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Date: NOV 2 3 2015
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LAUR: 15-28952

John Kieling, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Dear Mr. Kieling:

SUBJECT: 2015 LANL HAZARDOUS WASTE MINIMIZATION REPORT

The Los Alamos National Security, LLC (LANS) and the U.S. Department of Energy (DOE), the Permittees, are pleased to submit the enclosed annual report on hazardous waste minimization activities. The report was prepared pursuant to the requirements of Section 2.9 of the Los Alamos National Laboratory (LANL) Hazardous Waste Facility Permit and is required by the Permit to be submitted to the New Mexico Environment Department by December 1 for the previous year ending September 30.

The report included in Enclosure 1 details the progress made in the waste minimization program at LANL and describes the current and proposed methods the Permittees utilize to minimize the present and future threat to human health and the environment. The Permittees have made significant progress in minimizing hazardous waste and other waste types. Integrating pollution prevention and waste minimization into all operational activities will continue to increase waste minimization in the future.

Sincerely,

Patricia E. Gallagher
Group Leader
Environmental Stewardship Services Group (ENV-ES)

Sincerely,

Gene E. Turner
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NOV 23 2015

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Enclosure: 1. 2015 LANL Hazardous Waste Minimization Report

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ENCLOSURE 1

2015 LANL Hazardous Waste Minimization Report

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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Alison M. Dorries
Division Leader
Environment Division
Los Alamos National Laboratory
Operator

11/18/15
Date Signed

Gene E. Turner
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List of Acronyms

ADEP	Associate Directorate of Environmental Programs
ADESH	Associate Directorate of Environment, Safety, and Health
ALARA	as low as reasonably achievable
CFR	Code of Federal Regulations
CMR	Chemistry and Metallurgy Research facility
CRWSSDR	consolidated remote waste storage site disposal request
CWDR	chemical waste disposal request
D&D	decontamination and demolition
DOE	US Department of Energy
EAP	Environmental Action Plan
EMS	Environmental Management System
ENV-ES	Environmental Stewardship Group
EP	Environmental Programs Directorate
EP-CAP	Corrective Actions Projects
EPA	Environmental Protection Agency
ESH	Environment, Safety, and Health Directorate
FY	fiscal year
GIC	Green is Clean
ISO	International Organization of Standardization
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security, LLC
LANSCE	Los Alamos Neutron Science Center
LED	light-emitting diode
LLW	low-level waste
MDA	Material Disposal Area
MLLW	mixed low-level waste
MTRU	mixed transuranic waste
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyls
P2	Pollution Prevention (Program)
PPOA	Pollution Prevention Opportunity Assessment
R&D	Research and Development
RCA	radiological control area
RCRA	Resource Conservation and Recovery Act
RLUOB	Radiological Laboratory/Utility/Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
TA	Technical Area
TRU	transuranic (waste)
TSDF	treatment, storage, and disposal facility
TWSR	TRU waste storage request
URWSSDR	universal remote waste storage site disposal request
WCATS	Waste Compliance and Tracking System
WIPP	Waste Isolation Pilot Plant
WPF	Waste Profile Form

1.0 Hazardous Waste Minimization Report

1.1 Introduction

Waste minimization and pollution prevention are goals within the operating procedures of Los Alamos National Security, LLC (LANS). The US Department of Energy (DOE) and LANS are required to submit an annual hazardous waste minimization report to the New Mexico Environment Department (NMED) in accordance with the Los Alamos National Laboratory (LANL or the Laboratory) Hazardous Waste Facility Permit. The report was prepared pursuant to the requirements of Section 2.9 of the LANL Hazardous Waste Facility Permit. This report describes the hazardous waste minimization program, which is a component of the overall Pollution Prevention (P2) Program, administered by the Environmental Stewardship Group (ENV-ES). This report also supports the waste minimization and pollution prevention goals of the Environmental Programs Directorate (EP) organizations that are responsible for implementing remediation activities and describes its programs to incorporate waste reduction practices into remediation activities and procedures.

LANS was very successful in fiscal year (FY) 2015 (October 1, 2014 -September 30, 2015) in waste minimization and pollution prevention efforts. Staff funded several projects specifically related to reduction of waste with hazardous constituents. In FY15, there was no hazardous, mixed-transuranic (MTRU), or mixed low-level (MLLW) remediation waste shipped offsite from the Laboratory. Less non-remediation hazardous waste and MLLW was shipped offsite in FY15 than in FY14, and no non-remediation MTRU waste was shipped offsite during FY15. These accomplishments and analysis of the waste streams are discussed in much more detail within this report.

1.2 Background

In 1990, Congress passed the Pollution Prevention Act, which changed the focus of environmental policy from "end-of-pipe" regulation to source reduction and minimizing waste generation. Under the provisions of the Resource Conservation and Recovery Act (RCRA), and in compliance with the P2 Act and other institutional requirements for treatment, storage, and disposal of wastes, all waste generators must certify that they have a waste minimization program in place.

Specific DOE pollution prevention requirements are delineated in DOE Order 436.1, *Departmental Sustainability*, which was accepted into the LANS contract. The Order contains greenhouse gas emission reduction goals, energy and water conservation goals, and it places a strong emphasis on pollution prevention and sustainable acquisition. DOE Order 436.1 requirements are executed through the Laboratory's Environmental Management System (EMS). The Laboratory's EMS received third-party certification to the International Organization of Standardization (ISO) 14001:2004 standard in April 2006 and was recertified in March 2015.

The EMS is subject to surveillance audits every six months. Pollution prevention is a required element of the ISO 14001:2004 standard and is evident throughout the EMS.

A list of key applicable regulatory drivers for the P2 Program is presented below.

Federal Statutes and Executive Orders

- Resource Conservation and Recovery Act;
- Pollution Prevention Act of 1990;
- Executive Order 13693, Planning for Federal Sustainability in the Next Decade

Federal Regulations

- Code of Federal Regulations (CFR), Title 40, Parts 260–280, Hazardous Waste Management.

State of New Mexico Statutes

- New Mexico Hazardous Waste Act; and
- New Mexico Solid Waste Act.

State of New Mexico Regulations

- New Mexico Solid Waste Management Regulations, Title 20, Chapter 9, Part 1, New Mexico Administrative Code; and
- New Mexico Hazardous Waste Management Regulations, Title 20, Chapter 4, Part 1, New Mexico Administrative Code.

DOE Orders and Policies

- DOE Order 458.1, "Radiation Protection of the Public and the Environment";
- DOE Order 435.1, "Radioactive Waste Management";
- DOE Order 436.1, "Departmental Sustainability"; and
- Annual DOE Strategic Sustainability Performance Plan (DOE SSPP).

Directives and Policies

- Laboratory Governing Policy on Environment;
- SD 400, Environmental Management System Description;

- PD 400, Environmental Protection Program;
- P 401, Procedure to Identify, Communicate, and Implement Environmental Requirements;
- P 403, Environmental Aspects Identification Requirement;
- P 409, Waste Management; and
- P 412, Environmental Radiation Protection.

1.3 Purpose and Scope

The purpose of this report is to describe the waste minimization program that the Laboratory has implemented and maintained to reduce the volume and toxicity of hazardous wastes that it generates to minimize the threat to human health and the environment. This report discusses the methods and activities that are routinely employed to prevent or reduce waste generation, and the report documents FY15 waste quantities shipped offsite in comparison with FY14 quantities as well as significant waste minimization accomplishments. In most cases, waste minimization activities executed during FY15 will continue to occur during FY16 and beyond. This report also discusses the Laboratory Director's commitment to pollution prevention, specific elements of the Laboratory's pollution prevention efforts, and the barriers to implementation of further significant reductions.

The report discusses institutional policies, goals, and training activities that address hazardous and mixed waste reduction. The report provides waste minimization information by the following waste types: hazardous waste, MTRU, and MLLW. The last section of this report provides a description of the waste minimization and pollution prevention activities associated with remediation wastes.

1.4 Requirements of the Operating Permit

Section 2.9 of the LANL Hazardous Waste Facility Permit requires that a waste minimization program be in place and that a certified report be submitted annually to NMED. The list of permit requirements in Table 1-1 corresponds with a section of this report that addresses the requirement. Changes from the previous year are noted throughout this report.

Table 1-1. LANL Hazardous Waste Facility Permit Section 2.9

Permit Requirement	Topic	Report Section
Section 2.9 (1)	Policy Statement	Section 2.1
Section 2.9 (2)	Employee Training and Incentives	Section 2.2

Section 2.9 (3)	Past and Planned Source Reduction and Recycling	Sections 2.4.1, 2.4.2, 3.4, 4.4, 5.4, 6.4
Section 2.9 (4)	Itemized Capital Expenditures	Section 2.4
Section 2.9 (5)	Barriers to Implementation	Sections 3.5, 4.5, 5.5, 6.5
Section 2.9 (6)	Investigation of Additional Waste Minimization Efforts	Sections 2.4, 3.4, 4.4, 5.4, 6.4
Section 2.9 (7)	Waste Stream Flow Charts, Tables, and Analysis	Sections 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3 5.1, 5.2, 5.3, 6.2, 6.3
Section 2.9 (8)	Justification of Waste Generation	Sections 2.3, 6.1

1.5 Organizational Structure and Staff Responsibilities

The Laboratory Director, the Environmental Senior Management Steering Committee, and the Associate Director for Environment, Safety, and Health have oversight responsibilities and provide annual review of LANS' EMS, P2 Program goals, and environmental performance. The Environmental Protection (ENV) Division has primary responsibility and oversight responsibilities for the P2 Program. The goal of the P2 Program is to support core waste minimization activities and pollution prevention projects. Specific environmental remediation program waste minimization activities are discussed in Section 6 of this report.

The ENV-ES group is tasked to develop and manage the P2 Program and the EMS. The EMS establishes both institutional waste minimization and pollution prevention objectives and targets and directorate-level environmental action plans that contain waste minimization, pollution prevention, and other environmental improvement actions. ENV-ES provides:

- Oversight for P2 Program implementation;
- A base of technical knowledge and resources for pollution prevention practices;
- Assistance identifying waste generation trends and pollution prevention opportunities;
- Recommendations for pollution prevention solutions and applications;
- Support in tracking and reporting pollution prevention successes and lessons learned, funding for pollution prevention projects, and;
- Assistance identifying and addressing P2 Program implementation barriers.

The Waste Management Division provides all waste packaging, transporting, and disposal services at the Laboratory. The Waste Management Division is a key partner with ENV-ES in implementation of waste minimization projects and strategies.

2.0 Waste Minimization Program Elements

2.1 Governing Policy on Environment

The Laboratory Governing Policy on Environment states:

> *"We are committed to act as stewards of our environment to achieve our mission in accordance with all applicable environmental requirements. We set continual improvement objectives and targets, measure and document our progress, and share our results with our workforce, sponsors, and public. We reduce our environmental risk through legacy cleanup, pollution prevention, and long-term sustainability programs."*

2.1.1 FY15 EMS Institutional Objectives

A required element of the ISO 14001:2004 standard is the establishment of environmental objectives with quantifiable and achievable targets. The Laboratory's Environmental Senior Management Steering Committee established the following objectives as part of the EMS for FY15:

1. **Clean the Past**
    a. Continue to comply with the requirements of the Compliance Order on Consent with NMED
    b. Protect surface water runoff through implementation of the Individual Storm Water Permit with EPA
    c. Design and commence implementation of remediation activities for the chromium plume in groundwater beneath Sandia and Mortandad canyons
    d. Implement the institutional Facility Footprint Reduction Plan

2. **Control the Present**
    a. Maintain and improve the LANL environmental compliance program
    b. Fully integrate environmental controls with safety controls through integrated work management (IWM) requirements and standard work processes
    c. Implement sustainable acquisition (DOE Order 436.1, RCRA and SWEIS requirements)
    d. Implement pollution prevention across all environmental media
    e. Implement an enduring waste management program
    f. Implement and maintain a site cleanout and workplace stewardship program
    g. Implement and maintain an integrated, green infrastructure planning and maintenance program
    h. Design and implement integrated site planning and management

3. **Create a Sustainable Future**

    a. Implement an energy and water conservation program
    b. Implement an institutional plan for distributed server rooms and data centers
    c. Reduce greenhouse gas emissions
    d. Implement the institutional high performance sustainable buildings program
    e. Develop and deploy new environmental sustainable technologies
    f. Execute the long-term strategy for environmental stewardship and sustainability

Pollution prevention is an integral part of the EMS, the annual LANL Site Sustainability Plan, and the Long Term Strategy for Environmental Stewardship and Sustainability. The concept of As Low As Reasonably Achievable (ALARA) is being championed to encourage pollution prevention across the Laboratory as a means to sustainability.

The FY15 P2 Program approach focused on:

- Conducting pollution prevention opportunity assessments (PPOAs) on key processes;
- Utilizing material substitution as appropriate;
- Integrating pollution prevention principles into the project planning process;
- Developing and delivering guidance to address waste generation behaviors for staff and subcontractors;
- Communicating waste minimization lessons learned to the employees;
- Improving chemical use and management;
- Sustainable acquisition;
- Improving management of materials to reuse materials and equipment to the greatest extent possible before final disposition; and
- Recycling and reusing materials.

2.2 Employee Training and Incentive Programs

Several employee training and incentive programs exist to identify and implement opportunities for recycling and source reduction of various waste types.

Training courses that address waste minimization and pollution prevention requirements include:

- General Employee Training;
- Waste Generator Overview;

- Radworker II; and
- EMS Environmental Awareness Training.

LANS requires generators to minimize waste and conduct preventive measure assessments in waste management guidance documents.

In FY15, the Integrated Project Review Program provided a series of environmental permits and requirements briefings to several organizations to increase awareness of environmental concerns, including opportunities for waste minimization and prevention. Over forty briefings were provided to several organizations including:

- Project Management / Construction Management personnel;
- Deployed Environmental Professionals;
- Roads & Grounds and Heavy Equipment Operators;
- Numerous Worker Safety and Security teams throughout LANL; and
- Project Management Capital Project Leaders.

The DOE and NNSA sponsor annual pollution prevention awards competitions. The awards provide recognition to personnel who implement pollution prevention projects. LANS submits nominations for the DOE and NNSA awards each year. In FY14, LANS received five awards for pollution prevention projects, including one NNSA Best-in-Class award and four NNSA Environmental Stewardship awards. The winners for FY15 have not yet been announced.

The P2 Program holds a Pollution Prevention awards ceremony every year in conjunction with other Earth Day activities. Employees submit descriptions of projects they completed during the past year that reduced waste generation. Each participant is recognized by senior management with an award certificate and a small cash award. During FY15, the P2 Program gave awards to employees who worked on 32 projects to reduce waste generation, improve efficiency, and conserve resources. These projects have millions of dollars of value through cost savings, waste avoidance, and improved compliance. Benefits from these projects include reuse of ~100,000 lb of lead bricks, recycling of 750 tons of metal and 200 tons of concrete, and avoidance of about 2500 lb of hazardous waste and 1600 m^3 of MLLW.

Each year ENV-ES invites waste generators to submit proposals for pollution prevention project grants. ENV-ES coordinates the peer review of the project proposals and distributes the available funds to the projects. ENV-ES monitors progress on these projects and provides technical assistance as needed.

2.3 Utilization and Justification for the Use of Hazardous Materials

The Laboratory is a research and development (R&D) facility that executes thousands of projects requiring the use of chemicals or materials that may create hazardous waste. Pollution prevention and waste minimization requirements for waste generators include source reduction and material substitution techniques. Best management practices to reduce hazardous waste generation such as the use of micro-scale chemistry, use of nonhazardous cleaners, and other prevention techniques have been adopted. However, customer requirements, project specifications, or the basis of the research may demand the use of particular hazardous chemicals.

To encourage the use of nontoxic or less hazardous substitutes whenever possible, the P2 Program has a link to a database of alternative chemical choices on its website. The "Green Alternatives Wizard" was developed by researchers at the Massachusetts Institute of Technology. The database contains possible alternatives to some hazardous chemicals for particular processes. All employees can access this database of nontoxic or less hazardous alternative chemicals.

The Laboratory uses a database called ChemLog to track locations of all chemical containers onsite. All chemical containers are barcoded and entered into ChemLog upon arrival at the Laboratory. ChemLog allows chemical owners to mark chemicals that they no longer need as being available, and other onsite users can get these chemicals at no cost. In FY15, Laboratory personnel purchased 45,146 new containers of chemicals, which was slightly more than the 41,259 containers of chemicals purchased in FY14.

The implementation of DOE Order 436.1 gives buyers opportunities to choose less hazardous or non-hazardous janitorial products, office supplies, and other items that contain recycled materials. The janitorial supply catalog that the Laboratory uses offers "green" cleaning supplies, as does the office supply vendor. In addition, the computer procurement contract includes the preference for computers that meet the Electronic Product Environmental Assessment Tool certification standard. Other procurement requirements address remanufactured printer cartridges and energy efficiency standards for all printers and copiers. In addition, sustainable acquisition requirements for water and energy-efficient equipment and recycled-content construction supplies are in place at the Laboratory.

2.4 Investigation of Additional Waste Minimization and Pollution Prevention Efforts

ENV-ES monitors waste trends and develops improvement projects. Waste reduction projects often come directly from researchers, waste management coordinators, and the P2 staff members. Pollution Prevention staff provide technical support to waste generators in the implementation of these projects.

During FY15, fifteen directorates participated in the EMS process, and each examined its particular impacts on the environment. As a result of the EMS process, each directorate created an action plan with objectives and targets for reducing its environmental impact. These action plans detail projects that will reduce waste generation, increase recycling, save energy, or otherwise reduce environmental impacts.

The Site Wide Clean-up and Workplace Stewardship Program was established in FY14 in partnership with the P2 Program. Clean-up work continued during FY15, and this effort incorporates pollution prevention with safety improvement through a variety of activities. Unneeded equipment and chemicals are removed, and the tidier spaces pose less risk of injury or spills. Items removed, including furniture, equipment, and supplies, are either reused in other locations onsite, sold, or recycled. Unwanted chemicals are disposed. The program uses a quality-based 5S approach that has five primary aspects for space management: sort, straighten, shine, standardize, and sustain. Application of these structured housekeeping approaches reduces the future accumulation of unneeded chemicals and equipment. The first workplace Stewardship Sustainability Agreements were signed. Managers who signed the agreement commit to ensure good housekeeping practices to prevent accumulation of unneeded materials and unnecessary generation of waste.

The data support that these approaches are working. Fewer chemical containers were removed in FY15 than in FY14, although more than in FY13. The ChemLog database shows that the Laboratory disposed of 51,150 barcoded containers of chemicals in FY15 as compared with 60,874 containers in FY14 and 45,845 containers in FY13.

2.4.1 Funding for Past Projects

The following paragraphs describe P2 projects and capital funding amounts for the past five years. Pollution Prevention projects address all types of waste and pollutants. However, the following lists include projects that were designed to reduce hazardous waste, MLLW, or MTRU waste. Projects that address other waste types are not described in this report.

In FY11, funds were allocated to the following projects:

- Replacement of Lead-Loaded Glovebox Gloves with an Attenuation Medium of non-RCRA-Hazardous Metals ($7,500)

  The team ordered five pairs of Polyurethane – NonHaz Shielding – Hypalon gloves to test with gloveboxes. These do not contain lead, so they can ultimately be disposed of less expensively as LLW instead of as MLLW. In the future, many leaded gloves might be replaced with the Hypalon gloves.

- Two-Flange Gloveport Liner ($2,500)

The team designed an improvement for gloveboxes that involves using an extra liner between the glove and the gloveport. This extra liner helped reduce the chance of contamination getting onto the gloveport and glove inside the glovebox. This reduces the potential risk of contamination to employees and should result in the generation of less MLLW.

- Methanol Recirculation and Recovery Loop ($69,682)

  The multi-pass Methanol Recirculation and Recovery Loop (MRRL) replaced the single-pass methanol fuel system and provided methanol solution to four fuel cell test systems in parallel. The MRRL greatly reduces the volume and disposal cost of the hazardous methanol/water waste stream. Installation of the MRRL mitigates safety hazards associated with handling large volumes of methanol/water mixture.

- Target Fabrication Facility Centralized Chemical Stockroom ($75,000)

  This project established a centralized chemical stockroom for all operations at TA-35-213. By sharing chemicals among multiple projects, less hazardous waste in the form of unused or unspent chemicals is expected to be generated.

- 21st Century Solvent Purification for Actinide Chemistry ($20,000)

  This project is a continuation of work performed in FY10 to purify solvents for use in actinide chemistry. The system was made portable for use in multiple locations.

- Disposal of Hazardous Materials from TA-22-1 Cleanout ($4,000)

  Hazardous waste and oil were generated during the cleanout of a historical building at TA-22. The grant covered disposal costs of these wastes.

In FY12, funds were allocated to the following projects:

- Coolant Longevity Project ($30,000)

  This project implemented coolant filtering at several machines so that the coolant life is extended and less waste is produced. The allocated funds purchased equipment to filter the coolant.

- Waste Reduction Through Dry Cell Battery Recycling ($2,500)

  This project established more extensive recycling of various types of batteries from LANL-owned items such as cell phones and laptop computers.

- LANL Radiological and RCRA Constituents Background Study ($50,000)

This project updated and expanded the current background report for soil and construction debris. This new report gives remediation and demolition projects one clear set of background values, both for RCRA and radiological constituents.

- Microshield® Non-Destructive Analysis Tool Pilot Project ($50,000)

  This project demonstrated the site wide application of the Microshield® Non-Destructive Analysis software for radiological waste characterization. Using the software is expected to cut analytical costs by 30%.

- ISR-4 Waste Reduction through the Incorporation of Automated Cleaning Systems ($64,000)

  A Trident LD Automatic De-Fluxing and Cleanliness Testing System and a bench top Ultrasonic Cleaning System were installed, which eliminated use of alcohol and other solvents to clean circuit boards and other electronic components.

- Trichloroethylene replacement study: cleaning effectiveness determination ($100,000)

  This project tested Novec fluids in place of trichloroethylene for ultrasonic cleaning. Novec fluids are more stable than trichloroethylene and are expected to save time for researchers as well as reduce the volume of hazardous or MLLW.

In FY13, funds were allocated to the following projects:

- Smoke Alarm Recycling ($18,200)

  The funds for this project were used to recycle smoke detectors that contain americium and/or radium. These are smoke detectors that cannot be returned to their manufacturers and would otherwise be handled as MLLW.

- Oil-free and Cost Efficient Freeze Drying ($6,500)

  A new oil-free pump was installed for synthesizing and preserving peptides. The new pump will not generate any hazardous waste oil and will require less maintenance.

- Replacement of Oil-Based Vacuum Pumps ($81,200)

  Many new oil-free pumps were purchased with these funds for materials science research. Without oil, the new pumps will not generate hazardous waste oil, and there will be no chance of oil spills from these pumps.

- Sanitary Effluent Recycling Facility (SERF) Sludge Makes Carbon Neutral Concrete ($158,000)
  Research was performed on the best method to use for incorporating sludge from the SERF into concrete. Once the process is optimized, less sludge will need to be disposed of as New Mexico Special Waste because it can be incorporated into useful concrete.

In FY14, funds were allocated to the following projects:

- Electronics Roundup ($57,000)
  At multiple locations across the Laboratory, old and unwanted electronics were removed from RCAs. Approximately $35m^3$ of electronics were collected and disposed as MLLW. The expectation is that this equipment will not be replaced inside the RCAs, or that replacement equipment will be smaller so that much less MLLW will be created by old electronics in the future.

- Lead Brick Recovery ($55,000)
  Project personnel collected 25 pallets of lead bricks from TA-33, disinfected them, and shrink-wrapped them. These bricks are valuable since they were manufactured in the nineteenth century before nuclear testing began. Identification and the more protected storage of this material will prevent it from ever becoming waste.

- HS-Pu Filtrate Vessel Design & Replacement ($20,000)

  Process operators were able to significantly reduce TRU waste by designing and implementing a new vessel for the filtrate recovery process. This new vessel has a much longer life span, which will eliminate approximately $1m^3$ of contaminated plastics annually.

- Replace Oil-Based Pumps with Scroll Pumps in Rad Operations ($40,000)
  This team purchased six scroll pumps to replace traditional pumps lubricated with oil for particular operations that handle radioactive materials. This change prevents any oil from this operation from potentially becoming MLLW or LLW.

2.4.2 Funding for FY15 Projects

The LANS FY15 Pollution Prevention projects addressed MLLW, hazardous, and TRU waste streams, as well as other environmental impacts. The project titles are listed below.

- LED Replacement Plan ($65,000)
  Traditional light bulbs in glove boxes were replaced with LED bulbs. Since LED bulbs last longer, they generate a lower volume of waste less frequently. Since they need to be replaced less often, workers have lower exposure, and time spent on that task is spent on

more productive work instead. LED bulbs are also more energy efficient than traditional bulbs.

- Reduced Solvent Chemistry ($25,963)
  This team purchased a planetary mill, which allows them to synthesize custom compounds without using solvents, acids, or concentrated peroxides. Not only is hazardous waste avoided, but the reactions are performed more quickly and without the use of a pressure vessel.

- Workplace Stewardship Program ($100,000)
  Funds were provided to some cleanup projects that involved recycling or segregating materials that might otherwise have become waste. Many cubic meters of electronic equipment were tested and segregated to minimize the amount of MLLW generated.

3.0 Hazardous Waste

3.1 Introduction

The annual hazardous waste disposal volume that is reported as part of the P2 Program DOE reporting requirements is based on the total amount of waste shipped offsite for disposal recorded in the Waste Compliance and Tracking System (WCATS) database. This report does not include waste volumes generated prior to any onsite treatment, which is partially why waste volumes do not match with those reported in LANL's biennial report. Additionally, this report includes fiscal year data, and the biennial report includes calendar year data. Data quality assurance for WCATS is managed by the Operations Integration Office. The WCATS waste data used in this report was collected for FY15 on October 9, 2015.

In brief, 40 CFR §261.3, as adopted by the NMED as 20.4.1.200 NMAC, defines hazardous waste as any solid waste that

- is not specifically excluded from the regulations as hazardous waste;
- is listed in the regulations as a hazardous waste;
- exhibits any of the defined characteristics of hazardous waste (i.e., ignitability, corrosiveness, reactivity, or toxicity);
- is a mixture of solid and hazardous wastes; or
- is a used oil having more than 1000 ppm of total halogens.

Hazardous waste commonly generated includes many types of research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This waste may include equipment, containers, structures, and other items that are intended for disposal and that are contaminated with hazardous waste (e.g., compressed gas cylinders). Some contaminated wastewaters that cannot be sent to the sanitary wastewater system or the high explosives wastewater treatment plants also qualify as hazardous waste. Recycled wastes include aerosol cans, light bulbs, batteries, mercury, and ferric chloride solution. Figure 3-1 shows the process map for all waste generation at the Laboratory. This diagram comes from Procedure 409, which governs waste disposal at the Laboratory.

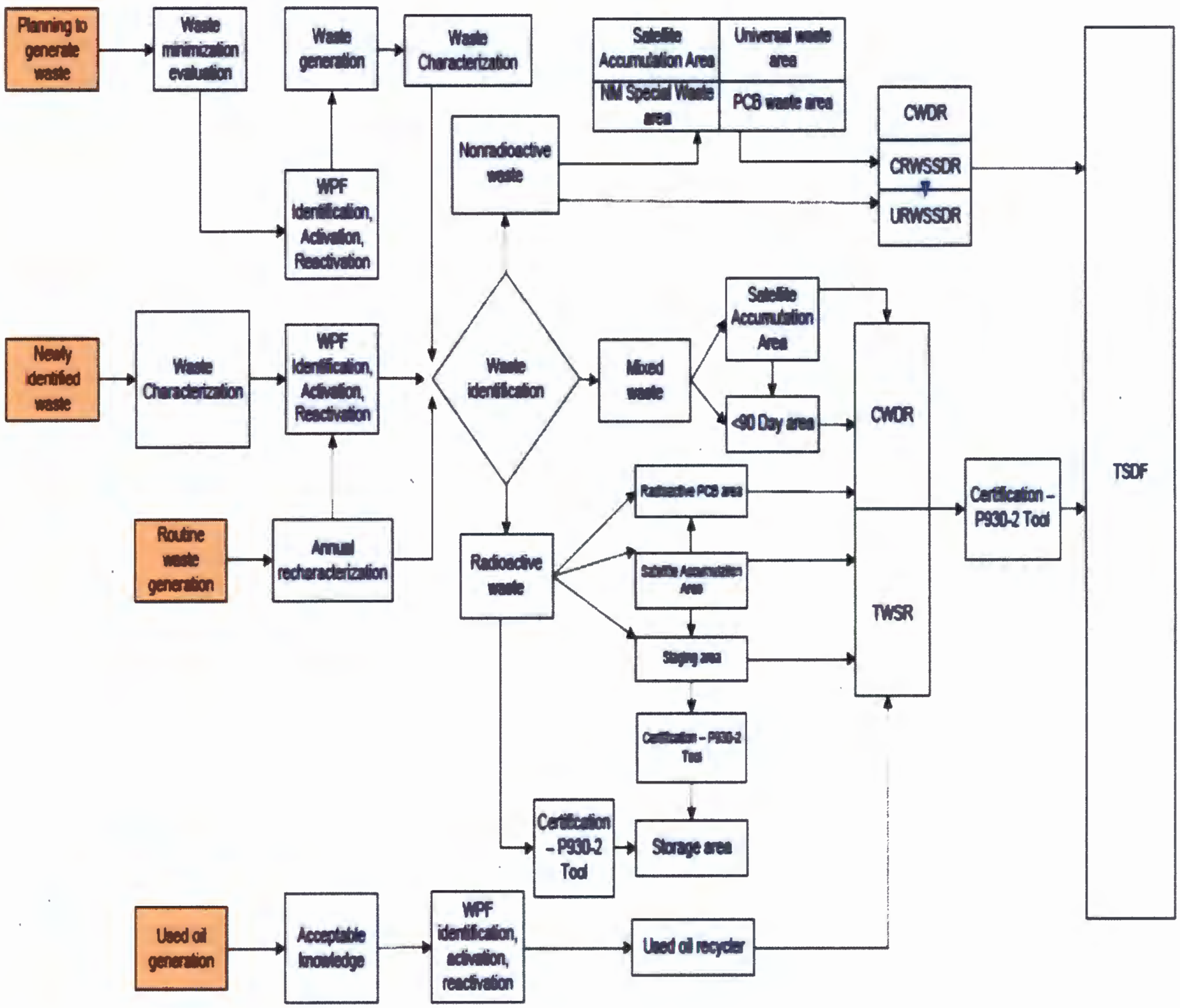

Figure 3-1. Waste Process Flow Map at the Laboratory.

3.2 Hazardous Waste Minimization Performance

The amount of non-remediation hazardous waste shipped from the Laboratory in FY15 was 26.5 m^3, excluding recycled materials. This amount is less than the 45.8 m^3 of hazardous waste shipped during FY14. The amount of hazardous waste that was recycled during FY15 was 40.5 m^3, which was less than the 55 m^3 that was recycled during FY14. During FY15 and FY14, no hazardous waste was generated from remediation activities. All of the non-recycled hazardous waste shipped offsite from the Laboratory in FY14 and FY15 is shown in Table 3-1 sorted by the TA location.

Table 3-1. Generation of Hazardous Waste by Technical Area during FY14 and FY15.

Technical Area	FY14 Hazardous Waste (m^3)	FY15 Hazardous Waste (m^3)
0 (leased space)	**0**	**0.1**
3	10.5	6.0
8	0.4	0.02
9	0.7	1.0
15	8.6	0.5
16	2.1	0.2
22	0.2	0.5
33	0	0.1
35	4.0	2.7
36	0.4	0.6
39	0.4	0.1
40	0.9	1.0
43	0.5	0.03
46	6.2	3.3
48	1.3	1.8
50	0.1	0.4
51	0.02	0
53	0.8	2.5
54	6.5	3.3
55	0.8	1.4
59	0.2	1.0
60	1.2	0.04

The TAs where the most hazardous waste was generated in FY15 are 3, 35, 54, 46, and 53.

Figure 3.2 shows the relative volumes of hazardous waste generated by TA.

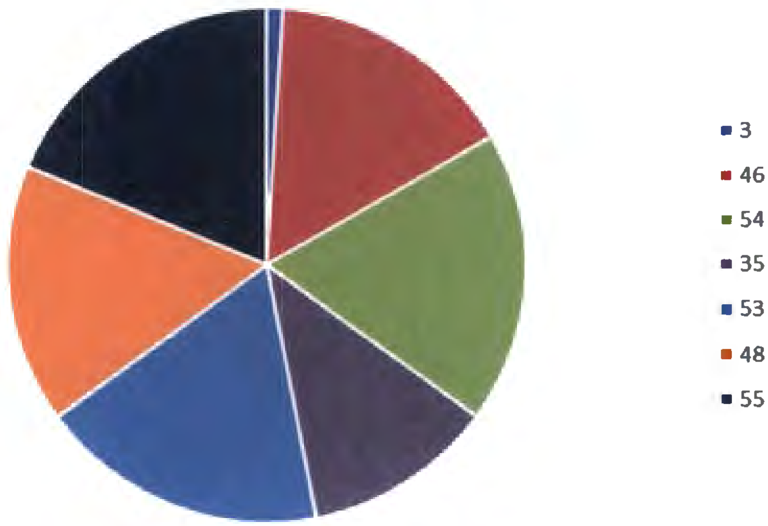

Figure 3-2. Hazardous Waste Shipped Offsite from LANL in FY15 by Technical Area.

3.3 Waste Stream Analysis

Hazardous waste is derived from hazardous materials and chemicals; hazardous materials disposed of as part of equipment replacement or facility decommissioning; and water contaminated with hazardous materials. After material is declared waste, the hazardous waste is characterized, labeled, and collected in appropriate storage areas. The waste is ultimately shipped to offsite TSDFs for final treatment or disposal.

The largest non-recycled hazardous waste streams for FY15 are described in this section. High explosives waste and wastewaters are treated onsite, and these are excluded from the analysis. Spent R&D chemicals make up the largest number of individual hazardous waste items. The breakdown of components of hazardous waste for FY15 is shown in Figure 3-3.

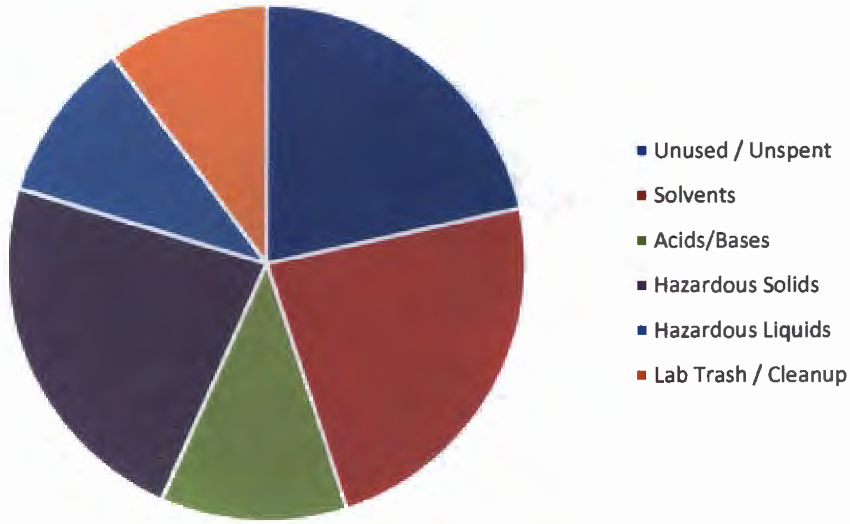

Figure 3-3. FY15 hazardous waste stream components, excluding recycled waste.

Unused/Unspent Chemicals. The volume of unused and unspent chemicals varies each year, but this waste stream comprised the second largest fraction of the hazardous waste in FY15. The ChemLog database allows researchers to find and request unwanted, unexpired chemicals from others onsite. Researchers are encouraged not to buy more of any chemical than they are certain to need for several months to avoid having any unused amount. Researchers are also encouraged to share chemicals among multiple users when possible. In FY15, the volume of unused and unspent chemicals in the hazardous waste stream was much lower than in FY14 due to the FY14 Laboratory-wide emphasis on cleaning out old and unneeded chemicals and equipment.

Solvents. EPA-listed and characteristic solvents and solvent-water mixtures are used widely in research, maintenance, and production operations, especially for cleaning and extraction. Nontoxic replacements for solvents are used whenever possible. New procedures are also adopted, where possible, that either require less solvent than before, or eliminate the need for solvent altogether. Recent acquisitions of solvent distillation equipment have reduced the total amount of solvent used, especially in Bioscience Division. As a result, the total volume of solvents generated has decreased over the past decade. However, solvents are still required for many procedures, and solvents persist as a large component of the hazardous waste stream. Solvents made up the largest component of LANL's hazardous waste in FY15.

Acids and Bases. A variety of strong acids and bases are routinely used in research, testing, and production operations. Over the past decade, the overall volume of hazardous acid and base waste has been reduced mainly by using new procedures that require less acid or base, by recycling acids onsite for internal reuse, and by reusing spent acids and bases as part of established neutralization procedures onsite. Acids made up about 90% of this waste stream during FY15.

Hazardous Solids. This waste stream includes inert barium simulants used in high explosives research, electronics, contaminated equipment, broken leaded glass, firing site debris, ash, and various solid chemical residues from experiments.

Hazardous Liquids. This waste stream is primarily aqueous, neutral liquids that are generated from a variety of analytical chemistry procedures. This waste stream also includes aqueous waste from chemical synthesis, spent photochemicals, electroplating solutions, refrigerant oil, and ethylene glycol.

Lab Trash and Spill Cleanup. Lab trash mostly consists of paper towels, pipettes, personal protective equipment, and disposable lab supplies. Rags are used for cleaning parts, equipment, and various spills. Equipment improvements have reduced the number of oil spills from heavy equipment, and new cleaning technologies have eliminated some processes where manual cleaning with rags was required.

Table 3-2 shows changes in the composition of the hazardous waste stream from FY14 to FY15.

Table 3-2. Hazardous Waste Generation in FY14 and FY15.

Hazardous Waste Component	FY14 (m^3)	FY15 (m^3)
Unused / Unspent	22.3	5.7
Solvent	8.5	6.2
Hazardous Solids	3.8	6.1
Lab Trash / Cleanup	2.7	2.7
Acids / Bases	5.2	3.1
Hazardous Liquids	3.3	2.7

3.4 Hazardous Waste Minimization and Operational Funding

Fewer bulbs and batteries were recycled during FY15 than during FY14 due to the special focus on cleanouts in FY14. Starting in late FY11, special recycling operations were established in TA-60-86 at the Laboratory. Spent bulbs, aerosol cans, and batteries are collected from various sites and brought together for empty aerosol cans to be punctured, used bulbs to be packaged together, and batteries to be packaged for recycling. Having all of these recycling operations together at one location is cost effective for packaging and encourages as much recycling as possible. The volume of aerosol cans punctured is not recorded in WCATS since these empty cans are recycled along with other scrap metal and not listed separately in WCATS.

Table 3-3 presents the operational costs to the Laboratory for recycling hazardous waste, based on total weight of the materials, for the past five years.

Table 3-3. Universal Waste Shipped Offsite for Recycling at the Laboratory.

Fiscal Year	Volume of Hazardous Waste Recycled (m^3)	Cost of Recycling Hazardous Waste
FY 2011	77	$716,738
FY 2012	35	$619,230
FY 2013	23	$480,997
FY 2014	55	$802,337
FY 2015	40.5	$321,711

During the past five years, the volume has decreased somewhat due to efforts to package the recyclable materials more efficiently. The lower volume of waste means that fewer shipments need to be made, which saves fuel and reduces emissions of carbon dioxide associated with transportation. The costs of recycling these materials are estimated based on the cumulative weight.

Mercury Substitution

Researchers typically replace mercury-containing thermometers as they get broken with non-mercury thermometers. By doing so, the chances of accidentally spilling mercury and creating hazardous waste are reduced. It is especially valuable to have non-mercury thermometers in RCAs so that generation of MLLW can be avoided. The elemental mercury in old thermometers and other obsolete mercury-containing equipment is recycled. As less mercury is present at the Laboratory, the volume of spills contaminated with mercury decreases.

Acid Waste Reduction and Recycling

The metal plating shop in Material Physics and Applications Division uses an acid recycling system to recover nitric and hydrochloric acids for reuse in plating procedures within the shop. The system recovers about 90% of the acid used. Plutonium Manufacturing and Technology

Division uses a nitric acid recycling system so that a significant fraction can be reused multiple times instead of becoming waste.

Solvent Waste Reduction and Recycling

There have been many projects implemented to reduce the use of solvents since solvents have consistently been one of the largest components of the hazardous waste stream. Some of the solvent waste reduction projects are described below.

- Experiments in organic synthesis laboratories generate a large amount of glassware with organic residues. Solvents and oxidizing acids were formerly used to clean this glassware, thus generating hazardous waste. Besides the generation of waste, this process is time consuming and expensive. Two organic synthesis labs purchased Tempyrox Pyroclean ovens to clean the glassware with heat. The ovens eliminate the chemicals and other problems associated with manual cleaning. The organic vapors from this process are destroyed by a catalytic oxidizer system.

- The Material Testing Lab uses a binder oven to test the amount of oil present in samples instead of performing solvent-based extractions. A sample can be weighed, baked in the oven, and then weighed again to determine how much oil was baked off from the sample.

- In Bioscience Division, the solvent formamide was eliminated from the preparation process to sequence strands of DNA. Formamide is a suspect teratogen, and employees proved that a water-based solution called TE worked just as well as formamide for suspending DNA prior to sequencing. Eliminating formamide reduces hazardous waste solvent and lab trash.

- The Chemistry Division organic synthesis team once performed experimental chemical synthesis activities in 25 mL-2 L reaction vessels. Now researchers use reaction vessels of 5 mL or less, which greatly reduces the volume of solvent used. Typical solvents include toluene, methylene chloride, tetrahydrofuran, and ethanol.

- Two laboratories in Bioscience Division installed solvent recovery systems for acetonitrile in high performance liquid chromatography waste. These systems prevent the generation of about 0.4 m^3 of hazardous waste solvents per week.

- The LANS protective forces subcontractor uses a non-hazardous cleaning solution, "Gunzilla", for their guns instead of the hazardous solution that was previously used.

Coolant Waste Reduction and Recycling

Material Physics and Applications and Weapons Components Manufacturing Divisions both implemented coolant recycling systems in their machine shops. Coolant is always used during machining procedures to ensure the quality of the machined pieces and maximize the lifetime of the machine tools. The coolant recycling system eliminated coolant waste from these facilities, and now only recyclable oil is generated.

Lead-Free Ammunition

Lead is a persistent, bio-accumulative toxin in the environment. Historically, the protective forces subcontractor, Special Operations Consulting, has used traditional lead-containing bullets during training exercises at the small-arms range. All ammunition used for indoor training is lead-free. The bullets used for certification are required by DOE to be the standard lead-containing variety. The protective forces staff uses high-accuracy scopes on their weapons, and this allows them to achieve certification while using many fewer bullets.

3.5 Barriers to Hazardous Waste Minimization

The largest component of the hazardous waste stream during FY15 was solvents. Unused and unspent chemicals were a close second, partly due to ongoing cleanout activities and partly due to regular research activities. Full or partially used bottles of chemicals or other products are sent for disposal once they have expired. If a research project is discontinued, the scientists may no longer need some of the chemicals that were allocated to that project. Usable chemicals are distributed to other researchers in the same building who can use them, although this practice has not been as widely adopted as it could be. Many researchers are reluctant to use bottles of chemicals that were used by other teams since they cannot be sure that no cross-contamination occurred. Through the EMS, directorates are being asked to set specific objectives and targets for chemical waste reduction.

4.0 Mixed Transuranic Waste

4.1 Introduction

MTRU waste has the same definition as TRU waste, except that it also contains hazardous waste regulated under RCRA. TRU waste contains >100 nCi of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years (atomic number greater than 92), except for (1) high-level waste; (2) waste that the DOE has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by 40 CFR 191; or (3) waste that the US Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61. MTRU waste is generated during research, development, nuclear weapons production, and spent nuclear fuel reprocessing.

MTRU waste has radioactive elements such as plutonium, neptunium, americium, curium, and californium. These radionuclides generally decay by emitting alpha particles. MTRU waste also contains radionuclides that emit gamma radiation. MTRU waste is disposed of at the Waste Isolation Pilot Plant (WIPP), a geologic repository near Carlsbad, New Mexico.

MTRU waste can be liquids, cemented residues, combustible materials, noncombustible materials, and non-actinide metals. Typically, research production materials and supplies are brought into an RCA and introduced into a glovebox. Waste leaves the glovebox as either solid or liquid. Liquid MTRU is a small percentage of total MTRU, and these wastes are primarily organic liquids. Liquid wastes are sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) for treatment. The radionuclides and other contaminants are removed as a cemented solid waste at the RLWTF and shipped to TA-54 for storage. Treated water is either pumped to the low-level RLW treatment process, or is sent for off-site evaporation and disposal. MTRU solid wastes are accumulated, characterized, and assayed for accountability purposes at the generation site. MTRU solid waste is packaged for disposal in metal 55-gallon drums, standard waste boxes, and oversized containers, and then this waste is shipped to TA-54 for storage. Security and safeguards assay measurements are conducted on the containers for accountability before they are removed for transport, and then the waste is certified for transport and disposal at WIPP. The waste process generation map is shown in Figure 3-1.

During FY15, no MTRU was shipped offsite from LANL due to the temporary closure of the WIPP facility. Most operations at TA-55 have undergone a work pause until the WIPP facility reopens, and this has reduced the volume of MTRU waste generated. The MTRU drums generated are expected to be stored onsite at LANL until the WIPP facility is accepting waste again.

4.2 MTRU Waste Minimization Performance

The Laboratory shipped no MTRU waste offsite during FY15, which is significantly less than the 695.4 m^3 of MTRU shipped during FY14. No remediation MTRU waste was shipped during FY15 or FY14. The breakdown of MTRU waste records at the Laboratory by location during FY15 and FY14 is shown in Table 4-1.

Table 4-1. Offsite Shipments of MTRU Waste by Technical Area during FY14 and FY15.

Technical Area	FY14 MTRU (m^3)	FY15 MTRU (m^3)
50	125.2	0
54	563.5	0
55	6.7	0

4.3 Waste Stream Analysis

MTRU wastes are generated within RCAs. These areas also are material balance areas for security and safeguards purposes. The TA-55 Plutonium Facility processes ^{239}Pu from residues generated throughout the defense complex into pure plutonium feedstock. The manufacturing and research operations performed in the processing and purification of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as possible. These recovery operations, associated maintenance, and plutonium research are the sources of MTRU waste generated at TA-55.

MTRU wastes, process chemicals, equipment, supplies, and some RCRA materials are introduced into the RCAs in support of the programmatic mission. Because of the hazards inherent in the handling, processing, and manufacturing of plutonium materials, all process activities involving plutonium are conducted in gloveboxes. All materials removed from the gloveboxes must be multiple-packaged to prevent external contamination. Currently, all material removed from gloveboxes is initially considered to be TRU or MTRU waste. However, a final analysis is performed to determine if the waste should be classified as MTRU or MLLW. In many cases, the drum contents are found to actually be MLLW. When this occurs, the drum's waste type is reclassified in the WCATS database. Large quantities of waste, primarily solid combustible materials such as plastic bags, cheesecloth, and protective clothing, are generated as a result of contamination avoidance measures taken to protect workers, the facility, and the environment. Operational waste normally generated at TA-55 when there is no work pause includes non–special nuclear material metal, plastic, cheesecloth, protective clothing, glass, filters, graphite, rubber, ceramics, ash, metals, lead-lined gloves, and a small volume of organic chemicals and oil.

Repackaging. Standards for waste acceptance at WIPP change periodically, so when this occurs, some drums of MTRU waste are repackaged to conform to new packaging standards. The waste inside the drums is old operational waste that is now packaged to meet the new standards. About 95% of the MTRU waste shipped from the Laboratory during FY14 came from repackaging activities.

TA-55 Operations. Operational waste generated at TA-55 includes non–special nuclear material metal, plastic, cheesecloth, protective clothing, glass, filters, graphite, rubber, ceramics, ash, metals, lead-lined gloves, and a small volume of organic chemicals and oil. About 5% of the MTRU waste shipped from the Laboratory in FY14 was from TA-55 operations.

Table 4-2 below shows the changes in composition of MTRU generation at the Laboratory from FY14 to FY15.

Table 4-2. MTRU Generation in FY14 and FY15.

MTRU Component	FY14 (m^3)	FY15 (m^3)
Repackaging	659.5	0
Operations	35.9	0

4.4 Mixed Transuranic Waste Minimization

Many process improvements have been identified for implementation within TA-55 and in the processing of MTRU waste after it is produced. Changes in TA-55 processes are made very slowly due to the caution involved with moving new equipment into RCAs and qualifying new processes or changes. Waste minimization projects focus on elimination of RCRA components from products and processes in operations that generate MTRU waste. MTRU waste minimization and avoidance projects are typically funded by the P2 Program. The projects are described in Section 2.4.1 of this report.

Routine MTRU waste generated by operational activities has been reduced as a result of past pollution prevention activities. These activities include replacing lead with a non-hazardous substance whenever possible in items such as gloves and shielding; using non-hazardous solvents or redesigning processes to minimize chemical use whenever possible; using reusable equipment, such as Teflon-coated tubes, instead of disposable equipment; using carbon dioxide plasma for cleaning parts instead of trichloroethylene; and decontaminating equipment to prolong its useful life.

In FY15, there was a renewed focus on finding ways to reduce the generation of TRU and MTRU since the WIPP facility was not accepting waste. LANL does not want to run out of onsite storage space for TRU and MTRU before the WIPP facility reopens.

4.5 Barriers to MTRU Minimization

Packaging requirements at WIPP often make minimization efforts difficult. There are wattage and dose limits that must not be exceeded, and a very small volume of MTRU could potentially have a high wattage. All of the containers sent to WIPP are 55 gallons or larger, and often the containers have very small volumes of waste inside with the majority of the internal volume being empty space.

5.0 Mixed Low-Level Waste

5.1 Introduction

For waste to be considered MLLW, it must contain hazardous waste and meet the definition of radioactive LLW. LLW is defined as waste that is radioactive and is not classified as high-level waste, TRU waste, spent nuclear fuel, or by-product materials such as uranium or thorium mill tailings. Test specimens of fissionable material irradiated only for R&D and not for the production of power or plutonium may be classified as LLW, provided that the activity of TRU waste elements is <100 nCi/g of waste.

Most of the routine MLLW comes from stockpile stewardship and from R&D programs. Most of the non-routine waste is generated by off-normal events such as spills in legacy-contaminated areas. Typical MLLW items include contaminated lead-shielding bricks and debris, old glove boxes, R&D chemicals, spent solution from analytic chemistry operations, mercury-cleanup waste, electronics, copper solder joints, and used oil. The waste process generation map is shown in Figure 3-1.

5.2 MLLW Waste Minimization Performance

The amount of MLLW shipped from the Laboratory during FY15 was 16.9 m^3, which is much less than the 783.4 m^3 of MLLW that was generated during FY14. There was no MLLW remediation waste generated during FY15 or FY14. Table 5-1 includes all MLLW shipped from the Laboratory by location during FY15.

MLLW is generated by routine programmatic work, cleanup activities, and repackaging efforts. The volume of non-routine MLLW from cleanup and repackaging efforts tends to vary significantly and often cannot be substantially minimized, so it is useful to examine the routine fraction of the MLLW waste stream separately to identify good waste minimization opportunities.

Table 5-1. Offsite Shipments of MLLW by Location during FY14 and FY15.

Technical Area	FY14 MLLW (m^3)	FY15 MLLW (m^3)
3	26.7	6.1
15	0.3	0
16	0.2	0.1
36	13.6	0
46	2.5	0
48	19.6	0.3
50	6.9	0
53	8.0	0
54	665.3	0.01
55	37.6	10.3
59	2.7	0

5.3 Waste Stream Analysis

Materials and equipment are introduced into an RCA as needed to accomplish specific work activities. In the course of operations, materials may become externally contaminated or become activated, thus becoming MLLW when the item is no longer needed.

MLLW is transferred to a satellite accumulation area after it is generated. Whenever possible, MLLW materials are surveyed to confirm the radiological contamination levels. If decontamination will eliminate the radiological or the hazardous component, materials are decontaminated to prevent them from becoming MLLW.

Waste classified as MLLW is managed in accordance with appropriate waste management and Department of Transportation requirements and is shipped to TA-54. From TA-54, MLLW is sent to commercial and DOE-operated TSDFs.

The largest components of the MLLW stream by volume in FY15 are lab maintenance trash and lead-containing debris. Less MLLW generation is anticipated in the future as historical MTRU shipments are completed, as non-toxic materials are substituted for mercury and lead, and as oil-free vacuum pumps replace older pumps. The relative volumes of various waste streams are shown in Figure 5-1.

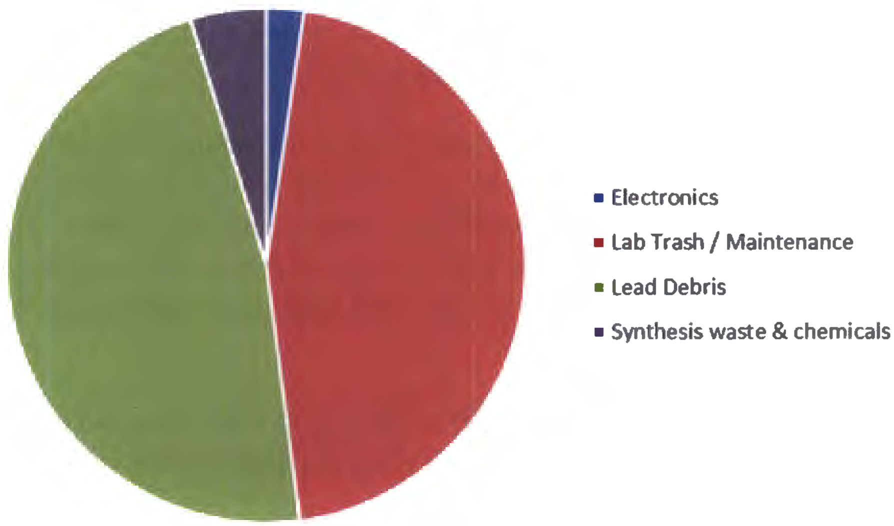

Figure 5-1. Constituents of MLLW in FY15.

Reclassification. This waste was formerly classified as MTRU, but as MTRU standards changed, these wastes were reclassified and disposed of as MLLW instead. Since this waste is already generated, there are not many opportunities for minimization of this component of the MLLW stream. No MTRU waste was reclassified as MLLW in FY15.

Electronics. This waste stream includes various pieces of electronic equipment that were previously located within RCAs. New RCAs are engineered so most or all electronics can remain outside, and smaller electronic equipment will be used inside whenever possible. The Chemistry Division set up a demonstration laboratory using the smallest possible electronic equipment. A special electronics roundup event was held at LANL in FY14, which is why the volume of this material shipped in FY14 was so much larger than in FY15.

Cleanup. These are one time wastes primarily composed of old equipment and personal protective equipment that project personnel used during the cleanup. There was somewhat more cleanup waste generated during FY14.

Lead Debris. The lead debris waste stream includes copper pipes with lead solder, lead-contaminated equipment, brass contaminated with lead, bricks, sheets, rags, circuit boards, cathode ray tubes, and personal protective equipment contaminated with lead from maintenance activities. The volume of this waste stream is expected to decrease as lead is used for fewer applications.

Sludge from Radioactive Liquid Waste Treatment. Sludge is generated from the treatment of the Laboratory's radioactive liquid waste at the RLWTF, and this sludge is cemented prior to shipping for disposal. No sludge was shipped during FY15.

Maintenance. This lab trash waste stream is composed of personal protective equipment, dry painting debris, spent light bulbs, and paper towels and rags. This waste stream also included some unwanted equipment that was removed during building upgrades. Much less lab trash and maintenance waste were generated during FY15 than during FY14. A glovebox was removed from service, and this was over 80% of the volume of maintenance and lab trash waste shipped during FY15.

Synthesis Waste and Chemicals. In FY15 this waste stream was composed of precipitated salts, spent solvents, aqueous solutions, unused/unspent chemicals that have become contaminated in RCAs, and analytical chemistry waste.

Oil. Used MLLW oil comes from vacuum pumps that are used within RCAs. A pollution prevention project in FY14 involved the purchase of oil-free scroll pumps, which decreased the volume of MLLW oil. Very small volumes of MLLW oil were shipped during FY15.

Table 5-2 shows the changes in the composition of the MLLW stream from FY14 to FY15.

Table 5-2. MLLW Generation in FY14 and FY15.

MLLW Component	FY14 MLLW (m^3)	FY15 MLLW (m^3)
Reclassification	684.8	0
Electronics	44.6	0.4
Cleanup	10.2	0
Lab Trash / Maintenance	32.5	7.7
Synthesis Waste & Chemicals	0.9	0.8
RLW Sludge	3.8	0
Oil	0.04	0.02
Lead Debris	6.6	8.0

5.4 Mixed Low-Level Waste Minimization

Efforts to substitute hazardous materials with alternatives and to improve sorting and segregation of these waste streams will reduce MLLW volumes in the coming years. TheP2 Program has implemented a number of projects such as lead-free solder, bismuth shielding in RCAs instead of lead, mercury-free thermometers, oil-free vacuum pumps in RCAs, reduction of electronics in RCAs, and elimination of nitric acid bioassay wastes. During FY15, the P2 Program funded projects designed to reduce the generation of MLLW waste. These projects are described in Section 2.5.1 of this report.

One effort involves replacing traditional fluorescent fixtures with LED fixtures in gloveboxes. The LEDs are much smaller and lighter than fluorescents, and the LEDs last longer, use less electricity, and generate less heat than fluorescents. Since they last longer, they ultimately generate less waste. From FY08 through FY15, groups at TA-55 purchased more LED lights for gloveboxes, and future plans are to expand use of LED lights in radiological areas across the Laboratory. During FY15, the Laboratory disposed of only 0.1 m^3 of fluorescent bulbs as MLLW. During the last three years, the Laboratory generated no MLLW that was contaminated with mercury.

One of the projects that won a Pollution Prevention award in 2015 carefully segregated electronics such that a minimum of MLLW was generated. Following the completion of the project, the team estimated that the generation of approximately 1600 m^3 of MLLW was avoided.

5.5 Barriers to MLLW Reduction

One barrier to reducing the generation of MLLW was the DOE-imposed suspension of metals recycling from RCAs with particular postings. Prior to the moratorium, any scrap metal could be surveyed for radioactive contamination and released for recycling if no activity was detected. When the suspension was imposed, scrap metal from RCAs with particular postings had to be handled as waste. Most of the metal affected is scrap steel that would be handled as LLW if not recycled, but a much smaller fraction of the metal would be handled as MLLW. Electronic components often contain lead or other hazardous metals.

In 2000, DOE suspended recycling of clean metals from certain radiological areas. In FY14, Laboratory staff began work on a proof of principle project to determine if radiation levels in certain recyclable metals are indistinguishable from background and to develop a regulatory process for release of these items to the public. In FY15, this process was verified by personnel from DOE Headquarters, the Stanford Linear Accelerator, and Sandia National Laboratory. The NNSA Field Office also performed independent verification for specific shipments. Approximately 1.2 million pounds of metal were recycled through this effort, which exceeded expectations. These metals were not encumbered by the DOE recycling suspension, but provided the technical basis for DOE to consider lifting the suspension. Although none of this metal would have been considered MLLW, lead items could potentially be handled through this process and recycled instead of becoming MLLW in the future.

6.0 Remediation Waste

6.1 Introduction

Section 6.0 of this report represents the P2 Program awareness plan for the corrective actions component of the Associate Directorate for Environmental Programs (ADEP). This component includes the Environmental Remediation Program (EP-ER) and its associated investigation, cleanup, and site closure projects.

The mission of the EP-ER corrective actions activities is to investigate and remediate potential releases of contaminants as necessary to protect human health and the environment. These activities are implemented to comply with the requirements of a Compliance Order on Consent (hereafter, Consent Order) between the NMED, DOE, and LANS. In completing this mission, activities may generate large volumes of waste, some of which may require special handling, treatment, storage, and disposal. Because the activities involve investigating and, as necessary, conducting corrective actions at historically contaminated sites, source reduction and material substitution are difficult to implement. The corrective action process, therefore, includes the responsibility and the challenge of minimizing the risk posed by contaminated sites while minimizing the amounts of waste that will require subsequent management or disposal. Minimization is desired because of the high cost of waste management, the limited capacity for onsite or offsite waste treatment, storage, or disposal, and the desire to minimize the associated liability.

6.2 Remediation Waste Minimization Performance

No hazardous, MTRU, or MLLW remediation waste was generated at LANL during FY15 or FY14. Project activities in FY15 involved investigations, including soil sampling and removal, storm water and groundwater monitoring, aquifer pump testing, and well drilling and abandonment.

In January 2012, DOE and NMED entered into a Framework Agreement for Realignment of Environmental Priorities (Framework Agreement) at the Laboratory. In accordance with the Framework Agreement, resources for activities by EP-ER have been prioritized on groundwater and surface water protection, which inherently generate less hazardous, MTRU, or MLLW remediation waste than other remediation projects. As a result, there was a significant reduction in the volume of remediation waste generated in FY12, which continued through FY15.

6.3 Waste Stream Analysis

This report addresses all RCRA-regulated waste that may be generated by corrective actions during the course of planning and conducting the investigation and remediation of contaminant releases. Wastes generated include "primary" and "secondary" waste streams. Primary waste consists of generated contaminated material or environmental media that was present as a result of past DOE activities, before any containment and restoration activities. It includes contaminated building debris or soil from investigations and remedial activities. Secondary waste streams consist of materials that were used in the investigative or remedial process and may include investigative-derived waste (e.g., personal protective equipment, sampling waste, drill cuttings); treatment residues (e.g., spent resins and activated carbon from groundwater treatment); wastes resulting from storage or handling operations; and additives used to stabilize waste. The corrective actions may potentially generate hazardous waste, MLLW, and MTRU.

The majority of FY15 waste generation was the result of investigations and monitoring and focused corrective actions. Investigations, corrective actions, and other activities associated with the Consent Order implemented during FY15 include the following:

- Investigations and soil remediation for TA-57 Aggregate Area (Fenton Hill);
- Subsurface vapor monitoring at Material Disposal Area (MDA) C;
- Removal of mercury-contaminated soil at SWMU 32-002(b2) in Upper Los Alamos Canyon Aggregate Area;
- Plugging and abandonment of 19 obsolete monitoring and test wells and boreholes;
- Performance of periodic groundwater monitoring for the Chromium Investigation, General Surveillance, MDA AB, MDA C, TA-16-260, TA-21, and TA-54 monitoring groups; Performance of storm water monitoring and installation and maintenance of storm water controls throughout the Laboratory and Los Alamos townsite;
- Operation of a soil vapor extraction (SVE) interim measure at MDA L;
- Drilling and/or completion of regional aquifer monitoring wells R-47, R-58, R-67, and SIMR-2; intermediate wells CdV-9-1(i) and R-63i; extraction well CrEX-1; and coreholes CrCH-1 through CrCH-6; and
- Pump tests of chromium pilot extraction well CrEX-1.

6.4 Remediation Waste Minimization

Waste minimization and pollution prevention were integral parts of the FY15 planning activities and field projects through recycling, reuse, contamination avoidance, risk-based cleanup strategies, and many other practices. Waste reduction benefits are typically difficult to track and quantify because the data to measure the amount of waste reduced (as a direct result of a pollution prevention activity) are often not available and are not easily extrapolated. In addition, many waste minimization practices employed during previous years are now incorporated into standard operating procedures.

The P2 Program techniques used in FY15 to reduce investigation-related waste streams led to the following accomplishments:

- Dry decontamination techniques continued to be used almost exclusively during field investigations, thereby minimizing generation of liquid decontamination wastes.

- The formal procedure for land application of the groundwater extracted during well drilling, development, sampling, and rehabilitation/reconfiguration developed by the Laboratory's Water Quality team in FY08 continued to be implemented. Drilling, development, reconfiguration, and purge waters constitute a major potential waste source for EP-ER (i.e., upwards of 100,000 gallons may be produced per well). This procedure, which incorporates a decision tree negotiated with NMED, allows groundwater to be land applied if this will be protective of human health and the environment. Use of this procedure minimizes the amount of purge water that must be managed as wastewater. The volume of land-applied development water and drilling fluids from well drilling and rehabilitation is compiled and reported to NMED on a calendar-year basis. The report for calendar year 2015 will be submitted in March 2016.

- The formal procedure for land application of drill cuttings developed by the Laboratory's RCRA team in FY08 was re-implemented in FY15 after drilling activities were curtailed in FY14. Drill cuttings constitute a major potential source of solid wastes generated by EP-ER. This procedure, which incorporates a decision tree negotiated with NMED, allows drill cuttings to be land applied if this will be protective of human health and the environment. These drill cuttings do not have to be managed and disposed of as waste. Additionally, land-applied drill cuttings can be beneficially reused as part of drill site restoration.

- ADEP stored and treated groundwater extracted during the pump tests of chromium plume pilot extraction well CrEX-1. The treated water was land applied in accordance with a temporary discharge permit granted by NMED. On-site treatment and the discharge permit eliminated the need for offsite treatment and disposal of the large volume of water generated in the extended pump tests.

- ADEP continued to take actions during FY15 to improve integration of the EMS into remediation activities and to improve awareness of the EMS by ADEP subcontractors. These actions included flowing down EMS requirements into the environmental requirements in subcontracts and continuing environmental communications through Worker Safety and Security Teams (WSSTs). These activities continue to increase awareness of waste minimization requirements and opportunities by ADEP subcontractors.

Sort, Decontaminate, and Segregate

This task is currently being implemented by EP-ER and is designed to segregate contaminated and non-contaminated soils so that non-contaminated soils can be reused as fill. These practices are implemented at sites where contaminated subsurface soils and structures are overlain by uncontaminated soils. During excavation to remove the contaminated soils and structures, the uncontaminated overburden is segregated and staged apart from contaminated materials. Following removal of the contaminated soils and structures, the overburden is tested to verify that it is nonhazardous and meets residential soil screening levels. If so, this material is used as backfill for the excavation. This practice minimizes the amount of contaminated soil that must be disposed of as waste and also minimizes the amount of backfill that must be imported from off site.

Segregation is also used to allow "contact" waste generated during investigations to be managed through the Green-is-Clean (GIC) Program, rather than disposed of as radioactive waste. During FY15, contact waste from site investigation and groundwater sampling activities continued to be managed through GIC as applicable.

Survey and Release

Past practices have conservatively classified non-indigenous investigation-derived waste (e.g., personal protective equipment, sampling materials) as contaminated, based on association with contaminated areas. New policy allows corrective actions managers and project leaders to develop procedures to survey and release these materials as non-radioactive if the survey finds no radioactivity. This reduces the volume of LLW from corrective actions activities.

Risk Assessment

Risk assessments are routinely conducted for corrective action projects to evaluate the human health and ecological risk associated with a site. The results of the risk assessment may be used by NMED to determine whether corrective measures are needed at a site to protect human health and the environment. The risk assessment may demonstrate that it is adequately protective and appropriate or beneficial to leave waste or contaminated media in place, thus avoiding the generation of waste. Properly designed land-use agreements and risk-based cleanup strategies can provide flexibility to select remedial actions (or other technical activities) that may avoid or reduce the need to excavate or conduct other actions that typically generate high volumes of remediation waste.

As described in more detail in Section 6.5, a risk-based data evaluation procedure is now being used to determine whether extent of contamination is defined at sites being investigated by EP-ER under the Consent Order. This approach will result in protection of human health and the environment while requiring fewer samples and generating less investigation-derived waste.

Equipment and Material Reuse

The reuse of equipment and materials (after proper decontamination to prevent cross contamination) such as plastic gloves, sampling scoops, plastic sheeting, and personal protective equipment produced waste reduction and cost savings. When reusable equipment is decontaminated, it is standard practice to use dry decontamination techniques to minimize the generation of liquid decontamination wastes.

In addition, an equipment-exchange program was initiated, which identifies surplus or inactive equipment available for use. This not only eliminates the cost of purchasing the equipment, but it also prolongs the useful life of the equipment.

6.5 Pollution Prevention Planning

The potential to incorporate pollution prevention practices into future activities is evaluated annually as part of the EMS planning efforts. As has been done in previous years, actions related to pollution prevention are being incorporated into the FY16 Environmental Action Plan (EAP) for ADEP developed as part of the EMS. As described in the EAP, waste generation, management, and disposition processes are being developed to minimize waste generation and maximize pollution prevention. As appropriate, specific actions and approaches that will be incorporated into planned corrective action projects for FY16 are:

- Segregation and recycle or reuse of uncontaminated materials;
- Continued use of land application of drill cuttings and fluids;
- Waste avoidance;
- Reuse and recycling of equipment and materials;
- Increasing use of sustainable acquisition strategies;
- Implementation of electronic tablets to replace paper records being used by field inspectors; and
- Risk-based cleanup strategies.

Additionally, pursuant to the January 2012 Framework Agreement, DOE and NMED have agreed to increase the efficiency of cleanup activities, while maintaining protection of human health and the environment. These increased efficiencies should result in a reduction in sampling activities for future investigations, with a commensurate reduction in investigation-derived waste generation. In FY13, EP-ER began re-evaluating sites being investigated under the Consent Order that had previously been recommended for additional Phase II sampling to define extent of contamination. Sites were re-evaluated using a risk-based approach agreed to by NMED under the Framework Agreement. The results of this effort showed that additional sampling was not required at most of these sites and that the remaining sites require fewer samples than originally recommended. As a result, future Phase II investigation activities will result in generation of substantially less waste. These activities continued into FY15.

To help improve the implementation of waste minimization activities, ADEP ensures communication of environmental issues to project participants. Environmental issues are and will continue to be integrated into routine project communications, including the Worker Safety and Security Teams, to increase awareness about waste minimization and promote sharing of lessons learned.

6.6 Barriers to Remediation Waste Minimization

In years when remediation waste is generated, levels of waste minimization achieved fell below potentially achievable levels based on site conditions. Examples follow:

- In order to allow for the possible future transfer of property from DOE ownership, some sites have been cleaned up to residential levels even though that is not the current land use (e.g., MDA B). The use of the more stringent residential cleanup levels has resulted in generation of a larger volume of waste than if the sites had been cleaned up based on current land use.
- The single largest potential source of waste generated by corrective actions is removal of buried waste or contaminated soil during implementation of corrective measures. Such actions have the potential to generate thousands of cubic meters of waste. In evaluating corrective measure alternatives, corrective action program and project leaders generally give preference to alternatives that would avoid generating large volumes of waste, provided they are protective of human health and the environment. The consideration of other factors by external stakeholders, however, may result in selection of an alternative that generates more waste than the alternative recommended by the Laboratory.
- Cleanup of canyon-side disposal sites in the Los Alamos townsite requires use of specialized equipment that is not easily mobilized. In delineating areas to be remediated, a conservative approach has been used to provide a high likelihood that cleanup levels are reached in order to avoid remobilization.