Report

Los Alamos
NATIONAL LABORATORY
EST. 1943
Los Alamos, New Mexico 87545
Phone 505-667-0666 /Fax 505-667-5224

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

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SUBJECT: 2005 LANL Hazardous Waste Minimization Report

As Los Alamos National Laboratory Program Manager for Pollution Prevention and Sustainability, 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, 2005 for the previous year ending September 30.

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

Please contact me by phone (505-665-7252) or email (dlh@lanl.gov) if you have any questions.

Sincerely,

Dr. Dennis Hjeresen
Program Manager, Pollution Prevention and Sustainability

DH:pg

Cy: Gene Turner, NNSA-LASO, A316
Ken Hargis, ENV-DO, J591
Jeanne Ball, NWIS-DO, J910
D. McInroy, RS, M992
Patricia Gallagher, ENV-SWRC, M992
Ellen Louderbough, LC-ESH, A187
IM-5, LANL, MS A150
ENV-SWRC File, K490

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Title: Los Alamos National Laboratory Hazardous Waste Minimization Report

Author(s): Sonja Salzman, ENV-SWRC
Pat Gallagher, ENV-SWRC
Leonard Trujillo, ENV-ECR
Joseph English, ENV-ECR

Submitted to: New Mexico Environment Department

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November 2005

Los Alamos National Laboratory
Hazardous Waste Minimization Report

1.0 Los Alamos National Laboratory 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 Stewardship Division – Pollution Prevention Program (ENV-PP). This plan also supports the Environmental Stewardship Division – Environmental Remediation Services Project (ENV-ERS) WMin/PP goals and describes its programs to incorporate waste reduction practices into ENV-ERS 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).

1.1.1 Background

In 1990 Congress passed the Pollution Prevention Act[i], which changed the focus of environmental policy from "end-of-pipe" regulation to encouraging source reduction or minimizing waste generation. Under the provisions of the Pollution Prevention Act and other institutional requirements for treatment, storage, and disposal of wastes, all waste generators must certify that they have a waste minimization program in place. The elements of this program are further defined in the May 1993 US Environmental Protection Agency (EPA) interim final guidance, 58 F.R. 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 also places responsibility for waste minimization/pollution prevention implementation with the waste-generating program.

1.1.2 Purpose and Scope

The purpose of this plan is to document the Laboratory's approach for minimizing hazardous and mixed wastes. This plan discusses the goals, methods, and activities that will be routinely employed to prevent or reduce waste generation in the fiscal year 2006 (FY06), and the plan reports FY05 waste generation quantities and significant waste minimization accomplishments for FY05. This plan also discusses the Laboratory Director's commitment to waste minimization and pollution prevention, provides a discussion of specific program elements of the ENV-PP Program and the ENV-ERS

WMin/PP Program, and presents the barriers to implementation of further significant reductions.

The plan will discuss institutional policies, goals, and training activities that address hazardous and mixed waste generation. The plan will then provide waste minimization information by the following newly generated waste types: hazardous waste, mixed transuranic waste, mixed low-level waste, and the last section will provide a description of the ENV-ERS WMin/PP Program.

1.1.3 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.

Table 1.3-1
Los Alamos National Laboratory Hazardous Waste Facility Permit, Module VIII, Section B.1

Permit Requirement	Topic	Refer to Report Section
Section B.1.(a)(1)	Policy Statement	Section 2.1
Section B.1.(a)(2)	Employee Training	Section 2.2
Section B.1.(a)(2)	Incentives	Section 2.2, 6.0
Section B.1.(a)(3)	Past and Planned Source Reduction and Recycling	Section 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	Section 3.4.1
Section B.1.(a)(6)	Sources of Information	Section 2.3
Section B.1.(a)(7)	Investigation of Additional WMin Efforts	Section 2.5
Section B.1.(a)(8)	Utilization of Hazardous Materials	Section 2.4
Section B.1.(a)(9)	Justification of Waste Generation	Section 2.4, 6.0
Section B.1.(a)(10)(a)	Site Lead Inventory Program	Section 3.5
Section B.1.(a)(10)(b)	Steel for Lead Substitution Program	Section 3.5
Section B.1.(a)(10)(c)	Lead Shielding Coating Program	Section 3.5
Section B.1.(a)(10)(d)	Lead Decontamination Program	Section 3.5
Section B.1.(a)(10)(e)	Scintillation Cocktail Substitution Program	Section 3.5
Section B.1.(a)(10)(f)	Radioactive Waste Segregation Program	Section 3.5

1.1.4 Organizational Structure and Staff Responsibilities

The Laboratory Director and the Associate Director for Technical Services have oversight responsibilities and provide annual review of the Laboratory-wide WMin/PP Program goals and performance. The ENV Division has primary responsibility for the Laboratory-wide WMin/PP Program, including the ENV-PP Program and the ENV-ERS Project.

The ENV-PP Program has been tasked by the ENV Division to develop and manage the Laboratory-wide WMin/PP and environmental stewardship program. The ENV-PP 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.

2.0 Laboratory Waste Minimization Program Elements

2.1 Laboratory Governing Policy on Environment

The Laboratory is developing a prevention-based environmental management system (EMS), which is expected to be self-certified in December 2005. 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:
It is the policy of the Los Alamos National Laboratory that we will be responsible stewards of our environment. It is our policy to manage and operate our site in compliance with environmental laws and standards and in harmony with the natural and human environment; meet our environmental permit requirements; use continuous improvement processes to recognize, monitor, and minimize the consequences to the environment stemming from our past, present, and future operations; prevent pollution; foster sustainable use of natural resources; and work to increase the body of knowledge regarding our environment.

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 (GET) 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 a section on minimization of low-level, mixed low-level, and transuranic waste. As part of the EMS implementation process at the Laboratory, an EMS awareness module was developed that features pollution prevention as a key mechanism for environmental management. All Laboratory employees were required to complete this awareness module.

The Laboratory requires generators to minimize waste and conduct prevention measure assessments in waste management guidance documents and in the work planning requirements under the Integrated Work Management Implementation Procedure (IMP 300-00-00.02)

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

The Laboratory's ENV-PP Program and DOE-EH Headquarters in conjunction with NNSA sponsor annual pollution prevention awards programs. The programs provide recognition to personnel who implement pollution prevention projects. The Laboratory submits nominations for the DOE/NNSA Headquarters awards each year. The Laboratory received seven awards for pollution prevention projects during FY05. These projects are expected to eliminate over $2 million in costs annually. The two projects described below involve a reduction of waste with a hazardous component.

- Los Alamos National Laboratory Integrated Work Management Process and Job Hazard Analysis Tool Implementation – This project integrates security, safety, and environment at the work level. This system ensures that pollution prevention is incorporated at the work planning stage. Possible methods for waste reduction can be identified at the beginning.

- Oil-Free Vacuum Pumps – Several Divisions have installed oil-free vacuum pumps for a variety of applications. These are especially valuable in radiation control areas since oil generated in those areas can become MLLW. The traditional oil pumps previously used for those applications required oil changes between one and twelve times per year, and now a substantial amount of time is saved.

The Pollution Prevention team holds a Pollution Prevention award ceremony every year in conjunction with other Earth Day activities. Laboratory employees can submit descriptions of projects they completed during the past year that reduced waste generation at the Laboratory. At the award ceremony, each participating individual and team is recognized with award certificates. Winning UC employees also receive a cash bonus. During FY05, the Pollution Prevention team gave over 200 awards to people who worked on 39 projects to reduce waste generation 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 commonly 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 waste item. The Pollution Prevention team reviews the GSAF proposals and distributes the available funds to the projects. If there is not enough money in a given year to fund all of the proposals, the projects are funded 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 being a positive financial incentive for researchers to try promising new equipment or procedures that might reduce waste, the GSAF program also acts as a negative financial incentive to creating waste because research programs must pay a tax on all waste generated. Costs of taxes and disposal fees will be lower by reducing the amount of waste produced, so researchers have multiple incentives to minimize waste.

2.3 External Sources of Information

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

The Pollution Prevention program manager is chair of the Industrial and Engineering Division of the American Chemical Society, serves on the Governing Board of the Green Chemistry Institute, and is on the Energy Facility Contractors Group environmental subcommittee. Three team members belong to the New Mexico Recycling Coalition, and one serves on their Board. One team member has actively participated in the National Pollution Prevention Roundtable's Federal Facility Workgroup since its inception. Two team members serve on the Los Alamos County Solid Waste Advisory Board, and one is the chair. Several team members belong to the National Registry of Environmental Professionals. One team member belongs to the Institute of Hazardous Materials Managers.

In FY05, the Pollution Prevention team had a booth at a community Earth Day event staged by a local environmental group called the Pajarito Environmental Education Center. The Pollution Prevention team gets 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.

The Pollution Prevention Team relies on internet resources such as the US EPA-sponsored P2 Rx, a national pollution prevention information network, US DOE websites, and vendor websites. The Laboratory is a member of the U.S. Green Building Council, and the Pollution Prevention Team makes use of their website. Staff regularly attends conferences on pollution prevention and sustainable design sponsored by DOE, Tradeline, Labs 21, National Pollution Prevention Roundtable, and other organizations. The Laboratory also participates in quarterly P2 conference calls hosted by DOE. The Pollution Prevention Team holds a quarterly P2 program review with DOE Pollution Prevention staff.

2.4 Utilization and Justification for the Use of Hazardous Materials

The Laboratory is a research and development (R&D) facility that sponsors thousands of projects requiring the use of chemicals or materials that may create a 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 cleaning solutions, and other prevention techniques have been adopted across the Laboratory. However, hazardous material use is necessary in some research projects due to customer requirements, project specifications, or the basis of the research.

To encourage the use of non-toxic or less hazardous substitutes whenever possible, the Pollution Prevention team linked a database of alternative chemical choices to its own website during FY05. The database of alternative chemicals was developed by researchers at the Massachusetts Institute of Technology. The database contains possible alternatives

to some hazardous chemicals for particular processes. Everyone at the Laboratory now has access to the database of non-toxic or less hazardous alternative chemicals.

2.5 Investigation of Additional Waste Minimization and Pollution Prevention Efforts
The Pollution Prevention team is constantly looking for new projects to implement that have the potential to reduce waste generation and increase recycling at the Laboratory. 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 their waste management coordinators, and the Pollution Prevention team also comes up with many of the project ideas. Pollution Prevention team members frequently assist waste generators with the implementation of these projects.

During FY05, each Division at the Laboratory participated in the EMS process and examined its particular impacts on the environment. As a result of the EMS process, each Division created an action plan with objectives and targets for reducing its environmental impact. These action plans provide ideas for projects to implement 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 FY 05, the following PPOAs were completed:

- Chemical Baseline: Environmental High Risk Chemicals (EHRC) and Greener Chemical Alternatives and Substitutions for Bioscience Division: This PPOA examined the use trends of environmentally high risk chemicals and identified green alternatives to two chemicals in use at B Division.
- Revisiting Green is Clean Program Implementation: This PPOA reexamined Green is Clean implementation over the past three years and identified actions to promote and increase GIC performance. This action plan is now tied to Appendix F measures for FY 06.
- Waste Reduction at Aramark Otowi Café: This PPOA examined solid waste trends at Otowi café and developed an action plan to reduce solid waste and increase Otowi Café users' awareness of solid waste issues and reduction opportunities.
- LLW Waste Reduction in Crafts at NMT and CMR: This PPOA examined crafts' material use in and around RCAs and identified procedures and approaches to reduce generation of unnecessary LLW from these activities.
- Minimization of Mercury-Containing Waste in a DX Laboratory: This PPOA examined the use of a mercury sampler at DX and identified non-mercury equipment that could be used as a replacement.
- Source Elimination at DX. This PPOA summarized the waste reductions that were realized through FY 05 through waste minimization activities. Total waste reductions for selected activities were 75%.

2.5.1 Funded Projects

The following lists are titles of GSAF projects and the amounts of funding that they received during the past five years. GSAF projects address TRU, MTRU, LLW, MLLW, HAZ, State, Solid Waste, Toxics Release Inventory Chemicals, and, beginning in FY 05, Radioactive Liquid Waste. However, the following lists only represent projects that were designed to reduce hazardous, MLLW, or MTRU waste.

In FY2001, GSAF funds were allocated to the following projects:

Reduction of Mixed and Low-Level Waste with Imaging Scanner ($23,524)
Nitric Acid Waste Elimination ($50,000)
Coolant Recovery System Upgrade and Addition ($34,500)
Chemical and Equipment Reuse System ($30,000)
Validation of New Chemical Oxygen Demand Test ($13,045)
Identification of Mercury in Sink Drains ($33,000)
Nitrate Waste Elimination ($30,000)

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

Organic Destruction of DX Waste Stream ($50,000)
Oil Characterization and Solidification ($50,000)
Solvent Still Chiller ($6,400)
Binder Ignition Oven for Materials Testing Lab ($10,000)
Granulator of Combustible TRU Waste ($112,585)
Solidification of Aqueous Liquids ($35,000)
LANSCE MLLW Reduction Project ($68,000)
Upgrade of Mercury Shutters ($121,000)

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 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 glassware used for inorganic chemical analysis. An estimated 100L per year of hazardous acid waste are now avoided.

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

- The Pollution Prevention team provided money to a research team from Bioscience Division to test a non-hazardous substitute for formamide that they developed in the process to prepare 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 DX Division to test a method for processing PETN with supercritical carbon dioxide instead of with a mixture of acetone, ethanol, and water. Using non-hazardous carbon dioxide would eliminate 250 gallons of hazardous waste annually.

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

- The Pollution Prevention team gave money to Chemistry Division to ship surplus, usable chemicals to the Chemistry Department at the University of Texas at El Paso. This project avoided the generation of approximately 60 kg 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 with some external radioactive contamination 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 30,000 kg of lead with external radioactive contamination 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 20 kg 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 switching to 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 a lot of 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. The idea is to oxidize materials such as cheesecloth and plastic contaminated with Pu-238 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 ($4111)

- The Pollution Prevention team paid to have a 7-year old ICP-AES machine and accompanying hardware sent to 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 will be tested during the next training class during January 2006.

Solidification of Liquid Residues ($25,000)

- This project examined the potential to use NoChar to solidify liquid rad 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 ($6360)

- 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 with surface radioactive contamination 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, NMT Division examined the causes of unplanned glove breaches. The data will assist in reducing the number of unexpected glove breaches, thereby reducing potential generation of TRU, MTRU, or low-level waste and also creating a safer working environment for the staff.

2.5.2 Current FY 06 Projects

FY06 GSAF projects are chosen from the submissions of Laboratory employees and funded in November. The first priority for funds is always given to projects with the potential to eliminate waste streams with no known disposal path. The second priority is given to projects that could reduce mixed TRU waste, TRU waste, MLLW, LLW, and hazardous waste. About 60% of the funds are for the solid wastes described above, and the balance is reserved for projects to minimize radioactive liquid waste. FY06 projects that support the EMS objectives and targets of a Division received additional consideration.

The following list contains titles of GSAF projects and the amounts of funding they received during FY06 that specifically address hazardous and mixed waste types.

Investigation of Chromatographic Resin Used for Trace Element Analysis ($10,000)
Recycle Nitric Acid Demonstration ($74,300)
Qualification of Recycled Nitric Acid for the Aqueous MOx PuO2 Polishing Project ($106, 978)
Acid Recycle ($30,000)
Plastic Replacement ($35,000)
Laboratory Automation to Reduce MLLW Generation ($25,000)
Eliminating high normality HCl ($20,420)
Statistical Analysis of Glovebox Failures, Part 2 ($45,000)
Elimination of Peroxide Forming Waste Stream ($12,000)
X-Ray Fluorescence Method Improvements to Reduce TRU Waste ($36,800)
MLLW Vacuum Pump Replacement ($25,000)
Sno-Machining, Part 2 ($60,000)
Plasite Paint Stripper Substitution Project ($8,000)
Tritium Sign Replacement Survey ($5,000)
Chemical Life Cycle Management ($60,000)
DX P2 Plan Development ($42,700)

3.0 Hazardous and New Mexico Special Waste

3.1 Introduction

The annual hazardous waste disposal amount reported as part of the Pollution Prevention Program DOE reporting requirements is based on the total waste disposed through the Laboratory's Solid Waste Operations (SWO) system and does not include waste generation amounts prior to on-site treatment.

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 Duratek Federal Services, a Laboratory subcontractor. This company sends 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 circumstance. Figure 3-1 shows a process map for waste generation at the Laboratory.

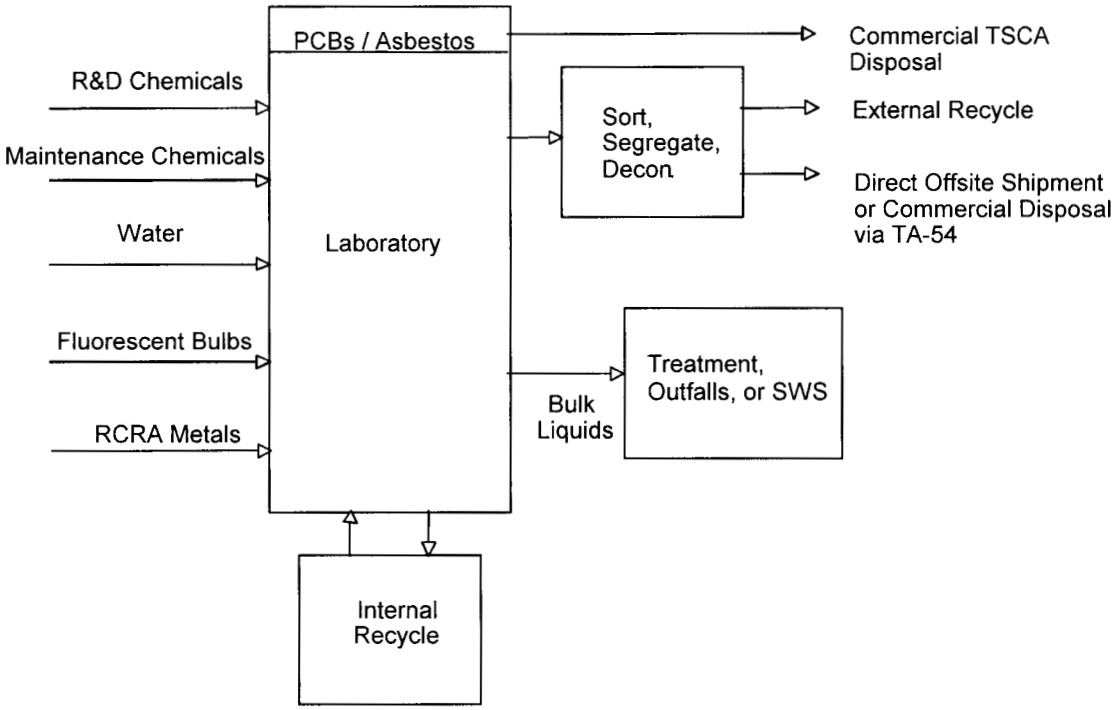

Figure 3-1. Waste process map

The quantity of routine and non-routine hazardous waste that was generated at the Laboratory and the amount of hazardous materials that were recycled during FY05 is shown in Figure 3-2.

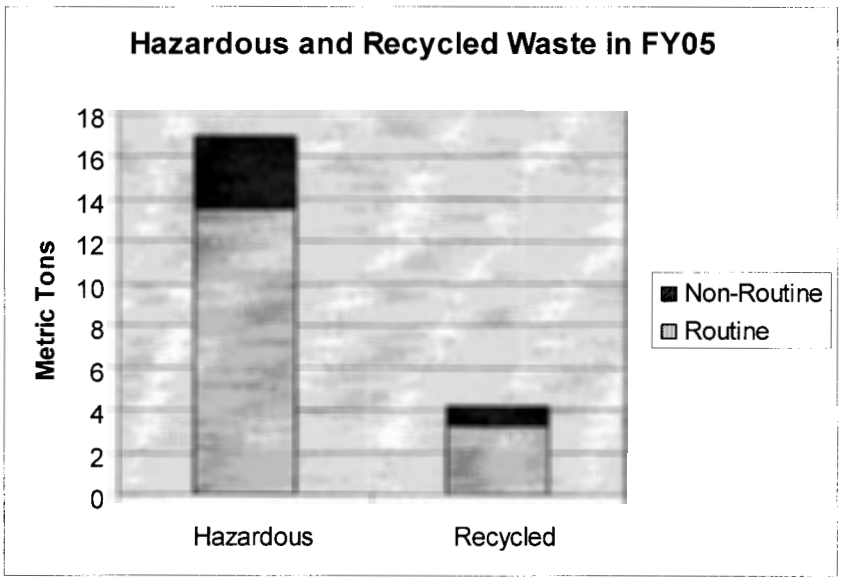

Figure 3-2. Hazardous waste and recycled hazardous materials generated during FY05

The Divisions that produced the most hazardous waste at the Laboratory during FY05 were Biosciences (B), Facility Management (FM), Chemistry (C), Material Science and Technology (MST), Dynamic Experimentation (DX), Engineering Science and Applications (ESA), and Nuclear Materials Technology (NMT). The hazardous waste generation by division is shown in the pie chart in Figure 3-3.

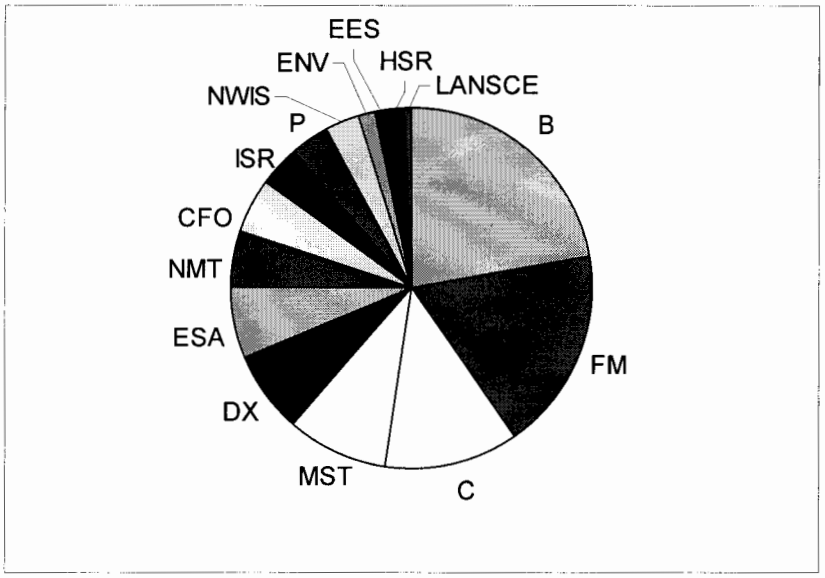

Figure 3-3. Hazardous waste by Division during FY05. This includes routine and non-routine hazardous waste generation.

3.2 Hazardous Waste Minimization Performance

The DOE Secretarial Pollution Prevention / Energy Efficiency 2005 goal was to reduce hazardous waste and New Mexico Special State waste from routine operations by 90%, using a calendar-year 1993 (CY93) baseline. The Laboratory's CY93 baseline quantity was 307,000 kg; therefore, the FY05 target was 30,700 kg. The graph created for the DOE is included in this report to illustrate the significant downward trend in routine hazardous and State waste generation over time. The DOE requires the Laboratory to separate routine and non-routine waste for reporting purposes, and the Pollution Prevention team focuses more attention on routine waste streams since they are generated from ongoing operations where prevention interventions are most applicable. Non-routine waste comes primarily from restoration activities where waste is already generated and prevention opportunities are limited.

The trend over the last several years has been good, with the FY05 goal having been met three years early in FY02. The amount of routine hazardous and State waste generated in FY05 was 14.63 metric tons, excluding recycled materials such as batteries, aerosol cans, bulbs, and elemental mercury. The Laboratory's performance in routine hazardous waste generation is shown in Figure 3-4.

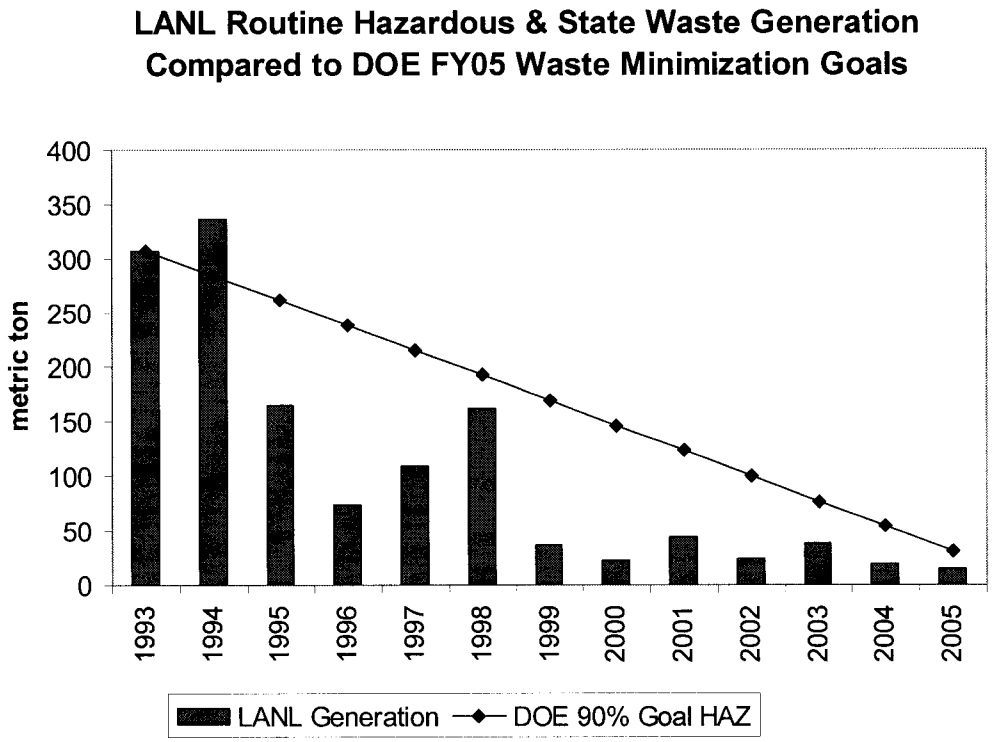

Figure 3-4. Routine hazardous and State waste generation compared with DOE's FY05 Hazardous and State Waste 90% reduction goal.

3.3 Waste Stream Analysis

Hazardous waste is derived from hazardous materials and chemicals purchased, used, and disposed of; hazardous materials already resident at the Laboratory that are disposed of as part of equipment replacement, facility replacement or decommissioning; and water contaminated with hazardous materials. After material is declared waste, hazardous waste is characterized, labeled, and collected in appropriate storage areas. The waste is then either shipped directly to offsite TSDFs or transshipped to Area L of Technical Area (TA)-54, from which the waste gets shipped to an offsite TSDF. ENV-ERS project waste is typically shipped directly from sites to commercial TSDFs. Spent research and production chemicals make up the largest number of hazardous waste items.

The largest waste streams in the Laboratory's routine and non-routine hazardous waste category for FY05 are described in section 3.3. This analysis excludes ENV-ERS wastes since this material is discussed in section 6.0. This analysis also excludes items that are recycled such as aerosol cans, batteries, and ferric chloride solution. The Laboratory also generates HE waste and HE waste waters that are treated on site, and these are also excluded. The breakdown of various components of hazardous waste for FY05 is shown in Figure 3-5.

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 available 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, 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 composes 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 the next several months to avoid having any unused amount. The Laboratory is always looking for ways to improve the chemical procurement system so that new chemicals can be delivered very quickly, and lost research time due caused by delays in chemical shipments can be avoided.

Strong Acids and Bases. A variety of strong acids and bases, such as hydrochloric acid and sodium hydroxide, 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 over 90% of this waste stream during FY05.

Hazardous Solids. This waste stream includes inert barium simulants from DX Division, soil samples, contaminated equipment, cathode ray tubes, demolition debris, and various solid chemical residues from experiments. Nearly 75% of this waste stream during FY05 was painted wallboard from a demolition project.

Hazardous Liquids. This waste stream is primarily aqueous, neutral liquids generated from a variety of analytical chemistry procedures. About half of this stream during FY05 came from spent photochemicals. This waste stream also includes cutting fluid contaminated with lead, nutrient broth, and water samples.

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

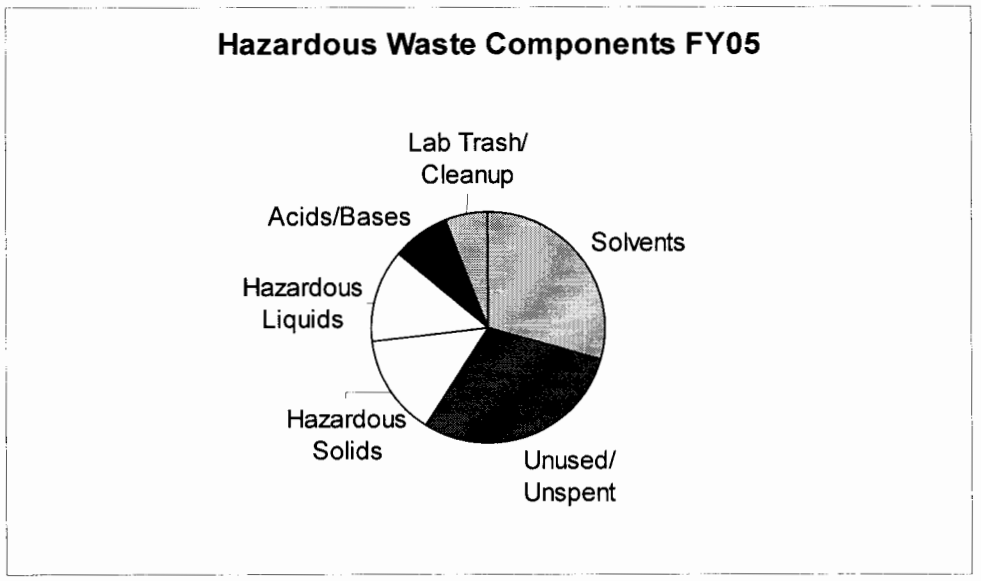

Figure 3-5. FY05 hazardous waste stream components excluding ENV-ERS waste.

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 working on a Chemical Life Cycle Management Plan that will improve chemical procurement, encourage use of surplus chemicals on-site and provide greener alternatives. Reducing chemical waste generation has many positive implications including improved efficiency, lower costs, easier compliance with environmental regulations, and a safer working environment.

3.4.1 Hindrances to Hazardous Waste Minimization

One significant component of the hazardous waste stream at the Laboratory is 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 good 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 very logistically complex.

The program would be costly from a personnel perspective since 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 is being 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 will allow researchers in the same building or nearby buildings to share unspent chemicals and reduce the number of items contributing to this waste stream.

3.5 Ongoing Hazardous Waste Minimization Programs

Lead Sharing
Several Divisions at the Laboratory maintain a supply of lead bricks for protective shielding purposes. The Laboratory has a program to share surplus lead among Divisions so that no new lead needs to be purchased. Each Division has an inventory of their stored lead reserves. Uncontaminated lead that is unnecessary anywhere at the Laboratory can be recycled offsite or recast into new shapes for internal reuse. During FY05, the Laboratory recycled 11.37 metric tons of lead.

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 surplus lead tends to be available from other Laboratory Divisions. Other lead substitutes are being used in many 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 FY05, over 230 lbs. of lead-containing cathode ray tubes from electronic equipment was removed from radiation control areas. 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 radiological control areas (RCAs), the potential for creating mixed low-level waste was significantly reduced.

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

The Laboratory does not use a bench-scale, onsite method to decontaminate lead. If lead bricks become damaged, the lead bricks can be sent to an offsite facility for recasting into new bricks or custom shapes. If lead becomes contaminated, it can be sent to a different offsite facility for decontamination.

Non-Hazardous Scintillation Fluid
Non-hazardous scintillation fluid has become commonly used at the Laboratory. No hazardous waste or mixed low-level waste scintillation fluid was generated at the Laboratory during FY05. The shift away from the hazardous variety of scintillation fluid reflects the desire of the Laboratory to improve safety for its employees and minimize impact to the environment.

Radioactive Waste Segregation
The Laboratory has had a program in place for many years to prevent the commingling of radioactive waste with other types of waste. In labs that perform work with radioactive substances, particular areas of the lab or bench are clearly marked off so that any potential contamination can be contained to a small area. The marked area in the lab contributes to overall good housekeeping procedures, and hazardous chemicals not directly involved in experiments in these marked areas can be kept away to prevent the unnecessary generation of mixed low-level waste.

Mercury Substitution
One ongoing project at the Laboratory is to replace mercury-containing thermometers 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 radiation control areas so that the generation of mixed low-level waste can be avoided. The mercury in replaced thermometers and in other obsolete mercury-containing equipment gets recycled.

Acid Waste Reduction and Recycling
The metal plating shop in MST 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 400kg of hazardous waste acid are eliminated every year.

Base Waste Reduction and Recycling
The Detonator Technology group (DX-1) uses sodium hydroxide solution to remove film resist from copper cables after etching. Over time the sodium hydroxide solution gets diluted and is no longer useful for this purpose. Instead of disposing of the spent caustic solution, it is used at the Laboratory in a process to neutralize acidic waste. The neutralization procedure works very well with the spent caustic solution. About 1200 gallons of caustic solution hazardous waste are avoided annually.

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 routine hazardous waste stream.

- Experiments in organic synthesis laboratories generate a large amount of glassware with organic residues. Solvents and oxidizing acids were formerly used to clean

this glassware, thus generating hazardous waste. Besides the generation of waste, this process is time consuming and expensive. Two organic synthesis labs purchased Tempyrox Pyroclean ovens to clean the glassware with heat. The ovens eliminate the chemicals and other problems associated with manual cleaning. The organic vapors are destroyed by a catalytic oxidizer system.

- The Laboratory's heavy equipment maintenance shop once cleaned metal parts by manually scrubbing them in solvent. The shop purchased a hot water parts washer, and the employees found that the hot water parts washer works better for cleaning metal parts than solvent. The hot water parts washer saves time for employees, decreases their chemical exposure, and reduced hazardous waste solvent generation by about 4000kg annually.

- The Material Testing Lab now 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 400kg of hazardous waste annually.

- In Bioscience Division, the solvent formamide has been eliminated from the preparation process to sequence strands of DNA. Formamide is a suspect teratogen, and Laboratory employees performed validation experiments to prove 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 National Nuclear Security Administration (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 (25mL to 2L) reaction vessels. Now the researchers use reaction vessels of 5mL or less, which reduces the volume of solvent used. Typical solvents include toluene, methylene chloride, tetrahydrofuran, and ethanol.

Coolant Waste Reduction and Recycling

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

Spill Waste Recycling and Reduction

One of the largest sources of routine State waste in the past was oil-contaminated soil from heavy equipment oil leaks on Laboratory property. The heavy equipment maintenance shop systematically replaced the aluminum hose fittings on heavy equipment with stronger

steel fittings, and the number of leaks and the amount of waste generated was reduced by over two-thirds.

The heavy equipment maintenance shop also generated routine State waste by soaking up oil spills inside the shop with vermiculite. The shop started using a different absorbent that contained oil-digesting bacteria. By storing used absorbent in a special bin for a few weeks, the oil would be completely digested, and the absorbent could be reused indefinitely within the shop. The heavy equipment maintenance shop reduced its generation of State waste and its purchases of vermiculite by over 95%. The NNSA gave the heavy equipment maintenance shop a Pollution Prevention award in 2004.

Lead-Free Ammunition

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 lbs. Historically, the Laboratory security contractor, PTLA, has used lead bullets during training exercises at the small-arms range. A lead-free ammunition project purchased 100,000 rounds of frangible lead-free ammunition for use in handguns during training exercises. PTLA received the lead-free bullets during the summer of 2005, and they will be used during the next training course that begins in January 2006.

4.0 Transuranic and Mixed Transuranic Waste

4.1 Introduction

Transuranic (TRU) waste is waste containing >100 nCi of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years (atomic number greater than 92), except for (1) high-level waste (HLW); (2) waste that the DOE has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by Code of Federal Regulations 40 CFR 191; or (3) waste that the United States Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR 61. TRU waste is generated during research, development, nuclear weapons production, and spent nuclear fuel reprocessing.

TRU waste has radioactive elements such as plutonium, with lesser amounts of neptunium, americium, curium, and californium. These radionuclides generally decay by emitting alpha particles. TRU waste also contains radionuclides that emit gamma radiation, requiring it to be either contact handled or remote handled. Mixed TRU (MTRU) waste is defined the same way as TRU waste, except that is also contains hazardous chemicals regulated under the Resource Conservation and Recovery Act (RCRA).

MTRU and TRU 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 (DOE/EM) is responsible for disposing of this waste at WIPP and for all associated costs. Newly generated waste is defined as waste generated after September 30, 1998; DOE/Defense Programs (DOE/DP) is responsible for disposing of this waste at WIPP. This report focuses only on the newly generated wastes. Within this broad category, 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.

TRU solid wastes are accumulated, characterized, and assayed for accountability purposes at the generation site. TRU solid waste is packaged for disposal in metal 55-gallon drums, 4-x-4-x-6 ft standard waste boxes (SWBs), and oversized containers. Security and safeguards assay measurements are conducted on the containers for accountability before they are removed from PF-4. TRU wastes removed from PF-4 in drums, Pipe Overpack Containers (POCs) and SWBs are shipped to TA-54, Area G for storage. Oversized containers of TRU waste are staged on an asphalt pad behind PF-4 and are shipped to TA-54. Detailed characterization of TRU wastes occurs at TA-54-34, the Radioassay and Nondestructive Testing Facility and at TA-50-69, the Waste Compaction, Reduction, and Repackaging Facility. Samples from drums are sent to the CMR building for characterization in some cases. TRU waste is stored at TA-54, Area G, until it is shipped to WIPP for final disposal. Certification of the waste for transport and disposal at WIPP is done by the TRU Certification Program group of the Nuclear Waste and Infrastructure Services Division (NWIS-TP). This work was formerly handled by the Environmental Stewardship Division before a reorganization event during November 2004. NWIS Division generates TRU wastes as a direct result of treating, characterizing, and certifying

legacy and newly generated waste produced by Nuclear Materials Technology Division (NMT). The top-level process map for TRU waste is shown in Fig. 4-1.

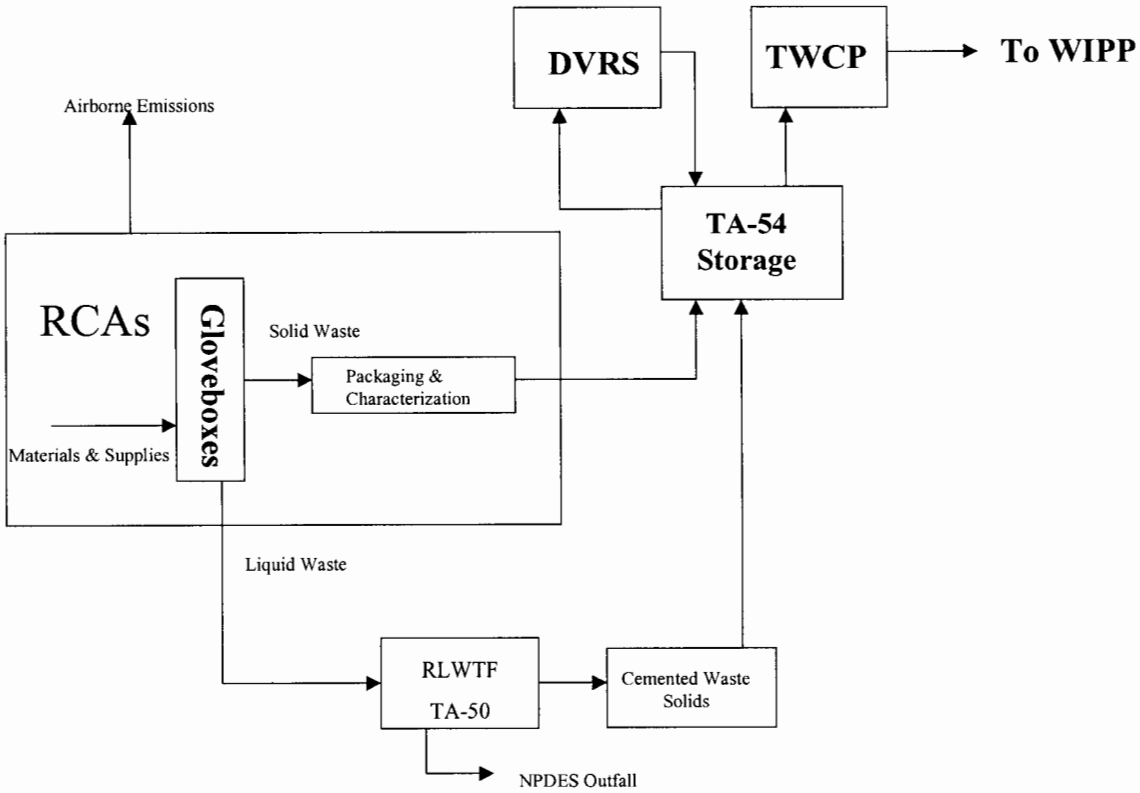

Figure 4-1. Top-level TRU and MTRU waste process map and waste streams

Materials and supplies are brought into a 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 Radioactive Liquid Waste Treatment Facility (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. Oversized TRU waste items are further processed at TA-54 through the DVRS facility where they are sized reduced and repackaged for shipment to WIPP. And finally, all waste is processed by the TRU Waste Characterization/Certification Program (TWCP) prior to shipment to WIPP.

During FY05, approximately 99% of the routine and non-routine MTRU was generated by NMT Division as a result of ongoing operations. NWIS Division contributed the other 1% of the MTRU waste generated during FY05. All of the MTRU waste from NWIS is secondary (non-routine) waste generated from the certification and repackaging of previously generated TRU waste. The D&D Program has produced TRU waste intermittently, and this waste is related directly to the area or facility being restored or decommissioned.

The total volume of routine and non-routine MTRU waste generated by the Laboratory is shown in Fig. 4-2.

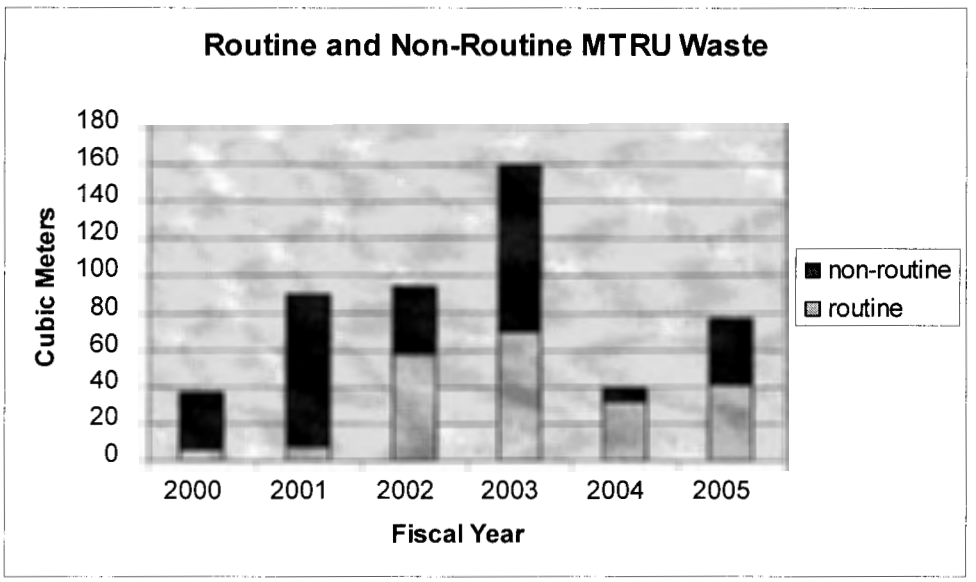

Figure 4-2. Generation rates for MTRU waste at the Laboratory

4.2 TRU Waste Minimization Performance

On March 16, 2000, a radiological release of ^{238}Pu occurred near a glovebox in the Laboratory's Plutonium Processing and Handling Facility (TA-55). As a result of the subsequent investigation and response, work within TA-55 was curtailed for the remainder of FY00 and a portion of FY01. The curtailment of operations resulted in artificially low MTRU waste generation rates for FY00 and FY01. Similarly, MTRU generation rates during FY04 were artificially low due to the shutdown of Laboratory activities during the fourth quarter. Figure 4-2 shows that the total volume of MTRU waste has decreased since 2002. Some of the annual fluctuation is a result of shipping legacy waste to WIPP in addition to newly-generated waste.

4.2.1 Future Goal Compliance

In FY01, NMT Division prepared an integrated TRU Waste Minimization Management Plan that included project descriptions, required technologies, cost, cost savings, waste reduction estimates, and implementation issues for a comprehensive set of waste avoidance/minimization activities specific to NMT Division operations. The NMT

Division philosophy and expectations for environmentally conscious plutonium processing are presented in the NMT Division Waste Management Program Plan. The goals of the Waste Management Program Plan were to reduce liquid waste by 90% and essentially to eliminate the combustible waste stream by CY03. Both plans made assumptions regarding annual funding levels and programmatic priorities.

Since the development of NMT Division Waste Management Program Plan, funding for waste minimization projects has not materialized. Waste minimization is secondary to the programmatic goals for new projects, and even ongoing waste generation reduction projects may not necessarily result in lower waste volumes. For example, the Defense Nuclear Facilities Safety Board recommendation 94-1 requires that much of the Special Nuclear Material (SNM) formerly held in the PF-4 vault for reprocessing be discarded as TRU waste. Although that material is discarded as non-routine waste, SNM material generated from ongoing activities that would have been held in the vault for reprocessing is also being discarded as routine TRU waste. Due to the actinide concentration of these waste items only a few can be packaged in each drum before the SNM limit of the drum is reached. Although the volume of the actual waste is quite small, the total volume of the drum or SWB is used to calculate waste volume. Thus a few small waste items are reported as a volume of 0.208 m^3 (55-gallons) of waste, and most of the "waste volume" is air. In addition, some waste items are being packaged in POCs to reduce the dose rate to levels acceptable for shipping and storage. The packing inside a POC limits the waste volume to approximately $1/6^{th}$ of the actual container volume. Further minimization of the waste volume results in an even smaller volume of waste being packaged in each drum.

4.3 Waste Stream Analysis

TRU wastes are generated within RCAs. These areas also are material balance areas used for security and safeguards to prevent the potential diversion of SNM. TRU and MTRU wastes are reported separately because of the different characterization requirements for the wastes. These requirements are detailed in the RCRA and the FFCO/STP—NMED, which stipulates treatment requirements for MTRU wastes. In CY99, WIPP received a "No Mitigation Variance", which allows it to accept MTRU waste for disposal without treatment. However, the characterization requirements for MTRU waste remain. MTRU waste can be shipped to WIPP without treatment, except as needed to meet storage and transportation requirements. In this report, TRU/MTRU wastes will be discussed as one waste type because the waste minimization strategy for both waste types is the same.

The TA-55 Plutonium Facility processes ^{239}Pu from residues generated throughout the defense complex into pure plutonium feedstock. The manufacturing and research operations performed at TA-55 in the processing and purification of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as possible. These recovery operations, associated maintenance, and plutonium research are the sources of TRU waste generated at TA-55.

TRU waste materials, process chemicals, equipment, supplies, and some RCRA materials are introduced into the RCAs in support of the programmatic mission. All SNM introduced into Building PF-4 at TA-55 is stored in the vault in the basement until needed

for processing. Because of the hazards inherent in the handling, processing, and manufacturing of plutonium materials, all process activities involving plutonium are conducted in gloveboxes. High levels of 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 waste. Large quantities of waste, primarily solid combustible materials such as plastic bags, cheesecloth, and protective clothing, are generated as a result of contamination avoidance measures taken to protect workers, the facility, and the environment. The percentage breakdown of that waste is shown in Fig. 4-4.

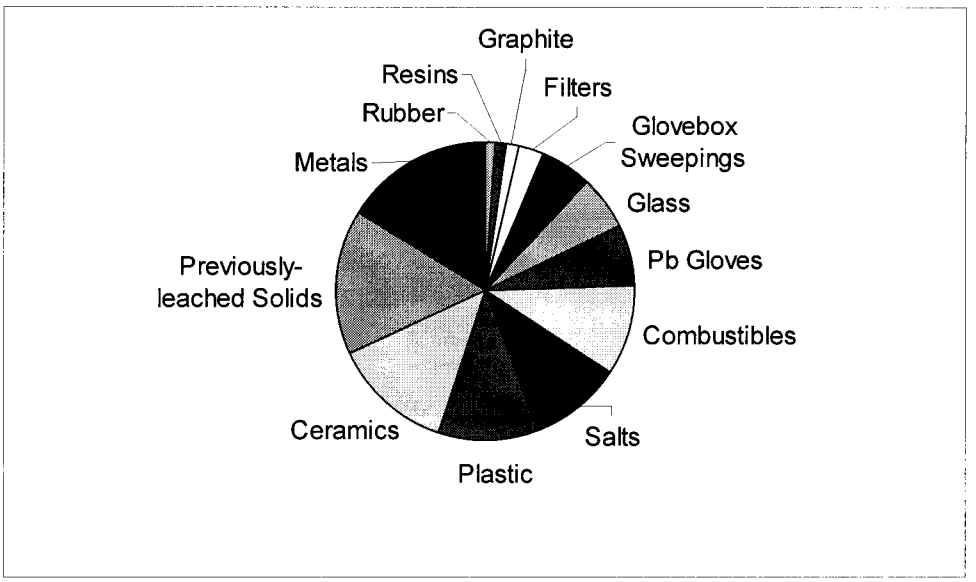

Figure 4-4. Composition of MTRU waste from NMT Division by Volume, FY05

Combustible Wastes. Combustible wastes comprise ~10% of the MTRU waste generated at the Laboratory. 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, high-efficiency particulate air (HEPA) filters, graphite, plastic, rubber, or other materials.

Nonactinide Metals. Nonactinide metals are any metallic waste constituents that may be contaminated with, but are not fabricated out of, actinide metals. 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 Improvement Projects.

Many process improvements have been identified for implementation within TA-55 and in the processing of TRU waste after it is produced. Priorities for new waste minimization projects and activities within TA-55 are detailed in the integrated TRU Waste Minimization Management Plan prepared by NMT Division in FY01. Many of the projects detailed in that plan have been terminated for technical or programmatic reasons.

MTRU waste minimization and avoidance projects are typically funded by the ENV-PP office, GSAF programs, and by operating funds. During FY05, money from the GSAF fund was used to pay for two projects designed to reduce the generation of MTRU waste.

Statistical Analysis of Glovebox Glove Failures. The causes of glove failures inside gloveboxes were compiled, and the resulting data was statistically analyzed. Having a glove fail can cause the generation of MTRU and/or other types of radioactive waste. The improved understanding of glove failures allows the researchers to recognize situations in which gloves might fail and either avoid those situations or change to new gloves before performing those activities so that waste created due to glove failures is minimized.

Bromine Replacement Project. This project evaluated the potential to replace bromine for certain separation procedures involving transuranic metals. Bromine is very corrosive and can cause steel, plastic, and other materials to wear out faster than usual. By eliminating bromine and substituting resin-based separation methods where possible, less MTRU waste is generated.

5.0 Mixed Low-Level Waste

5.1 Introduction

For waste to be considered mixed low-level waste (MLLW), it must contain RCRA materials and meet the definition of radioactive LLW. LLW is defined as waste that is radioactive and is not classified as high-level waste (HLW), TRU waste, spent nuclear fuel, or by-product materials (e.g., uranium or thorium mill tailings). Test specimens of fissionable material irradiated only for R&D and not for the production of power or plutonium may be classified as LLW, provided that the activity of TRU waste elements is <100 nCi/g of waste. Because MLLW contains radioactive components, it is regulated by DOE Order 435.1. Because it contains RCRA waste components, MLLW also is regulated by the State of New Mexico through the Laboratory's operating permit, the FFFCO/STP provided by the NMED, and the EPA. Materials in use that will be RCRA waste upon disposal are defined as hazardous materials.

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. 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.

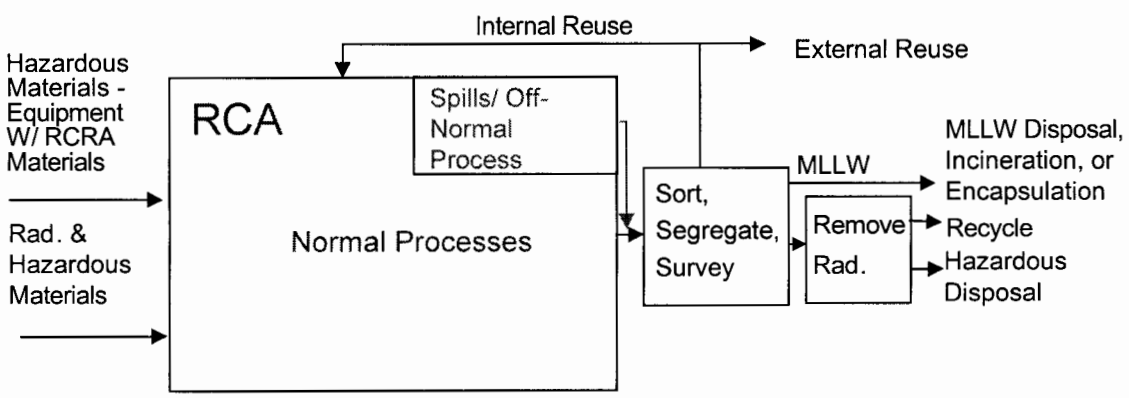

Fig. 5-1. Top-level MLLW process map

Figure 5-2 shows routine and non-routine MLLW generation by division.

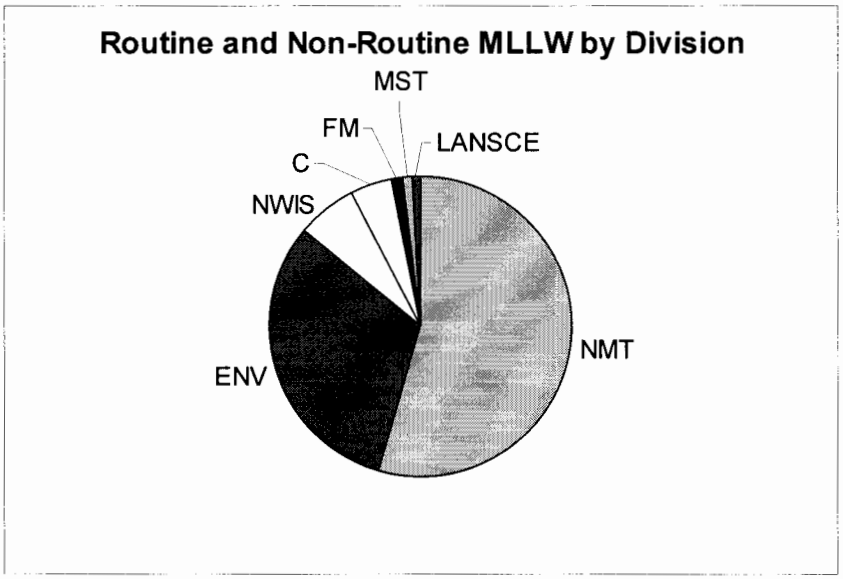

Figure 5-2. Total MLLW generated by division

The Divisions that generated the most routine and non-routine MLLW during FY05 were NMT, ENV, NWIS, and C Divisions. The largest component by far of NMT's MLLW was old gloveboxes. NMT also generated smaller amounts of copper solder joints and lead debris. The MLLW generated by ENV was all non-routine waste generated as a result of site remediation efforts. The MLLW generated by NWIS was all non-routine waste that was generated as a result of repackaging efforts. The C Division MLLW was composed of research chemicals and mercury debris.

5.2 MLLW Minimization Performance

The DOE has implemented goals for waste minimization. The DOE-proposed MLLW goal is to reduce MLLW from routine operations by 80% by 2005 using CY93 as the baseline. Because the MLLW generation in the baseline year was a low 12.3 m^3, the proposed DOE FY05 goal for routine MLLW is a very low 2.5 m^3. Routine MLLW generation at the Laboratory for FY05 was 1.89 m^3.

Figure 5-3 shows the Laboratory's progress toward achievement of this 80% routine MLLW reduction goal.

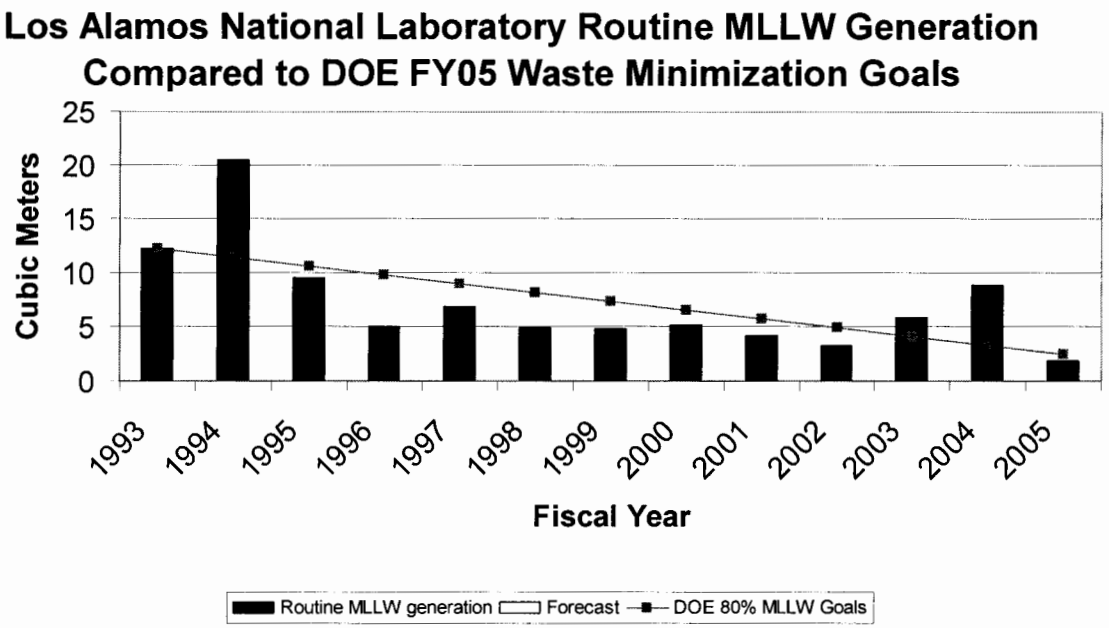

Figure 5-3. Generation of routine MLLW from 1993 to 2005

From 1998-2003, the Laboratory has averaged ~5 m^3 of MLLW generation annually. The spike in MLLW generation of 8.88 m^3 that occurred in FY04 was partially caused by some MLLW that was generated during FY99 and FY00, then placed in the STP, but was not received at TA-54 until FY04. The higher MLLW volume during FY04 does not reflect a sudden increase in MLLW generation at the Laboratory.

5.3 Waste Stream Analysis

Routine MLLW is generated in RCAs. Hazardous materials and equipment containing RCRA materials, as well as MLLW materials, are introduced into the RCA as needed to accomplish specific activities. In the course of operations, hazardous materials become contaminated with LLW or become activated, thus becoming MLLW when the item is designated as waste.

Typically, MLLW is transferred to a satellite storage 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 and removed from the MLLW category.

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. The waste is treated/disposed of by various processes, such as incineration or segregation of hazardous components and macroencapsulation.

In some cases, the Laboratory procures spent MLLW materials from other DOE/commercial sites. 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. GTS Duratek fabricates parts at no cost to the Laboratory because the fabrication costs are much less than those of MLLW lead disposal.

The largest components of the routine and non-routine MLLW stream are gloveboxes, restoration waste and environmental media samples, electronics, mercury debris, oil, and lead debris. Lower MLLW generation is anticipated in the future as environmental restorations are completed, as non-toxic materials are substituted for mercury and lead, and as oil-free vacuum pumps replace older pumps.

The relative volumes of various waste streams are shown in Figure 5-4.

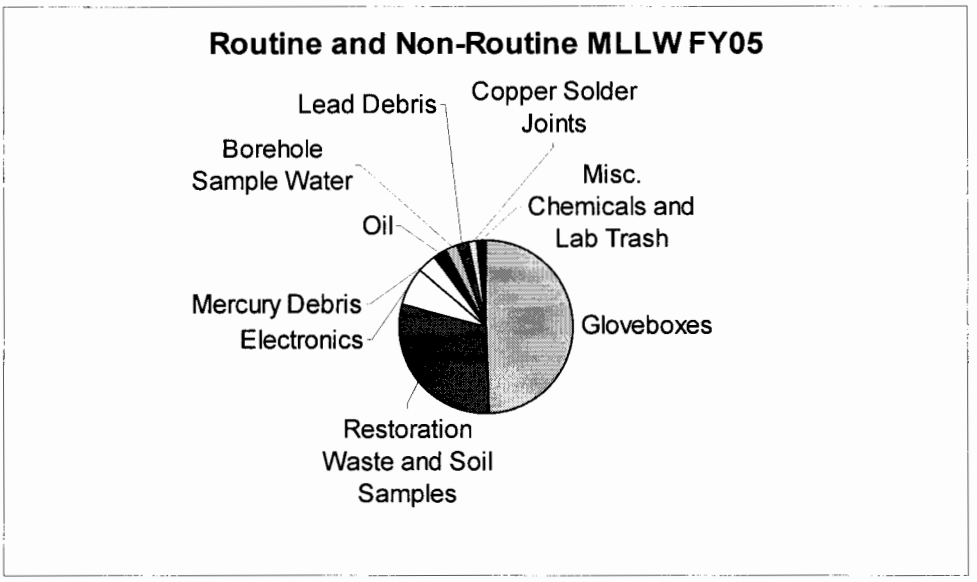

Figure 5-4. Constituents of MLLW in FY05

Gloveboxes. When a glovebox reaches the end of its useful life, it is surveyed and classified as the appropriate waste type. By eliminating the use of as many hazardous chemicals as possible, fewer gloveboxes are expected to become MLLW in the future.

Restoration Waste and Soil/Water Samples. This waste is all non-routine MLLW generated as a result of environmental restoration projects. The waste consists of personal protective equipment, soil samples, and water samples.

Electronics. 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 electronics within the RCA is evaluated.

Mercury and Lead Debris. This waste stream consists of lead for shielding, mercury compounds, and assorted equipment contaminated with either mercury or lead.

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.

Copper Solder Joints. This waste consists of the lead solder joints formed during the construction of copper piping systems.

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

Waste is disposed of either by incineration or by macro-encapsulation and land disposal. Macro-encapsulation involves potting the waste (typically solid parts) in a suitable plastic and creating a barrier around the waste. A small fraction of the MLLW generated has no disposal path. Typically, this waste is mercury or mercury compounds that became contaminated in RCAs.

5.4 Improvement Projects

Efforts to substitute alternatives and to improve sorting and segregation of these waste streams will reduce these volumes in the coming years. The P2 Program has implemented the following improvements:

- Use of lead free solder to minimize the generation of copper solder joint waste
- Substitutes for lead shielding or protective barriers to prevent radiological contamination of the lead
- Oil free vacuum pumps are being installed in RCAs to eliminate the generation of used oil. Use of low mercury bulbs in some RCAs

The Laboratory has proposed MLLW reduction projects that could reduce MLLW generation. These projects include:

- Elimination of RCRA hazardous paint strippers,
- Solidification of MLLW hydraulic oils,
- Improvements in chemical analysis processes
- Elimination of nitric acid bioassay wastes.

The Laboratory will continue to make every effort to reduce the MLLW generation to the lowest possible level consistent with funding and operational constraints.

6.0 Environmental Remediation and Surveillance Waste Minimization Awareness Plan

Introduction

Section 6.0 represents the waste minimization and pollution prevention (WMin/PP) awareness plan for the Laboratory's Environmental Stewardship (ENV) Division Environmental Remediation and Surveillance (ENV-ERS) Program. This plan supports the ENV-ERS Program's WMin/PP goals and describes its program to incorporate waste reduction practices into ENV-ERS activities and procedures. The plan was prepared by the ENV-ERS Program, formerly the Environmental Restoration Project, pursuant to the requirements of Module VIII, Section B.1 of the Laboratory's Hazardous Waste Facility Permit (NM0890010515).

Background

The mission of the Laboratory's ENV-ERS Program 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, ENV-ERS activities may generate large volumes of waste, some of which may require special handling, treatment, storage, and disposal. Because the ENV-ERS Program is tasked with investigating and, as necessary, conducting corrective actions at historically contaminated sites within the Laboratory, source reduction and material substitution are difficult to implement. The ENV-ERS Program is, therefore, faced with the responsibility and the challenge of minimizing the risk posed by contaminated sites while at the same time 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.

Purpose and Scope

The purpose of this plan is to document the ENV-ERS Program's approach for minimizing the wastes it generates. This plan discusses the goals, methods, and activities that will be routinely employed to prevent or reduce waste generation in fiscal year 2006 (FY06), and it reports FY05 waste generation quantities and waste minimization accomplishments for FY05. This plan also discusses the ENV-ERS Deputy Program Director's commitment to WMin/PP, provides a discussion of specific program elements of the ENV-ERS WMin/PP process, and presents the barriers to implementation of further significant reductions. This plan addresses all Resource Conservation and Recovery Act (RCRA)-regulated waste classifications potentially generated by the ENV-ERS Program during the course of planning and conducting the investigation and remediation of contaminant releases. Wastes generated by ENV-ERS 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 ENV-ERS Program may potentially generate the following RCRA-regulated waste classifications: hazardous waste, low-level mixed waste (LLMW); and mixed transuranic (TRU) radioactive waste.

The scope of WMin/PP efforts for an individual ENV-ERS project will be dependent on the primary and secondary wastes anticipated to be generated and the feasibility of waste reduction for those waste streams.

ENV-ERS Deputy Program Director Policy Statement and Management Commitment

The Laboratory's Deputy Program Director for ENV-ERS and all other personnel supporting the ENV-ERS Program are committed to preventing or reducing the generation of waste from ENV-ERS Program activities, as much as is technically and economically feasible and consistent with the ENV-ERS Program mission and compliance with Consent Order requirements.

The Laboratory's support for pollution prevention and waste minimization programs is documented in the Laboratory waste management requirements. Waste minimization is also included in the ENV Environmental Characterization and Remediation (ENV-ECR) Group standard operating procedures (SOPs) used to implement ENV-ERS Program activities. In addition, the Pollution Prevention (PP) Team within the ENV Solid Waste Regulatory Compliance (ENV-SWRC) Group is tasked by DOE and the Laboratory to champion and implement an aggressive waste minimization program for the entire Laboratory.

The ENV-ERS Program fully supports the Laboratory's and ENV Division's written WMin/PP policies, programs, and commitments. The ENV-ERS Program will support the goal of waste reduction by giving preference to source reduction, improved segregation and characterization, and environmentally sound recycling practices regarding waste treatment and disposal techniques, to the degree determined to be economically practicable and consistent with mission and compliance requirements. Evidence of the ENV-ERS Program commitment is demonstrated by this plan, as well as by the documentation of past waste reduction efforts within the ENV-ERS Program. The ENV-ERS Program will allocate sufficient resources to pursue the goals and approaches established by this plan and will coordinate with PP Team as necessary.

Organizational Structure and Staff Responsibilities

The ENV-ERS Program is part of the ENV Division at the Laboratory and is subject to all Laboratory and ENV Division policies and requirements. The program is operating under the organizational structure shown in Figure 6-1.

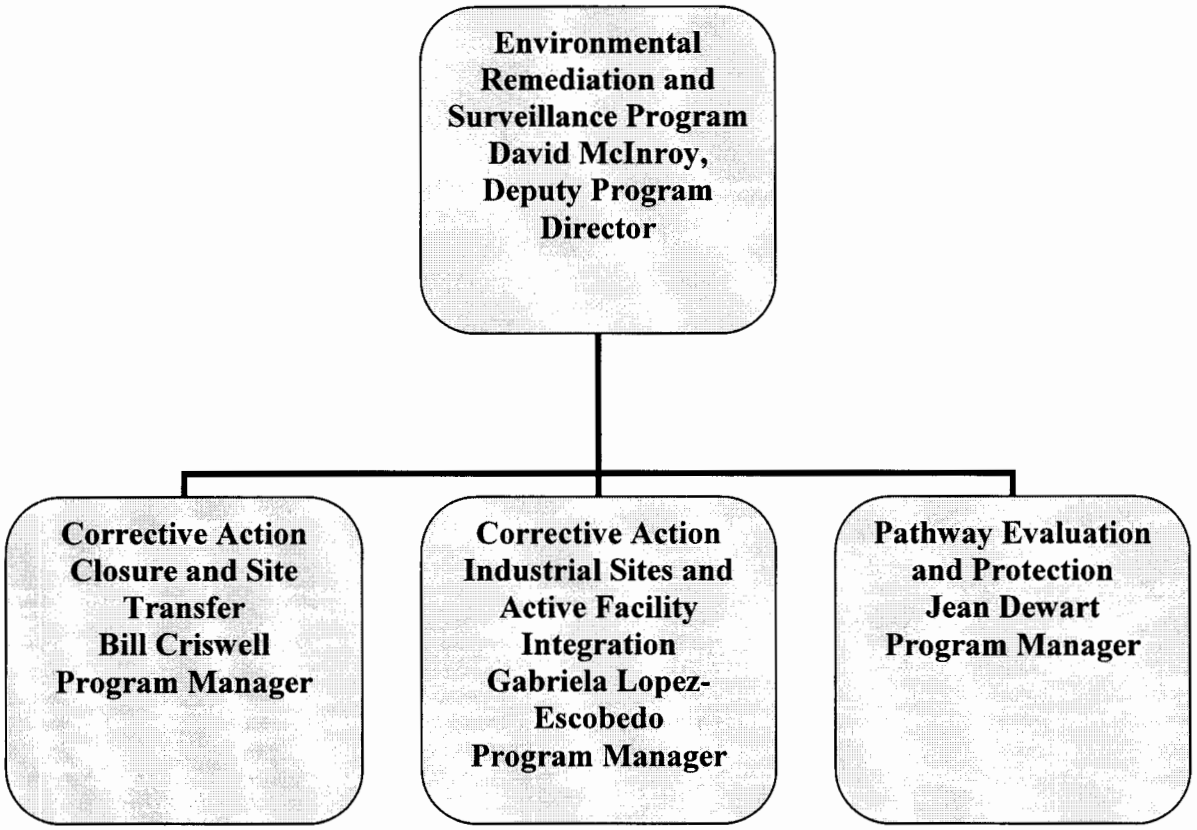

Figure 6-1. ENV-ERS Program Organization Chart

The organizational structure for developing and implementing WMin/PP programs is outlined below:

- The ENV-ERS Deputy Program Manager has primary responsibility for developing and implementing WMin/PP programs and strategies for all ENV-ERS projects that result in waste generation, as described in this plan. The ENV-ERS Program must allocate sufficient resources to attain the goals and approaches identified in this plan. The ENV-ERS Program is responsible for providing program-specific input to the annual WMin/PP plan submitted to the administrative authority, establishing WMin/PP goals and performance measures, and coordinating with the ENV-SWRC PP Team to implement WMin/PP activities and to report success stories.

- The ENV-ERS Program Office is the focal point for planning and implementing waste minimization activities and reporting waste minimization successes and lessons learned for the ENV-ERS Program. ENV-ERS Program Managers, who report to the Deputy Program Director, are responsible for assuring that ENV-ECR project leaders identify and incorporate WMin/PP practices into project plans and field activities, as much as technically and economically feasible.

- Waste management coordinators supporting the ENV-ERS Program are responsible for coordinating waste minimization activities, coordinating

proposals for waste minimization implementation projects, advising ENV-ECR project leaders on WMin/PP technologies and techniques, recommending ENV-ERS Program-wide policy, and compiling waste generation and minimization data.

Goals and Performance Measures

The ENV-ERS FY06 WMin/PP approach will focus on:

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

Figure 6-2 shows the waste management hierarchy for ENV-ERS Program wastes. Although source reduction is preferred, the ENV-ERS WMin/PP approach recognizes there may be limited opportunity for source reduction of primary wastes because the ENV-ERS Program is tasked to investigate and conduct corrective actions, as necessary, at historically contaminated sites within the Laboratory. Potential environmental concerns may require removal of contaminated material. When appropriate, source reduction of primary wastes will be accomplished through the application of risk-based cleanup criteria and associated land-use scenarios, the consideration of in situ or nonintrusive remediation technologies, and improved characterization and segregation during the execution of field activities. Source reduction of secondary wastes will be accomplished through proper planning; improved housekeeping, segregation, and characterization; and application of WMin/PP criteria during technology selection, design, and construction activities. Recycling and reuse practices will be considered for all primary and secondary wastes. Volume reduction, including size reduction, compaction, and optimal packaging, will be considered for all primary and secondary wastes for which generation cannot be avoided and which cannot be recycled.

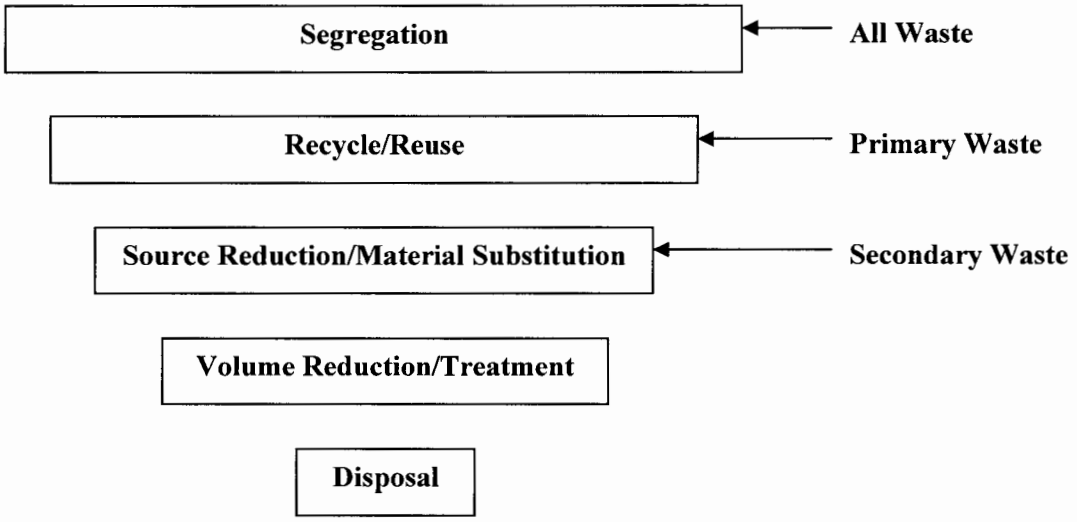

Figure 6-2. Waste management hierarchy within the ENV-ERS Program

The WMin/PP approaches outlined above are consistent with the waste reduction priorities established by the Laboratory's site-wide waste minimization plan, which recognizes the severe limitations of on-site disposal capacity for low-level radioactive waste and on-site storage capacity for LLMW. In addition, the approach was adopted to address the variable and nonrecurring nature of wastes coming from ENV-ERS activities.

Situation Analysis

The majority of FY05 waste generation was the result of investigations and accelerated corrective actions. Investigations and corrective actions implemented by ENV-ERS pursuant to the Consent Order included:

- Subsurface investigations and borehole drilling at Material Disposal Areas (MDAs) U and V in Technical Area (TA)-21, MDA C in TA-50, and MDAs G and L in TA-54.
- Removal of contaminated soil and debris at MDA V in TA-21 and the TA-16-340 Complex.
- Surface and alluvial groundwater investigations in Los Alamos/Pueblo, Mortandad, and Pajarito Canyons.
- Surface and subsurface investigations at Middle Mortandad/Ten Site and DP Site Aggregate Areas and the TA-16-340 Complex.
- Groundwater investigations at SWMU 03-010(a) and the TA-16-260 Outfall.
- Accelerated corrective actions at SWMUs 03-029, 33-013, 61-002 and

AOC 03-001(i).

- Voluntary corrective action at Consolidate Unit 19-001-19.
- SWMU assessment of SWMU 03-013(i).

In addition to Consent Order activities implemented by ENV-ERS, additional activities were conducted directly by DOE, including drilling and construction of intermediate and regional groundwater wells.

These types of activities will continue throughout the life of the Laboratory's ENV-ERS Program. The FY06 planned activities for ENV-ERS pursuant to the Consent Order include:

- Subsurface investigations and borehole drilling at MDAs A, B, T, U, and V in TA-21 and MDA C in TA-50.
- Surface and subsurface investigations at the Bayo Canyon, Pueblo Canyon, Guaje/Barrancas/Rendija Canyons, DP Site, and Middle Los Alamos Canyon Aggregate Areas and the 30's and 90's Lines at TA-16.
- Surface and alluvial groundwater investigations in Guaje, Barrancas, Rendija, Bayo, Pajarito, and Sandia Canyons and Cañada del Buey.
- Remediation of residual radioactive contamination at TA-10.
- Removal of septic tanks, drain lines, and subsurface structures within the DP Site Aggregate Area at TA-21.
- Removal of contaminated soil and debris at MDA V in TA-21.
- Removal of contaminated soil, debris, and waste at MDA B in TA-21.
- Implementation of a soil vapor extraction pilot test at MDA L in TA-54
- Accelerated corrective actions at SWMUs and AOCs impacted by infrastructure projects.

In addition to Consent Order activities implemented by ENV-ERS, additional activities are planned to be conducted directly by DOE, including drilling and construction of intermediate and regional groundwater wells and investigation and corrective actions at SWMUs 73-001(a-d), 73-004(d), and Consolidated Unit 73-002-99.

Applicable Statutory, Regulatory, and Institutional Requirements

The primary regulatory driver for the ENV-ERS Program is the Consent Order, which contains specific requirements for investigating and, as necessary, remediating releases of contaminants at the Laboratory. Specific requirements in the Consent Order include those for management of investigation-derived waste. Other key regulatory drivers for the WMin/PP program are listed 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 13148 — Greening the Government Through Leadership in Environmental Management

Federal Regulations

- Code of Federal Regulations, Title 40, Part 262, "Standards Applicable to Generators of Hazardous Waste"
- Code of Federal Regulations, Title 40, Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"
- Code of Federal Regulations, Title 40, Part 270, "EPA Administered Permit Programs: The Hazardous Waste Permit Program"

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 5400.1, "General Environmental Protection Program"
- DOE Order 5400.3, "Hazardous and Radioactive Mixed Waste Program"
- DOE Order 5400.5, "Radiation Protection of the Public and the Environment"
- DOE Order 435.1, "Radioactive Waste Management"
- Secretary of Energy Notice 37-92, "Waste Minimization Policy Statement"
- DOE Pollution Prevention Program Plan, 1996

Los Alamos National Laboratory Directives and Policies

- Los Alamos National Laboratory, Laboratory Implementation Requirement LIR 404-00-02.3, "General Waste Management Requirements"

- Los Alamos National Laboratory, Laboratory Implementation Requirement LIR 404-00-04.2, "Managing Solid Waste"
- Los Alamos National Laboratory, Laboratory Implementation Requirement LIR 404-00-05.3, "Managing Radioactive Waste"

Justification for the Use of Hazardous Materials

ENV-ERS Program activities currently introduce only small amounts of hazardous materials into field and support operations. During the past years, most use of hazardous materials has been substituted with nonhazardous alternatives in an effort to reduce the generation of secondary hazardous or mixed waste. These efforts include the following:

- Decontamination Solvents — The use of hazardous solvents has been eliminated in the ENV-ERS Program.
- Scintillation Cocktails — The routine use of scintillation cocktail media that results in a mixed waste has been discontinued at the Laboratory.
- Analytical Processes — Some samples collected for site characterization may require the use of hazardous chemicals evaluated by EPA, private companies, and universities for potential alternative processes and material substitution. The use of hazardous chemicals for sample preservation is currently viewed as necessary. In addition, hazardous chemicals are used in some field screening tests.

FY05 Waste Generation Summary

The ENV-ERS Program FY05 waste generation and waste minimization summary is listed in Table 6-1. Waste projections for FY06 are listed in Table 6-2.

Waste Type	Volume, m^3
Solid Hazardous	0.16
Solid MLLW	7.6
Solid Mixed TRU	0.0

Table 6-1. Fiscal Year 2005 Waste Generation Summary

Waste Type	Volume, m^3
Solid Hazardous	2970
Solid MLLW	195
Solid Mixed TRU	0

Table 6-2. Fiscal Year 2006 Estimated Waste Generation Summary

The large anticipated increase in waste generation from FY05 to FY06 reflects the change in project scope for ENV-ERS. Projects implemented during FY05 were primarily focused on investigation activities, which generate lower volumes of waste. Project activities in FY06 are expected to include more cleanup, including removal of contaminated soil, debris, and wastes.

Waste Minimization Accomplishments during FY05

WMin/PP was an integral part of the FY05 ENV-ERS 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 no longer reported.

Activities in FY05 were primarily related to investigations and did not result in high-volume waste streams, such as contaminated soil and demolition debris, including metal and concrete. The WMin/PP techniques used in FY05 to reduce these investigation-related waste streams led to the following accomplishments:

- Dry decontamination techniques were used almost exclusively during field investigations, thereby eliminating generation of liquid decontamination wastes.
- Accelerated corrective actions being implemented at sites in operational areas within LANL used cleanup levels based on industrial land use scenarios. This approach reduced the amount of soil and debris requiring excavation, while still being protective of human health and the environment.
- Waste segregation techniques were employed to minimize the generation of low-level radioactive waste generated during the investigations conducted at Material Disposal Area (MDA) G at TA-54. As a result, it was possible to manage spent personnel protective equipment and other wastes as nonradioactive solid waste rather than low-level radioactive waste.

The ENV-ERS Program also evaluated the potential to incorporate WMin/PP practices into future activities.

- Corrective measures to be implemented at TA-54, Area G may require large volumes of fill material for final grading of the site. ENV-ERS is presently evaluating potential sources of recycled material that could be used for fill. For example, ENV-ERS completed a feasibility study for reusing approximately 30,000 cubic yards of material from the Pajarito Flood Retention Structure for structural fill. A similar evaluation is planned for material to be excavated during construction of the Chemical and Metallurgical Research Replacement Facility.
- ENV-ERS is planning to conduct a pilot test of soil vapor extraction at MDA L. This technology involves extraction of volatile organic compounds (VOCs) from the subsurface, followed by destruction of the VOCs by catalytic oxidation. If feasible, this technology would reduce the risk associated with buried wastes at MDA L while generating minimal primary and secondary

wastes.

Waste Minimization Program Elements

Listed below are the Laboratory's ENV-ERS Program waste minimization program elements for FY06. The elements will be implemented if economically and technically feasible.

Waste Management Coordinators

The waste management coordinators supporting ENV-ERS will have a primary role in FY06 for developing and implementing programmatic elements of the ENV-ERS WMin/PP Program by conducting the following activities:

- Improve WMin/PP awareness and information exchange within the ENV-ERS Program.
- Provide technical reviews and WMin/PP input for ENV-ERS documents and procedures, such as corrective measures studies, sampling and analysis plans, or other project work plans and provide working examples of "model" documents that incorporate WMin/PP elements.
- Provide technical assistance and consistency among ENV-ERS projects to formalize standard approaches for WMin/PP in ENV-ERS plans and procedures and institutionalize the use of design reviews, WMin/PP checklists, or value engineering for WMin/PP applications.
- Assist in developing WMin/PP language for ENV-ERS subcontractor documents and project specifications, thus providing incentives and measurable goals for waste reduction.
- The waste management coordinator(s) will provide WMin/PP tools and practices to the ENV-ERS Program. The specific application and waste reduction potential of a tool will be dependent on the specific project and will be left to the judgment of the individual project leaders. The common WMin/PP tools for use in the ENV-ERS Program are summarized in the list that follows.

WMin/PP tools for the planning phase

- Write WMin/PP into ENV-ERS Program documents
- Include WMin/PP in budgets and contracts
- Integrate WMin/PP into construction of engineered structures and best management practices
- Train ENV-ERS personnel on WMin/PP and build WMin/PP awareness

WMin/PP tools for the assessment phase

- Conduct efficient sample management and analysis

- Consider alternative sampling techniques
- Consider alternative drilling techniques
- Segregate materials and waste through field screening
- Use site control techniques
- Use bulk waste packaging
- Train ENV-ERS personnel on WMin/PP and build WMin/PP awareness

WMin/PP tools for the alternative evaluation and selection phase

- Identify WMin/PP as a key criterion during treatment selection
- Incorporate WMin/PP in key decision-making documents
- Conduct treatability studies that support WMin/PP
- Train RRES-RS personnel on WMin/PP and build WMin/PP awareness

WMin/PP tools for the implementation phase

- Scour and decontaminate building materials
- Recycle and reuse materials from decommissioning activities
- Prevent contamination migration
- Dedicate a person on each ENV-ERS project to promote WMin/PP
- Reuse equipment
- Train ENV-ERS personnel on WMin/PP and build WMin/PP awareness

WMin Planning

WMin/PP is best integrated during the project planning (including design and engineering) phase. WMin/PP strategies incorporated during the planning phase are some of the few opportunities for "source reduction" because they have the potential to avoid or reduce the generation of contaminated soil and building debris, which represent a significant waste volume within the ENV-ERS Program. Well-defined agreements (with regulators and stakeholders) regarding land-use scenarios, cleanup performance standards, and risk and pathway scenarios are highly effective in avoiding or reducing these primary wastes (e.g., soil, building debris) and secondary wastes.

The Permits and Requirements Identification (PR-ID) process provides a tool in the planning and design phase to assist Laboratory personnel in identifying and managing environment, safety, and health Laboratory implementation requirements having the potential to impact a project. This process incorporates evaluation of potential waste

generating activities before project startup and includes review by a waste minimization/pollution prevention subject-matter expert.

The ENV-ECR waste management standard operating procedures (ER-SOP-01.06, "Management of ER Project Waste" and ER-SOP-01.10, "Waste Characterization") also afford an opportunity to incorporate WMin/PP into project planning. In accordance with these procedures, a strategy for characterizing and managing each waste stream that will be generated during an ENV-ERS project must be developed and approved by the waste management coordinator before the waste stream can be generated. During the strategy review and approval process, the waste management coordinator can identify WMin/PP practices and incorporate these into the strategy. During FY06, SOP-01.06 will be revised to include formal review and documentation of WMin/PP as part of the WCSF review and approval. This will help assure that WMin/PP opportunities for each ENV-ERS waste stream are evaluated prior to generating wastes.

Employee Training and Awareness

Waste minimization implementation is most effective when all employees consider WMin/PP part of their job responsibilities. To accomplish this, a planned approach to building waste minimization awareness has been developed. The goals of the awareness program are to:

- Improve recognition among employees that WMin/PP practices apply to ENV-ERS activities;
- Educate employees about successful implementation at the Laboratory and within DOE; and
- Improve documentation of WMin/PP accomplishments.

WMin/PP is also an integral part of the environmental management system (EMS) being implemented at the Laboratory. All staff working on the ENV-ERS Program have received EMS awareness training and may receive additional EMS training as the system continues to be implemented.

All waste management coordinators supporting the ENV-ERS Program are required to attend quarterly meetings as ongoing training in issues important to performing the duties of a waste management coordinator, including periodic updates from the ENV-SWRC PP Team.

Laboratory managers are required to attend integrated safety management training, which addresses management of all environment, safety, and health issues, including waste minimization and pollution prevention awareness.

Information and Technology Introduction

The introduction of new technologies for WMin/PP and waste management approaches is important to minimizing wastes. To support technology exchange, the waste management coordinator is available to research technologies or WMin/PP tools for ENV-ERS project

leaders, as necessary to obtain information on technical or economic feasibility. Some sources for documents include:

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
DOE, Technology Information Exchanges Conferences and Abstract Summaries
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

Tracking and Reporting

The Consent Order requires that waste management documentation be submitted with all investigation and corrective action reports submitted by the Laboratory. This documentation includes the types, volumes, and disposition of wastes generated by individual ENV-ERS projects.

Sort, Decontaminate, and Segregate

This task is currently implemented and is designed to sort and decontaminate recyclable/recoverable radioactive LLW materials from decommissioning operations for the purpose of eliminating their disposal at TA-54 as radioactive LLW. Typical sorting practices include collection of all metal debris (including steel, lead, etc.) in separate boxes destined for shipment to a decontamination facility or commercial smelter for metals recovery. Decontamination work will involve the removal of surface radioactive contamination on equipment to allow for its reuse either at Los Alamos or other DOE facilities.

Additionally, many sites containing radioactively contaminated heterogeneous materials will place emphasis on proper segregation at the source to attain the maximum recycling and waste classification advantages.

Compaction

The ENV-ERS Program plans to improve this process by using the compaction unit at TA-54 on suitable waste before final disposal. The compactor at TA-54 has a higher compaction yield than past equipment.

Survey and Release

Past practices have conservatively classified nonindigenous investigation-derived waste (e.g. personal protective equipment, sampling materials) as contaminated, based on association with contaminated areas. New policy within the Laboratory allows the ENV-ERS Program to develop procedures to survey and release these materials as nonradioactive. This will reduce the volume of radioactive LLW disposed of at Area G

from RRES-RS activities. Waste management coordinators will be trained in the Laboratory occupational radiation protection requirements.

Risk Assessment

Risk assessments are routinely conducted for ENV-ERS Program 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.

Incentives

The ENV-ERS Program participates in the Laboratory-wide "Waste Minimization/Waste Generation Set aside Tax" system. This system charges waste generators according to the volumes and toxicity of wastes generated. This financial burden is an incentive for waste generators to reduce waste generation to lower total project costs. The ENV-ERS Program has previously submitted Return on Investigation proposals for WMin/PP projects that are eligible for funding through this tax.

Lead-Handling Procedures

The ENV-ERS Program does not routinely procure or use lead or handle excess lead. The inventory and decontamination of existing lead at the Laboratory has been conducted as part of a milestone of the Laboratory's Federal Facilities Compliance Act agreement and is outside the scope of the ENV-ERS Program.

ENV-ERS personnel will manage and minimize the amount of lead-contaminated waste using the following approaches.

- Projects will specify a preference to avoid the procurement or use of lead, when possible, giving preference to the use of steel in place of lead.
- Projects will specify the use of strippable or washable coatings for any lead materials that must be used and have the potential to become contaminated.
- Projects will plan for the decontamination of lead materials, when economically feasible, using blast grit, carbon dioxide blast (or other nondestructive blast), or chemical decontamination techniques. Preference will be given to decontamination techniques that minimize the generation of secondary waste (from the treatment process).
- Projects that handle no contaminated lead waste as a primary waste from the removal action or decommissioning activity will make efforts to recover and redistribute the lead for use at the Laboratory or at another DOE facility.

- Projects will coordinate with the Laboratory's Solid Waste Operations Group for the appropriate handling and disposition of radioactively contaminated lead that cannot be decontaminated or redistributed.

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 will produce waste reduction and cost savings in FY05. When reusable equipment is decontaminated, it is standard ENV-ERS practice to use dry decontamination techniques to minimize the generation of liquid decontamination wastes. In addition, the Laboratory has 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 delays the point at which the equipment is no longer needed and must be disposed.

Barriers to Waste Minimization Implementation

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

- The amount of investigation-derived waste generated during investigations conducted under the Consent Order has increased relative to investigations conducted under Module VIII. The investigation scope has increased under the Consent Order, resulting in the drilling of more boreholes and generation of more investigation-derived waste. Previous practices by ENV-ERS included returning borehole cuttings to the borehole if this would not increase the potential for contaminant migration. This practice is not allowed under investigation work plans approved pursuant to the Consent Order and cuttings are now containerized and disposed of.

- The use of risk assessments to establish risk-based cleanup levels is one of the few opportunities available to the ENV-ERS Program 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, of 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.

- Wastes generated by ENV-ERS projects may contain low, but detectable, concentrations of constituents from RCRA listed hazardous wastes. The presence of these constituents would cause the waste to be regulated as a hazardous waste. The NMED may determine that such wastes "no longer contain" listed hazardous waste and need not be regulated as hazardous waste if the concentrations of listed waste constituents are below risk-based levels. The ENV-ERS Program has previously requested and received these "no-longer-contained-in" determinations to reduce to volumes of hazardous and MLLW wastes generated by investigations and cleanups. Recently, ENV-ERS has not been able to obtain "no longer contained in"

determinations for waste streams containing trace levels of listed solvents at concentrations below human-health risk levels. As a result, these wastes had to be managed as MLLW, increasing the amount of MLLW generated by ENV-ERS.

- The single largest potential source of waste generated by ENV-ERS is removal of buried waste or contaminated soil during implementation of corrective measures. Such actions have the potential to generate tens to hundreds of thousands of cubic meters of waste. In evaluating corrective measure alternatives, ENV-ERS would 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 ENV-ERS Program has little control over the amount of waste to be generated during implementation of corrective actions.

REFERENCES

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

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

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