Report

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Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Protection Division
Environmental Stewardship Group (ENV-ES)
P.O. Box 1663, Mail Stop J978
Los Alamos, New Mexico 87545
(505) 667-2278

National Nuclear Security Administrations
Los Alamos Site Office, A316
3747 West Jemez Road
Los Alamos, New Mexico 87545
(505) 667-5794/FAX (505)667-5948

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

NOV 2012

Dear Mr. John Kieling:

SUBJECT: 2012 LANL HAZARDOUS WASTE MINIMIZATION REPORT

The Department of Energy/Los Alamos National Security, LLC 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 Hazardous Waste Facility Permit for the Laboratory 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 Permittees have made significant progress in minimizing hazardous waste as well as other waste types. By integrating pollution prevention and waste minimization into all operational activities more progress is expected in the future.

Sincerely,

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

Sincerely,

Gene E. Turner
Environmental Permitting Manager
Environmental Projects Office
Los Alamos Site Office

35588

U.S. Department of Energy

PEG:SLSmcm

Enclosure: 1. 2012 LANL Hazardous Waste Minimization Report

Cy: Tim Hall, Hazardous Waste Bureau, New Mexico Environment Department, w/enc.
Carl A. Beard, PADOPS, w/o enc., A102
Michael T. Brandt, ADESH, w/o enc., (E-File)
Alison M. Dorries, ENV-DO, w/enc., (E-File)
Michael T. Saladen, ENV-RCRA, w/enc. (E-File)
Mark P. Haagenstad, ENV-RCRA, w/enc. (E-File)
IRM, A150 or locatesteam@lanl.gov
ENV-ES Correspondence File, w/enc., J978

Enclosure 1

2012 Los Alamos National Laboratory

Hazardous Waste Minimization Report

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Document: Hazardous Waste Minimization Report
Date: November 2012

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
Environmental Protection Division
Los Alamos National Security, LLC
Operator

11/15/12
Date Signed

Gene E. Turner
Environmental Permitting Manager
Los Alamos Site Office
National Nuclear Security Administration
U.S. Department of Energy
Owner/Operator

11/15/12
Date Signed

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List of Acronyms

ADEP	Associate Directorate of Environmental Programs
ADESH	Associate Directorate of Environment, Safety, and Health
CFR	Code of Federal Regulations
CMR	Chemistry and Metallurgy Research facility
D&D	decontamination and demolition
DOE	US Department of Energy
DP	Defense Programs
EMS	Environmental Management System
ENV-ES	Environmental Stewardship Group
ENV-RCRA	Water Quality and RCRA Group
EP	Environmental Programs Directorate
EP-CAP	Corrective Actions Projects
EP-TA21	TA-21 Closure Project
EPA	Environmental Protection Agency
ESH	Environment, Safety, and Health Directorate
FY	fiscal year
GIC	Green is Clean
GSAF	Generator Set-Aside Fund
HPLC	high-performance liquid chromatography
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
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
TWCP	TRU Waste Characterization Program
WCATS	Waste Compliance and Tracking System
WIPP	Waste Isolation Pilot Plant
WMin/PP	Waste Minimization/Pollution Prevention (Program)

1.0 Hazardous Waste Minimization Report

1.1 Introduction

Waste minimization and pollution prevention are inherent goals within all 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, which was issued in November 2010. This report describes the hazardous waste minimization program (a component of the overall Waste Minimization/Pollution Prevention [WMin/PP] 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) 2012 (October 1-September 30) in WMin/PP efforts. Staff funded six projects specifically related to reduction of waste with hazardous wastes, and LANS won six national awards for pollution prevention efforts from the National Nuclear Security Administration (NNSA) and one national award for pollution prevention from DOE. In FY12, much less remediation waste was generated at the Laboratory than in FY11 (1,861 kilograms (kg) in FY12 vs. 118,966 kg in FY11). Less non-remediation hazardous waste, mixed transuranic waste, and mixed low-level waste were also generated in FY12 than in FY11 (116,128 kg in FY12 vs. 158,548 kg in FY11). 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[i], which changed the focus of environmental policy from "end-of-pipe" regulation to source reduction and minimizing waste generation. Under the provisions of the Pollution Prevention 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 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 registration to the International Organization of Standardization (ISO) 14001:2004 standard in April 2006 and was recertified in February 2012.

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

A list of key applicable regulatory drivers for the WMin/PP Program is presented below.

Federal Statutes and Executive Orders

- Resource Conservation and Recovery Act (RCRA);
- Pollution Prevention Act of 1990;
- Executive Order 12873, Federal Acquisition, Recycling, and Waste Prevention;
- Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention;
- Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management; and
- Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance.

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 402, Environmental Communication Procedure;
- P 403, Environmental Aspects Identification Requirement;
- P 405, National Environmental Policy Act (NEPA), Cultural Resources, and Biological Resources Reviews;
- P 407, Water Quality;
- P 408, Air Quality Reviews;
- P 409, Waste Management; and
- P 412, Environmental Radiation Protection.

1.3 Purpose and Scope

The purpose of this report is to document the approach for minimizing hazardous wastes and to document performance results. This report discusses the methods and activities that will be routinely employed to prevent or reduce waste generation in FY13, and the report documents FY12 waste generation quantities and significant waste minimization accomplishments. In most cases, waste minimization activities executed during FY12 will continue to occur during FY13 and beyond. This report also discusses the Laboratory Director's commitment to pollution prevention, specific elements of the Laboratory's WMin/PP programs, 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, mixed transuranic waste (MTRU), and mixed low-level waste (MLLW). The last section 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.

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, 6.0
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, 6.0
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, 6.0

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, WMin/PP Program goals, and environmental performance. The Environmental Protection (ENV) Division has primary responsibility and oversight responsibilities for the WMin/PP Program as well as for the environmental remediation program waste minimization activities. The goal of the WMin/PP Program is to support core waste minimization activities and pollution prevention projects. Specific environmental remediation program waste minimization activities are discussed in Section 6.0.

The ENV-Environmental Stewardship Group (ENV-ES), EMS/Pollution Prevention team is tasked to develop and manage the WMin/PP 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 and pollution prevention actions and other environmental improvement actions. The ENV-ES EMS/Pollution Prevention team provides:

- Oversight for WMin/PP 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 WMin/PP Program implementation barriers.

2.0 Waste Minimization Program Elements

2.1 Governing Policy on Environment

LANS developed a prevention-based EMS, which was third-party certified to the ISO 14001:2004 standard in April 2006 by an independent ISO 14001 third-party registrar. The EMS was most recently recertified to the ISO 14001:2004 standard in February 2012. 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 FY13 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 FY13:

1. **Clean the Past**

    a. Monitor to detect changes to water and soil, take appropriate actions and apply "defense in depth" strategy according to 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. Ship waste to the Waste Isolation Pilot Plant (WIPP)
    d. Reduce volume of waste listed in Site Treatment Plan
    e. Footprint Reduction and Reduction of Excess materials/ Equipment/ Liabilities

2. **Control the Present**

    a. Monitor for compliance
    b. Integrate environment with safety tools for common work control
    c. Reduce spills and leaks

d. Sustainable acquisition
e. Expand chemical re-use program
f. Pollution Prevention with focus on problematic waste streams from all environmental media
g. Fund no-exposure projects to reduce compliance liabilities
h. Improve access to government vehicles and fuel efficiency

3. Create a Sustainable Future

a. Site Sustainability Plan implementation, including:
   - Energy Intensity Reduction
   - Water Use Reduction
   - Greenhouse Gases with 10-Year Greenhouse Gas Reduction Plan
   - High-performance sustainable buildings
   - Design an Environmental "As Low As Reasonably Achievable" (ALARA) strategy for the Laboratory
   - Data Center Management
   - Regional and Local Planning
   - New Environmental / Sustainable Technologies
b. Long Term Environment Stewardship and Sustainability Plan
   - Integrated Site Planning and use of the Decision Support Tool and the Public Communication Tool
   - Implement the "Integrating Strategies" of the Long Term Environmental Stewardship and Sustainability Plan (formally the 50 Year Environmental Stewardship Plan)
c. "Green" existing facilities through expansion of the Green Team concept beyond high-performance sustainable buildings

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

The WMin/PP Program is an integral part of the EMS and supports LANS in meeting the EMS objectives. The FY13 WMin/PP Program approach will focus on:

- Baselining waste trends and identifying improvement targets at the directorate level;
- 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;
- Dedicating waste minimization resources to assist with remedial actions;
- 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 and in the work planning requirements under the Integrated Work Management Procedure (P 300).

In FY12, the Integrated Environmental Review Program provided a series of environmental permits and requirements briefings to several organizations to increase awareness of environmental concerns, including opportunities for prevention and waste minimization. Twenty briefings were provided to several organizations including:

- Construction Safety personnel;
- Deployed Environmental Professionals;
- Waste Management Coordinators; and

- Environment, Safety, and Health Managers.

These organizations have responsibilities related to work planning, subcontractor support and oversight, WMin/PP Program efforts, EMS, and more.

The Permits and Requirements Identification system is a tool to assist personnel in identifying, managing, and complying with environment, safety, and health requirements that may impact project planning and execution. This process helps project managers clearly understand what WMin/PP Program requirements apply to their project.

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 FY12, LANS received seven awards for pollution prevention projects, including three NNSA Best-in-Class awards, three NNSA Environmental Stewardship awards, and a DOE Sustainability Award. The winning projects are described below. The first three projects received the Best in Class awards. The first project described below also received a Sustainability Award.

- LANS nominated an Environmental Protection Division employee as an agent of positive environmental change. For over a decade, the employee has been at the forefront of waste minimization activities both at his site and institutionally. The employee has led dozens of recognized pollution prevention projects, and his work has gone far above and beyond his job requirements. His efforts have saved the Laboratory millions of dollars in avoided procurement and waste disposal, and literally millions of pounds of material have been recycled thanks to his work.

- The Outfall Reduction Program was established to reduce environmental impacts of discharges, conserve potable water, and improve regulatory compliance. The full realization of the Outfall Reduction Program strategy anticipates the reclamation, reuse, and recycling of approximately 163 million gallons of potable groundwater annually.

- A LANS researcher developed a strategy to use much less sulfur hexafluoride in his equipment. The strategy has resulted in fewer electronics failures, less lost time to maintenance work, and no contamination of the system by toxic trace gases. The strategy avoids the use of approximately 240lb/year of sulfur hexafluoride and potentially over one million dollars per year in lost productive time for the accelerator at Los Alamos Neutron Science Center (LANSCE).

- Crude glycerol, a waste produced in the production of biodiesel, is being used to improve the effluent water quality of the Laboratory's sewage treatment facility and increase opportunities for the reclamation and reuse of cooling tower discharges. The crude glycerol provides supplementary "food" to the microorganisms responsible for sewage breakdown and increases the microorganisms' activity while subsequently improving the

removal of pharmaceuticals and metabolites, endocrine disruptors, heavy metals, and nitrates. The improved plant performance has allowed the diversion of about 14.7 million gallons water/year of cooling tower discharges from the environment to the Laboratory's sewage plant. This water is now available for reclamation and reuse.

- A new and versatile thorium chloride reagent has been developed using legacy thorium nitrate waste. This process is cost-effective, safe, and green. In addition, it has applications in thorium chemistry, materials science, and nuclear reactors.
- The US does not currently have the domestic capability to produce precursor chemicals to manufacture the high explosive 1,3,5-triamino-2,4,6-trinitrobenzene (TATB) used in some weapons systems. Some of the chemical processes to make the precursor chemicals are no longer allowed domestically due to environmental concerns over hazardous processes and solvents that contribute to global warming. LANS researchers have overcome these concerns by developing an environmentally-friendly method to produce TATB.

The Pollution Prevention Program holds a Pollution Prevention award 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 FY12, the Pollution Prevention Program gave awards to employees who worked on 53 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.

Each year the EMS/Pollution Prevention team invites waste generators to submit proposals for pollution prevention project (formerly known as the Generator Set-Aside Fee or GSAF) grants. The EMS/Pollution Prevention team coordinates the peer review of the project proposals and distributes the available funds to the projects. The EMS/Pollution Prevention team 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 Pollution Prevention Program has a link to a database of alternative chemical choices on its website. The database of alternative chemicals was developed in conjunction with 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 implementation of DOE Order 436.1 provides buyers with opportunities to choose less hazardous or nonhazardous janitorial products, office supplies, and other items that contain recycled content. The janitorial supply catalog 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. In FY12, LANS received a Bronze GreenBuy Award for procuring products in FY11 with sustainable attributes. LANS met the DOE's leadership goals for five product types in three product categories, including:

- Construction category: carpet and concrete;
- Office category: furniture and computers/laptops; and
- Custodial category: trash bags.

2.4 Investigation of Additional Waste Minimization and Pollution Prevention Efforts

The EMS/Pollution Prevention team monitors waste trends and develops improvement projects. Waste reduction projects often come directly from researchers, waste management coordinators, and the EMS/Pollution Prevention team itself. EMS/Pollution Prevention staff provides engineering support to waste generators in the implementation of these projects.

During FY12, each directorate participated in the EMS process and 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.

2.4.1 Funded Projects

The following paragraphs describe Pollution Prevention projects and funding amounts for the past five years. Pollution Prevention projects address all types of pollutants. However, the following only represent projects that were designed to reduce hazardous waste, MLLW, or MTRU.

In FY08, funds were allocated to the following projects:

- Replacement of Lead Bricks with Nonhazardous Bismuth ($25,000)

  The purpose of this project was to replace lead bricks used in a shielding cave with bismuth bricks. Past research indicated that bismuth worked for this application, but the nonhazardous bismuth will never become MLLW as the lead bricks might.

- Waste Reduction by Distillation for High-Performance Liquid Chromatography Processes (HPLC) ($20,000)

  A unit was installed to recover acetonitrile from an aqueous HPLC solution so that the acetonitrile could be reused and not become waste. This new process reduces hazardous waste generation by over 50 gallons per week and still allows all of the same work to be performed.

- Radioactive Waste Technical Support ($185,000)

  The purpose of this project was to provide technical support to all of the Pollution Prevention projects in FY08 concerned with reducing MLLW, MTRU, TRU, and LLW. The funds paid for time and effort of a dedicated Wmin/PP staff member.

- Oil-Free Pump for the 1L Service Area ($55,000)

  An oil-free pump was purchased for an energy research lab. The previous pump generated about 170 kg of oil that had to be handled as MLLW every year. The new pump does not use oil, so none of this MLLW is generated.

- Lead Recycle ($75,000)

  This project recycled/reused six drums of lead bricks and three pallets of lead-lined and solid lead pigs. The usable lead and steel will be re-cast as shielding containers and drum linings to be resold to DOE contractors.

- Plasma Cleaning Process ($55,000)

  This was a demonstration project that used plasma-cleaning technology as a replacement for trichloroethylene. This project, once fully deployed, will eliminate a MTRU waste stream.

In FY09, funds were allocated to the following projects:

- Nonhazardous Lead Equivalent Shielding Glovebox Gloves ($15,000)

  The purpose of this project was to replace lead-lined glovebox gloves with a new type of gloves that uses bismuth and tungsten instead. For certain applications, other gloveboxes

can be retrofitted over time, and less MLLW will result in the future since bismuth and tungsten are both nonhazardous materials.

- Acid Bath Glassware Cleaning Substitute ($30,000)

  A nonhazardous, biodegradable detergent was tested in place of a nitric acid bath to clean glassware for sensitive samples. By using this replacement, the team plans to avoid the generation of over 50 gallons of nitric acid waste annually.

- Light-Emitting Diode (LED) Lights at Technical Area (TA)-55 ($40,000)

  Based on the success of a previous project, gloveboxes are being retrofitted with LED lights instead of fluorescent panels. LED lights operate at cooler temperatures, are more energy efficient, last longer than fluorescent bulbs, and are low voltage, which reduces the chance of an injurious shock to a worker. The nonhazardous characteristics and longer life of the LEDs mean that less MLLW will be generated over time.

- Bioscience Organic Solvent Recycle ($48,000)

  Solvent distillation equipment was installed so that solvents used for separations could be reused in a closed-loop system onsite. This improvement reduces approximately 1300 kg of solvent waste and new solvent purchases each year.

- Ion Pump Hazardous Waste Elimination ($22,500)

  New ion pumps were purchased for the accelerator, so the old ion pumps no longer need to be reconditioned with an acid bath. The new parts reduce hazardous waste generation by about 180 kg annually.

In FY10, funds were allocated to the following projects:

- Direct Solid Analysis Using Direct Current (DC) Arc Spectrometry to Eliminate Waste Generation ($40,000)

  A new spectrometer with a solid-state detector was purchased for use in the plutonium-238 Heat Source Program. The old spectrometer that was replaced used about 3000 gallons of water and generated about 16 liters (L) of MLLW with silver annually. The new instrument is also expected to be used for another process, in which about 23 gallons of solid TRU waste can be avoided each year.

- Ion Exchange Column Reduction Project ($30,000)

  Wizard Bags are a super strong type of plastic bag that can completely cover a tall ion exchange column. When encased in a Wizard Bag, a 6-foot column can be safely broken

apart without the risk of puncture from broken glass. This size reduction minimizes the number of waste containers containing TRU or MTRU that would be sent away as waste.

- Satellite Accumulation Area Elimination from PF-4 Analytical Method ($55,000)

  This funding allowed Chemistry Division to obtain an unwanted alpha spectrometer from Plutonium Manufacturing and Technology Division instead of having the instrument sent away as waste. This spectrometer may eliminate the need for xylene in some experiments, which will reduce the volume of MTRU generated from this work by about 0.1 cubic meters per year.

- Purchase and Supply LED Lights for TA-50 ($50,000)

  This project replaced 4-foot fluorescent bulbs in radiological control areas (RCAs) at TA-50 with LED lights. Since fluorescent bulbs in RCAs can potentially become MLLW, the expected reduction in overall MLLW generation is 3 to 5 cubic meters each year.

- Fluorescent Light Substitution at TA-48 ($30,000)

  Fluorescent lights in hot cells at TA-48 were replaced with LED lights to avoid the potential generation of about 0.5 cubic meter of MLLW.

- Reduction of MLLW and Reuse of LLW at TA-53 ($125,000)

  Some older equipment at TA-53 was refurbished so that used targets can be remotely cut apart and disposed of as MLLW in normal, 55-gallon drums instead of in very large casks. The reduction in MLLW waste volume is expected to be about 3.8 cubic meters.

- Mercury Ignitron Replacement Prototype Project ($86,500)

  This project is to prototype, test, and install a solid-state ignitron to replace a mercury ignitron. If all 15 mercury ignitrons are ultimately replaced, about 11 kg of mercury-containing hazardous waste can be eliminated.

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

  A solvent-purification system was purchased for performing actinide chemistry operations. This system produces less hazardous waste than the old system did.

- Chemical Storage and Re-Use Centers, Virtual Chemical Exchange ($48,303)

  This project investigated the possibilities of having chemical pharmacies for sharing unused chemicals among divisions. Unused and unspent chemicals have long been a significant fraction of the hazardous waste stream at the Laboratory, so minimizing this waste stream is very desirable.

- Perchloric Acid Fume Hoods ($100,000)

  A new fume hood dedicated to work with perchloric acid reduces the amount of piping that must be washed down by 75%. Concentrating all perchloric acid work into one hood means that about 70,000 L less of radioactive liquid waste will be generated each year.

- Chemical Inventory Reduction ($30,000)

  The Plutonium Manufacturing and Technology Division disposed of about 40 kg of unwanted chemicals as hazardous waste. The chemicals had been taking up valuable room in cold storage space.

- Van de Graaff Cleanout Project ($60,000)

  The old Ion Beam Facility was shut down, and this funding helped to remove the materials inside. Approximately 55 gallons of MLLW and 26 cubic meters of LLW were removed for disposal.

- Low-Energy Demonstration Accelerator Containment Trench Extension ($5,000)

  A secondary containment trench was extended to become capable of holding all of the oil in several transformers at TA-53 in case there were simultaneous catastrophic failures. If oil escaped in the event of such failures, then surrounding soil could get contaminated and ultimately become hazardous waste.

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 is expected to help 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.

2.4.2 Current FY13 Projects

The LANS FY13 Pollution Prevention projects will address MLLW, hazardous, and New Mexico Special waste streams, as well as other environmental impacts. The project titles that directly address regulated waste streams are listed below.

- Smoke Alarm Recycling ($18,200)

  The funds for this project will be 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 will be installed for synthesizing and preserving peptides. The new pump will not generate any hazardous waste oil and will require less maintenance.

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

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

- Sanitary Effluent Recycling (SERF) Sludge Makes Carbon Neutral Concrete ($158,000) Research will be 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.

3.0 Hazardous Waste

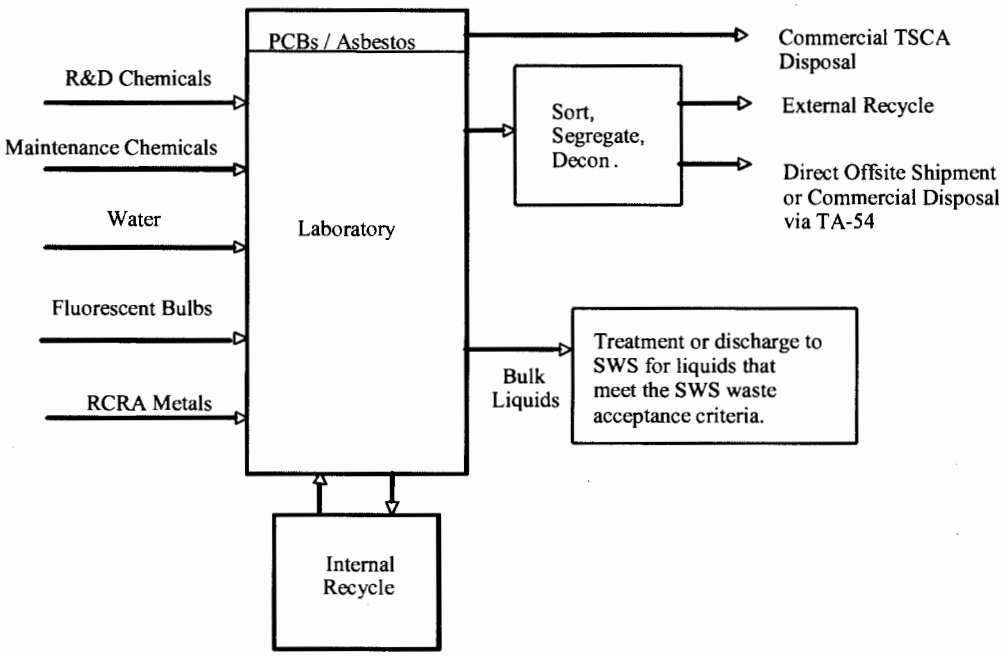
3.1 Introduction

The annual hazardous waste disposal amount that is reported as part of the Pollution Prevention Program DOE reporting requirements is based on the total waste disposed recorded in the Waste Compliance and Tracking System database (WCATS) system and does not include waste generation amounts prior to onsite treatment. Data quality assurance for this system is managed by the Environmental Protection Division Leader. The WCATS waste data used in this report was collected for FY12 on October 19, 2012.

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. Figure 3-1 shows the process map for waste generation.



PCBs = polychlorinated biphenyls, SWS = Sanitary Wastewater System, TSCA = Toxic Substances Control Act

Figure 3-1. Hazardous waste process map

The quantity of hazardous waste that was generated and the amount of hazardous waste that was recycled during FY12 are shown in Figure 3-2. Recycled wastes include aerosol cans, light bulbs, batteries, mercury, and ferric chloride solution.

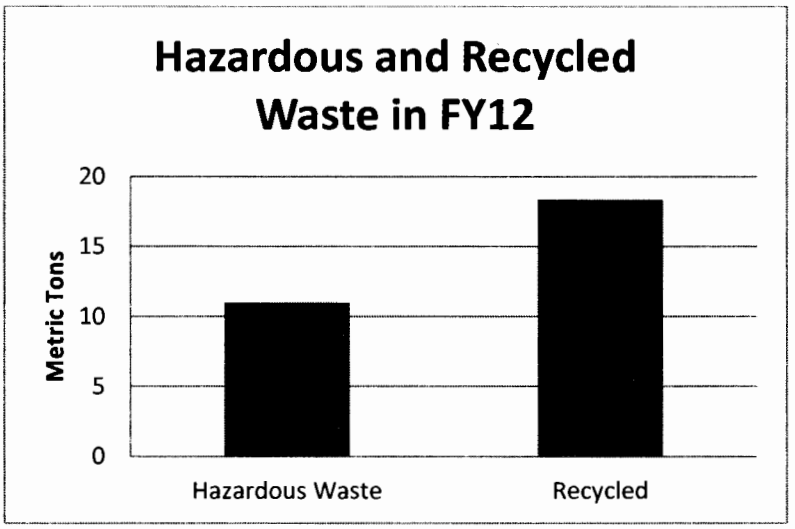


Figure 3-2. Hazardous waste and recycled hazardous waste generated during FY12

The divisions that produced the most non-recyclable hazardous waste during FY12 were Chemistry (C), Weapons Experimentation (WX), TA-55 Operations (TA55), Materials Physics and Applications (MPA), TA-21 Closure Project (TA21), Maintenance and Site Services (MSS), Nuclear Process Infrastructure (NPI), International and Applied Technology (IAT), Materials Science and Technology (MST), and Physics (P). The hazardous waste generation by division is shown in Figure 3-3.

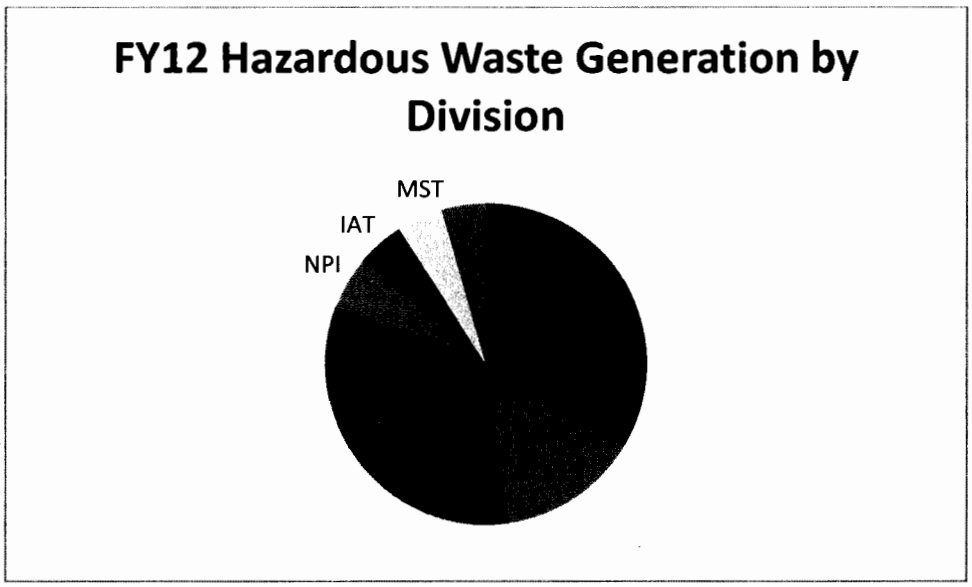


Figure 3-3. Hazardous waste by division during FY12.

3.2 Hazardous Waste Minimization Performance

The amount of non-remediation hazardous waste generated in FY12 was 10,070 kg, excluding recycled materials. This amount was slightly less than the 11,335 kg of non-remediation hazardous waste generated during FY11. The amount of hazardous waste that was recycled during FY12 was 18,353 kg, which was more than was recycled during FY11. During FY12, remediation activities generated 899 kg of hazardous waste. This amount is much less than the 41,460 kg of hazardous waste generated from remediation activities during FY11. Hazardous waste generated by remediation activities is discussed in more detail in Section 6.0. All of the non-recycled hazardous waste generated at the Laboratory in FY12 is shown in Table 3-1 sorted by the generating division. Hazardous waste from remediation is listed as well and noted after the division name.

Table 3-1. Generation of Hazardous Waste by Division during FY12

Division	Hazardous Waste in kg
Chemistry	1,495
Weapons Experimentation	1,314
TA-55 Facility Operations	1,202
Materials Physics and Applications	1,141
TA-21 Closure Project (*remediation*)	843
Maintenance and Site Services	800
Materials Physics and Applications	779
Nuclear Process Infrastructure	442
International and Applied Technology	406
Materials Science & Technology	388
Physics	377
Earth and Environmental Science	335
Bioscience	286
Waste Projects and Services	247
Weapon Systems Engineering	245
Nuclear Component Operations	236
Radiation Protection	201
Waste and Environmental Services	193
Applied Engineering and Technology	191
Weapons Facilities Operations	112
Emergency Operations	106
Waste Management	102
Corrective Actions Project *(remediation)*	56
Manufacturing Engineering and Technology	47
Intelligence and Space Research	45
LANSCE	35
Physical Security	34
Plutonium Manufacturing and Technology	18
Manager of Functions	15
Environmental Protection	13
Associate Directorate of Environment, Safety & Health	11
Industrial Hygiene and Safety	7
Plutonium Facility	6
Engineering Services	6
Central Training	6
Quality and Performance Assurance	4
Director's Office	4

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 hazardous waste streams for FY12 are described in this section. This analysis excludes recycled items and wastes from remediation activities since remediation wastes are discussed in Section 6.0. High explosives waste and wastewaters are treated onsite, and these are also excluded. Spent R&D chemicals make up the largest number of individual hazardous waste items. The breakdown of components of hazardous waste for FY12 is shown in Figure 3-4.

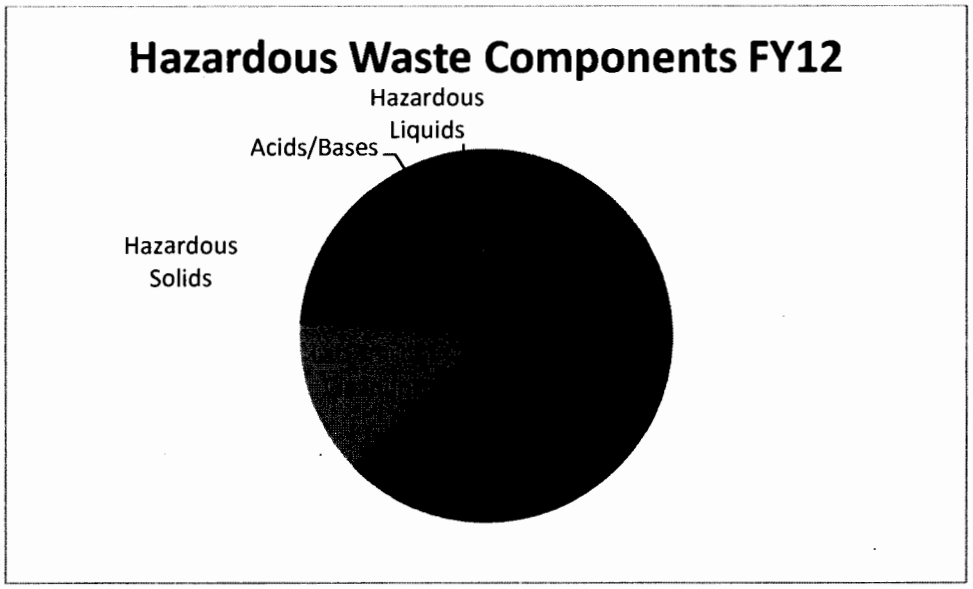


Figure 3-4. FY12 hazardous waste stream components, excluding remediation and recycled waste.

Unused/Unspent Chemicals. The volume of unused and unspent chemicals varies each year, but this waste stream comprised the largest fraction of the total non-remediation hazardous waste in FY12. 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. Efforts to "right-size" chemical procurements and share chemicals are being addressed. Past cleanouts at the Laboratory and lower rates of chemical purchasing have reduced the volume of this waste stream. The ChemLog system is set up to allow researchers to find and request unwanted, unexpired chemicals from other researchers.

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. A project in FY12 studied a possible substitute for trichloroethylene. 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, such as HPLC and solvents persist as a large component of the hazardous waste stream. The weight of solvents generated in FY12 was slightly less than was generated during FY11.

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 internally as part of established neutralization procedures. Acids made up over 80% of this waste stream during FY12.

Hazardous Solids. This waste stream includes inert barium simulants used in high explosives research, contaminated equipment, cathode ray tubes, broken leaded glass, firing site debris, ash, and various solid chemical residues from experiments. The weight of hazardous solids generated during FY12 was about the same as was generated during FY11.

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. In FY12, the weight of hazardous liquids was less than was generated during FY11.

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. In FY12, the weight of lab trash and spill cleanup was more than was generated during FY11.

3.4 Hazardous Waste Minimization

More bulbs, batteries, and aerosol cans were recycled during FY12 than in past years. Starting in late FY11, special recycling operations were established in a small building 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 crushed, 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. FY12 was the first full year of recycling operations in this special building.

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 in other obsolete mercury-containing equipment is recycled.

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, and over 400 kg of hazardous waste acid are avoided every year through this reuse activity. 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. Approximately 1488 kg of ferric chloride solution were sent offsite to be recycled and resold during FY12, and this would otherwise have become hazardous waste.

Base Waste Reduction and Recycling

Weapons Experimentation Division uses sodium hydroxide solution to remove film resist from copper cables after etching. Over time, the sodium hydroxide solution gets diluted and is no longer useful for this purpose. Instead of disposing of the spent caustic solution, it is used in a process to neutralize waste acidic liquid. The neutralization procedure works very well with the spent caustic solution, and no new caustic chemicals need to be purchased for this purpose.

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.

- 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 heavy equipment maintenance shop once cleaned metal parts by manually scrubbing them in solvent. The shop purchased a hot water parts washer, and the employees found that the hot water parts washer worked better for cleaning metal parts than solvent. The

hot water parts washer saves time for employees, decreases their chemical exposure, and reduces hazardous waste solvent generation by about 4000 kg annually.

- 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 initially, baked in the oven, and then weighed again to determine how much oil was baked off from the sample. This improvement project reduces about 400 kg of hazardous waste annually.

- 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 large glassware (25 mL to 2 L) reaction vessels. Now the 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 HPLC waste. These systems prevent the generation of about 100 gallons 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. These two divisions used to produce about 15,000 kg of hazardous waste coolant annually. 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. A lead-free ammunition project purchased 14,000 rounds of frangible lead-free ammunition in 2010, and an additional 100,000 rounds in 2011, for use in handguns during training exercises.

In addition, the protective forces staff uses high-accuracy scopes on their weapons, and this allows them to achieve certification while using many fewer bullets. The bullets used for certification are required to be the standard lead-containing variety.

3.5 Barriers to Hazardous Waste Minimization

The largest component of the hazardous waste stream during FY12 was unused and unspent chemicals. 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. In some cases of project discontinuation, usable chemicals are distributed to other researchers in the same building who can use them. Through the EMS, directorates are being asked to set specific objectives and targets for chemical waste reduction.

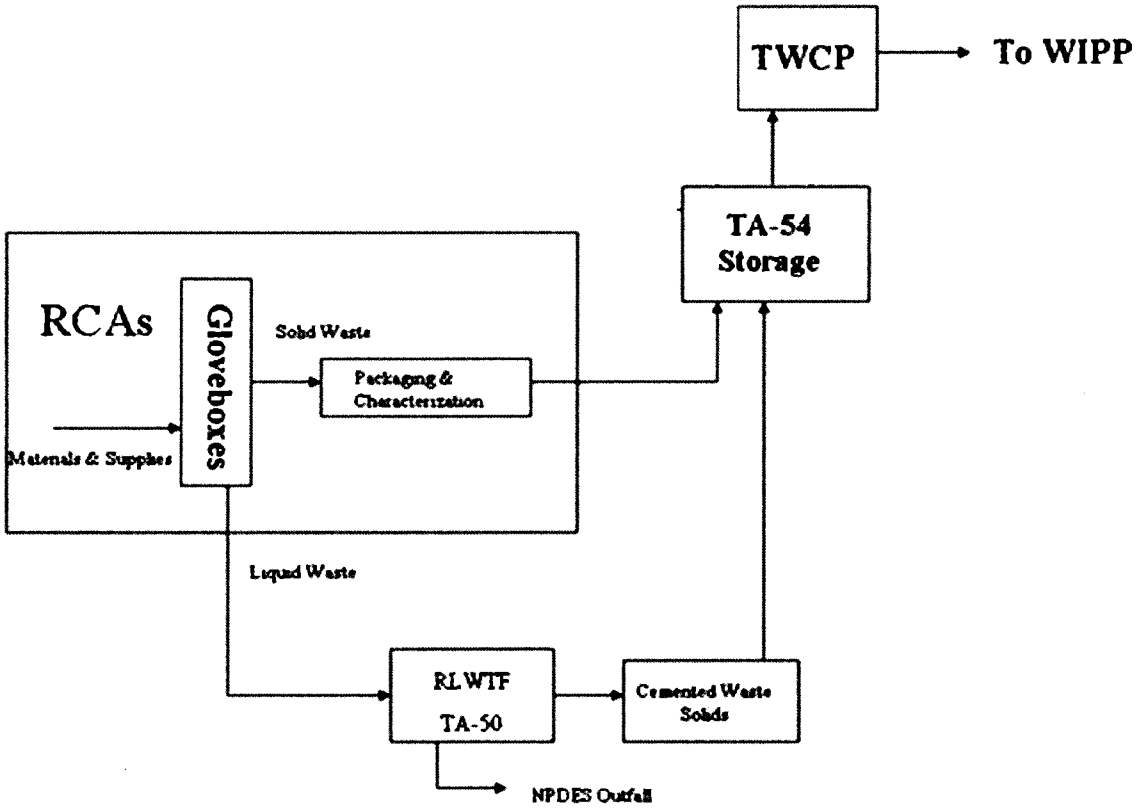
4.0 Mixed Transuranic Waste

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, requiring it to be either contact handled or remote handled. 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. Liquid MTRU is a small percentage of total MTRU, and these wastes are primarily organic liquids. 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. Security and safeguards assay measurements are conducted on the containers for accountability before they are removed for transport. Certification of the waste for transport and disposal at WIPP is currently done by the TRU Waste Project Support Group. The top-level process map for MTRU waste is shown in Figure 4-1.



TWCP = TRU Waste Characterization Program

Figure 4-1. Top-level MTRU waste process map and waste streams

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. Solid wastes are packaged, characterized, and shipped to TA-54 for storage. Liquid wastes are sent to the 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, and the remaining water is discharged to a NPDES-permitted outfall. All waste is processed by the TRU Waste Characterization Program (TWCP in Figure 4-1) prior to shipment to WIPP.

During FY12, MTRU waste was generated by the groups at TA-55, operations at the RLWTF, operations at CMR, and by the Offsite Source Recovery Program. Some of the MTRU waste was repackaged so that WIPP acceptance criteria were fulfilled.

4.2 MTRU Waste Minimization Performance

LANS shipped offsite 80,576 kg of MTRU waste during FY12. This is considerably less than the 161,604 kg of MTRU shipped during FY11, and most of this was due to completed

remediation activity at TA-21. No remediation MTRU waste was generated during FY12. During FY12, repackaging activities generated 70,529 kg of MTRU. Programmatic work activities generated 10,035 kg of MTRU at CMR, TA-55, and TA-50 during FY12. In FY12, the Offsite Source Recovery Program generated 11 kg of MTRU. The breakdown of MTRU generation at the Laboratory during FY12 is shown in Table 4-1.

Table 4-1. Generation of MTRU Waste by Division during FY12

Division	MTRU Waste in kg
LANL TRU Program (repackaging)	70,529
Nuclear Process Infrastructure (TA-55 Operations)	9,042
Waste and Environmental Services (CMR Operations)	778
Radioactive Liquid Waste Treatment Facility	216
Nuclear Nonproliferation (Offsite Source Recovery)	11

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 considered to be TRU or MTRU waste. 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. The percentage breakdown of MTRU generated during FY12 is shown in Figure 4-2.

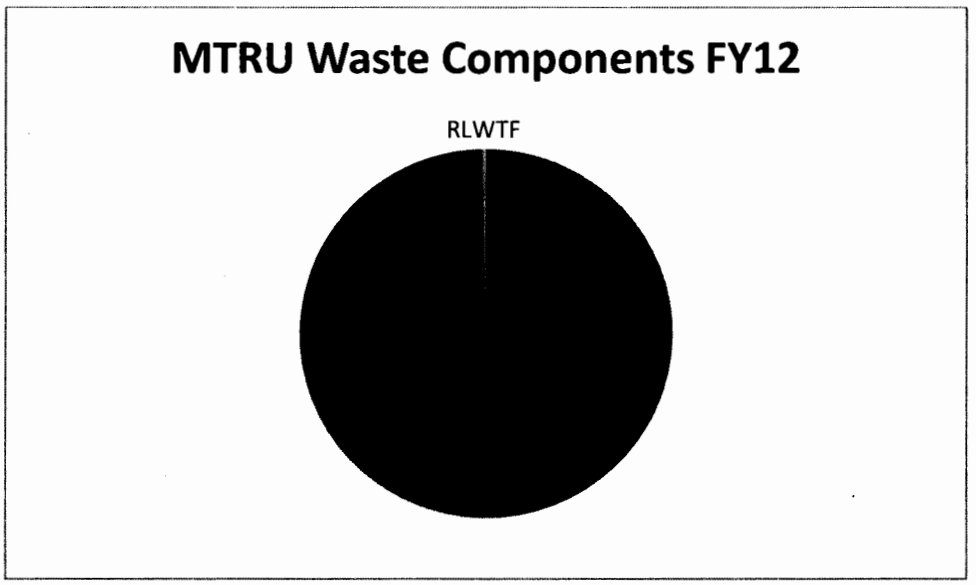


Figure 4-2. Composition of MTRU waste by volume for FY12

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. Over 81% of the MTRU waste generated at the Laboratory during FY12 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 18% of the MTRU waste generated at the Laboratory in FY12 was from TA-55 and CMR operations.

RLWTF. The RLWTF treats MTRU liquid in batches. At the end of the treatment process, the settled sludge is removed, dewatered, and then cemented in drums for disposal at WIPP. Less than 1% of the MTRU waste generated at the Laboratory during FY12 was sludge from the RLWTF.

Offsite Source Recovery. The Offsite Source Recovery Program collects radioactive sources from offsite and packages them for disposal to prevent these items from being used or disposed of improperly. These items were not originally produced at the Laboratory, but it is safer for everyone to have LANS collect and dispose of these items rather than leave them in their offsite locations. Less than 1% of the MTRU waste generated at the Laboratory in FY12 was from the Offsite Source Recovery Program.

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 ENV-ES Pollution Prevention Program. The projects are described in Section 2.4.1 of this report.

The great majority of MTRU waste generated in FY12 was from repackaging work. Since repackaging will not continue indefinitely, the amounts of waste from this process will decrease over time. 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.

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. As seen in Figure 4-2, repackaging waste was the largest fraction of MTRU generated at the Laboratory during FY12.

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 (e.g., 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 results 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. The DOE is interested in the volumes of routine and non-routine MLLW, so these materials are tracked separately. Typical MLLW items include contaminated lead-shielding bricks and debris, R&D chemicals, spent solution from analytic chemistry operations, mercury-cleanup-kit waste, electronics, copper solder joints, and used oil. Figure 5-1 shows the process map for MLLW generation.

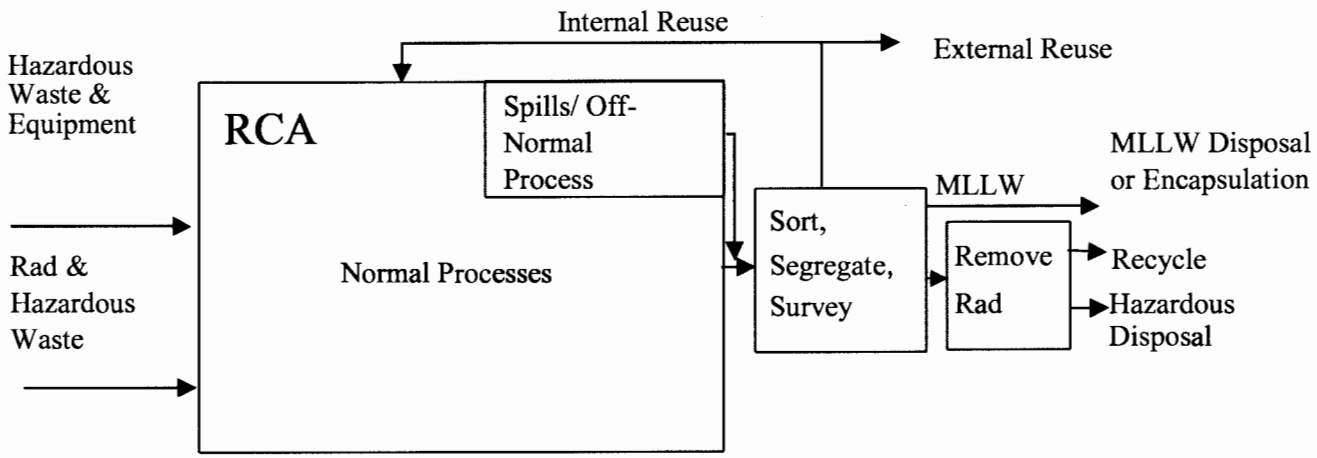


Figure 5-1. Top-level MLLW process map

Figure 5-2 shows MLLW generation by division during FY12, including MLLW from remediation work.

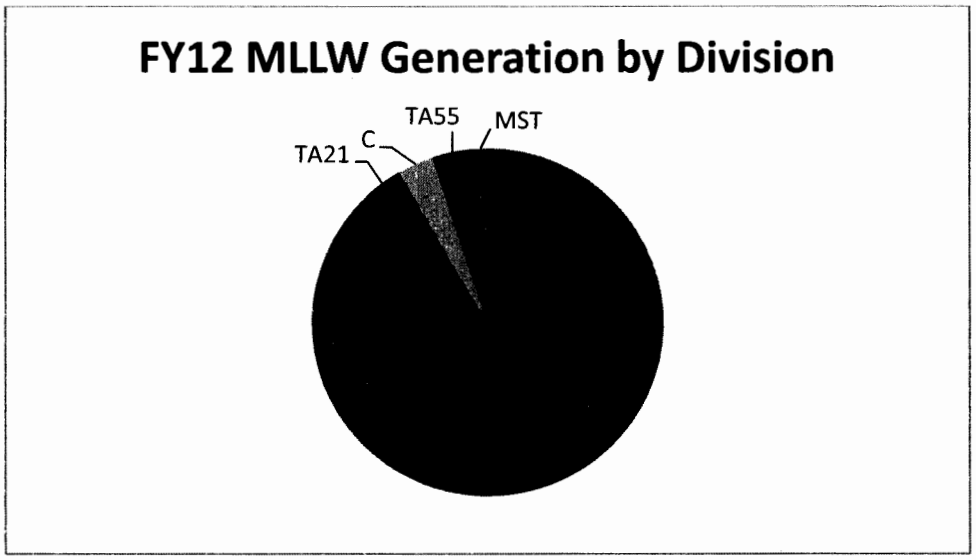


Figure 5-2. Total MLLW generated by division in FY12

The divisions that generated the most routine and non-routine MLLW during FY12 were the LANL TRU Program (LTP), TA-21 Closure Project, Chemistry (C), TA-55 Facility Operations (TA55), and Materials Science and Technology (MST).

5.2 MLLW Waste Minimization Performance

MLLW generation for FY12 was 25,482 kg, excluding MLLW generated from remediation work. This total includes former MTRU waste that now qualifies as MLLW and was repackaged as such. Remediation work performed during FY12 generated 962 kg of MLLW, and this waste is discussed in greater detail in section 6.0. This is less MLLW than was generated during FY11. Table 5-1 includes all MLLW generated at the Laboratory during FY12, and remediation waste is noted after the division name.

MLLW is generated by routine programmatic work, remediation activities, lab cleanup activities, and D&D efforts. The remediation waste is discussed separately in Section 6.0 of this report. The volume of non-routine MLLW 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. Generation of MLLW by Division during FY12

Division	MLLW in Kilograms
LANL TRU Program	23,009
TA-55 Facility Operations	1,004
TA-21 Closure Project (*remediation*)	962
Chemistry	860
Materials Science and Technology	321
Weapon Systems Engineering	97
Materials Physics and Applications	96
Director's Office	55
Weapons Facilities Operations	24
Weapons Experiments	12
Plutonium Facility	4

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 contaminated with LLW 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 shipped to TA-54. From TA-54, MLLW is sent to commercial and DOE-operated treatment and disposal facilities.

The largest components of the MLLW stream by weight in FY12 are reclassified MTRU, repackaging waste, remediation waste, electronics, spent aqueous waste and solvents, lead debris, oil, and tritium-contaminated bulbs. Less MLLW generation is anticipated in the future as environmental restorations are completed, as nontoxic materials are substituted for mercury and lead, and as oil-free vacuum pumps replace older pumps. The relative weights of various waste streams are shown in Figure 5-3.

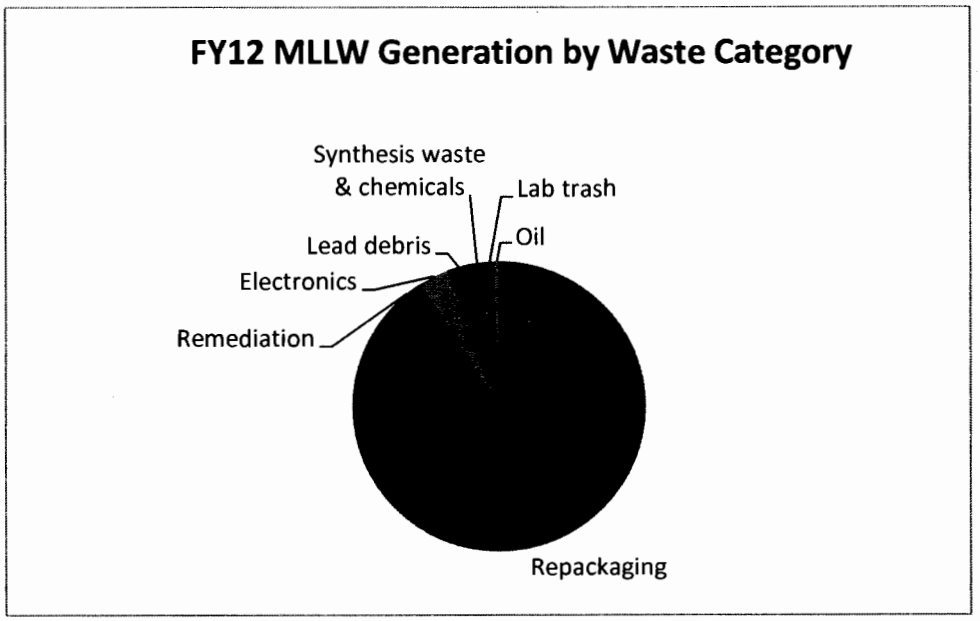


Figure 5-3. Constituents of MLLW in FY12

Repackaging. This waste was formerly classified as MTRU, but as MTRU standards changed, it was discovered that these wastes could be 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.

Electronics. This waste includes various pieces of electronic equipment that were previously located within RCAs. In the future, RCAs will be engineered to not require electronics to be within them, and smaller electronic equipment will be used whenever possible. The Chemistry Division set up a demonstration laboratory using the smallest possible electronic equipment.

Lead Debris. The lead debris waste stream includes copper pipes with lead solder, lead-contaminated equipment, brass contaminated with lead, bricks, sheets, rags, electronics, 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.

Synthesis Waste and Chemicals. In FY12 this waste stream was composed of precipitated sodium nitrate, spent solvents, aqueous solutions, unused/unspent chemicals that have become contaminated in RCAs, and analytical chemistry waste.

Lab Trash. This waste is composed of gloves, personal protective equipment, dry painting debris, inert stimulant waste, and paper towels.

Oil. Used MLLW oil comes from vacuum pumps that are used within RCAs. Two projects funded for FY13 will purchase oil-free pumps, which should decrease the weight of this component of the MLLW stream in the future.

5.4 Mixed Low-Level Waste Minimization

Efforts to substitute alternatives and to improve sorting and segregation of these waste streams will reduce MLLW volumes in the coming years. The Pollution Prevention Program has implemented a number of projects such as lead-free solder, bismuth shielding in RCAs instead of lead, oil-free vacuum pumps in RCAs, reduction of electronics in RCAs, and elimination of nitric acid bioassay wastes. During FY12, the Pollution Prevention Program funded projects designed to reduce the generation of MLLW waste. These projects are described in Section 2.5.1 of this report.

One especially promising project involves replacing traditional fluorescent fixtures with LED fixtures in gloveboxes. The LED lights do not contain any RCRA-regulated components, so after their useful life, they will not become MLLW as fluorescent lights do. The LEDs are much smaller and lighter than fluorescents, and the LEDs last longer, use less electricity, and generate less heat than fluorescents. From FY08 through FY12, groups at TA-55 purchased more LED lights for gloveboxes. During FY12, LANS disposed of only 24kg of fluorescent bulbs as MLLW.

5.5 Barriers to MLLW Reduction

One barrier to reducing the generation of MLLW is the DOE-imposed suspension of metals recycling from RCAs with particular postings. Previously, any scrap metal could be surveyed for radioactive contamination and released for recycling if no activity was detected. Since the suspension was imposed, scrap metal from RCAs with particular postings must be handled as waste. In particular, this suspension impacts MLLW in the area of electronics waste generation since electronic components often contain lead or other hazardous metals. Without the suspension, a larger percentage of electronics waste and lead debris could be sent for recycling.

6.0 Remediation Waste

6.1 Introduction

Section 6.0 represents the WMin/PP Program awareness plan for the corrective actions component of ADEP. This component includes the Corrective Action Program (EP-CAP) and its associated investigation, cleanup, and site closure projects.

The mission of the EP-CAP 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

The FY12 remediation waste generation and waste minimization summary is listed in Table 6-1.

Table 6-1. FY12 Remediation Waste Generation Summary

Waste Type	Weight in Kilograms
Hazardous	899
MLLW	962
MTRU	0

Project activities in FY12 involved investigations, including soil sampling and removal, stormwater and groundwater monitoring, and well installation.

In January 2012, DOE and NMED entered into a framework agreement for realignment of environmental priorities at the Laboratory. In accordance with the framework agreement, resources for shipment of above ground TRU waste from TA-54 Area G to WIPP were increased in FY12. This resulted in a commensurate decrease in resources for Consent Order investigation/remediation work by EP-CAP. As a result, there was a significant reduction in the

volume of remediation waste generated in FY12.

6.3 Waste Stream Analysis

This report addresses all RCRA-regulated waste that may be generated by the 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; 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 FY12 waste generation was the result of investigations, including well installation, and focused corrective actions. Investigations, corrective actions, and other activities associated with the Consent Order implemented during FY12 include the following:

- Investigations and corrective actions for Upper Los Alamos Canyon Aggregate Area;
- Soil removal and sampling in Bayo Canyon;
- Investigations of Sandia Canyon and Water Canyon and Cañon de Valle;
- Subsurface vapor monitoring at Material Disposal Area (MDA) C;
- Plugging and abandonment of 10 obsolete monitoring 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 sediment monitoring in Los Alamos and Pueblo Canyons and Pajarito Canyon;
- Drilling, completion, and development of intermediate and regional aquifer monitoring wells including R-62, R-66, and SCI-3;
- Redevelopment of regional aquifer monitoring well R-61; and
- Biennial asphalt and ordnance surveys in Bayo and Rendija Canyons.

6.4 Remediation Waste Minimization

Waste minimization and pollution prevention were integral parts of the FY12 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 WMin/PP Program techniques used in FY12 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 developed by the Water Quality and RCRA Group (ENV-RCRA) in FY08 continued to be implemented. Drilling, development, and purge waters constitute a major potential waste source for EP-CAP (i.e., upwards of 100,000 gal. 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 2012 will be submitted in March 2013.

- The formal procedure for land application of drill cuttings developed by ENV-RCRA in FY08 continued to be implemented. Drill cuttings constitute a major potential source of solid wastes generated by EP-CAP. 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. A total of approximately 100 cubic yards of drill cuttings from well drilling and subsurface investigation boreholes were land applied during FY12.

- ADEP continued implementation of an Enterprise Document Management System (EDMS) that has resulted in significant reductions in resource use and waste generation associated with Consent Order compliance. Benefits include the elimination of 100 boxes of paper, 100 records storage boxes, about 1900 miles of vehicle use, 95 gallons of

fuel consumption, and over $20,000 in office supply costs annually.

- ADEP continued to take actions during FY12 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 increasing environmental communications through Worker Safety and Security Teams. These activities resulted in increase awareness of waste minimization requirements and opportunities by ADEP subcontractors.

Sort, Decontaminate, and Segregate

This task is currently being implemented by EP-CAP 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 FY12, contact waste from site investigation and groundwater sampling activities continued to be managed through GIC.

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 actions 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.

Equipment 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 LANS' EMS planning efforts. As has been done in previous years, actions related to pollution prevention are being incorporated into the FY13 Environmental Action Plan for ADEP developed as part of the EMS. As appropriate, specific actions and approaches that will be incorporated into planned corrective action projects for FY13 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 drilling equipment and materials;
- Increasing use of affirmative procurements; 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.

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 to increase awareness about

waste minimization and promote sharing of lessons learned.

6.6 Barriers to Remediation Waste Minimization

In some instances, levels of waste minimization achieved fell below potentially achievable levels based on site conditions. Examples follow:

- The amount of investigation-derived waste generated during investigations conducted under the Consent Order has increased relative to investigations conducted under Module VIII. The investigation scope has increased under the Consent Order, resulting in the drilling of more boreholes and generation of more investigation-derived waste.

- The use of risk assessments to establish risk-based cleanup levels is one of the few opportunities available to corrective actions for source reduction. The Consent Order limits the use of risk-based cleanup levels in lieu of the cleanup levels prescribed by the Consent Order. Therefore, the cleanup levels prescribed in the Consent Order may result in generation of more waste than would result from use of risk-based cleanup levels.

- The Consent Order requires long-term controls on sites that are cleaned up to other than residential cleanup levels. 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.

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[i]Pollution Prevention Act of 1990, United States Code Title 42, The Public Health and Welfare, Chapter 133 (http://www.epa.gov/p2/pubs/p2policy/act1990.htm)