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Date: November 21, 2011
Refer To: ENV-ES-11-0276
LAUR: LAUR-11-06642

SUBJECT: 2011 LANL Hazardous Waste Minimization Report

Dear Mr. James Bearzi:

I am pleased to submit this annual report on hazardous waste minimization activities. This report was prepared pursuant to the requirements of section 2.9 of the Laboratory's Hazardous Waste Facility Permit and is required by the Permit to be submitted to the New Mexico Environment Department by December 1, 2011 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 at 667-2278 or by email at patg@lanl.gov if you have any questions.

Sincerely,

Patricia E. Gallagher
Group Leader
Environmental Stewardship Group
Los Alamos National Laboratory

Sincerely,

Gene E. Turner
Environmental Permitting Manager
Environmental Projects Office
Los Alamos Site Office
National Nuclear Security Administration

Enclosure: a/s

Cy: Carl A. Beard, PADOPS, w/o enc., A102
Michael T. Brandt, ADESHQ, w/o enc., K491
ENV-ES File, J978
IRM-RMMSO, A150

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NMED Hazardous Waste Bureau

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November 2011

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

Author(s): Environmental Stewardship Group

Intended for: New Mexico Environment Department

Los Alamos
NATIONAL LABORATORY
EST. 1943

Document:	Hazardous Waste Minimization Report
Date:	November 2011

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.

11/21/11

Dennis Hjeresen
Division Leader
Environmental Protection Division
Los Alamos National Security, LLC

Date Signed

11/29/11

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

Date Signed

LA-UR-11-06642

CONTENTS

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
ESH&Q	Environment, Safety, Health and Quality Directorate
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 Report
1.1 Introduction

Waste minimization and pollution prevention are inherent goals within all the operating procedures of Los Alamos National Security, LLC (LANS). The US Department of Energy (DOE) and LANS are required to submit an annual hazardous waste minimization report to the New Mexico Environment Department (NMED) in accordance with the Los Alamos National Laboratory (LANL) Hazardous Waste Facility Permit. The report was prepared pursuant to the requirements of Section 2.9 of the LANL Hazardous Waste Facility Permit, which was issued in November 2010. This report describes the hazardous 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 report 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.

During fiscal year (FY) 2011 (October 1-September 30), LANL had a successful year with WMin/PP efforts. Staff accomplished six projects specifically related to reduction of waste with hazardous wastes, and employees conducted four new pollution prevention opportunity assessments. LANL won six national awards for pollution prevention efforts from NNSA. In FY11, much more remediation waste was generated at LANL than in FY10 (118,966 kg in FY11 vs. 2729 kg in FY10). However, less non-remediation hazardous waste, mixed transuranic waste, and mixed low-level waste were generated in FY11 than in FY10 (158,548 kg in FY11 vs. 282,257 kg in FY10). All of these accomplishments and analysis of the waste streams are discussed in much more detail within this report.

1.2 Background

In 1990, Congress passed the Pollution Prevention Act[i], which changed the focus of environmental policy from "end-of-pipe" regulation to source reduction and minimizing waste generation. Under the provisions of the Pollution Prevention Act and other institutional requirements for treatment, storage, and disposal of wastes, all waste generators must certify that they have a waste minimization program in place. 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 was accepted into the LANS contract and was recently replaced by DOE Order 436.1 *Departmental Sustainability* which contains aggressive greenhouse gas emission reduction goals, energy and water conservation goals and continues to place a strong emphasis on pollution prevention and sustainable acquisition. DOE Order 436.1 requirements are executed through the Site Sustainability Plan which is managed under the Laboratory's 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 260–280, Hazardous Waste Management

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 458.1, "Radiation Protection of the Public and the Environment"
- DOE Order 435.1, "Radioactive Waste Management"
- DOE Order 436.1, "Departmental Sustainability"

- 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 report is to document the approach for minimizing hazardous and mixed wastes and to document performance results. This report discusses the methods and activities that will be routinely employed to prevent or reduce waste generation in FY2012, and the report documents FY11 waste generation quantities and significant waste minimization accomplishments for FY11. In most cases, waste minimization activities executed during FY11 will continue to occur during FY12 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 waste (MTRU), and mixed low-level waste (MLLW). The last section provides a description of the waste minimization and pollution prevention activities associated with remediation wastes.

1.4 Requirements of the Operating Permit

Section 2.9 of the LANL Hazardous Waste Permit requires that a waste minimization program be in place and that a certified report 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 report that addresses the requirement.

Table 1-1. LANS/DOE Hazardous Waste Facility Permit Section 2.9

Permit Requirement	Topic	Refer to Report Section
Section 2.9 (1)	Policy Statement	Section 2.1
Section 2.9 (2)	Employee Training and Incentives	Section 2.2
Section 2.9 (3)	Past and Planned Source Reduction and Recycling	Sections 2.4.1, 2.4.2, 3.4, 4.4, 5.4, 6.0

Section 2.9 (4)	Itemized Capital Expenditures	Section 2.4
Section 2.9 (5)	Barriers to Implementation	Sections 3.5, 4.5, 5.5, 6.5
Section 2.9 (6)	Investigation of Additional Waste Minimization Efforts	Sections 2.4, 6.0
Section 2.9 (7)	Waste Stream Flow Charts, Tables, and Analysis	Sections 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3 5.1, 5.2, 5.3, 6.2, 6.3
Section 2.9 (8)	Justification of Waste Generation	Sections 2.3, 6.0

1.5 Organizational Structure and Staff Responsibilities

The 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 as well as other environmental improvement 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 FY12 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 for FY12:

1. **Clean the Past**
    a. Investigate legacy contamination according to the requirements of the Consent Order with NMED
    b. Protect surface water runoff through implementation of the Individual Storm Water Permit with EPA
    c. Ship waste to WIPP
    d. Reduce volume of waste in Site Treatment Plan
    e. Footprint Reduction
    f. Excess materials/Equipment/Liabilities reduction

2. **Control the Present**
    a. Site Sustainability Plan Implementation
    b. Integrate environment with safety tools for common work control message
    c. Outfall Reduction / Zero Liquid Discharge
    d. Consolidation of R&D Open Detonation operations at Phermex
    e. Monitor for compliance
    f. Pollution Prevention with focus on problematic waste streams

g. Reduce spills and leaks
h. Sustainable Acquisition
i. Expand chemical re-use program

3. **Create a Sustainable Future**

   a. Energy Intensity Reduction
   b. Water Use Reduction
   c. 10 Year Greenhouse Gas Reduction Plan
   d. High Performance Sustainable Buildings
   e. Data Center Management
   f. Regional and Local Planning
   g. 50-Year Environment Stewardship Plan
   h. Integrated Site Planning
   i. Environmental Outreach and Communications
   j. New Environmental / Sustainable Technologies

The Pollution Prevention Program is an integral part of the Site Sustainability Plan and the 50-Year Environmental Stewardship Plan. The concept of "As Low as Reasonably Achievable" (ALARA) is being championed to encourage pollution prevention across the Laboratory as a means to sustainability.

The WMin/PP Program is an integral part of the EMS and supports LANS in meeting the EMS objectives. The FY12 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,
- sustainable acquisition,
- improving management of materials to reuse materials and equipment to the greatest extent possible before final disposition, and
- recycling and reusing materials.

2.2 Employee Training and Incentive Programs

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

Training courses that address waste minimization and pollution prevention requirements include

- General Employee Training
- Waste Generator Overview
- Radworker II
- 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 FY11, the Integrated Environmental Review Program provided a series of environmental permits and requirements briefings to several organizations to increase awareness of environmental concerns, including opportunities for prevention and waste minimization. More than twenty briefings were provided to several organizations including:

- Construction Safety personnel
- Deployed Environmental Professionals
- Waste Management Coordinators
- Environment, Safety, Health, and Quality Managers

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

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 six awards for pollution prevention projects during FY11, including two Best-in-Class awards. The winning projects are described below, and the first two bullets describe the Best in Class awards.

- Coordinated activities introduced during the 2010 Earth Week laid the foundation for several sustainable practices that have maintained momentum and continued in 2011. The Third Annual Energy Town Hall highlighted innovative projects surrounding energy issues and facilitated discussions relating to energy at the Laboratory. Several divisions launched an organic vegetable garden to demonstrate the importance of locally grown and sustainable food and the concept of slow food. The goal of using the produce from the garden for dishes served at the Otowi

Cafeteria was a success. The events of Earth Week encouraged a greater awareness of recycling, public transportation, waste minimization, and energy use.

- Replacement of a vacuum pump used in a rinse water recycle system and elimination of steam heating of the electroplating baths resulted in significant energy and water savings as well as waste avoidance for the Sigma Electroplating Laboratory.
- An unclassified video teleconference center was established in the Chemistry and Metallurgy Research Replacement Project Office. This teleconference center allows for live, interactive, and efficient communications without involving travel. It is estimated that one meeting alone saved approximately $10,000 in travel costs while simultaneously reducing carbon dioxide emissions.
- The flow-down of new DOE/NNSA sustainability goals late in FY10 tested the ability of the EMS to absorb, analyze, and respond with meaningful objectives and targets for the upcoming fiscal year activities. Through the use of a mature EMS, the Laboratory was able to provide a reasonable response that covered the scope of the new Site Sustainability Plan (SSP) requirements within the time required. This process continued during FY11. The Laboratory was recognized by DOE/NNSA reviewers as being the only site within the complex to successfully integrate EMS and the SSP.
- The Laboratory's Algal Biofuels Consortium Development Team provides leadership in renewable energy research focused on innovative technologies that will help bring biofuels to a commercial reality. The Team formed the National Alliance for Advanced Biofuels and Bioproducts (NAABB) consortium. The NAABB secured funding from DOE to develop innovative technologies for cost-effective production of algal biomass and lipids, economically-viable fuels and co-products, and a framework for a sustainable biofuels industry.
- A new variation on an analytical technique has significantly reduced problematic waste and improved worker safety. The new process utilizes a miniature column separation technique coupled with gas pressurized extraction chromatography to separate plutonium from trace impurities for inductively coupled plasma spectroscopy analysis. This new technique reduces 90% of the transuranic liquid waste and eliminates all of the transuranic solid and low-level waste generated by the current gravity column separation and elution methods now commonly employed. It is amenable to other applications where chromatographic separation of actinides is required for sample preparation.

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 FY11, the Pollution Prevention Program Team gave awards to employees who worked on 68 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 improved compliance.

In FY11, 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. 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 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 has a link to a database of alternative chemical choices on its website. The database of alternative chemicals was developed in conjunction with researchers at the Massachusetts Institute of Technology. The database contains possible alternatives to some hazardous chemicals for particular processes. All employees can access this database of nontoxic or less hazardous alternative chemicals.

The Sustainable Acquisition Program 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. In addition, sustainable acquisition requirements for water and energy-efficient equipment and recycled-content construction supplies are in place.

2.4 Investigation of Additional Waste Minimization and Pollution Prevention Efforts

The Pollution Prevention Program monitors waste trends and develops improvement projects. 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 FY11, 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 FY11, the following PPOAs were completed:

- ARAMARK Food Waste. The waste stream at the ARAMARK cafeteria at LANL was examined to find potential sources of sanitary waste reduction.
- Clean Fill Management Custom Database Application. This is a specification document describing how the new database that tracks the surplus and reuse of clean fill at LANL will work.
- Environment, Safety, Health and Quality (ESH&Q) Directorate Paper Use Evaluation. This document examines paper use within the Divisions of the ESH&Q Directorate.
- Sulfur Hexafluoride Use at LANL. This is a summary document that describes some of the locations where and ways in which sulfur hexafluoride is used at LANL.

2.4.1 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 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 radioactive materials 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 pieces 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:

- 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 meters per year.

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

  This project replaced 4-foot fluorescent bulbs in radiological control areas (RCAs) at TA-50 with LED lights. Since fluorescent bulbs in RCAs can potentially become MLLW, 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 were removed for disposal.
- Low-Energy Demonstration Accelerator Containment Trench Extension ($5,000)
  A secondary containment trench was extended to become capable of holding all of the oil in several transformers at TA-53 in case there were simultaneous catastrophic failures. If all of the oil was not contained in the event of such failures, then surrounding soil could get contaminated and ultimately become hazardous waste.

In FY11, GSAF funds were allocated to the following projects that addressed hazardous and mixed waste issues:

- Replacement of Lead-Loaded Glovebox Gloves with an Attenuation Medium of non-RCRA-Hazardous Metals ($7500)
  The team ordered five pairs of Polyurethane – NonHaz Shielding – Hypalon gloves to test with gloveboxes. These do not contain lead, so they can ultimately be disposed of less expensively as LLW instead of MLLW. In the future, many leaded gloves might be replaced with the Hypalon gloves.
- Two-Flange Gloveport Liner ($2500)
  The team designed an improvement for gloveboxes that involves using an extra liner between the glove and the gloveport. This extra liner is expected to help reduce the chance of contamination getting onto the gloveport and glove inside the glovebox. This reduces the potential risk of contamination to employees and should result in the generation of less MLLW.
- Methanol Recirculation and Recovery Loop ($69,682)
  The multi-pass Methanol Recirculation and Recovery Loop (MRRL) will replace the single-pass methanol fuel system and provide methanol solution to four fuel cell test systems in parallel. The MRRL will greatly reduce the volume and disposal cost of the hazardous methanol/water waste stream. The installation of the MRRL will mitigate safety hazards associated with handling large volumes of methanol/water mixture.
- Target Fabrication Facility Centralized Chemical Stockroom ($75,000)
  This project establishes a centralized chemical stockroom for all operations at TA-35-213. By sharing chemicals among multiple projects, less hazardous waste in the form of unused or unspent chemicals is expected to be generated.
- 21st Century Solvent Purification for Actinide Chemistry ($20,000)
  This project is a continuation of work performed in FY10 to purify solvents for use in actinide chemistry. The money this year was spent on making the system portable for use in multiple locations.
- Disposal of Hazardous Materials from TA-22-1 Cleanout ($4000)
  Hazardous waste and oil were generated during the cleanout of a historical building at TA-22. This GSAF proposal covers disposal costs of these wastes.

2.4.2 Current FY12 Projects

FY12 GSAF projects were chosen, and approximately $1.2 million was allocated. About 60% of the funds are for solid wastes, and the balance is reserved for projects to minimize radioactive liquid waste. FY12 projects that support directorate EMS objectives and targets received extra consideration. FY12 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.

- Green is Clean Expansion/Upgrade ($30,000)
- Automated Plutonium Separation System to Reduce TRU Waste ($46,000)
- Combining Actinide Analytical Chemistry Processes To Eliminate Waste: Gallium and Uranium by XRF ($75,000)
- Coolant Longevity Project ($30,000)

- Clean Fill Yard Implementation ($150,000)
- Continuation of SWWS Sludge Composting ($70,000)
- Waste Reduction Through Dry Cell Battery Recycling ($2,500)
- SERF Waste Makes Carbon Neutral Concrete ($100,000)
- LANL Radiological and RCRA Constituents Background Study ($50,000)
- TRU Surface Contaminated Object Reclassification Pilot Project ($25,000)
- Microshield NDA Analysis Tool Pilot Project ($50,000)
- Bulk Dewar Recycle Program ($25,000)
- Institutional Implementation of Innovative PPE ($50,000)
- ISR-4 Waste Reduction through the Incorporation of Automated Cleaning Systems ($64,000)
- Trichloroethylene replacement study: cleaning effectiveness determination ($100,000)

2.5 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.

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 recorded in 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 FY11 on October 18, 2011.

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.

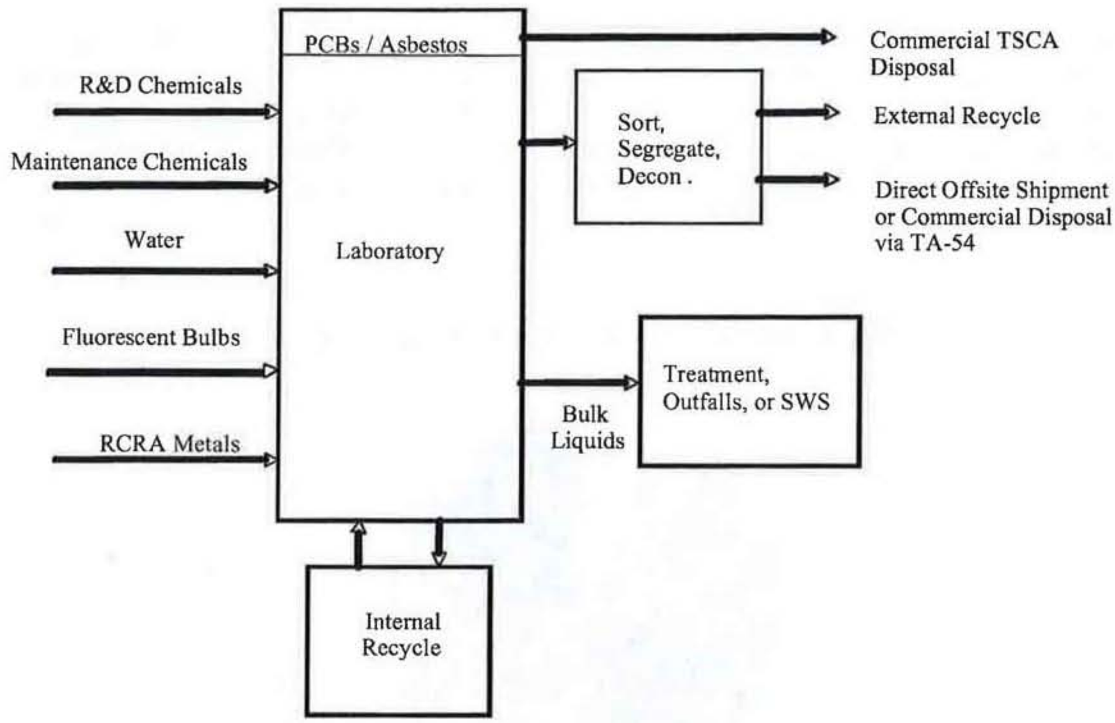

Figure 3-1. Hazardous waste process map
(Note: PCBs = polychlorinated biphenyls, SWS = Sanitary Wastewater System, TSCA = Toxic Substances Control Act)

The quantity of routine and non-routine hazardous waste that was generated and the amount of hazardous waste that was recycled during FY11 are shown in Figure 3-2. This graph does not include hazardous waste from remediation activities which are discussed separately in Section 6.0 of this report.

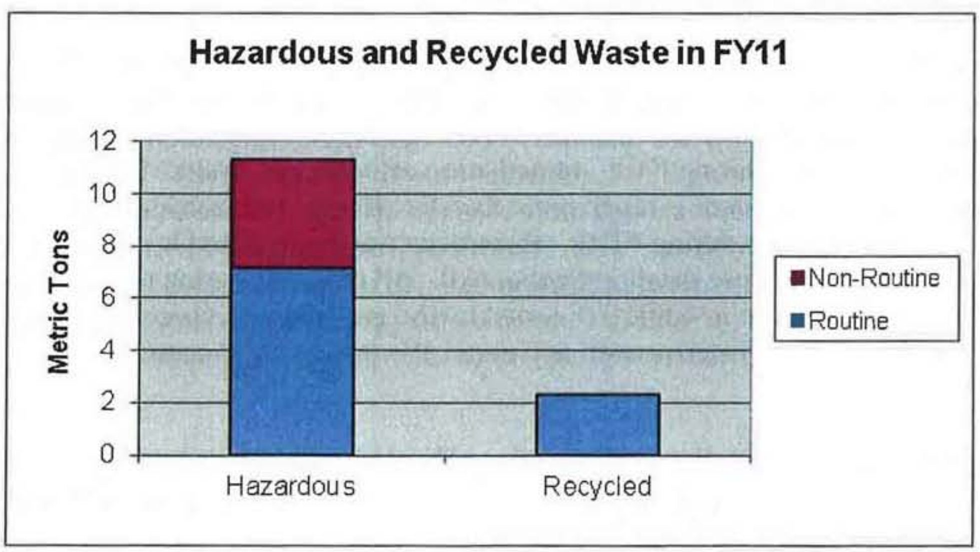

Figure 3-2. Hazardous waste and recycled hazardous waste generated during FY11, excluding remediation activities

The divisions that produced the most hazardous waste during FY11 were Chemistry (C), Weapons Experimentation (WX), Maintenance and Site Services (MSS), Materials Science and Technology (MST), Materials Physics and Applications (MPA), Nuclear Component Operations (NCO), Waste and Environmental Services (WES), Bioscience (B), and Nuclear Process Infrastructure (NPI). The hazardous waste generation by division is shown in Figure 3-3.

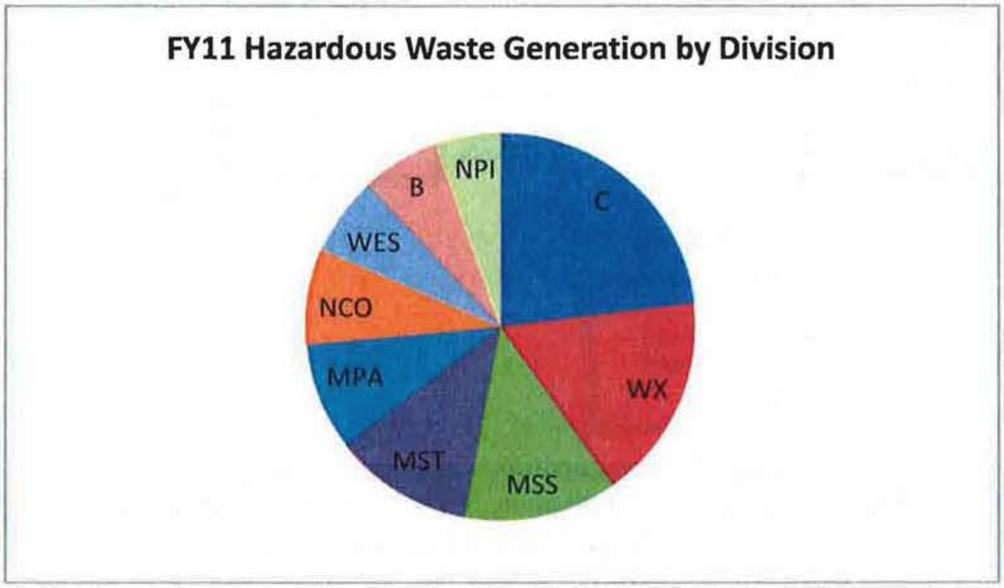

Figure 3-3. Hazardous waste by division during FY11. This includes routine and non-routine hazardous waste generation, but it does not include remediation waste.

3.2 Hazardous Waste Minimization Performance

The amount of non-remediation hazardous waste generated in FY11 was 11,335 kg, excluding recycled materials such as batteries, aerosol cans, bulbs, and elemental mercury. This amount was considerably less than the 14,603 kg of non-remediation hazardous waste generated during FY10. During FY11, remediation activities generated 41,460 kg of hazardous waste. This amount is much more than the 460 kg of hazardous waste generated from remediation activities during FY10. Hazardous waste generated by remediation activities is discussed in more detail in Section 6.0. All of the hazardous waste generated at LANL in FY11 is shown in Table 3-1 sorted by the generating division. Hazardous waste from remediation is listed as well and noted after the division name.

Table 3-1. Generation of Hazardous Waste by Division during FY11

Division	Hazardous Waste in kg
Corrective Actions Project *(remediation)*	22,849
Environmental Programs *(remediation)*	18,148
Chemistry	2011
Weapons Experimentation	1492

Maintenance and Site Services	1112
Materials Science and Technology	1014
Materials Physics and Applications	779
Nuclear Component Operations	699
Waste and Environmental Services	570
Bioscience	567
Nuclear Process Infrastructure	473
Waste Disposition Project	462
Site Projects	432
Earth and Environmental Sciences *(remediation)*	336
Chemistry and Metallurgy Research Replacement	220
International and Applied Technology	220
Weapon Systems Engineering	181
Director's Office	161
Earth and Environmental Science	160
Physics	142
Nuclear Nonproliferation	136
Accelerator Operations and Technology	117
Radiation Protection	73
International Space and Response	68
Waste Disposition Project *(remediation)*	59
Prototype Fabrication	56
Chemistry *(remediation)*	45
Applied Engineering and Technology	33
Weapons Program	24
Environment, Safety, Health, and Quality	24
Industrial Hygiene and Safety	23
TA-55 Facility Operations	22
LANSCE	19
Plutonium Manufacturing and Technology	17
Bioscience *(remediation)*	13
Manufacturing Engineering and Technology	12
Security and Safeguards	7
Central Training	3
Emergency Operations	2
Construction Management	1
Environmental Protection	1
Project Management Function	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 non-routine hazardous waste category for FY11 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 FY11 is shown in Figure 3-4.

Figure 3-4. FY11 hazardous waste stream components excluding remediation waste

Unused/Unspent Chemicals. The volume of unused and unspent chemicals varies each year, but this waste stream comprised the largest fraction of the total non-remediation hazardous waste in FY11. Researchers are encouraged not to buy more of any chemical than they are certain to need for several months to avoid having any unused amount. Efforts to "right-size" chemical procurements and share chemicals are being addressed. Past cleanouts at LANL and lower rates of chemical purchasing have reduced the volume of this waste stream. LANL's ChemLog system is set up to allow researchers to find and request unwanted, unexpired chemicals from other researchers.

Solvents. EPA-listed and characteristic solvents and solvent-water mixtures are used widely in research, maintenance, and production operations, especially for cleaning and extraction. Nontoxic replacements for solvents are used whenever possible, and new procedures are adopted when possible that either require less solvent than before or eliminate the need for solvent altogether. Recent acquisitions of solvent distillation equipment have reduced the total amount of solvent used, especially in Bioscience Division. As a result, the total volume of solvents generated has decreased over the past decade. However, solvents are still required for many procedures, such as HPLC, and solvents persist as a large component of the hazardous waste stream. In FY11, about one fifth of the solvent waste stream was composed of lacquer thinner. Also, over one tenth of the solvent waste stream was composed of thermostatic control beads that contain toluene, and this waste came from a one-time clean-out event. The volume of solvents generated in FY11 was slightly less than was generated during FY10.

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 FY11. The volume of acids produced during FY11 was slightly more than was produced in FY10.

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 FY11, leaded glass and broken, non-recyclable lead-acid batteries were the largest components of this waste stream. In FY11, one demolition project at TA-54 contributed over one third of the total non-remediation hazardous solid waste, and this waste stream is not likely to occur again.

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 FY11, the largest components were mop water from cleaning out a tank at DAHRT, spent machining coolant, and nitrate solutions. In FY11, the weight of hazardous liquids was significantly less than was generated during FY10.

Lab Trash and Spill Cleanup. Lab trash mostly consists of paper towels, pipettes, personal protective equipment, and disposable lab supplies. Rags are used for cleaning parts, equipment, and various spills. Equipment improvements have reduced the number of oil spills from heavy equipment, and new cleaning technologies have eliminated some processes where manual cleaning with rags was required. In FY11, the weight of lab trash and spill cleanup was about half of the amount generated during FY10.

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. The Pollution Prevention Program provides many new projects to minimize the amount of hazardous waste generated with GSAF funds each year. A virtual chemical reuse site was launched in 2011 and two pilot "chemical pharmacies" were established. The pharmacies are managing non-hazardous materials in the first year while results are measured and evaluated. Reducing chemical waste generation has many positive implications, including improved efficiency, lower costs, easier compliance with environmental regulations, and a safer working environment.

Mercury Substitution

Researchers typically replace mercury-containing thermometers as they get broken with non-mercury thermometers. By doing so, the chances of accidentally spilling mercury and creating hazardous waste are reduced. It is especially valuable to have non mercury thermometers in RCAs so that generation of MLLW can be avoided. The elemental mercury in old thermometers and in other obsolete mercury-containing equipment 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. Approximately 2036 kg of ferric chloride solution were sent offsite to be recycled and resold during FY11, and this would otherwise have become hazardous waste.

Base Waste Reduction and Recycling

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

Solvent Waste Reduction and Recycling

There have been many projects implemented to reduce the use of solvents since solvents have consistently been one of the largest components of the hazardous waste stream.

- Experiments in organic synthesis laboratories generate a large amount of glassware with organic residues. Solvents and oxidizing acids were formerly used to clean this glassware, thus generating hazardous waste. Besides the generation of waste, this process is time consuming and expensive. Two organic synthesis labs purchased Tempyrox Pyroclean ovens to clean the glassware with heat. The ovens eliminate the chemicals and other problems associated with manual cleaning. The organic vapors from this process are destroyed by a catalytic oxidizer system.
- The heavy equipment maintenance shop once cleaned metal parts by manually scrubbing them in solvent. The shop purchased a hot water parts washer, and the employees found that the hot water parts washer worked better for cleaning metal parts than solvent. The hot water parts washer saves time for employees, decreases

their chemical exposure, and reduces hazardous waste solvent generation by about 4000 kg annually.

- The Material Testing Lab uses a binder oven to test the amount of oil present in samples instead of performing solvent-based extractions. A sample can be weighed initially, baked in the oven, and then weighed again to determine how much oil was baked off from the sample. This improvement project reduces about 400 kg of hazardous waste annually.
- In Bioscience Division, the solvent formamide was eliminated from the preparation process to sequence strands of DNA. Formamide is a suspect teratogen, and employees proved that a water-based solution called TE worked just as well as formamide for suspending DNA prior to sequencing. Eliminating formamide reduces hazardous waste solvent and lab trash.
- The Chemistry Division organic synthesis team once performed experimental chemical synthesis activities in large glassware (25 mL to 2 L) reaction vessels. Now the researchers use reaction vessels of 5 mL or less, which greatly reduces the volume of solvent used. Typical solvents include toluene, methylene chloride, tetrahydrofuran, and ethanol.
- Two laboratories in Bioscience Division installed solvent recovery systems for acetonitrile in HPLC waste. These systems prevent the generation of approximately 100 gallons of hazardous waste solvents per week.
- The LANS protective forces subcontractor uses a non-hazardous cleaning solution, "Gunzilla", for their guns instead of the hazardous solution that was previously used.

Coolant Waste Reduction and Recycling

Material Physics and Applications and Weapons Components Manufacturing Divisions both implemented coolant recycling systems in their machine shops. Coolant is always used during machining procedures to ensure the quality of the machined pieces and maximize the lifetime of the machine tools. These two divisions used to produce about 15,000 kg of hazardous waste coolant annually. The coolant recycling system eliminated coolant waste from these facilities, and now only recyclable oil is generated.

Lead-Free Ammunition

Lead is a persistent, 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.

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

3.5 Barriers to Hazardous Waste Minimization

The largest component of the hazardous waste stream during FY11 was unused and unspent chemicals. Full or partially used bottles of chemicals or other products are sent for disposal once they have expired. If a research project is discontinued, the scientists may no longer need some of the chemicals that were allocated to that project. In some cases of project discontinuation, usable chemicals are distributed to other researchers in the same building who can use them.

Through the EMS, directorates are being asked to set specific objectives and targets for chemical waste reduction. 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 non-routine wastes. Solid wastes include cemented residues, combustible materials, noncombustible materials, and non-actinide metals. Liquid MTRU is a small percentage of total MTRU, and these wastes are primarily organic liquids.

MTRU solid wastes are accumulated, characterized, and assayed for accountability purposes at the generation site. MTRU solid waste is packaged for disposal in metal 55-gallon drums, standard waste boxes, and oversized containers. Security and safeguards assay measurements are conducted on the containers for accountability before they are removed for transport. Certification of the waste for transport and disposal at WIPP is currently done by the TRU Waste Project Support Group. The top-level process map for MTRU waste is shown in Figure 4-1.

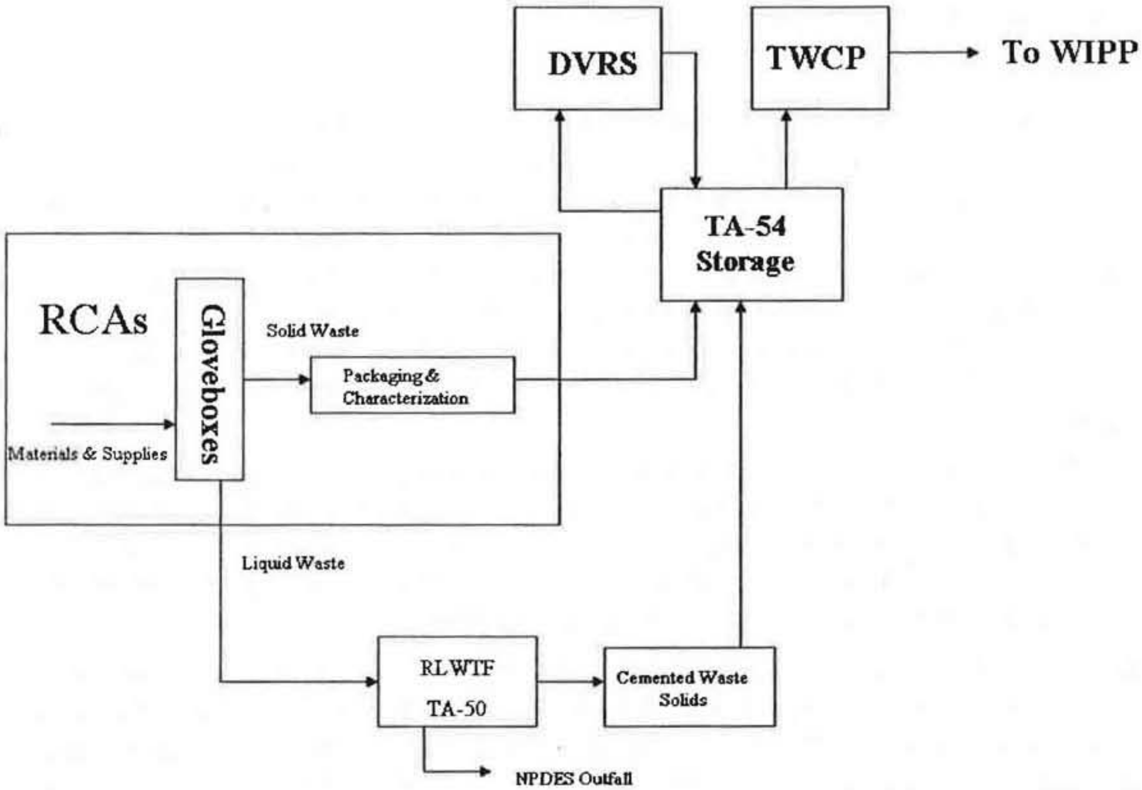

Figure 4-1. Top-level MTRU waste process map and waste streams
(Note: DVRS = Decontamination and Volume Reduction System,
TWCP = TRU Waste Characterization Program)

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 FY11, the routine and non-routine MTRU waste was generated by the groups at TA-55, remediation at TA-21, operations at the RLWTF, and by the Offsite Source Recovery Program. The Waste Disposition Project repackaged some of this MTRU waste so that WIPP acceptance criteria were fulfilled. The TA-21 remediation project generated significantly more MTRU cleanup waste in FY11 than in FY10, and remediation waste is discussed further in Section 6.0.

4.2 MTRU Waste Minimization Performance

LANS shipped offsite 161,604 kg of MTRU waste during FY11. This is considerably more than the 142,220 kg of MTRU shipped during FY10, and most of this was due to increased remediation activity at TA-21. During FY11, repackaging activities generated

94,578 kg of MTRU. Programmatic work activities generated 17,945 kg of MTRU at TA-55 and TA-50 during FY11. Demolition and remediation at TA-21 generated 48,745 kg of MTRU remediation waste during FY11. In FY11, the Offsite Source Recovery Program generated 336 kg of MTRU. The breakdown of MTRU generation at LANL during FY11 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 FY11

Division	MTRU Waste in kg
Waste Disposition Project (repackaging)	94,578
Waste Services and TA-21 *(remediation)*	48,745
Waste and Environmental Services (TA-55 operations)	12,482
Radioactive Liquid Waste Treatment Facility	5463
Nuclear Nonproliferation (Offsite Source Recovery)	336

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 FY11 is shown in Figure 4-2.

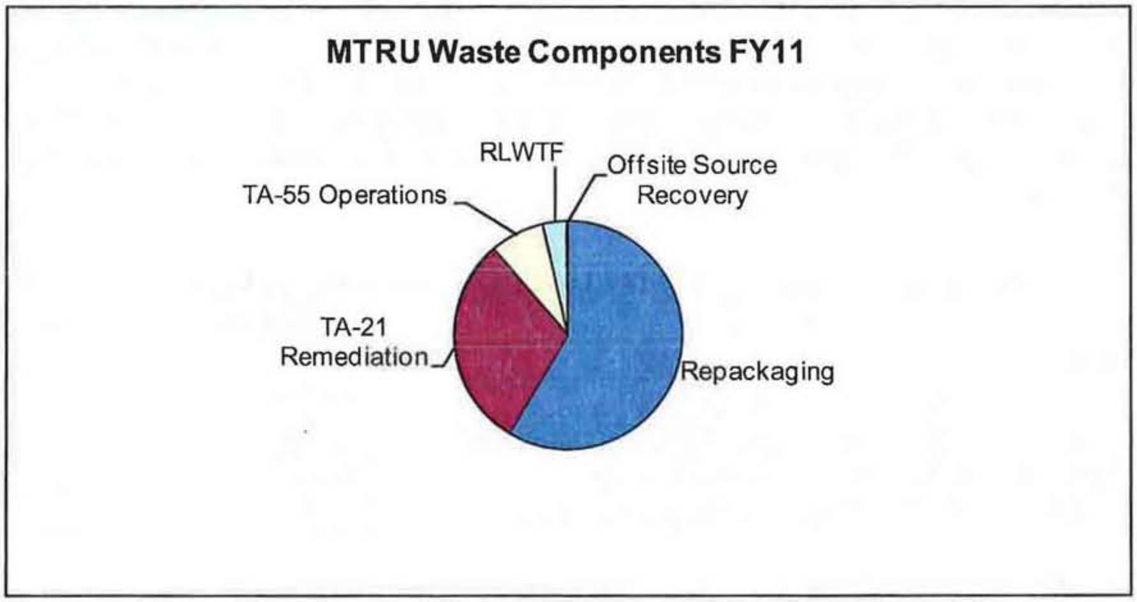

Figure 4-2. Composition of MTRU waste by volume for FY11

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 58% of the MTRU waste generated at LANL during FY11 came from repackaging activities. In FY11, the total weight of repackaged MTRU waste was less than was generated during FY10.

TA-55 Operations. Operational waste generated at TA-55 includes non–special nuclear material metal, plastic, cheesecloth, protective clothing, glass, filters, graphite, rubber, ceramics, ash, metals, lead-lined gloves, and a small volume of organic chemicals and oil. About 8% of the MTRU waste generated at LANL in FY11 was from TA-55 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 3% of the MTRU waste generated at LANL during FY11 was sludge from the RLWTF.

Remediation. Structures at TA-21 are being demolished and material from an old landfill onsite is being removed, and some of the materials qualify as MTRU waste. Remediation work is discussed in more detail in Section 6.0. About 30% of the MTRU waste generated at LANL in FY11 was from remediation work at TA-21, and this is significantly more than was generated during FY10.

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 leave them in their offsite locations. Less than 1% of the MTRU waste generated at LANL in FY11 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 FY11.

The great majority of MTRU waste generated in FY11 was from remediation work and repackaging work. Since these activities will not continue indefinitely, the amounts of waste from these processes will decrease over time. Routine MTRU waste generated by operational activities has been reduced as a result of past Pollution Prevention activities. These activities include replacing lead with a non-hazardous substance whenever possible in items such as gloves and shielding; using non-hazardous solvents or redesigning processes to minimize chemical use whenever possible; using reusable equipment, such as Teflon-coated tubes, instead of disposable equipment; using carbon dioxide plasma for cleaning parts instead of trichloroethylene; and decontaminating equipment to prolong its useful life.

4.5 Barriers to MTRU Minimization

Packaging requirements at WIPP often make minimization efforts difficult. There are wattage and dose limits that must not be exceeded, and a very small volume of MTRU could potentially have a high wattage. All of the containers sent to WIPP are 55 gallons or larger, and often the containers have very small volumes of waste inside with the majority of the internal volume being empty space. As seen in Figure 4-2, repackaging waste was the largest fraction of MTRU generated at LANL during FY11.

5.0 Mixed Low-Level Waste

5.1 Introduction

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

Most of the routine MLLW results from stockpile stewardship and from R&D programs. Most of the non-routine waste is generated by off-normal events such as spills in legacy-contaminated areas. The DOE is interested in the volumes of routine and non-routine MLLW, so these materials are tracked separately. Typical MLLW items include contaminated lead-shielding bricks and debris, R&D chemicals, spent solution from analytic chemistry operations, mercury-cleanup-kit waste, electronics, copper solder joints, and used oil.

Figure 5-1 shows the process map for MLLW generation.

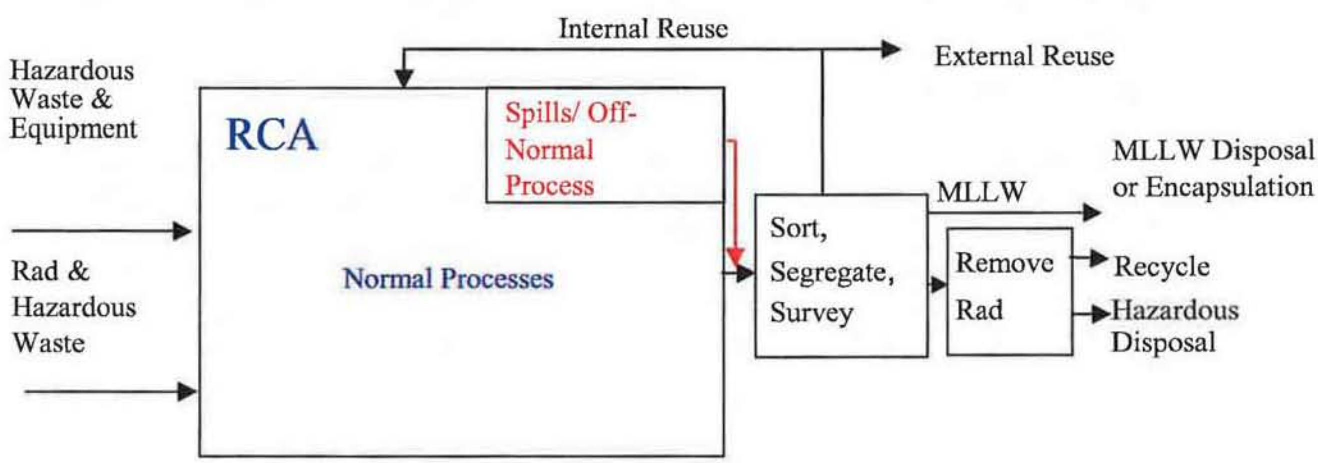

Figure 5-1. Top-level MLLW process map

Figure 5-2 shows MLLW generation by division during FY11, including MLLW from remediation work.

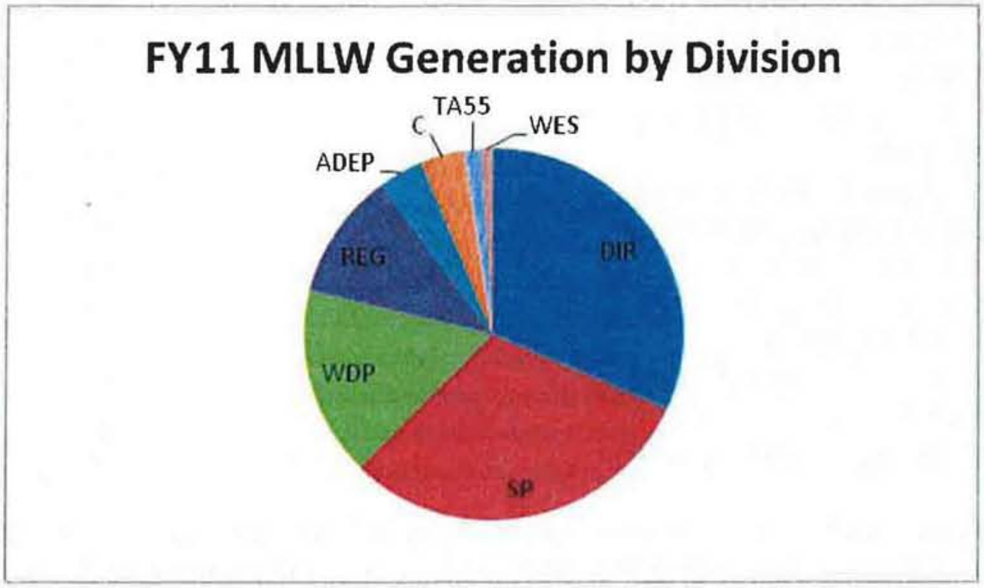

Figure 5-2. Total MLLW generated by division in FY11, including MLLW generated by remediation work

The divisions that generated the most routine and non-routine MLLW during FY11 were the Director's Office (DIR), Site Projects (SP), the Waste Disposition Project (WDP), Regulatory Management (REG), Environmental Programs (ADEP), Chemistry (C), TA-55 Facility Operations (TA55), and Waste and Environmental Services (WES).

5.2 MLLW Waste Minimization Performance

MLLW generation for FY11 was 34,354 kg, excluding MLLW generated from remediation work. This total includes waste from dismantling the old Ion Beam Facility and also former MTRU waste that now qualifies as MLLW and was repackaged as such. Remediation work performed during FY11 generated 28,761 kg of MLLW, and this waste is discussed in greater detail in section 6.0. Table 5-1 includes all MLLW generated at LANL during FY11, and remediation waste is noted after the division name.

Table 5-1. Generation of MLLW by Division during FY11

Division	**MLLW in Kilograms**
Director's Office *(remediation)*	19,386
Site Projects (equipment from old Ion Beam Facility)	18,921
Waste Disposition Project (reclassification of former MTRU)	10,108
Regulatory Management *(remediation)*	6771
Environmental Programs *(remediation)*	2391
Chemistry	2298

TA-55 Facility Operations	959
Waste and Environmental Services	600
Maintenance and Site Services	364
Plutonium Science and Manufacturing	357
Nuclear Component Operations	264
Corrective Actions Project *(remediation)*	213
Weapons Program	198
Weapons Component Manufacturing	61
Applied Engineering and Technology	56
Weapons Facilities Operations	54
Materials Physics and Applications	46
LANSCE Facility Operations	27
Weapon Systems Engineering	21
Materials and Science Technology	12
Chemistry and Metallurgy Research	9

MLLW is generated by routine programmatic work, remediation activities, lab cleanup activities, and D&D efforts. The remediation waste is discussed separately in Section 6.0 of this report. The volume of non-routine MLLW tends to vary significantly and often cannot be substantially minimized, so it is useful to examine the routine fraction of the MLLW waste stream separately to identify good waste minimization opportunities.

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 non-routine MLLW stream by weight in FY11 are reclassified MTRU, removal of old equipment from the Ion Beam Facility, repackaging waste, electronics, remediation waste, lead debris, oil, tritium-contaminated bulbs, and spent solvents. Less 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.

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

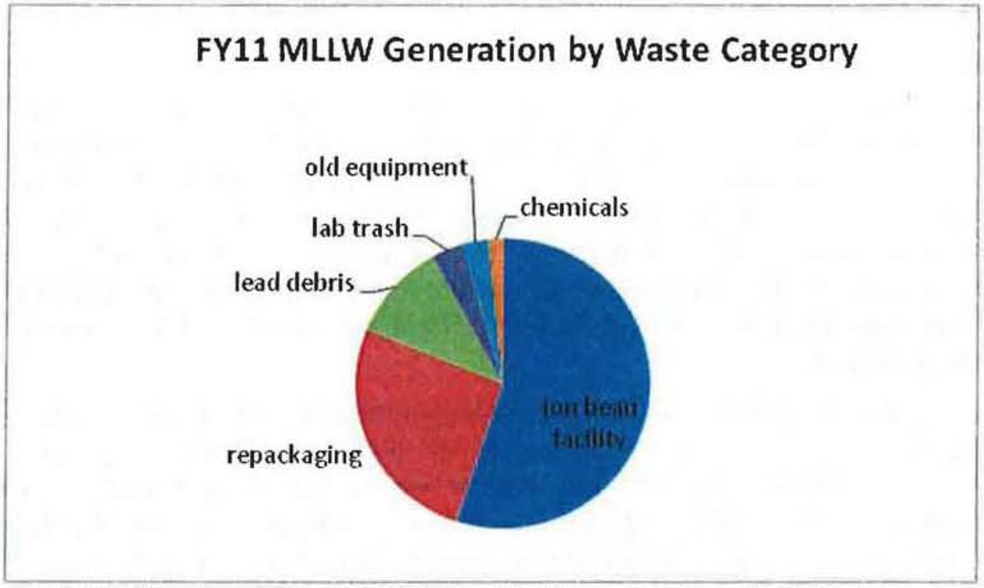

Figure 5-3. Constituents of MLLW in FY11, excluding MLLW generated by remediation work

Equipment from the Ion Beam Facility. This is a one-time project ongoing from last year that involved removing 18,921 kg of old equipment from the Ion Beam Facility in FY11, which is almost as much MLLW as was removed from the facility in FY10. The equipment included electronics contaminated with tritium.

Repackaging. This waste was formerly classified as MTRU, but as MTRU standards changed, it was discovered that these wastes could be reclassified and disposed of as MLLW instead. This amount of this waste stream should be less in the future as more old MTRU waste is shipped offsite.

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

Old Equipment. In FY11 this waste stream was composed of old gloveboxes being taken out of service, removal of an old tritium-contaminated freezer, maintenance on lighting and sprinkler systems in certain buildings, and removal of a building HEPA filtration system.

Research Chemicals and Lab Trash. This waste is composed of spent solvents, aqueous solutions, unused/unspent chemicals that have become contaminated in RCAs, analytical chemistry waste, gloves, personal protective equipment, dry painting debris, and paper towels. During FY11, 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 FY11, 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. In FY11, no nitric acid MLLW was generated.

One especially promising project involves replacing traditional fluorescent fixtures with LED fixtures in gloveboxes. The LED lights do not contain any RCRA-regulated components, so after their useful life, they will not become MLLW as fluorescent lights do. The LEDs are much smaller and lighter than fluorescents, and the LEDs last longer, use less electricity, and generate less heat than fluorescents. From FY08 through FY11, groups at TA-55 purchased more LED lights for gloveboxes. During FY11, LANL disposed of only 15kg of fluorescent bulbs as MLLW from non-remediation projects.

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 FY11 waste generation and waste minimization summary is listed in Table 6-1.

Table 6-1. FY11 Waste Generation Summary

Waste Type	Weight in Kilograms
Solid Hazardous	41,460
Solid MLLW	28,761
Solid MTRU	48,745

Project activities in FY11 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 report addresses all RCRA-regulated waste that may be generated by the corrective actions during the course of planning and conducting the investigation and remediation of contaminant releases. Wastes generated include "primary" and "secondary" waste streams. Primary waste consists of generated contaminated material or environmental media that was present as a result of past DOE activities, before any containment and restoration activities. It includes contaminated building debris or soil from investigations and remedial activities. Secondary waste streams consist of materials that were used in the investigative or remedial process and may include investigative-derived waste (e.g., personal protective equipment, sampling waste, drill cuttings); treatment residues; wastes resulting from storage or handling operations; and additives used to stabilize waste. The corrective actions may potentially generate hazardous waste, MLLW, and MTRU.

The majority of FY11 waste generation was the result of remediation and D&D, primarily at TA-21. Other waste-generating activities consisted of investigations, including well installation, and focused corrective actions. Investigations, corrective actions, and other activities associated with the Consent Order implemented during FY11 include the following:

- Excavation of Material Disposal Area (MDA) B
- D&D of 24 inactive structures at TA-21
- Investigations and corrective actions for Upper Cañada del Buey Aggregate Area, S-Site Aggregate Area, DP Site Aggregate Area, Middle Los Alamos Canyon Aggregate Area, Upper Los Alamos Canyon Aggregate Area, Lower Sandia Canyon Aggregate Area, Cañon de Valle Aggregate Area, Lower Mortandad/Cedro Canyons Aggregate Area, and Potrillo and Fence Canyons Aggregate Area
- Investigations of Potrillo and Fence Canyons; Ancho, Chaquehui, and Indio Canyons; and Water Canyon and Cañon de Valle
- Completion of the Phase III investigation for MDA C
- Completion of a background investigation for Bandelier Tuff Unit 4
- Maintenance of the Surface Corrective Measures Implementation at the 260 Outfall at TA-16
- Continued implementation 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
- Subsurface vapor monitoring at MDAs C, G, H, L, T, and V
- Plugging and abandonment of obsolete monitoring wells
- Performance of periodic groundwater monitoring in Ancho, Los Alamos, Mortandad, Pajarito, Sandia, Water, and White Rock Canyons
- Performance of sediment monitoring in Los Alamos and Pueblo Canyons
- Drilling and development of regional aquifer monitoring wells including R-60, R-61, R-63, and R-64
- Drilling and development of perched intermediate monitoring and test wells including CdV-16-4ip and R-55i
- Performance of pump testing at well CdV-16-4ip.

6.4 Remediation Waste Minimization

Waste minimization and pollution prevention were integral parts of the FY11 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 FY11 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 637,000 gallons of development water and drilling fluids from well drilling and rehabilitation and 406,000 gallons of purge water from well sampling was land applied during FY11.
- 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 1500 cubic yards of drill cuttings from well drilling and subsurface investigation boreholes were land applied during FY11.
- Overburden materials at MDA B were characterized before excavation to determine if these materials could be beneficially reused. These materials were determined to be uncontaminated and were segregated from other excavated materials to avoid contamination. Fifteen thousand cubic years of overburden materials were reused as excavation backfill and storm water best management practices rather than managed as waste.
- Additional investigations were conducted at two suspected waste disposal trenches at MDA B that were planned for excavation. Based on these investigations it was determined that these areas were never used for waste disposal and the areas were not excavated, thereby avoiding generation of waste.
- Workers at the MDA B remediation project utilized over 100,000 articles of personnel protective equipment (PPE). The MDA B project used OREX PPE, which is made of a recyclable material. Use of OREX PPE avoided generation of approximately 260 cubic yards of solid waste.
- Waste characterization and segregation were incorporated into TA-21 D&D activities to maximize opportunities for recycling, salvage, and beneficial reuse. Four hundred eighteen tons of structural metal and metal equipment was

determined to be suitable for recycling and sent to off-site recycling facilities. Sixty-nine cubic yards of other equipment, including an emergency generator, air compressors, boilers, pumps, tanks, fencing, circuit boards, and a glovebox were determined to be suitable for salvage. Approximately 4,600 cubic yards of concrete and concrete masonry units were size-reduced and beneficially reused on site as backfill material.

- Well drilling activities funded under the American Recovery and Reinvestment Act (ARRA) generated approximately 320,000 gallons of drilling fluids. These fluids were evaporated on site, eliminating the need for discharge or disposal.
- Lead "pigs" that had been used at Area G to store radioactive sources were sent off site for recycling, rather than being disposed of as waste. The lead was used to make lead drums for transporting radioactive materials at other DOE sites.
- Forty-six cubic yards of metal associated with D&D of Dome 281 at Area G was characterized and determined to be suitable for recycle. This material was sold to an off-site metal recycler rather than being disposed of as waste.
- EP continued to take actions during FY11 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 non-contaminated soils so that non-contaminated soils can be reused as fill. These practices are implemented at sites where contaminated subsurface soils and structures are overlain by uncontaminated soils. During excavation to remove the contaminated soils and structures, the uncontaminated overburden is segregated and staged apart from contaminated materials. Following removal of the contaminated soils and structures, the overburden is tested to verify that it is nonhazardous and meets residential soil screening levels. If so, this material is used as backfill for the excavation. This practice minimizes the amount of contaminated soil that must be disposed of as waste and also minimizes the amount of backfill that must be imported from off site.

Segregation is also used to allow "contact" waste generated during investigations to be managed through the GIC (Green-is-Clean) Program, rather than disposed of as radioactive waste. During FY11, a total of approximately 500 cubic feet of contact waste from site investigation and groundwater sampling activities was managed through GIC.

Survey and Release

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

Risk Assessment

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

Equipment Reuse

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

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

6.5 Pollution Prevention Planning

The potential to incorporate pollution prevention practices into future activities is evaluated annually as part of LANL's EMS planning efforts. As has been done in previous years, actions related to pollution prevention are being incorporated into the FY12 Environmental Action Plan for EP developed as part of the EMS. As appropriate, specific actions and approaches that will be incorporated into planned corrective action projects for FY12 are:

- Segregation and recycle or reuse of uncontaminated materials.
- Continued use of land application of drill cuttings and fluids.
- Waste avoidance.
- Risk-based cleanup strategies.

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.