odh/about-us/offices-bureaus-and-departments/bureau-of-environmental-health-and-radiation-protection (accessed 12/2019)

Oklahoma	Department of Environmental Quality Land Protection Division Hazardous Waste PO Box 1677 Oklahoma City, OK 73101-1677 https://www.deq.ok.gov/land-protection-division/waste-management/hazardous-waste/ (accessed 12/2019)	Department of Environmental Quality Land Protection Division Radiation Management P.O. Box 1677 Oklahoma City, OK 73101-1677 https://www.deq.ok.gov/land-protection-division/radiation/ (accessed 12/2019)
Oregon	Department of Environmental Quality Hazards and Clean Up Hazardous Waste 700 NE Multnomah Street, Suite 600 Portland, OR 97232-4100 http://www.oregon.gov/deq/Hazards-and-Cleanup/hw/Pages/default.aspx (accessed 12/2019)	Oregon Health Authority Public Health Division Environmental Public Health Radiation Protection Services 800 NE Oregon St. #640 Portland, OR 97232-2162 https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RADIATIONPROTECTION/Pages/index.aspx (accessed 12/2019)
Pennsylvania	Department of Environmental Protection Bureau of Waste Management Rachel Carson State Office Building 400 Market Street Harrisburg, PA 17101 http://www.dep.pa.gov/Business/Land/Waste/Services/Pages/default.aspx (accessed 12/2019)	Department of Environmental Protection Bureau of Radiation Protection Radiation Control Division Rachel Carson State Office Building P.O. Box 8469 Harrisburg, PA 17105-8469 http://www.dep.pa.gov/Business/RadiationProtection/RadiationControl/Pages/default.aspx (accessed 12/2019)
Rhode Island	Department of Environmental Management Office of Waste Management 235 Promenade Street Providence, RI 02908-5767 http://www.dem.ri.gov/programs/wastemanagement/ (accessed 12/2019)	Department of Health Radiation Control Radiological Health Program 3 Capitol Hill, Room 206 Providence, RI 02908-5097 http://www.health.ri.gov/programs/detail.php?pgm_id=161 (accessed 12/2019)
South Carolina	Department of Health and Environmental Control Hazardous Waste J. Marion Sims Building 2600 Bull Street Columbia, SC 29201 https://www.scdhec.gov/environment/land-management/hazardous-waste (accessed 12/2019)	Department of Health & Environmental Control Radioactive Waste Management 2600 Bull Street Columbia, SC 29201 https://www.scdhec.gov/environment/land-management/radioactive-waste (accessed 12/2019)
South Dakota	Department of Environmental & Natural Resources Waste Management Program Foss Building 523 East Capitol Pierre, SD 57501 http://denr.sd.gov/des/wm/wmp/wmpmainpage.aspx (accessed 12/2019)	

Tennessee	Department of Environment and Conservation Division of Solid Waste Management (DSWM) Hazardous Waste Management 312 Rosa L. Parks Ave Nashville, TN 37243 https://www.tn.gov/environment/program-areas/solid-waste/hazardous-waste-management.html (accessed 12/2019)	Department of Environment and Conservation Division of Radiological Health William R. Snodgrass TN Tower 312 Rosa L. Parks Avenue, 15th Floor Nashville, TN 37243 https://www.tn.gov/environment/program-areas/rh-radiological-health1.html (accessed 12/2019)
Texas	Texas Commission on Environmental Quality Industrial and Hazardous Waste 12100 Park 35 Circle Austin, TX 78753 https://www.tceq.texas.gov/permitting/waste_permits/ihw_permits (accessed 12/2019)	Texas Department of State Health Services Radiation Control Program The Exchange Building 8407 Wall Street Austin, Texas 78754 http://www.dshs.state.tx.us/radiation/default.shtm (accessed 12/2019)
Utah	Department of Environmental Quality Division of Waste Management and Radiation Control State Office Building 195 North 1950 West Salt Lake City, Utah 84116 https://deq.utah.gov/Divisions/dwmrc/index.htm (accessed 12/2019)	
Vermont	Agency of Natural Resources Department of Environmental Conservation Waste Management Division Davis Building - 1st Floor One National Life Drive Montpelier, VT 05620-3704 http://dec.vermont.gov/waste-management (accessed 12/2019)	Environmental Health Division Radiological Health Program 108 Cherry Street P.O. Box 70 – Drawer 30 Burlington, VT 05402-0070 http://www.healthvermont.gov/environment/radiological (accessed 12/2019)
Virginia	Department of Environmental Quality Land Protection and Revitalization Solid and Hazardous Waste Regulatory Programs 1111 East Main St., Suite 1400 Richmond, VA 23219 http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/SolidHazardousWasteRegulatoryPrograms.aspx (accessed 12/2019)	Virginia Department of Health Office of Radiological Health 109 Governor Street, 7th Floor Richmond, VA 23219 http://www.vdh.virginia.gov/radiological-health/ (accessed 12/2019)
Washington	Department of Ecology Waste and Toxics 300 Desmond Drive SE Lacey, WA 98503 **Mailing Address** P.O. Box 47600 Olympia, WA 98504 https://ecology.wa.gov/Waste-Toxics (accessed 12/2019)	Department of Health Environmental Public Health Division of Radiation Protection 309 Bradley Boulevard Richland, WA 99352 http://www.doh.wa.gov/AboutUs/ProgramsandServices/EnvironmentalPublicHealth/RadiationProtection (accessed 12/2019)

West Virginia	Department of Environmental Protection Hazardous Waste Section 601 57th Street SE Charleston, WV 25304 https://dep.wv.gov/WWE/ee/hw/Pages/default.aspx (accessed 12/2019)	Department of Health and Human Resources Bureau for Public Health Office of Environmental Health Services Radiation, Toxics and Indoor Air (RTIA) Division Radiological Health Program 350 Capitol Street, Room 313 Charleston, West Virginia 25301- 3713 https://www.wvdhhr.org/rtia/radiological_health.asp (accessed 12/2019)
Wisconsin	Department of Natural Resources Waste Management Program 101 South Webster Street Madison, WI 53703 http://dnr.wi.gov/topic/waste/ (accessed 12/2019)	Department of Health Services Radiation Protection Section P.O. Box 2659 Madison, WI 53701-2659 https://www.dhs.wisconsin.gov/radiation/index.htm (accessed 12/2019)
Wyoming	Department of Environmental Quality Solid & Hazardous Waste Division 200 West 17th Street Cheyenne, WY 82002 http://deq.wyoming.gov/shwd/ (accessed 12/2019)	Department of Transportation Roadway Evaluation Materials Laboratory 5300 Bishop Blvd. Cheyenne, WY 82009-3340 http://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Materials/Radiation/WYDOT%20RADIATION%20PROTECTION%20PROGRAM%20(Rev.%2003-24-2015).pdf (accessed 12/2019)

Note: Links to hazardous waste programs and environmental agencies for U.S. Territories can be accessed using: https://www.epa.gov/hwgenerators/links-hazardous-waste-programs-and-us-state-environmental-agencies. Links are provided for: American Samoa, Guam, Northern Mariana Islands, Marshall Islands, Micronesia, Puerto Rico and Trust Territories. Information is not available for the U.S. Virgin Islands.

Appendix C

State Regulatory Information Sources for Management and Disposal of Waste Containing Biological Contamination

State	Web Address	Administrative Code / Document
Alabama	http://www.adem.state.al.us/alEnviroRegLaws/files/Division17.pdf (accessed 12/2019)	1975, §§ 22-27-1 to 7/ADEM Admin. Code r. 335-17-7
Alaska	https://dec.alaska.gov/media/1042/18-aac-60.pdf (accessed 12/2019)	Title 18 AAC 60.030
Arizona	http://apps.azsos.gov/public_services/Title_18/18-13.pdf (accessed 12/2019)	Title 18, Chapter 13, Supp. 17-4, Article 14, Sections R18-13-1401–R18-13-1420
Arkansas	http://www.healthy.arkansas.gov/images/uploads/pdf/Medical_Waste_Regs_2017_FINAL.pdf (accessed 12/2019)	Rules and Regulations Pertaining to the Management of Medical Waste from Generators and Health Care Related Facilities
California	https://www.cdph.ca.gov/Programs/CEH/DRSEM/CDPH%20Document%20Library/EMB/MedicalWaste/MedicalWasteManagementAct.pdf (accessed 12/2019)	Medical Waste Management Act, California Health and Safety Code, Sections 117600 – 118360
Colorado	https://leg.colorado.gov/sites/default/files/images/olls/crs2016-title-25.pdf (accessed 12/2019) https://www.sos.state.co.us/CCR/Upload/AGORequest/AdoptedRules02011-00441.RTF (accessed 12/2019)	Title 25 Article 15 Part 4 - Infectious Waste; 6 CCR 1007-2 Section 13- Medical Waste
Connecticut	http://www.ct.gov/deep/cwp/view.asp?A=2718&Q=325340&deepNav_GID=1646 (accessed 12/2019)	Biomedical Waste Frequently Asked Questions Sections 22a-208a-1, 22a-209-15, Sections 22a-208a-1, 22a-209-15, and 22a-449(c)-11
Delaware	http://regulations.delaware.gov/AdminCode/title7/1000/1300/1302/index.shtml (accessed 12/2019)	Section 11 Part 1 Special Waste Management
Florida	http://www.floridahealth.gov/%5C/environmental-health/biomedical-waste/index.html (accessed 12/2019)	Chapter 64E-16
Georgia	https://epd.georgia.gov/sites/epd.georgia.gov/files/Chapter391-3-4_SolidWasteStrawman_81517.docx (accessed 12/2019)	391-3-4, Rule 15
Hawaii	https://health.hawaii.gov/shwb/files/2013/06/11-5811.pdf (accessed 12/2019)	11-58.1-52

State	Web Address	Administrative Code / Document
Idaho	http://www.deq.idaho.gov/waste-mgmt-remediation.aspx (accessed 12/2019)	None
Illinois	https://www2.illinois.gov/epa/topics/waste-management/waste-disposal/special-waste/Pages/pimw.aspx (accessed 12/2019)	35 Illinois Admin. Code: Subtitle M, and 1420.102
Indiana	http://iga.in.gov/legislative/laws/2018/ic/titles/001#IC16-41-16-4 (accessed 12/2019)	IC-16-41-16
Iowa	https://www.legis.iowa.gov/docs/ACO/chapter/567.109.pdf (accessed 12/2019)	Rule 567, Chapter 109, Special Waste Authorizations
Kansas	http://www.kdheks.gov/waste/p_regsandstatutes.html (accessed 12/2019)	K.A.R.28-29
Kentucky	https://eec.ky.gov/Environmental-Protection/Waste/recycling-and-local-assistance/Pages/medical-waste.aspx (accessed 12/2019)	Medical Waste in Kentucky
Louisiana	http://www1.deq.louisiana.gov/portal/Default.aspx?tabid=264 (accessed 12/2019)	L.A.C. Title 33 Part VII Chapter 13 Paragraphs 1350.D.1(a) and 13305.1.1(a)
Maine	http://www.maine.gov/dep/waste/laws/index.html (accessed 12/2019)	38 M.R.S.A. Sec. 1319-O 06-096 C.M.R. 900
Maryland	https://phpa.health.maryland.gov/OEHFP/EH/Pages/special-medical-waste.aspx (accessed 12/2019)	COMAR 26.04.07
Massachusetts	http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/comm-sanitation/medical-waste.html (accessed 12/2019)	State Sanitary Code Title VIII, 105 CMR 4800.00 and 310 CMR 19.000
Michigan	http://www.michigan.gov/deq/0,1607,7-135-3312_4119---,00.html http://www.deq.state.mi.us/documents/deq-whm-hwrp-mwRegAct-Rules.pdf (accessed 12/2019)	MWRA Part 138 Sec. 333.13801 –333.13831
Minnesota	http://www.pca.state.mn.us/index.php/view-document.html?gid=13329 (accessed 12/2019)	Minnesota Statutes Sec. 116.76 –116.82
Mississippi	http://www.mdeq.ms.gov/wp-content/uploads/2010/07/MedWasteFactSheet.pdf (accessed 12/2019)	Medical Waste Fact Sheet; no applicable state regulations
Missouri	http://www.sos.mo.gov/adrules/csr/current/10csr/10csr.asp (accessed 12/2019)	10 CSR 807.010
Montana	http://deq.mt.gov/Land/hazwaste (accessed 12/2019)	Title 75, Chapter 10, Part 1002
Nebraska	http://deq.ne.gov/RuleAndR.nsf/Title_132.xsp (accessed 12/2019)	Title 132, Chapter 1 and Chapter 13
Nevada	https://ndep.nv.gov/land/waste/solid-waste/special-waste-management (accessed 12/2019)	N.A.C. 444.646 and 444.662

State	Web Address	Administrative Code / Document
New Hampshire	https://www.des.nh.gov/organization/commissioner/legal/rules/index.htm#waste (accessed 12/2019)	NHCAR Part Env-Sw 904
New Jersey	http://www.nj.gov/dep/dshw/rrtp/rmw.htm (accessed 12/2019) http://www.nj.gov/dep/dshw/resource/rules.html (accessed 12/2019)	N.J.A.C. 7:26
New Mexico	https://www.env.nm.gov/waste/ (accessed 12/2019)	20 NMAC 9.1.706 Paragraph F
New York	http://www.health.state.ny.us/facilities/waste/ (accessed 12/2019)	Title 10 NYCRR Part 70
North Carolina	https://files.nc.gov/ncdeq/Waste%20Management/DWM/SW/Programs%20and%20Planning/MedicalWaste/Section.1200.pdf (accessed 12/2019)	15A NCAC 13B Section 1200
North Dakota	http://www.legis.nd.gov/information/acdata/pdf/33-20-12.pdf (accessed 12/2019)	Title 33, Article 20, Chapter 12 (33-20-12) and 23-29-03.5 NDCC
Ohio	http://www.epa.ohio.gov/dmwm/dmwmnonhazrules.aspx#126793969-effective-rules (accessed 12/2019)	OAC Chapter 3745.27
Oklahoma	http://www.deq.state.ok.us/rules/515.pdf (accessed 12/2019)	Title 252.515
Oregon	http://public.health.oregon.gov/DiseasesConditions/CommunicableDisease/Pages/infectw.aspx (accessed 12/2019)	Oregon Law 1989, Chapter 763 and ORS 459
Pennsylvania	http://www.dep.pa.gov/Business/Land/Waste/Services/Pages/default.aspx (accessed 12/2019) http://www.pacode.com/secure/data/025/chapter284/chap284toc.html (accessed 12/2019)	Title 25 PAC 284
Rhode Island	http://www.dem.ri.gov/programs/wastemanagement/facilities/medical-waste.php (accessed 12/2019)	DEM-DAH-MW-01-92
South Carolina	https://www.scdhec.gov/environment/land-management/infectious-waste (accessed 12/2019)	R 61-1-5 S.C. Code Ann. 44-93-10
South Dakota	https://denr.sd.gov/des/wm/sw/swmedicalwaste.aspx (accessed 12/2019)	Article 74:35 (repealed September 19, 2011)
Tennessee	http://publications.tnsosfiles.com/rules/0400/0400-11/0400-11.htm (accessed 12/2019) https://www.tn.gov/content/dam/tn/environment/solid-waste/documents/sw-solid-waste-policy-manual.pdf (accessed 12/2019)	Chapter 0400-11-01; Solid Waste Program Policy and Guidance Manual
Texas	https://www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw_specialwaste.html (accessed 12/2019)	30 TAC, Chapter 330, § 330.3(148); §330.171; and §330.173
Utah	https://rules.utah.gov/publicat/code/r315/r315-316.htm (accessed 12/2019)	Title R315-316
Vermont	https://legislature.vermont.gov/statutes/chapter/10/159 (accessed 12/2019)	VSA Title 10 Chapter 159

State	Web Address	Administrative Code / Document
Virginia	http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/SolidHazardousWasteRegulatoryPrograms/MedicalWaste.aspx (accessed 12/2019) http://lis.virginia.gov/cgi-bin/legp604.exe?000+reg+9VAC20-120-300 (accessed 12/2019)	Title 9 VAC 20-120
Washington	http://apps.leg.wa.gov/RCW/default.aspx?cite=70.95K (accessed 12/2019)	RCW Chapter 70.95K
West Virginia	http://www.wvdhhr.org/wvimw/index.asp (accessed 12/2019)	Code of State Rules, Title 64-56
Wisconsin	http://docs.legis.wisconsin.gov/code/admin_code/nr/500/526/Title (accessed 12/2019)	WAC NR526
Wyoming	http://www.hercenter.org/rmw/wy-rmw.cfm (accessed 12/2019)	WS 35-11-101, 102, 109, and 501

Note: Links to hazardous waste programs and environmental agencies for U.S. Territories can be accessed using: https://www.epa.gov/hwgenerators/links-hazardous-waste-programs-and-us-state-environmental-agencies. Links are provided for: American Samoa, Guam, Northern Mariana Islands, Marshall Islands, Micronesia, Puerto Rico and Trust Territories. Information is not available for the U.S. Virgin Islands.

Appendix D

Example Hazardous Waste Manifest Form and Bill of Lading

An example Waste Manifest Form and Bill of Lading are provided in this appendix. Also see https://www.epa.gov/hwgenerators/hazardous-waste-electronic-manifest-system-e-manifest for information about EPA's Hazardous Waste Electronic Manifest System.

Please print or type. *(Form designed for use on elite (12-pitch) typewriter.)* *Form approved. OMB No. 2050-0039. Expires 9-30-91*

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. | Manifest Document No. | 2. Page 1 of | Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address | A. State Manifest Document Number

B. State Generator's ID

4. Generator's Phone ( )

5. Transporter 1 Company Name | 6. US EPA ID Number | C. State Transporter's ID

D. Transporter's Phone

7. Transporter 2 Company Name | 8. US EPA ID Number | E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address | 10. US EPA ID Number | G. State Facility's ID

H. Facility's Phone

11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
GENERATOR a.					
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above | K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; **OR**, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name | Signature | Month Day Year

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Month Day Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name | Signature | Month Day Year

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete.

U.S. GOVERNMENT BILL OF LADING
INTERNATIONAL AND DOMESTIC OVERSEAS SHIPMENTS

B/L NUMBER

TRANSPORTATION COMPANY TENDERED TO | SCAC | DATE B/L PREPARED

DESTINATION NAME AND ADDRESS | SPLC (Dest.) | SPLC (Orig.) | ORIGIN NAME AND ADDRESS

CONSIGNEE (Name and full address of installation) | GBLOC (Cons.) | SHIPPER NAME AND ADDRESS

APPROPRIATION CHARGEABLE | BILL CHARGES TO (Dept./agency, bureau/office mailing address and ZIP code) | AGENCY LOC CODE

VIA (Route shipment when advantageous to the Government)

MARKS AND ANNOTATIONS

PACKAGES NO.	PACKAGES KIND	HM	DESCRIPTION OF ARTICLES (Use carrier's classification or tariff description if possible; otherwise use a clear nontechnical description.)	19. WEIGHTS* (Pounds only)	FOR USE OF BILLING CARRIER ONLY Services	Rate	Charges
			CLASSIFICATION ITEM NO.		TOTAL CHARGES		

TARIFF/SPECIAL RATE AUTHORITY | CARRIER WAY/FREIGHT BILL NO. AND DATE

STOP THIS SHIPMENT AT

FOR

FURNISH INFORMATION ON CAR/TRUCKLOAD/CONTAINER SHIPMENTS

SEAL NUMBERS	LENGTH/CUBE ORDERED	LENGTH/CUBE FURNISHED	MARKED CAPACITY ORDERED	MARKED CAPACITY FURNISHED	DATE FURNISHED
APPLIED BY:					

CARRIER'S PICKUP DATE (Year, month, and day)

MODE	ESTIMATE	NO. OF CLS/TLS	TYPE RATE	PSC	REASON

This U.S. Government shipment is subject to terms and conditions of 41 CFR 102-117 and CFR 102-118.

CERTIFICATE OF CARRIER BILLING -- CONSIGNEE MUST NOT PAY ANY CHARGES

DELIVERED ON (Year, month, and day)

FOR USE OF ISSUING OFFICE

ISSUING OFFICE (Name and complete address) | GBLOC | ISSUING OFFICER

CONTRACT/PURCHASE ORDER NO. OR OTHER AUTHORITY | DATED

FOB POINT NAMED IN CONTRACT

*Show also cubic measurements for shipments via air, truck or water carrier in cases where required.

AUTHORIZED FOR LOCAL REPRODUCTION

STANDARD FORM 1103 (REV. 9/2003)
Prescribed by GSA/FMR 102-118