20 WASTE MANAGEMENT IN A RADIOANALYTICAL LABORATORY

20.1 Introduction

This chapter presents information on the management of radioactive waste generated during analytical processes. Federal, state, and local laws stringently regulate radioactive waste and impose severe consequences for violations. Management of waste in compliance with such regulations is, therefore, critical to the laboratory's sustained operation. Many—but not all—applicable regulations are addressed in this Chapter. A laboratory waste management plan that details procedures for the management of radioactive waste should be implemented before radioactive materials are accepted for processing.

The following sections provide background information on managing radioactive waste and identifies issues that should be considered when preparing a laboratory-waste management plan. Sections 20.2 through 20.5 of this chapter provide general guidance for managing waste in a radioanalytical laboratory. Descriptions of the types of wastes that may be produced in a radioanalytical laboratory are provided in Section 20.2. Section 20.3 reviews various approaches that have been used to achieve effective laboratory-waste management programs. Waste avoidance and waste minimization programs are discussed in Section 20.4. Waste determination and characterization are briefly reviewed in Section 20.5. Some of the specific regulatory requirements that apply to laboratory waste management are provided in Section 20.6. A proposed outline for a waste management plan is provided in Section 20.7, and Section 20.8 suggests a number of useful web resources related to the management of laboratory waste.

20.2 Types of Laboratory Wastes

The types of wastes generated and the waste management issues the laboratory may face are determined by the analytical processes used in the laboratory and the characteristics of the samples analyzed. A laboratory that performs only one or two analytical processes may produce only a few waste streams, whereas a multi-service laboratory that performs a variety of processes may produce many waste streams. Waste streams produced by radioanalytical procedures can include radioactive and non-radioactive wastes. A laboratory waste stream is defined as all wastes that are produced by a given analytical process. Table 20.1 provides a list of wastes that may be generated by a laboratory.

TABLE 20.1 — Examples of Laboratory-Generated Wastes

Waste	Example of Laboratory Generation (Not Inclusive)
Dry solid waste	Gloves, glassware, pipette tips, plastic vials generated through analytical processes
Aqueous waste	Solutions from analytical processes (filtrates, supernates, liquid scintillation fluid)
Organic solvent waste (used solvents, analytical processes)	Used solvents, de-greasers in cleaning operations, liquid scintillation fluid
Acidic wastes	Solutions from analytical processes (filtrates, supernates)
Waste Oil	Used oil from vacuum pumps
Sample	Unused sample from analytical process
Sample residue	Processed sample residue from analytical processes (precipitate, filters, planchets)
Reagent chemicals	Unused, expired, or surplus reagent chemicals
Sanitary waste	Sewage
Sludge waste	Water treatment
Sharps	Analytical processes (gas chromatography)
Various metal wastes/Radioactive sources	Laboratory equipment
Biohazardous waste	Fecal, urine, blood-borne pathogen waste, animal carcasses, body parts, tissues generated from bioassay, tissue or other biological analyses
Toxic Substances Control Act (TSCA) waste	Analytical processes on polychlorinated bi-phenyls (PCB), asbestos, chlorinated dioxin/furans
Radioactive waste	Analytical processes, radioactive standards, radioactive solutions, dry waste, aqueous waste
Resource Conservation and Recovery Act (RCRA) hazardous waste	Analytical processes generating characteristic and listed waste as defined per 40 CFR 261 (Used solvents, reagent chemicals, acidic waste, etc.)
Mixed waste	Analytical processes generating any combination of RCRA waste and radioactive wastes or TSCA waste and radioactive wastes

20.3 Waste Management Program

One source of guidance in assisting the laboratory in developing a waste management plan is *Profile and Management Options for EPA Laboratory Generated Mixed Waste* (EPA, 1996). This report reviews various approaches that have been taken to achieve effective laboratory waste management programs. Much of the EPA report provides a review of articles and books that

detail the experiences of labs that manage radioactive wastes. This section draws significantly from that report.

20.3.1 Program Integration

Successful waste management programs integrate important components, such as administrative, regulatory requirements, training, record keeping, treatment, waste minimization, and prevention. Individual management options, taken in isolation, may not be as effective as a more comprehensive approach to waste management (EPA, 1996). Reviewing all aspects of waste management in the laboratory should reveal the interactions among the component areas, providing insights that allow improvements to the program as a whole without creating unknown negative effects.

20.3.2 Staff Involvement

All levels of management, scientists, and technicians should be actively involved in developing and implementing the waste management program since each brings a valuable and unique perspective to the waste management issue. Upper management must be committed to maintaining a current and effective waste management plan because of the significant costs of waste management and because of the serious civil and criminal penalties associated with non-compliance. Program and project managers bring insight regarding issues, such as returning samples to a site, waste management cost recovery, and data quality objectives. These managers are also familiar with a full range of waste management alternatives. Laboratory environmental, safety, and health personnel are essential to the process since they typically interface with regulators to ensure that waste management practices are fully compliant. The input from laboratory supervisors, scientists, and technicians is necessary because they generate waste at the bench level and have first-hand process knowledge of how various waste streams are produced. These individuals also have to implement the waste management plan on a daily basis and can provide valuable feedback on improving the waste management system.

Waste generation planning is essential to proper waste management. Waste life cycle management is a concept within the U.S. Department of Energy (DOE) Order 435.1 to reduce the amount of radioactive waste generated. Waste life cycle is described as the life of a waste from generation through storage, treatment, transportation, and disposal. For waste generated from a new project or activity, consideration of the waste begins in the planning stage of the project or activity.

20.4 Waste Minimization

Waste avoidance actively reduces the amount of waste to be managed and is a critical part of a waste management plan. An integrated approach to laboratory waste management necessarily implies pollution prevention. The term pollution prevention has served as an all-encompassing term for any technique, process, or procedure that minimizes waste. Broadly defined, pollution prevention refers to activities that keep pollutants from being created in any media (i.e., control pollution at the source). There are many strong benefits to pollution prevention including safety, waste minimization, efficiency, regulatory compliance, reduction in liability, and cost reduction. Pollution prevention techniques are a critical component of prudent laboratory practices and have been incorporated into many laboratory waste management procedures (EPA, 1996).

Management options that address waste avoidance will result in the most substantial cost savings. Two of the primary areas to review when seeking to minimize laboratory waste are the processes and definitions that the laboratory uses to identify and categorize waste. A laboratory may define and manage various categories of wastes and may develop a hierarchy of waste streams similar to the one described in Table 20.1. Properly categorizing waste at the point of production will help to ensure health, safety, and regulatory compliance. This process also will help to avoid unnecessary, costly, and inappropriate treatment, storage, and disposal. However, proper categorization of waste streams can be difficult, requiring knowledge of the chemical and radiological characteristics of the wastes, the production process, and a thorough understanding of all-applicable regulations and regulatory guidance. Waste management regulations were written primarily to regulate industrial production facilities and commercial storage, treatment, and disposal facilities; their application to laboratories may not be readily apparent. The laboratory waste management plan should require that each waste stream be identified prior to production, so that waste minimization steps may be taken and production of unknown wastes avoided.

The processes and definitions that a laboratory uses to determine that a waste is radioactive or non-radioactive have a great influence on the amount of radioactive waste that a laboratory must manage. The regulations offer little or no guidance for establishing that a waste is non-radioactive, therefore it may be up to the laboratory to make this determination. Laboratory management should develop clear guidelines to make this determination. The guidelines must comply with requirements specified by the agency that issues the laboratory's license for radioactive materials since waste considered non-radioactive in one state may be considered radioactive in another.

Once the waste has been properly categorized (either through 10 CFR Part 61 or DOE O 435.1), the laboratory can prioritize the review of waste streams for elimination, reduction, or modification. A waste stream schematic or flow diagram that lists waste stream characteristics and management pathways can be a useful tool in reviewing waste stream management. Various management options that have been used to achieve waste stream minimization include the following:

REGULATORY. Some wastes may be exempted from regulations because of the production process, level of contaminants, volume of waste produced, or management option chosen. For example, some hazardous wastes may be disposed in an industrial wastewater discharge if their contaminants are below established regulatory levels and if the discharge is regulated under the Clean Water Act. Also, a hazardous waste generator that produces less than 100 kg of waste in a month may be considered a conditionally exempt small quantity generator and thus be exempt from many of the requirements of RCRA (40 CFR 261.5). Some radioactive waste may be managed as not-radioactive if the total level of radioactivity is below an exempt or *de minimis* level, or if the activity for specific radionuclides is below established levels (10 CFR 61 20.2005). For certain licensees, radioactive wastes are released into the environment as gaseous and liquid effluents in accordance with 10 CFR Part 61 20.2001(a)(3) and specific license conditions.

METHOD SELECTION. The analytical method selected for the analysis of radioactive material determines the type and volume of waste generated. When two methods will achieve the required measurement quality objectives of the project, the laboratory may select the method that produces the most easily managed waste (see Chapter 6, *Selection and Application of an Analytical Method*).

PRODUCT SUBSTITUTION. In an analytical method, it may be possible to replace a hazardous reagent with a non-hazardous reagent and still meet all health, safety, and data quality objectives. In addition, substituting a short-lived radionuclide for a long-lived radionuclide may ultimately result in a reduction of radioactive waste.

SAMPLE VOLUME COLLECTED. Excess sample material should not be collected. Personnel should only collect enough sample material for the planned analysis and any reserve needed for re-analysis or potential future use. Reserve volume should be minimized with up-front planning.

SAMPLE/REAGENT VOLUME. It may be possible to reduce the amount of sample and/or reagents used in a method. It may also be possible to convert a method to a micro-scale method that uses significantly less sample and reagents than the original method.

REAGENT PROCUREMENT CONTROLS. Often, the quantities of chemicals purchased by a laboratory are determined by the price discounts available on larger quantities, instead of by the amount of chemical required. The real cost of chemicals should be recognized as the initial purchase price plus any disposal costs (lifetime costs). It should be noted that disposal costs of excess chemicals can easily exceed the initial purchase costs. Procurement procedures for hazardous material should be implemented to determine if a non-hazardous substitute is available. Rotating chemical stock (first in, first out) may help avoid expiration of the chemical shelf life.

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.

DECAY IN STORAGE. Since the level of radioactivity decreases with time, it may be possible to store a short-lived radionuclide until the natural-decay process reduces the radioactivity to a level at which the waste can be considered non-radioactive for waste management purposes. Laboratory management should be aware that RCRA storage limitations might impact the feasibility of this option.

WASTE STREAM SEGREGATION. 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 must be managed as hazardous waste.
- Non-radioactive waste mixed with radioactive waste must be managed as radioactive waste.
- Hazardous waste mixed with radioactive waste must be managed in compliance with the requirements of the Atomic Energy Act (AEA), RCRA, and TSCA.

20.5 Waste Determinations and Characterization

Laboratory wastes should be properly characterized to assure compliance with applicable federal, state, and local regulations, and to determine appropriate means of disposal. Waste container contents should be adequately characterized during waste generation and packaging. Characterizations should address the type of material and the physical and chemical characteristics of the waste. Minimum waste characterization criteria may be specified for the radioactive waste generated (DOE M 435.1-1, Ch. IV, Sec. I and NRC criteria specified in 10 CFR Part 61 for commercial low-level radioactive waste sites).

Three basic methods of characterization are denoted here: (a) process knowledge; (b) chemical characterization through laboratory analysis; and (c) activities. Factual process knowledge (e.g., from a process waste assessment) influences the amount of sampling required to correctly characterize waste.

A generic laboratory waste management plan should be established to describe the waste life cycle. This plan should focus on characterizing each waste stream and establishing a waste stream profile, so that the waste stream can be properly managed. The profiled waste stream may only require a periodic partial characterization, based on the profile and regulatory status.

20.6 Specific Waste Management Requirements

This section provides general guidance on the storage, treatment, and disposal of radioactive waste generated within a laboratory. It should not be used as definitive guidance for managing radioactive waste. Laboratory managers are encouraged to review the complete regulatory requirements in developing a waste management plan to fit the compliance and operational needs of the laboratory. Laboratory managers may choose to have an environmental compliance specialist assist with developing the waste management plan since waste management requirements can be complex and contradictory.

Radioactive waste is regulated under AEA, administered by the Nuclear Regulatory Commission (NRC). Thirty states are NRC Agreement States and have the authority and the regulatory programs in place to regulate radioactive materials management in accordance with 10 CFR Part 61. Some wastes may also be regulated under RCRA , TSCA, or both, administered by EPA. Most states have been granted authority to administer the mixed waste rules under RCRA. Although many of the state hazardous waste laws are very similar to the federal RCRA regulations, important differences may exist. This chapter focuses only on the federal requirements, therefore, to ensure compliance with all applicable regulations, laboratory management is strongly encouraged to review state and local regulations when developing a waste management plan. Wastes that are regulated as radioactive under AEA and as hazardous under RCRA or TSCA are termed “mixed wastes.” Laboratories that generate mixed waste must satisfy both NRC, which regulates the radioactive component, and EPA, which regulates the hazardous component. Mixed waste management is a difficult responsibility, due to the complex regulatory framework and the lack of approved treatment and disposal options for these wastes. Other laws, such as the Clean Water Act (CWA) and the Clean Air Act (CAA), are not summarized in this chapter. However, they may also have some impact on the management of radioactive waste.

Federal regulatory requirements for waste management are found in Title 10 of the *Code of Federal Regulations* (10 CFR) and Title 40 of the *Code of Federal Regulations* (40 CFR). The following Federal citations address specific areas that regulate the management of waste generated by a laboratory.

NRC REQUIREMENTS FOR RADIOACTIVE WASTE. Title 10 CFR 20, *Standards for Protection Against Radiation*, and 10 CFR 61, *Licensing Requirements for Land Disposal of Radioactive Waste*, address issues that may apply to management of radioactive waste in the laboratory.

LICENSE. Each laboratory that handles radioactive materials must be licensed by NRC, a NRC Agreement State, or be operating under a site-wide license held by DOE. Radioactive materials license issued by NRC or an Agreement State may provide additional requirements that affect the management of waste. DOE-owned laboratories might be required to comply with DOE orders that regulate the management of radioactive wastes (such as O 435.1 or 5820.2a).

DOE REQUIREMENTS FOR RADIOACTIVE WASTE. Any generator of DOE radioactive waste and radioactive recyclable materials shall have a Waste Certification Plan (WCP). This plan provides assurance that appropriate sections of the acceptance criteria of the waste and applicable RCRA waste analysis requirements are met (DOE Order 5820.2A, *Radioactive Waste Management*). The radioactive waste generator requirements are to ensure the development, review, approval, and implementation of a program for waste generation planning, characterization, certification, and transfer. This program shall address characterization of waste, preparation of waste for transfer, certification that waste meets the receiving facility's radioactive waste acceptance requirements, and transfer of waste (DOE M 435.1-1).

RCRA REQUIREMENTS FOR HAZARDOUS WASTE. Laboratories that generate hazardous waste must meet detailed and specific requirements for the storage, treatment, and disposal of that waste. Some of the regulatory requirements vary with the total amount of hazardous waste generated each month, thus it is important that the laboratory understand how to properly categorize its operation (small quantity exempt generator, small quantity generator, or large quantity generator). Generator status is a regulatory issue that may vary among states. RCRA regulations for generators found in 40 CFR 260-262, *Hazardous Waste Management System: General*, list requirements in the following sections:

- 40 CFR 261, *Identification and Listing of Hazardous Waste*, describes what is, and what is not, hazardous waste and how to determine if a waste is considered hazardous under RCRA.

- 40 CFR 262, *Standards Applicable to Generators of Hazardous Waste*, establishes management requirements for generators of hazardous waste.

- 40 CFR 262.34, *Accumulation Time*, provides specific time and volume limitations on the storage of hazardous waste.

- 40 CFR 262.40, *Recordkeeping and Reporting*, lists requirements a generator must meet in documenting and reporting hazardous waste management activities.

TSCA REQUIREMENTS FOR PCB WASTE. The primary TSCA regulations that normally would apply to an analytical laboratory relate to PCB waste. Laboratory waste containing PCBs at concentrations of 50 ppm or greater, or are derived from PCB waste samples with concentrations of 50 ppm or greater, are considered PCBs and are subject to the following regulations:

- 40 CFR 761.60, *Disposal Requirements*, describes requirements for the disposal of PCB waste.

- 40 CFR 761.61, *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*, establishes prohibitions of, and requirements for, the manufacture, processing, distribution in commerce, use, disposal, storage, and marking of PCBs and PCB items.

- 40 CFR 761.65, *Storage and Disposal*, describes time limits for storage and storage requirements of PCB waste.

- 40 CFR 761.64, *Disposal of Wastes Generated as a Result of Research and Development Activities ... and Chemical Analysis of PCBs*, provides regulatory exclusion for some PCB analytical samples.

20.6.1 Sample/Waste Exemptions

Laboratory samples and certain mixed wastes may be exempted or excluded from certain regulatory provisions. Management should evaluate those regulations to determine if they affect their waste management practices. Three examples are provided below.

RCRA ANALYTICAL SAMPLE/TREATABILITY SAMPLE EXCLUSIONS. Under 40 CFR 261.4(d), a sample of solid waste or a sample of water, soil, or air, which is collected for the sole purpose of testing to determine its characteristics or composition, is not subject to certain RCRA regulations

if the laboratory is meeting the conditions specified in 40 CFR 261.4. Similarly, samples undergoing treatability studies, and the laboratory or testing facility conducting such treatability studies, are not subject to certain portions of RCRA [40 CFR 261.4(e)]. However, once a material can no longer be considered a sample, it becomes waste and is subject to RCRA requirements.

POLYCHLORINATED BIPHENYL (PCB) SAMPLE EXCLUSION. Portions of samples used in a chemical extraction and analysis method for PCBs, and extracted for purposes of determining the presence of PCBs or concentration of PCBs, are unregulated for PCB disposal (40 CFR 761.64). All other PCB wastes from laboratory operations must be disposed in accordance with 40 CFR 761.61. Radioactive PCB waste may be exempt from the one year time limit for storage if the waste is managed in accordance with all other applicable federal, state, and local laws and regulations for the management of radioactive material (40 CFR 761.65).

MIXED WASTE EXEMPTION. Since August 1991, EPA has maintained a special policy on the enforcement of the storage prohibition of RCRA mixed waste, which applies to generators that are storing mixed wastes for which no viable treatment technology or disposal capacity exists. The policy explains that EPA considers violation of the RCRA storage prohibition in section 3004(j) of RCRA to be a relatively low priority item among the Agency's potential civil enforcement actions, as long as the wastes are stored in accordance with a RCRA permit or interim status or in an environmentally sound manner. This policy, which only applies to certain wastes, has been extended to October 2001. However, the policy does not apply to DOE facilities.

20.6.2 Storage

Regulatory requirements for the storage of radioactive, hazardous, or PCB waste vary by the type of waste, and typically address the waste storage area, type of acceptable waste containers, length of time the waste may be stored, marking the storage area and the containers, and waste monitoring. Significant civil and criminal penalties exist for storing waste improperly or for a longer time period than allowed. The following sections summarize some of these requirements. However, laboratory management is encouraged to review the regulations in depth so they may develop a waste management plan that meets the compliance and operational needs of the laboratory.

In the case of DOE analytical contract laboratories, low-level radioactive waste that has an identified path to disposal shall not be stored longer than one year prior to disposal, except for the purpose of radioactive decay. Low-level waste that does not have an identified path to

disposal shall be characterized as necessary to meet the data quality objectives and minimum characterization requirements to ensure safe storage and to facilitate disposal (DOE M 435.1-1).

20.6.2.1 Container Requirements

RADIOACTIVE WASTE. NRC has container requirements for low-level waste. Refer to 10 CFR Part 61 for Class B and C requirements. For disposal, NRC requires the use of a high integrity container approved by NRC.

RCRA HAZARDOUS WASTE. 40 CFR 265.170-177 provides requirements for the use and management of containers storing hazardous waste. In summary, this section requires that containers be in good condition, be compatible with the waste stored, be closed at all times except when adding or removing waste, and be inspected weekly, in the case of 90-day accumulation areas, for signs of corrosion or leakage.

PCB WASTE. 40 CFR 761.65 details TSCA requirements for the storage of PCB waste, including the physical constraints of the storage area and the type of containers acceptable for storing liquid and non-liquid PCB wastes. Laboratory PCB waste and samples returned to the sample collector or submitted to a disposal facility when sample use is terminated may be exempt from the storage requirements of 40 CFR 761.65.

20.6.2.2 Labeling Requirements

RADIOACTIVE WASTE. Radioactive waste storage areas should be posted with signs and labeled in accordance with 10 CFR 20.1901 -1906, *Precautionary Procedures*. This section specifies requirements for caution signs, labeling, signals, controls, and the storage of licensed material in unrestricted areas.

RCRA HAZARDOUS WASTE. Hazardous waste containers must be labeled with the words "Hazardous Waste" and, in the case of a 90-day accumulation area, the date upon which the waste accumulation began 40 CFR 262.34(a)(4)(c)(ii).

PCB WASTE. 40 CFR 761.40 and 761.45 provides requirements for marking and labeling PCB containers and the PCB storage area (40 CFR 761.50).

20.6.2.3 Time Constraints

RADIOACTIVE WASTE. NRC regulations in Title 10 of the *Code of Federal Regulations* do not specifically establish a maximum amount of time that one may store radioactive waste. A facility's NRC or Agreement State radioactive materials license may address this issue.

RCRA-HAZARDOUS WASTE. 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 262.34). 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 262.34). 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.

PCB WASTE. Radioactive PCB waste may be exempt from the one-year time limit for PCB storage if the waste is managed in accordance with all other applicable federal, state, and local laws and regulations for the management of radioactive material (40 CFR 761.65). According to 40 CFR 761.65(a)10, certain PCB waste containers may be exempt from 40 CFR 761.65 if the containers are disposed within 30 days.

20.6.2.4 Monitoring Requirements

RADIOACTIVE WASTE. Radioactive waste storage areas should be surveyed and personnel should be monitored in accordance with 10 CFR 20.1901-1906, *Precautionary Procedures*. These sections specify the requirements for surveys, personnel monitoring, and storage of licensed material in unrestricted areas. 10 CFR 20.1101 and 10 CFR 20.1201 address permissible doses, levels, and concentrations of airborne radiation that would apply to radioactive waste storage areas.

RCRA HAZARDOUS WASTE. The owner or operator of a hazardous waste storage area must inspect areas in which containers are stored, at least weekly, looking for leaks and deterioration caused by corrosion or other factors (40 CFR 265.174). 40 CFR 262.34 address requirements for Prevention and Preparedness, Contingency Plans, and Emergency Procedures that may apply to a laboratory that stores RCRA waste.

PCB WASTE. All PCB containers in storage shall be checked for leaks at least once every 30 days [40 CFR 761.65(c)(5)].

20.6.3 Treatment

Radioactive and mixed waste may require treatment to meet one or more objectives prior to final disposal. Treatment involves the physical or chemical processes that result in a waste form that is acceptable for disposal or further treatment. Treatment objectives include: (1) producing a waste form acceptable for land disposal; (2) volume/mobility reduction through possible solidification or sizing; (3) producing a waste more amenable for further treatment; or (4) separating radio-active components from RCRA or TSCA components. Another treatment objective is to convert

a radioactive RCRA regulated waste to a radioactive non-RCRA waste. *Special permits may be required from regulatory agencies prior to the treatment of waste.*

Radioactive wastes may require treatment to meet the waste characteristics provided in 10 CFR 61.56. The following types of treatment have been 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. Low-level radioactive waste (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.

- Some radioactive waste items may be decontaminated for unrestricted release by removal of surface radioactivity through chemical or physical means. The residue from the decontamination of a surface may require disposal as a radioactive waste.

- The relatively short half-lives of some radionuclides warrant storing the waste for a period of time. Once the levels of radioactivity are undetectable or below an accepted *de minimis* level, the waste may be disposed as a non-radioactive waste or in accordance with license conditions.

20.6.4 Disposal

The disposal of radioactive waste is regulated by NRC in accordance with 10 CFR 20.2001, which requires that waste be disposed at a licensed LLRW site. Radioactive waste that is mixed with waste regulated under RCRA or TSCA is also subject to disposal requirements of the respective regulations. Mixed waste must go to a facility that is 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 at a LLRW site that is not licensed under RCRA**.**

In some cases, radioactive material may be disposed in a sanitary-sewage system if the requirements of 10 CFR 20.2003 are met. This section provides specific limits on the quantity of radionuclides that can be discharged into a sewage system. Discharges into a sewage system may also be regulated by the Clean Water Act. For example, media used for liquid scintillation counting, containing tritium (^{3}H) or carbon-14 (^{14}C) in concentration of 0.05 microcuries per gram or less may be disposed as if it were not radioactive. Also, animal tissue containing ^{3}H or ^{14}C at levels less than or equal to 0.05 microcuries per gram (1,850 Bq/g) may be disposed without regard to radioactivity (10 CFR 20.2005).

The DOE also regulates the disposal of radioactive waste. Under DOE M 435.1-1, all radioactive waste generators must have a waste certification program to ensure that the waste acceptance criteria for the radioactive disposal facility are met. An outline of a waste certification plan is contained in the following section.

20.7 Contents of a Laboratory Waste Management Plan/Certification Plan

20.7.1 Laboratory Waste Management Plan

A laboratory waste management plan will describe the waste generated by the analytical laboratory. Each section of the plan is usually divided into two separate entities B one addressing the needs of the laboratory analyst and the second addressing the needs of the waste management personnel. An outline of a generic plan follows:

1. Recyclable Wastes
2. Sanitary Wastes/Industrial Wastes
3. Radioactive Wastes
4. Hazardous and Mixed Wastes
    - Satellite Accumulation Area operations
    - 90-day Accumulation Area operations

Within each section, the laboratory should delineate the types of waste that fall into each category. Also, within the section for laboratory analysts, the disposal of the waste should be clearly defined (e.g., paper in recyclable waste bin, unknown waste to environmental and/or waste personnel). The waste management section should describe the process used by the waste management personnel to dispose of the waste.

20.7.2 Waste Certification Plan/Program

The general outline for waste certification plans described below was taken from DOE M 435.1-1 Ch. IV, Sec. J (1-3):

CERTIFICATION REQUIREMENTS. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment and to specify the documentation required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditing, retrieving and storing required documentation, including records retention.

CERTIFICATION BEFORE TRANSFER. Low-level waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

MAINTAINING CERTIFICATION. Low-level waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

A general outline for a laboratory waste certification plan follows:

1. FACILITY NAME AND LOCATION. Provide the name and the physical location of the facility.

2. ORGANIZATION. Describe the organizational structure for the facility's operation, quality assurance program, and waste management program.

3. CONTENTS OF WASTE CERTIFICATION PLAN. Provide a detailed Table of Contents, including list of tables, figures, and appendices as appropriate.

4. FACILITY RECYCLABLE AND WASTE MINIMIZATION STRATEGY. Identify the wastes and waste streams the facility has targeted for recycling and waste minimization (i.e., source reduction through product replacement).

5. DUTIES AND RESPONSIBILITIES OF MANAGEMENT AND WASTE MANAGEMENT PERSONNEL. Provide a description of the positions at the laboratory, including primary and secondary responsibilities and line of reporting.

6. QUALIFICATION REQUIREMENTS AND TRAINING OF WASTE MANAGEMENT PERSONNEL. Describe the training and qualification program implemented for the environmental and waste personnel. No specialized certifications (e.g., certified hazardous materials manager, professional engineer) is needed unless specified by the job description or standard operation procedures.

7. QUALIFICATIONS OF PROCEDURES AND EQUIPMENT USED IN WASTE MANAGEMENT. Describe all equipment used in the waste management processes and procedures.

8. RECYCLABLE MATERIAL AND WASTE SEGREGATION CONTROL. Describe the process of segregating various types of waste streams, especially in regards to radioactive and non-radioactive wastes.

9. PACKAGING, HANDLING AND STORAGE CONTROL. Describe the process of packaging, handling, and storing waste at the facility. This would include drum inspections, cipher-locked storage, etc. The disposal of the supernates is a third example of a waste stream. These supernates may be disposed in a sewage system, but the pH must be above 2 or below 12 to allow the supernate solutions to be exempt from RCRA regulations. Elementary neutralization is allowed in the laboratory under RCRA, but state regulations

may require registration of the laboratory as an elementary neutralization unit before neutralization and disposal take place.

20.8 Useful Web Sites

Listed below are useful federal web sites relevant to the management of laboratory waste. Due to the nature of the Internet, these addresses may change in the future.

Federal and State Government Regulation and Program References
http://www.epa.gov/docs/epacfr40/find-aid.info/state/

Environmental Laws and Regulations, Full Text (U.S. Code)
More than a dozen major statutes or laws form the legal basis for the programs of the Environmental Protection Agency (EPA). The full text of these laws and the U.S. Code Citation for each environmental law can be accessed through the following address.
http://www.epa.gov/epahome/lawreg.htm

Environmental Regulations in *Federal Register*
Full text of all *Federal Register* documents issued by EPA, as well as selected documents issued by other Departments and Agencies. Notices, meetings, proposed rules, and regulations are divided into twelve topical categories for easy access (e.g., air, water, pesticides, toxics, and waste).
http://www.epa.gov/fedrgstr/

State and Federal Agency Contact List for Mixed Waste Regulations
http://www.epa.gov/rpdweb00/mixed-waste/mw_pg6e.htm

States and Territories Where EPA Regulates Mixed Waste
http://www.epa.gov/rpdweb00/mixed-waste/mw_pg6a.htm

States and Territories With EPA Authorization to Regulate Mixed Waste
http://www.epa.gov/rpdweb00/mixed-waste/mw_pg6b.htm

State Solid and Hazardous Waste Web Sites
http://www.epa.gov/epaoswer/osw/stateweb.htm

RCRA State Authorization, By State and Program Element
http://www.epa.gov/epaoswer/hazwaste/state/index.htm

NRC Agreement States
http://www.hsrd.ornl.gov/nrc/asframe.htm

DOE Mixed Waste Policies
http://www.directives.doe.gov/

EPA Mixed Waste Home Page
http://www.epa.gov/rpdweb00/mixed-waste/index.html

Mixed Waste Glossary
http://www.epa.gov/radiation/mixed-waste/mw_pg5.htm#AEA

Guidance on the Definition and Identification of Commercial Mixed Low Level Radioactive and Hazardous Waste
http://www.epa.gov/rpdweb00/mixed-waste/mw_pg25.htm

Current Mixed Waste Treatment, Storage, or Disposal Facilities (TSDFs)
http://www.epa.gov/rpdweb00/mixed-waste/mw_pg11a.htm

NRC/EPA Draft Storage Guidance
http://www.epa.gov/radiation/mixed-waste/mw_pg27.htm

Mixed Waste Shipping and Transportation
http://www.epa.gov/rpdweb00/mixed-waste/mw_pg10.htm

Mixed Waste Pollution Prevention
http://www.epa.gov/rpdweb00/mixed-waste/mw_pg23.htm

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