Report

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NATIONAL LABORATORY
EST. 1943

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Risk Reduction Office (ENV-RRO)
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Date: November 26, 2007
Refer To: ENV-RRO: 07-050

HAND DELIVERY

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MED Hazardous Waste Bureau

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: 2007 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, 2007 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
Office Leader

DH/bb

Enclosures: a/s

31396

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Document: Hazardous Waste Minimization Report
Date: November 2007

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.

Richard S. Watkins
Associate Director
Environment, Safety, Health, and Quality Directorate
Los Alamos National Laboratory

11/20/07
Date Signed

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

11/27/07
Date Signed

LA-UR-07-7504

November 2007

Los Alamos National Laboratory
Hazardous Waste Minimization Report

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Associate Director
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_____ _____

Dennis L. Hjeresen
Office Leader
Environmental Protection Division
Risk Reduction Office
Los Alamos National Laboratory

Date Signed

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Date: November 2007

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_____ _____

Victoria A. George
Division Leader
Environmental Protection Division
Los Alamos National Laboratory

Date Signed

Document: Hazardous Waste Minimization Report
Date: November 2007

INTERNAL CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared in accordance with the requirements of Module VIII, Section B.1 of the Laboratory's Hazardous Waste Facility Permit (NM0890010515-1). I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Anthony R. Grieggs
Group Leader
Environmental Protection Division
Water Quality and RCRA
Los Alamos National Laboratory

Date Signed

Document: Hazardous Waste Minimization Plan
Date: November 2007

INTERNAL 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.

_____ _____

Susan G. Stiger
Associate Director
Environmental Programs Directorate
Los Alamos National Laboratory

Date Signed

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1.0 Hazardous Waste Minimization Plan

1.1 Introduction

Waste minimization is an inherent goal within all the operating procedures of the Los Alamos National Laboratory (the Laboratory). The US Department of Energy (DOE) and the Laboratory are required to submit an annual waste minimization plan to the New Mexico Environment Department (NMED) in accordance with the Laboratory's Hazardous Waste Facility Permit. This plan describes the Laboratory-wide 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. The plan was prepared pursuant to the requirements of Module VIII, Section B.1, of the Laboratory's Hazardous Waste Facility Permit (NM0890010515-1).

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 encouraging source reduction or 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 450.1, Revision 2 (Environmental Protection Program), which has been accepted into the Laboratory contract. DOE Order 450.1 requirements are executed through the Laboratory's Environmental Management System (EMS). The Laboratory's EMS received third-party registration to the International Organization of Standardization ISO 14001:2004 standard in April 2006. Pollution prevention and waste minimization are required elements of the ISO 14001:2004 standard and are evident throughout the EMS.

The primary regulatory driver for corrective actions is the New Mexico Environment Department Order on Consent signed March 1, 2005, which contains specific requirements for investigating and, as necessary, remediating releases of contaminants at the Laboratory. Specific requirements in the Consent Order include those for management of investigation-derived waste.

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 13243 - Strengthening Federal Environmental, Energy, and Transportation Management

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 450.1 Change 2, "Environmental Protection Program"
- Secretary of Energy Notice 37-92, "Waste Minimization Policy Statement"
- DOE Pollution Prevention Program Plan, 1996

Los Alamos National Laboratory Directives and Policies

- Laboratory Governing Policy
- IPP Environmental Protection
- IMP 401 Procedure to Identify, Communicate, and Implement Environmental Requirements
- IMP 402 Environmental Communication Procedure
- IMP 403 Environmental Aspects Communication Requirements
- IMP 404 National Environmental Policy Act (NEPA), Cultural Resources and Biological Resources Reviews
- LIR 404-10-01 Air Quality Reviews
- LIR 404-50-10 Water Ollution Control
- Los Alamos National Laboratory, Laboratory Implementation Requirement LIR 404-00-02.3, "General Waste Management Requirements"
- Los Alamos National Laboratory, Laboratory Implementation Requirement LIR 404-00-04.2, "Managing Solid Waste"
- Los Alamos National Laboratory, Laboratory Implementation Requirement LIR 404-00-05.3, "Managing Radioactive Waste"

1.3 Purpose and Scope

The purpose of this plan is to document the Laboratory's approach for minimizing hazardous and mixed wastes. This plan discusses the methods and activities that will be routinely employed to prevent or reduce waste generation in the fiscal year 2008 (FY08), and the plan reports FY07 waste generation quantities and significant waste minimization accomplishments for FY07. This plan also discusses the Laboratory Director's commitment to waste minimization and pollution prevention; provides a discussion of specific elements of the ENV-RRO and EP WMin/PP programs; and discusses 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 Laboratory's 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, 6.0

Section B.1.(a)(2)	Employee Training	Sections 2.2, 6.0
Section B.1.(a)(2)	Incentives	Sections 2.2, 6.0
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, 6.0
Section B.1.(a)(10)(d)	Lead Decontamination	Sections 3.4, 6.0
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. Los Alamos National Laboratory Hazardous Waste Facility Permit, Module VIII, Section B.1

1.5 Organizational Structure and Staff Responsibilities

The Laboratory Director, the Environmental Senior Management Steering Committee, and the Associate Director for Environment, Safety, Health, and Quality have oversight responsibilities and provide annual review of the Laboratory-wide EMS, WMin/PP Program goals, and performance. The Environmental Protection Division (ENV) has primary responsibility for the Laboratory-wide WMin/PP Program. 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 Laboratory-wide 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 waste generation trends and WMin/PP successes and lessons

learned; assistance in preparing funding applications and proposals for WMin/PP projects; and assistance in overcoming WMin/PP implementation barriers.

In terms of remediation waste, the corrective action process is designed to prevent or reduce the generation of waste, as much as is technically and economically feasible, consistent with the mission of corrective actions and in compliance with Consent Order requirements.

Support for pollution prevention and waste minimization programs is documented in the Laboratory's EMS and in its waste management requirements. Waste minimization is also included in the applicable corrective actions operating procedures used to implement program and project-specific activities.

Corrective action activities fully support the Laboratory's written WMin/PP policies, programs, and commitments. The activities are designed to give preference to practices that lead to and result in source reduction, improved segregation and characterization, and environmentally sound recycling practices regarding waste treatment and disposal techniques. This is accomplished to the degree determined to be economically practicable and consistent with mission and compliance requirements. The corrective action process will continue placing a priority on allocating sufficient resources to pursue the goals and approaches established by this plan and will coordinate with the Pollution Prevention team as necessary.

2.0 Laboratory Waste Minimization Program Elements

2.1 Laboratory Governing Policy on Environment

The Laboratory has developed a prevention-based EMS, which was third-party certified to the ISO 14001:2004 standard in April 2006 by NSF-ISR. As part of the EMS, the Laboratory Governing Policy contains the Laboratory's official policy on environment. This policy is the basis for setting annual environmental targets and objectives.

The following is the Laboratory's environmental policy statement:

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 07 EMS Institutional Objectives

The Senior Management Environmental Steering Committee established the following objectives as part of the EMS:

1. Conduct the Laboratory mission while demonstrating rigorous compliance with Federal and State environmental regulations and permits.
2. Reduce the volume of hazardous and radioactive waste generated at the Laboratory.
3. Improve Laboratory-wide energy and fuel conservation.
4. Achieve zero liquid discharge by 2012. Ensure compliance with the Laboratory's NPDES outfall permit by eliminating discharges to the environment.
5. Effectively manage waste, excess materials and equipment generated during historical, current and future Laboratory operations. Disposition unneeded chemicals and equipment by the end of FY11.

2.2 Employee Training and Incentive Programs

Several employee training and incentive programs exist at the Laboratory to identify and implement opportunities for recycling and source reduction of various waste types. The General Employee Training course, which is mandatory for all Laboratory employees upon being hired, describes recycling policies at the Laboratory and instructs employees on ways to minimize the volume of solid waste generated at the Laboratory. The Waste Generator Overview course, which is mandatory for all employees who generate waste, includes a section on hazardous waste minimization. The Radworker II course, which is mandatory for all employees who come in contact with radioactive wastes, includes sections on minimization of low-level (LLW), MLLW , and transuranic (TRU) waste. Employees who take Waste Generator Overview or Radworker II must repeat these courses periodically to learn about any new developments or requirements. As part of the EMS implementation at the Laboratory, the EMS Environmental Awareness Training for

Workers module was developed and features pollution prevention as a key mechanism for environmental management. All Laboratory employees are required to complete this awareness module and take a refresher course annually.

The Laboratory 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 Implementation Procedure (IMP 300-3).

Another management program in place at the Laboratory is the Permits and Requirements Identification (PR-ID) process. This is a tool to assist Laboratory personnel in identifying, managing, and complying with environment, safety, and health Laboratory Implementation Requirements that may impact project planning and execution. This process incorporates the evaluation of potential waste-generating activities before project startup and includes review by WMin/PP subject-matter experts.

The Laboratory's ENV-RRO Program and DOE-EH 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. The Laboratory submits nominations for the DOE/NNSA Headquarters awards each year. The Laboratory received seven awards for pollution prevention projects during FY07 from DOE/NNSA, including two Best-in-Class awards. The winning projects are described below.

- Slip Top Can Reduction - The Slip Top Can Reduction Project prevented 11,000 containers at the Lab from becoming useless and thereby reduced TRU waste, saved time, reduced worker exposure, and avoided about $1.4 million in costs. Slip top cans that the Laboratory uses to store TRU waste did not meet new standards for pressure relief and were going to be replaced until this team was able to solve the problem by replacing only the lids.

- Environmentally-Friendly Primary Explosives - The Green Primaries group invented a new set of primary explosives that do not contain toxic components and do not create hazardous waste during manufacturing or use. Once the new primaries are in widespread use, the project has the potential to eliminate thousands of pounds of lead use and environmental dispersion of lead. The new primaries increase the safety of those who routinely handle primaries. This R&D breakthrough has widespread applications in the commercial world including construction, demolition, mining and other explosives applications.

- Institutional Improvement Projects Developed from the Environmental Management System - The materials disposition project and the chemical life cycle project, two projects identified by the Environmental Management System, help the Laboratory minimize the accumulation and storage of unneeded materials. The materials disposition project helped ensure materials were salvaged and recycled during the cleanout of TA-59, while the chemical life cycle team streamlined

chemical procurement and created a database of alternatives to twenty-four high hazard chemicals.

- Power Grid Infrastructure Upgrades Transmission Line - The innovative use of materials during a power transmission line construction project, which required new utility poles and the disturbance of twenty-five acres of ground, saved $72,000. In order to comply with regulatory requirements, log and rock displaced during the project were used for sediment control. In addition, ninety cubic yards of wood mulch from the Los Alamos County landfill was used to stabilize three acres of the project from March until May.

- Removal and Asset Recovery of a Copper-Lined Faraday Cage - A pilot program for the removal of a copper Faraday cage from TA-39 saved $21,611 and allowed for the recycling of 1,400 pounds of copper. The project was managed as a deactivation and decommissioning project rather than a remodeling project. The value of the copper offset the majority of the cost of the deactivation and decommissioning work. Re-categorizing the project allowed for earlier completion of the work.

- Improvements to the Plutonium Electrorefining Process - The cathode used in the plutonium electrorefining process was redesigned to eliminate cathode failure. This improvement reduced the need to reprocess material, which decreased the waste generated by a factor of three. The new cathode saves fifteen days of labor, $18,450 in disposal costs, and prevents the generation of excess liquid and solid TRU waste.

- Low-Level Waste Minimization at DARHT - The DARHT facility at TA-15 implemented several new practices to reduce the amount of beryllium-contaminated LLW generated during explosive diagnostic experiments. The new process reduces low-level waste generation, saves more than $60,000 in waste disposal costs each year, and reduces the turnaround time between shots. The staff minimized the amount of material entering the test area, reused equipment, and began to use water bladders to minimize the amount of waste generated.

The Pollution Prevention team holds a Pollution Prevention award ceremony every year in conjunction with other Earth Day activities. Laboratory employees submit descriptions of projects they completed during the past year that reduced waste generation at the Laboratory. Each participating team is recognized by senior management with an award certificate. Winning LANS employees also receive a cash bonus. During FY07, the Pollution Prevention team gave over 200 awards to people who worked on 40 projects to reduce waste generation, improve efficiency, and conserve resources at the Laboratory. In FY07, the Pollution Prevention team helped to coordinate a Laboratory-wide participation event called "The Great Garbage Grab" to clean up trash at the Laboratory in April to coincide with Earth Day. In FY 07, Pollution Prevention Projects resulted in cost avoidances of approximately $18.4 million dollars.

Each year the Pollution Prevention team invites waste generators to submit proposals for funds to buy new equipment or validate new processes that are expected to reduce waste. The program is known as the Generator Set-Aside Fee (GSAF) program, and the funds for these grants are collected by means of a small tax on the generation of each unit of waste. The Pollution Prevention Team coordinates the peer review of GSAF proposals and distributes the available funds to the projects. If there is not enough money in a given year to fund all of the proposals, the projects are prioritized based on the amount and type of waste that could be reduced. Estimated returns on investment are calculated, and the projects with the highest projected returns are funded first. Projects that have the potential to continually reduce waste for many years into the future are given priority funding.

In addition to the positive financial incentive for researchers to try promising new equipment or procedures that might reduce waste, the GSAF program also acts as a financial disincentive to creating waste because programs must pay a tax on all waste generated. Taxes and disposal fees will be lower by reducing the amount of waste produced, so the GSAF program gives researchers multiple reasons to minimize waste.

2.3 External Sources of Information

The Pollution Prevention team members at the Laboratory are active in other organizations dedicated to the reduction of various types of waste, and some of the information used in ideas implemented at the Laboratory 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.

Several team members belong to the New Mexico Recycling Coalition, and one serves on their Board. One team member is chair of the Los Alamos County Solid Waste Advisory Board. Several team members belong to the National Registry of Environmental Professionals.

Pollution Prevention Team members attend conferences and meetings on pollution prevention and sustainable design sponsored by DOE, the National Recycling Coalition, the National Pollution Prevention Roundtable, the US Green Building Council and other organizations and makes use of their websites and publications. The Laboratory also participates in pollution prevention, affirmative procurement, and electronics recycling conference calls hosted by DOE. The Pollution Prevention team also holds a quarterly program review with DOE Pollution Prevention staff. The Pollution Prevention team relies on Internet information resources such as:

- US Green Building Council
- EPA, P2Rx
- DOE, Remedial Action Project Information Center, Oak Ridge, Tennessee
- DOE, EPIC (the DOE Pollution Prevention Information Clearinghouse), Pacific Northwest National Laboratory, Richland, Washington

- EPA, Superfund Innovative Technology Evaluation (SITE) Database
- 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
- State of Kentucky, Kentucky Pollution Prevention Center Web Site
- DOE Oak Ridge National Laboratory, ORNL Pollution Prevention Web Site

Waste minimization information from these sources is routinely distributed through Laboratory-wide Enviro-Grams, which are email summaries of specific problems and proposed alternatives. Approximately 25 Enviro-Grams were distributed in FY07.

2.4 Utilization and Justification for the Use of Hazardous Materials

The Laboratory is a research and development (R&D) facility that executes thousands of projects requiring the use of chemicals or materials that may create hazardous waste. The Laboratory has established pollution prevention and waste minimization requirements 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 across the Laboratory. 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 by researchers at the Massachusetts Institute of Technology. The database contains possible alternatives to some hazardous chemicals for particular processes. Everyone at the Laboratory has access to the database of non-toxic or less hazardous alternative chemicals.

2.5 Investigation of Additional Waste Minimization and Pollution Prevention Efforts

The Pollution Prevention team is constantly looking for new projects to implement that have the potential to reduce waste generation or increase recycling at the Laboratory. Incorporation of prevention into the EMS has significantly increased prevention and waste minimization awareness, and divisions are actively seeking pollution prevention support. The GSAF program is an ongoing program that provides funds to researchers for equipment or validation of new procedures that have the potential to reduce waste generation. The funds cover capital expenditures and frequently cover a portion of the installation and/or operating expenses as well. The ideas for waste reduction often come directly from waste generators or waste management coordinators, and the Pollution Prevention team also develops many of the project ideas. Pollution Prevention team members provide engineering support to waste generators in the implementation of these projects.

During FY07, each directorate at the Laboratory 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 (PPOA) to analyze waste generating processes and develop prevention alternatives. In FY07, the following PPOAs were completed:

- Tracking Ammonia/Nitrogen in the Industrial/LLW Influent to RLWTF: This PPOA examined potential sources of ammonia and nitrogen-containing compounds that enter the Radioactive Liquid Waste Treatment Facility (RLWTF)
- Reducing Organic Bearing Waste Discharged to the RLWTF: This PPOA looked for ways to reduce the volume of organic compounds received at the RLWTF
- Recycling Program Operational Improvements: This PPOA looked for ways to improve recycling at the Laboratory
- 1L Service Area at TA-53: This PPOA examined methods for reducing the amount of solid LLW generated at the 1L Service Area at TA-53
- Low-Level Waste at TA-53: This PPOA looked at all generating sources of LLW at TA-53 to identify waste reduction targets

2.5.1 Funded Projects

The following lists are titles of 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 lists only represent projects that were designed to reduce hazardous, MLLW, or mixed TRU (MTRU) waste.

In FY2002, GSAF funds were allocated to the following projects:

- Organic Destruction of DX Waste Stream ($50,000)

  This project will demonstrate the viability of Advanced Oxidative Processes (AOP) to decompose organic materials, in particular high explosives (HE), developmental HE, intermediates, degradation products, precursors, and organic solvents, in waste streams produced in the High Explosive Research and Development Facility (TA-9). Advanced Oxidative Processes utilize a combination of UV energy, ozone, catalysis, temperature, and supplemental organic oxidants to decompose organic compounds, to include RDX, HMX, and TNT. Final products include carbon dioxide, nitrate, nitrite, phosphate, and small organic molecules. The second and final phase of this project will install and optimize a production system for TA-9.
- Oil Characterization and Solidification ($50,000)

  TA-55 generates waste oil that must be disposed of as MLLW. The oil is classified as hazardous waste because of heavy metals (lead and cadmium) and because the detection limits of semi-volatile organic compounds are above the regulatory limits. The purpose of this project is to eliminate the disposal of this waste stream as MLLW and develop a pathway for this waste stream to be disposed of as LLW. To

accomplish this, solidification will be implemented to eliminate the heavy metal hazard of the waste.

- Solvent Still Chiller ($6,400)

  This project minimizes waste from spray and brush painting cleanup activities. GSAF funds were used to install a solvent still and chiller for this solvent still. The chiller increases the still's recovery efficiency for reclaiming solvent for reuse and reducing the generation of hazardous waste.

- Binder Ignition Oven for Materials Testing Lab ($10,000)

  The Materials Testing Laboratory tests asphalt content using a chemical solvent to dissolve oil off the asphalt aggregate. This procedure generates hazardous solvent waste. The use of a binder oven replaces the chemical solvent procedure by heating the asphalt to remove oil from the aggregate. The binder oven system eliminates the need to buy, store, and dispose of hazardous chemical solvent. Further, it eliminates potential exposure to the solvent during operations and cuts processing time in half. The increased productivity and quality control offered by the binder oven allows real-time identification of non-conforming material and better overall process management.

- Solidification of Aqueous Liquids ($35,000)

  This project developed a procedure to absorb MTRU brine liquids using a material similar to NoChar. The absorbed liquids were packaged in a WIPP acceptable shipping container. This project created a disposal path for waste that previously had no disposal path.

- LANSCE MLLW Reduction Project ($68,000)

  This project applied sorting and segregation techniques to newly generated waste to minimize the amount of mercury contaminated MLLW generated. Careful management of materials helped to avoid MLLW creation.

- Upgrade of Mercury Shutters ($121,000)

  The Manuel Lujan Neutron Scattering Center produces beams of neutrons to study matter on the atomic scale. These neutron beams are arranged around the neutron source in a radial fashion like the spokes on a wagon wheel. Each beam line has a shutter, which blocks the flow of neutrons so that the experiment caves can be safely entered. The neutron shutter uses several hundred pounds of mercury to block the neutron beam. The major problem is that small amounts of mercury tend to exhaust with the helium when the shutters are closed. Mercury contaminated MLLW is generated during clean-up of mercury exhaust contaminated areas. To solve this problem, LANSCE modified the original shutters.

In FY2003, GSAF funds were allocated to the following projects:

- Pyroclean Oven for Organic Synthesis Laboratory ($17,000)

  The Pyroclean oven is used to clean glassware contaminated with organic residues using only heat to destroy the residues. The oven eliminates the need for solvents and acid to clean the glassware and eliminates the hazardous waste generated by the cleaning process. The laboratory staff can spend their time on more important tasks, and using the oven causes less glass breakage and risk than manual cleaning.

- Chemical Pharmacy ($50,000)

  Chemistry Division piloted a chemical pharmacy in one of their groups. The idea was to generate less hazardous waste by sharing chemicals so that they could be completely used up instead of disposing of partially used chemicals. The idea was successful, and researchers working in close proximity to each other are encouraged to share chemicals whenever possible.

- Cost and Waste Reduction in Ultra-Trace Cleaning Operation ($37,667)

  The Pollution Prevention team purchased an ultra-trace cleaning system to recycle acid used for cleaning laboratory glassware. An estimated 100L per year of hazardous acid waste are now avoided.

- Non-Hazardous Resuspension Solution for DNA Sequencing ($56,632)

  A research team from Bioscience Division tested a non-hazardous substitute for formamide that they developed for preparing DNA for sequencing. By eliminating formamide, no hazardous waste gets generated from the DNA sequencing process.

- Processing of PETN with Supercritical Carbon Dioxide ($50,000)

  The Pollution Prevention team provided money to test a method for processing PETN explosive with supercritical carbon dioxide instead of with a mixture of acetone, ethanol, and water. Using non-hazardous carbon dioxide can eliminate 250 gallons of hazardous waste annually.

- Reuse of CMR Surplus Chemicals at UTEP Chemistry Department ($1,200)

  Chemistry Division shipped surplus, usable chemicals to the Chemistry Department at the University of Texas at El Paso. This project avoided the generation of approximately 60kg of hazardous 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 collected at the Laboratory for shipping 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 30,000kg 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)

  The Pollution Prevention team purchased an aerosol can puncturing unit for the staff 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)

  The Pollution Prevention team purchased a commercial electrowinning unit for MST Division. By installing this unit in the plating shop, approximately 100gallons of cyanide solution hazardous waste can be avoided annually since the cyanide is broken down and the resulting liquid can act as rinsate. In addition, about 2kg 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 500kg 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.

- 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. This project is waiting for WIPP certification.

- Aerosol Can Puncture Units ($6,360)

  The Pollution Prevention team purchased six aerosol can puncturing units for various sites so that more of these 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.

- 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 TRU, MTRU, or low-level 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 labware every month. The Ultra-Trace system uses an automatic acid reflux system that cleans about 20 pieces of labware 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 established a demonstration of 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 investigators expect to reduce hazardous waste by about 50kg 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)

  On a daily basis, the Plasma Spectrometry task area uses 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 contacted a Teflon company that produces Teflon tubes and columns that can reused for years. Also, the Teflon nebulizers will reduce solid waste and will greatly reduce MTRU liquid waste due to shorter rinse out times and lower volumes.

2.5.2 Current FY07 Projects

FY07 GSAF projects were chosen from the submissions of Laboratory employees, and approximately $1.08 million was allocated. About 60% of the funds are for the solid wastes and the balance is reserved for projects to minimize radioactive liquid waste. FY07 projects that support the EMS objectives and targets of a directorate received additional consideration. FY08 projects have not yet been selected but approximately the same amount of money will be allocated to these projects as was allocated during FY07.

GSAF funds were allocated to the following projects for FY07:

- Chemical Life Cycle Management ($60,000)

  This project identified improvements to procurement practices at the Laboratory so that chemicals arrive more quickly and users will not be tempted to order larger quantities than necessary. The project also identifies a set of environmental high-risk chemicals, and more environmentally friendly substitutions will be examined for those who use these chemicals.

- Lead Brick Recycling ($168,000)

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

- UPS Waste Reduction ($34,000)

  The people involved with this project will work to remove uninterrupted power supplies (UPS) from places where they are not necessary. The batteries in these UPSs become hazardous waste. Other options, such as surge protectors, may be a better solution for most applications.

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

  This group examined root causes of chemical and material accumulation, developed procedures, and 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 conducted 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 ten times more energy efficient, last 10-15 times longer than fluorescent bulbs, and are low voltage, which reduces the chance of an injurious shock 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. Not only were disposal costs saved, but tens of thousands of dollars worth of silver were prevented from becoming hazardous waste.

- Refrigerant Recycling ($12,000)

  Approximately 2000lb of unneeded refrigerant were recycled from the Laboratory by packaging it and sending it to a Department of Defense facility in Virginia.

- Silver Recovery Units ($7,300)

  Waste photochemicals can be filtered with silver recovery units to reclaim the silver for recycling. Doing so 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 generated at the Laboratory. Four of these 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.

FY 08 GSAF proposals are currently in review. Although final funding decisions have not been made, the following are proposals that apply to hazardous or mixed wastes are under consideration:

- Trial use of environmentally friendly ice melter ($500)
  This project will use a "green" alternative ice melter to reduce degradation of concrete to reduce sanitary waste.
- Seal-less Water Pumps for the 1L Service Area at TA-53 ($69,000)
  This project will purchase seal-less pumps to eliminate a source of MLLW at TA53.
- Replacement of MLLW Lead Bricks with Non-Hazardous Bismuth ($25,000)
  This project will evaluate use of bismuth as an alternative to lead for shielding.
- Waste reduction by distillation for HPLC processes ($20,000)
  This project will investigate reduction of solvent use in the HPLC process.

3.0 Hazardous Waste

3.1 Introduction

The annual hazardous waste disposal amount reported as part of the Pollution Prevention Program DOE reporting requirements is based on the total waste disposed through the Laboratory's 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 FY07 on October 15, 2007.

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, corrosivity, 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 at the Laboratory 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 Laboratory 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 to the Laboratory at commercial rates specific to the treatment and disposal circumstances. Figure 3-1 shows the process map for waste generation at the Laboratory.

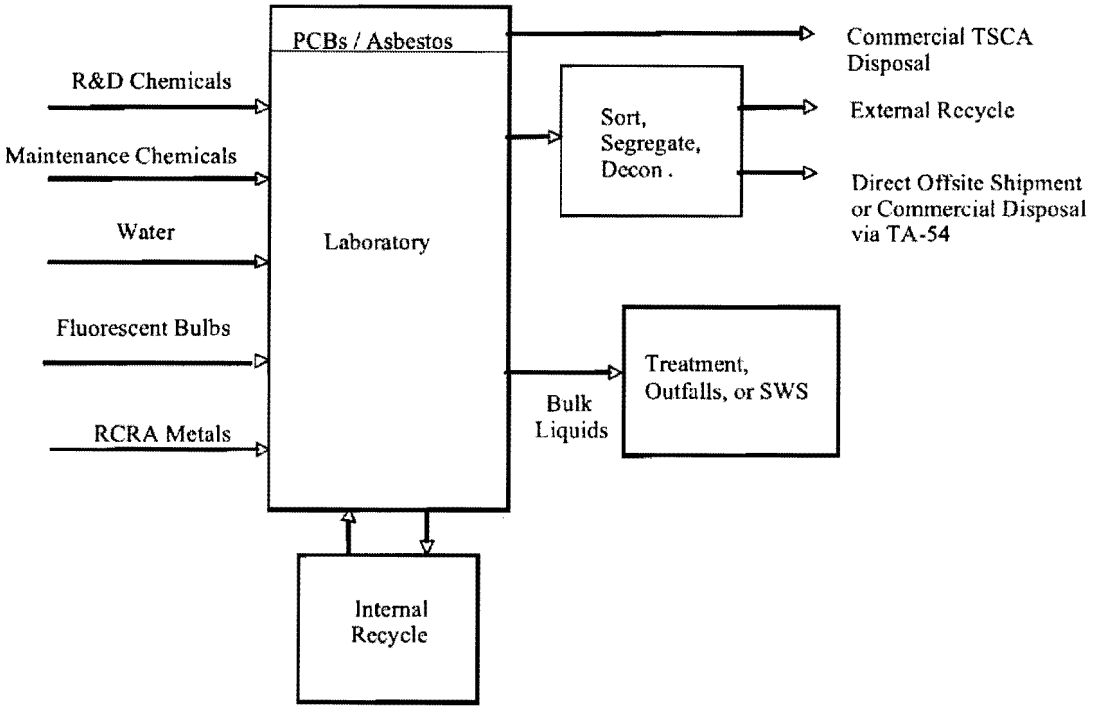

Figure 3-1. Waste process map

The quantity of routine and non-routine hazardous waste that was generated at the Laboratory and the amount of hazardous waste that was recycled during FY07 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.

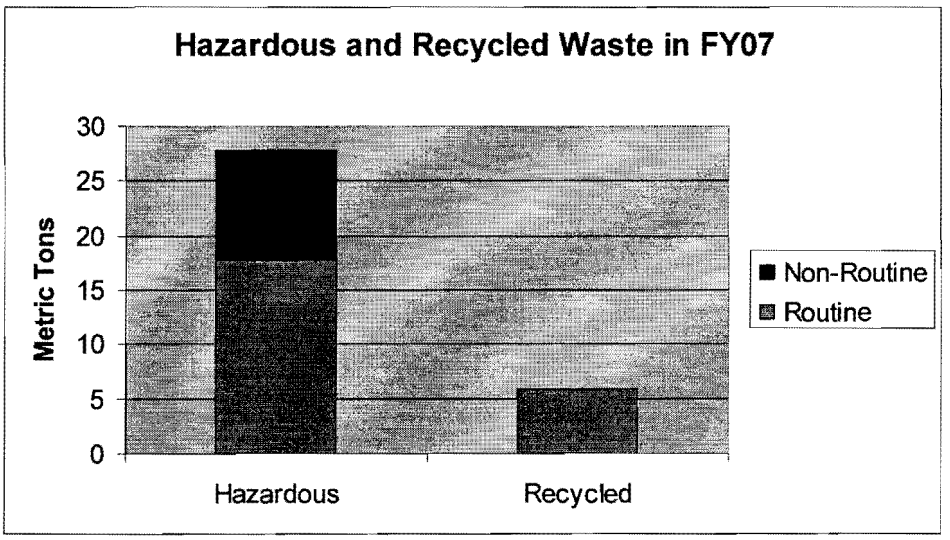

Figure 3-2. Hazardous waste and recycled hazardous waste generated during FY07

The divisions that produced the most hazardous waste at the Laboratory during FY07 were Weapons Technology (WT), Biosciences (B), Waste Services (WS), Dynamic and Energetic Materials (DE), Chemistry (C), Applied Engineering and Technology (AET), Hydrodynamic Experiments (HX), and Facility Management and Engineering (FME). The hazardous waste generation by division is shown in Figure 3-3.

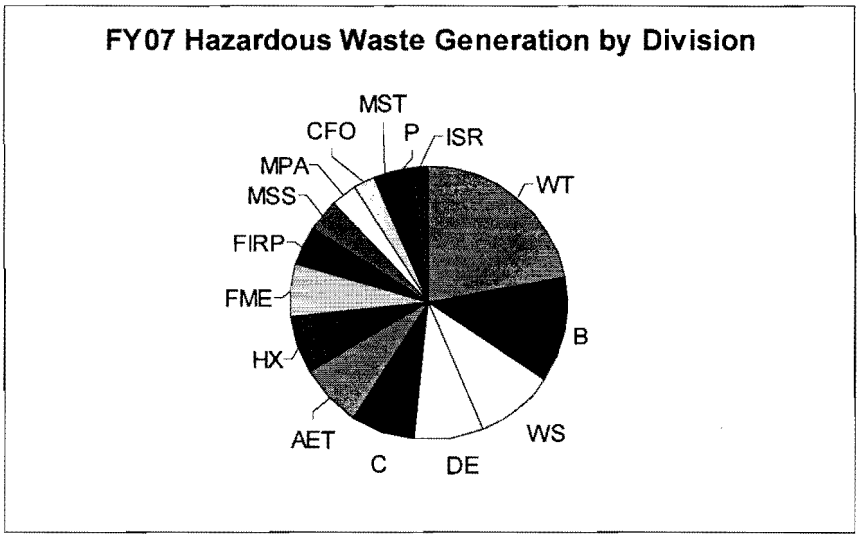

Figure 3-3. Hazardous waste by division during FY07. This includes routine and non-routine hazardous waste generation, but it does not include remediation waste.

3.2 Hazardous Waste Minimization Performance

The amount of non-remediation hazardous waste generated in FY07 was 27,877 kg, excluding recycled materials such as batteries, aerosol cans, bulbs, and elemental mercury. During FY07, remediation activities generated 29,665 kg of hazardous waste. Hazardous waste generated by remediation activities are discussed in more detail in section 6.0. The Laboratory's performance in hazardous waste generation by division for FY07 is shown in Table 3-1.

Table 3-1. Generation of Hazardous Waste by Division during FY07

Division	Hazardous Waste in Kilograms
Corrective Action Project (remediation)	26016
Weapons Engineering Technology	5772
Environment & Remediation Support Services (remediation)	3621
Biosciences	3291
Waste Services	2383
Dynamic and Energetic Materials	2081
Chemistry	1973
Applied Engineering and Technology	1924
Hydrodynamic Experiments	1831
Facility Management and Engineering	1604
Facility & Infrastructure Recapitalization Project	1225
Maintenance and Site Services	1004
Materials Physics and Applications	814
Chief Financial Officer	681
Material Science and Technology	594
Physics	544
International Space and Response	505
Weapons Component Manufacturing	359
Earth and Environmental Sciences	297
Plutonium Facility	263
International and Applied Technology	213
Radiation Protection	147
LANSCE	138
Weapons Systems Engineering	109
Environmental Protection	50
Emergency Response	41
LANL Water Stewardship Project (remediation)	28
Nuclear Nonproliferation	19
Engineering Facility Operations	5
Accelerator Operations and Technology	4
Technology Transfer	2
Radioactive Liquid Waste	2
Industrial Hygiene and Safety	1

3.3 Waste Stream Analysis

Hazardous waste is derived from hazardous materials and chemicals purchased, used, and disposed of; hazardous materials already resident at the Laboratory that are disposed of as part of equipment replacement, facility replacement or decommissioning; and water

contaminated with hazardous materials. After material is declared waste, hazardous waste is characterized, labeled, and collected in appropriate storage areas. The waste is then either shipped directly to offsite TSDFs or transshipped to Area L of Technical Area (TA)-54, from which the waste gets shipped to an offsite TSDF.

The largest waste streams in the Laboratory's routine and non-routine hazardous waste category for FY07 are described in this section. This analysis excludes recycled items and wastes from remediation activities since remediation wastes are discussed in section 6.0. The Laboratory also generates HE waste and HE waste waters that 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 FY07 is shown in Figure 3-5.

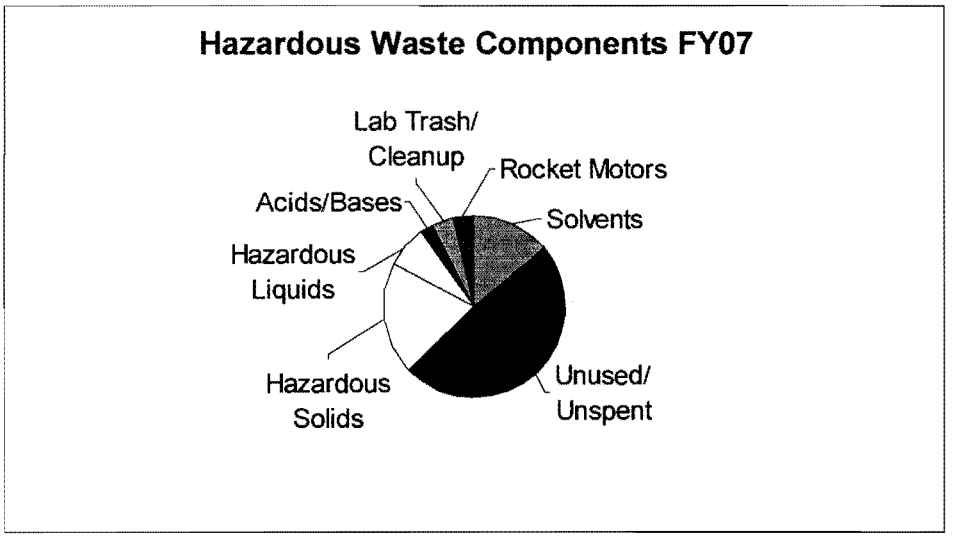

Figure 3-5. FY07 hazardous waste stream components excluding remediation waste

Solvents. EPA-listed and characteristic solvents and solvent-water mixtures are used widely at the Laboratory 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 at the Laboratory 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 Laboratory's 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 Laboratory's 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. The Laboratory is currently modifying the chemical procurement system so that new chemicals can be delivered very quickly and lost research time caused by delays in chemical procurement can be avoided. This waste category was an especially large fraction of overall hazardous waste generation during FY07 due to cleanouts of old chemicals in laboratories throughout the year.

Strong Acids and Bases. A variety of strong acids and bases are routinely used in research, testing, and production operations. Over the past decade, the Laboratory has reduced its overall volume of hazardous acid and base waste 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. Strong acids made up nearly 90% of this waste stream during FY07.

Hazardous Solids. This waste stream includes inert barium simulants used in high explosives research, contaminated equipment, cathode ray tubes, demolition debris, and various solid chemical residues from experiments. This category of waste was larger than usual during FY07 due to disposal of unwanted inert simulants. During FY07, inert simulants made up over 50% of this waste stream.

Hazardous Liquids. This waste stream is primarily aqueous, neutral liquids generated from a variety of analytical chemistry procedures. Over half of this stream during FY07 came from spent photochemicals. This waste stream also includes aqueous waste from chemical synthesis, nutrient broth, and automotive fluids.

Lab Trash and Spill Clean-up. 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. Lab trash mostly consists of paper towels, pipettes, personal protective equipment, and disposable lab supplies.

Rocket Motors. Rocket motors were a substantial component in the Laboratory's hazardous waste during FY07. These were non-routine items generated during a special cleanout of old equipment, and these are not expected to reappear in the Laboratory's hazardous waste stream again.

3.4 Hazardous Waste Minimization

The Laboratory requires chemicals to perform research and development experiments, properly maintain its facilities, and produce materials and items related to mission activities. The Laboratory follows good laboratory practices and trains its employees extensively to work safely with chemicals and minimize the amount of waste generated. The Laboratory is always looking for new equipment or process technologies that will reduce the amount and/or toxicity of chemical waste generated. The Laboratory is executing the Chemical Life Cycle Management Project 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, the Laboratory keeps track of its purchases of all lead-containing items and also keeps track of all lead or lead-containing materials sent offsite as waste or for recycling. Lead maintained onsite at the Laboratory can be shared among divisions. An inventory of lead bricks and shielding was updated in 2007.

A few divisions at the Laboratory maintain a supply of lead bricks for protective shielding purposes. These divisions can share lead when possible so that no or less new lead needs to be purchased. Uncontaminated lead that is unnecessary at the Laboratory has been recycled offsite or recast into new shapes for internal reuse.

Lead Substitution and Removal

Several Laboratory 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 Laboratory 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 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 FY07, approximately 350 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 mixed low-level waste was significantly reduced.

Lead Protection

Many researchers at the Laboratory 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.

The Laboratory does not currently use a bench-scale, onsite method to decontaminate lead, although this practice was used for a few years during the early 1990s. At present, if lead bricks become damaged, they can be sent to an offsite facility for recasting into new bricks

or custom shapes. If lead becomes contaminated, it can be sent to a different offsite facility for decontamination.

Non-Hazardous Scintillation Fluid

Non-hazardous scintillation fluid has become commonly used at the Laboratory. No hazardous waste or mixed low-level waste scintillation fluid was generated at the Laboratory during FY07 The shift away from the hazardous variety of scintillation fluid reflects the desire of the Laboratory to improve safety for its employees and minimize impact to the environment.

Radioactive Waste Segregation

The Laboratory has had the Green-is-Clean (GIC) program 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 mixed low-level waste. 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 at the Laboratory 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 mixed low-level waste can be avoided. The mercury in old thermometers and in other obsolete mercury-containing equipment gets recycled.

Acid Waste Reduction and Recycling

The metal plating shop in 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. PMT Division uses a nitric acid recycling system so that a significant fraction of the nitric acid that it uses can be reused multiple times instead of becoming waste.

Base Waste Reduction and Recycling

HX and DE 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

at the Laboratory in a process to neutralize acidic liquid. The neutralization procedure works very well with the spent caustic solution. Over 5000kg of caustic solution hazardous waste were avoided during FY07.

Solvent Waste Reduction and Recycling

There have been many projects implemented at the Laboratory 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 are destroyed by a catalytic oxidizer system.
- The Laboratory's 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 works 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 Laboratory 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, thereby reducing paperwork and costs. 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 macro-scale 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.

Coolant Waste Reduction and Recycling

MPA and ESA 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. Collectively, 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 Laboratory security contractor, Protective Technology Los Alamos (PTLA), has used traditional lead-containing bullets during training exercises at the small-arms range. A lead-free ammunition project purchased 100,000 rounds of frangible lead-free ammunition for use in handguns during training exercises. PTLA used the lead-free bullets during the first training course in 2006.

In 2006, a researcher from DE Division completed a multi-year project that developed a new class of primary explosives that are non-toxic and contain no lead at all. 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. Commercialization efforts for the new lead-free primary explosives are already underway, and in the future, truly lead-free bullets should be available thanks to this research.

3.5 Barriers to Hazardous Waste Minimization

The largest component of the hazardous waste stream at the Laboratory during FY07 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.

Many private companies and DOE facilities have a chemical pharmacy that provides a central location where reusable chemicals can be stored and used by any employee who needs them. However, this situation is not practical at the Laboratory because the research sites are very spread out. Transporting the large number of unused and unspent chemicals generated at the Laboratory would make individual shipments logistically complex. Extra packaging would be required to comply with Department of Transportation regulations governing shipping chemicals on public roads. Additional full-time employees would be required to manage the pharmacy, coordinate shipping, and drive the chemicals safely from one site to another.

Although a central chemical pharmacy at the Laboratory is impractical, the existing ChemLog chemical inventory system was modified so that chemical users can list and look at unspent chemical lists of other researchers before those chemicals become classified as waste. This list allows researchers in the same building or nearby buildings to share unspent chemicals and reduce the number of items contributing to the unused chemical waste stream. Further, pilot projects have demonstrated the feasibility of a chemical pharmacy within a technical area.

Finally, through the EMS, Laboratory 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 is defined the same as TRU waste, except that is 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 (NRC) 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, with lesser amounts of 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 at the Laboratory 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 (SWBs), 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 of the Waste Services Division (WS-TWPS). The top-level process map for MTRU waste is shown in Figure 4-1.

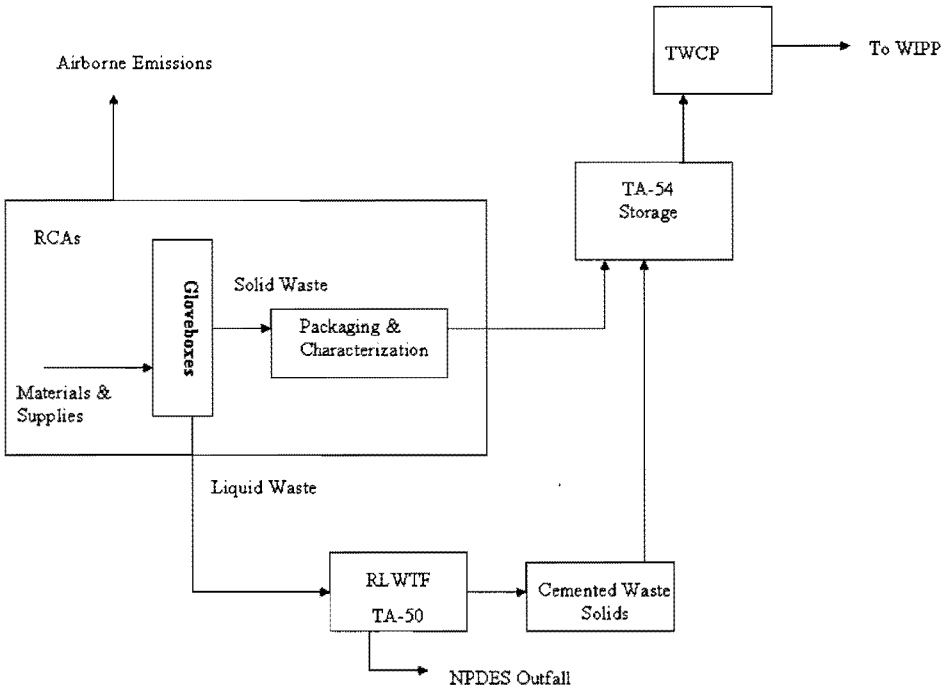

Figure 4-1. Top-level MTRU waste process map and waste streams

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 Characterization/Certification Program (TWCP) prior to shipment to WIPP.

During FY07, 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. On rare occasions it is necessary for WS Division to split the contents of an existing drum to meet the WIPP acceptance criteria. The D&D Program has produced MTRU waste intermittently in past years, and this waste is related directly to the area or facility being restored or decommissioned.

4.2 MTRU Waste Minimization Performance

The Laboratory generated 21,642.9 kg of MTRU waste during FY07. Waste Services is listed as the generator of all MTRU at the Laboratory, but the MTRU is generated in several locations through different processes. Repackaging is performed at TA-54, and during FY07, this activity generated 330.0 kg of MTRU. Liquid MTRU solidification occurs at TA-50 from RLWTF operations, and during FY07 this activity generated 1014.6 kg of MTRU. Programmatic work that generates the majority of MTRU occurs at TA-55, and during FY07 these activities generated 20,298.3 kg of MTRU.

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 at TA-55 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. Plutonium contamination can build up on the inside surfaces of gloveboxes and process equipment as a result of the process or leaking equipment. 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 FY07 was non-SNM (Special Nuclear Material) metal, and some of this resulted from clean-out activities of the vault. The percentage breakdown of operational MTRU generated at the Laboratory during FY07 is shown in Figure 4-2.

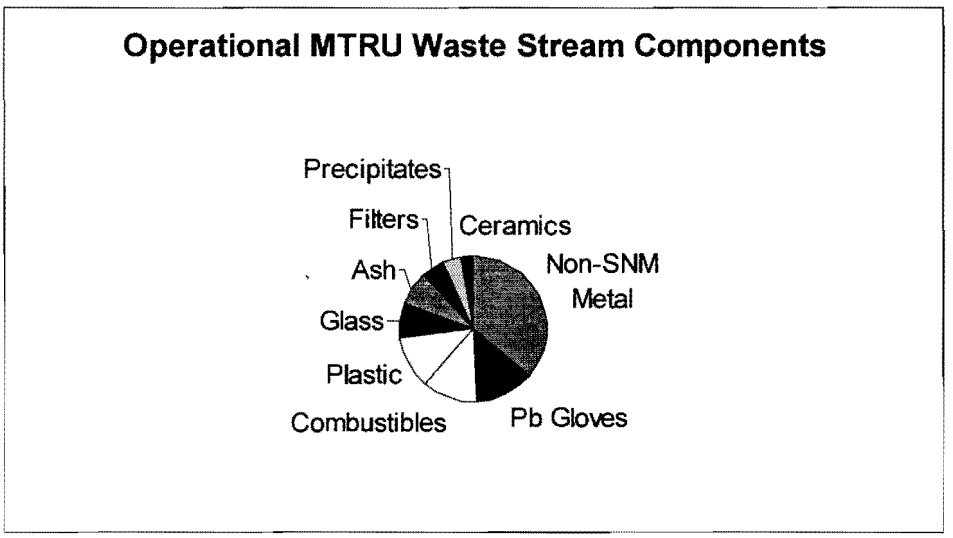

Figure 4-2. Composition of operational MTRU waste by volume for FY07

Combustible Wastes. Combustible wastes comprised ~11% of the operational MTRU waste generated at the Laboratory during FY07. 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, air filters, graphite, plastic, rubber, ceramics, ash, 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 FY07, approximately 32% of the operational MTRU generated at the Laboratory 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. During FY07, approximately 32% of the operational MTRU generated at the Laboratory was non-SNM metal.

4.4 Mixed Transuranic Waste Minimization

Many process improvements have been identified for implementation within TA-55 and in the processing of MTRU waste after it is produced. Changes in TA-55 processes are made very slowly due to the caution involved with moving new equipment into RCAs and qualifying new processes or changes. Waste minimization projects focus on elimination of RCRA components from products and processes in operations that generate MTRU waste. MTRU waste minimization and avoidance projects are typically funded by the ENV-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. Starting in FY06, GSAF money was used to fund projects to reduce the generation of radioactive liquid waste, and these same projects should also reduce the volume of MTRU resulting from solidification at TA-50. The GSAF projects are described in section 2.5.1 of this report.

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 mixed low-level waste (MLLW), it must contain hazardous waste and meet the definition of radioactive LLW. LLW is defined as waste that is radioactive and is not classified as high-level waste (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. Because MLLW contains radioactive components, it is regulated by DOE Order 435.1. Because it contains hazardous waste components, MLLW also is regulated by the State of New Mexico through regulation of the Laboratory's operating permit, the FFFCO/STP provided by the NMED and the EPA.

Most of the Laboratory's 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 the Laboratory tracks these materials 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 at the Laboratory.

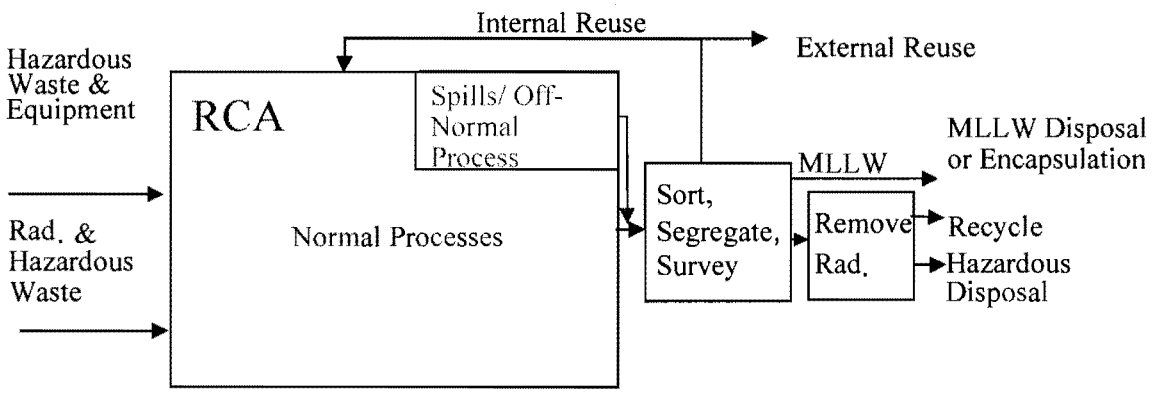

Figure 5-1. Top-level MLLW process map

Figure 5-2 shows MLLW generation by division generated at the Laboratory during FY07, excluding MLLW from remediation activities.

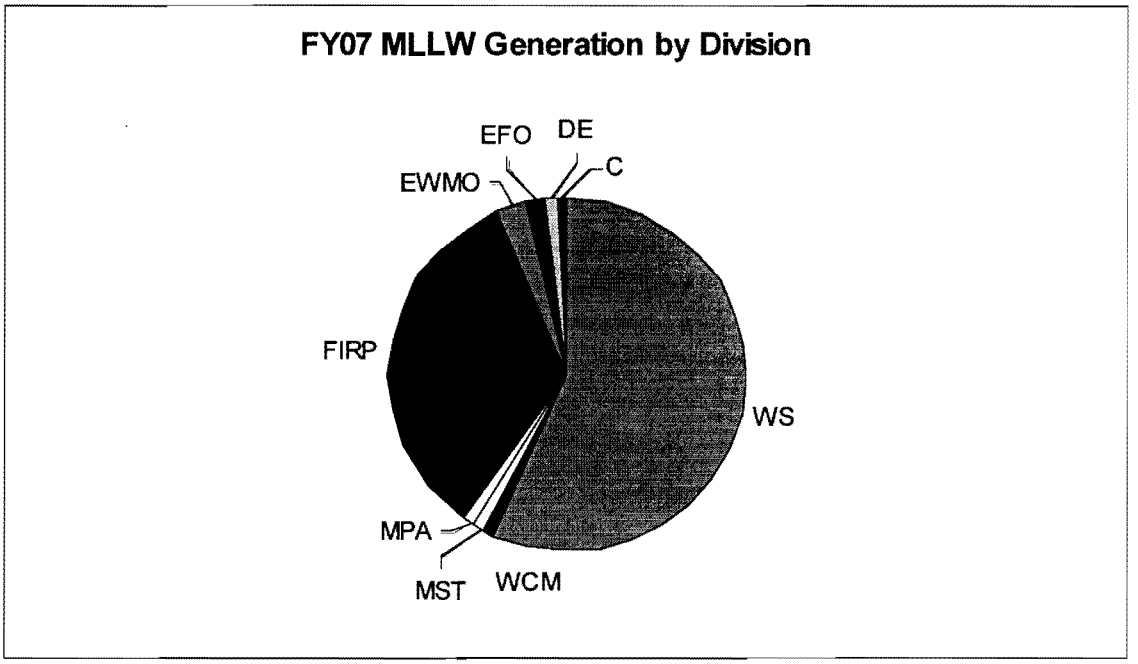

Figure 5-2. Total MLLW generated by division in FY07, excluding MLLW generated by remediation activities

The divisions that generated the most routine and non-routine MLLW during FY07 were Waste Services (WS), Facility and Infrastructure Recapitalization Project (FIRP), Environment & Waste Management Facility Operations (EWMO), Engineering Facility Operations (EFO), Weapons Component Manufacturing (WCM), and Materials Physics and Applications (MPA). The MLLW from WS Division comes from multiple TAs and includes many types of MLLW, so the percentage of MLLW attributed to WS Division is the largest.

5.2 MLLW Waste Minimization Performance

MLLW generation at the Laboratory for FY07 was 12,895 kg, excluding MLLW generated from remediation projects. Remediation projects during FY07 generated 27,824 kg of MLLW, and this waste is discussed in greater detail in section 6.0. Figure 5-3 shows the breakdown of all MLLW generated at the Laboratory during FY07 by Division.

Table 5-1. Generation of MLLW by Division during FY07.

Division	MLLW in Kilograms
TA-21 Cleanup (remediation)	23,352
Waste Services	7253
Facility & Infrastructure Recapitalization Project	4355
Environment & Remediation Support Services (remediation)	2599
Corrective Action Project (remediation)	1874
Environment & Waste Management Facility Operations	348
Engineering Facility Operations	203
Weapons Component Manufacturing	149
Materials Physics and Applications	147
Dynamic and Energetic Materials	137
Chemistry	115
Material Science and Technology	100
Maintenance and Site Services	47
Plutonium Manufacturing and Technology	33
LANSCE	9

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, equipment, and MLLW, 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 either 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 treatment and disposal facilities.

In some cases, the Laboratory procures recycled materials from other DOE/commercial sites that might otherwise be handled as MLLW. For example, in FY01 the Los Alamos Neutron Science Center Experiment (LANSCE) designed several new beam stops and shutters from lead. Rather than fabricating these from uncontaminated lead, LANSCE received these parts at no expense from GTS Duratek, a company that processes contaminated lead from naval nuclear reactor shielding.

The largest components of the routine and non-routine MLLW stream are restoration waste and environmental media samples, gloveboxes, electronics, mercury debris, oil, and lead debris. 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 volumes of various waste streams are shown in Figure 5-3.

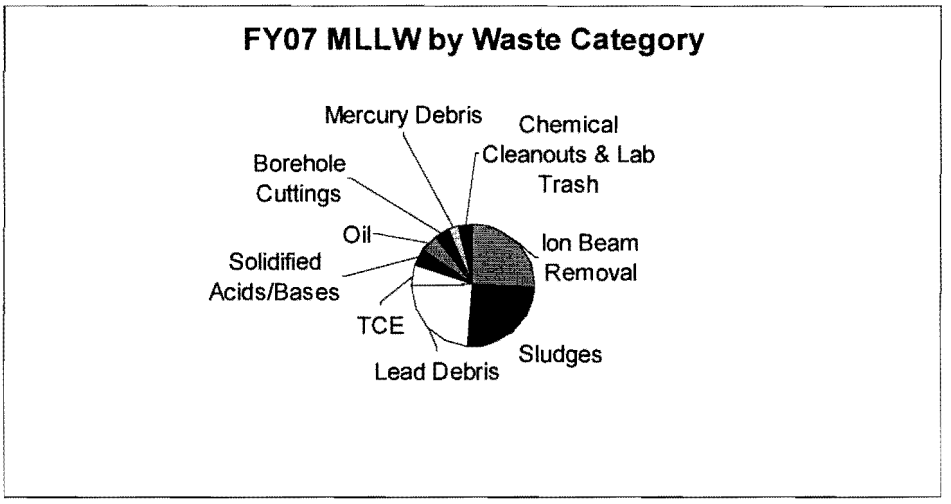

Figure 5-3. Constituents of MLLW in FY07

Ion Beam Removal. A project to remove an ion beam was performed during FY07, and nearly 4.5 cubic meters of lead and mercury-contaminated MLLW resulted from this work. This was a one-time project, so this is non-recurring waste.

Sludges. This waste stream consists of cemented waste sludges from the TA-50 RLWTF.

Lead Debris. The lead debris waste stream includes copper pipes with lead solder, lead-contaminated equipment, rags and PPE contaminated with lead from maintenance activities, ash with lead chips from the Cerro Grande fire, and 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 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 less expensively as MLLW instead.

Solidified Acids and Bases. Spent acids and bases from work at TA-55 were neutralized, and the resulting liquid was concentrated by precipitation using calcium hydroxide. Portland cement was added to the drums to solidify the liquid. This one container of waste was originally generated as MTRU waste, but it was subsequently reclassified as MLLW after analysis. The generation of this item was a one-time event and is not expected to be a recurring part of the Laboratory's MLLW stream.

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 at the Laboratory, this MLLW stream should diminish.

Borehole Cuttings. These borehole cuttings were generated by Waste Services Division during an investigation that required underground sampling at TA-54. The volume of waste generated through investigative work will vary from year to year, but the overall volume of MLLW generated by this activity is never expected to be very large.

Miscellaneous Chemicals and Lab Trash. This waste is composed of unused/unspent chemicals that have become contaminated in RCAs, analytical chemistry waste, gloves, PPE, and paper towels.

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 FY07, 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 took place 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, the groups at TA-55 intend to purchase more LED lights for gloveboxes. Ultimately this project will reduce the volume of MLLW generated at the Laboratory.

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 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 Laboratory's Environmental Program Directorate (EP). This component includes the Environmental Remediation Support Services (ERSS) Division, Corrective Action Projects (EP-CAP), TA-21 Closure Project (EP-TA21), and LANL Water Stewardship Project (EP-LWSP). The existing WMin/PP goals, previously applicable to the Remediation Services Program, are used to guide programmatic waste reduction practices into corrective actions activities and procedures. The existing goals are considered applicable until revised by the new Environmental Program Directorate.

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 within the Laboratory, 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 FY07 waste generation and waste minimization summary is listed in Table 6-1.

Table 6-1. FY07 Waste generation summary

Waste Type	Weight in Kilograms
Solid Hazardous	29,665
Solid MLLW	27,825
Solid Mixed TRU	0

Project activities in FY07 involved 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 FY07 waste generation was the result of investigations and accelerated corrective actions. Investigations and corrective actions implemented pursuant to the Consent Order included:

- Investigations and corrective actions for Bayo Canyon Aggregate Area; DP Site Aggregate Area; Guaje, Barrancas, and Rendija Canyons Aggregate Area; Middle Los Alamos Canyon Aggregate Area; Middle Mortandad Canyon/Ten Site Aggregate Area; Pueblo Canyon Aggregate Area; and Upper Los Alamos Canyon Aggregate Area
- Subsurface investigations and borehole drilling at Material Disposal Areas (MDAs) A, and T in TA-21, MDA C in TA-50, and MDAs G and L in TA-54 and the 30's- and 90's-Line Ponds at TA-16
- Supplemental investigation and remediation of MDA V at TA-21
- Alluvial groundwater investigations in Pajarito and Rendija Canyons
- Accelerated corrective actions (ACAs) at AOC 16-024(v) and SWMUs 16-026(r) and 16-031(f) at TA-16 and SWMU 61-002 at TA-61
- Sediment sampling and investigations in Pajarito, Bayo, Guaje, Rendija, Barrancas and Sandia Canyons
- Investigation and corrective action for the Airport Ash Pile
- Completion of the corrective action for the Airport Landfill
- Implementation of periodic groundwater monitoring in Ancho, Los Alamos, Mortandad, Pajarito, Sandia, Water, and White Rock Canyons
- Rehabilitation of Regional Wells R-12, R-16, and R-20
- Drilling and development of Regional Wells R-35a and R-35b

6.4 Remediation Waste Minimization

WMin/PP was an integral part of the FY07 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 incorporated into standard operating procedures and are no longer reported.

Activities in FY07 were primarily related to investigations and cleanup of small sites (e.g., septic systems and drain lines) did not result in high-volume waste streams, such as contaminated soil and demolition debris, including metal and concrete. The WMin/PP techniques used in FY07 to reduce these 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.
- Accelerated corrective actions being implemented at sites in operational areas within the Laboratory used cleanup levels based on industrial land use scenarios. This approach reduced the amount of soil and debris requiring excavation, while still being protective of human health and the environment.
- Waste segregation techniques were employed to minimize the generation of low-level radioactive waste generated during field investigations. As a result, it was possible to manage spent personnel protective equipment and other wastes as non-radioactive solid waste rather than LLW.
- Corrective actions being implemented at DP Site Aggregate Area involved removal of numerous contaminated subsurface structures, including septic tanks and waste lines. Fill material overlying these subsurface structures was carefully screened and segregated into clean and contaminated fill. Uncontaminated fill was used to backfill the excavations thereby greatly reducing the amount of waste soil from original estimates.
- Wastes generated by corrective actions projects may contain low, but detectable, concentrations of constituents from RCRA listed hazardous wastes. The presence of these constituents will cause the waste to be regulated as a hazardous waste. If the concentrations of listed constituents are below risk-based levels, the Laboratory has requested "no longer contained in" determinations from NMED so that the wastes do not need to be regulated as hazardous waste.

The corrective actions effort also evaluated the potential to incorporate WMin/PP practices into future activities.

- Corrective measures to be implemented at TA-54, Area G, may require large volumes of fill material for final grading of the site. Project managers are presently evaluating potential sources of recycled material that could be used for fill. For example, a feasibility study was conducted for reusing approximately 30,000 cubic yards of material from the Pajarito Flood Retention Structure for structural fill. A similar evaluation is planned for material to be excavated during construction of the Chemical and Metallurgical Research Replacement Facility.
- Corrective actions activities have included successful extraction of approximately 800 pounds of volatile organic compounds (VOCs) from MDA L as part of a test-

scale pilot study. The technology used involved extraction of VOCs from the subsurface, followed by treatment of the VOCs by carbon adsorption. The study proved that this technology reduced the risk associated with buried wastes at MDA L while generating minimal primary and secondary wastes compared to excavation. A similar test will be conducted at MDA G.

- Corrective actions at the former operating area at TA-21 will require D&D of former operating facilities. D&D planning is being integrated with corrective action planning to minimize the overall amount of waste that must be generated while meeting project objectives. For example, it may be possible to leave building foundations and subsurface utilities in place and manage these in conjunction with other wastes and contaminated media that will remain on site.

Sort, Decontaminate, and Segregate

This task is currently implemented and is designed to sort and decontaminate recyclable/recoverable LLW materials from decommissioning operations for the purpose of eliminating their onsite disposal as LLW. Typical sorting practices include collection of all metal debris (steel, lead, etc.) in separate boxes destined for shipment to a decontamination facility or commercial smelter for metals recovery. Decontamination work will involve the removal of surface radioactive contamination on equipment to allow for its reuse either at Los Alamos or other DOE facilities. Additionally, many sites containing radioactively contaminated heterogeneous materials will place emphasis on proper segregation at the source to attain the maximum recycling and waste classification advantages.

Compaction

The corrective actions projects currently planned include considerations for the use of the onsite compaction unit on suitable waste before final disposal.

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 within the Laboratory 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 Laboratory 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 in FY07. When reusable equipment is decontaminated, it is standard practice to use dry decontamination techniques to minimize the generation of liquid decontamination wastes.

In addition, the Laboratory initiated an equipment-exchange program, 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 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. Previous practices included returning borehole cuttings to the borehole if this would not increase the potential for contaminant migration. This practice is not allowed under investigation work plans approved pursuant to the Consent Order, and cuttings are now containerized and sent for disposal.
- 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 have little control over the amount of waste to be generated during implementation of corrective actions.

The FY08 WMin/PP approach will focus on:

- integrating waste minimization principles into the project planning process;
- recycling and reusing materials;
- utilizing material substitution as appropriate;
- developing subcontractor waste minimization incentives through contract specifications;
- dedicating waste minimization resources to assist with large remedial actions; and
- tracking, projecting, and analyzing waste data to improve waste management economies of scale.

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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.