

Reports

ENTERED



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Date: November 26, 2008
Refer To: ENV-RRO: 08-045

HAND DELIVERY

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



SUBJECT: 2008 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, 2008 for the previous year ending September 30.

National Nuclear Security Administration and Los Alamos National Security, LLC have 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.



Mr. Bearzi
ENV-RRO-08-045

- 2 -

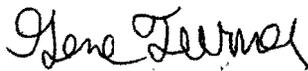
November 26, 2008

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

Sincerely,



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



Gene Turher
Environmental Permitting Manager
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Owner/Operator

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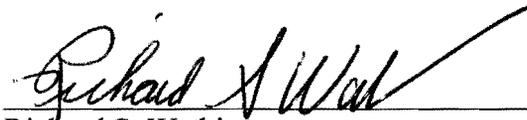
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Minimization Report
Date: November 2008

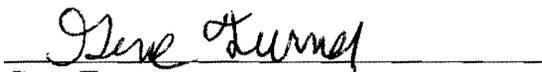
CERTIFICATION

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

11/20/08
Date Signed



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

11/25/08
Date Signed

LA-UR-08-07274

November 2008

**Los Alamos National Laboratory
Hazardous Waste Minimization Plan**

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

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

Federal Statutes and Executive Orders

- Resource Conservation and Recovery Act
- Pollution Prevention Act
- Executive Order 12873 — Federal Acquisition, Recycling, and Waste Prevention
- Executive Order 12856 — Federal Compliance with Right-to-Know Laws and Pollution Prevention
- Executive Order 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 450.1a, “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
- IP 400 Environmental Protection Program
- P 401 Procedure to Identify, Communicate, and Implement Environmental Requirements
- P 402 Environmental Communication Procedure

- P 403 Environmental Aspects Communication Requirements
- P 405 National Environmental Policy Act (NEPA), Cultural Resources, and Biological Resources Reviews
- P 408 Air Quality Reviews
- LIR 404-50-01 Water Pollution Control
- P 409 Waste Management

1.3 Purpose and Scope

The purpose of this plan is to document the Laboratory's approach for minimizing hazardous and mixed wastes and to document performance results. This plan discusses the methods and activities that will be routinely employed to prevent or reduce waste generation in the fiscal year 2009 (FY09), and the plan reports FY08 waste generation quantities and significant waste minimization accomplishments for FY08. In most cases, waste minimization activities executed during 2008 will continue to occur during FY09 and beyond. This plan also discusses the Laboratory Director's commitment to waste minimization and pollution prevention; specific elements of the ENV-RRO and EP WMin/PP programs; and the barriers to implementation of further significant reductions.

The plan discusses institutional policies, goals, and training activities that address hazardous and mixed waste reduction. The plan provides waste minimization information by the following waste types: hazardous waste, mixed transuranic waste (MTRU), and mixed low-level waste (MLLW). The last section provides a description of the WMin/PP activities associated with remediation wastes.

The FY09 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;
- tracking, projecting, and analyzing waste data to improve waste management economies of scale; and
- communicating waste minimization lessons learned to project leaders.

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
Section B.1.(a)(2)	Employee Training	Sections 2.2
Section B.1.(a)(2)	Incentives	Sections 2.2
Section B.1.(a)(3)	Past and Planned Source Reduction and Recycling	Sections 2.5.1, 2.5.2, 3.5, 4.4, 5.4, 6.0
Section B.1.(a)(4)	Itemized Capital Expenditures	Section 2.5.1 and 2.5.2
Section B.1.(a)(5)	Barriers to Implementation	Sections 3.4.1, 4.2.1, 5.2.1, 6.0
Section B.1.(a)(6)	External Sources of Information	Section 2.3
Section B.1.(a)(7)	Investigation of Additional WMin Efforts	Sections 2.5, 6.0
Section B.1.(a)(8)	Utilization of Hazardous Materials	Sections 2.4, 3.1, 4.1, 5.1
Section B.1.(a)(9)	Justification of Waste Generation	Sections 2.4, 6.0
Section B.1.(a)(10)(a)	Site Lead Inventory	Section 3.4
Section B.1.(a)(10)(b)	Lead Substitution and Removal	Section 3.4
Section B.1.(a)(10)(c)	Lead Shielding and Coating	Section 3.4
Section B.1.(a)(10)(d)	Lead Decontamination	Sections 3.4
Section B.1.(a)(10)(e)	Scintillation Cocktail Substitution	Section 3.4
Section B.1.(a)(10)(f)	Radioactive Waste Segregation	Section 3.4

Table 1.3-1. 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. Primary funding for the WMin/PP Program comes from the Laboratory's Readiness in Technical Base and Facilities (RTBF) 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, an independent ISO 14001 third-party registrar. 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 Laboratory's environmental policy statement reads:

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

2.1.1 FY 08 EMS Institutional Objectives

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

1. Ensure environmental compliance.
2. Reduce solid radioactive waste.
3. Improve Laboratory-wide energy and fuel conservation.
4. Laboratory-wide cleanout activities to disposition unneeded equipment, materials and chemicals and associated waste by end of FY11.
5. Achieve zero liquid discharge by 2012.

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 300.7).

New in 2008, the Integrated Environmental Review program in the Environmental Protection Division provided a training program for Work Planners to increase awareness of environmental concerns, including opportunities for prevention and waste minimization. The briefings were delivered to four organizations that have upstream work planning responsibilities:

- Work Planners
- Subcontract Technical Representatives
- Deployed Environmental Generalists
- ESH&Q Managers

In FY 2008 more than 25 briefings were delivered.

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 to determine potential alternative processes.

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 eight awards for pollution prevention projects during FY08 from DOE/NNSA, including two Best-in-Class awards. The winning projects are described below.

- Ultrapure Carbon and Carbon-Nitride Nanomaterials - New solvent-free methods were developed to prepare ultrapure carbon and carbon-nitride nano-particles. The new methods are faster, involve less purification, and eliminate the need for high temperatures and pressures so that the preparation work is safer for employees. These very useful materials can now be produced without generating hazardous fumes or waste in the process.
- Water Recycling at LANL - The Radioactive Liquid Waste Treatment Facility reduced the amount of reverse osmosis concentrate (ROC) that needs treatment by the evaporator. Instead of sending all of the ROC directly to the evaporator, it was recycled to an intermediate storage tank before being recycled and blended with

influent. The amount of ROC that is wasted was reduced fourfold, and total cost savings exceed \$1.3 million per year.

- Steam Generator Optimization – This project eliminated approximately half of the low-level liquid waste produced at the Plutonium Facility for a waste reduction of over 500,000L and a cost avoidance of over \$900,000 annually. This was accomplished by changing the operation of the steam generators so that they only run as needed instead of non-stop.
- Perchloric Acid Exhaust System - Activities involving perchloric acid were consolidated at TA-48 so that just one exhaust system could be used for this work instead of the original four separate exhaust systems. This project is expected to eliminate the generation of about 500,000L per year of low-level liquid waste since fewer ducts require washing and also avoid costs of approximately \$1 million annually.
- Recycling of Soil, Asphalt, and Mulch - The Chemistry and Metallurgy Research Replacement Project reused soil, asphalt, and mulch from vegetation instead of paying for their disposal. Approximately 207,000 cubic yards of soil and 486 cubic yards of asphalt will be used at the Laboratory and at the Los Alamos county landfill. Trees and other vegetation will be turned into mulch to help with dust suppression. Total cost avoidance could be up to \$1,735,000.
- Mixed Office Paper Recycle Program - The new mixed office paper recycle program simplifies collection of paper at the Laboratory while addressing safety and security concerns. The combined collection is more efficient and user-friendly because all unclassified paper can be recycled together. The program reduces the amount of sanitary waste disposed and alleviates previous environmental impacts and security issues related to using out-of-state recyclers.
- Integrating Safety and Security into the Environmental Management System Life-Cycle: A Body-contact Sport - Full integration of Environmental Management Systems (EMS) with Integrated Safety Management Systems (ISMS) is required by DOE Order 450.1 and Executive Order. However, such integration depends on sustained effort and the cumulative effect of many individual steps to assure that meaningful results are demonstrated at the worker level of the organization. In FY07, the Laboratory executed efforts at every stage of the EMS life-cycle to continuously improve such integration.
- The Uninterruptible Power Supply Project - The Uninterruptible Power Supply (UPS) project was an educational, electrical safety, pollution prevention, waste reduction, and environmentally preferable purchasing initiative. Unnecessary UPSs were removed, and workers were educated about the proper uses of UPSs. This project will help avoid future legacy waste materials and assist in Laboratory clean up efforts. UPSs are essentially batteries that constantly draw power to stay charged and must be disposed as hazardous waste at the end of life which is

typically only five years. This project eliminated all non-essential use of UPSs in these areas and lessons learned and computer desktop staff are limiting use across the Laboratory.

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 FY08, the Pollution Prevention team gave awards to 221 LANS employees and 128 contract employees who worked on 56 projects to reduce waste generation, improve efficiency, and conserve resources at the Laboratory. These projects contribute significant value to the Laboratory through cost savings, waste avoidance and improving compliance. Most importantly, these activities enhance mission accomplishment through risk reduction. Environmental and operational benefits included:

- Time savings: 4930 hours
- Radioactive Liquid Waste avoided: 30,000 gal
- Low Level Waste avoided: 2790 m³
- Liquid Hazardous Waste avoided: 5800 gal
- Solid Hazardous Waste avoided: 9760 kg
- Solid Waste avoided: 4 tons
- Mixed Low Level waste avoided: 5800 kg
- Transuranic waste avoided: 0.3 m³
- Energy saved: 873,000 kWh
- 200,000 lb of steel recycled
- Over \$100,000 in materials reused

Total cost savings for the awards given was \$4.96 million dollars not including labor costs. Labor costs add another \$567,000 to the total.

In FY08, the Pollution Prevention team participated in a Laboratory-wide participation event called "The Great Garbage Grab" to clean up trash at the Laboratory in April to coincide with Earth Day. The Laboratory held a Student Sustainability Challenge during

the summer to engage students in the Environmental Management System and to encourage them to contribute to reducing waste and conserving resources at the Laboratory.

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. 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. In FY 08, pollution prevention and GSAF projects resulted in cost avoidances of approximately \$10.9 million dollars.

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. Several team members belong to the National Registry of Environmental Professionals.

Pollution Prevention Team members read documents and attend 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. 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 Web Site
- EPA, P2Rx Web Site

- 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
- FedCenter Web Site

Waste minimization information from these sources is routinely distributed through Laboratory-wide email as summaries of specific problems and proposed alternatives.

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 in conjunction with chemical 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.

The Laboratory has an environmentally preferable purchasing program in place that requires that buyers choose less hazardous or non-hazardous janitorial and office supplies and supplies that contain recycled content. The Laboratory cosponsored a Green Products Fair with Sandia Office Supply in September to highlight “green” office supplies. The new janitorial supply catalog offers “green” cleaning supplies as the first choice. In addition, the new computer procurement request for proposals includes the procurement preference for computers that meet the Electronic Product Environmental Assessment Tool (EPEAT) certification standard.

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 FY08, 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 FY08, the following PPOAs were completed:

- Radioactive Liquid Waste Flowmeter Enhancements: This PPOA examined potential improvements to the system of flowmeters that track radioactive liquid waste generation throughout LANL.
- Pollution Prevention in Work Planning: This PPOA looked for ways to incorporate pollution prevention in the earliest stages of project planning.
- Materials and Equipment Disposition Kaizen Report: This report was developed from a Lean Six Sigma Kaizen event that was conducted to determine how unwanted equipment becomes waste and to find better ways of handling these materials at lower cost.
- Life Cycle of Hazardous Materials Kaizen Report: This report was developed from a Lean Six Sigma Kaizen event that was conducted to determine various ways that hazardous materials enter and pass through LANL. The goal of the analysis was to reduce the generation of hazardous waste.

2.5.1 Funded Projects

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

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 Pentaerythritol Tetranitrate (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 be 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.

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

- **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 uninterruptible 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. Ultimately the silver was found to be uncontaminated, but the DOE metal moratorium prevented this silver from being recycled.
- **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. As a result, this refrigerant did not become hazardous waste.
- **Silver Recovery Units (\$7,300)**
Waste photochemicals can be filtered with silver recovery units to reclaim the silver for recycling. 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.

2.5.2 Current FY08 Projects

FY08 GSAF projects were chosen from the submissions of Laboratory employees, and approximately \$949,000 was allocated. About 60% of the funds are for the solid wastes and the balance is reserved for projects to minimize radioactive liquid waste. FY08 projects that support the EMS objectives and targets of a directorate received additional consideration. A smaller number of higher value projects were funded in FY08 as compared to previous years.

In FY08, GSAF funds were allocated to the following projects:

- **Replacement of Lead Bricks with Non-Hazardous Bismuth (\$25,000)**
The purpose of this project was to replace lead bricks used in a shielding cave with bismuth bricks. Past research indicated that bismuth worked as well for this application, but the non-hazardous bismuth will never become MLLW as the lead bricks might.
- **Waste Reduction by Distillation for HPLC Processes (\$20,000)**
The purpose of this project was to install a unit to recover acetonitrile from an aqueous high performance liquid chromatography (HPLC) solution so that the acetonitrile could be reused and not become waste. This new process reduces hazardous waste generation by over 50 gallons per week and still allows all of the same work to be performed.
- **Radioactive Waste Technical Support (\$185,000)**
The purpose of this project was to provide technical support to all of the GSAF projects in FY08 concerned with reducing MLLW, MTRU, TRU, and LLW. The funds paid for time and effort of a dedicated pollution prevention staff member.
- **Oil-Free Pump for the 1L Service Area (\$55,000)**
The purpose of this project was to purchase an oil-free pump for an area where energy research occurs. The previous pump generated about 170 kg of oil that had to be handled as MLLW every year. The new pump does not use oil, so all of this MLLW is prevented.
- **Lead Recycle (\$75,000)**
This project recycled/reused six drums of lead bricks and the three pallets of lead-lined and solid lead pigs. The useable lead and steel will be re-cast as shielding containers and drum linings, to be resold to the DOE contractors at various DOE Sites.
- **Plasma Cleaning Process (\$55,000)**
This was a demonstration project that used plasma-cleaning technology as a replacement for trichloroethylene. This project, once fully deployed, will eliminate a mixed transuranic waste stream.

FY09 projects have not yet been selected but approximately the same amount of money will be allocated to these projects as was allocated during FY08.

2.5.3 EMS Accomplishments

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

Environmental Programs (ADEP) Directorate

1. Six pallets of lead bricks and pigs were shipped for metal melt and recycling.
2. Local visual examination services implemented for on site TRU operations.
3. RCRA Waste Tracking System developed and implemented for Environmental Programs Directorate programs.
4. Increased use of barcode scanners to better track TRU waste container movements on site.
5. Completed a PPOA and Yellow-Belt assessment for the LANL Material Recycling Facility (MRF) operations.
6. Completed installation of air monitoring network associated with future MDA B corrective actions project work.
7. A drill press and circular saw were removed from an operations area at TA-54. A significant rework of office space at Pueblo Complex resulted in reuse or salvage of quantities of office furniture and equipment.
8. Reuse of excavation and vegetation materials from corrective actions road improvement activities at TA-21.

Threat Reduction (ADTR) Directorate

1. ADTR relocated the remaining D Division personnel out of the Administration Building. These moves were completed in support of the institutional footprint reduction plan.
2. A self assessment of ADTR's Hazardous or Mixed Waste Generation and Management and/or Radioactive Material Use and Storage was conducted. Opportunities for improvement were addressed.

3. ADTR successfully recovered 92.1% of the off-site, non-Laboratory radioactive sources to which it committed for recovery in FY08.
4. ADTR's program successfully resulted in the proper disposal and/or recycling of approximately 1,300 legacy chemical containers.

Stockpile Manufacturing and Support (ADSMS) Directorate

1. Performed internal monthly waste accumulation area reviews to ensure continual improvement of RCRA compliance. There were zero NMED findings in ADSMS RCRA storage areas for FY08.
2. The facility achieved compliance with new FY08 NPDES permit requirements.
3. The Legacy Equipment Initiative was successful in dispositioning unneeded equipment, materials and chemicals. A database was created to track progress of legacy waste.
4. Completed GSAF funded pilot project to test LED light assemblies on gloveboxes.
5. Completed GSAF funded pilot project to D&D centerline gloveboxes in an effort to minimize generation of oversize transuranic waste.
6. Completed GSAF funded pilot project for In-Situ Gamma Measurements in an effort to minimize oversize transuranic waste.
7. Implemented improvements to the Aqueous Chloride and ATLAS operations. This resulted in 40% reduction in caustic waste and an estimated cost savings of over \$300,000.
8. Minimized generation of hazardous waste at TA-55 by eliminating use of WD-40 aerosol cans and replacing with reusable/refillable containers.
9. Implemented a chiller retrofit project. ADSMS is in the process of retrofitting three large chillers from R-22 refrigerant, a Class 1 ozone-depleting substance (ODS), to R-123 a Class 2 ODS before the 2010 deadline. Upon completion, approximately 90% of all Class 1 ODS at the Laboratory will have been eliminated.

Experimental Physical Sciences (ADEPS) Directorate

1. Recycled 100,000 lb of metal from boneyard cleanouts and a deionized water system.
2. Recycled 55,000 lb of metal from removal of five buildings for footprint reduction program work.

3. Recycled 40,000 lb of wood from boneyard cleanouts.
4. Recycled 140,000 lb of metal from the Lujan boneyard.
5. Recycled 1250 lb of lead bricks.
6. Recycled 600 gallons of used oil.
7. Removed large, empty tank and recycled 55,000 lb of metal.
8. Characterized, removed, and recycled 122 gas cylinders.
9. Purchased seal-less water pumps that will reduce labor and generation of MLLW.
10. Reused activated lead bricks for building a shielded drum for target disposal.
11. Upgraded a water system that will reduce labor needs by about 1000 hours annually.
12. Substituted a non-hazardous chemical for a hazardous chemical in a particular process that is being planned. Doing so will prevent the generation of approximately 5500 gallons of hazardous waste annually.
13. Eliminated an acid-wash process by purchasing new tungsten plates and using a non-hazardous cleaning process.
14. Reviewed over 250 experiments at a user facility to identify issues with chemical use, safety, and waste generation.

Environment, Health, Safety and Quality (ADESHQ) Directorate

1. Completed the feasibility study that sets the framework for eliminating outfalls. Eliminating outfalls will enable the Laboratory to meet new NPDES requirements.
2. Presented environmental compliance briefings to work planners and deployed environmental generalists to increase environmental awareness and enhance good working relationships between the core environmental staff and deployed staff.
3. Trained personnel to minimize hazardous chemical purchases and to meet goals for reducing hazardous waste.

Director's Office

1. Removed all canned air from office and purchased a hand vacuum for cleaning keyboards.

2. Repaired warranty items such as office chairs and palm scanners instead of salvaging the items and buying new ones.
3. Set large rental copier to “sleep” mode when not in service to use less energy.
4. Switched to paper plates, bowls, and cups instead of Styrofoam.
5. Added a can/bottle recycling container in the Director’s kitchen.

Business Services (ADBS) Directorate

1. Established Request for Proposals criteria for environmentally friendly office supplies, computers, janitorial supplies and printers and copiers.
2. Co-sponsored the Green Products Fair with Sandia Office Supplies
3. Completed enhancements to the Oracle iProcurement system to encourage and track environmentally preferable purchases.
4. Conducted training of Designated Procurement Representatives on environmentally preferable purchasing requirements and benefits
5. Conducted the first “Green” theme directorate picnic and distributed 150 compact fluorescent lamps (CFLs) to raise energy conservation awareness.

2.6 Waste Cost Recovery

Until the early 1990s, waste processing and management were considered overhead functions at the Laboratory, included as part of the general and administrative tax. In 1991, these activities moved under the jurisdiction of Department of Energy-Environmental Management (DOE-EM), which began direct-funding both legacy (including clean-up) and newly-generated waste management. Starting in fiscal year 1999 (FY1999), the responsibility was divided between DOE-EM handling legacy waste and Defense Programs (DP) via the Readiness in Technical Base and Facilities (RTBF) program managing newly-generated waste and pollution prevention activities. In FY2000 Los Alamos implemented an indirect recharge on non-DP newly-generated waste so those programs would pay their fair share of the waste management expenses. The non-DP recharge system is still in use today. DOE-EM pays the cost of processing waste generated from EM-funded work such as environmental restoration and legacy waste disposition at Los Alamos; the Facilities and Infrastructure Recapitalization Project pays waste disposal costs associated with its activities.

From FY1999 to FY2007 RTBF funded its waste processing activities via work packages that defined the resources and activities for each year. This method is simple in terms of accounting, with the drawback that the level of detail in these packages is often low. Also, little incentive is passed to the generator to minimize waste.

In FY08, the Laboratory developed and implemented cost recovery to support consolidation and modernization plans of its plutonium infrastructure. Fiscal year 2008 represents a transition period for cost recovery followed by implementation of full cost recovery in FY2009. The basis for waste cost recovery is to charge waste generators for the transportation, storage and disposal of their wastes. This will motivate waste generators to minimize waste, make investments to eliminate/reduce future waste and challenge waste management operations to be more efficient.

3.0 Hazardous Waste

3.1 Introduction

The annual hazardous waste disposal amount that is reported as part of the Pollution Prevention Program DOE reporting requirements is based on the total waste disposed through the 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 FY08 on October 14, 2008.

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.

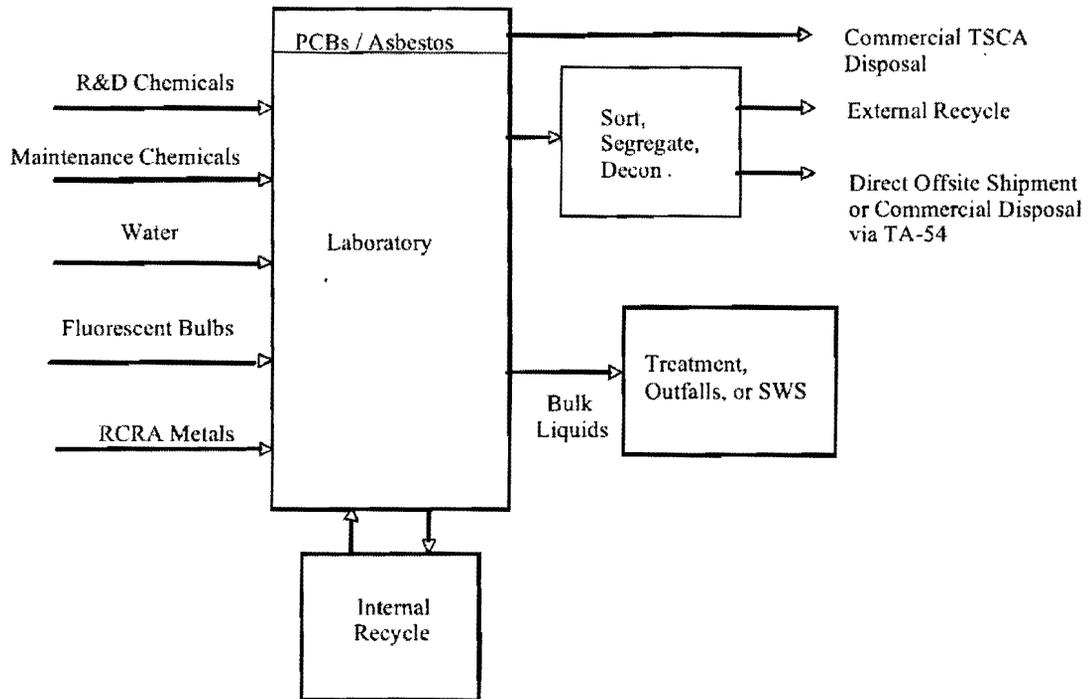


Figure 3-1. Waste process map

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 FY08 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.

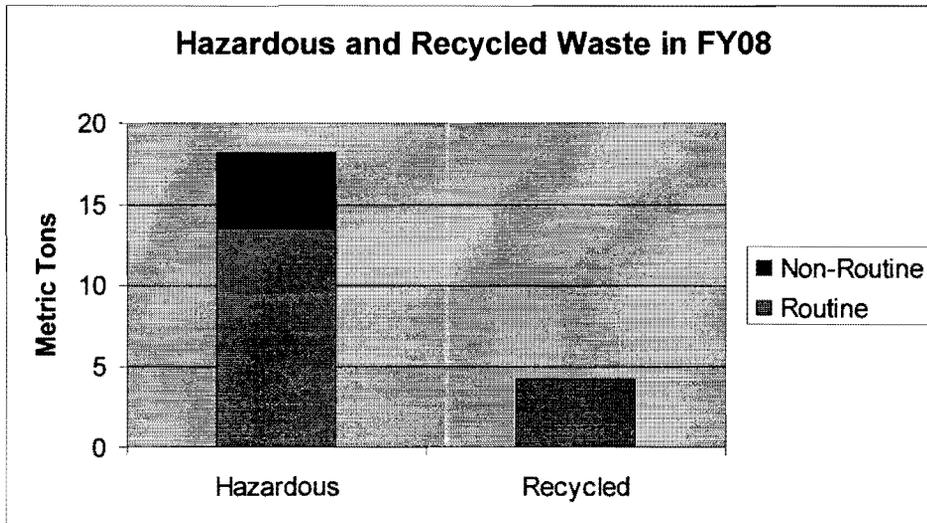


Figure 3-2. Hazardous waste and recycled hazardous waste generated during FY08

The divisions that produced the most hazardous waste at the Laboratory during FY08 were Waste Services (WS), Maintenance and Site Services (MSS), Chemistry (C), Biosciences (B), Materials Physics and Applications (MPA), International Space and Response (ISR), and Dynamic and Energetic Materials (DE). The hazardous waste generation by division is shown in Figure 3-3.

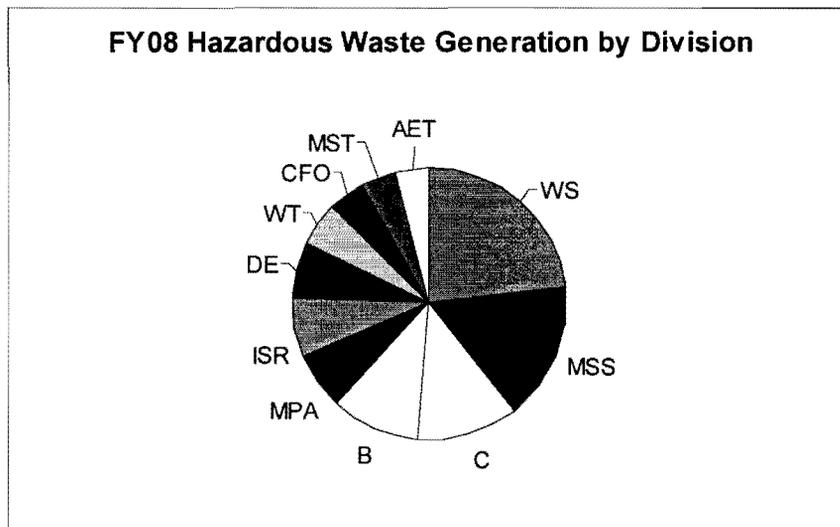


Figure 3-3. Hazardous waste by division during FY08. This includes routine and non-routine hazardous waste generation, but it does not include remediation waste.

3.2 Hazardous Waste Minimization Performance

The amount of non-remediation hazardous waste generated in FY08 was 15,913 kg, excluding recycled materials such as batteries, aerosol cans, bulbs, and elemental mercury.

This is considerably less than the 27,877 kg of non-remediation hazardous waste generated during FY07. During FY08, remediation activities generated 43,377 kg of hazardous waste. This is considerably more than the 29,665 kg of hazardous waste generated from remediation activities during FY07. 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 FY08 is shown in Table 3-1.

Table 3-1. Generation of Hazardous Waste by Division during FY08

Division	Hazardous Waste in Kg
Corrective Action Project (remediation)	43010
Waste Services	3331
Maintenance and Site Services	2379
Chemistry	1727
Biosciences	1499
Materials Physics and Applications	1017
International Space and Response	1007
Dynamic and Energetic Materials	964
Weapons Engineering Technology	751
Chief Financial Officer	649
Material Science and Technology	607
Applied Engineering and Technology	550
Earth and Environmental Sciences	369
Weapons Component Manufacturing	209
Accelerator Operations and Technology	186
LANSCE	184
Facility Management and Operations	153
Waste and Environmental Services (remediation)	116
Hydrodynamic Experiments	106
Radioactive Liquid Waste	101
Weapons Systems Engineering	62
Waste Facilities Operations	51
Radiation Protection	45
Nuclear Nonproliferation	40
Physics	29
Computing, Telecommunications, and Networking	27
Occupational Medicine	25
Plutonium Facility	21
Waste Disposition Project	14
Emergency Operations	11
Security	9
Facility & Infrastructure Recapitalization Project	7
Plutonium Manufacturing and Technology	5
International and Applied Technology	4
Community Programs Office	3
Manufacturing Quality	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 ultimately shipped to offsite TSDFs for final treatment or disposal.

The largest waste streams in the Laboratory's routine and non-routine hazardous waste category for FY08 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 high explosives (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 FY08 is shown in Figure 3-5.

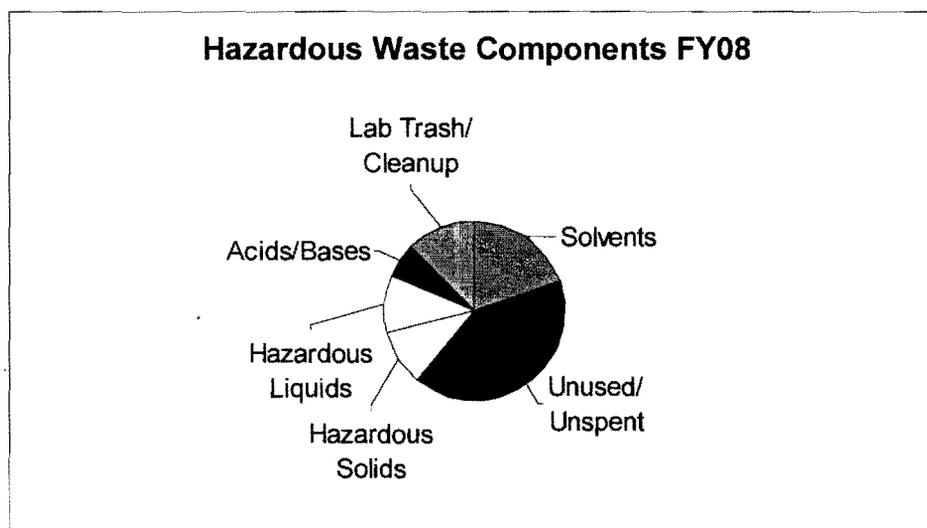


Figure 3-5. FY08 hazardous waste stream components excluding remediation waste

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.

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 about 60% of this waste stream during FY08.

Hazardous Solids. This waste stream includes inert barium simulants used in high explosives research, contaminated equipment, cathode ray tubes, broken leaded glass, and various solid chemical residues from experiments. During FY08, cathode ray tubes made up over 50% of this waste stream.

Hazardous Liquids. This waste stream is primarily aqueous, neutral liquids that are generated from a variety of analytical chemistry procedures. Over half of this stream during FY08 came from spent nutrient broth for biological research. This waste stream also includes aqueous waste from chemical synthesis and spent photochemicals.

Lab Trash and Spill Clean-up. Lab trash mostly consists of paper towels, pipettes, personal protective equipment, and disposable lab supplies. Rags are used for cleaning parts, equipment, and various spills. Equipment improvements have reduced the number of oil spills from heavy equipment, and new cleaning technologies have eliminated some processes where manual cleaning with rags was required. About 30% of this waste stream came from spill cleanup during FY08.

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.

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 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 FY08, approximately 915 kg of lead-containing cathode ray tubes from electronic equipment were removed from radiological control areas (RCAs). The tubes were carefully surveyed for contamination, and when none was found, they were sent away for disposal as non-routine hazardous waste. By removing these items from RCAs, the potential for creating MLLW is significantly reduced.

Lead Protection

Many researchers 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. If lead bricks become damaged, they can be sent to an offsite facility for recasting into new bricks or custom shapes. If lead bricks become contaminated, they can be sent to a different offsite facility for surface decontamination.

Non-Hazardous Scintillation Fluid

Non-hazardous scintillation fluid has become commonly used at the Laboratory. No hazardous waste or MLLW scintillation fluid was generated at the Laboratory during FY08. The shift to the non-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 MLLW. In addition, workers are required to minimize the amount of materials that are introduced into radioactive control areas to prevent unnecessary generation of radioactive waste.

Mercury Substitution

One ongoing project 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 MLLW can be avoided. The elemental mercury in old thermometers and in other obsolete mercury-containing equipment gets recycled.

Acid Waste Reduction and Recycling

The metal plating shop in Material Physics and Applications (MPA) Division uses an acid recycling system to recover nitric and hydrochloric acids for reuse in plating procedures within the shop. The system recovers about 90% of the acid used, and over 400 kg of hazardous waste acid are avoided every year through this reuse activity. Plutonium Manufacturing and Technology (PMT) Division uses a nitric acid recycling system so that a significant fraction of the nitric acid that it uses can be reused multiple times instead of becoming waste. The Laboratory sent over 3600 kg of ferric chloride solution offsite to be recycled and resold during FY08, and this would otherwise have become hazardous waste.

Base Waste Reduction and Recycling

Hydrodynamic Experimentation and Dynamics and Energetic Materials Divisions use sodium hydroxide solution to remove film resist from copper cables after etching. Over time, the sodium hydroxide solution gets diluted and is no longer useful for this purpose. Instead of disposing of the spent caustic solution, it is used at the Laboratory in a process

to neutralize waste acidic liquid. The neutralization procedure works very well with the spent caustic solution, and no new caustic chemicals need to be purchased for this purpose.

Solvent Waste Reduction and Recycling

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

- Experiments in organic synthesis laboratories generate a large amount of glassware with organic residues. Solvents and oxidizing acids were formerly used to clean this glassware, thus generating hazardous waste. Besides the generation of waste, this process is time consuming and expensive. Two organic synthesis labs purchased Tempyrox Pyroclean ovens to clean the glassware with heat. The ovens eliminate the chemicals and other problems associated with manual cleaning. The organic vapors from this process are destroyed by a catalytic oxidizer system.
- The 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 worked better for cleaning metal parts than solvent. The hot water parts washer saves time for employees, decreases their chemical exposure, and reduces hazardous waste solvent generation by about 4000 kg annually.
- The Material Testing Lab uses a binder oven to test the amount of oil present in samples instead of performing solvent-based extractions. A sample can be weighed initially, baked in the oven, and then weighed again to determine how much oil was baked off from the sample. This improvement project reduces about 400 kg of hazardous waste annually.
- In Bioscience Division, the solvent formamide was eliminated from the preparation process to sequence strands of DNA. Formamide is a suspect teratogen, and 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.
- One laboratory in Bioscience Division installed a solvent recovery system for acetonitrile in HPLC waste during FY08. This system is expected to prevent the generation of approximately 55 gallons of hazardous waste solvents per week.

Coolant Waste Reduction and Recycling

MPA Material Physics and Applications and Weapons Components Manufacturing Divisions both implemented coolant recycling systems in their machine shops. Coolant is always used during machining procedures to ensure the quality of the machined pieces and maximize the lifetime of the machine tools. 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, Special Operations Consulting (SOC), has used traditional lead-containing bullets during training exercises at the small-arms range. Current “lead-free” bullets still have lead in the primary explosive needed to fire the bullet, and this lead becomes airborne and settles into the environment. A lead-free ammunition project purchased 100,000 rounds of frangible lead-free ammunition for use in handguns during training exercises. SOC used the lead-free bullets during the first training course in 2006.

3.5 Barriers to Hazardous Waste Minimization

The largest component of the hazardous waste stream at the Laboratory during FY08 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 that govern chemical shipments 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 has the same definition as TRU waste, except that it also contains hazardous waste regulated under RCRA. Transuranic (TRU) waste is waste containing >100 nCi of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years (atomic number greater than 92), except for (1) high-level waste (HLW); (2) waste that the DOE has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by Code of Federal Regulations 40 CFR 191; or (3) waste that the United States Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61. MTRU waste is generated during research, development, nuclear weapons production, and spent nuclear fuel reprocessing.

MTRU waste has radioactive elements such as plutonium, 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, and oversized containers. Security and safeguards assay measurements are conducted on the containers for accountability before they are removed for transport. Certification of the waste for transport and disposal at WIPP is currently done by the TRU Waste Project Support group (WDP-TWPS). The top-level process map for MTRU waste is shown in Figure 4-1.

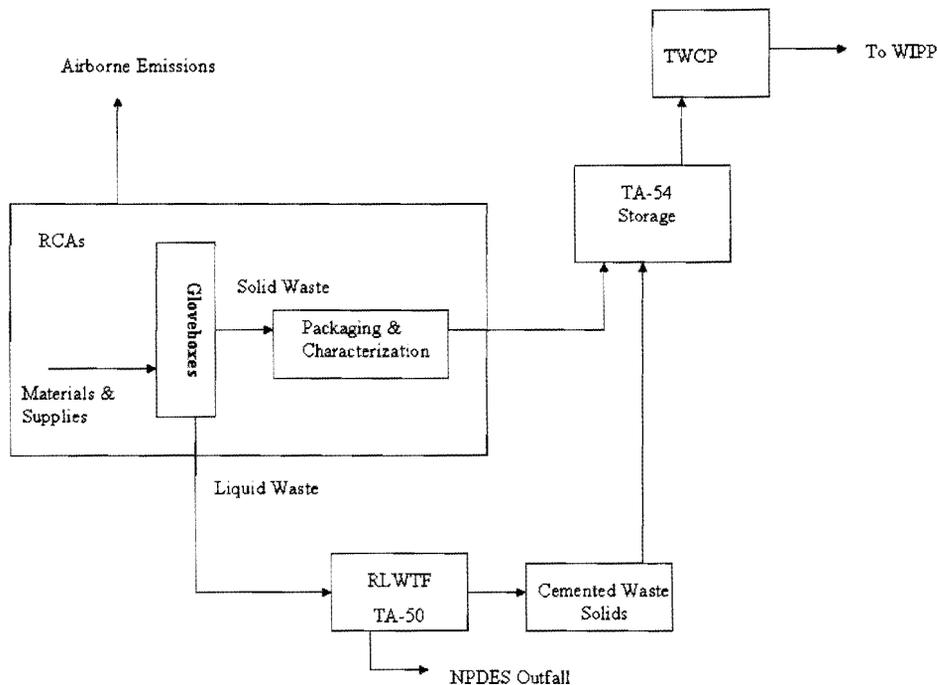


Figure 4-1. Top-level MTRU waste process map and waste streams

Typically, research production materials and supplies are brought into an RCA and introduced into a glovebox. Waste leaves the glovebox in the form of either solid or liquid wastes. Solid wastes are packaged, characterized, and shipped to TA-54 for storage. Liquid wastes are sent to the RLWTF for treatment. The radionuclides and other contaminants are removed as a cemented solid waste at the RLWTF and shipped to TA-54 for storage, and the remaining liquid is discharged to a NPDES permitted outfall. All waste is processed by the TRU Waste Disposition Project (TWCP in Figure 4-1) prior to shipment to WIPP.

During FY08, the routine and non-routine MTRU waste was generated by the groups at TA-55, Chemistry Division, and by the Offsite Source Recovery program as a result of ongoing operations. The Waste Services Division repackaged some of this MTRU waste so that WIPP acceptance criteria were fulfilled. The D&D Program has produced MTRU waste intermittently in past years, and this waste is related directly to an area or facility being restored or decommissioned.

4.2 MTRU Waste Minimization Performance

The Laboratory generated 48,263 kg of MTRU waste during FY08. This is considerably more than the 21,642 kg of MTRU generated during FY07, and this was due to increased programmatic work. Waste Services Division and Chemistry Division are listed as the generator of all MTRU at the Laboratory, but the MTRU is generated in several locations through different processes. During FY08, repackaging activities generated 32,180 kg of MTRU. Programmatic work that generates MTRU occurs at TA-55 and TA-3, and during FY08 these activities generated 16,083 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 ²³⁹Pu 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 FY08 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 FY08 is shown in Figure 4-2.

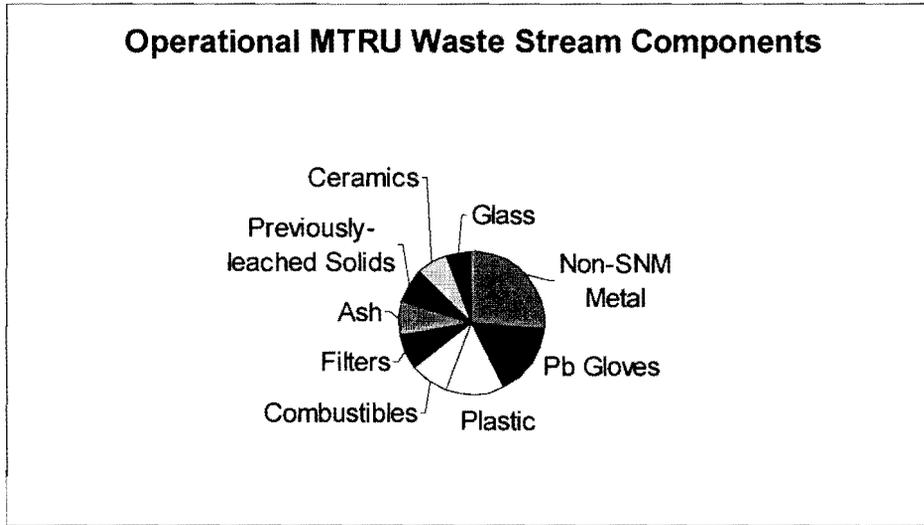


Figure 4-2. Composition of operational MTRU waste by volume for FY08

Combustible Wastes. Combustible wastes comprised ~7% of the operational MTRU waste generated at the Laboratory during FY08. 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 FY08, almost 24% 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.

4.4 Mixed Transuranic Waste Minimization

Many process improvements have been identified for implementation within TA-55 and in the processing of MTRU waste after it is produced. Changes in TA-55 processes are made very slowly due to the caution involved with moving new equipment into Radiological Control Areas and qualifying new processes or changes. Waste minimization projects focus on elimination of RCRA components from products and processes in operations that generate MTRU waste. MTRU waste minimization and avoidance projects are typically funded by the ENV-RRO GSAF program and by operating funds. Money from the GSAF

fund is used to pay for projects designed to reduce the generation of MTRU waste. The GSAF projects are described in section 2.5.1 of this report.

4.5 Barriers to MTRU Minimization

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

5.0 Mixed Low-Level Waste

5.1 Introduction

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

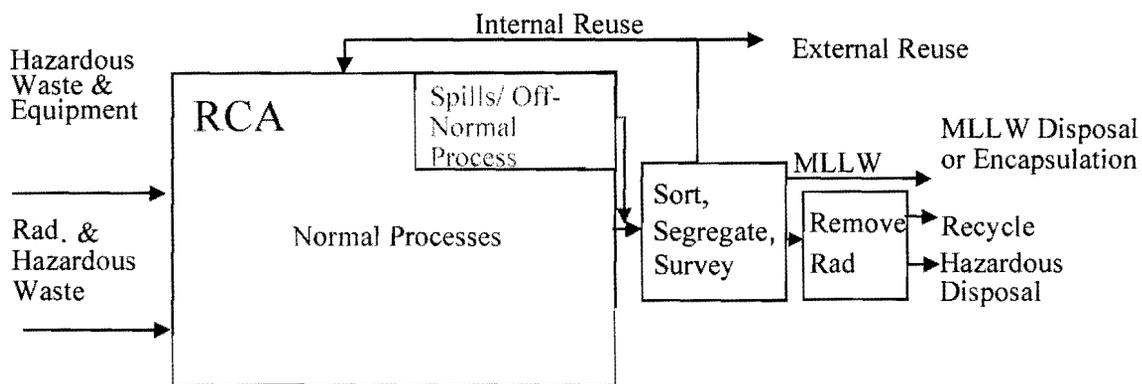


Figure 5-1. Top-level MLLW process map

Figure 5-2 shows MLLW generation by division generated at the Laboratory during FY08, excluding MLLW from work performed using remediation cost codes.

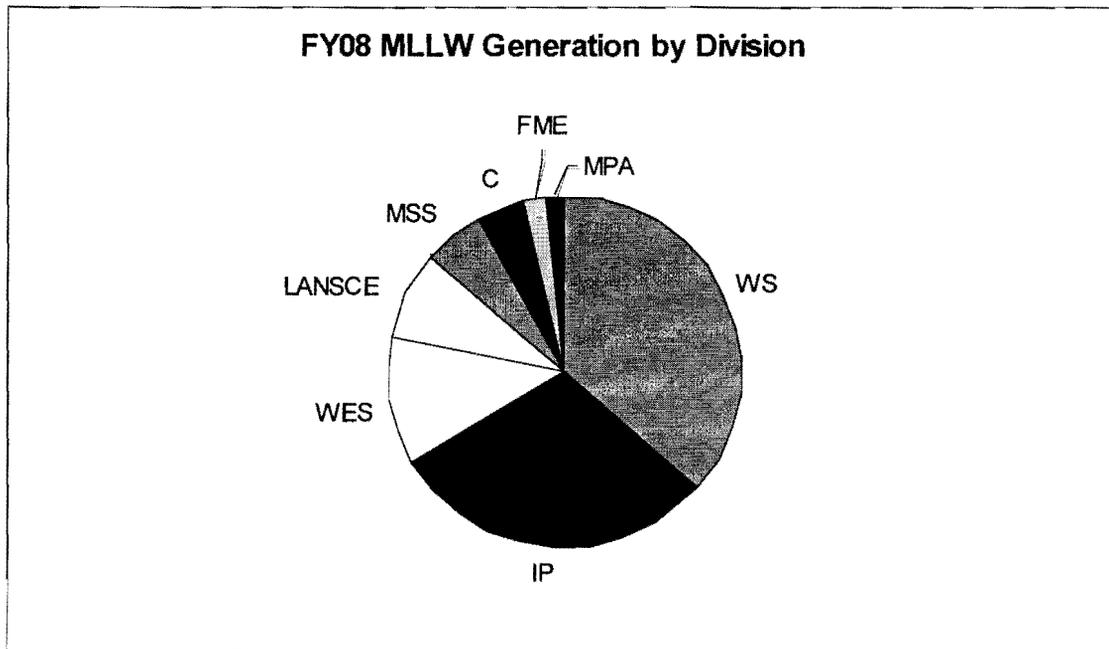


Figure 5-2. Total MLLW generated by division in FY08, excluding MLLW generated by work performed with remediation cost codes.

The divisions that generated the most routine and non-routine MLLW during FY08 were Waste Services (WS), Infrastructure Planning (IP), Waste & Environmental Services (WES), and Los Alamos Neutron Science Center (LANSCE). 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 FY08 was 6,275 kg, excluding MLLW generated from work performed with remediation cost codes. This is considerably less than the 12,895 kg of MLLW generated from non-remediation activities during FY07. Work performed with remediation cost codes during FY08 generated 28,951 kg of MLLW, and 27,623 kg of this waste was cemented sludge from the Radioactive Liquid Waste Treatment Facility. The other 1,328 kg of remediation waste is discussed in greater detail in section 6.0. The amount of MLLW generated with remediation cost codes did not change much from FY07, at which time the amount generated was 27,824 kg. Figure 5-3 shows the breakdown of all MLLW generated at the Laboratory during FY08 by Division, excluding waste generated from work performed with remediation cost codes.

Table 5-1. Generation of MLLW by Division during FY08.

Division	MLLW in Kilograms
Waste Disposition Project (sludge)	27,687
Waste Services	2205
Infrastructure Planning	1814
TRU Waste Disposition Project (remediation)	983
Waste & Environmental Services (partly remediation)	982
Los Alamos Neutron Science Center	476
Maintenance and Site Services	346
Chemistry	255
Facility Maintenance and Engineering	127
Materials Physics and Applications	101
Weapons Component Manufacturing	80
Material Science and Technology	74
Hydrodynamic Experiments	44
Corrective Action Project (remediation)	25
Engineering Facility Operations	17
Plutonium Manufacturing and Technology	5

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 by weight are sludge, restoration waste, electronics, lead debris, mercury debris, and oil. Lower MLLW generation is anticipated in the future as environmental restorations are completed, as non-toxic materials are substituted for mercury and lead, and as oil-free vacuum pumps replace older pumps.

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

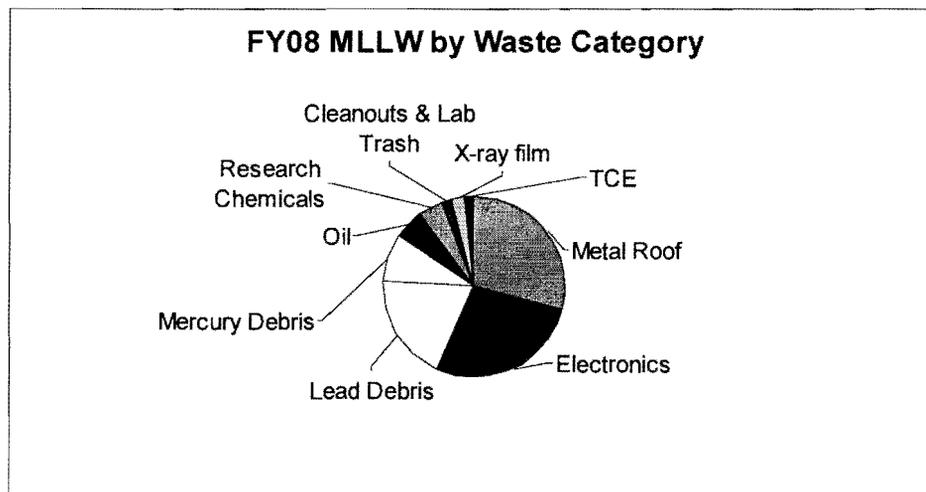


Figure 5-3. Constituents of MLLW in FY08, excluding MLLW generated by work done on remediation cost codes.

Sludges. This waste stream consists of cemented waste sludges from the Laboratory's Radioactive Liquid Waste Treatment Plant. During FY08, approximately 27,687 kg of MLLW resulted from this process.

Metal Roof. A project to remove a metal roof was performed during FY08, and approximately 1814 kg MLLW resulted from this work. This was a one-time project, so this is non-recurring waste.

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

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

X-Ray Film. This was exposed X-ray film that was generated in an RCA and removed as part of a building cleanout. Newer technologies have almost completely eliminated the need for X-ray film, and it is unlikely that this MLLW stream will be generated in the future.

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.

Research 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. During FY08, many Divisions cleaned out unwanted chemicals from RCAs, so this component of the total MLLW generated was larger than usual during FY08.

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 FY08, money from the GSAF fund was used to pay for projects designed to reduce the generation of MLLW waste. These projects are described in section 2.5.1 of this report.

One especially promising pilot project that started during FY07 involved replacing traditional fluorescent fixtures with light-emitting diode (LED) fixtures in gloveboxes. The LED lights do not contain any RCRA-regulated components, so after their useful life, they will not become MLLW as fluorescent lights do. The LEDs are much smaller and lighter than fluorescents, and the LEDs last longer, use less electricity, and generate less heat than fluorescents. During FY08, the groups at TA-55 purchased 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 Waste and Environmental Services (WES) Division, Corrective Action Projects (EP-CAP), TA-21 Closure Project (EP-TA21), and LANL Water Stewardship Project (EP-LWSP).

The mission of the EP corrective actions activities is to investigate and remediate potential releases of contaminants as necessary to protect human health and the environment. These activities are implemented to comply with the requirements of the March 1, 2005, Compliance Order on Consent (hereafter, Consent Order) between the NMED, DOE, and UC. In completing this mission, activities may generate large volumes of waste, some of which may require special handling, treatment, storage, and disposal. Because the activities involve investigating and, as necessary, conducting corrective actions at historically contaminated sites 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 FY08 waste generation and waste minimization summary is listed in Table 6-1.

Table 6-1. FY08 Waste generation summary

Waste Type	Weight in Kilograms
Solid Hazardous	43,377
Solid MLLW	1328
Solid Mixed TRU	0

Project activities in FY08 involved investigations, including well installation, and cleanup, including removal of contaminated soil, debris, and wastes.

6.3 Waste Stream Analysis

This plan addresses all RCRA-regulated waste that may be generated by the corrective actions during the course of planning and conducting the investigation and remediation of contaminant releases. Wastes generated include "primary" and "secondary" waste streams. Primary waste consists of generated contaminated material or environmental media that was present as a result of past DOE activities, before any containment and restoration

activities. It includes contaminated building debris or soil from investigations and remedial activities. Secondary waste streams consist of materials that were used in the investigative or remedial process and may include investigative-derived waste (e.g., personal protective equipment, sampling waste, drill cuttings); treatment residues; wastes resulting from storage or handling operations; and additives used to stabilize waste. The corrective actions may potentially generate hazardous waste, MLLW, and MTRU.

The majority of FY08 waste generation was the result of investigations, including well installation, and accelerated corrective actions. Investigations, corrective actions, and other activities implemented pursuant to the Consent Order included:

- Investigations and corrective actions for Bayo Canyon Aggregate Area; DP Site Aggregate Area; Middle Los Alamos Canyon 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, MDAs G, H, and L in TA-54, and the 16-340 Complex at TA-16
- Performance of a soil vapor extraction (SVE) pilot test at MDA G
- Supplemental investigation and remediation of MDA V at TA-21
- Alluvial groundwater investigations in Pajarito and Rendija Canyons
- Sediment sampling and investigations in Pajarito, Threemile, Twomile, and Sandia Canyons
- Implementation of periodic groundwater monitoring in Ancho, Los Alamos, Mortandad, Pajarito, Sandia, Water, and White Rock Canyons
- Rehabilitation of Regional Wells R-14, R-20, R-32, and R-33
- Drilling and development of Regional Wells R-25b, R-25c, R-36, R-37, R-40, R-42, and R-43
- Drilling and development of Intermediate Well SCI-2
- Removal of a permeable reactive barrier in Mortandad Canyon

6.4 Remediation Waste Minimization

WMin/PP was an integral part of the FY08 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 FY08 were primarily related to investigations and cleanup of small sites (e.g., septic systems and drain lines) and did not result in high-volume waste streams. The WMin/PP techniques used in FY08 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.

- The Laboratory's ENV-RCRA Group developed a formal procedure for land application of the groundwater extracted during well drilling, development, sampling, and rehabilitation. Drilling, development, and purge waters constitute a major potential waste source for EP-LWSP (i.e., upwards of 100,000 gal. may be produced per well). This procedure, which incorporates a decision tree negotiated with NMED, allows groundwater to be land applied if this will be protective of human health and the environment. Use of this procedure minimizes the amount of purge water that must be managed as wastewater.
- The Laboratory's ENV-RCRA Group developed a formal procedure for land application of drill cuttings. Drill cuttings constitute a major potential source of solid wastes generated by EP-LWSP. This procedure, which incorporates a decision tree negotiated with NMED, allows drill cuttings to be land applied if this will be protective of human health and the environment. These drill cuttings do not have to be managed and disposed of as waste. Additionally, land-applied drill cuttings can be beneficially reused as part of drill site restoration.
- Corrective actions activities included successful extraction of approximately 250 pounds of volatile organic compounds (VOCs) from MDA G as part of a SVE 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 G while generating minimal primary and secondary wastes compared to excavation.
- 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.

Sort, Decontaminate, and Segregate

This task is currently being implemented and is designed to segregate contaminated and noncontaminated soils so that noncontaminated soils can be reused as fill. These practices are implemented at sites where contaminated subsurface soils and structures are overlain by uncontaminated soils. During excavation to remove the contaminated soils and structures, the uncontaminated overburden is segregated and staged apart from contaminated materials. Following removal of the contaminated soils and structures, the overburden is used as backfill for the excavation. This practice minimizes the amount of contaminated soil that must be disposed of as waste and also minimizes the amount of backfill that must be imported from off site.

Compaction

The corrective actions projects currently planned include considerations for the use of an 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. 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 Pollution Prevention Planning

The potential to incorporate WMin/PP practices into future activities has also been evaluated. Several actions related to WMin/PP have been incorporated into the FY09 Environmental Action Plan for EP developed as part of LANL's EMS. These planned actions are summarized below.

- Field activities associated with remediation of MDA B at TA-21 began in September 2008 and will continue into FY09. Initial field activities include

clearing and grubbing prior to construction of a haul road. Site activities will also include construction of erosion control best management practices (BMPs) needed for storm water discharge permit compliance. Vegetation removed during clearing and grubbing, which would otherwise have to be managed and disposed of as waste, will be reused on site to construct BMPs.

- Field activities at MDA B will also include removing overburden above waste disposal trenches. This overburden, which is expected to be uncontaminated, will be segregated from soil excavated from contaminated areas. The overburden will be sampled to determine whether it meets cleanup levels established for the MDA B site. If so, this soil can be used to backfill trenches following removal of wastes. Segregating contaminated and uncontaminated soil and reusing the uncontaminated soil in this manner will reduce the amount of waste generated during the field activities.
- As described above, the Laboratory developed formal procedures during FY08 that allow land application of groundwater and drill cuttings when this is protective of human health and the environment. EP-LWSP will apply these procedures to all purge water and drill cuttings generated during FY08 to minimize the amount of wastes from drilling operations.
- Well drilling activities often result in generation of materials and equipment that are no longer needed. EP-LWSP is undertaking an action to recycle and reuse these materials and equipment to the extent possible to avoid having to manage them as waste. This action will include coordinating with the Army Corps of Engineers, Bureau of Reclamation, and other agencies that may have need for excess materials and equipment.

6.6 Barriers to Waste Minimization

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

- The amount of investigation-derived waste generated during investigations conducted under the Consent Order has increased relative to investigations conducted under Module VIII. The investigation scope has increased under the Consent Order, resulting in the drilling of more boreholes and generation of more investigation-derived waste.
- The use of risk assessments to establish risk-based cleanup levels is one of the few opportunities available to corrective actions for source reduction. Pursuant to the Consent Order, however, implementation of such strategies is subject to approval by NMED. Further, the Consent Order limits the use of risk-based cleanup levels in lieu of the cleanup levels prescribed by the Consent Order. Therefore, the cleanup levels prescribed in the Consent Order may result in generation of more waste than would result from use of risk-based cleanup levels.
- The Consent Order requires long-term controls on sites that are cleaned up to other than residential cleanup levels. In order to allow for the possible future transfer of

property from DOE ownership, some sites have been cleaned up to residential levels even though that is not the current land use (e.g., MDA V). The use of the more stringent residential cleanup levels has resulted in generation of a larger volume of waste than if the sites had been cleaned up based on current land use.

- The single largest potential source of waste generated by corrective actions is removal of buried waste or contaminated soil during implementation of corrective measures. Such actions have the potential to generate thousands of cubic meters of waste. In evaluating corrective measure alternatives, corrective action program and project leaders generally give preference to alternatives that would avoid generating large volumes of waste, provided they are protective of human health and the environment. The final decision on which corrective measure to implement at a site, however, will be made by NMED, subject to review and comment by the public. Thus, the corrective actions program and project leaders have little control over the amount of waste to be generated during implementation of corrective actions.

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>.