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Date: November 23, 2009
Refer To: ENV-RRO: 09-083

HAND DELIVERY

NOV 2009

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

SUBJECT: 2009 LANL Hazardous Waste Minimization Report

Dear Mr. Bearzi:

I am pleased to submit this annual report on hazardous waste minimization activities. This report was prepared pursuant to the requirements of Module VIII, Section B.1 of the Laboratory's Hazardous Waste Facility Permit (NM0890010515-1) and is required by the Permit to be submitted to the New Mexico Environment Department by December 1, 2009 for the previous year ending September 30.

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

Please contact me by phone (505) 665-7251 or email (dlh@lanl.gov), if you have any questions.

Sincerely,

Dennis Hjeresen
Acting Division Leader

DH/mcm

Enclosures: a/s

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Document:	Hazardous Waste Minimization Plan
Date:	November 2009

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.

James C. Cantwell
Associate Director
Environment, Safety, Health, and Quality Directorate
Los Alamos National Laboratory

11/21/09
Date Signed

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

11/23/09
Date Signed

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List of Acronyms	
ADEP	Associate Directorate of Environmental Programs
B	Bioscience Division
C	Chemistry Division
CMR	Chemistry and Metallurgy Research facility
DE	Dynamic and Energetic Materials Division
DOE	Department of Energy
DOE-EM	Department of Energy-Environmental Management
DP	defense programs
EMS	Environmental Management System
ENV	Environmental Protection Division
ENV-RRO	Environmental Protection Division Risk Reduction Office
EP	Environmental Programs Directorate
EPA	Environmental Protection Agency
GIC	Green is Clean
GSAF	Generator Set-Aside Fund
HE	high explosives
ISO	International Organization of Standardization
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LED	light-emitting diode
LLW	low-level waste
MLLW	Mixed low-level waste
MPA	Materials Physics and Applications Division
MSS	Maintenance and Site Services Division
MST	Materials and Science Technology Division
MTRU	Mixed transuranic waste
N	Nuclear Nonproliferation Division
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NNSA	National Nuclear Security Administration
NPDES	National Pollution Discharge Elimination System
NSF-ISR	National Sanitation Foundation - International Strategic Registrations
PADWP	Principal Associate Directorate for Weapons Programs
PF	Plutonium Facility
PMT	Plutonium Manufacturing and Technology Division
PPE	personal protective equipment
PPOA	Pollution Prevention Opportunity Assessment
R&D	Research and Development
RCA	Radioactive Control Area
RCRA	Resource Conservation and Recovery Act
RLWTF	Radioactive Liquid Waste Treatment Facility
RTBF	Readiness and Technical Base Facilities
SOC	Special Operations Consulting
STO	Science and Technology Operations
TRU	transuranic waste

TSDF	Treatment, Storage, and Disposal Facility
TWCP	TRU Waste Disposition Project
WCM	Weapon Components Manufacturing Division
WIPP	Waste Isolation Pilot Plant
Wmin/PP	Waste Minimization / Pollution Prevention
WS	Waste Services Division

LA-UR-09-07682

November 2009

Los Alamos National Security, LLC
Hazardous Waste Minimization Plan

1.0 Hazardous Waste Minimization Plan

1.1 Introduction

Waste minimization is an inherent goal within all the operating procedures of Los Alamos National Security (LANS). The US Department of Energy (DOE) and LANS are required to submit an annual waste minimization plan to the New Mexico Environment Department (NMED) in accordance with the LANS/DOE Hazardous Waste Facility Permit. The plan was prepared pursuant to the requirements of Module VIII, Section B.1, of the LANS/DOE Hazardous Waste Facility Permit (NM0890010515-1). This plan describes the hazardous and mixed waste minimization program (WMin/PP) administered by the Environmental Protection Division – Risk Reduction Office (ENV-RRO). This plan also supports the WMin/PP goals of the Environmental Programs Directorate (EP) organizations responsible for implementing remediation activities and describes its programs to incorporate waste reduction practices into remediation activities and procedures.

1.2 Background

In 1990, Congress passed the Pollution Prevention Act[i], which changed the focus of environmental policy from "end-of-pipe" regulation to source reduction and minimizing waste generation. Under the provisions of the Pollution Prevention Act and other institutional requirements for treatment, storage, and disposal of wastes, all waste generators must certify that they have a waste minimization program in place. The elements of this program are further defined in the May 1993 US Environmental Protection Agency (EPA) interim final guidance, 58 Federal Register 10, *Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program*[ii]. The program guidance lists what EPA considers the minimum level of infrastructure and effort that constitute an acceptable program. This includes top management support, process evaluation, technology exchange, waste minimization employee training, and waste generation tracking and projections.

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

Specific DOE pollution prevention requirements are also delineated in DOE Order 450.1A, (Environmental Protection Program), which has been accepted into the LANS contract. DOE Order 450.1A requirements are executed through the Environmental Management System (EMS). The EMS received third-party registration to the International Organization of Standardization ISO 14001:2004 standard in April 2006 and was recertified in March 2009. The EMS is subject to surveillance audits every six months. Pollution prevention and waste minimization are required elements of the ISO 14001:2004 standard and are evident throughout the EMS.

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

Federal Statutes and Executive Orders

- Resource Conservation and Recovery Act
- 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, Title 40, Parts 259-280, "Standards Applicable to Generators of Hazardous Waste"

State of New Mexico Statutes

- New Mexico Hazardous Waste Act
- New Mexico Solid Waste Act

State of New Mexico Regulations

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

DOE Orders and Policies

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

Directives and Policies

- Laboratory Governing Policy
- PD 400 Environmental Protection Program
- P 401 Procedure to Identify, Communicate, and Implement Environmental Requirements

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

1.3 Purpose and Scope

The purpose of this plan is to document the approach for minimizing hazardous and mixed wastes and to document performance results. This plan discusses the methods and activities that will be routinely employed to prevent or reduce waste generation in the fiscal year 2010 (FY10), and the plan reports FY09 waste generation quantities and significant waste minimization accomplishments for FY09. In most cases, waste minimization activities executed during 2009 will continue to occur during FY10 and beyond. This plan also discusses the Director's commitment to pollution prevention; specific elements of the ENV-RRO 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 WMin/PP activities associated with remediation wastes.

1.4 Requirements of the Operating Permit

Module VIII, Section B.1, of the LANS/DOE Hazardous Waste Facility Permit requires that a waste minimization program be in place and that a certified plan be submitted annually to the administrative authority. The specific requirements of the permit are listed in Table 1.3-1 along with the corresponding section of the plan that addresses the requirement.

Permit Requirement	Topic	Refer to Report Section
Section B.1.(a)(1)	Policy Statement	Sections 2.1
Section B.1.(a)(2)	Employee Training	Sections 2.2
Section B.1.(a)(2)	Incentives	Sections 2.2
Section B.1.(a)(3)	Past and Planned Source Reduction and Recycling	Sections 2.5.1, 2.5.2, 3.5, 4.4, 5.4, 6.0
Section B.1.(a)(4)	Itemized Capital Expenditures	Section 2.5.1 and 2.5.2
Section B.1.(a)(5)	Barriers to Implementation	Sections 3.4.1,

		4.2.1, 5.2.1, 6.0
Section B.1.(a)(6)	External Sources of Information	Section 2.3
Section B.1.(a)(7)	Investigation of Additional WMin Efforts	Sections 2.5, 6.0
Section B.1.(a)(8)	Utilization of Hazardous Materials	Sections 2.4, 3.1, 4.1, 5.1
Section B.1.(a)(9)	Justification of Waste Generation	Sections 2.4, 6.0
Section B.1.(a)(10)(a)	Site Lead Inventory	Section 3.4
Section B.1.(a)(10)(b)	Lead Substitution and Removal	Section 3.4
Section B.1.(a)(10)(c)	Lead Shielding and Coating	Section 3.4
Section B.1.(a)(10)(d)	Lead Decontamination	Sections 3.4
Section B.1.(a)(10)(e)	Scintillation Cocktail Substitution	Section 3.4
Section B.1.(a)(10)(f)	Radioactive Waste Segregation	Section 3.4

Table 1.3-1. LANS/DOE Hazardous Waste Facility Permit, Module VIII, Section B.1

1.5 Organizational Structure and Staff Responsibilities

The Director, the Senior Environmental Management 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 (ENV) has primary responsibility for the WMin/PP Program. WMin/PP Program comes from a tax levied on each waste item. This tax supports the core Pollution Prevention Program activities and pollution prevention projects. The Associate Director for Environmental Programs has oversight responsibilities and provides review for the environmental remediation program waste minimization activities. For this organizational reason, specific environmental remediation program waste minimization activities are discussed separately in Section 6.0.

The ENV-RRO Pollution Prevention Program has been tasked to develop and manage the WMin/PP and the EMS. The EMS establishes both institutional WMin/PP objectives and targets and directorate-level environmental action plans that contain WMin/PP actions. The ENV-RRO Pollution Prevention Program provides oversight for WMin/PP implementation; a base of technical knowledge and resources for WMin/PP practices; assistance with identifying waste generation trends and WMin/PP opportunities; recommendations for WMin/PP solutions and applications; support in tracking and reporting WMin/PP successes and lessons learned; provides funding for WMin/PP projects; and assistance in identifying and addressing WMin/PP implementation barriers.

2.0 Waste Minimization Program Elements

2.1 Governing Policy on Environment

LANS has developed a prevention-based EMS, which was third-party certified to the ISO 14001:2004 standard in April 2006 by NSF-ISR, an independent ISO 14001 third-party registrar. LANS was recertified by NSR-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 the basis 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 FY 09 EMS Institutional Objectives

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

1. Integrated compliance improvement
2. Achieve laboratory-wide reductions in waste generation
3. Improve laboratory-wide energy and fuel conservation.
4. Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and associated waste.
5. Achieve zero liquid discharge by 2012

The Pollution Prevention Program is an integral part of the EMS and supports LANS in meetings the EMS objectives. The FY10 WMin/PP approach will focus on:

- baselining waste trends and identifying improvement targets at the directorate level
- conducting pollution prevention opportunity assessments on key processes
- utilizing material substitution as appropriate
- integrating pollution prevention principles into the project planning process
- developing and delivering guidance to address waste generation behaviors for staff and subcontractors
- communicating waste minimization lessons learned to the employees
- dedicating waste minimization resources to assist with large remedial actions
- improving chemical use and management, including the unused, unspent chemicals
- promoting purchase of environmentally preferable products
- improving management of materials to reuse materials and equipment to the

greatest extent possible before final disposition
- 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 FY09, the Integrated Environmental Review program provided a training program for work planners to increase awareness of environmental concerns, including opportunities for prevention and waste minimization. The briefings were delivered to three organizations that have responsibilities related to work planning, WMin/PP efforts, and the EMS:

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

In FY09 22 briefings were delivered.

Another management program is the Permits and Requirements Identification (PR-ID) 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/P2 requirements apply to their project.

DOE Headquarters, in conjunction with the National Nuclear Security Administration (NNSA), sponsor annual pollution prevention awards programs. The programs provide recognition to personnel who implement pollution prevention projects. LANS submits nominations for the DOE/NNSA awards each year and received eight awards for pollution prevention projects during FY09, including three Best-in-Class awards. The winning projects are described below.

- The Fleet Management and Process Improvement Project - The team investigated the underlying causes of increased fleet costs and created a strategy for down-sizing and right-sizing the onsite fleet. The work of the team saved approximately $156,000.

- A Green Synthesis Path to the Explosive DAAF - High explosive synthesis is often unable to benefit from a greener synthesis path due to constraints on purity, yield, and the types of impurities. However, this team replaced the original synthesis path to diaminoazoxyfurazan (DAAF), with an environmentally-friendly alternative. This method decreased the process time by 90% and improved purity of the final product. It also maintains a high product yield and generates no hazardous waste.

- LED Replacement Lights for Glove Boxes – This team replaces about 90 fluorescent light fixtures in glove boxes with LED lights each year. LED lights consume less electricity and have a life span up to ten times longer than fluorescent fixtures. Additionally, LED lights contain no hazardous components and can be disposed of at a lower cost than fluorescent fixtures. The annual savings is over $32,600, which includes energy costs, procurement, and waste disposal.

- Using a Mature EMS for Meaningful Institutional Improvements – LANS uses its EMS to systematically improve institutional environmental performance. The EMS is moving beyond traditional sustainability programs and merging with worker safety, regulatory compliance, and institutional infrastructure programs. Such improvements are critical to the credibility of the EMS and the continued willingness of employees to participate in the improvement process.

- MRAD Pollution Prevention Plan - The Muon Radiography Project (MRAD) project uses thousands of sensitive drift tubes that require careful cleaning. The initial plan was to clean the tubes using an acid waste tank system. An alternative cleaning system was implemented, and this change avoids 5,500 gallons of hazardous waste annually. This effort saved over $900,000 in disposal, facility, and regulatory costs. Worker safety was greatly enhanced with the reduction in hazardous chemical exposure.

- Extending Reuse Period of Anti-C Lab Coats at CMR – It was determined that the Chemistry and Metallurgy Research (CMR) lab coat change frequency could be extended from one day to one week. Employees now spend less time surveying and handling laundry, and this also provides an estimated times savings of 1800 hours per year. Spending on the laundry contract is reduced by about half.

- Server Virtualization Results in Continual Cost and Energy Savings - This team reduced the overall server computer footprint by leveraging a technology that "virtualizes" multiple computers on a consolidated platform that reduces hardware procurement, maintenance, disposal, and energy use. The technology allows for multiple operating systems to be run on a single computer. This team reduced the number of computer servers from 200 to 12. The estimated energy savings are over 873,000 kilowatt-hours and $1.4 million per year.

- Remediation Project Minimizes Waste - Approximately 2,400 cubic yards of clean overburden soil was segregated and reused as backfill material. Reuse of the overburden soil eliminated the need for this material to be processed as waste and avoided approximately $2 million in storage, transportation, and disposal costs. To control dust and minimize runoff, the overburden stockpiles were covered with non-hazardous magnesium chloride, and this resulted in 40 cubic yards of plastic sheeting waste avoidance. Additionally, a clean metal tank sent to a metal recycler.

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 FY09, the Pollution Prevention team gave awards to over 200 employees who worked on 40 projects to reduce waste generation, improve efficiency, and conserve resources. These projects have millions of dollars worth of value through cost savings, waste avoidance and improving compliance.

In FY09, the Pollution Prevention team participated in a site-wide event called "The Great Garbage Grab" to clean up trash in April to coincide with Earth Day. LANS held a Student Sustainability Challenge during the summer to engage students in the EMS and to encourage them to contribute to reducing waste and conserving resources.

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

2.3 External Sources of Information

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

Pollution Prevention Program staff actively engage with professional organizations to further enhance their technical capabilities. The list includes, but is not limited to the New Mexico Recycling Coalition, the US Green Building Council, the Air and Waste

Management Association, the National Pollution Prevention Roundtable, and NNSA, DOE and Office of the Federal Environmental Executive-sponsored conference calls and activities. Several team members belong to the National Registry of Environmental Professionals.

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

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

The Pollution Prevention Program routinely communicates with staff through one-page tips on how to reduce waste called "enviro-links", which are distributed to all employees on a routine basis. Also, articles and success stories are published on the internal Pollution Prevention webpage as well as through internal publications.

2.4 Utilization and Justification for the Use of Hazardous Materials

Los Alamos National Laboratory (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 have been established for waste generators that include source reduction and material substitution techniques. Best management practices to reduce hazardous waste generation such as the use of micro-scale chemistry, use of non-hazardous 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 non-toxic or less hazardous substitutes whenever possible, the Pollution Prevention team has a linked database of alternative chemical choices on its own 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. Everyone can access this database of non-toxic or less hazardous alternative chemicals.

An environmentally preferable purchasing program is in place that requires that buyers choose less hazardous or non-hazardous 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 new computer procurement contract includes the procurement preference for computers that meet the Electronic Product Environmental Assessment Tool certification standard. Other procurement requirements address remanufactured printer cartridges and energy efficiency standards for all printers and copiers.

2.5 Investigation of Additional Waste Minimization and Pollution Prevention Efforts

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

During FY09, 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 Pollution Prevention Opportunity Assessments (PPOAs) to analyze waste generating processes and develop prevention alternatives. In FY09, the following PPOAs were completed:

- Ammonia Reduction to the Radioactive Liquid Waste Treatment Facility: This PPOA examined potential ways that the amount of ammonia going to the Radioactive Liquid Waste Treatment Facility could be reduced.
- MSS Division Fluorescent Light Bulbs: This PPOA looked at potential alternatives to using fluorescent bulbs in Maintenance and Site Services (MSS) Division.
- MSS Division Unused and Unspent Chemical Products: This PPOA looked for possible ways to reduce the volume of unused and unspent chemicals that enter the waste stream from MSS Division.

2.5.1 Funded Projects

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

In FY2004, GSAF funds were allocated to the following projects:

- Contaminated Lead and Scrap Metal Abatement ($35,000)

  Excess lead bricks and pigs were shipped to Duratek. The lead was recast into linings for drums designed to store radioactive waste.

- Recycling Shipment of Lead from Radiation Control Areas ($36,000)

  Approximately 30,000 kg of lead bricks were shipped to Duratek for recycling into drum liners. This lead would have become MLLW if it had not been recycled.

- Micro-Scale Chemistry ($5,000)

  This project proved the effectiveness of using micro-scale quantities of solvents for chemical synthesis experiments. Instead of reactions involving 25ml – 2L of solvents each, these experiments can now be done with 1-5ml each. An estimated 20kg of hazardous waste is avoided annually through this project.

- Oil-Free Vacuum Pumps at LANSCE Lujan Target ($91,530)

  An estimated 368 kg of MLLW oil is avoided annually with this project. By using oil-free vacuum pumps to operate the target at the Lujan Neutron Scattering Center, no oil needs to be changed monthly. Not only is a significant amount of MLLW avoided, but time is saved for more important tasks as well.

- Aerosol Puncturing Unit ($1,000)

  An aerosol can puncturing unit was purchased by use at TA-55. By puncturing aerosol cans and draining the contents, the steel bodies can be recycled, and the amount of hazardous waste generated can be reduced.

- Precious Metals Recovery by Electrowinning ($15,000)

  MST Division purchased a commercial electrowinning unit. By installing this unit in the plating shop, about 100 gallons of liquid cyanide waste are avoided annually since the cyanide is broken down and the resulting liquid can act as rinsate. In addition, about 2 kg each of gold and silver were recovered from solution.

- Development of Bench Scale Molten Salt Oxidation Processes for Treating Pu-238 Contaminated Combustible Waste ($89,500)

  The Pollution Prevention team provided money to test a molten salt oxidation unit. Materials such as cheesecloth and plastic contaminated with Pu-238 will be oxidized without using a flame. Doing so allows recovery of the Pu-238 and reduces the volume of waste.

In FY2005, GSAF funds were allocated to the following projects:

- Reuse, Recycling, and Reduction of an ICP-AES ($4,111)

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

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

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

- Solidification of Liquid Residues ($25,000)

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

- Aerosol Can Puncture Units ($6,360)

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

- Mercury-Free Sampler ($10,000)

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

- Lead Recycling from TA-48 and CMR ($120,000)

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

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

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

In FY2006, 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 FY2006, 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 5-7 days to remove trace contaminants, so the new system is significantly faster. The team estimates that 500L of concentrated nitric acid are no longer needed annually, for a savings of about $50,000 in procurement and disposal.

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

A Chemistry Division laboratory demonstrated a system to integrate multiple diagnostic machines with just one laptop computer. The demonstration is meant to convince labs that use radioactivity to adopt the same strategy and reduce the chance of contaminating electronics and generating a 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 Pollution Prevention Opportunity Assessment to help identify issues regarding waste disposal and pollution prevention during clean out activities. Management is very interested in pursuing clean out 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 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 identifies a set of environmental high-risk chemicals, and environmentally friendly substitutions will be examined for each project.

- Lead Brick Recycling ($168,000)

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

- UPS Waste Reduction ($34,000)

  The people involved with this project worked to remove unnecessary uninterrupted power supplies (UPS). The batteries in these UPS 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 they conducted pilot projects to identify and resolve any potential roadblocks to clean-out 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 un-needed items within a prioritized EMS planning framework. Cleanouts were done at TA-35 at TA-16.

- LED Light Assemblies on Glove Boxes ($1,500)

  This project tested light-emitting diode (LED) light panels to replace existing fluorescent light panels on glove boxes. LED lights operate at cooler temperatures, are up to 10 times more energy efficient, last 10-15 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 400lb of silver were analyzed to verify their potential to be reused as silver instead of being handled as hazardous waste. Ultimately the silver was found to be uncontaminated, but the DOE metal moratorium prevented this silver from being recycled.

- Refrigerant Recycling ($12,000)

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

- Silver Recovery Units ($7,300)

  Waste photochemicals can be filtered with silver recovery units to reclaim the silver for recycling. Filtering also removes the hazardous component from the liquid photochemical waste and renders the waste non-hazardous. Spent photochemicals are the largest 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. Trichloroethylene 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 Non-Hazardous 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 non-hazardous bismuth will never become MLLW as the lead bricks might.

- Waste Reduction by Distillation for HPLC Processes ($20,000)

  A unit was installed to recover acetonitrile from an aqueous high performance liquid chromatography (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 useable lead and steel will be re-cast as shielding containers and drum linings, to be resold to the DOE contractors.

- Plasma Cleaning Process ($55,000)

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

2.5.2 Current FY09 Projects

FY09 GSAF projects were chosen from the submissions of employees, and approximately $1,162,500 was allocated. About 60% of the funds are for solid wastes and the balance is reserved for projects to minimize radioactive liquid waste. FY09 projects that support directorate EMS objectives and targets received extra consideration.

In FY09, GSAF funds were allocated to the following projects that addressed hazardous and mixed waste issues:

- Non-Hazardous 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 use 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 non-hazardous materials.

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

  A non-hazardous, biodegradable detergent was tested in place of a nitric acid bath to clean glassware for sensitive samples. The replacement 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, all 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 non-hazardous characteristics and longer life of the LEDs means 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 on-site. This improvement reduces approximately 1300 kg of solvent waste and new 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.

FY10 projects have been selected, and will address all regulated waste streams including transuranic waste and mixed transuranic waste, low-level and mixed low-level waste, hazardous waste, radioactive liquid waste, and the Zero Liquid Discharge project. The project titles are listed below.

- Paper Elimination Project (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)

- Direct Solid Analysis Using DC Arc Spectrometry to Eliminate Waste

Generation (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)

- Ion Exchange Column Reduction Project (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- SAA elimination from PF-4 analytical method (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- OREX LLW Implementation Project (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- Purchase and supply LED lights for TA-50 (EMS Objective 2: Achieve laboratory-wide reductions in waste generation; EMS Objective 3 Improve laboratory-wide energy and fuel conservation)
- Fluorescent Light Substitution at TA-48-continued (EMS Objective 2: Achieve laboratory-wide reductions in waste generation; EMS Objective 3 Improve laboratory-wide energy and fuel conservation
- Waste Reduction Through Dry Cell Battery Recycling (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- Reduction of MLLW and Reuse of LLW at TA 53 (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- Mercury Ignitron Replacement Prototype Project (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- 21st Century Solvent Purification for Actinide Chemistry (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- Chemical Storage and Re-Use Centers, Virtual Chemical Exchange (EMS Objective 2: Achieve laboratory-wide reductions in waste generation and EMS Objective 4: Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and associated waste)
- New Evaporator for Shop Upgrade (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- Perchloric Acid Fume Hoods (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)
- Use of biodiesel co-product to boost Biological Oxygen Demand at the Sanitary Waste Treatment Facility (EMS Objective 5: Achieve Zero Liquid Discharge by 2012)

- Ammonia Elimination to RLWTF (EMS Objective 2: Achieve laboratory-wide reductions in waste generation)

- Chemical Inventory Reduction (EMS Objective 4: Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and associated waste)

- The Characterization and Cleanout of Hazardous Materials at TA-22-1 (EMS Objective 4: Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and associated waste)

- Van de Graaff Cleanout Project (EMS Objective 4: Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and associated waste)

- LEDA Containment Trench Extension (EMS Objective 1: Integrated compliance improvement; and EMS Objective 4: Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and associated waste)

2.5.3 EMS Accomplishments

The various directorates accomplished many of their environmental goals that were set in their respective EMS documents. Some of the many environmental accomplishments driven by the EMS program are listed below.

Environmental Programs (ADEP) Directorate

- Development of a use and re-use policy for lead shielding at TA-55 to reduce MLLW generation.

- Implementation of the site-wide electronic waste disposal request system to improve waste tracking and processing capability.

- Transfer and re-use of functional drilling equipment to minimize salvaging of operable resources.

Project Management and Site Services (ADPMSS) Directorate

- A structured funding mechanism now allows for efficient transfer of reuse furniture on-site.

- Exhibit F was updated and specifies that contractors must maintain their own chemical inventory.

Chemistry, Life, and Earth Sciences (ADCLES) Directorate

- Earth and Environmental Sciences Division removed 688 containers of chemicals during lab cleanouts, recycled approximately 600 lb of batteries, and reused over 1000 lb of rock as fill.
- Chemistry Division reduced waste by using new analytical procedures such as pressurized gas extraction chromatography, gamma ray spectrometry, and x-ray fluorescence.
- Chemistry Division substituted an acid bath for cleaning glassware with a system that uses a less hazardous substance and reduces waste.
- One laboratory previously used to store radioactive materials was cleaned and converted into a general use space.

Experimental Physical Sciences (ADEPS) Directorate

- Lujan Center recycled approximately 30 tons of metal waste..
- During the Sigma Chemical Clean Out Project, the team collected 714 containers of unused/unspent chemicals.
- Physics Division can monitor some of their experiments far away remotely, thereby saving time and fuel to monitor the experiments in person. Fewer airplane trips reduced carbon dioxide emissions by over 100,000 lb.
- Physics Division disposed of 45 unwanted UPS units.

Engineering and Engineering Sciences (ADE) Directorate

- Berms were constructed around outdoor transformers.
- An outdoor water drainage problem was corrected to reduce erosion from outdoor containments.
- Twenty-six pallets of accelerator capacitors were salvaged, and 14 spent resin beds were removed for disposal.

Weapons Engineering (ADWE) Directorate

- Several trailers were removed to support the goal of decreasing its physical footprint.

Stockpile Manufacturing and Support (ADSMS) Directorate

- Chillers that contained refrigerant R-11 were retrofitted with a refrigerant that has lower ozone depleting potential.

- Fewer lead-lined gloves are being used, and this will translate into less MTRU waste generation in the future.

Business Services (ADBS) Directorate

- Held a reuse and recycle event in June where $35,000 of materials were redistributed.

2.6 Waste Cost Recovery

Until the early 1990s, waste processing and management were considered overhead functions, included as part of the general and administrative tax. In 1991, these activities moved under the jurisdiction of Department of Energy-Environmental Management (DOE-EM), which began direct-funding both legacy (including clean-up) and newly-generated waste management. Starting in FY1999, 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 FY2000 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 FY1999 to FY2007 RTBF funded its waste processing activities via work packages that defined the resources and activities for each year. This method is simple in terms of accounting, with the drawback that the level of detail in these packages is often low. Also, little incentive is passed to the generator to minimize waste.

In FY08, LANS developed and implemented cost recovery to support consolidation and modernization plans of its plutonium infrastructure. Fiscal year 2008 represents a transition period for cost recovery followed by implementation of full cost recovery in FY2009. The basis for waste cost recovery is to charge waste generators for the transportation, storage and disposal of their wastes.

3.0 Hazardous Waste

3.1 Introduction

The annual hazardous waste disposal amount that is reported as part of the Pollution Prevention Program DOE reporting requirements is based on the total waste disposed through the Solid Waste Operations database (SWOON) system and does not include waste generation amounts prior to on-site treatment. Data quality assurance for this for this system is certified by the Associate Director for Environmental Programs. The SWOON waste data used in this report was collected for FY09 on October 21, 2009.

In brief, 40 Code of Federal Regulations (CFR) 261.3, as adopted by the NMED as 20.4.1.200 NMAC, define hazardous waste as any solid waste that:

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

Hazardous waste commonly generated includes many types of research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This waste may include equipment, containers, structures, and other items that are intended for disposal and that are contaminated with hazardous waste (e.g., compressed gas cylinders). Some contaminated wastewaters that cannot be sent to the sanitary wastewater system or the high-explosives (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.

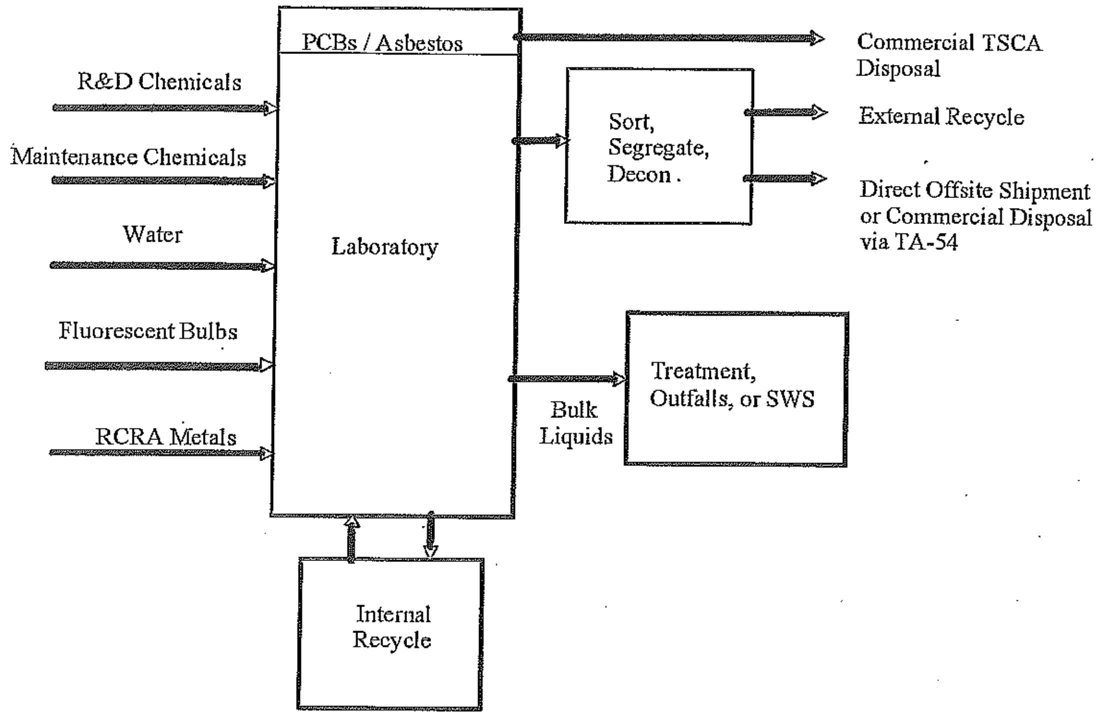

Figure 3-1. Waste process map

The quantity of routine and non-routine hazardous waste that was generated and the amount of hazardous waste that was recycled during FY09 is shown in Figure 3-2. This graph does not include hazardous waste for remediation activities since that is discussed separately in section 6.0 of this report.

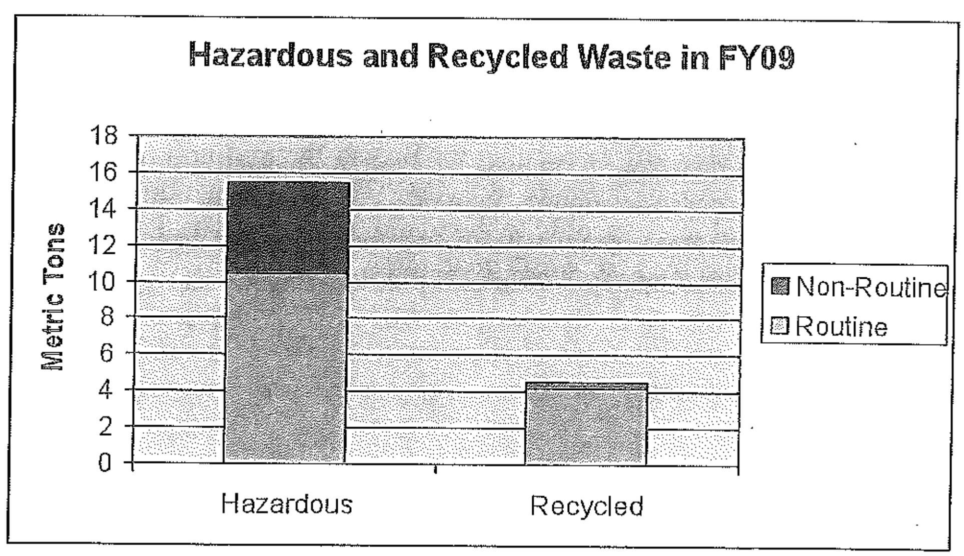

Figure 3-2. Hazardous waste and recycled hazardous waste generated during FY09

The divisions that produced the most hazardous waste during FY09 were Materials Science and Technology (MST), Dynamic and Energetic Materials (DE), Chemistry (C), Materials Physics and Applications (MPA), Biosciences (B), and Weapons Component Manufacturing (WCM). The hazardous waste generation by division is shown in Figure 3-3.

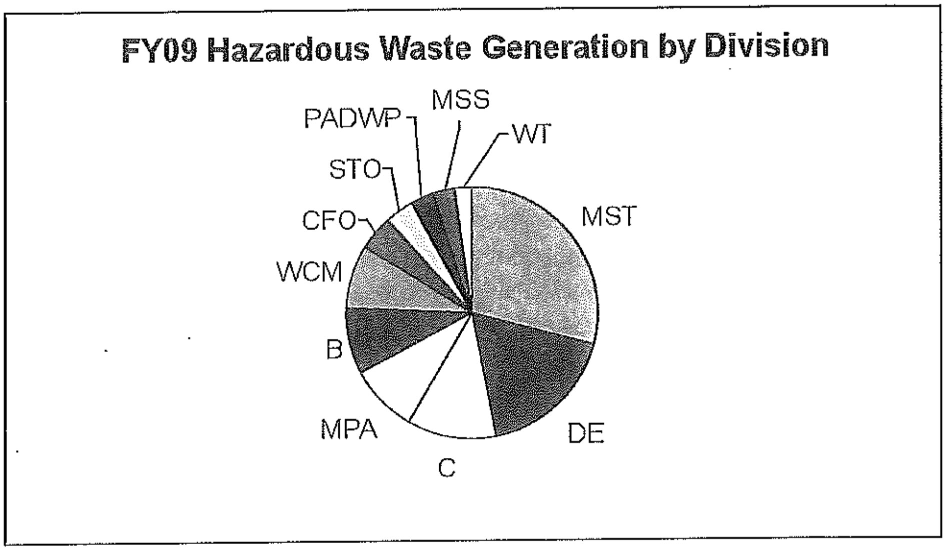

Figure 3-3. Hazardous waste by division during FY09. This includes routine and non-routine hazardous waste generation, but it does not include remediation waste.

3.2 Hazardous Waste Minimization Performance

The amount of non-remediation hazardous waste generated in FY09 was 15,830 kg, excluding recycled materials such as batteries, aerosol cans, bulbs, and elemental mercury. This is almost the same amount as the 15,879 kg of non-remediation hazardous waste generated during FY08. During FY09, remediation activities generated 108,492 kg of hazardous waste. This is considerably more than the 43,477 kg of hazardous waste generated from remediation activities during FY08. Hazardous waste generated by remediation activities are discussed in more detail in section 6.0. The performance in hazardous waste generation by division for FY09 is shown in Table 3-1.

Table 3-1. Generation of Hazardous Waste by Division during FY09

Division	Hazardous Waste in Kg
LANL Water Stewardship Project (remediation)	108,492
Materials Science and Technology	3904
Dynamic and Energetic Materials	2391
Chemistry	1526
Materials Physics and Applications	1202
Bioscience	1165
Weapons Component Manufacturing	1086
Chief Financial Office	600

Science and Technology Operations	474
Earth and Environmental Sciences	422
Principal Associate Directorate of Weapons Physics	410
Maintenance and Site Services	359
Weapon Engineering Technology	306
Waste and Environmental Services	241
Plutonium Manufacturing and Technology	230
Waste Services	204
Hydrodynamic Experiments	154
Weapons	148
Institutional Facilities and Central Services	116
Project Management	99
Nuclear Nonproliferation	92
Radiation Protection	88
Radioactive Liquid Waste	86
International Space and Response	83
Physics	78
LANSCE	74
Associate Directorate of Environment, Safety, Health,& Quality	61
International and Applied Technology	38
Associate Directorate for Chemistry, Life, and Earth Sciences	29
Weapons Facilities Operations	28
Waste Disposition Project	28
Security Operations	27
Institutes	27
Industrial Hygiene and Safety	20
Prototype Fabrication	13
Applied Engineering and Technology	6
Corrective Action Project	5
Central Training	4
Acquisition Services Management	3
Infrastructure Planning	3

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 FY09 are described in this section. This analysis excludes recycled items and wastes from remediation activities since remediation wastes are discussed in section 6.0. High explosives (HE) waste and HE waste waters are treated on site, and these are also excluded. Spent research and production chemicals make up the largest number of hazardous waste items. The breakdown of various components of hazardous waste for FY09 is shown in Figure 3-4.

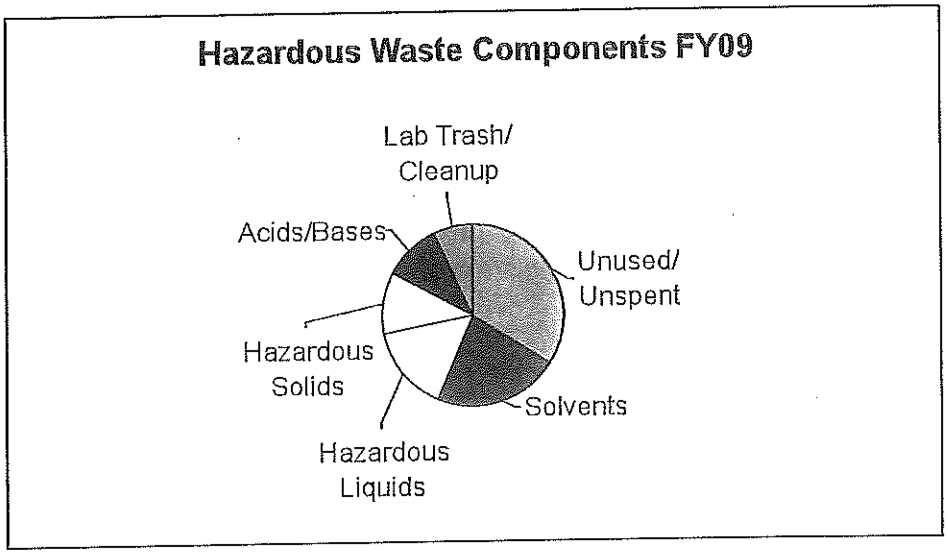

Figure 3-4. FY09 hazardous waste stream components excluding remediation waste

Solvents. EPA-listed and characteristic solvents and solvent-water mixtures are used widely in research, maintenance, and production operations. Non-toxic replacements for solvents are used whenever possible, and new procedures are adopted when possible that either require less solvent than before or eliminate the need for solvent altogether. As a result, the total volume of solvents generated has decreased over the past decade. However, solvents are still required for many procedures, such as high-performance liquid chromatography, and solvents persist as a large component of the hazardous waste stream.

Unused/Unspent Chemicals. The volume of unused and unspent chemicals varies each year, but this waste stream usually comprises a significant fraction of the total hazardous waste. Researchers are encouraged not to buy more of any chemical than they are certain to need for several months to avoid having any unused amount. Efforts to "right-size" chemical procurements and share chemicals will be addressed in 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 90% of this waste stream during FY09.

Hazardous Solids. This waste stream includes inert barium simulants used in high explosives research, contaminated equipment, cathode ray tubes, broken leaded glass, and various solid chemical residues from experiments. During FY09, cathode ray tubes made up nearly 50% of this waste stream.

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, and contaminated ferric chloride solution.

Lab Trash and Spill Clean-up. 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. About 20% of this waste stream came from spill cleanup during FY09.

3.4 Hazardous Waste Minimization

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

Lead Inventory and Sharing

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

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

Lead Substitution and Removal

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

During FY09, approximately 793 kg of lead-containing cathode ray tubes from electronic equipment were removed from radiological control areas (RCAs). The tubes were carefully surveyed for contamination, and when none was found, they were sent away for disposal as non-routine hazardous waste. By removing these items from RCAs, the potential for creating MLLW is significantly reduced.

Lead Protection

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

A bench-scale, onsite method is currently used to decontaminate lead, although this practice was used for a few years during the early 1990s. If lead bricks become damaged, they can be sent to an offsite facility for recasting into new bricks or custom shapes. If lead bricks become contaminated, they can be sent to a different offsite facility for surface decontamination.

Non-Hazardous Scintillation Fluid

Non-hazardous scintillation fluid has become commonly used. No hazardous waste or MLLW scintillation fluid was generated during FY09. The shift to the non-hazardous variety of scintillation fluid reflects the desire of LANS to improve safety for its employees and minimize impact to the environment.

Radioactive Waste Segregation

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

Mercury Substitution

One ongoing project is to 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 (MPA) 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 (PMT) Division uses a nitric acid recycling system so that a significant fraction can be reused multiple times instead of becoming waste. Over 3200 kg of ferric chloride solution was sent offsite to be recycled and resold during FY09, and this would otherwise have become hazardous waste.

Base Waste Reduction and Recycling

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

Solvent Waste Reduction and Recycling

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

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

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

- The Material Testing Lab uses a binder oven to test the amount of oil present in samples instead of performing solvent-based extractions. A sample can be weighed initially, baked in the oven, and then weighed again to determine how much oil was baked off from the sample. This improvement project reduces about 400 kg of hazardous waste annually.
- In Bioscience Division, the solvent formamide was eliminated from the preparation process to sequence strands of DNA. Formamide is a suspect teratogen, and employees proved that a water-based solution called TE worked just as well as formamide for resuspending DNA prior to sequencing. Eliminating formamide reduces hazardous waste solvent and lab trash. The NNSA gave this project a Best-in-Class Pollution Prevention award in 2004.
- The Chemistry Division organic synthesis team once performed experimental chemical synthesis activities in large glassware (25 mL to 2 L) reaction vessels. Now the researchers use reaction vessels of 5 mL or less, which greatly reduces the volume of solvent used. Typical solvents include toluene, methylene chloride, tetrahydrofuran, and ethanol.
- One laboratory in Bioscience Division installed a solvent recovery system for acetonitrile in HPLC waste during FY08. This system is expected to prevent the generation of approximately 55 gallons of hazardous waste solvents per week. An additional solvent recovery system was installed in Bioscience Division in FY09.
- The LANS protective forces subcontractor moved from a hazardous gun-cleaner to a non-hazardous cleaning solution in FY 06. They are testing a plant-based gun cleaner in FY09-10 called Gunzilla as part of their continuous improvement efforts.

Coolant Waste Reduction and Recycling

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

Lead-Free Ammunition

Lead is a persistent, bioaccumulative toxin in the environment. Historically, the security contractor, Special Operations Consulting (SOC), has used traditional lead-containing bullets during training exercises at the small-arms range. Current "lead-free" bullets still have lead in the primary explosive needed to fire the bullet, and this lead becomes airborne and settles into the environment. A lead-free ammunition project purchased 100,000 rounds of frangible lead-free ammunition for use in handguns during training exercises. SOC used the lead-free bullets during the first training course in 2006.

3.5 Barriers to Hazardous Waste Minimization

The largest component of the hazardous waste stream during FY09 was unused and unspent chemicals. Full or partially used bottles of chemicals or other products are sent for disposal once they have expired. If a research project is discontinued, the scientists may no longer need some of the chemicals that were allocated to that project. In some cases of project discontinuation, usable chemicals are distributed to other researchers in the same building who can use them.

Chemical pharmacies have been attempted onsite but distance between research facilities and researcher concerns about purity have limited the success of such programs. Chemical sharing by researchers in close proximity to each other has been encouraged and has been successful. In FY10, a "virtual" chemical pharmacy and locally sponsored pharmacies will be piloted.

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

4.0 Mixed Transuranic Waste

4.1 Introduction

MTRU waste has the same definition as TRU waste, except that it also contains hazardous waste regulated under RCRA. Transuranic (TRU) waste is waste containing >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 (HLW); (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 Code of Federal Regulations 40 CFR 191; or (3) waste that the United States 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 Environmental Management 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/Defense Programs 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 nonactinide metals. Liquid MTRU is a small percentage of total MTRU, and these wastes are primarily organic liquids.

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

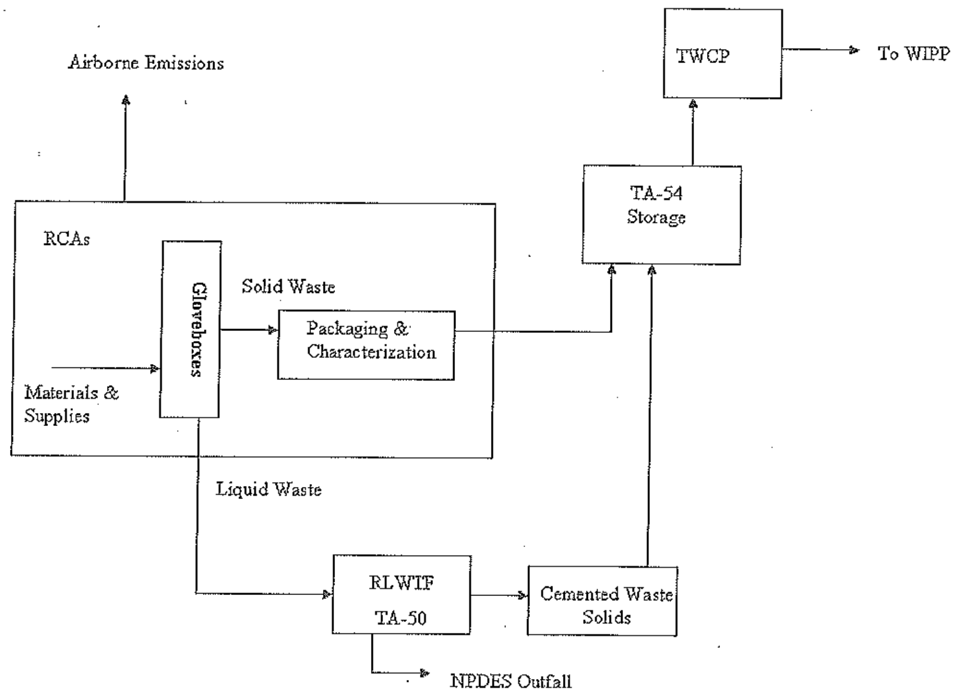

Figure 4-1. Top-level MTRU waste process map and waste streams

Typically, research production materials and supplies are brought into an RCA and introduced into a glovebox. Waste leaves the glovebox in the form of either solid or liquid wastes. 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 liquid is discharged to a NPDES permitted outfall. All waste is processed by the TRU Waste Disposition Project (TWCP in Figure 4-1) prior to shipment to WIPP.

During FY09, the routine and non-routine MTRU waste was generated by the groups at TA-55, Chemistry Division, and by the Offsite Source Recovery program as a result of ongoing operations. The Waste Services Division repackaged some of this MTRU waste so that WIPP acceptance criteria were fulfilled. The Waste and Environmental Services Division generated MTRU cleanup waste in FY09, and this is discussed in section 6.0.

4.2 MTRU Waste Minimization Performance

LANS shipped offsite 92,186 kg of MTRU waste during FY09. This is considerably more than the 48,263 kg of MTRU shipped during FY08, and most of this was due to increased repackaging activities. During FY09, repackaging activities generated 85,905 kg of MTRU. Programmatic work that generates MTRU occurs at TA-55 and TA-3, and during FY09 these activities generated 6281 kg of MTRU. No MTRU remediation waste was generated during FY09.

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. An unusually large percentage of the overall volume of operational MTRU generated during FY09 was non-SNM (Special Nuclear Material) metal, and some of this resulted from clean-out activities. The percentage breakdown of operational MTRU generated during FY09 is shown in Figure 4-2.

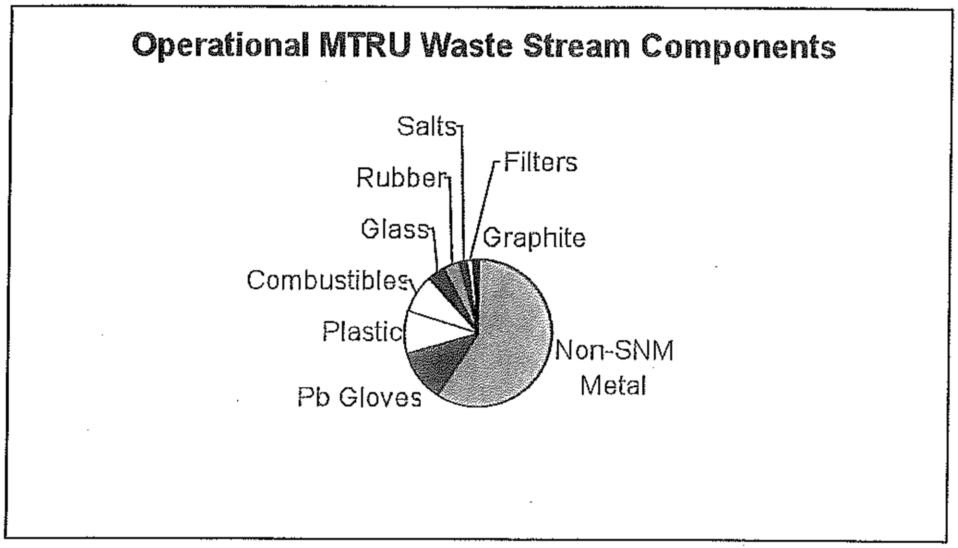

Figure 4-2. Composition of operational MTRU waste by volume for FY09

Combustible Wastes. Combustible wastes comprised about 8% of the operational MTRU waste generated during FY09. Combustible waste comprises mostly plastic bags, plastic reagent bottles, plastic-sheets used for contamination barriers, cheesecloth, gloves, protective clothing worn by workers, and a small volume of organic chemicals and oils. The combustible solids are contaminated with hazardous chemicals such as solvents or lead.

Noncombustible MTRU Waste. Noncombustible MTRU waste includes glass, filters, graphite, plastic, rubber, ceramics, ash, metals, and lead-lined gloves.

Nonactinide Metals. Nonactinide metals are any metallic waste constituents that may be contaminated with, but are not fabricated out of, actinide metals. During FY09, approximately 57% of the operational MTRU generated was non-SNM metal. Metallic wastes typically include tools, process equipment, facility piping and supports, and ventilation ducting. Significant volumes of metallic waste are generated under the following conditions: (1) when gloveboxes have reached the end of their useful life, (2) when processes within the facility and glovebox are changed, (3) when routine and non-routine maintenance activities are completed, and (4) as facility construction projects are implemented to meet new programmatic missions.

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 Radiological Control Areas 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-RRO 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 with unleaded gloves were replaced in FY09. This effort will be expanded in FY10.

4.5 Barriers to MTRU Minimization

Packaging requirements at WIPP often make minimization efforts difficult. There are wattage limits and dose limits that must not be exceeded, and a very small volume of MTRU could potentially have a high wattage. All of the containers sent to WIPP are 55 gallons or larger, but often the containers have very small volumes of waste inside and the majority of the internal volume of the container is air. However, it is the external volume of the container that is recorded for reporting purposes.

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 HLW, 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 management 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.

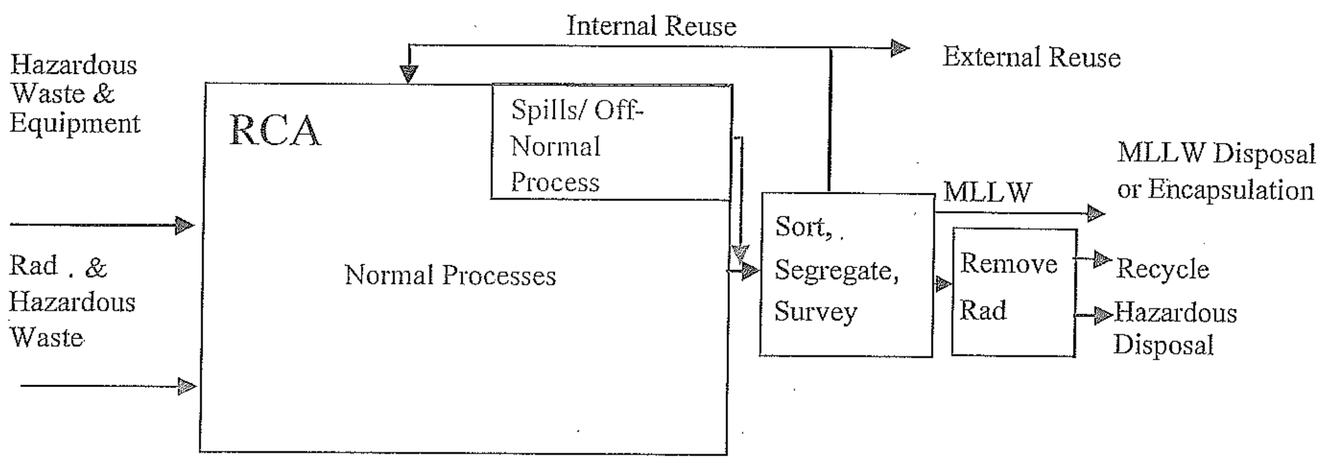

Figure 5-1. Top-level MLLW process map

Figure 5-2 shows MLLW generation by division generated during FY09, excluding MLLW from remediation work.

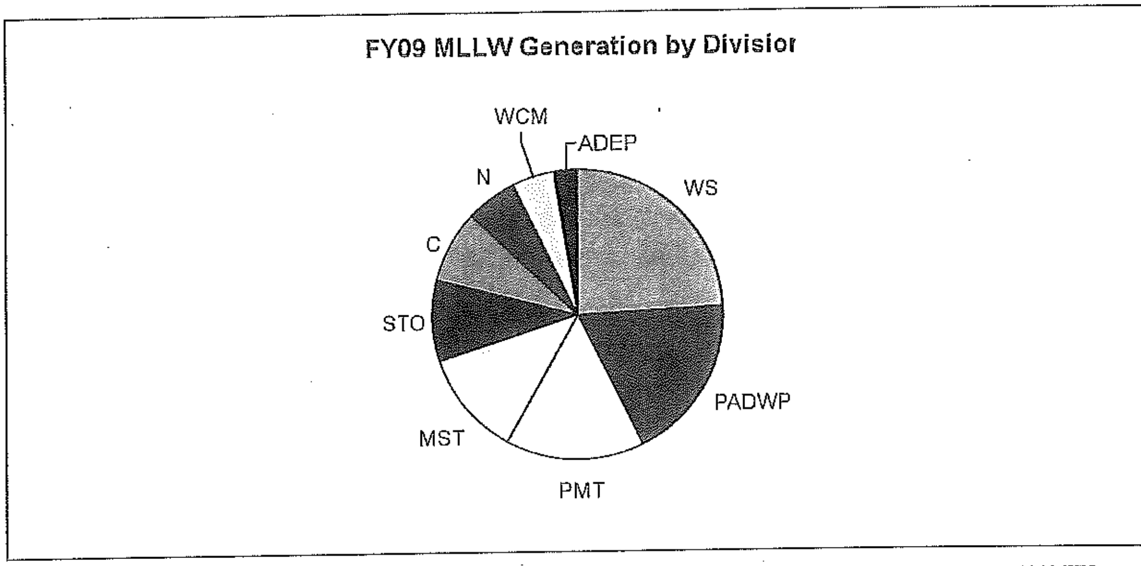

Figure 5-2. Total MLLW generated by division in FY09, excluding MLLW generated by remediation work.

The divisions that generated the most routine and non-routine MLLW during FY09 were Maintenance and Site Services (MSS), Waste Services (WS), the Principal Associate Directorate of Weapons Physics (PADWP), Plutonium Manufacturing and Technology (PMT), and Materials Science and Technology (MST).

5.2 MLLW Waste Minimization Performance

MLLW generation for FY09 was 8,134 kg, excluding MLLW generated from remediation work. This is about 30% more than the 6,275 kg of MLLW generated from non-remediation activities during FY08. Remediation work performed during FY09 generated 195,966 kg of MLLW, and 129,928 kg of this waste was cemented sludge from the Radioactive Liquid Waste Treatment Facility (RLWTF). Another 65,498 kg was waste that had been previously classified as MTRU waste but now qualifies as MLLW and was reclassified as such. The other 540 kg of remediation waste is discussed in greater detail in section 6.0. Figure 5-3 shows the breakdown of all MLLW generated during FY09 by division, excluding RLWTF waste and the reclassified waste.

Table 5-1. Generation of MLLW by Division during FY09.

Division	MLLW in Kilograms
Maintenance and Site Services	2325
Waste Services	1344
Principal Associate Directorate of Weapons Physics	1034
Plutonium Manufacturing and Technology	863
Materials Science and Technology	656
Science and Technology Operations	523
Chemistry	448

Nuclear Nonproliferation	310
Weapons Component Manufacturing	252
Associate Directorate for Environmental Programs	147
Waste and Environmental Services	114
Radioactive Liquid Waste Treatment Facility	63
Materials Physics and Applications	47
Hydrodynamic Experiments	6

MLLW is generated by routine programmatic work, remediation activities, lab cleanup activities, and decontamination 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 the 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.

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

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

The largest components of the routine and non-routine MLLW stream by weight are reclassified MTRU, sludge, electronics, lead debris, lab trash, spent nitric acid, remediation waste, and oil. Lower MLLW generation is anticipated in the future as environmental restorations are completed, as non-toxic 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.

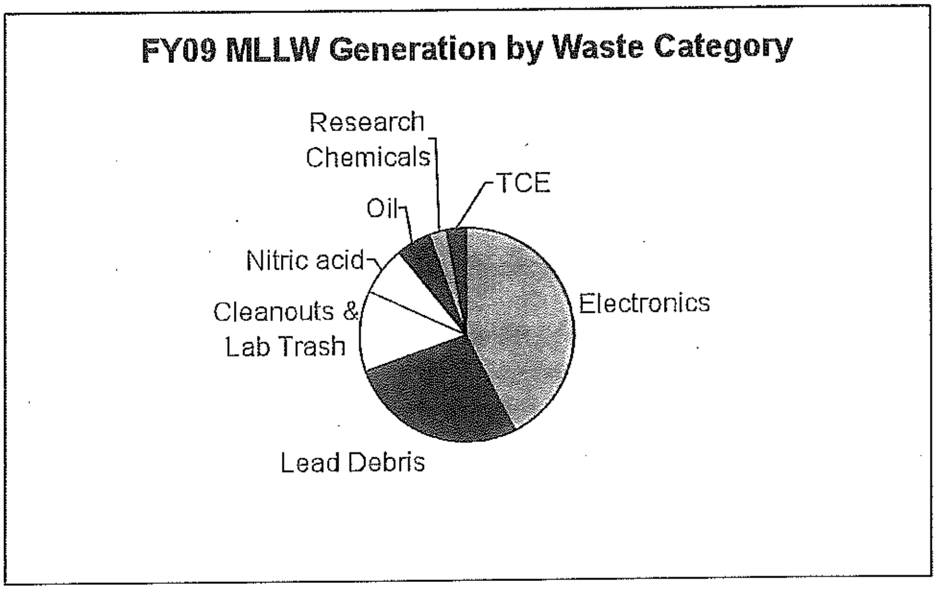

Figure 5-3. Constituents of MLLW in FY09, excluding MLLW generated by remediation work.

Sludges. This waste stream consists of cemented waste sludges from the Radioactive Liquid Waste Treatment Plant. Some of this waste attributed to FY09 is cemented waste that was previously classified as MTRU and was reclassified as MLLW during FY09.

Lead Debris. The lead debris waste stream includes copper pipes with lead solder, lead-contaminated equipment, bricks, sheets, rags and PPE contaminated with lead from maintenance activities.

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

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

Used Oil. The oil in the MLLW stream primarily comes from oil changes in vacuum pumps within RCAs. As more oil-free vacuum pumps are installed, this MLLW stream should diminish.

Research Chemicals and Lab Trash. This waste is composed of unused/unspent chemicals that have become contaminated in RCAs, analytical chemistry waste, gloves, PPE, dry painting debris, and paper towels. During FY09, many divisions cleaned out unwanted chemicals from RCAs and/or had painting work done in RCAs.

Nitric Acid. This spent nitric acid was generated by the Materials Science and Technology division when they emptied a pickling bath that had been used for work with depleted uranium. This acid could not be recycled due to the nature of the metal. This was non-routine work, and this waste stream does not occur every year.

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 bio-assay wastes. During FY09, money from the GSAF fund was used to pay for projects designed to reduce the generation of MLLW waste. These projects are described in section 2.5.1 of this report.

One especially promising pilot project that started during FY07 involved replacing traditional fluorescent fixtures with light-emitting diode (LED) fixtures in gloveboxes. The LED lights do not contain any RCRA-regulated components, so after their useful life, they will not become MLLW as fluorescent lights do. The LEDs are much smaller and lighter than fluorescents, and the LEDs last longer, use less electricity, and generate less heat than fluorescents. During FY08 and FY09, the groups at TA-55 purchased more LED lights for gloveboxes. During FY09, there were very few fluorescent bulbs disposed of as MLLW.

5.5 Barriers to MLLW Reduction

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

6.0 Remediation Waste

6.1 Introduction

Section 6.0 represents the WMin/PP awareness plan for the corrective actions component of the Environmental Program Directorate (EP). This component includes the Waste and Environmental Services (WES) Division, Corrective Action Projects (EP-CAP), TA-21 Closure Project (EP-TA21), and LANL Water Stewardship Project (EP-LWSP).

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 the March 1, 2005, Compliance Order on Consent (hereafter, Consent Order) between the NMED, DOE, and UC. 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 on-site or off-site waste treatment, storage, or disposal, and the desire to minimize the associated liability.

6.2 Remediation Waste Minimization Performance

The FY09 waste generation and waste minimization summary is listed in Table 6-1.

Table 6-1. FY09 Waste generation summary

Waste Type	Weight in Kilograms
Solid Hazardous	*108,492*
Solid MLLW	540
Solid Mixed TRU	0

Project activities in FY09 involved investigations, including well installation, and cleanup, including removal of contaminated soil, debris, and wastes.

6.3 Waste Stream Analysis

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

The majority of FY09 waste generation was the result of investigations, including well installation, and focused corrective actions. Investigations, corrective actions, and other activities implemented pursuant to the Consent Order included:

- Investigations and corrective actions for Middle Cañada del Buey Aggregate Area, North Ancho Aggregate Area, , Upper Mortandad Canyon Aggregate Area, Bayo Canyon Aggregate Area; DP Site Aggregate Area; and Upper Los Alamos Canyon Aggregate Area
- Excavation of MDA Y and one other subsurface disposal site at TA-39
- Initiation of the Surface Corrective Measures Implementation (CMI) at the 260 Outfall at TA-16
- Removal of contaminated soils and sediments from Bayo Canyon and the 30s and 90s Line Ponds at TA-16
- Preparation for cleanup activities at MDA B, including installation of an access road and direct push sampling
- Surveys and removal of ordnance and asphalt debris in Guaje, Barrancas, and Rendija Canyons,
- Subsurface vapor monitoring at MDAs G, H, and L
- Subsurface investigations and borehole drilling at MDAs A and T in TA-21 and MDA C in TA-50
- Plugging and abandonment of monitoring wells at SWMU 03-010(a) and AOC 03-001(e) and in Mortandad Canyon
- Implementation of periodic groundwater monitoring in Ancho, Los Alamos, Mortandad, Pajarito, Sandia, Water, and White Rock Canyons
- Drilling and development of Regional Wells R-25b, R-37, R-38, R-39, R-40, R-41, R-42, R-43, R-44, R-45, R-46, R-48, and R-49
- Drilling and development of Intermediate Wells 53-1i, PCI-2, R-40(i), and SCI-2

6.4 Remediation Waste Minimization

WMin/PP was an integral part of the FY09 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 WMin/PP 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 techniques used in FY09 to reduce investigation-related waste streams led to the following accomplishments:

- Dry decontamination techniques were used almost exclusively during field investigations, thereby eliminating generation of liquid decontamination wastes.
- The formal procedure for land application of the groundwater extracted during well drilling, development, sampling, and rehabilitation developed by ENV-RCRA in FY08 continue to be implemented. Drilling, development, and purge waters constitute a major potential waste source for EP-LWSP (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 335,220 gal. of purge water was land applied during FY09.
- 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-LWSP. 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 275 cubic yards of drill cuttings were land applied by EP-LWSP during FY09 and an additional 288 cubic yards were land applied by EP-CAP at MDA C in TA-50.
- Hand methods for sample collection were used instead of mechanical drilling methods during the Upper Los Alamos Canyon Aggregate Area investigation at sites within the Los Alamos Townsite. These methods were used to minimize disruption to residents and businesses and minimize the amount of waste generated. In addition, the Green is Clean program was implemented to dispose of investigation-derived LLW.
- Natural materials were beneficially reused as storm water best management practices (BMPs) when constructing the haul road associated with the cleanup of MDA B at TA-21. Rather than installing approximately 2600 ft of engineered silt fence material, logs and rocks left in place after site preparation activities were used to construct detention ponds, sediment containment berms, check dams, and runoff diversion berms. In addition to avoiding having to dispose of these materials, this approach also avoiding having to dispose of silt fence material at the conclusion of the project.
- Material reuse, recycling, and substitution was used at the Delta-Prime Site Aggregate Area project at TA-21 to minimize waste associated with remediation of twenty-two SWMUs and AOCs across the TA-21 site. During the project, approximately 2,420 cubic yards of clean overburden soil was segregated and reused as backfill material. Reuse of the overburden soil eliminated the need for this material to be processed as waste. To control dust and minimize runoff, the overburden stockpiles were originally covered with plastic sheeting. The plastic sheeting was replaced with magnesium chloride, a non-toxic, non-hazardous substance, and resulted in 40 cubic yards of industrial waste avoidance.

Additionally, a large metal tank, found to be free of radiological and hazardous constituents, was sent to a metal recycler. This resulted in another 20 cubic yards of industrial waste avoidance. Land application of non-hazardous overburden meeting residential screening levels was used at other sites, as well, to minimize waste generation. A total of 4065 cubic yards of this material was land applied during FY09.

Sort, Decontaminate, and Segregate

This task is currently being implemented and is designed to segregate contaminated and noncontaminated soils so that noncontaminated soils can be reused as fill. These practices are implemented at sites where contaminated subsurface soils and structures are overlain by uncontaminated soils. During excavation to remove the contaminated soils and structures, the uncontaminated overburden is segregated and staged apart from contaminated materials. Following removal of the contaminated soils and structures, the overburden is tested to verify that it is non-hazardous 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.

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 will reduce the volume of LLW from corrective actions activities. Waste management coordinators will be trained in the occupational radiation protection requirements.

Risk Assessment

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

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 intiated, 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 WMin/PP practices into future activities has also been evaluated. Several actions related to WMin/PP have been incorporated into the FY10 Environmental Action Plan for EP developed as part of the EMS. These planned actions are summarized below.

- A number of remedial activities are planned for TA-21, and ADEP has established a goal of minimizing the amount of waste generated from these activities. Several actions have been identified to accomplish this goal. Overburden and excavation spoils that are expected to be uncontaminated, will be segregated from soil and waste excavated from contaminated areas. This overburden will be sampled to determine whether it is nonhazardous and meets residential soil screening levels. If so, this soil can be used to backfill excavations. Uncontaminated metals from D&D activities will be segregated and recycled. In addition, sanitary wastes will be segregated from other waste streams to reduce the volume of these waste streams.
- A significant amount of well drilling will be conducted during FY10. LANS will continue to implement the formal procedures developed during FY08 that allow land application of groundwater and drill cuttings when this is protective of human health and the environment. ADEP has established a goal of managing all non-hazardous purge water and drill cuttings from all well drilling activities by on-site land application.
- To help improve the implementation of waste minimization activities, ADEP has established a goal of ensuring communication of environmental issues to project participants. Environmental issues will 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] May 1993 US Environmental Protection Agency (EPA) interim final guidance, 58 F.R. 10, "Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program."

[iii] DOE (US Department of Energy), 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.