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Radioactive Waste Management BasisSept 2001

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U.S. Department of Energy

Oakland Operations Office, Oakland, California

RADIOACTIVE WASTE MANAGEMENT BASIS

for the:

Lawrence Livermore National Laboratory

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

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Rev. 0

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DOE Approvals Page

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PREFACE

This Radioactive Waste Management Basis describes the systematic approach for planning, executing, and evaluating the management of radioactive waste at LLNL. The implementation of this document will ensure that waste management activities at LLNL are conducted in compliance with the requirements of DOE Order 435.1, *Radioactive Waste Management*, and the Implementation Guide for DOE Manual 435.1-1, *Radioactive Waste Management Manual*.

ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHEW	Chemical Exchange Warehouse
CWAA	Consolidation Waste Accumulation Area
DOE	Department of Energy
DQO	Data Quality Objectives
EA	Environmental Analyst
EPA	Environmental Protection Agency
EPD QAPP	Environmental Protection Department Quality Assurance Management Plan
ES&H	Environmental Safety and Health
FSP	Facility Safety Plan
HWM	Hazardous Waste Management
HWMD	Hazardous Waste Management Division
HWM WAC	Hazardous Waste Management Waste Acceptance Criteria
ISM	Integrated Safety Management
IWS	Integrated Work Sheet
LLNL	Lawrence Livermore National Laboratory
LLW	Low-Level Waste
MLLW	Mixed Low-Level Waste
NCAR	Nonconformance and Corrective Action Report
NEPA	National Environmental Policy Act
NORM	Naturally Occurring Radioactive Material
RCRA	Resource Conservation and Recovery Act
RPP	Radiological Protection Program
RWMB	Radioactive Waste Management Basis
SAA	Satellite Accumulation Area
TRU	Transuranic Waste
TSCA	Toxic Substances Control Act
WAA	Waste Accumulation Area

WAC	Waste Acceptance Criteria
WCP	Waste Certification Program
WDR	Waste Disposal Requisition
WGS	Waste Generator Services
WIPP	Waste Isolation Pilot Plant
WSS	Work Smart Standards

DEFINITIONS

by-product material	(1) Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material, and (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. [Source: Atomic Energy Act of 1954, as amended, section 11(e)]
defense-in-depth	The practice of using physical and administrative systems in a structure of mutual reinforcement to avoid exposure of the public, the workforce, and the environment to nuclear radiation and radioactive materials. [Source: DNFSB/TECH-6]
Disposal	Emplacement of waste in a manner that ensures protection of the public, workers, and the environment with no intent of retrieval and that requires deliberate action to regain access to the waste. [Source: DOE Order 435.1]
hazard	A source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel or damage to an operation or to the environment (without regard for the likelihood or credibility of accident scenarios or consequence mitigation). [Source: DOE Manual 411.1-1]
high-level waste	High-level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation. [Adapted from: Nuclear Waste Policy Act of 1982, as amended]
life cycle	The life of a waste from generator planning through generation, storage, treatment, and disposal. [Adapted from: DOE Order 430.1A]
low-level waste	Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, by-product material (as defined in section 11e.(2) of the Atomic Energy Act of 1954, as amended), or naturally occurring radioactive material. [Adapted from: Nuclear Waste Policy Act of 1982, as amended]
mixed low-level radioactive waste (mixed waste)	Waste that contains both source, special nuclear, or by-product material subject to the Atomic Energy Act of 1954, as amended, and a hazardous component subject to the Resource Conservation and Recovery Act. [Adapted from: Federal Facility Compliance Act of 1992]

naturally occurring radioactive material (NORM)	Naturally occurring materials not regulated under the <i>Atomic Energy Act of 1954</i> , as amended, whose composition, radionuclide concentrations, availability, or proximity to man have been increased by or as a result of human practices. NORM does not include the natural radioactivity of rocks or soils, or background radiation. [Adapted from: January 1997 Draft Part N, Regulation and Licensing of Naturally Occurring Radioactive Material, Conference of Radiation Control Program Directors, Inc.]
oversight	The responsibility and authority assigned to line management to assess the adequacy of DOE and contractor performance. Independent Oversight refers to the responsibility and authority assigned to the Assistant Secretary for Environment, Safety and Health to independently assess the adequacy of DOE and contractor performance. [Adapted from: DOE Manual 411.1-1]
radioactive waste	Any garbage, refuse, sludges, and other discarded material, including solid, liquid, semisolid, or contained gaseous material that must be managed for its radioactive content. [Adapted from: 40 CFR Part 240]
radioactive waste management facility/operations/activities	All land, structures, other appurtenances, and improvements on the land which generate, treat, store, or dispose of radioactive waste, and the operations and activities associated therewith. [Source: DOE Order 435.1]
record	A completed document or other medium that provides objective evidence of an item, service, or process. [Source: 10 CFR 830.3]
release	Any discharging, dumping, emitting, emptying, escaping, injecting, leaching, leaking, pouring, pumping, spilling of radioactive substances into the environment including abandoning any type of receptacle containing radioactive substances, but does not include disposal in a permitted disposal facility. [Adapted from: DOE Glossary]
release of waste	The exercising of DOE's authority to release property that has been declared waste from its control after confirming that residual radioactive material on the waste has been determined to meet the guidelines for residual radioactive material in accordance with DOE Order 5400.5, Radiation Protection of the Public and the Environment, and other applicable radiological requirements. [Adapted from: DOE Order 5400.5]
site	A geographic entity comprising leased or owned land, buildings, and other structures required to perform program activities. [Source: DOE Order 430.1A]
source material	(1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of (i) uranium, (ii) thorium or (iii) any combination thereof. Source material does not include special nuclear material. [Source: 10 CFR Part 40]

special nuclear material	(1) Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which is determined, pursuant to the provisions of section 51 [of the Atomic Energy Act of 1954, as amended], to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material. [Source: Atomic Energy Act of 1954, as amended]
spent nuclear fuel	Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. Test specimens of fissionable material irradiated for research and development only, and not production of power or plutonium, may be classified as waste, and managed in accordance with the requirements of this Order when it is technically infeasible, cost prohibitive, or would increase worker exposure to separate the remaining test specimens from other contaminated material. [Source: DOE Order 435.1]
staging	Storing waste for the purpose of accumulation to facilitate transportation transfer, treatment and/or disposal. [Adapted from: Surplus Plutonium Disposition Draft Environmental Impact Statement, July 1998]
storage	The holding of radioactive waste for a temporary period, at the end of which the waste is treated, disposed of, or stored elsewhere. [Adapted from: 40 CFR Part 260]
transuranic waste	Transuranic waste is radioactive waste containing more than 100 nanocuries (3,700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or (3) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61. [Source: Waste Isolation Pilot Plant (WIPP) Land Withdrawal Act of 1992, as amended]
treatment	Any method, technique, or process designed to change the physical or chemical character of waste to render it: less hazardous; safer to transport, store, or dispose of; or reduce its volume. [Source: DOE Order 435.1]
waste acceptance criteria (WAC)	Waste acceptance criteria are the technical and administrative requirements that a waste must meet in order for it to be accepted at a storage, treatment, or disposal facility. [Source: DOE Order 435.1]
waste acceptance requirements	Waste acceptance requirements are waste acceptance criteria, and all other requirements that a facility receiving radioactive waste for storage, treatment, or disposal must meet to receive waste (e.g., waste acceptance program requirements, receiving facility operations manual). [Source: DOE Order 435.1]

waste certification	A process by which a waste generator (LLNL) affirms that a given waste or waste stream meets the waste acceptance criteria of the facility to which the generator intends to transfer waste for treatment, storage, or disposal. [Source: DOE Order 435.1]
waste characterization	The identification of waste composition and properties, by review of acceptable knowledge (which includes process knowledge), or by nondestructive examination, nondestructive assay, or sampling and analysis, to comply with applicable storage, treatment, handling, transportation, and disposal requirements. [Adapted from: DOE Glossary ("Characterization" definition) and Federal Register, Vol. 62, No. 224]
waste container	A receptacle for waste, including any liner, shielding, or material that is intended to accompany the waste in disposal. [Source from: DOE Order 435.1]
waste designation	A determination of the category to which the waste belongs: hazardous, low-level radioactive, mixed low-level, etc.
waste management	The planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities. [Source: DOE Order 435.1]
Waste stream	A waste or group of wastes from a process or a facility with similar physical, chemical, or radiological properties. [Source: DOE Order 435.1]

1. INTRODUCTION

This Radioactive Waste Management Basis (RWMB) documents radioactive waste management practices adopted at Lawrence Livermore National Laboratory (LLNL) pursuant to Department of Energy (DOE) Order 435.1, *Radioactive Waste Management*.

1.1 Purpose

The purpose of this Radioactive Waste Management Basis is to describe the systematic approach for planning, executing, and evaluating the management of radioactive waste at LLNL. The implementation of this document will ensure that waste management activities at LLNL are conducted in compliance with the requirements of DOE Order 435.1, *Radioactive Waste Management*, and the Implementation Guide for DOE Manual 435.1-1, *Radioactive Waste Management Manual*. Technical justification is provided where methods for meeting the requirements of DOE Order 435.1 deviate from the DOE Manual 435.1-1 and Implementation Guide.

1.2 Scope

The activities covered by this RWMB include the generation, on-site management, characterization, profiling, packaging, storage, transfer, certification, treatment, and off-site disposal of all radioactive wastes, which consist of low-level, transuranic (including mixed transuranic), and mixed low-level radioactive waste (LLW, TRU, and MLLW, respectively). High-level waste is not managed at LLNL and is therefore not included in this plan. Hazardous wastes are covered by other LLNL documents. Non-radioactive wastes are not discussed as part of this RWMB.

1.3 Updates and Revisions

This RWMB will be updated as necessary to reflect changes in the regulations, DOE Orders, and significant changes in programs and expected waste streams. At a minimum, the RWMB will be reviewed and revised every three (3) years to ensure that it is current with LLNL's waste management programs and practices. Minor deviations in waste management activities will be addressed in other appropriate documentation.

2. RADIOACTIVE WASTE MANAGEMENT BASIS

DOE adopted the concept of a radioactive waste management basis to provide assurances that controls are developed, documented, and properly implemented for management of radioactive waste. The term "controls" refers to processes, procedures, equipment, instruments, and other items that are intended to reduce the likelihood of, or the consequences from, a problem that could arise from managing radioactive waste. This document describes LLNL programs aimed at assuring the application of proper controls in all radioactive waste management activities.

2.1 Radioactive Waste Management Basis Requirements

In accordance with DOE Order 435.1, a radioactive waste management basis must be developed and maintained for each DOE radioactive waste management facility, operation, and activity, and shall:

- Reference or define the conditions under which the facility may operate based on the radioactive waste management documentation;
- Include the applicable elements identified in the specific waste-type chapters of DOE Manual 435.1;
- Be developed using a graded approach process.

The RWMB for low-level and TRU waste facilities, operations, and activities shall consist of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the Radioactive Waste Management Basis:

- **Generators.** The waste certification program.
- **Treatment Facilities.** The waste acceptance requirements and the waste certification program.
- **Storage Facilities.** The waste acceptance requirements and the waste certification program.
- **Disposal Facilities.** The performance assessment, composite analysis, disposal authorization statement, closure plan, waste acceptance requirements, and monitoring plan.

The LLNL Radioactive Waste Management Basis includes only the requirements for generators, treatment, and storage facilities. No waste disposal occurs at LLNL, and therefore the disposal facility requirements are not applicable.

2.2 LLNL Radioactive Waste Management Basis

The LLNL Waste Management Basis is comprised of this document and other supporting documents. Supporting documents include but are not limited to:

- LLNL. *Environmental Protection Department Quality Assurance Management Plan (EPD QAPP)*, latest revision.

- LLNL. *Environmental Safety & Health Manual. (ES&H)*, UCRL-MA-119618, latest revision.
- LLNL. *Integrated Safety Management System Description*, UCRL-AR-132791, latest revision.
- LLNL. *Low-Level Waste Program Certification and Quality Assurance Plan*, M-078-95, latest revision.
- LLNL. *Onsite Hazardous Materials Packaging and Transportation Safety Manual*, UCRL-MA-108269, latest revision.
- LLNL. *TRU Waste Program Certification and Quality Assurance Plan*, M-07080121, latest revision.
- LLNL. *Waste Acceptance Criteria (WAC)*, UCRL-MA-115877, latest revision.
- LLNL. *Waste Certification Program Sampling and Analysis Plan*, UCRL-AR-121797, latest revision.

2.3 Radioactive Waste Management Basis Review

The RWMB must be reviewed and approved by the DOE Field Element Manager or designee.

3. RADIOACTIVE WASTE STREAMS

Waste managed at LLNL consists of laboratory, operations, research, and development, legacy material/waste, and decontamination & decommissioning of contaminated soil and debris generated during remedial activities. The scope of this basis consists of on-site management, storage, treatment, and off-site disposal of low-level, transuranic (including mixed transuranic), and mixed low-level radioactive waste (LLW, TRU, and MLLW, respectively). High-level waste is not managed at LLNL and is therefore not included in this plan. Hazardous wastes are covered by other LLNL documents.

3.1 Radioactive Waste Stream Descriptions

3.1.1 *Low-Level Radioactive Waste*

Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, and byproduct material (as defined in section 11e (2) of the Atomic Energy Act of 1954 as amended) or naturally occurring radioactive material (NORM).

3.1.2 *TRU Waste*

Transuranic waste is radioactive waste containing >100 nanocuries (3700 Becquerels) of alpha-emitting transuranium radionuclides per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency (EPA), does not need the degree of isolation required by the 40 Code of Federal Regulations (CFR) Part 191 disposal regulations; or (3) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61. This also includes transuranic waste that has a RCRA hazardous component.

3.1.3 *Mixed Waste*

Mixed waste is radioactive waste that contains both a radioactive constituent and a Resource Conservation and Recovery Act (RCRA) hazardous constituent. Waste can become mixed because of: (1) generation as mixed waste during an experiment or procedure; (2) exposure of RCRA hazardous waste to unconfined sources of radioactivity to the point that the waste becomes radioactive; or (3) improper waste segregation.

3.1.4 *California Combined Waste*

Waste that meets the definition of LLW and also contains a state of California regulated hazardous constituent only and is free of RCRA hazardous waste constituents.

* NORM is managed as Low-Level Radioactive Waste.

4. RESPONSIBILITIES

4.1 Department of Energy

Provide guidance on Waste Management practices and review and provide direction on the generation of waste without a path to disposal.

4.2 Generator

- Prior to generating a waste with a radioactive component, contact a HWM representative so that the life-cycle planning on the proposed waste can be completed.
- Properly store and characterize the waste they generate to provide Hazardous Waste Management representatives with sufficient information to safely handle and manage the waste.

4.3 Hazardous Waste Management Division

Manage or assist in managing the waste from generation to disposal in an environmentally safe manner protective of the worker and public health.

5. GENERAL REQUIREMENTS

5.1 Conduct of Operations

DOE O 5480.19 has been partially accepted in the Work Smart Standards (WSS) set. The requirements of DOE O 5480.19 that have been accepted as part of LLNL WSS are paragraphs 4 and 5 (b-c). The DOE orders referenced are applicable only to some extent of those adopted in the work smart standards at LLNL. Conduct of operations is addressed in the LLNL ES&H Manual Volume I, Part 3.5, *Conduct of Operations for LLNL Facilities*.

5.2 Quality Assurance

DOE O 414.1 has been partially accepted in the WSS set. Operations and activities at LLNL are performed in accordance with the requirements of 10 CFR Part 830 Subpart A, *Quality Assurance Requirements*, and DOE Order 414.1, *Quality Assurance*. General Quality Assurance for the laboratory is addressed in the LLNL ES&H Manual Volume IV, Section 3, *LLNL Quality Assurance Program*. Waste related activities impacting quality are controlled by the LLNL LLW Program Certification and Quality Assurance Plan, LLNL TRU Waste Program Certification and Quality Assurance Plan, and LLNL EPD Quality Assurance Management Plan.

5.3 Radiation Protection Program

Operations and activities at LLNL are conducted in conformance with the Radiological Protection Program (RPP) which complies with the applicable requirements of 10CFR 835, *Occupational Radiation Protection*, and Volume II, Part 20 of the LLNL ES&H Manual.

5.4 Defense-In-Depth

Defense-in-depth principles advocate the use of multiple levels of engineered and administrative controls to provide protection to the public, workers, and the environment. These principles are incorporated where potential uncertainties or vulnerabilities warrant their use during the review and approval of radioactive waste management activities and documents. Waste management activities are evaluated through the Integrated Safety Management (ISM) process and appropriate levels of engineering or administrative controls are applied to ensure the safety of the workers, the public, and the environment.

5.5 Resource Conservation and Recovery Act Compliance

LLNL follows the requirement in RCRA as prescribed by 40 CFR Chapter I, Subchapter I, and California regulations Title 26, Section 22-66261, for hazardous components of mixed waste. LLW determined to contain a hazardous component subject to RCRA is under the purview of the RCRA regulations. RCRA substantive requirements for storage, inspections, management, and treatment of hazardous waste are complied with at LLNL.

5.6 California Hazardous Waste Regulations

In addition to RCRA, LLNL must comply with California's hazardous waste regulations when handling, hazardous waste in California. If LLW contains constituents considered hazardous in California but not hazardous under RCRA, the waste will be stored as a LLW and may also be shipped as LLW if shipped to a disposal site outside of California or Nevada.

5.7 Toxic Substances Control Act Compliance

Waste containing regulated toxic components, such as polychlorinated biphenyls, asbestos, or other such materials, must be managed in accordance with requirements of the Toxic Substances Control Act (TSCA), as amended. The definitions and other compliance related requirements of TSCA regulated material/waste is incorporated into the LLNL *Hazardous Waste Management Waste Acceptance Criteria (HWM WAC)*. The requirements for storage are addressed in the facility specific Facility Safety Plans (FSPs).

5.8 Emergency Management

Emergency management activities at LLNL are covered by the ES&H Manual, Volume II, Part 22.1, *Emergency Management*.

5.9 Environmental Occurrence Reporting

DOE O 151.1 has been accepted in the WSS set and both DOE O 231.1 and O 232.1A have been partially accepted in the WSS set. Occurrence reporting is performed through the occurrence reporting office. General guidelines are addressed in the LLNL ES&H Manual, Volume I, Section 5, *Occurrence Reporting and Processing of Operations Information*; LLNL Implementation Procedures for DOE Order 232.1A.

5.10 Environmental Monitoring

Currently environmental monitoring aspects of all operations and activities at LLNL are addressed in DOE Orders 5400.1 and 5400.5, which have been partially accepted in the WSS set. The LLNL ES&H Manual, Volume I, Part 3.6, *Environmental Planning*, addresses how the program is implemented.

5.11 Work Smart Standards

The set of Work Smart Standards was developed jointly with the Department of Energy using the Work Smart Closure Process. These standards contain environmental, safety, and health requirements applicable to Contract 48. The Laboratory is responsible for complying with these requirements.

LLNL has defined 19 categories of hazards and has determined which Work Smart Standards are associated with each of these 19 types of hazards.

Work Smart Standards for DOE M 435.1 and DOE O 435.1 are standards B251 and B252 respectively. The WSS Hazard Category Number is 39a. The Work Smart Standard for DOE M 435.1 is DOE M 435.1, Chapter I General Requirements and Responsibilities. All sections except the DOE Orders incorporated by reference are applicable only to the extent they were adopted site-wide in the LLNL WSS set of standards (delete 1.2.A through 1.2.F).

Chapter II High-Level Waste Requirements are not applicable. Chapter III Transuranic Waste Requirements. Sections A through Q (Delete B (3), C, D (4), H (1), H (2), N (4), and P). Chapter IV Low-Level Waste Requirements, Sections A through R (Delete C, D (4), G (1)(d) 1-5, M (1)(c), M (3), N (2), N (7), P, Q, and R (3)).

The Work Smart Standard for DOE 435.1 is Radioactive Waste Management, Attachment 1, Contractor Requirement Document.

6. WASTE GENERATION

6.1 Life Cycle Planning

In most cases prior to waste generation, planning is performed to address the entire life cycle for all waste streams. The Hazardous Waste Management Division (HWMD) is notified of potential new waste streams through the following avenues:

- Integrated Work Sheet (IWS) Process
- National Environmental Policy Act (NEPA) evaluation
- New design package review
- Monthly Radiological Procurements
- Generator, Environmental Analyst (EA), and/or Hazardous Waste Management (HWM) technician awareness of proposed new waste stream or change to existing waste stream.

The technical representatives from HWMD evaluate the potential waste stream to identify characterization, storage, management, treatment, and disposal strategies. The life cycle planning process will be used to evaluate potential waste and to identify any waste that does not have an identified path to disposal.

6.2 Waste with No Identified Path to Disposal

LLNL has developed the following definitions to assist in categorizing and managing waste that has No Path to Disposal and therefore must be reported to DOE as waste that does not have a disposal option.

No Path to Disposal – Planned waste that cannot be made to meet the acceptance criteria of any disposal facility. (Cost for characterization, transportation, treatment, and/or disposal are not factors in the evaluation of acceptability of the waste by the disposal facility.)

No Disposal Option – Planned waste for which meeting the acceptance criteria of a disposal facility would be cost-prohibitive for characterization, treatment, transportation, disposal, and/or technology development.

The Waste Generator Services (WGS) form 0039, *Disposal Path/Option Evaluation for Radiological Waste Types* form will be used to evaluate the life cycle planning including the disposal path and options.

LLNL will report to DOE waste streams with no identified path to disposal. The WGS form 0040, *No Path to Disposal Exemption* form will be used to report the following information concerning the potential waste stream:

- Programmatic need to generate the waste.
- Characteristics and issues preventing the disposal of the waste.
- Safe storage of the waste until disposal can be achieved.
- Activities and plans for achieving final disposal of the waste.

7. WASTE CHARACTERIZATION AND DESIGNATION

Waste process knowledge evaluation and characterization is critical in determining the management and disposal requirements for each waste stream generated at LLNL.

7.1 Characterization Methods

LLW and MLLW are characterized using direct and/or indirect methods. To the extent discernible, process knowledge is used to initially characterize the waste for proper storage and/or disposal. LLNL uses Waste Certification Program (WCP) and/or HWM procedures to evaluate the information provided by the generator to ensure safe storage according to the HWM WAC. If more characterization is needed, LLNL may use the Data Quality Objectives (DQO) process, LLNL *Waste Certification Program Sampling and Analysis Plan* or other appropriate Waste Certification Program procedures to further obtain information about the waste. Process knowledge, HWM WAC, and the disposal facility WAC dictate the type of analysis performed to characterize the waste further, if needed.

7.2 Data Quality Objectives

In most cases, the HWM WAC for storage and the disposal facility WAC's are used to identify characterization parameters and acceptable uncertainty in characterization data.

WCP procedures describe the DQO process. The DQO process includes planning for both the sampling and analytical portions of the characterization process. The Data Quality Objective process must be developed and initialed prior to the implementation and assessment of sampling and analysis activities. This process may be applied to low-level, mixed low-level, and California Combined waste streams at LLNL to plan proper characterization for off-site disposal facilities. The DQO process may be used in place of the process described in the LLNL *Waste Certification Program Sampling and Analysis Plan*.

In the case of waste being characterized for release as a clean material, regulatory drivers such as preliminary remediation goals, risk-based action standards, maximum contaminant levels and radioactive waste release criteria established by the Nuclear Regulatory Commission and DOE are used as the characterization parameters. The process for free and authorized release of material is defined in the LLNL ES&H Volume II, Supplement 8.07.

7.3 Waste Disposal Requisition (WDR)

Waste data is collected and recorded on the WDR. The type of data collected is:

- Physical and compatibility characteristics (including hazardous contents);
- Waste volume;
- Weight of the container and contents;
- Identities and activities of radionuclides;

- Characterization information;
- Generating source;
- Any other information required for safe storage of the waste.

8. PACKAGING

All waste generated at LLNL is packaged in a manner that provides containment and protection for the duration of the anticipated storage period until disposal is achieved, or until the waste is removed from the container. If waste has the potential for pressurizing or generating flammable or explosive concentrations of gases within the waste container, then vents or other measures that are needed will be installed according to WCP procedures or an equivalent approved procedure as necessary to safely package the waste. If such waste streams might be generated during future activities, safe packaging methods will be evaluated during the life cycle planning process and safe packaging will be prescribed to the generator.

8.1 Packaging Procedures

The LLNL *Onsite Hazardous Material Packaging and Transportation Safety Manual* is the primary document used for packaging waste. In addition, the LLNL ES&H Manual and the LLNL HWM WAC, and WCP procedures describe how waste is packaged. Containers shall be marked such that their contents can be identified. Waste is packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste is removed from the container or repackaged.

8.2 Waste Information

To document the contents, properties, proper packaging, and other relevant characteristics of each waste container, a WDR serves as the record for retention of the minimum required information.

8.3 Segregation

LLNL segregates waste by packaging the waste in separate containers. Defense waste is separated from non-defense waste. Low level waste is separated from mixed or combined waste. When possible and space permits, containers may be further separated, but in small or high volume storage locations, this is not always an option.

9. ON-SITE STORAGE

In general, waste is stored in a Satellite Accumulation Area (SAA), Waste Accumulation Area (WAA), 693, 233, 169 (Consolidation Waste Accumulation Area (CWAA)), 361 (CWAA), 514 Area, or the 696, 612-storage yard.

9.1 Waste Storage Procedures

The FSP for each facility documents the procedures and processes for waste storage, which dictate how waste is stored and managed within the storage areas.

9.2 Waste Acceptance Requirements for On-Site Storage

Radioactive waste storage requirements at LLNL are intended to ensure the stability of the facility, minimize the need for long-term active maintenance, and eliminate contact of water with waste. The acceptance requirements for on-site storage at LLNL are detailed in facility specific FSPs, HWM WAC, and HWM procedures and specify:

- Allowable activities of specific radionuclides;
- Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal;
- Restrictions or prohibitions on waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance;
- That void spaces within the waste and between the waste and its container shall be reduced to the extent practical;
- That no free liquid is present in solid waste;
- The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements and the required documentation for such exceptions, including disposition as approved or not approved.

LLNL manages the following types of waste as indicated:

- LLW or TRU readily capable of detonation, explosive decomposition, or reaction or explosive reaction with water or pyrophoric materials are managed on a case by case basis or in accordance with WCP procedures and/or equivalent approved procedures.
- LLW or TRU capable of generating by radiolysis or biodegradation, quantities of toxic gases, vapors, or fumes harmful to the public, workers, disposal facility personnel or the long-term structural stability of the disposal site are managed using vents and with materials such as lime for biowaste to reduce degradation or other gas formation;

- LLW or TRU waste in a gaseous form is managed in appropriate containers on a case by case basis.

9.3 Storage Timeline

LLNL did not accept the 12-month storage limit, but instead created a standard establishing a risk-based storage limit based on dose rates. Any radioactive waste that creates a "high radiation area" as defined in 10 CFR 835 (i.e., a deep dose equivalent rate in excess of 0.1 rem in one hour at 30 cm from the waste container) will be subject to an eighteen month storage limitation.

10. TREATMENT

Treatment of radioactive waste to provide waste forms acceptable for disposal will be conducted in conformance with treatment procedures. Treatment procedures will define requirements for treatment to ensure that all radioactive waste is treated in a manner that protects the public, workers, and the environment and is in accordance with the LLNL ES&H Manual and the identified waste disposal facility WAC, if applicable.

11. TRANSPORTATION

All radioactive waste is packaged and transported in accordance with relevant U.S. Department of Transportation requirements, DOE Order 460.1A, Packaging and Transportation Safety, and DOE Order 460.2, Departmental Materials Transportation and Packaging Management. To the extent practical, the volume of waste and number of shipments are minimized.

HWM procedures and the LLNL *Onsite Hazardous Material Packaging and Transportation Safety Manual* describe the steps required to ensure safe transportation of radioactive waste including:

- Packaging and labeling of trucks and containers;
- Vehicle safety inspection requirements;
- Radiological surveys and documentation;
- Vehicle placarding requirement, as applicable;
- Emergency contacts.

12. DISPOSAL

12.1 Disposal Facility Waste Acceptance Criteria

All waste is evaluated using process knowledge and/or characterized to ensure that it complies with the disposal facility's WAC. Before any additional analytical characterization is undertaken for any waste stream, the WAC requirements for the potential disposal facilities are obtained and characterization is performed as needed to support process knowledge to verify that the waste meets the intended disposal site's WAC. LLNL uses WCP procedures to certify that the waste is sufficiently characterized to meet the disposal site WAC.

12.2 Exemption for Use of Non-DOE Facilities

When feasible, radioactive waste may be sent to DOE facilities for disposal. An exemption letter authorizing LLNL to ship certain waste to non-DOE facilities for disposal is drafted, as needed, every fiscal year for each facility that will be used. Such facilities must comply with applicable federal, state, and local requirements in order to accept waste from DOE. LLNL will verify that the non-DOE disposal facilities have all necessary permits, licenses, and approvals for the specific waste being shipped.

12.3 Compliance with CERCLA Section 121(d)(3), Off-Site Rule

Hazardous substances, pollutants or contaminants resulting from a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response action and transferred off site for treatment, storage or disposal must be transferred to a facility operating in compliance with Sections 3004 and 3005 of RCRA and other applicable laws or regulations. The receiving units at any land disposal facility to which the CERCLA waste is shipped can have no releases of hazardous wastes or hazardous constituents. The compliance status of any disposal facility receiving LLNL CERCLA waste will be verified with the Regional Off-Site Contact for compliance with the Off-Site Rule and the verification will be documented in the record file.

13. TRAINING

A training and qualification program commensurate with radioactive waste management job duties and responsibilities is implemented for waste management program personnel and generators, as specified by the LLNL *EPD QAPP*, LLNL *LLW Program Certification and Quality Assurance Plan*, and LLNL *TRU Program Certification and Quality Assurance Plan*. Additionally, the LLNL ES&H Manual describes general health and safety training requirements and hazard communication requirements for LLNL employees that may be exposed to hazardous substances, radiological health hazards, or safety hazards. Specific training for low-level and TRU waste generators is also given.