Report

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Environmental Protection Division
Environmental Stewardship Group
P.O. Box 1663, MS J978
Los Alamos, New Mexico 87545
(505) 665-8855/FAX: (505) 665-8858

Date: November 18, 2010
Refer to: ENV-ES: 10-250

HAND DELIVERY

Mr. James Bearzi
Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

NOV 2010

SUBJECT: 2010 LANL HAZARDOUS WASTE MINIMIZATION REPORT

Dear Mr. Bearzi:

I am pleased to submit this annual report on hazardous waste minimization activities. This report was prepared pursuant to the requirements of Module VIII, Section B.1 of the Laboratory's Hazardous Waste Facility Permit (NM0890010515-1) and is required by the Permit to be submitted to the New Mexico Environment Department by December 1, 2010 for the previous year ending September 30.

Los Alamos National Laboratory has made significant progress in minimizing hazardous waste as well as other waste forms. By integrating pollution prevention and waste minimization into all operational activities we expect even more progress in the future.

Please contact me by phone (505) 667-2278 or email (patg@lanl.gov), if you have any questions.

Sincerely,

Patricia E. Gallagher
Group Leader

PG/mcm

Enclosures: a/s

34131

CY:
M. Mallory, PADOPS, w/enc., MS A102
C. Cantwell, ADESHQ, w/enc., MS K491
M. Graham, ADEP, w/enc., MS M991
A. Dorries, WES-DO, w/enc., MS M992
A. Grieggs, ENV-RCRA, w/enc., MS K490
K. Hargis, ADEP, w/enc., MS M996
D. Hjeresen, ENV-DO, w/enc., MS K404
P. Gallagher, ENV-ES, w/enc., J978
B. Poff, ENV-ES, w/enc., MS J978
ENV-DO, File, w/enc., MS K404
ENV-ES, File, w/enc., MS J978
IRM-RMMSO, w.enc., MS A150

Document: Hazardous Waste Minimization Plan
Date: November 2010

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.

Cynthia Dutro
James C. Cantwell
Associate Director
Environment, Safety, Health, and Quality Directorate
Los Alamos National Security, LLC

11-16-2010
Date Signed

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

11/17/10
Date Signed

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Approved for public release; distribution is unlimited.

November 2010

Title: U.S. Department of Energy and Los Alamos National Security, LLC Hazardous Waste Minimization Plan

Author(s): Environmental Stewardship Group

Intended for: New Mexico Environment Department

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List of Acronyms

ADEP	Associate Directorate of Environmental Programs
ADESHQ	Associate Directorate of Environment, Safety, Health, and Quality
CFR	Code of Federal Regulations
CMR	Chemistry and Metallurgy Research facility
D&D	decontamination and demolition
DOE	US Department of Energy
DOE-EM	DOE-Environmental Management
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
FY	fiscal year
GIC	Green is Clean
GSAF	Generator Set-Aside Fund
HE	high explosives
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
LEED	Leadership in Energy and Environmental Design
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
NSF-ISR	National Sanitation Foundation - International Strategic Registrations
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
RTBF	Readiness and Technical Base Facilities
SAA	satellite accumulation area
SOC	Special Operations Consulting
TA	Technical Area
TCE	trichloroethylene
TRU	transuranic (waste)

TSDF	treatment, storage, and disposal facility
TWCP	TRU Waste Characterization Program
UPS	uninterrupted power supply
WIPP	Waste Isolation Pilot Plant
WMin/PP	Waste Minimization/Pollution Prevention (Program)

1.0 Hazardous Waste Minimization Plan

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 plan to the New Mexico Environment Department (NMED) in accordance with the Los Alamos National Laboratory (LANL) Hazardous Waste Permit. The plan was prepared pursuant to the requirements of Module VIII, Section B.1, of the LANL Hazardous Waste Permit (NM890010515-1). This plan describes the hazardous and mixed waste minimization program (a component of the overall Waste Minimization/Pollution Prevention [WMin/PP] Program) administered by the Environmental Stewardship Group (ENV-ES). This plan also supports the waste minimization and pollution prevention goals of the Environmental Programs Directorate (EP) organizations responsible for implementing remediation activities and describes its programs to incorporate waste reduction practices into remediation activities and procedures.

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. The elements of this program are further defined in the May 1993 US Environmental Protection Agency (EPA) interim final guidance, 58 Federal Register 10, *Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program*[ii]. The program guidance lists what EPA considers the minimum level of infrastructure and effort that constitute an acceptable program. This includes top management support, process evaluation, technology exchange, waste minimization employee training, and waste generation tracking and projections.

The DOE Office of the Secretary also requires a pollution prevention program as outlined in the 1996 Pollution Prevention Program Plan (DOE/S-0118)[iii]. The DOE plan has specific program requirements for every waste generator, including evaluating waste minimization options as early in the planning process as possible. The DOE plan places responsibility for waste minimization/pollution prevention implementation with the waste-generating program.

Specific DOE pollution prevention requirements are also delineated in DOE Order 450.1A, *Environmental Protection Program*, which has been accepted into the LANS contract. DOE Order 450.1A requirements are executed through the Environmental Management System (EMS). The EMS received third-party registration to the International Organization of Standardization ISO 14001:2004 standard in April 2006 and was recertified in March 2009. 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
- 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
- Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance

Federal Regulations

- Code of Federal Regulations (CFR), Title 40, Parts 259–280, "Standards Applicable to Generators of Hazardous Waste"

State of New Mexico Statutes

- New Mexico Hazardous Waste Act
- 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
- New Mexico Hazardous Waste Management Regulations, Title 20, Chapter 4, Part 1, New Mexico Administrative Code

DOE Orders and Policies

- DOE Order 5400.5, "Radiation Protection of the Public and the Environment"
- DOE Order 435.1, "Radioactive Waste Management"
- DOE Order 450.1A, "Environmental Protection Program"
- Secretary of Energy Notice 37-92, "Waste Minimization Policy Statement"
- DOE Pollution Prevention Program Plan, 1996

Directives and Policies

- Laboratory Governing Policy
- 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

1.3 Purpose and Scope

The purpose of this plan is to document the approach for minimizing hazardous and mixed wastes and to document performance results. This plan discusses the methods and activities that will be routinely employed to prevent or reduce waste generation in fiscal year (FY) 2011, and the plan reports FY10 waste generation quantities and significant waste minimization accomplishments for FY10. In most cases, waste minimization activities executed during FY10 will continue to occur during FY11 and beyond. This plan also discusses the Director's commitment to pollution prevention, specific elements of the ENV-ES and EP WMin/PP programs, and the barriers to implementation of further significant reductions.

The plan discusses institutional policies, goals, and training activities that address hazardous and mixed waste reduction. The plan provides waste minimization information by the following waste types: hazardous waste, mixed transuranic (TRU) 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

Module VIII, Section B.1, of the LANL Hazardous Waste Permit requires that a waste minimization program be in place and that a certified plan be submitted annually to the administrative authority. The specific requirements of the permit are listed in Table 1-1 along with the corresponding section of the plan that addresses the requirement.

Table 1-1. LANS/DOE Hazardous Waste Facility Permit, Module VIII, Section B.1

Permit Requirement	Topic	Refer to Report Section
Section B.1.(a)(1)	Policy Statement	Section 2.1
Section B.1.(a)(2)	Employee Training	Section 2.2
Section B.1.(a)(2)	Incentives	Section 2.2
Section B.1.(a)(3)	Past and Planned Source Reduction and Recycling	Sections 2.5.1, 2.5.2, 3.4, 4.4, 5.4, 6.0
Section B.1.(a)(4)	Itemized Capital Expenditures	Section 2.5
Section B.1.(a)(5)	Barriers to Implementation	Sections 3.5, 4.5, 5.5, 6.5
Section B.1.(a)(6)	External Sources of Information	Section 2.3
Section B.1.(a)(7)	Investigation of Additional Waste Minimization Efforts	Sections 2.5, 6.0
Section B.1.(a)(8)	Utilization of Hazardous Materials	Sections 2.4, 3.1, 4.1, 5.1
Section B.1.(a)(9)	Justification of Waste Generation	Sections 2.4, 6.0
Section B.1.(a)(10)(a)	Site Lead Inventory	Section 3.4
Section B.1.(a)(10)(b)	Lead Substitution and Removal	Section 3.4
Section B.1.(a)(10)(c)	Lead Shielding and Coating	Section 3.4
Section B.1.(a)(10)(d)	Lead Decontamination	Section 3.4
Section B.1.(a)(10)(e)	Scintillation Cocktail Substitution	Section 3.4
Section B.1.(a)(10)(f)	Radioactive Waste Segregation	Section 3.4

1.5 Organizational Structure and Staff Responsibilities

The Director, the Senior Environmental Steering Committee, and the Associate Director for Environment, Safety, Health, and Quality have oversight responsibilities and provide annual review of the EMS, WMin/PP Program goals, and performance. The Environmental Protection Division has primary responsibility and oversight responsibilities for the WMin/PP Program as well as for the environmental remediation program waste minimization activities. WMin/PP Program funding comes from a tax levied on each waste item. This tax supports the core WMin/PP Program activities and pollution prevention projects. Specific environmental remediation program waste minimization activities are discussed in Section 6.0.

The ENV-ES Pollution Prevention Program Team has been 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. The ENV-ES Pollution Prevention Program Team provides oversight for WMin/PP Program implementation, a base of technical knowledge and resources for pollution prevention practices, assistance with 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 in 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 National Sanitation Foundation International Strategic Registration (NSF-ISR), an independent ISO 14001 third-party registrar. LANS was most recently recertified by NSF-ISR to the ISO 14001:2004 standard in March 2009. As part of the EMS, the Laboratory Governing Policy contains the official policy on environment. This policy is used for setting annual environmental targets and objectives.

The environmental policy statement reads:

Environment: We approach our work as responsible stewards of the environment to achieve our mission. We prevent pollution by identifying and minimizing environmental risk. We set quantifiable objectives, monitor progress and compliance, and minimize consequences to the environment, stemming from our past, present, and future operation. We do not compromise the environment for personal, programmatic, or operational reasons.

2.1.1 FY11 EMS Institutional Objectives

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

1. Improve environment and safety performance through improved integration and communication at the work level.
2. Reduce cost and increase efficiency and operating capacity through systematic implementation of pollution prevention.
3. Reduce cost and increase efficiency and operating capacity through energy conservation and reductions in fuel, electricity, and water consumption.
4. Enhance workplace environment, safety, and security through implementation of Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and waste.
5. Ensure operational capacity through implementation of the National Pollutant Discharge Elimination System (NPDES) Outfall Reduction Program by 2012.
6. Reduce long-term impacts, increase operational capacity, and ensure Laboratory sustainability through an integrated approach to site-wide planning and development.

The WMMin/PP Program is an integral part of the EMS and supports LANS in meeting the EMS objectives. The FY11 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 large remedial actions,
- improving chemical use and management, including the unused, unspent chemicals,
- promoting purchase of environmentally preferable products,
- 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
- 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 FY10, the Integrated Environmental Review Program provided a training program for work planners to increase awareness of environmental concerns, including opportunities for prevention and waste minimization. Fifteen briefings were delivered to three organizations that have responsibilities related to work planning, WMin/PP Program efforts, and the EMS:

- Utilities and Institutional Facilities
- Deployed Environmental Generalists
- Environment, Safety, Health, and Quality Managers

Another management program is the Permits and Requirements Identification process. This 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.

DOE Headquarters, in conjunction with the National Nuclear Security Administration (NNSA), sponsors an annual pollution prevention awards program. The program provides recognition to personnel who implement pollution prevention projects. LANS submits nominations for the DOE/NNSA awards each year and received four awards for pollution prevention projects during FY10, including two Best-in-Class awards. The winning projects are described below. The first project mentioned also received an EStar DOE Environmental Sustainability award.

- The Radiological Laboratory/Utility/Office Building (RLUOB) was designed and built to achieve Leadership in Energy and Environmental Design (LEED) Silver Certification. The RLUOB was sited on a predeveloped location, thereby meeting LEED sustainable site requirements. The RLUOB was designed with energy and water saving features such as low-flow faucets, shower heads, and toilets and native vegetation to reduce potable water use. Low off-gassing materials were used to improve the quality of indoor air. Approximately 85% of construction waste was recycled or reused rather than disposed of in a landfill.
- A nontoxic, copper-based protocol was developed to control the oxidation states of uranium. Standard actinide chemistry that combines radioactive elements with RCRA-listed reagents, such as silver and thallium, results in a MLLW stream. Removing the RCRA-listed reagents from the process allows the waste to be disposed of as low-level waste (LLW). This new protocol has received notice throughout the actinide chemistry community.
- Property management staff applied new security requirements and implemented an improved process that provided environmental stewardship of electronic property. The new security requirements expanded the universe of devices requiring the removal of memory. A new process was developed that shipped electronic devices to one facility capable of memory-device destruction and full component recycling. Process and transportation costs to this facility are 37% less than were previously spent, and the devices are completely recycled.
- Fleet Management undertook a project to right-size the Laboratory's vehicle fleet. As a result, half of the Laboratory's vehicle fleet has flex-fuel capabilities, and over 75% of the Special Operations Consulting (SOC) fleet utilizes the alternative fuel, E85, for its operations. Because no local vendors were found to supply E85, Fleet Management procured a mobile E85 fuel transport truck.

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 FY10, the Pollution Prevention Program Team gave awards to employees who worked on 56 projects to reduce waste generation, improve efficiency, and conserve resources. These projects have millions of dollars worth of value through cost savings, waste avoidance, and improving compliance.

In FY10, the Pollution Prevention Program Team participated in a site-wide event called "The Great Garbage Grab" to clean up trash in April to coincide with Earth Day. LANS held a Student Sustainability Challenge during the summer to engage students in the EMS and to encourage them to contribute to reducing waste and conserving resources. This year the students built an onsite garden and grew vegetables that were used in dishes served at the main LANL cafeteria in the summer.

Each year the Pollution Prevention Program invites waste generators to submit proposals for pollution prevention project grants. The program is known as the Generator Set-Aside Fee (GSAF) Program, and the funds for these grants are collected via a small tax on the generation of each unit of waste. The Pollution Prevention Program coordinates the peer review of GSAF proposals and distributes the available funds to the projects. Projects are prioritized by waste type, return on investment, and matching program funds. The Pollution Prevention Program monitors progress on these projects and provides technical assistance as needed.

2.3 External Sources of Information

The Pollution Prevention Program Team members are active in other organizations dedicated to the reduction of various types of waste, and some of the information used in ideas implemented comes from these external sources. The Pollution Prevention Program Team receives information on waste source reduction and recycling from environmental organizations as well as from lessons learned from the DOE and other sites with waste management issues.

Pollution Prevention Program staff actively engage with professional organizations to further enhance their technical capabilities. The list of organizations includes, but is not limited to, the New Mexico Recycling Coalition, the US Green Building Council, the Air and Waste Management Association, and the National Pollution Prevention Roundtable. Pollution Prevention Program staff participate in NNSA, DOE, and Office of the Federal Environmental Executive–sponsored conference calls and activities. Several team members belong to the National Registry of Environmental Professionals.

The Pollution Prevention Program Team holds a semiannual review with the Los Alamos Site Office. The team also compiles an annual report on activities through the DOE-sponsored Pollution Prevention Tracking and Reporting System. The Pollution Prevention Program Team relies on Internet information resources such as

US Green Building Council Web Site
EPA, P2Rx Web Site
DOE, Remedial Action Project Information Center, Oak Ridge, Tennessee
DOE, EPIC (the DOE Pollution Prevention Information Clearinghouse)
EPA, National Center for Environmental Publications Web Site
DOE, Environmental Web Site
University of Texas at El Paso, Southwest Pollution Prevention Center Web Site
US Navy, Joint Service Pollution Prevention Technical Library Web Site
FedCenter Web Site

The Pollution Prevention Program routinely communicates with LANL staff through information distributed via email in "LANL Today." Articles and success stories are published on the internal Pollution Prevention webpage as well as through internal publications. The team creates posters that feature environmental issues and successes, and these are distributed throughout LANL.

2.4 Utilization and Justification for the Use of Hazardous Materials

LANL 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 microscale 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 Team 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.

An environmentally preferable purchasing program is in place that requires buyers to choose less hazardous or nonhazardous janitorial and office supplies and 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.

2.5 Investigation of Additional Waste Minimization and Pollution Prevention Efforts

The Pollution Prevention Program monitors waste trends and develops improvement projects. In FY10, a new waste generation baseline was developed for directorates to better identify their key waste issues and develop pollution prevention projects to address them. This information will improve waste minimization planning for the FY11 EMS cycle. Waste reduction projects often come directly from researchers, waste management coordinators, and the Pollution Prevention Program Team. Pollution Prevention Program staff provide engineering support to waste generators in the implementation of these projects.

During FY10, 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.

In addition, the Pollution Prevention Program conducts PPOAs to analyze waste generating processes and develop prevention alternatives. In FY10, the following PPOAs were completed:

- Fluorescent Light Bulbs: This PPOA examined the fluorescent light bulb waste stream at LANL and ways to minimize it.

- Toxicity Characteristics Leaching Procedure Compliant "Green" Fluorescent Light Bulbs: This PPOA looked at low-mercury and low-lead fluorescent bulbs that would not become hazardous waste or MLLW.
- Lava Melt Deicer Use at LANL. This PPOA examined use of an environmentally friendly ice melter that could be used to clear ice from sidewalks with less impact to the surroundings.
- Waste Data Baseline Evaluations. The waste streams from 13 directorates were examined to establish baselines against which they can chart future progress towards reducing waste.
- Waste Minimization Planning for the Los Alamos Neutron Science Center (LANSCE). A waste minimization plan was developed for LANSCE. This focuses especially on reducing the amount of personal protective equipment that becomes LLW.
- 2010 TRU Waste Roadmap. The processes that generate TRU waste at LANL were mapped out to look for opportunities for waste reduction.
- Reduce the Cost for Associate Directorate of Environmental Programs (ADEP) EMS Planning Process. This PPOA mapped out the planning process used for establishing EMS goals to look for potential time and cost savings in the ADEP.
- Improving Associate Directorate for Environment, Safety, Health, and Quality (ADESHQ) Environmentally Preferred Purchasing Data Accuracy. For several years the system that tracks purchases of products that contain recycled content has been in a state of transition. This PPOA looked for ways to improve the quality of purchasing data that can be obtained.
- Building Energy-Usage Reduction Potential Human Behavior Assessment at Technical Area (TA) 59-3. Building 3 at TA-59 was used as a pilot study to determine if behavior modification suggestions to the residents could significantly reduce the amount of energy consumed in the building.
- Building Energy-Usage Reduction Potential Human Behavior Assessment at Occupational Medicine. The same pilot study as described above was also implemented in LANL's occupational medicine building.
- Materials Lifecycle Implementation—Reuse Centers. This PPOA looked at ways to establish reuse centers for unused chemicals, furniture, and office supplies at LANL.
- Fire Suppression Technologies and Glovebox Waste Minimization Opportunities. This PPOA examined various fire suppression technologies for use in gloveboxes that might also allow the amount of waste from the gloveboxes to be minimized.

2.5.1 Funded Projects

The following are GSAF projects and the amounts of funding that they received during the past five years for both capital purchases and the labor necessary to execute the improvement projects. GSAF projects address all types of waste. However, the following only represent projects that were designed to reduce hazardous waste, MLLW, or MTRU.

In FY05, GSAF funds were allocated to the following projects:

- Reuse, Recycling, and Reduction of an Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) Machine ($4,111)

  The Pollution Prevention Program Team paid to have a seven-year-old ICP-AES machine and accompanying hardware sent to the New Mexico Institute of Mining and Technology. Without the new user, the equipment would have become about 500 kg of hazardous waste.

- Lead-Free Ammunition for Small-Arms Range ($40,000)

  The Pollution Prevention Program Team purchased 100,000 rounds of lead-free ammunition for the guard staff to use at the practice range. These bullets were tested during the training class of January 2006. Lead-free bullets are used exclusively in the indoor training facility.

- Solidification of Liquid Residues ($25,000)

  This project examined the potential to use NoChar to solidify liquid radioactive waste with RCRA constituents to provide a disposal path for the materials, which were classified as No Path Forward wastes.

- Aerosol Can Puncture Units ($6,360)

  The Pollution Prevention Program purchased six aerosol can puncturing units for various sites so that more aerosol steel can bodies can be recycled.

- Mercury-Free Sampler ($10,000)

  This team designed a new system for testing compatibility of high explosives (HE) with other materials. The old system involved glass tubes of mercury to detect gas generation, and this method sometimes created a No Path Forward waste. The new system uses no mercury, reduces waste, and saves staff time on machine maintenance since filtering the mercury was frequently necessary in the past.

- Lead Recycling from TA-48 and Chemistry and Metallurgy Research (CMR) Facility ($120,000)

  The Pollution Prevention Program Team paid to have approximately 22,000 lbs of lead bricks sent to Duratek for recycling into drum liners, thereby reducing MLLW generation.

- Statistical Analysis of Glovebox Glove Failures ($45,000)

  Working with New Mexico State University, TA-55 staff examined the causes of unplanned glove breaches. The data will assist in reducing the number of unexpected glove breaches, thereby reducing the potential for generating waste. This project also creates a safer working environment for the staff.

In FY06, the Pollution Prevention Program received authorization to expand the GSAF Program to include radioactive liquid waste streams. This approximately doubled the amount of funding available to reduce upstream waste sources.

In FY06, GSAF funds were allocated to the following projects:

- Acid Recycling at CMR ($30,000)

The Plasma Spectroscopy Team at CMR installed an Ultra-Trace cleaning system to clean approximately 300 pieces of glassware every month. The Ultra-Trace system uses an automatic acid reflux system that cleans about 20 pieces of glassware per hour. The old method was to soak the labware in acid for 5 to 7 days to remove trace contaminants, so the new system is significantly faster. The team estimates that 500 L less of concentrated nitric acid are purchased annually.

- Laboratory Automation to Reduce MLLW Generation ($25,000)

  A Chemistry Division laboratory demonstrated a system to integrate multiple diagnostic machines with just one laptop computer. The demonstration is meant to convince labs that use radioactivity to adopt the same strategy and reduce the chance of contaminating electronics and generating potential MLLW.

- Minimizing Hydrochloric Acid in High-Volume Separation Chemistry ($20,410)

  Chemical separation of isotopes creates some acidic TRU liquid, and the goal of this project is to minimize the volume of this waste. The project substituted smaller separation columns to get smaller elution volumes. The investigators also studied the effectiveness of using lower concentrations of acid.

- Elimination of a Peroxide-Forming Waste Stream ($12,000)

  A set of experiments using gel permeation chromatography produce a liquid waste that contains tetrahydrofuran, which can form peroxides over time. Newer chromatography columns and alternative solvents were tested to minimize hazardous tetrahydrofuran waste and the necessity of testing for peroxides.

- Plasite Paint Substitution Pilot Project ($8,000)

  This project investigated the feasibility of using water-based paints for painting the floors in certain locations. By using a water-based paint instead of an oil-based paint, the team expects to reduce hazardous waste by about 50 kg every year.

- Chemical Lifecycle Management ($30,000)

  This project provides an alternatives database of green chemicals to help researchers select less toxic and less hazardous chemicals for use in projects. This project also includes enhancement to the ChemLog chemical inventory system to facilitate surplus chemical reuse to reduce waste generation.

- Materials Disposition ($40,000)

  This project performed a PPOA to help identify issues regarding waste disposal and pollution prevention during cleanout activities. Management is very interested in pursuing cleanout work, and this project will help reduce the overall amount of waste generated in the future.

- MLLW Vacuum Pump Waste Elimination ($25,000)

  The investigators purchased new oil-free vacuum pumps to work with a variety of instruments that analyze minute quantities of radioisotopes. The oil-free vacuum pumps need less maintenance and do not have the potential to generate MLLW. This project is expected to reduce MLLW by about 6 quarts annually.

- Plastic Replacement ($35,000)

The Plasma Spectrometry task requires the use of plastic tubes, columns, various tubing, and an assortment of nebulizers for analysis of plutonium matrices. In an effort to reduce the MTRU liquid waste, the generator purchased Teflon tubes and columns that can be reused for years. Also, the Teflon nebulizers will reduce solid waste and MTRU liquid waste due to shorter rinse out times and lower volumes.

In FY07, GSAF funds were allocated to the following projects:

- Chemical Life Cycle Management ($60,000)

  This project improved procurement practices so that chemicals arrive more quickly and users will not want to order larger quantities than necessary. The project also identified a set of environmental high-risk chemicals and potential environmentally friendly substitutions.

- Lead Brick Recycling ($168,000)

  Several divisions recycled unwanted lead bricks, pigs, and sources with this GSAF grant.

- Uninterrupted Power Supply (UPS) Waste Reduction ($34,000)

  The people involved with this project worked to remove unnecessary UPSs. The batteries in these UPSs become hazardous waste. Other options, such as surge protectors, may be a better solution for most applications.

- Materials Disposition Initiative and Cleanouts ($69,000)

  This group examined root causes of chemical and material accumulation, developed procedures, and conducted pilot projects to identify and resolve any potential roadblocks to cleanout and disposition activities. The team developed a toolkit that contains the resources, contacts, links, lessons learned, pathways, and strategies needed to identify, evaluate, and disposition unnecessary items within a prioritized EMS planning framework. Cleanouts were done at TA-35 and TA-16.

- Light-Emitting Diode (LED) Light Assemblies on Gloveboxes ($1,500)

  This project tested LED light panels to replace existing fluorescent light panels on gloveboxes. LED lights operate at cooler temperatures, are up to 10 times more energy efficient, last 10 to 15 times longer than fluorescent bulbs, and are low voltage, which reduces the chance of an injury to a worker. The longer life of the LEDs means that less mixed waste will be generated over time.

- Silver Analysis ($6,000)

  Approximately 400 lb of silver were analyzed to verify their potential to be reused as silver instead of being handled as hazardous waste. Ultimately the silver was found to be uncontaminated, but the DOE metal moratorium prevented this silver from being recycled.

- Refrigerant Recycling ($12,000)

  Approximately 2000 lb of unneeded refrigerant were recycled by packaging it and sending it to a Department of Defense facility in Virginia. As a result, this refrigerant did not become hazardous waste.

- Silver Recovery Units ($7,300)

Waste photochemicals can be filtered with silver recovery units to reclaim the silver for recycling. Filtering also removes the hazardous component from the liquid photochemical waste and renders the waste nonhazardous. Spent photochemicals are a large component of hazardous waste liquid. Four silver recovery units were purchased with GSAF funds.

- Plasma Cleaning at TA-55 ($55,000)

  The purpose of this project was to determine the cleaning effectiveness of low-temperature plasma processing on various metal substrates instead of using trichloroethylene (TCE). TCE is a RCRA-regulated chemical, and using plasma processing would eliminate this source of MLLW.

In FY08, GSAF 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 (HPLC) Processes ($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 GSAF projects in FY08 concerned with reducing MLLW, MTRU, TRU, and LLW. The funds paid for time and effort of a dedicated pollution prevention 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 all of this MLLW is prevented.

- 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 TCE. This project, once fully deployed, will eliminate a MTRU waste stream.

In FY09, GSAF 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.

- LED Lights at TA-55 ($40,000)

  Based on the success of a previous GSAF 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 the 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, GSAF funds were allocated to the following projects that addressed hazardous and mixed waste issues:

- Direct Solid Analysis Using DC Arc Spectrometry to Eliminate Waste Generation ($40,000)
  A new spectrometer with a solid-state detector was purchased for use in the Pu-238 Heat Source Program. The old spectrometer that was replaced used about 3000 gallons of water and generated about 16 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 puncture risks 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 (SAA) 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 meter 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, this project expects to reduce overall MLLW generation by 3 to 5 cubic meters.

- 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 LANL, 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 is helping to remove the materials inside. Approximately 55 gallons of MLLW and 26 cubic meters of LLW will be 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 all of the oil was not contained in the event of such failures, then surrounding soil could get contaminated and ultimately become hazardous waste.

2.5.2 Current FY11 Projects

FY11 GSAF projects were chosen, and approximately $1.1 million was allocated. About 60% of the funds are for solid wastes, and the balance is reserved for projects to minimize radioactive liquid waste. FY11 projects that support directorate EMS objectives and targets received extra consideration. FY11 projects will address all regulated waste streams including TRU waste and MTRU waste, LLW and MLLW, hazardous waste, radioactive liquid waste, and the Zero Liquid Discharge project. The project titles are listed below.

- Replacement of Lead-Loaded Glovebox Gloves with an Attenuation Medium of non-RCRA-Hazardous Metals ($7500)
- Two-Flange Gloveport Liner ($2500)
- OREX LLW Reduction Project ($30,000)
- Green is Clean (GIC) Expansion/Upgrade ($30,000)
- TRU Waste Reduction and Operation Safety Enhancement through an Automated Plutonium Separation System ($150,000)
- TA-53 Culligan Bottle Upgrade ($20,000)
- Methanol Recirculation and Recovery Loop ($69,682)
- Tanks Proposed for Reuse NOT Recycling ($45,000)
- TA-53 Lead Bricks ($17,000)
- Installation of Replacement Dewar ($40,000)
- Additional Radioactive Liquid Waste Treatment Facility (RLWTF) NPDES Permit Compliance Measures ($41,000)
- Clean Fill Management Database ($40,000)
- Target Fabrication Facility Centralized Chemical Stockroom ($75,000)
- 21st Century Solvent Purification for Actinide Chemistry ($20,000)
- Biological Oxygen Demand Supplementation Continuation ($70,000)
- Sludge Composting ($120,000)
- Disposal of Hazardous Materials from TA-22-1 Cleanout ($4000)
- Decontamination and Demolition (D&D) & Remediation Radioactive Waste Avoidance/Minimization ($130,000)
- No Exposure Coverage at TA-60-1 ($50,000)
- No Exposure Coverage at TA-3-38 ($70,000)

2.6 Waste Cost Recovery

Until the early 1990s, waste processing and management were considered overhead functions, included as part of the general and administrative tax. In 1991, these activities moved under the jurisdiction of DOE-Environmental Management (DOE-EM), which began direct funding both legacy (including cleanup) and newly generated waste management. Starting in FY99, the responsibility was divided between DOE-EM handling legacy waste and Defense Programs (DP) via the Readiness in Technical Base and Facilities (RTBF) Program managing newly generated waste and pollution prevention activities. In FY00 an indirect recharge was placed on non-DP newly generated waste so those programs would pay their fair share of the waste management expenses. DOE-EM pays the cost of processing waste generated from EM-funded work such as environmental restoration and legacy waste disposition at Los Alamos; the Facilities and Infrastructure Recapitalization Project pays waste disposal costs associated with its activities.

From FY99 to FY07 RTBF funded its waste processing activities via work packages that defined the resources and activities for each year. This method is simple in terms of accounting, with the drawback that the level of detail in these packages is often low. Also, little incentive is passed to the generator to minimize waste.

In FY08, LANS developed and implemented cost recovery to support consolidation and modernization plans of its plutonium infrastructure. FY08 was a transition period for cost recovery followed by implementation of full cost recovery in FY09. The basis for waste cost recovery is to charge waste generators for the transportation, storage, and disposal of their wastes. Assessing waste costs to the individual generators will increase waste awareness and provide an incentive for waste reduction.

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 through the Solid Waste Operations database (SWOON) system and does not include waste generation amounts prior to onsite treatment. Data quality assurance for this system is managed by the Waste and Environmental Services Division Leader. The SWOON waste data used in this report was collected for FY10 on November 1, 2010.

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 HE wastewater treatment plants also qualify as hazardous waste.

Most hazardous wastes are disposed of through subcontractors. These companies send waste to permitted treatment, storage, and disposal facilities (TSDFs); recyclers; energy recovery facilities for fuel blending or burning for British-thermal-unit recovery; or other licensed vendors, as in the case of mercury recovery. The treatment and disposal fees are charged back at commercial rates specific to the treatment and disposal circumstances. Figure 3-1 shows the process map for waste generation.

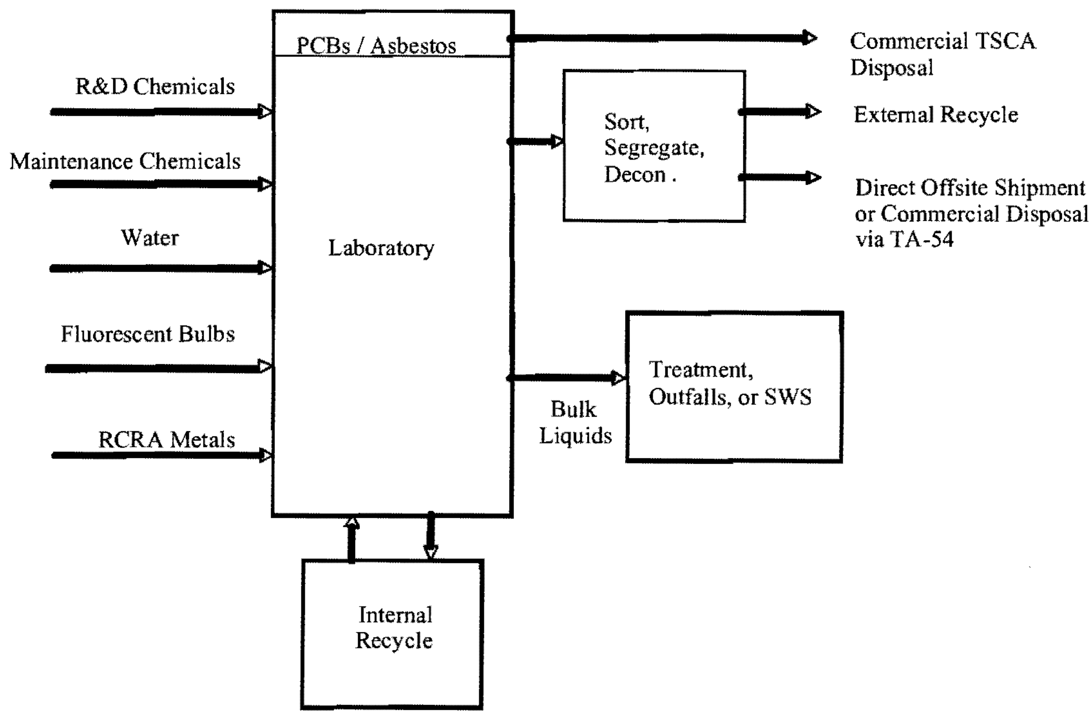

Figure 3-1. Hazardous waste process map
(Note: PCBs = polychlorinated biphenyls, SWS = Sanitary Wastewater System, TSCA = Toxic Substances Control Act)

The quantity of routine and nonroutine hazardous waste that was generated and the amount of hazardous waste that was recycled during FY10 are shown in Figure 3-2. This graph does not include hazardous waste for remediation activities since that is discussed separately in Section 6.0 of this report.

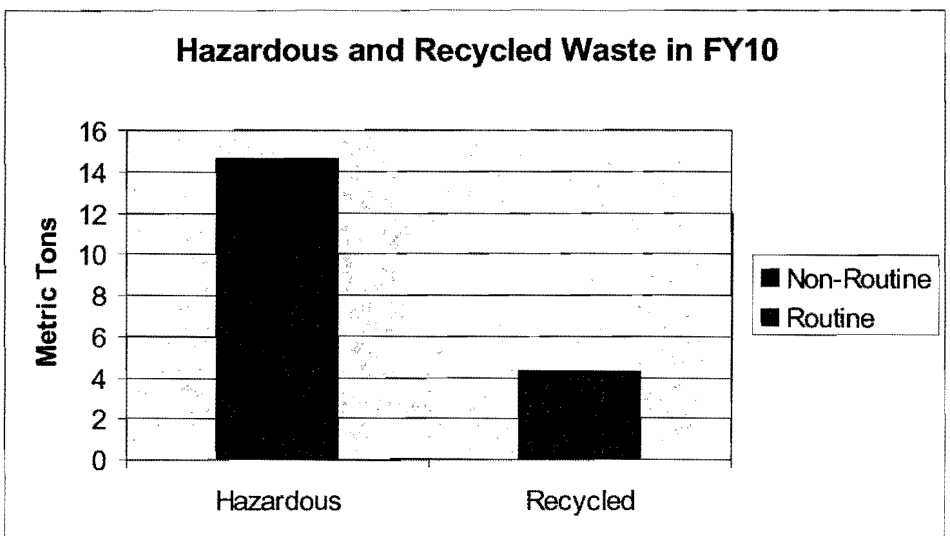

Figure 3-2. Hazardous waste and recycled hazardous waste generated during FY10

The divisions that produced the most hazardous waste during FY10 were Weapons Experimentation (WX), Chemistry (C), Materials Physics and Applications (MPA), Site Projects (SP), Chief Financial Office (CFO), and Materials Science and Technology (MST). The hazardous waste generation by division is shown in Figure 3-3.

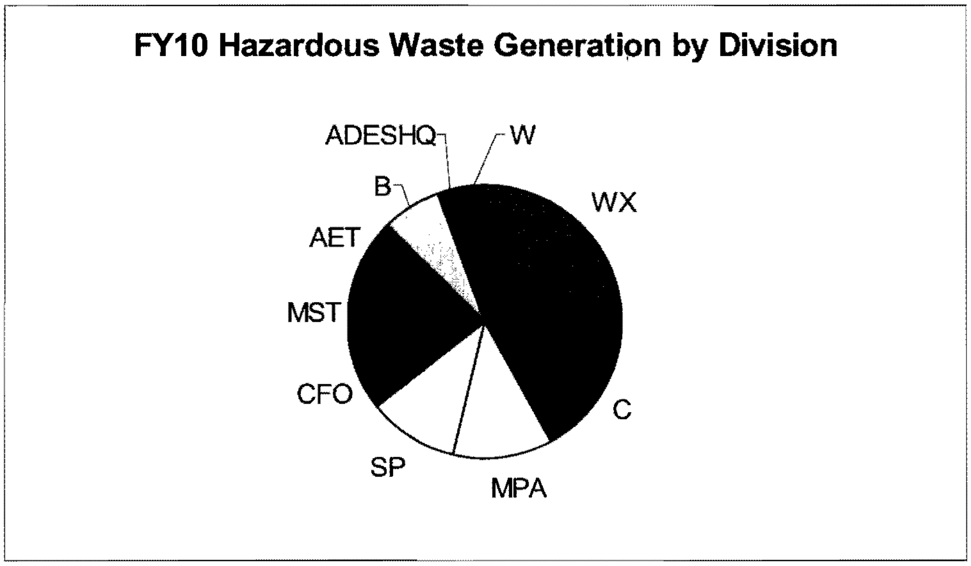

Figure 3-3. Hazardous waste by division during FY10. This includes routine and nonroutine hazardous waste generation, but it does not include remediation waste.

3.2 Hazardous Waste Minimization Performance

The amount of nonremediation hazardous waste generated in FY10 was 14,603 kg, excluding recycled materials such as batteries, aerosol cans, bulbs, and elemental mercury. This amount was somewhat less than the 15,830 kg of nonremediation hazardous waste generated during FY09. During FY10, remediation activities generated 460 kg of hazardous waste. This amount is considerably less than the 108,492 kg of hazardous waste generated from remediation activities during FY09. Hazardous waste generated by remediation activities is discussed in more detail in Section 6.0. All of the hazardous waste generated at LANL in FY10 is shown in Table 3-1 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 FY10

Division	Hazardous Waste in kg
Weapons Experimentation	3129
Chemistry	2028
Materials Physics and Applications	1435
Site Projects	1292
Chief Financial Office	1007
Materials Science and Technology	956
Applied Engineering and Technology	926

Bioscience	863
Earth and Environmental Science *(remediation)*	373
ADESHQ	342
Weapon Systems Engineering	329
Project Management Function	261
Plutonium Manufacturing and Technology	237
Weapons Technology	223
International and Applied Technology	197
Waste and Environmental Services	158
Radiation Protection	132
Prototype Fabrication	128
Physics	128
Weapons Component Manufacturing	127
International Space and Response	119
Associate Directorate of Weapons Programs	103
Program Management and Production Planning	94
Science and Technology Operations	86
Accelerator Operations and Technology	62
Maintenance and Site Services	55
Technical Area 21 *(remediation)*	52
Waste Disposition Project	49
LANL Water Stewardship Project *(remediation)*	28
Institutional Facilities and Central Services	27
Earth and Environmental Science	19
LANSCE	11
Weapons Facilities Operations	9
ADEP *(remediation)*	7
Industrial Hygiene and Safety	5
Associate Directorate of Security and Safeguards	4
Human Resources	4
Chemistry and Metallurgy Research	2
Nuclear Nonproliferation	1
Engineering Services	1
Quality Assurance	1

3.3 Waste Stream Analysis

Hazardous waste is derived from hazardous materials and chemicals purchased, used, and disposed of; hazardous materials already present that are disposed of as part of equipment replacement, facility replacement, or 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 waste streams in the routine and nonroutine hazardous waste category for FY10 are described in this section. This analysis excludes recycled items and wastes from remediation activities since remediation wastes are discussed in Section 6.0. HE waste and HE wastewaters are treated onsite, and these are also excluded. Spent research and production chemicals make up the largest number of individual hazardous waste items. The breakdown of components of hazardous waste for FY10 is shown in Figure 3-4.

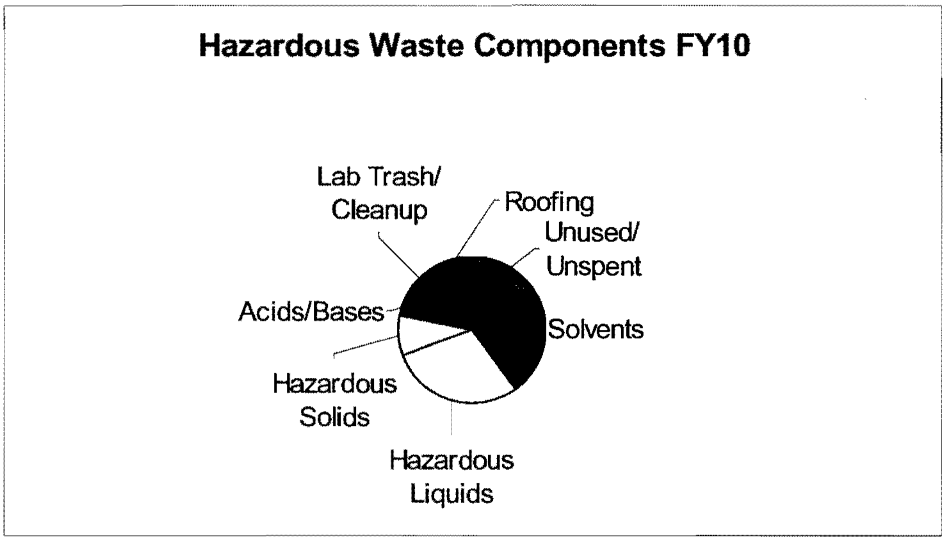

Figure 3-4. FY10 hazardous waste stream components excluding remediation waste

Solvents. EPA-listed and characteristic solvents and solvent-water mixtures are used widely in research, maintenance, and production operations. Nontoxic replacements for solvents are used whenever possible, and new procedures are adopted when possible that either require less solvent than before or eliminate the need for solvent altogether. 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.

Unused/Unspent Chemicals. The volume of unused and unspent chemicals varies each year, but this waste stream usually comprises a significant fraction of the total hazardous waste. 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. For the first time in many years, unused and unspent chemicals were not the largest fraction of nonremediation hazardous waste. Past cleanouts at LANL and lower rates of chemical purchasing have reduced the volume of this waste stream. A pilot project is being developed to share chemicals among all researchers at LANL.

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 60% of this waste stream during FY10. The volume of acids produced during FY10 was less than half of that produced in FY09.

Hazardous Solids. This waste stream includes inert barium simulants used in HE research, contaminated equipment, cathode ray tubes, broken leaded glass, firing site debris, and various solid chemical residues from experiments. During FY10, firing site debris and cathode ray tubes were the largest components. In FY10, an old roof from a building was removed, and this contributed over 1000 kg of hazardous waste to the total generated at LANL.

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, ethylene glycol, and contaminated ferric chloride solution. In FY10, the largest components were photochemicals and a small spill of solvent into a container of water. In FY10, hazardous liquids made up the largest volume of nonremediation hazardous waste.

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.

3.4 Hazardous Waste Minimization

Chemicals are required to perform R&D experiments, properly maintain facilities, and produce materials and items related to mission activities. Good laboratory practices are followed, and employees are trained extensively to work safely with chemicals and minimize the amount of waste generated. The Pollution Prevention Program is always looking for new equipment or process technologies that will reduce the amount and/or toxicity of chemical waste generated. A chemical lifecycle management project is underway that will improve chemical procurement, encourage use of available chemicals onsite, and provide more environmentally friendly alternatives. Reducing chemical waste generation has many positive implications, including improved efficiency, lower costs, easier compliance with environmental regulations, and a safer working environment.

Lead Inventory and Sharing

Lead is a persistent, bioaccumulative toxin in the environment. Under the Emergency Planning and Community Right-to-Know Act, Section 313, lead is a toxic release inventory compound with a reporting threshold of 100 lb. As part of the requirements for the annual toxic release inventory report, purchases of all lead-containing items are tracked. All lead or lead-containing materials sent offsite as waste or for recycling are tracked. Lead maintained onsite can be shared among divisions.

A few divisions maintain a supply of lead bricks for protective shielding purposes. These divisions can share lead when possible so that less new lead needs to be purchased. Uncontaminated lead that is unnecessary has been recycled offsite or recast into new shapes for internal reuse.

Lead Substitution and Removal

Several divisions have examined nonhazardous substitutes for lead. Stainless steel is a good substitute for many purposes, but it is often too expensive to be practical, especially when lead can be reused from other divisions. Other lead substitutes are being used in some instances. Shielding bricks made of a bismuth or tungsten-based material are being used in some areas; lead-free personal protection aprons and lead-free glovebox gloves are used in some laboratories; and plastic pipe valve ties replaced all of the lead ties that were formerly used to protect valves from tampering.

During FY10, approximately 266 kg of lead-containing cathode ray tubes from electronic equipment were removed from RCAs. The tubes were carefully surveyed for contamination, and when none was found, they were sent away for disposal as nonroutine hazardous waste. By removing these items from RCAs, the potential for creating MLLW is significantly reduced.

Lead Protection

Many researchers protect their lead bricks from contamination by wrapping them in tape or by placing them in plastic bags. Lead bricks are often used behind concrete barriers for shielding purposes, and the concrete acts as protection for the lead in these cases.

A bench-scale, onsite method is not currently used to decontaminate lead, although this practice was used for a few years during the early 1990s. If lead bricks become damaged, they can be sent to an offsite facility for recasting into new bricks or custom shapes. If lead bricks become contaminated, they can be sent to a different offsite facility for surface decontamination.

Nonhazardous Scintillation Fluid

Nonhazardous scintillation fluid has become commonly used. No hazardous waste or MLLW scintillation fluid was generated during FY10. The shift to the nonhazardous variety of scintillation fluid reflects the desire of LANS to improve safety for its employees and minimize impact to the environment.

Radioactive Waste Segregation

The GIC Program has been in place for many years to prevent the commingling of radioactive waste with other types of waste. In labs that perform work with radioactive substances, particular areas of the lab or bench are clearly marked off so that any potential contamination can be contained to a small area. The marked area in the lab contributes to overall good housekeeping procedures, and hazardous chemicals not directly involved in experiments in these marked areas can be kept away to prevent the unnecessary generation of MLLW. In addition, workers are required to minimize the amount of materials that are introduced into RCAs to prevent unnecessary generation of radioactive waste.

Mercury Substitution

Researchers typically replace mercury-containing thermometers as they get broken with nonmercury thermometers. By doing so, the chances of accidentally spilling mercury and creating hazardous waste are reduced. It is especially valuable to have nonmercury thermometers in RCAs so that generation of MLLW can be avoided. The elemental mercury in old thermometers and in other obsolete mercury-containing equipment gets 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. Over 4200 kg of ferric chloride solution were sent offsite to be recycled and resold during FY10, 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 resuspending 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.
- One laboratory in Bioscience Division installed a solvent recovery system for acetonitrile in HPLC waste during FY08. This system prevents the generation of approximately 55 gallons of hazardous waste solvents per week. An additional solvent recovery system was installed in Bioscience Division in FY09.
- The LANS protective forces subcontractor moved from a hazardous gun-cleaner to a nonhazardous cleaning solution in FY06. LANL personnel started testing a plant-based gun cleaner in FY10 called "Gunzilla" as part of continuous improvement efforts.
-

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, bioaccumulative toxin in the environment. Historically, the protective forces subcontractor, SOC, has used traditional lead-containing bullets during training exercises at the small-arms range. A lead-free ammunition project purchased 100,000 rounds of frangible lead-free ammunition for use in handguns during training exercises. SOC used the lead-free bullets during the first training course in 2006.

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 third largest component of the hazardous waste stream during FY10 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.

Chemical pharmacies have been attempted onsite but distance between research facilities and researcher concerns about purity have limited the success of such programs. Chemical sharing by researchers in close proximity to each other has been encouraged and has been successful. In FY10, a "virtual" chemical pharmacy and locally sponsored pharmacies began to be piloted. More results on these experiments should be available in FY11. This is the first year in many years when unused and unspent chemicals were not the largest fraction of the nonremediation hazardous waste stream at LANL.

Finally, through the EMS, directorates are being asked to set specific objectives and targets for chemical waste reduction. Contract performance measures have been adopted to require comprehensive inventory and disposition pathway development.

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 classified as either legacy waste or newly generated waste. Legacy waste is that waste generated before September 30, 1998. DOE-EM is responsible for disposing of this waste at WIPP and for all associated costs. Newly generated waste is defined as waste generated after September 30, 1998, and DOE DP is responsible for disposing of this waste at WIPP. Newly generated wastes are subdivided further into solid and liquid wastes, as well as routine and nonroutine wastes. Solid wastes include cemented residues, combustible materials, noncombustible materials, and nonactinide 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.

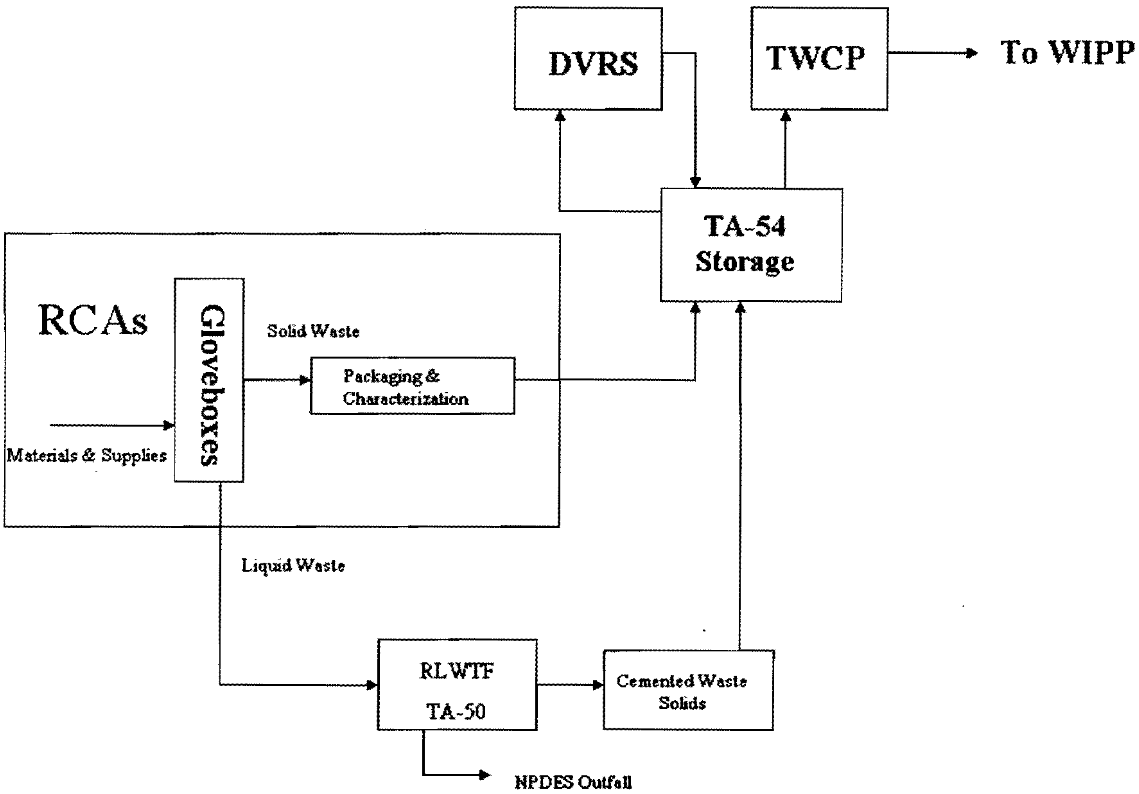

Figure 4-1. Top-level MTRU waste process map and waste streams
(Note: DVRS = Decontamination and Volume Reduction System,
TWCP = TRU Waste Characterization Program)

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 FY10, the routine and nonroutine MTRU waste was generated by the groups at TA-55, Chemistry Division, remediation at TA-21, operations at the RLWTF, and by the Offsite Source Recovery Program. The Waste Services Division repackaged some of this MTRU waste so that WIPP acceptance criteria were fulfilled. The TA-21 remediation project generated MTRU cleanup waste in FY10, and remediation waste is discussed in Section 6.0.

4.2 MTRU Waste Minimization Performance

LANS shipped offsite 142,220 kg of MTRU waste during FY10. This is considerably more than the 92,186 kg of MTRU shipped during FY09, and most of this was due to increased repackaging activities. During FY10, repackaging activities generated 129,651 kg of MTRU. Programmatic work that generates MTRU occurs at TA-55, TA-50, and TA-3, and during FY10 these activities generated 10,774 kg of MTRU. Demolition at TA-21 generated 671 kg of MTRU remediation waste during FY10. In FY10, the Offsite Source Recovery Program generated 553 kg of MTRU. The breakdown of MTRU generation at LANL during FY10 is shown in Table 4-1. All MTRU waste is included, and remediation waste is noted after the division name.

Table 4-1. Generation of MTRU Waste by Division during FY10

Division	MTRU Waste in kg
Waste Services (repackaging)	130,222
Waste and Environmental Services (TA-55 operations)	9171
Radioactive Liquid Waste Treatment Facility	1517
TA-21 *(remediation)*	671
Nuclear Nonproliferation (Offsite Source Recovery)	553
Chemistry (CMR operations)	86

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 FY10 is shown in Figure 4-2.

MTRU Waste Components FY10

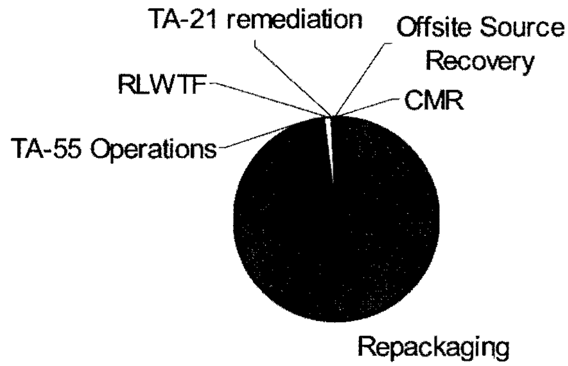

Figure 4-2. Composition of MTRU waste by volume for FY10

Repackaging. Standards for waste acceptance at WIPP change periodically, so when this occurs, some drums of MTRU waste at LANL need to be 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 93% of the MTRU waste generated at LANL during FY10 came from repackaging activities.

TA-55 and CMR Operations. Operational waste generated at TA-55 and CMR 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. Less than 1% of the MTRU waste generated at LANL in FY10 was from 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. About 1% of the MTRU waste generated at LANL during FY10 was sludge from the RLWTF.

Remediation. Buildings at TA-21 are being demolished, and a few parts of these old buildings qualify as MTRU waste. Remediation work is discussed in more detail in Section 6.0. Less than 1% of the MTRU waste generated at LANL in FY10 was from remediation work at TA-21.

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 LANL, but it is safer for everyone to have LANL collect and dispose of these items rather than to leave them in their offsite locations. Less than 1% of the MTRU waste generated at LANL in FY10 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 GSAF Program and by operating funds. Money from the GSAF fund is used to pay for projects designed to reduce the generation of MTRU waste. The GSAF projects are described in Section 2.5.1 of this report. In addition, some leaded glovebox gloves were replaced with unleaded gloves in FY10.

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, but often the containers have very small volumes of waste inside and the majority of the internal volume of the container is air. However, it is the external volume of the container that is recorded for reporting purposes. As seen in Figure 4-2, repackaging waste is the largest fraction of MTRU generated at LANL.

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 nonroutine waste is generated by off-normal events such as spills in legacy-contaminated areas. The DOE is interested in the volumes of routine and nonroutine 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.

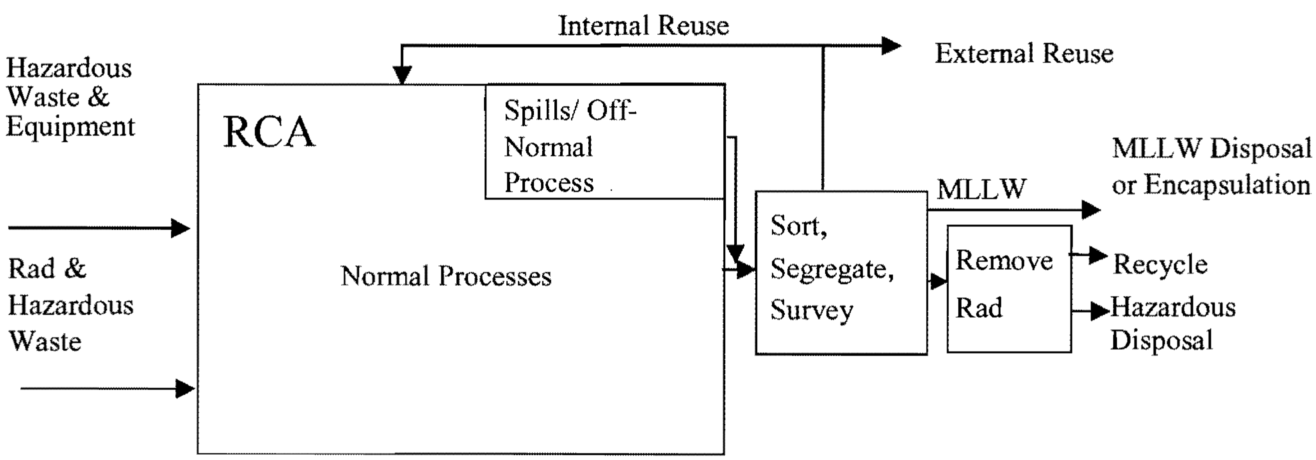

Figure 5-1. Top-level MLLW process map

Figure 5-2 shows MLLW generation by division during FY10, excluding MLLW from remediation work.

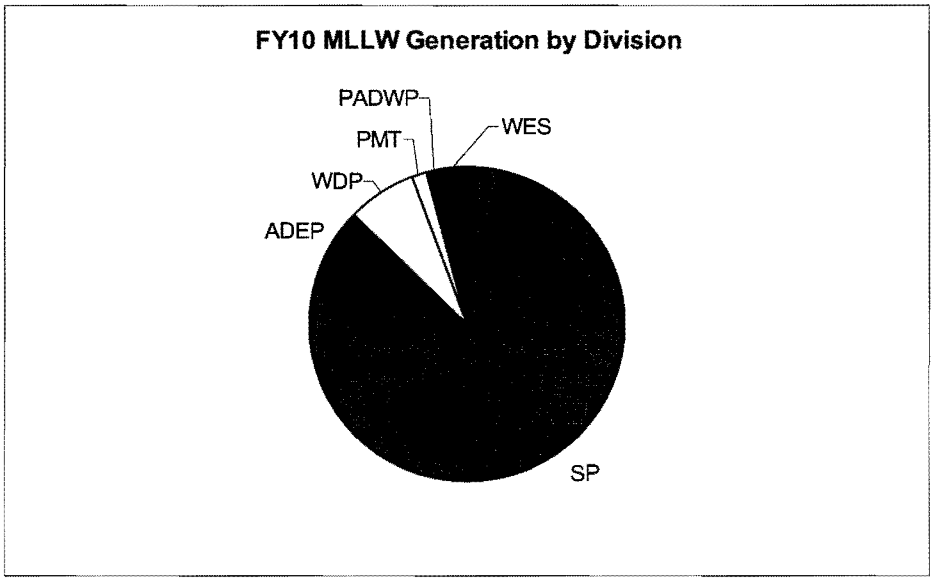

Figure 5-2. Total MLLW generated by division in FY10, excluding MLLW generated by remediation work

The divisions that generated the most routine and nonroutine MLLW during FY10 were Site Projects (SP), the ADEP, the Waste Disposition Project (WDP), Plutonium Manufacturing and Technology (PMT), Waste and Environmental Services (WES), and the Principal Associate Directorate of Weapons Physics (PADWP).

5.2 MLLW Waste Minimization Performance

MLLW generation for FY10 was 24,005 kg, excluding MLLW generated from remediation work. This is about three times more than the 8,134 kg of MLLW generated from nonremediation activities during FY09. Remediation work performed during FY10 generated 103,698 kg of MLLW, and 88,497 kg of this waste was cemented sludge from the RLWTF. Another 13,603 kg was waste that had been previously classified as MTRU waste but now qualifies as MLLW and was reclassified as such. The other 1,598 kg of remediation waste is discussed in greater detail in Section 6.0. Table 5-1 includes all MLLW generated at LANL during FY10, and remediation waste is noted after the division name.

Table 5-1. Generation of MLLW by Division during FY10

Division	MLLW in Kilograms
Waste Disposition Program (RLWTF cemented sludge)	88,497
Site Projects (equipment from Ion Beam Facility)	19,292
Waste Disposition Project (reclassification)	13,603
ADEP	1013
Waste Disposition Project *(remediation)*	872
Waste Disposition Project	775

Plutonium Manufacturing and Technology	584
Principal Associate Directorate of Weapons Programs	549
Waste and Environmental Services	483
LANL Water Stewardship Project *(remediation)*	409
ADEP *(remediation)*	317
Weapons Component Manufacturing	231
Radiation Protection	200
Materials Science and Technology	166
Chemistry	134
Maintenance and Site Services	132
Chemistry and Metallurgy Research	105
Weapons Facilities Operations	101
Accelerator Operations and Technology	98
Materials Physics and Applications	53
Institutional Facilities and Central Services	53
LANL Water Stewardship Project	32
Bioscience	5
Program Management and Production Planning	1

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 nonroutine 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.

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 an SAA 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 routine and nonroutine MLLW stream by weight in FY10 are sludge, reclassified MTRU, removal of old equipment from the Ion Beam Facility, demolition waste, decontamination waste, electronics, remediation waste, lead debris, and spent TCE. Lower MLLW generation is anticipated in the future as environmental restorations are completed and old buildings are replaced, as nontoxic materials are substituted for mercury and lead, and as oil-free vacuum pumps replace older pumps. No MLLW oil was generated at LANL during FY10.

The relative weights of various waste streams are shown in Figure 5-3. This does not include MLLW generated from remediation work.

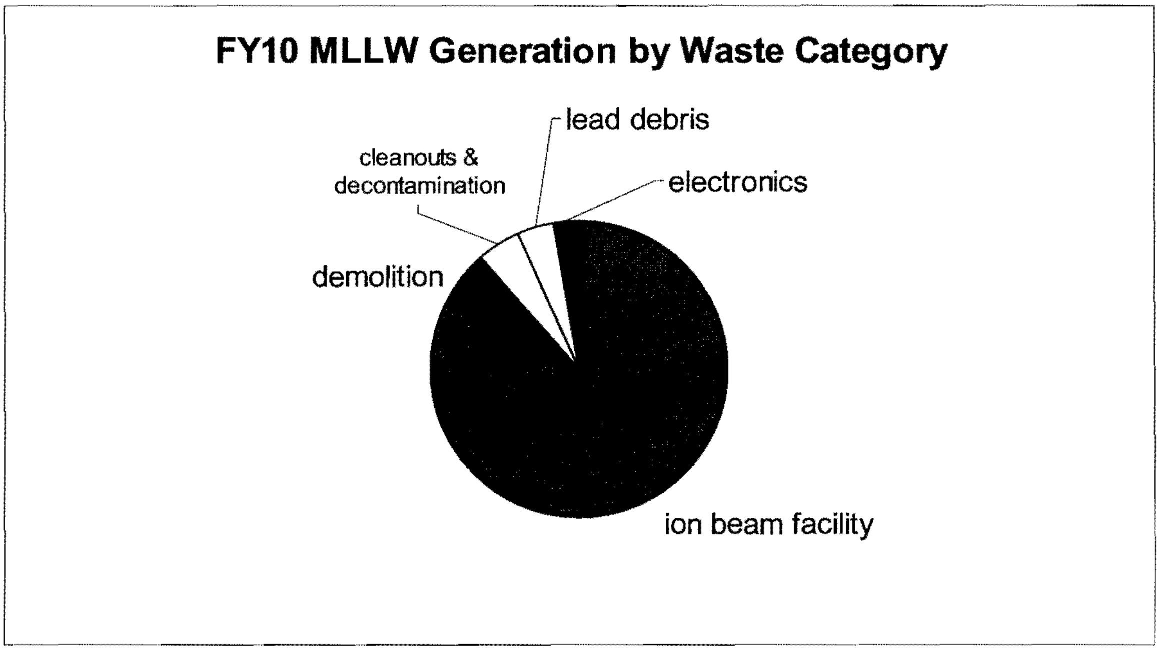

Figure 5-3. Constituents of MLLW in FY10, excluding MLLW generated by remediation work

Sludges. This waste stream consists of cemented waste sludges from the RLWTF. This was sludge waste from operations at the RLWTF that has been cemented into a solid state. In FY10, 88,497 kg of MLLW sludges were generated at the RLWTF.

Equipment from the Ion Beam Facility. This was a one-time project that involved removing 19,292 kg of old equipment from the Ion Beam Facility in FY10. The equipment included electronics contaminated with tritium.

Lead Debris. The lead debris waste stream includes copper pipes with lead solder, lead-contaminated equipment, brass contaminated with lead, bricks, sheets, rags, 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. In FY10, LANL generated 876 kg of lead-containing MLLW.

Electronics. This waste stream includes electronics and circuit boards from RCAs. As computers and peripherals become obsolete, they are removed from RCAs and sometimes become MLLW. Since computers are constantly becoming smaller, less electronic MLLW is expected in the future. Whenever electronics are removed from an RCA, the need for replacement electronics within the RCA is carefully evaluated. In FY10, LANL generated 653 kg of MLLW electronics.

Trichloroethylene. This waste stream consists of TCE used for degreasing activities at TA-55. This waste had formerly been classified as MTRU, but a past GSAF project to filter the TCE was implemented so that the waste can be handled as MLLW instead. In FY10, 220 kg of TCE were generated.

Demolition Debris. This waste is composed of wood, metal, plastic, and other building materials that have hazardous components and radioactive contamination. These are all one-time events. In FY10, demolition occurred at TA-21 and TA-18, and some contaminated sprinkler heads were removed from TA-55.

Research Chemicals and Lab Trash. This waste is composed of unused/unspent chemicals that have become contaminated in RCAs, analytical chemistry waste, gloves, personal protective equipment, dry painting debris, and paper towels. During FY10, the old CMR building continued to be cleaned out for future closure.

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 FY10, money from the GSAF fund was used to pay for projects designed to reduce the generation of MLLW waste. These projects are described in Section 2.5.1 of this report.

One especially promising pilot project that started during FY07 involved 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. During FY08 through FY10, groups at TA-55 purchased more LED lights for gloveboxes. During FY10, LANL disposed of no 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 scrap lead 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 the EP Directorate. This component includes the Business and Project Services Division, Corrective Action Projects (EP-CAP), TA-21 Closure Project (EP-TA21), and TA-54 Closure Project.

The mission of the EP 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 FY10 waste generation and waste minimization summary is listed in Table 6-1.

Table 6-1. FY10 Waste Generation Summary

Waste Type	Weight in Kilograms
Solid Hazardous	460
Solid MLLW	1,598
Solid MTRU	671

Project activities in FY10 involved investigations, including well installation; cleanup, including removal of contaminated soil, debris, and wastes; and D&D of inactive facilities.

6.3 Waste Stream Analysis

This plan 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 FY10 waste generation was the result of investigations, including well installation, focused corrective actions, and D&D. Investigations, corrective actions, and other activities implemented pursuant to the Consent Order included the following:

- Investigations and corrective actions for North Ancho Aggregate Area, Upper Sandia Canyon Aggregate Area, Upper Cañada del Buey Aggregate Area, S-Site Aggregate Area, Threemile Canyon Aggregate Area, DP Site Aggregate Area, Middle Los Alamos Canyon Aggregate Area, Pueblo Canyon Aggregate Area, Lower Sandia Canyon Aggregate Area, TA-49, and Water and Ancho Canyons
- Excavation of Material Disposal Area (MDA) Y and one other subsurface disposal site at TA-39
- Installation of the Surface Corrective Measures Implementation at the 260 Outfall at TA-16
- Completion of an interim measure to remove contaminated soils and sediments from the drainage below Solid Waste Management Unit 01-001(f) in Los Alamos Canyon and to construct runoff retention ponds
- Construction of grade control and sediment migration control structures in Los Alamos, DP, and Pueblo Canyons
- Completion of an accelerated corrective action at former TA-32
- Removal of contaminated soils from Bayo Canyon
- Initiation of cleanup activities at MDA B, including remote excavation of buried waste
- D&D of inactive structures at TA-21
- Subsurface vapor monitoring at MDAs G, H, L, T, and V
- Performance of a soil vapor extraction pilot test at MDA G
- Plugging and abandonment of monitoring wells TW-1, TW-2, TW-2A, TW-2B, TW-4, TW-8, and MCOBT-4.4
- Performance of periodic groundwater monitoring in Ancho, Los Alamos, Mortandad, Pajarito, Sandia, Water, and White Rock Canyons
- Drilling and development of regional aquifer monitoring wells including R-29, R-30, R-37, R-48, R-50, R-52, R-53, R-54, R-55, R-56, and R-60
- Drilling and development of perched intermediate monitoring and test wells including CdV-16-4ip, CdV-37-1i, R-27i, and R-47i

6.4 Remediation Waste Minimization

Waste minimization and pollution prevention were integral parts of the FY10 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 FY10 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. A total of approximately 602,000 gallons of development water and drilling fluids from well drilling and 19,000 gallons of purge water from well sampling was land applied during FY10.
- 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 3200 cubic yards of drill cuttings from well drilling and 130 cubic yards of cuttings from subsurface investigation boreholes were land applied during FY10.
- Natural materials were beneficially reused as storm water best management practices in Los Alamos Canyon as part of sediment mitigation activities. Sediment mitigation activities also included planting willows and other vegetation to control sediment migration. In addition to avoiding having to dispose of the reused materials, this approach also avoided generation of waste associated with use of engineered materials.
- Material reuse, recycling, and substitution were used at TA-21 to minimize waste associated with remediation activities funded by the American Reinvestment and Recovery Act. Uncontaminated metals were segregated from other D&D wastes and recycled rather than managed as waste. Similarly, uncontaminated nonhazardous wastes were segregated from other wastes for disposal in a sanitary landfill to reduce volumes of hazardous, radioactive, and mixed wastes.
- EP took actions during FY10 to improve integration of the EMS into remediation activities and to improve awareness of the EMS by EP 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 EP subcontractors.

•

Sort, Decontaminate, and Segregate

This task is currently being implemented by EP-CAP and EP-TA21 and is designed to segregate contaminated and noncontaminated soils so that noncontaminated 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 offsite.

Segregation is also used to allow "contact" waste generated during investigations to be managed through the GIC Program, rather than disposed of as radioactive waste. During FY10, a total of approximately 220 cubic feet of contact waste from site investigation and groundwater sampling activities was managed through GIC.

Survey and Release

Past practices have conservatively classified nonindigenous 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 nonradioactive if the survey finds no radioactivity. This will reduce the volume of LLW from corrective actions activities. Waste management coordinators are being trained in the occupational radiation protection requirements.

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.

During FY10, significant amounts of waste were generated from projects to remove polychlorinated biphenyl–contaminated soils and sediments from sites in Los Alamos and North Ancho Canyons. Removal was implemented at these sites because of the high potential for contaminant migration associated with these sites' locations in canyon bottoms. Wastes at similar sites located on mesa tops within active industrial areas would likely be left in place.

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 has also been evaluated. Several actions related to pollution prevention were incorporated into the FY11 Environmental Action Plan for EP developed as part of the EMS. These actions are summarized below.

- A number of remedial activities are ongoing for TA-21, and ADEP is minimizing the amount of waste generated from these activities. Several actions were identified to minimize waste. Overburden and excavation spoils that are expected to be uncontaminated are segregated from soil and waste excavated from contaminated areas. This overburden is sampled to determine whether it is nonhazardous and meets residential soil screening levels. If so, this soil is used to backfill excavations. Uncontaminated metals from D&D activities are segregated and recycled. In addition, sanitary wastes will be segregated from other waste streams to reduce the volume of these waste streams.
- A significant amount of well drilling was conducted during FY10 and will continue during FY11. LANL continued to implement the formal procedures developed during FY08 that allow land application of groundwater and drill cuttings when this is protective of human health and the environment. ADEP manages nonhazardous purge water and drill cuttings from well drilling activities by onsite land application.
- 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 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. Pursuant to the Consent Order, however, implementation of such strategies is subject to approval by NMED. Further, 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 V). 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 final decision on which corrective measure to implement at a site, however, will be made by NMED, subject to review and comment by the public. Thus, the corrective actions program and project leaders' waste minimization efforts may be affected by these decisions.

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[i] Pollution Prevention Act of 1990 (Omnibus Budget Reconciliation Act of 1990), 42 U.S.C. 13101, et seq., available at http://www.cornell.edu/uscode.

[ii] US Environmental Protection Agency (EPA), May 1993. Interim Final Guidance, 58 F.R. 10, "Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program."

[iii] US Department of Energy (DOE), May 1996. "Pollution Prevention Program Plan 1996," US Department of Energy Office of the Secretary, DOE/S-0118, Washington D.C., available at http://tis.eh.doe.gov/p2/p2integratedhomepage/p2plan.asp.