Permit

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NATIONAL LABORATORY

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Date: November 22, 2004
Refer To: ENV-SWRC:04-085

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NOV 2004
NMED Hazardous
Waste Bureau

SUBJECT: 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. The report was prepared pursuant to the requirements of Module VIII, Section B.1 of the Laboratory's Hazardous Waste Facility Permit (NM0890010515-1).

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 further progress in the future.

Please contact me by phone (505 665-72510 or e-mail (dlh@lanl.gov) if you have any questions.

Sincerely,

Dr. Dennis L. Hjeresen
Program Manager, Pollution Prevention and Sustainability

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Document: Waste Minimization Report
Date: December 2004

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Kenneth M. Hargis

Kenneth M. Hargis
Division Leader
Environmental Stewardship Division
Los Alamos National Laboratory

11/17/04
Date Signed

Gene Turner for

Edwin L. Wilmot
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Owner/Operator

11/18/04
Date Signed

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December 2004

Los Alamos National Laboratory

Waste Minimization Report

Los Alamos
NATIONAL LABORATORY

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 annually submit a 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 Remediation Services Project (ENV-RS) WMin/PP goals and describes its program to incorporate waste reduction practices into ENV-RS 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 [1], 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 guidance2, 58 F.R. 10[2], "Guidance to Hazardous Waste Generators on the
Elements of a Waste Minimization Program." 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)[3]. 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 fiscal year 2005 (FY05), and it reports FY04 waste generation quantities and significant waste minimization accomplishments for FY04. 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-RS 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-RS 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 2.2.0
Section B.1.(a)(2)	Employee Training	Section 2.6.3
Section B.1.(a)(2)	Incentives	Section 2.6.10
Section B.1.(a)(3)	Past and Planned Source Reduction and Recycling	Section 2.5.4
Section B.1.(a)(4)	Itemized Capital Expenditures	Section 2.5.4
Section B.1.(a)(5)	Barriers to Implementation	Section 2.7.0
Section B.1.(a)(6)	Sources of Information	Section 2.6.4
Section B.1.(a)(7)	Investigation of Additional WMin Efforts	Section 2.6.2
Section B.1.(a)(8)	Utilization of Hazardous Materials	Section 2.5.2
Section B.1.(a)(9)	Justification of Waste Generation	Section 2.5.0
Section B.1.(a)(10)(a)	Site Lead Inventory Program	Section 2.6.11
Section B.1.(a)(10)(b)	Steel for Lead Substitution Program	Section 2.6.11
Section B.1.(a)(10)(c)	Lead Shielding Coating Program	Section 2.6.11
Section B.1.(a)(10)(d)	Lead decontamination Program	Section 2.6.6
Section B.1.(a)(10)(e)	Scintillation Cocktail Substitution Program	Section 2.5.2
Section B.1.(a)(10)(f)	Radioactive Waste Segregation Program	Section 2.6.6

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-RS 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). 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.

LANL's en vironmental 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 Incentives 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 the environmental management system is implemented, an all-employee awareness module features P2 as a key mechanism for environmental management.

The Laboratory requires generators to minimize waste and conduct prevention measures assessments in waste management guidance documents and in the newly released work planning requirements under the Integrated Work Management Implementation Procedure (IMP 300-00-00.0).

Another management program in place at the Laboratory is the Permits and Requirements Identification (PR-ID) process, which is a tool designed to assist Laboratory personnel in identifying and 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 waste minimization/pollution prevention subject-matter expert.

A periodic email message is sent out to all Laboratory administrative personnel regarding recycling events and waste minimization opportunities at the Laboratory and in the surrounding communities. This weekly message is often forwarded to entire groups or posted in common areas of buildings.

The Laboratory's ENV-PP Program, NNSA, and DOE-EH Headquarters sponsor annual pollution prevention awards programs. Both of these programs provide financial awards and recognition to personnel who implement pollution prevention projects.

The Pollution Prevention team holds a Pollution Prevention award ceremony every year in conjunction with other Earth Day activities. All Laboratory employees can submit descriptions of projects they completed during the past year that contributed to waste reduction at the Laboratory. At the award ceremony, each participating individual and team is recognized for their efforts with award certificates. Winning UC employees also receive a cash bonus. The Laboratory submits nominations for the DOE/NNSA Headquarters Award each year. Two awards were made to Laboratory projects in FY 04. FY03 and FY 04 projects yielded over $7,000,000 in savings to the Laboratory.

Each year the Pollution Prevention team also 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 preferred, but one-time waste reduction projects also receive funding in some instances.

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 will be lowered on taxes and waste disposal fees by reducing the amount of waste produced, so researchers have multiple incentives to minimize waste. The rate of return for these GSAF projects is in excess of 230%.

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 serves on the Governing Board of the Green Chemistry Institute, the EFCOG environmental subcommittee, and he is also a member of the U.S. Green Building Council. Three team members belong to the New Mexico Recycling Coalition, and one serves on their Board. One team member co-chairs the National Pollution Prevention Roundtable's Federal Facility Work group and has actively participated in the organization since its inception. Two team members serve on the Los Alamos County Solid Waste Advisory Board, and one is the vice-chair. Several team members belong to the National Registry of Environmental Professionals, and at least 20 Laboratory employees recently submitted applications for membership in this organization. One team member belongs to the Institute of Hazardous Materials Managers.

In FY04, the Pollution Prevention team worked with a local environmental group called the Pajarito Environmental Education Center to sponsor Earth Day activities for the community. The Pollution Prevention team gets information on waste source reduction and recycling from local environmental organizations as well as ideas from other DOE environmental managers.

The Pollution Prevention Team relies on internet resources such as the US Environmental Protection Agency sponsored P2 Rx, a national pollution prevention information network, US DOE websites, and vendor websites. Staff regularly attends conferences on pollution prevention and sustainable design sponsored by the Department of Energy, Tradeline, Labs 21, National Pollution Prevention Roundtable, and other organizations. The Laboratory also participates in quarterly P2 conference calls hosted by DOE. On occasion, vendors are invited to LANL to make presentations to the staff regarding new equipment or technologies that could be used to save time, work better than an existing process, or reduce the volume or toxicity of waste produced. Depending on cost and availability of funding, scientists can try promising new equipment or technologies at LANL. The Pollution Prevention team provides the necessary funds for some of the equipment that can reduce waste through the GSAF program. We do a quarterly P2 program review with DOE Pollution Prevention staff.

2.4 Justification for the Use of Hazardous Materials

The Laboratory is a research and development 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 includes 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 required in some research projects due to customer requirements, project specifications or the basis of the research.

2.5 DOE Routine and Non-Routine Reporting Requirements

For the purposes of reporting waste minimization performance for the DOE, the Laboratory distinguishes between routine and non-routine waste generation. For the purposes of waste generation, the definition of routine generation results from production, analytical, and/or other research and development (R&D) laboratory operations; treatment, storage, and disposal operations; and "work for others" or any other periodic and recurring work considered to be ongoing. Non-routine waste is cleanup stabilization waste and relates mostly to the legacy from previous site operations, construction, or any other waste stream not considered to be generated on a routine basis. The amount of non-routine waste often varies significantly from year to year, depending on demolition and decommissioning activities, environmental restoration, construction, or clean-out activities. Therefore, focusing on the change in the amount of routine waste generated over time is a better reflection of the ongoing pollution prevention and waste minimization efforts taking place at the Laboratory.

For the purposes of reporting for the DOE P2 goals, the ENV-PP Program excludes wastes that are recycled, scrap metal that cannot be recycled due to the DOE metal recycle suspension.

Any information other than that regulated by the New Mexico Hazardous Waste Regulations is provided to the NMED for informational purposes only.

3.0 Hazardous and State 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 system and does not include wa ste 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, defines hazardous waste as any solid waste that:

- is not specifically excluded from the regulations as hazardous waste;
- is listed in the regulations as a hazardous waste;
- exhibits any of the defined characteristics of hazardous waste (i.e., ignitability, corrosivity, reactivity, or toxicity);
- is a mixture of solid and hazardous wastes; or
- is a used oil having more than 1000ppm 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 (SWS) or the high-explosives 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/or 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. The actual cost varies with the circumstances; however, the average cost for onsite waste handling by solid waste operations (SWO) and offsite disposal is $6.49/kg. Figure 3-1 shows a process map for waste generation at the Laboratory.

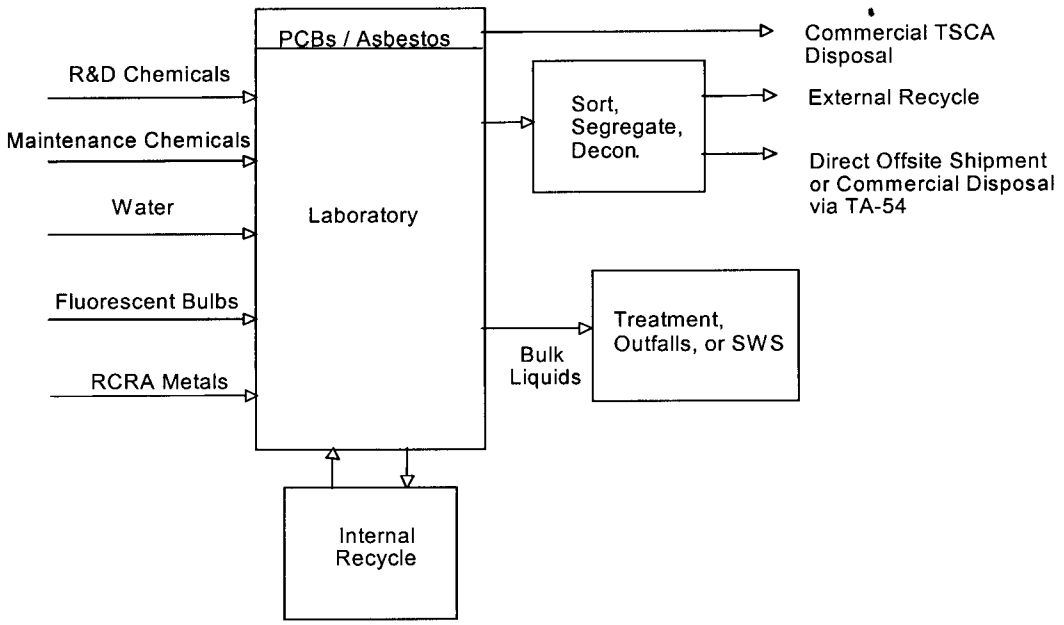

Fig. 3-1. Waste process map.

The quantity of routine and non-routine hazardous waste that was generated at LANL and the amount that was recycled during FY04 is shown in Figure 3-2.

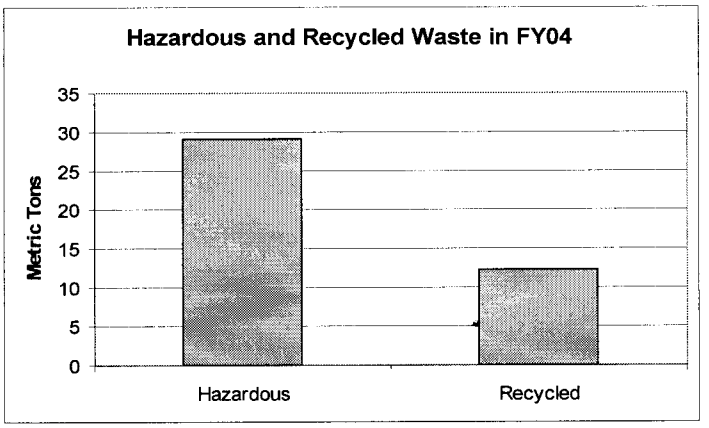

Fig. 3-2. Relative weights of waste by type generated during FY04. These waste amounts exclude ENV-RS wastes.

The divisions that produced the most hazardous waste at the Laboratory during FY04 were Nuclear Materials Technology (NMT), Biosciences (B), Material Science and Technology (MST), Chemistry (C), Dynamic Experimentation (DX), and Engineering Science and Applications (ESA). The hazardous waste generation by division is shown in the pie chart in Figure 3-3.

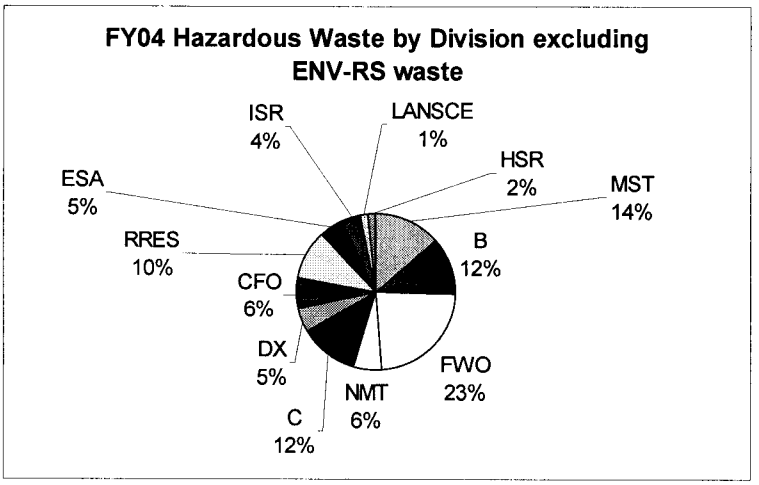

Fig. 3-3. Hazardous waste by Division during FY04. This includes routine and non-routine hazardous waste generation.

3.2 Hazardous Waste Minimization Performance

The DOE Secretarial Pollution Prevention/ Energy Efficiency (P2E2) 2005 goal is to reduce hazardous waste and State waste from routine operations by 90%, using a calendar-year (CY)93 baseline. The Laboratory' s CY93 baseline quantity was 307,000 kg; therefore, the FY05 target becomes 30,700 kg. State waste, for the purposes of DOE reporting, includes TSCA and New Mexico Special Waste.

The trend over the last several years has been good, with the fiscal year (FY)05 goal having been met in FY02. The amount of routine hazardous and State waste generated in FY04 was less than was generated during FY03. The Laboratory' s performance in routine hazardous waste generation is shown in Figure 3-4.

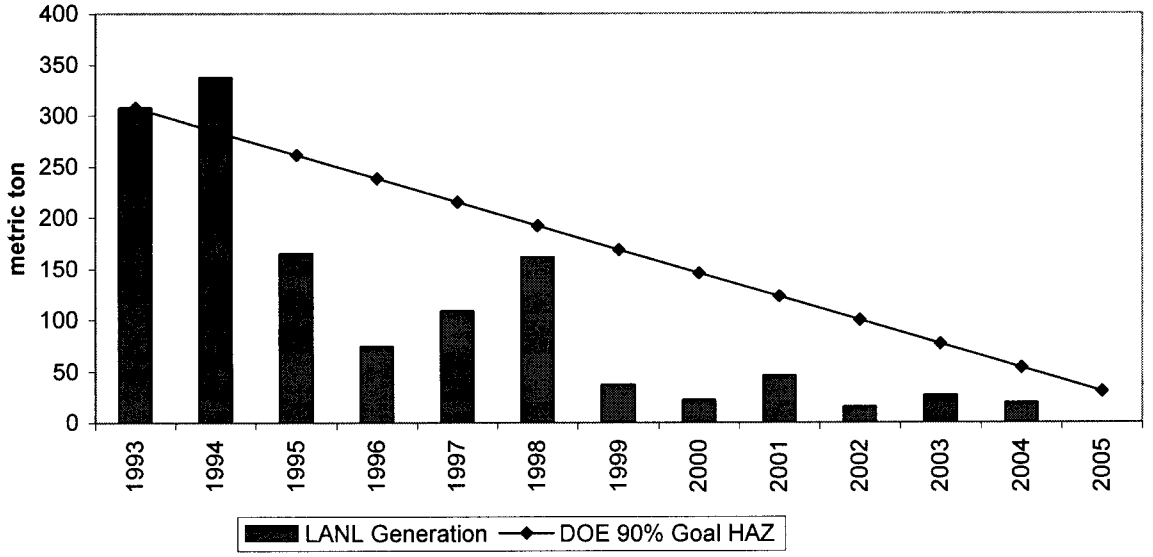

Fig. 3-4. Routine hazardous and State waste generation compared with the DOE's FY05 Hazardous and State Waste 90% reduction goal.

Routine hazardous waste decreased sharply from FY98 because the Laboratory began excluding recycled hazardous waste from the hazardous waste total. Routine hazardous waste generation unexpectedly increased in FY01. A major factor was the disposal of hazardous wastes that had been recycled in the past. Approximately 10,250 kg of hazardous waste that could have been recycled was instead sent off site for disposal. This action resulted from a conflict between the Laboratory' s performance measure for hazardous waste minimization and the waste management performance measure to process waste as quickly and cost effectively as possible. Thus, disposal was chosen over recycling. This issue has been resolved, and recyclable wastes have been recycled since then.

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, Technical Area (TA)-54, from which the waste gets shipped to an offsite TSDF. ENV-RS project waste is typically shipped directly from RS 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 hazardous waste category for FY04 are described in the following list in section 3.3. This list excludes ENV-RS wastes since this material which is discussed in section 6.0. The Laboratory also has HE and HE waste waters that are treated on site, and these are not included on the following list.

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 routine 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 haz ardous 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 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. Acidic liquids become hazardous waste if they have a pH of 2.0 or less, and basic liquids become hazardous waste if they have a pH of greater than 12.5. 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. Over 90% of the basic liquid waste generated during FY04 came from scrubber solution that contains sodium hydroxide from MST Division.

Hazardous Solids. Approximately half of the hazardous solids generated at the Laboratory during FY04 were inert solids containing barium used by DX Division to simulate explosive material in experiments. Over one third of this waste stream was just a few items of equipment that had become contaminated with lead and were no longer needed. Volumes of hazardous solids decrease as smaller samples can be used

for experiments and as hazardous chemicals are replaced with appropriate non-hazardous substitutes.

Rags and Spill Clean-up. Rags are used for cleaning parts and equipment. Absorbent pads and cloths are used to clean up various spills. The majority of this material is used for cleaning up non-hazardous liquids, and it is classified as State waste. Rags and absorbents become hazardous waste if the material absorbed has EPA-listed or characteristic waste codes applied to them. 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.

Laboratory Trash. This waste stream consists of contaminated wipes, glassware, pipettes, and laboratory equipment that could not be reused or recycled. These common laboratory items become hazardous waste when they become contaminated with chemicals that have EPA-listed or characteristic waste codes applied to them and are no longer needed for the experiment. The total volume of lab trash decreases when new procedures are developed to perform experiments with very small quantities of chemicals and when appropriate non-hazardous substitutes are found for existing chemicals.

The largest waste streams in the routine hazardous waste category for FY04 are shown as a percent of routine, non-recycled hazardous waste in Figure 3-5. It is evident that these streams do not account for all of the hazardous waste. Much of the hazardous waste is composed of many small items such as lab equipment, contaminated containers, and miscellaneous chemicals.

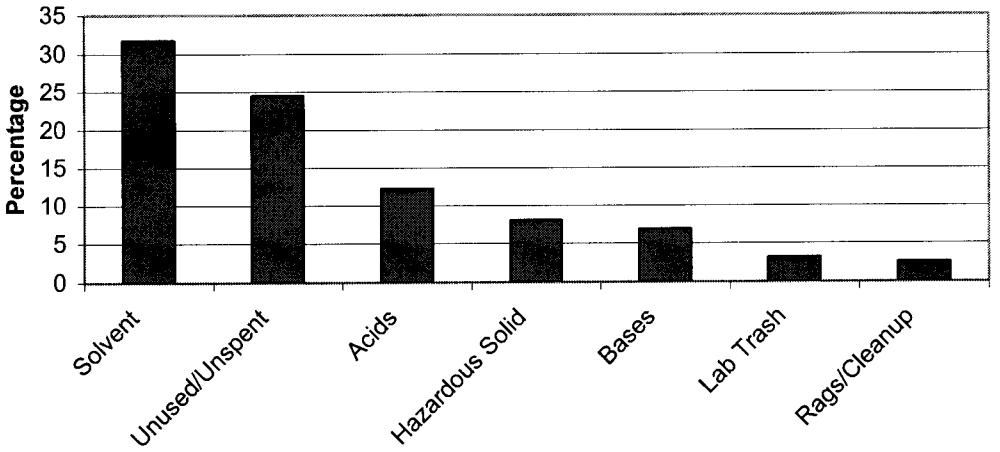

Fig. 3-5. FY04 routine hazardous waste stream components.

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. LANL follows good laboratory practices and gives its employees extensive training 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. 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. If a research project is discontinued, the scientists no longer have any need for some of the chemicals that were allocated to that project. In some cases of project discontinuation, these chemicals are distributed to other researchers who can use them in the same building.

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. A chemical pharmacy is being piloted within one technical area. However, this option is not practical at the Laboratory as a whole facility 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.

FY04 was unusual due to the mandatory work shutdown that began in mid July. As part of restart procedures, each group was asked to perform Management Self-Assessments (MSAs). All research laboratories with chemicals were closely examined to find potential sources of risks, and most groups used time during the shutdown to initiate substantial cleanouts of unnecessary chemicals. Extra hazardous waste resulting from these MSA laboratory cleanouts is expected to appear during FY05.

In the future, a program currently under development at the Laboratory is expected to reduce the volume of unused and unspent hazardous chemicals generated. If feasible, the Life Cycle Chemical Management Program will require all cost packages to incorporate appropriate life-cycle costing to cover disposition of wastes, excess equipment, and facilities. Since waste costs will have a higher profile with all

researchers at the Laboratory in the near future, it is expected that more waste minimization and pollution prevention projects will take place to reduce costs.

3.5 Improvement Projects

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.

3.5.1 Funded Projects

The following lists are titles of GSAF projects and the amounts of funding that they received during the past five years. Descriptions of these projects are available on the Laboratory's Pollution Prevention website (p2.lanl.gov).

In 1999, GSAF funds were allocated to the following projects:

Waste Minimization and Microconcentric Nebulization ($20,000)
Plutonium Ingot Storage Cubicle ($100,000)
Nitric Acid Recovery ($19,280)
55-Gallon Drum Recycle ($8,000)
Reduction of Acid Wastes and Emissions ($129,020)
Reduction of Photochemical Waste ($33,000)
Solid Phase Extraction System for Oil and Grease Determinations ($18,178)
Real-Time Surface Contamination Detector ($15,000)
Purchase and Install Laboratory Glassware Washers ($21,040)
Installation of Sump Computer Monitoring Equipment ($26,000)
SM-391 Hazardous Waste Reduction Project ($14,500)

In 2000, GSAF funds were allocated to the following projects:

Ion Beam Polish/Etch of Plutonium Alloys ($55,000)
Plutonium Oxidation State Diagnostic for Chloride Line ($113,400)
PF-4 Trichloroethylene Upgrade ($85,200)
Mixed Low-Level Cask Reuse and Recycle ($30,000)
Mercury-Contaminated Rad Waste Reduction ($20,000)

Oil-Free Vacuum Pumps ($48,400)
Oil Recycle Staging Area ($5,100)
Ozone Treatment for HE Wastewater ($85,000)
Machine Turning and Chip Recycling ($100,000)
Recycling Bisco Cabinets ($10,000)
Material Recycling Facility Baler ($100,000)
Cardboard Compactor ($62,662)
Nitric Acid Waste Reduction ($24,028)
Size Reduction for Inorganic Analysis ($10,370)
Recycling Equipment at TA-3 Paint Shop ($1,695)

In 2001, 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)
Sustainable Design Changes to Engineering Standards ($16,000)
Identification of Mercury in Sink Drains ($33,000)
Nitrate Waste Elimination ($30,000)
Nitrogen Oxide and Greenhouse Gas Reduction ($10,000)

In 2002, GSAF funds were allocated to the following projects:

TA-35 and TA-48 Cooling Tower Optimization ($88,000)
Green is Clean Verification Equipment Upgrades ($35,000)
Recycling of Non-Rad Metal from Radiation Control Areas ($64,500)
Organic Destruction of DX Waste Stream ($50,000)
Verification of Scrap Metal Release Surveys ($15,000)
Oil Characterization and Solidification ($50,000)
Solvent Still Chiller ($6,400)
Binder Ignition Oven for Materials Testing Lab ($10,000)
Biodiesel Infrastructure Modification ($30,000)
Outdoor Storage Shed for Recycling ($3,000)
Job Control Waste Minimization ($25,000)
TA-48 Chiller Replacement ($200,000)
Granulator of Combustible TRU Waste ($112,585)
New Compactor Boxes ($20,000)
Solidification of Aqueous Liquids ($35,000)
LANSCE MLLW Reduction Project ($68,000)
Upgrade of Mercury Shutters ($121,000)

Composting ($25,000)
Glass Recycling ($25,000)

In 2003, GSAF funds were allocated to the following projects:

Small Scale Granulator and Compactor for TRU Waste ($119,640)
Pyroclean Oven for Organic Synthesis Laboratory ($17,000)
Chemical Pharmacy ($50,000)
Lead Waste Minimization and Recycle ($42,500)
Cost and Waste Reduction in Ultra-Trace Cleaning Operation ($37,667)
Non-Hazardous Resuspension Solution for DNA Sequencing ($56,632)
Processing of PETN with Supercritical Carbon Dioxide ($50,000)
Waterless Urinals Pilot Project ($1,500)
Reuse of CMR Surplus Chemicals at UTEP Chemistry Department ($1,200)

3.5.2 Current and Ongoing Projects

The following list contains titles of GSAF projects and the amounts of funding they received during FY04. Descriptions of these projects are available on the Laboratory's Pollution Prevention website (p2.lanl.gov).

In 2004, GSAF funds were allocated to the following projects:

Contaminated Lead and Scrap Metal Abatement ($35,000)
Recycling Shipment of Lead from Radiation Control Areas ($35,000)
Micro-Scale Chemistry ($5,000)
Barium Removal Using Ion Exchange at the HEWTF ($8,200)
Implementation of Granulation and Compaction Technology at TA-55 ($135,120)
WITS Liquid Waste Module ($50,000)
Oil-Free Vacuum Pumps at LANSCE Lujan Target ($91,530)
Cable Stripper for DU Contaminated Firing Site Cables ($69,000)
PF-4 Blower and Vacuum Cleaner Pre-Filters ($32,800)
Aerosol Puncturing Unit ($1,000)
Precious Metals Recovery by Electrowinning ($15,000)
Development of Bench Scale Molten Salt Oxidation Processes for Treating Pu-238 Contaminated Combustible Waste ($89,500)

The projects described below have been funded and currently are being executed. In some cases, the remedies are administrative actions that have been taken to resolve conflicting goals. Hazardous waste reduction projects are funded by the Defense Programs (DP)-funded Pollution Prevention Program, the GSAF Program, and various mission 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.

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 FY04, about 1600kg of electronic equipment with lead-containing cathode ray tubes were removed from radiation control areas. The items were carefully surveyed for contamination, and when none was found, they were sent away for disposal as nonroutine hazardous waste. By removing these items from radiation control areas (RCAs), the potential for creating mixed low-level waste, which is much more difficult to handle than hazardous 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 more commonly used at the Laboratory. In a search of FY04 waste record descriptions for "scintillation", all of the resulting records were labeled as either non-hazardous or low-level waste. No hazardous waste or mixed low-level waste scintillation fluid was generated at the Laboratory during FY04. 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.

Source Segregation.
The Laboratory has had a program in place for many years to prevent the commingling of hazardous or radioactive waste with other types of waste. For example, 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.
By replacing mercury-containing thermometers with non-mercury thermometers, 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 LANL 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.

- Organic synthesis laboratories generate a large amount of glassware covered with organic residues. Solvents and oxidizing acids were 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 Pyroclean ovens (www.tempyrox.com) 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 mainten ance 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 national Pollution Prevention award in 2004.

Chemical Pharmacy in Chemistry Division
The Applied Chemicals Technologies (C-ACT) group has one of the largest chemical inventories at the Laboratory. Maintenance of large chemical inventories is time consuming and expensive, but these inventories are the result of multiple laboratories located at different areas and the need to maintain a large enough variety of chemicals to respond to different R&D and analytical requests in a timely manner. Duplications within the overall chemical inventory are common. Without coordination, sharing and reuse of chemicals among labs does not often occur. C-ACT is in the process of establishing a formal inventory coordination system within the group so that employees can access lists of chemicals available in the inventory and easily borrow chemicals from other C-ACT labs at the same site. By consolidating the chemical management and procurement into one unified system, duplications and the quantity and number of unused, unspent, or surplus chemicals can be reduced dramatically. If C-ACT can demonstrate the success of its system, other groups at the Laboratory may follow their example.

3.5.3 Proposed Projects

These projects or actions have been proposed to allow further reduction in the routine hazardous waste stream and to improve operational efficiency. Many projects are currently unfunded. If implemented, these projects will provide an additional margin against unexpected and unplanned increases in hazardous waste generation.

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 100lb reporting threshold. Historically, the Laboratory has used lead bullets during training and qualification for PTLA (a Laboratory subcontractor) security force personnel exercises at the small-arms range. This lead-free ammunition project will purchase 100,000 rounds of frangible lead-free

ammunition to be used for handguns in training exercises. PTLA personnel will test these bullets against the standard bullets to determine if they could be a permanent replacement for the lead bullets used in future training.

Methyl Ethyl Ketone (MEK) Recycle Unit.
DX Division is hoping to use a solvent distillation unit to recycle the MEK used in explosives research. Recycling MEK would prevent the generation of approximately 300 gallons of hazardous waste solvent annually. If the MEK distillation project is successful, DX Division might consider recycling other types of solvents as well.

4.0 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 yr (atomic number greater than 92), except for (1) high-level waste (HLW); (2) waste that the Department of Energy (DOE) has determined, with the concurrence of the Administrator of the Environmental Protection Agency (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 managed as either contact handled or remote handled. Approximately half of the TRU waste analyzed is mixed TRU (MTRU) waste, containing both radioactive elements and hazardous chemicals regulated under the Resource Conservation and Recovery Act (RCRA).

The total volume of TRU waste managed by the DOE—currentlyin inventory (storage) and projected through 2034—isestimated to be ~171,000 m^3. TRU waste is disposed of at the Waste Isolation Pilot Plant (WIPP), a geologic repository near Carlsbad, New Mexico.

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 roadmap 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 nonroutine wastes. Solid wastes include cemented residues, combustible materials, noncombustible materials, and nonactinide metals. Liquid wastes comprise effluent solutions associated with the nitric acid and hydrochloric acid plutonium-processing streams. Because of the final pH of these streams, they are also referred to, and are reported as, the acid and caustic waste streams, respectively. Routine waste is defined as waste produced from any type of production operation, analytical and/or research and development (R&D) laboratory operations; treatment, storage, and disposition facility operations; "work for others"; or any other periodic and recurring work that is considered ongoing in nature.

Nonroutine is defined as one-time operations waste: wastes produced from environmental restoration program activities, including primary and secondary wastes associated with retrieval and remediation operations, legacy wastes, and decontamination and decommissioning (D&D)/transition operations. TRU and MTRU wastes are reported separately because of the differing characterization requirements applied to them. These requirements are detailed in the RCRA and the Federal Facilities Compliance Order/Site Treatment Plan (FFCO/STP).

The Nuclear Materials Technology (NMT) Division conducts and provides support for scientific research and development on strategic nuclear materials in Category I nuclear facilities, the Plutonium Facility [Technical Area (TA)-55-PF4] and the Chemistry and Metallurgy Research (CMR) Facility (TA-3, Building SM-29, in support of the Nation's defense needs. The Division plays a significant role in each of the following major programs:

- Stockpile Management: manufacture and certification of nuclear weapons components.
- Stockpile Stewardship: disassembly and evaluation of nuclear weapons components.
- Materials Disposition: preparation of nuclear materials for long-term storage and the production of MOX fuels.
- Energy: manufacture of heat sources for the Nation's space exploration program.
- Environment: establish technical basis for long-term storage and development of more efficient processes for recovery of nuclear materials.

NMT Division's tech nical role in these programs is to:

- install the capabilities to manufacture specified pits,
- to produce nuclear materials for manufacture and surveillance,
- to assist in the material characterization in order to understand aging phenomena,
- to disassemble, sample, and evaluate pits,
- and to design and operate prototype facilities for the disposition of excess nuclear materials.

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-gal. 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 55-gal. 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, Building 34, the Radioassay and Nondestructive Testing (RANT) Facility; and at TA-50, Building 69, the Waste Compaction, Reduction, and Repackaging Facility (WCRRF). 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 the responsibility of the Environmental Stewardship (ENV) Division's Transuranic Certification (ENV-CE) and Transuranic Characterization (ENV-CH) Groups. TRU waste shipments to WIPP began on March 25, 1999, and are expected to continue through 2032. ENV Division and FWO Division generate TRU wastes as a direct result of treating, characterizing and certifying NMT-Division-produced waste (both legacy and newly generated). The top-level process map for TRU waste is shown in Fig. 4-1.

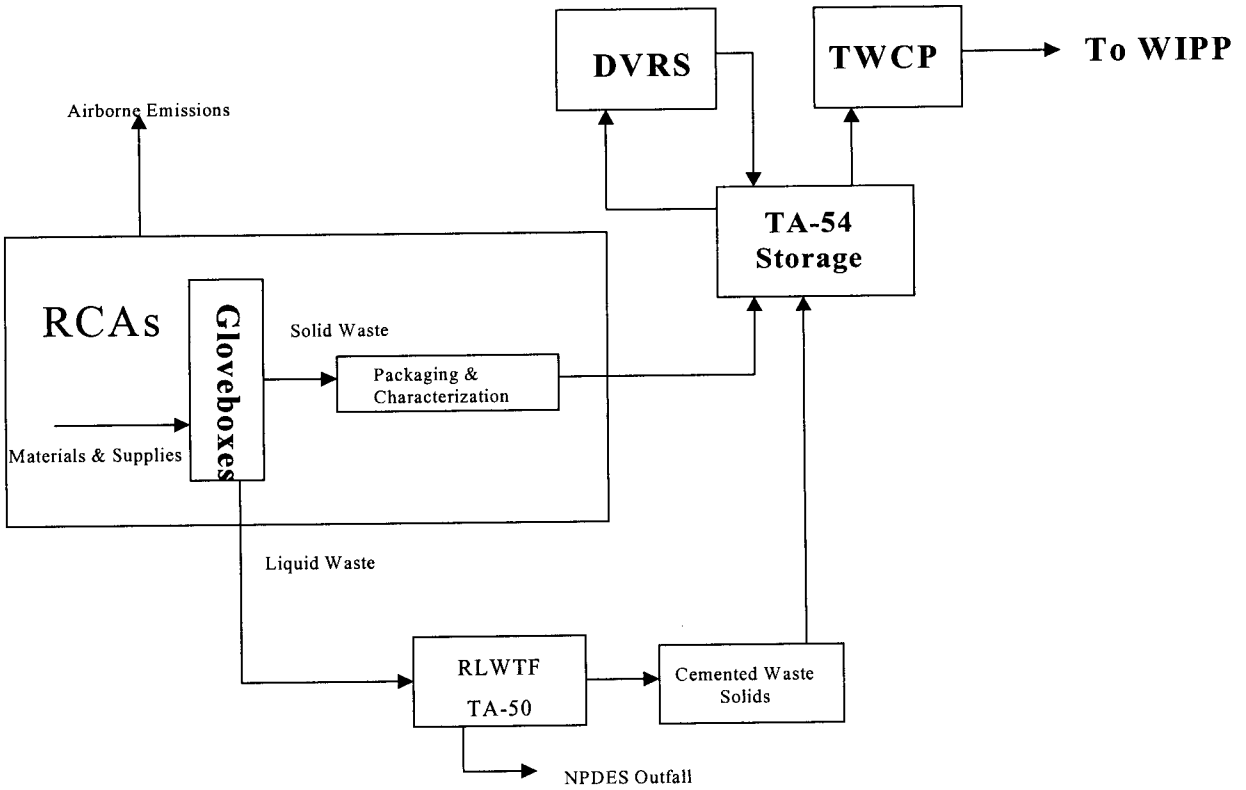

Fig. 4-1. Top-level TRU waste process map and waste streams.

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 and characterized and then shipped to TA-54 for storage. Liquid wastes are sent to the RLWTF for treatment. The radionuclides and other contaminants are removed as a cemented solid waste at the RLWTF and shipped to TA-54 for storage, and the remaining liquid is discharged to a NPDES permitted outfall. 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 TWCP prior to shipment to WIPP.

Figure 4-2 shows the relative volumes of routine and nonroutine TRU and MTRU generated in FY04 by LANL organizations. All of the ENV TRU waste is secondary (non-routine) waste generated from the certification and repackaging of previously generated TRU waste. FWO-Waste Facility Management (WFM) TRU waste was generated from the treatment of the NMT Division liquid waste streams at the Radioactive Liquid Waste Treatment Facility (RLWTF). NMT Division waste was generated from ongoing operations.

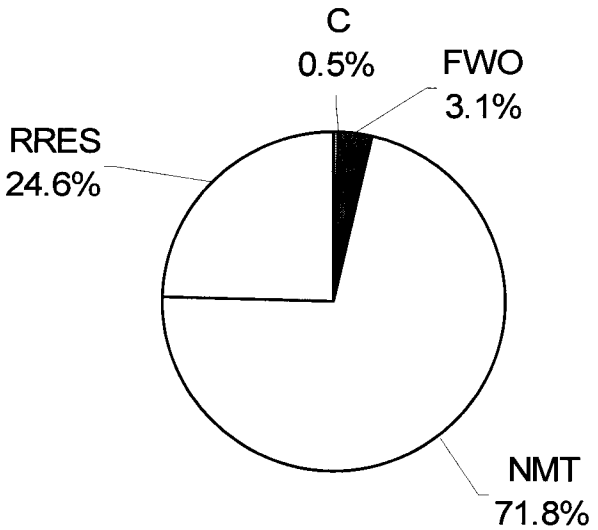

Fig. 4-2. TRU and MTRU waste generating organizations.

The total volume of TRU waste generated by the Laboratory is shown in Fig. 4-3 and is identified as routine, nonroutine, and environmental remediation waste. The ENV-RS Project has produced TRU waste intermittently; this waste is related directly to the area or facility being remediated or decommissioned. In FY97, significant quantities were generated because of the D&D of TA-21, which was the old uranium- and plutonium-processing site. On March 16, 2000, a radiological release of ^{238}Pu occurred near a glovebox in Los Alamos National Laboratory's (the Laboratory's) Plutonium Processing and Handling Facility (TA-55). As a result of the subsequent Type A Accident Investigation and the response to that investigation, work within TA-55 was curtailed for the remainder of FY00 and a portion of FY01. The curtailment of operations resulted in artificially low TRU waste generation rates for FY00 and FY01. Similarly, in the last quarter of FY-04, all Laboratory operations were shutdown to address safety and security issues reducing TRU waste generation rates. Changes in packing guidelines resulting in lower weight limits resulted in increase in routine waste generation values in FY03.

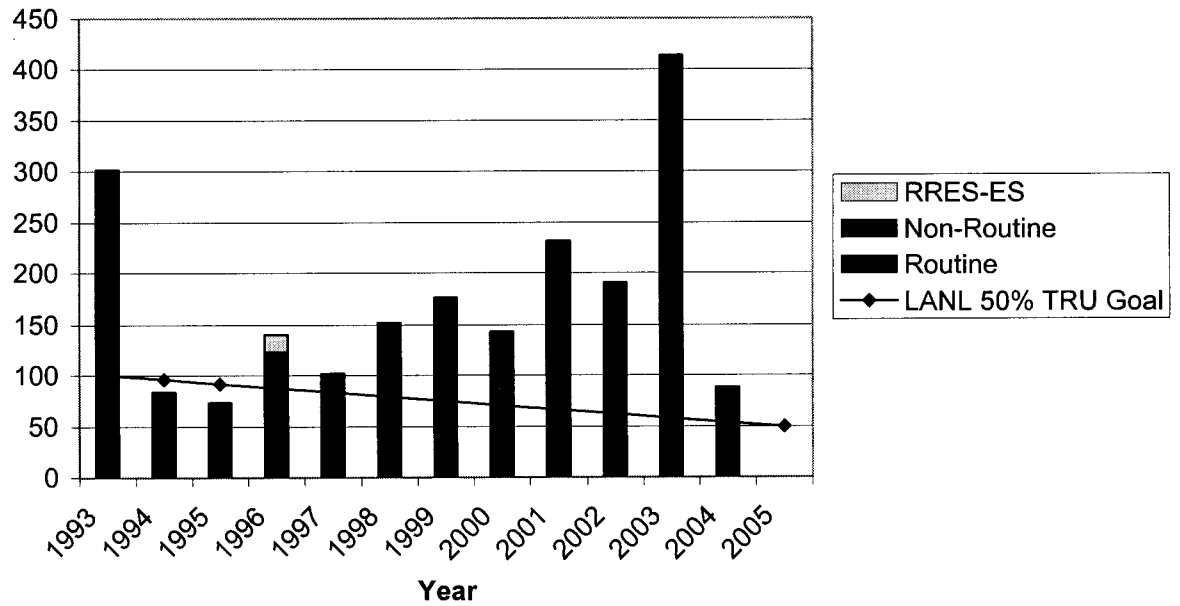

Fig. 4-3. Generation rates for TRU waste at the Laboratory.*

*All data are for FYs. Data for 1995 obtained from EM/ES: 96-350 letter of baseline corrections submitted to the DOE in December 1996. Data for 1996 to 1999 were obtained from previous reports to the DOE on waste generation and are stored in the "t wilight.saic" database. Data for 1999 to 2004 were obtained from the solid-waste operation (SWO) database "swo on".

4.2 TRU Waste Minimization Performance

The DOE 2005 pollution prevention goals require that the DOE complex reduce "routine" TRU/MTRU waste generation by 80% to <141 m^3 by 2005. The Laboratory's allocation of that 141 m^3 has not been determined but only the Laboratory and the Savannah River Site have ongoing missions related to the use of plutonium. However, the Laboratory must reduce its present generation rate if the DOE is to achieve that goal. Between 1993 and 1998, the amount of routine TRU waste generated by the Laboratory increased from 76.7 to 133 m^3 (73%). To help achieve the DOE complex-wide goal, the Laboratory set an FY05 performance goal that includes decreasing routine TRU waste generation by 50% to 50m^3 from a baseline of 100m^3 (See Figure 4-3).

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 and waste minimization is secondary to the programmatic goals for new projects. Ongoing waste generation reduction projects may not necessarily result in lower waste volumes. For example the DNFSB recommendation 94-1 requires that much of the SNM formerly held in the PF-4 vault for reprocessing be discarded as TRU waste. Although that material is discarded as nonroutine 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, volume of the shipping container (Drum or SWB) is used to calculate waste volume. Thus a few small waste items are reported as a volume of 0.208m3 (55-gallons) of waste. Most of the "waste volume" is air. In addition, some waste items are being packaged in 55-gallon Pipe Overpack Containers (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. Minimizing the waste volume further results in an even smaller volume of waste going into each drum.

4.3 Waste Stream Analysis

TRU wastes are generated within radiological control areas (RCAs). These areas also are material balance areas (MBAs) used for security and safeguards to prevent the potential diversion of special nuclear material (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—NewMexico Environment Department (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 the following sections, TRU/MTRU wastes will be discussed as one waste type because the waste minimization strategy for both waste types is the same. As shown in Fig. 4-5, MTRU waste is ~65% of the routine TRU waste stream.

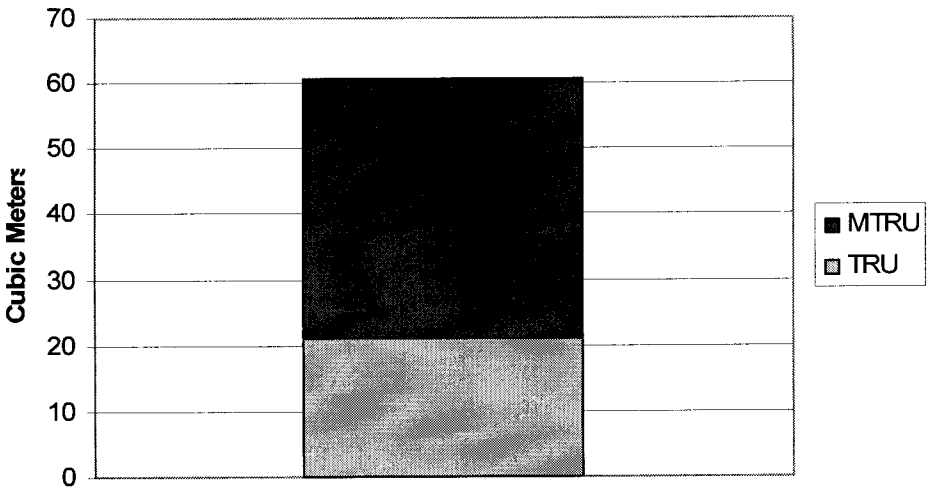

Fig. 4-5. The proportion of Laboratory-generated mixed TRU waste

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 is practical. These recovery operations, associated maintenance operations, and TA-55 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 PF-4 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 because of leaking process equipment. All materials being removed from the gloveboxes must be multiple-packaged to prevent the spread of contamination outside the glovebox. 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. 4-6.

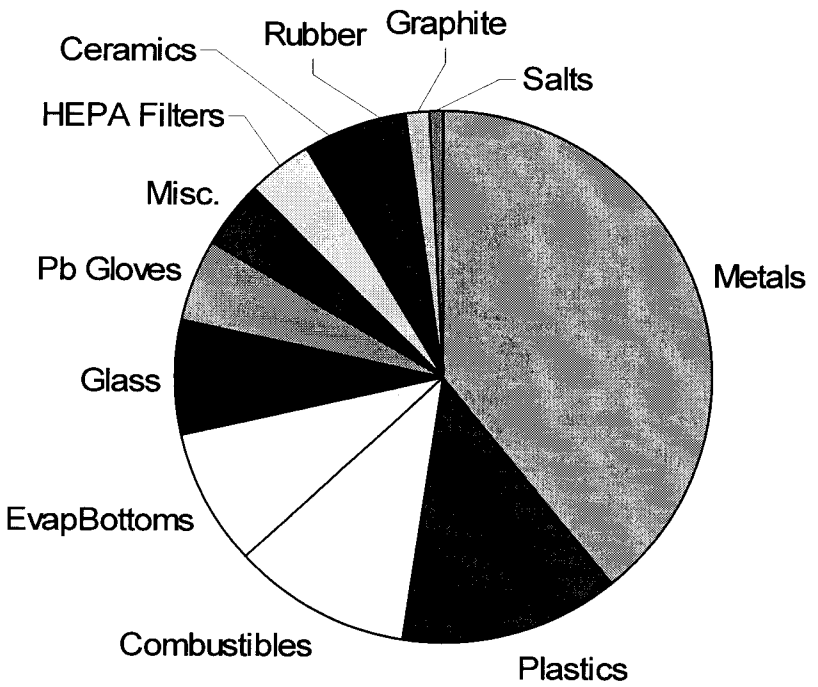

Fig. 4-6. Composition of Solid TRU waste from NMT Division, FY03.

Combustible Wastes. Combustible wastes comprise ~10% of the TRU waste generated at the Laboratory. For the MilliWatt Heat Source Program, combustible solids account for almost 90% of the TRU wastes contaminated with ^{238}Pu, for which there is currently no disposal pathway. In all instances, combustible waste comprises mostly plastic bags, plastic reagent bottles, plastic-sheet goods used for contamination barriers, cheesecloth, gloves, protective clothing worn by workers, and a small volume of organic chemicals and oils.

Noncombustible TRU Waste. Noncombustible TRU 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 nonroutine maintenance activities are completed, and (4) as facility construction projects are implemented to meet new programmatic missions.

Evaporator Bottoms. Evaporator Bottoms are those acidic and caustic processing sludges and oxalate precipitation residues that contain levels of plutonium exceeding the STLs but containing less than the values requiring reprocessing. Before being discarded, the residues must be immobilized to minimize their potential attractiveness for diversion. Cementation meets this immobilization requirement. The high concentrations of actinides in this sludge frequently exceed the thermal wattage limit for WIPP disposal and require dilution by as much as a factor of five to meet certification requirements. Implementation of vitrification for this waste stream will reduce the final volume by a factor of four.

Caustic and Acidic Liquid Waste. Caustic liquid waste results from the final hydroxide precipitation step in the aqueous chloride process. Feedstocks for this process typically are anode heels, chloride salt residues, and other materials having relatively high chloride content. Acidic liquid waste is derived from processing plutonium feedstock with nitric acid for matrix dissolution. Following oxalate precipitation, the effluent is sent to the evaporator, where the overheads are removed and sent to the acid waste line for further processing at the TA-50 RLWTF. Evaporator bottom sludge is cemented into 55-gal. drums for disposal.

Liquid TRU wastes from the acidic and caustic processes are transferred from TA-55 to the TA-50 RLWTF via separate, double-encased transfer lines for processing. The processed waste is cemented into 55-gal. drums and transported to TA-54 for storage and ultimate disposal at WIPP as TRU solid waste.

The cost for handling, storage, and disposal of TRU waste was estimated at ~\$58,000/m^3 in FY01. However, that cost did not include the fixed cost of the storage facility at TA-54 or the cost to open and operate WIPP (fixed disposal cost).

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.

These projects have been funded in previous fiscal year and are currently undergoing evaluation for funding in FY-05. These TRU waste minimization and avoidance projects are typically funded by the ENV-PP Program, GSAF programs, and by operating funds.

Small Scale Granulator and Compactor for PF-4 TRU Waste (T). This project proposes to use *waste minimization* to reduce the volume of the current inventory of radioactive contaminated plastic bottles and ceramics by at least 60%. Over the last year a smaller scale granulator has been tested for use in an existing glovebox in PF-4. With the space limitations at PF-4 and the focus on new programs, a full-scale system (glove box, granulator, and a material transport system) clearly could not be integrated at TA-55 in a timely fashion. Focusing on a smaller granulator will ensure fast and safe deployment of a small and efficient granulation and compactor system into an existing glove box that will fit in the space allocated at TA-55.

Vitrification System (T). The NV-PP Program is funding the fabrication, testing, and installation of a vitrification process for the TRU waste that currently is solidified with cement. The project provides for the fabrication and installation of gloveboxes to house the vitrification equipment, fabricate and operationally test the vitrification system, and install the equipment within the gloveboxes in TA-55 PF-4. The Vitrification System will produce waste drums certifiable to WIPP waste acceptance criteria (WAC) and is expected to reduce the generation of TRU/MTRU cemented waste at a rate of 20 to 30 drums per year.

5.0 Mixed Low-Level Waste

5.1 Introduction

For waste to be considered mixed low-level waste (MLLW), it must contain Resource Conservation and Recovery Act (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), transuranic (TRU) waste, spent nuclear fuel, or by-product materials (e.g., uranium or thorium mill tailings). Test specimens of fissionable material irradiated only for research and development (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 Department of Energy (DOE) Order 435.1. Because it contains RCRA waste components, MLLW also is regulated by the State of New Mexico through Los Alamos National Laboratory's (the Laborato ry's) operating permi t, the Federal Facility Compliance Order/Site Treatment Plan (FFCO/STP) provided by the New Mexico Environment Department (NMED), and the Environmental Protection Agency (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 nonroutine waste is generated by

off-normal events such as spills in legacy-contaminated areas. Environmental restoration (ER) and waste management legacy operations, which also produce MLLW, are not included in this roadmap. Typical MLLW items include contaminated lead-shielding bricks and debris, R&D chemicals, spent solution from analytic chemistry operations, mercury-cleanup-kit waste, fluorescent light bulbs, copper solder joints, and used oil.

Figure 5-1 shows the process map for MLLW generation at the Laboratory. Routine waste generation by division is displayed in Fig. 5-2.

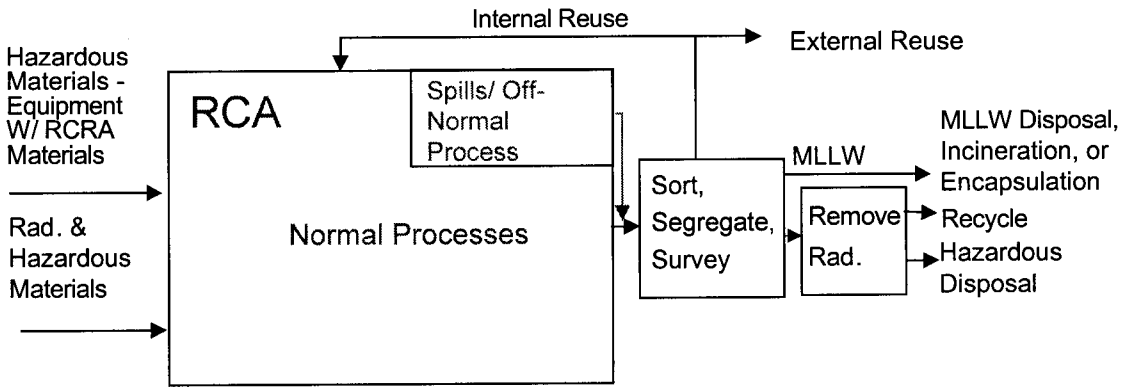

Fig. 5-1. Top-level MLLW process map.

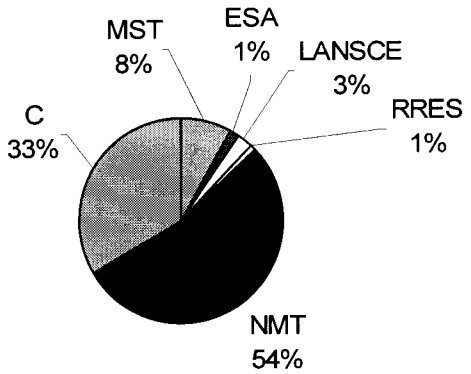

Fig. 5-2. Total MLLW generation by division.

Nuclear Materials Technology (NMT) and Chemistry Divisions were the largest producers of routine MLLW in fiscal year (FY)04. The largest contributor to NMT division waste volumes was used oil, lead and lead debris, TCE, and copper solder joints. Fluorescent light bulbs and spent chemical waste was the largest contributor to the C division waste volumes.

Routine MLLW generation is shown by year in Fig. 5-3. The total MLLW generation including routine, non-routine, and environmental restoration waste is presented in Fig. 5-4 .

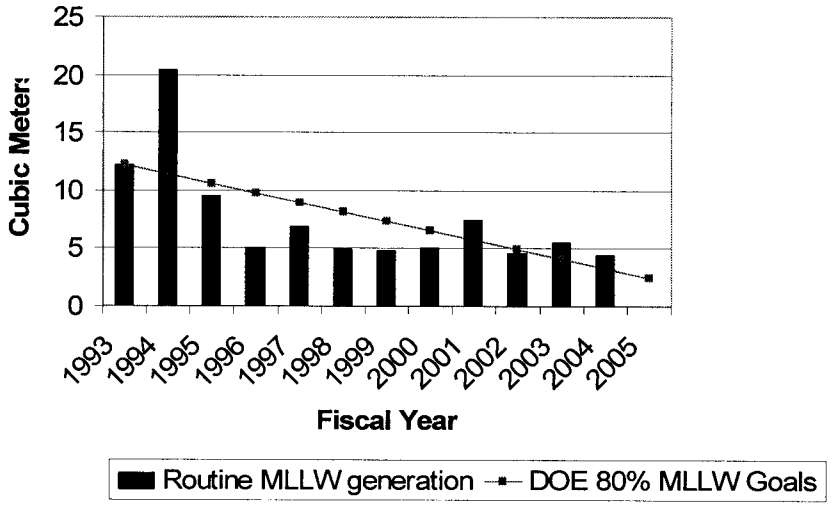

Fig. 5-3. Routine waste generation.

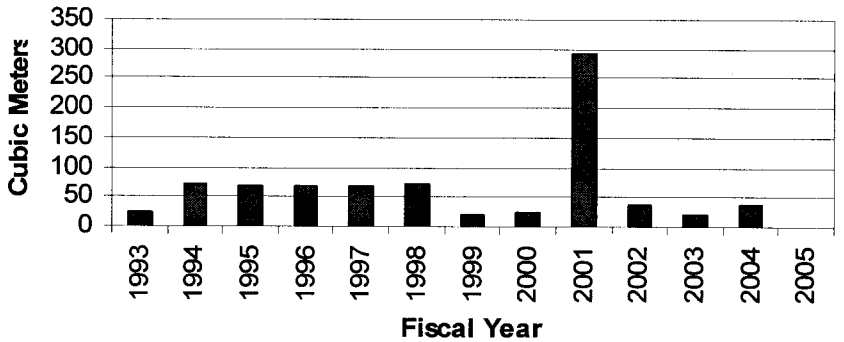

Fig. 5-4. Total Waste Generation.

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 calendar-year (CY)93 as the baseline. Because the MLLW generation in the baseline year was a low 12.3 m^3, the proposed DOE FY05 goal would be a very low 2.5 m^3. MLLW generation at the Laboratory is currently only 4.46 m^3/yr. The Laboratory has proposed MLLW reduction projects that could reduce MLLW generation over the next 4 years. These projects include elimination of RCRA hazardous paint strippers, solidification of MLLW

hydraulic oils, improvements in chemical analysis processes, and 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.

Figure 5-3 shows the Laboratory's progress toward achieving this goal. For the past 3 years, the Laboratory has averaged ~5m^3 of MLLW generation. The spike in waste generation of 7.45 m3 that occurred in FY01 was caused by FY99 and FY00 waste that was placed in the Site Treatment Plan (STP) but not yet received at the disposal site at Technical Area (TA)-54, Area G. All of this waste was added to the FY01 generation rate to avoid further complication of the waste accounting system.

5.3 Waste Stream Analysis

Routine MLLW is generated in radiological control areas (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, 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 (DOT) 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 (e.g., segregation of hazardous components and macroencapsulation or incineration).

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 (formerly SEG), a company that processes contaminated lead from naval nuclear reactor shielding. Duratek fabricates parts at no cost to the Laboratory because their fabrication costs are much less than those of MLLW lead disposal.

The largest FY04 waste streams are fluorescent bulbs, lead and lead debris, copper solder joints, TCE, and used oil. These waste streams constitute over 89% of the MLLW

waste type and are the primary targets for reduction or elimination. The individual waste streams are as follows.

Fluorescent Light Bulbs (1.19 m3). This waste consists of used fluorescent light bulbs.

Lead and Lead Debris (0.866 m3). This waste consists of lead used for radiological shielding and other miscellaneous lead waste.

Copper Solder Joints (0.757 m3). This waste consists of the lead solder joints formed during the construction of copper piping systems.

Used Oil (0.72 m3). This waste consists of used vacuum pump and other equipment oil. This waste stream has been significantly reduced in recent years by replacing oil filled vacuum pumps with oil-less vacuum pumps.

Trichloroethylene (TCE) (0.416 m3). This waste consists of spent TCE solvent.

Miscellaneous Chemical Waste (.336 m3). This waste is generated by a variety of analytical chemistry and other processes.

Unused/Unspent Chemicals (0.06 m3). This waste consists of unused/unspent chemicals that have become radiologically contaminated.

The relative size of the various waste streams, expressed in percent, is shown in Fig. 5-5.

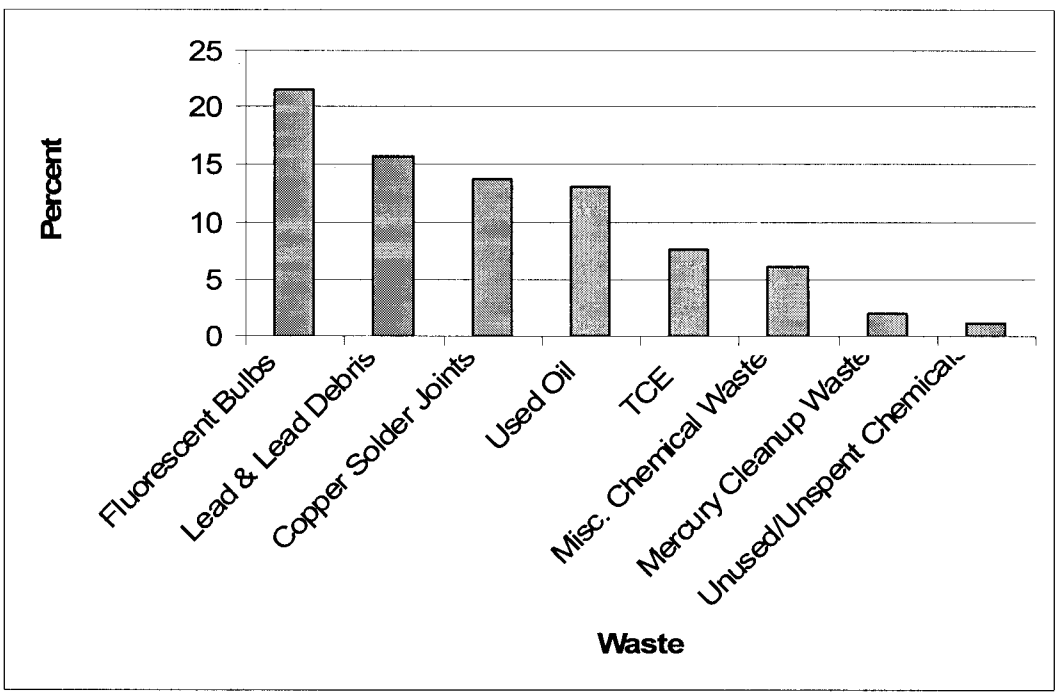

Fig. 5-5. Waste stream constituents.

Efforts to substitute alternatives and to improve sorting and segregation of these waste streams will reduce these volumes dramatically in the coming years. The Laboratory has implemented the used of low mercury fluorescent light bulbs and lead free solder to minimize the generation of fluorescent light bulb waste and copper solder joint waste. Substitutes for lead shielding or protective barriers to prevent radiological contamination of the lead are currently being implemented. Oil free vacuum pumps are being installed to eliminate the generation of used oil and recycling options for the TCE waste are being considered.

MLLW costs an average of $42.13/kg to characterize, treat, and dispose of in FY04. 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 radiologically contaminated mercury or mercury compounds.

6.0 Remediation Services Waste Minimization Awareness Plan

6.1 Introduction

Section 6 represents the waste minimization and pollution prevention (WMin/PP) awareness plan for the Laboratory's Risk Reduction and Environmental Stewardship Remediation Services (ENV-RS) Project.

This plan supports the ENV-RS Project' s WMin/PP goals and describes its program to incorporate waste reduction practices into ENV-RS activities and procedures. The plan was prepared by the ENV-RS Project, formerly the Environmental Restoration Project, pursuant to the requirements of Module VIII, Section B.1 of the Laboratory's Hazardous Waste Facility Permit (NM0890010515-1).

6.1.1 Background

The mission of the Laboratory's ENV-RS Project is to investigate and remediate potential release sites as necessary to protect human health and the environment. In completing this mission, ENV-RS activities may generate large volumes of waste, some of which may require special handling, treatment, storage, and disposal. Because the ENV-RS Project is tasked with investigating and conducting corrective action, as necessary, at historically contaminated sites within the Laboratory, source reduction and material substitution are difficult to implement. However, the ENV-RS Project generates waste in the conduct of site cleanups and, thus, is faced with the responsibility and the challenge of minimizing the amounts of waste that will require subsequent management or disposal. Minimization is necessary 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.

The DOE Office of the Secretary also requires a pollution prevention program as outlined in the 1996 Pollution Prevention Program Plan (DOE/S-0118)[1]. 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 (WMin/PP) implementation with the waste generating program. In a November 12, 1999 memorandum[2], the Secretary of Energy set an annual 10% reduction goal for all wastes generated from facility decommissioning and site stabilization activities (Richardson 1999, 73681). The Laboratory's approach to achieving the 10% reduction goal is addressed later in this document.

6.1.2 Purpose and Scope

The purpose of this plan is to document the ENV-RS Project'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 2005 (FY05), and it reports FY04 waste generation quantities and significant waste minimization accomplishments for FY04. This plan also discusses the ENV-RS Deputy Project Director's commitment to WMin/PP, provides a discussion of specific program elements of the ENV-RS WMin/PP Program, and presents the barriers to implementation of further significant reductions.

This plan addresses all waste classifications generated by the ENV-RS Project as a result of planning and conducting the investigation and remediation of environmental media. This plan is applicable to activities funded by the DOE Office of Environmental Management (DOE-EM). Wastes generated by ENV-RS include "primary" and "secondary" waste streams. Primary waste consists of waste generated from 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-RS Project may generate the following waste classifications: radioactive low-level waste (LLW); low-level mixed waste (LLMW); transuranic radioactive waste (TRU); chemical wastes (which include Resource Conservation and Recovery Act [RCRA] hazardous, Toxic Substances Control Act [TSCA], and New Mexico Special wastes); and/or solid waste.

The scope of a WMin/PP effort for an individual ENV-RS project will be dependent on

the primary and secondary wastes anticipated to be generated and the feasibility of waste reduction for those waste streams.

6.2 ENV-RS Deputy Project Director Policy Statement and Management Commitment

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

The Laboratory's support for pollution prevention and waste minimization programs is documented in the Laboratory waste management requirements. The ENV-RS Project additionally mandates waste minimization techniques in several of its standard operating procedures. In addition, the ENV Division Pollution Prevention Program (ENV-PP) is tasked by DOE and the Laboratory to champion and implement an aggressive waste minimization and environmental stewardship program for the entire Laboratory.

The ENV-RS Project fully supports the Laboratory's and ENV Division' s written WMin/PP policies, programs, and commitments. The ENV-RS Project 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. Evidence of the ENV-RS Project commitment is demonstrated by this plan, as well as by the documentation of past waste reduction efforts within the ENV-RS Project (formerly the Environmental Restoration Project) (Section 6.4). The ENV-RS Project will allocate sufficient resources to pursue the goals and approaches established by this plan and will coordinate with ENV-PP Program, as necessary.

6.3 Organizational Structure and Staff Responsibilities

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

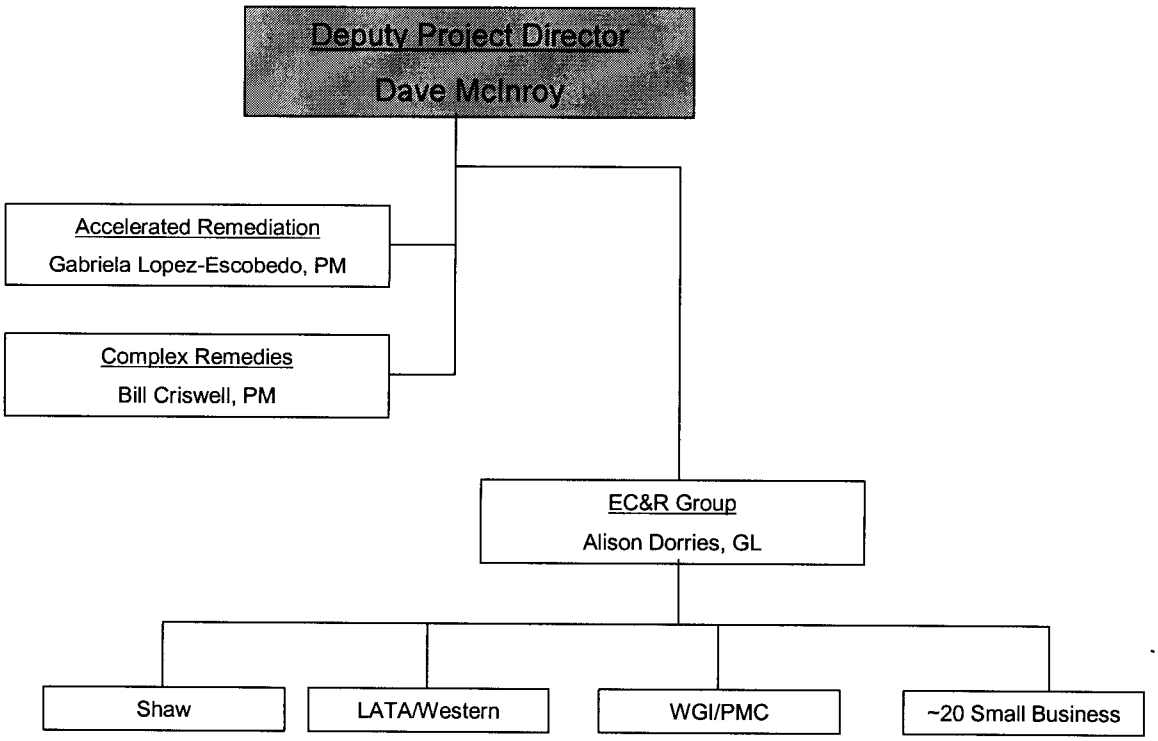

Figure 6-1. Remediation Services Organization Chart

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

The Deputy Project Director for the ENV-RS Project has primary responsibility for developing and implementing WMin/PP programs and strategies for all ENV-RS projects that result in waste generation, as described in this plan. The ENV-RS Project must allocate sufficient resources to attain the goals and approaches identified in this plan. The ENV-RS Project is responsible for establishing and submitting an annual WMin/PP plan to the administrative authority, establishing WMin/PP goals and performance measures, and coordinating with the ENV-PP Program to implement WMin/PP activities and to report success stories.

The ENV-RS Project office is the focal point for planning and implementing waste minimization activities and reporting waste minimization successes and lessons learned for the ENV-RS Program. ENV-RS program managers, who report to the Deputy Project Director, are responsible for identifying and incorporating WMin/PP practices into project plans and field activities, as much as technically and economically feasible.

The ENV-RS Project waste management coordinators are responsible for coordination of waste minimization activities, coordinating proposals for waste minimization

implementation projects, advising project leaders on Wmin/PP technologies and techniques, recommending ENV-RS Project-wide policy, and compiling waste generation and minimization data.

6.4 Goals and Performance Measures

The DOE Headquarters established an annual DOE complex-wide 10% reduction goal for environmental restoration activities based upon overall waste projections. Additionally, the University of California FY05 contract performance measures include the same 10% waste reduction goal for cleanup/stabilization activities.

The ENV-RS FY05 WMin/PP approach will focus on:

- integrating waste minimization principles into the remedial 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 6.0-1 shows the environmental hierarchy for ENV-RS Project wastes. Although source reduction is preferred, the ENV-RS WMin/PP approach recognizes there may be limited opportunity for source reduction of primary wastes because the ENV-RS Project is tasked to investigate and conduct corrective actions, as necessary, at historically contaminated sites within the Laboratory, and 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 during project planning and negotiation stages, 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.

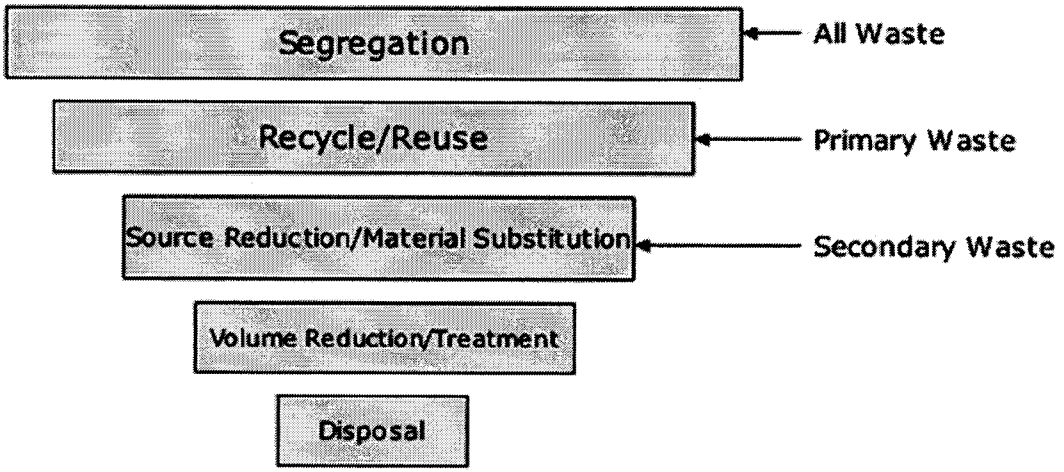

Figure 6-2. Waste management hierarchy within the ENV-RS Project

The WMin/PP approaches outlined above are consistent with the waste reduction priorities established by the Laboratory's sitewide waste minimization plan, which recognizes the severe limitations of on-site disposal capacity for radioactive LLW 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-RS activities.

6.5.0 Situation Analysis

The FY04 activities that resulted in waste generation included remedial actions and site investigations. These types of activities will continue throughout the life of the Laboratory's ENV-RS Project. The majority of FY04 waste generation was the result of investigations and voluntary corrective actions.

The FY05 planned activities include an Interim Action at the TA-16-340 Complex [Solid Waste Management Units (SWMUs) 13-003(a)-99, 16-003(n)-99, 16-003(o), 16-026(j2), and 16-029(f)], removal of structures and contaminated soil at 19 SWMUs in TA-21, and investigations at Material Disposal Areas and other sites. Wastes from Potential Release Sites (PRSs) may also be generated by organizations other than ENV-RS. Specifically, wastes may be generated from corrective actions at PRSs in TA-73 being implemented directly by the DOE. Also, wastes from PRSs may be generated during the implementation of Laboratory construction and demolition projects.

6.5.1 Applicable Statutory, Regulatory, and Institutional Requirements

The Laboratory's ENV-RS Project is subject to many environmental regulations. The key drivers for the WMin/PP program are listed below. A complete description of these regulations may be found in the Laboratory's Waste Minimization Awareness Plan or the "Waste Minimization and Pollution Prevention Regulations and Orders, Requirements and Identification List. "[5]

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 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 Policy

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"

DOE Order 450.1 "Environmental Protection Program"

Secretary of Energy Notice 37-92, "Waste Minimization Policy Statement"

DOE Pollution Prevention Program Plan, 1996

Los Alamos National Laboratory Directives and Policies

Los Alamos National Laboratory 2001 Pollution Prevention Roadmap [6], LA-UR-01-6634, December 2001

Laboratory waste management requirements

6.5.2 Justification for the Use of Hazardous Materials

ENV-RS Project 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-RS Project.

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 field screening tests, but are consumed by the process and do not result in generation of hazardous waste.

6.5.3 FY04 Waste Generation Summary

The ENV-RS Project FY04 waste generation and waste minimization summary is listed in Table 5.3-1. Waste projections and reduction goals for FY05 are listed in Table 5.3-2.

Waste Type	Volume, m^3
Solid TRU	0
Solid MLLW	3
Solid LLW	33
Solid Hazardous	38
Solid Sanitary	210

Table 2-1. Fiscal Year 2004 Waste Generation Summary

Waste Type	Volume, m^3
Solid TRU	0
Solid MLLW	9
Solid LLW	2490
Solid Hazardous	421
Solid Sanitary	2875

Table 2-2. Fiscal Year 2004 Waste Generation Summary

6.5.4 Waste Minimization Accomplishments during FY04

WMin/PP was an integral part of the FY04 ENV-RS 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. Operating expenses of approximately $50,000 are provided annually to evaluate best management approaches, source reduction, and recycling options.

Activities in FY04 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 FY04 to reduce these investigation-related waste streams led to the following accomplishments:

- The ENV-RS High Explosives Production Sites team offered excess chemicals needed for analyses through the Laboratory's chemical exchange program.

- Dry decontamination techniques were used to reduce the volume of liquid decontamination waste.

6.6.0 Waste Minimization Program Elements

Listed below are the Laboratory's ENV-RS Project waste minimization program elements for FY04. Several of the elements are currently in place; however, several are in the planning stages. The elements will be implemented if economically and technically feasible.

6.6.1 Waste Management Coordinators

The ENV-RS waste management coordinators will have a primary role in FY05 for developing and implementing programmatic elements of the ENV-RS WMin/PP Program by conducting the following activities:

- Improve WMin/PP awareness and information exchange within the ENV-RS Project.

- Provide technical reviews and WMin/PP input for ENV-RS documents and procedures, such as waste characterization strategy forms, 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-RS projects to formalize standard approaches for WMin/PP in ENV-RS Project 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-RS subcontractor documents and project specifications, thus providing incentives and measurable goals for waste reduction.

- The waste management coordinators will provide WMin/PP tools and practices to the ENV-RS Project. 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-RS Project are summarized in the list that follows.

WMin/PP tools for the negotiations and planning phases

-Negotiate with regulators to recognize and implement WMin/PP where appropriate

-Write WMin/PP into ENV-RS Project documents

- Include WMin/PP in budgets and contracts

-Integrate WMin/PP into construction of engineered structures and best management practices

-Train ENV-RS 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-RS 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 ENV-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-RS project to promote WMin/PP (e.g., a Wmin coordinator)
- Reuse equipment
- Train ENV-RS personnel on WMin/PP and build WMin/PP awareness

6.6.2 WMin Planning

WMin/PP is best integrated during the project planning (including design and engineering) phase. WMin/PP strategies incorporated during the planning (and negotiations) phases 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-RS 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 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-Environmental Characterization and Remediation (ENV-ECR) waste management standard operating procedure (ER-SOP-01.06, Management of ER Project Waste and ER-SOP-01.10, Waste Characterization) also afford an opportunity in incorporate WMin/PP into ENV-RS project planning. In accordance with these procedures, a strategy for characterizing and managing each waste stream that will be generated during a ENV-RS 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.

6.6.3 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-RS activities;

educate employees about successful implementation at the Laboratory and within DOE; and

improve documentation of WMin/PP accomplishments.

All ENV-RS waste management coordinators 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-PP Program.

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.

6.6.4 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 minimization coordinator is available to research technologies or WMin/PP tools for ENV-RS 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 Labs, Richland, Washington

EPA, Superfund Innovative Technology Evaluation (SITE) Database

DOE, Technology Information Exchanges Conferences and Abstract Summaries

EPA, Pollution Prevention Homepage Web Site

EPA, Pollution Prevention Clearing House Web Site

EPA, Envirosense Web Site

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

6.6.5 Tracking and Reporting

The routine collection of waste minimization data was established in FY96. Project managers are asked to provide documentation of accomplishments as they occur, with

a formal quarterly data consolidation effort.

6.6.6 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.

6.6.7 Compaction

The ENV-RS Project 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.

6.6.8 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-RS Project 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 ENV-RS activities. Waste management coordinators will be trained in the Laboratory occupational radiation protection requirements.

6.6.9 Risk Assessment

Risk assessments are routinely conducted for ENV-RS Project projects, as prescribed in the Laboratory's Installation Work Plan (LANL 1998, 62060) [7]. Risk assessments allow the ENV-RS Project to plan remediation activities on the basis of the future risk to human health and the environment based on current and reasonably foreseeable future land use. Often the risk assessment may determine that it is adequately protective and appropriate or beneficial to leave the material in the ground, 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. This is one of the few opportunities available to the ENV-RS Project for source reduction. For example, use of risk-based cleanup standards based on industrial land use scenarios for sites located within active operating areas of the Laboratory should result in generation of far less waste than cleanup standards based on residential exposure scenarios.

6.6.10 Incentives

The ENV-RS Project participates in the Laboratory-wide "Waste Minimization/Waste Generation Set Aside Fee" 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-RS Project has previously submitted Return on Investigation proposals for WMin/PP projects that are eligible for funding through this tax.

6.6.11 Lead-Handling Procedures

The ENV-RS Project 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-RS Project.

ENV-RS 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 noncontaminated 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.

6.6.12 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-RS practice to use dry decontamination techniques to minimize 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.

6.7 Barriers to Waste Minimization Implementation

In some instances, levels of waste minimization achieved fell below potentially achievable levels based on site conditions. For example, the ENV-RS High Explosives Production Sites team was able to offer excess chemicals to the Laboratory's chemical exchange program. However, no takers for the chemicals have been identified.

The selection of corrective measures for material disposal areas (MDAs) will have a tremendous impact on the amount of waste generated in the future by the ENV-RS project. During FY05, NMED is expected to select the remedy for the MDA H. In the corrective measure study, the Laboratory recommended a corrective measure that would leave disposed waste in place, thus resulting in minimal waste generation. If NMED chooses to select a corrective measure that requires wastes to be excavated, a large volume of waste will be generated.

REFERENCES

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