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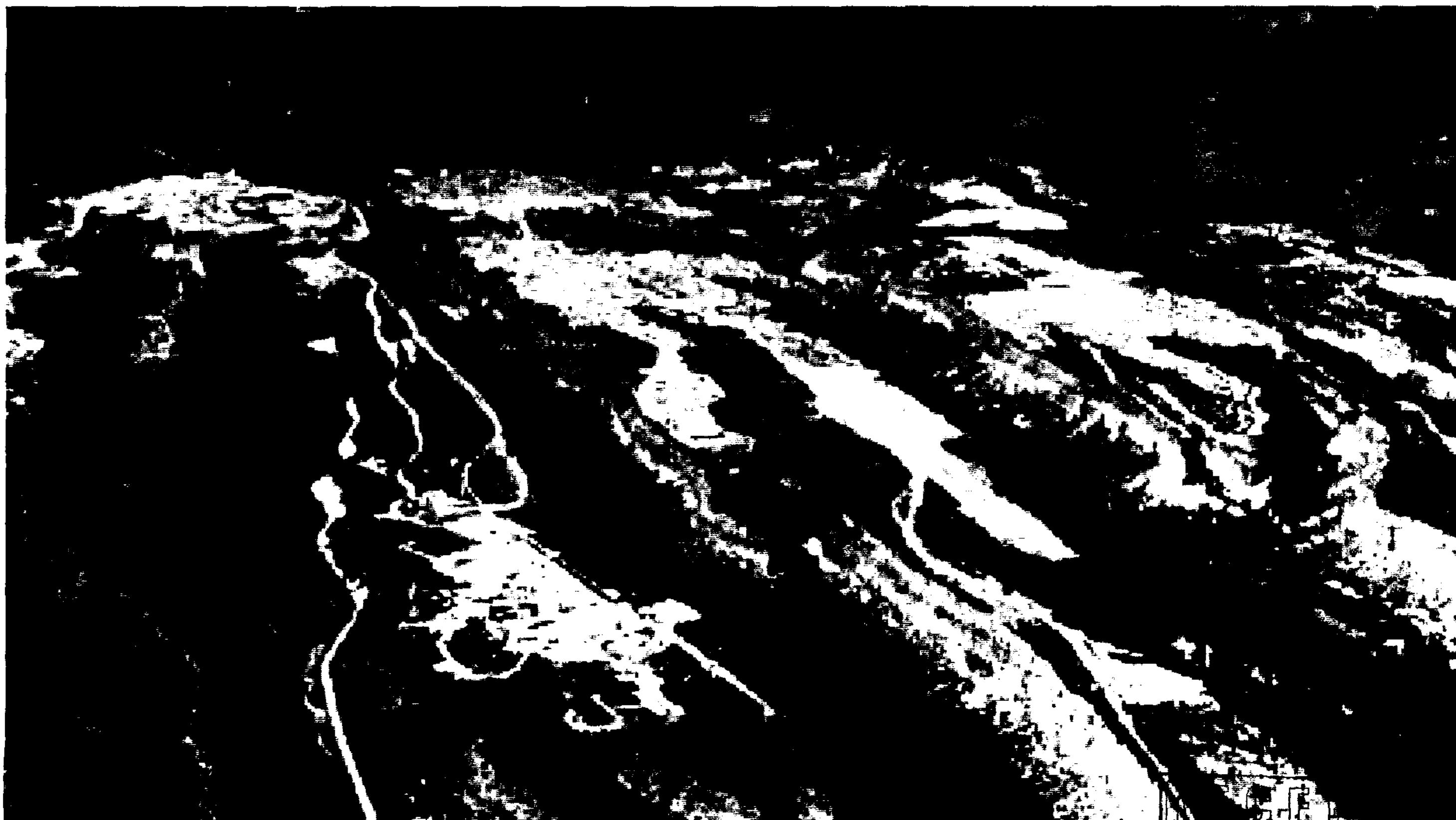
2004 POLLUTION PREVENTION ROADMAP

Bryan Carlson, Alison Dorries, Patricia Gallagher, Denny Hjeresen, Sonja Salzman, Monica Witt, Joe English, Jennifer Griffin, and James Scott



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Los Alamos NATIONAL LABORATORY

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LA-UR-04-8973

Foreword

Acknowledgments

The 2004 Pollution Prevention Roadmap is the result of the dedicated efforts of many individuals and organizations. We gratefully acknowledge and thank the following for their commitment to the success of this Roadmap.

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Executive Summary

Los Alamos National Laboratory (the Laboratory) executes important missions in national security, fundamental science, and energy. Identifying, mitigating, and eliminating the environmental risks posed by these missions is the goal of the Pollution Prevention (PP) and Stewardship Office in the Environmental Stewardship (ENV) Division. The PP Office assists the Laboratory in eliminating these sources and reducing risk through proactive PP, waste minimization, recycling, and resource conservation. PP practices move the Laboratory beyond compliance-based goals toward zero waste produced, zero pollutants released, zero natural resources wasted, and zero natural resources damaged. Zero pollution means zero environmental risk to mission continuity.

This roadmap documents the Laboratory's PP program and the processes used to define and implement environmental improvements. It describes current operations, improvements that will eliminate potential sources of environmental incidents, and the end state that is the Laboratory's goal. During the next 24 months, the Laboratory will move to an Environmental Management System (EMS) that embodies the concepts of International Standards Organization (ISO) 14001. The Laboratory currently has implemented environmental protection as part of integrated safety management (ISM). The focus of the EMS is on PP practices that will allow the Laboratory to move beyond a compliance-based approach to environmental management.

Systematic PP and environmental stewardship not only protect the environment; they also pay for themselves by reducing costs and creating a safer workplace. Furthermore, they increase productivity by minimizing waste- and pollution-related planning, reporting, and work tasks, thus enabling staff to devote more time to mission activities. Through a PP-focused EMS, environmental awareness, good environmental practices, and reducing the sources of environmental incidents become the responsibility of every person working at the site.

This 2004 roadmap is responsive to the PP and environmental efficiency goals issued by the Secretary of Energy on November 12, 1999; it also is certified to satisfy the waste minimization (WMin) program documentation requirements of 40 CFR 264.73(b)(9) (Resource Conservation and Recovery Act). The roadmap also is responsive to 58 CFR 102 (Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program) and to Module VIII, Section B.1 of the Laboratory's Hazardous Waste Facility Permit.

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Contents

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Acronyms and Abbreviations

B	Bioscience (Division)
C	Chemistry (Division)
C-ACT	Chemistry Division, Applied Chemical Technology
CCF	Central Computing Facility
CFC	Chlorofluorocarbon
CFO	Chief Financial Officer
CFR	Code of Federal Regulations
C-INC	Isotope and Nuclear Chemistry Group in the Chemistry Division
CLEAR	Chloride Extraction for Actinide Recovery
CMR	Chemistry and Metallurgy Research (Facility)
CMRR	Chemistry and Metallurgy Research Replacement
COMPASS	Cultural and Operations Model Plan and Surety Systems
County	Los Alamos County
County Landfill	The DOE-Owned, Los-Alamos-County-Operated Landfill
CTWC	Cooling Tower Water Conservation
CY	Calendar Year
D&D	Decontamination and Decommissioning
DARHT	Dual Axis Radiographic Hydrodynamic Test
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOE/DP	Department of Energy/Defense Programs
DOE/EM	Department of Energy/Environmental Management
DOT	Department of Transportation
DP	Defense Programs
DU	Depleted Uranium
DVRS	Decontamination and Volume Reduction System
DX	Dynamic Experimentation (Division)
EES	Earth and Space Sciences
EM	Environmental Management
EMS	Environmental Management System
ENV	Environmental Stewardship Division
ENV/CE	Transuranic Certification Group of ENV Division
ENV/CH	Transuranic Characterization Group of RRES Division
ENV/ECR	Environmental Characterization and Remediation Group of ENV Division
ENV-PP	ENV Division Prevention Program
ENV/RS	ENV Division, Remediation Services
EO	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPIC	DOE PP Information Clearinghouse
ER	Environmental Restoration
ESA	Engineering Sciences and Applications (Division)

Acronyms and Abbreviations (cont)

ESPC	Energy Savings Performance Contract
ETA	Eastern Technical Area
F&OR	Functional and Operating Requirements
FFCO/STP	Federal Facility Compliance Order/Site Treatment Plan
FWO	Facility and Waste Operations (Division)
FWO/UI	Facility and Waste Operations Utilities and Infrastructure Group
FY	Fiscal Year
GBC	Green Building Council
GET	General Employee Training
GIC	Green Is Clean
GPP	General Plant Project
GSAF	Generator Set-Aside Fee
HE	High Explosives
HEC	High-Explosives Characterization
HEPA	High-Efficiency Particulate Air
HEWTF	High-Explosives Water Treatment Facility
HLW	High-Level Waste
HSR	Health, Safety, and Radiation Protection
IM	Information Management (Division)
IMDO	Information Management Division Operations
ISM	Integrated Safety Management
ISO	International Standards Organization
ISR	International Space and Response Division
IWM	Integrated Work Management
JIT	Just In Time
Laboratory	Los Alamos National Laboratory
Landfill	The DOE-Owned, Los-Alamos-County-Operated Landfill
LANL	Los Alamos National Laboratory or the Laboratory
LANSCE	Los Alamos Neutron Science Center Experiment, or Los Alamos Neutron Science Center (Division)
LAPP	Los Alamos Power Pool
LASO	Los Alamos Site Office
LATA	Los Alamos Technical Associates
LDCC	Laboratory Data Communications Center
LEED™	Leadership in Energy and Environmental Design
LIR	Laboratory Implementation Requirement
LLW	Low-Level (Radioactive) Waste
LPY	Liters per Year
MBA	Material Balance Area
MDA	Materials Disposition Area
MEK	Methyl Ethyl Ketone
MLLW	Mixed Low-Level Waste
MOA	Memorandum of Agreement

Acronyms and Abbreviations (cont)

MOX	Mixed Oxide
MRF	Material Recycle Facility
MSA	Management Self-Assessment
MST	Materials Science and Technology
MT	Metric Ton
MTRU	Mixed Transuranic
MW	Megawatt
N	Nuclear Nonproliferation Division
NARS	Nitric Acid Recovery System
NDA	Nondestructive Assay
NMED	New Mexico Environment Department
NMSWMR	New Mexico Solid Waste Management Regulations
NMT	Nuclear Materials Technology (Division)
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
ODS	Ozone-Depleting Substances
ORNL	Oak Ridge National Laboratory
OSRP	Offsite Source Recovery Project
PCB	Polychlorinated Biphenyl
PHERMEX	Pulsed High-Energy Radiographic Machine Emitting X-Rays (Facility)
PM	Project Management (Division)
PNM	Public Service Company of New Mexico
POC	Pipe Overpack Container
PP	Pollution Prevention Office
PPE	Personnel Protective Equipment
PR-ID	Permits and Requirements Identification
PRS	Potential Release Site
PTLA	Protection Technologies Los Alamos
R&D	Research and Development
R&R	Repaired and Renovated
RANT	Radioassay and Nondestructive Testing
RCA	Radiological Control Area
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RLW	Radioactive Liquid Waste
RLWTF	Radioactive Liquid Waste Treatment Facility
SCC	Strategic Computing Complex
SITE	Superfund Innovative Technology Evaluation
SNM	Special Nuclear Material
STA	Southern Technical Area
STL	Safeguards Termination Limit

Acronyms and Abbreviations (cont)

STP	Site Treatment Plan
SWB	Standard Waste Box
SWEIS	Sitewide Environmental Impact Statement
SWMU	Solid Waste Management Unit
SWO	Solid Waste Operation
SWS	Sanitary Wastewater System
TA	Technical Area
TCE	Trichloroethylene
TRI	Toxic Release Inventory
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TWCP	Transuranic Waste Characterization Program
UC	University of California
US	United States
WAC	Waste Acceptance Criteria
WCRRF	Waste Compaction, Reduction, and Repackaging Facility
WFM	Waste Facilities Management
WIPP	Waste Isolation Pilot Plant
WITS	Waste Inventory Tracking System
WM	Waste Management
WMin	Waste Minimization
WTA	Western Technical Area

Chapter 1: Pollution Prevention—What and Why

1.1. Background

The Pollution Prevention (PP) Program improves Los Alamos National Laboratory (the Laboratory) operations with the goal of preventing environmental damage and adverse regulatory findings. The Laboratory's commitment to PP and broader environmental stewardship arises from two goals: maintaining a good environmental and ecological condition for present and future employees, residents, and neighbors; and remaining in compliance with the various regulatory requirements attendant to operation of the Laboratory. To progress toward these goals, the Laboratory's Waste Minimization (WMin)/PP approach will focus on

- ensuring that Laboratory policies and procedures highlight prevention as the preferred methodology to address waste issues;
- integrating waste minimization principles into the planning process;
- supporting the development of new technologies to minimize waste;
- working with generators to identify waste minimization opportunities;
- using material substitution and process improvements, as appropriate;
- recycling and reusing materials; and
- tracking, projecting, and analyzing waste data to improve waste management.

Figure 1-1 shows the hierarchy for waste generation. Source reduction clearly will have the largest economic and volume effects on the waste streams and is the preferred method of reducing waste. Although source reduction is preferred, the WMin/PP approach recognizes that opportunities for source reduction of primary wastes may be limited. When appropriate, sources of primary wastes will be reduced

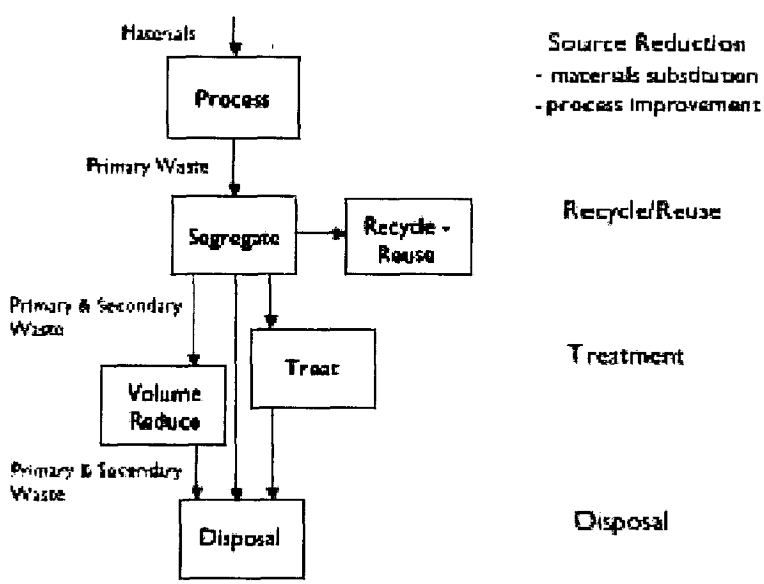

Fig. 1-1. Waste-generation hierarchy.

through process modification or material substitution. It is important to the program to work directly with waste generators in the early stages of technical processes to have the greatest impact. Beyond this point, further waste reductions are managed by waste management staff.

Secondary wastes will be reduced through proper planning; improved housekeeping, segregation, and characterization; and application of WMin/PP criteria during project planning, 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) and waste treatment will be considered for all primary and secondary wastes for which generation cannot be avoided and that cannot be recycled. Wastes that remain after the previous steps have been completed will be disposed of. Disposal is the least desirable and often the most expensive way of solving the waste generation problem.

The WMin/PP approaches outlined in the previous paragraphs 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 low-level waste (LLW) and on-site storage capacity for low-level mixed waste (LLMW). In addition, the approach was adopted to address the variable and nonrecurring nature of wastes coming from Environmental Stewardship (ENV)-remediation services (RS) activities.

This roadmap outlines the steps being taken at the Laboratory to focus on the life cycle of waste generation, management, and disposal through proactive PP programs. Such analysis begins when technical programs are envisioned, facilities are planned, and processes are selected. It also describes projects to revisit current processes and their waste streams to provide environmentally preferable alternatives.

In fiscal year (FY)04, the Laboratory began development and implementation of an Environmental Management System (EMS) to comply with United States (US) Department of Energy (DOE) Order 450.1 (Environmental Protection). The Laboratory has chosen to develop a PP-based system founded on the International Standards Organization (ISO) 14001 standard. Full implementation of this system will extend PP principles to a much broader set of Laboratory activities.

1.2. Regulatory Drivers

Driver/Document Title	Requirement
DOE Order 413.3 Program and Project Management for the Acquisition of Capital Assets	Sustainable building design principles must be applied to the siting, design, and construction of new facilities. New Federal buildings must meet or exceed energy efficiency standards established under the Energy Policy Act, Public Law 102-486, Section 305.
DOE Order 430.1A Life Cycle Asset Management	The management of physical assets from acquisition through operation and disposition shall be an integrated and seamless process linking the various life cycle phases.
DOE Order 430.2A Departmental Energy and Utilities Management	Major facilities contractors managing and operating DOE, including National Nuclear Security Administration (NNSA), facilities or subcontracting the operation and maintenance of DOE facilities must have a documented energy management program and an energy management plan.
DOE Order 435.1 Radioactive Waste Management	In the performance of this contract, the contractor is required to: C. Assist DOE in meeting its obligations and responsibilities under Executive Order 12856 (replaced by 13148), Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, and Executive Order 13101, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, and The Pollution Prevention Act of 1990.

Driver/Document Title	Requirement
DOE Order 450.1 Environmental Protection Program	Implement sound stewardship practices by implementing Environmental Management Systems (EMSs) at DOE sites.
LANL 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 program must include elements as listed in Module VIII, Section B.1 of the permit.
Executive Order 13101 Greening the Government through Waste Prevention, Recycling and Federal Acquisition	Consistent with the demands of efficiency and cost effectiveness, the head of each executive agency shall incorporate waste prevention and recycling in the agency's daily operations and work to increase and expand markets for recovered materials through greater Federal Government preference and demand for such products and through services that serve the same purpose. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product or service.
Executive Order 13123 Greening the Government through Efficient Energy Management	Through life-cycle cost-effective energy measures, each agency shall reduce its greenhouse gas emissions and resource consumption attendant to energy usage.
Executive order 13148 Greening the Government through Leadership in Environmental Management	Each agency shall comply with environmental regulations by establishing and implementing environmental compliance audit programs and policies that emphasize pollution prevention as a means to both achieve and maintain environmental compliance.
Executive order 13149 Greening the Government through Federal Fleet and Transportation Efficiency	The purpose of this order is to ensure that the Federal Government exercises leadership in the reduction of petroleum consumption through improvements in fleet fuel efficiency and the use of alternative fuel vehicles (AFVs) and alternative fuels.
Executive Order 13221 Energy Efficiency Standby Power Devices	Each agency, when it purchases commercially available, off-the-shelf products that use external standby power devices or that contain an internal standby power function, shall purchase products that use no more than one watt in their standby power consuming mode.
Pollution Prevention Act of 1990 (42 USC 13101)	National policy requires that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.
Resource Conservation & Recovery Act (RCRA) Affirmative Procurement (42 USC 6962)	This regulation was further codified in 40 CFR 247 - Comprehensive Guidelines for the Procurement of Products Containing Recovered Materials. All agencies or subcontractors will have an affirmative procurement program if >$10,000 in supplies is purchased annually.
Clean Air Act	The *Clean Air Act* (CAA) *Amendments of 1990* adds to the CAA by establishing two waste-minimization-related reporting requirements.
Clean Water Act	The *Clean Water Act* (CWA) *Amendments of 1992* (Section 402p) establishes new regulations related to pollution prevention. Requires National Pollutant Discharge Elimination System (NPDES) permits for discharged water.
Emergency Planning and Community Right-to-Know Act	The head of each Federal agency is responsible for ensuring that all necessary actions are taken for the prevention of pollution with respect to that agency's activities and facilities and for ensuring that agency's compliance with pollution prevention and emergency planning and community right-to-know provisions.

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.Chapter 2: 2004 Pollution Prevention Results

2.1. Metrics

The Pollution Prevention (PP) program improves Los Alamos National Laboratory (the Laboratory) operations with the goal of preventing environmental damage and adverse regulatory findings. To assess progress toward that goal, the PP Office has developed and the Department of Energy (DOE) has approved a set of performance metrics. Progress is measured against the goals established in the November 12, 1999, Secretary of Energy's Memorandum "Pollution Prevention, Energy Efficiency Leadership Goals."[2-1] The DOE 2005 PP Prevention, Energy Efficiency Leadership Goals that were addressed include

- routine hazardous waste minimization (WMin),
- routine low-level waste (LLW) minimization,
- routine mixed low-level waste (MLLW) minimization,
- toxic release inventory (TRI) chemical use reduction,
- routine solid sanitary WMin,
- sanitary material recycling,
- remediation/stabilization waste reduction,
- affirmative procurement [purchase of Environmental Protection Agency (EPA)-designated recycled content items], and
- replacement of Ozone Depleting Substances (ODS) class I chillers (>150 T).

The measures and associated metrics for all of these waste types are presented in Table 2-1. Laboratory performance toward the goals will be measured through an index that combines performance toward individual goals into a single index number expressed as a percentage. A 0 index corresponds to baseline year performance; a 100 corresponds to achieving the 2005 goal. The performance metrics are based on the weighted average of the index using the nine individual goals in this measure. All nine goals are weighted equally.

Table 2-1. DOE FY05 Performance Goals

	Goal Title	DOE 2005 Goal % Reduction	Baseline (year)	2004 Performance	2005 Goal	FY04 Index
1a	Hazardous waste reduction	90%	307 tonnes (93)	19.1 MT	31 tonnes	110.0%
1b	LLW reduction	80%	1987 m^3 (93)	787.1 m^3	397 m^3	75.5%
1c	MLLW reduction	80%	12.3 m^3 (93)	4.46 m^3	2.46 m^3	79.6%
1d	TRI chemical use reduction	90%	88,293 lb (93)	16,122 lb	8829 lb	90.8%
1e	Sanitary waste reduction	55%	2780 tonnes (93)	1476 tonnes	1,509 tonnes	103.0%
1f	Sanitary material recycling	50%	N/A	64%	50%	110%
1g	Cleanup/stabilization waste reduction	10%	N/A	10%	10%	100%
1h	Affirmative procurement	100%	N/A	100%	100%	100%
1i	Replace ODS Class I chillers, >150 T	100%	3050 T (00)	3050 T	0	100%
1j	Transuranic (TRU) WMin	50%	100 m^3	60.7 m^3	50 m^3	78.5%
Overall Index						**94.7%**

A comparison of the fiscal-year (FY)04 metrics with last year's metrics shows that the performance for replacement of Class I ODS, hazardous waste, sanitary waste recycling, and sanitary waste generation improved markedly. TRU waste and MLLW improved somewhat. LLW generation increased substantially for the second consecutive year.

The sharp decrease in sanitary waste disposal primarily is due to far better recycling performance and to adoption of a more technically defensible metric in FY04.

The increase in LLW generation occurred primarily in the Dynamic Experimentation (DX) Division. The sharp rise in DX Division LLW generation was caused by hydrotest containment. This containment strategy was implemented fully in FY04 and, although it prevents the release of hydrotest products to the environment, it also generates large volumes of LLW.

Projects to reduce waste generation in each waste area are described in the specific waste area summaries in the next section.

2.2. *Performance*

In this section, a detailed review and analysis of the 2004 PP performance is presented. Each waste or conservation category is discussed.

2.3. *Transuranic Waste*

2.3.1. Introduction

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 DOE has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by Code of Federal Regulations (CFR) 40 191; or (3) waste that the United States (US) 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, thus 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—currently in inventory (storage) and projected through 2034—is estimated 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 mixed oxide (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 technical role in these programs is to

- implement the capabilities to manufacture specified pits;
- produce nuclear materials for manufacture and surveillance;
- assist in the material characterization to understand aging phenomena;
- disassemble, sample, and evaluate pits; and
- 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-×-4-×-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 Building PF-4, TA-55. 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 Facility Waste Operations (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. 2-1.

Materials and supplies are brought into a radiological control area (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 Radioactive Liquid Waste Treatment Facility (RLWTF) for treatment. The radionuclides and other contaminants are removed as a cemented solid waste at the RLWTF and shipped to TA-54 for storage, and the remaining liquid is discharged to a National Pollutant Discharge Elimination System (NPDES)-permitted outfall. Oversized TRU waste items are processed further at TA-54 through the Decontamination and Volume Reduction System (DVRS) facility, where they are sized, reduced, and repackaged for shipment to WIPP. And finally, all

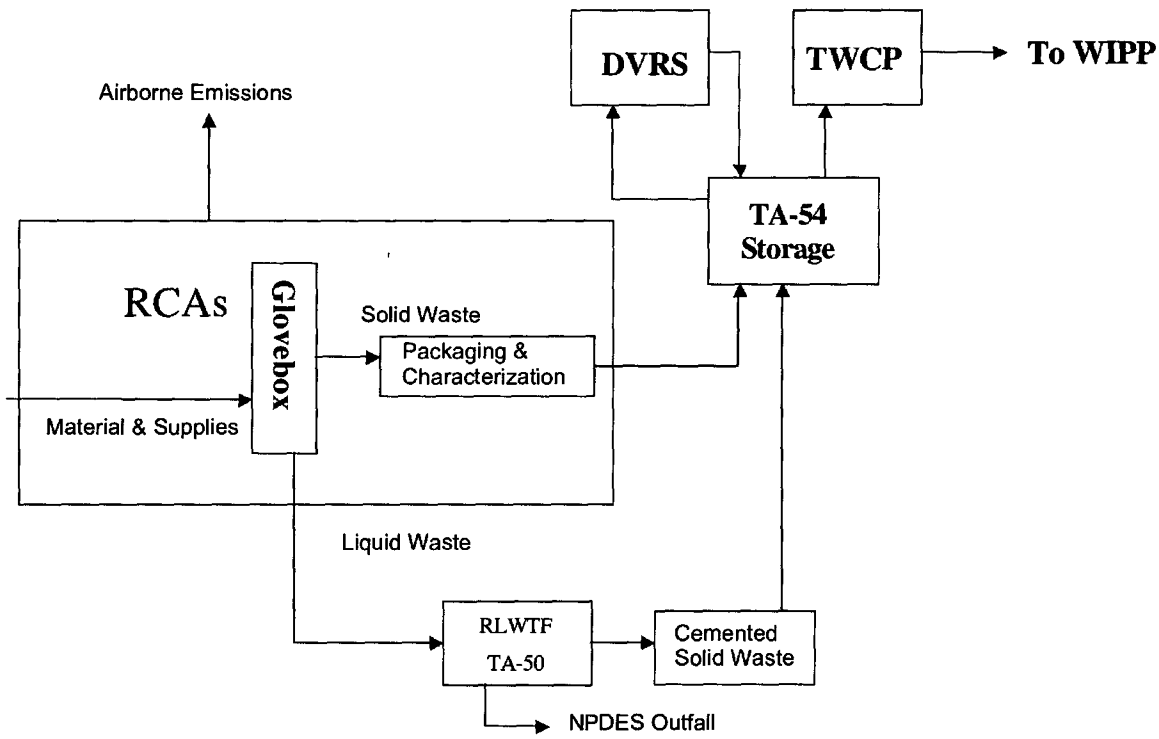


Fig. 2-1. Top-level TRU waste process map and waste streams.

waste is processed by the TRU waste characterization program (TWCP) before being shipped to WIPP.

Figure 2-2 shows the relative volumes of routine and nonroutine TRU and MTRU generated in FY04 by the Laboratory's organizations. All of the ENV TRU waste is secondary (nonroutine) 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 NMT Division's liquid waste streams at the RLWTF. NMT Division waste was generated from ongoing operations.

The total volume of TRU waste generated by the Laboratory is shown in Fig. 2-3 and is identified as routine, nonroutine, and environmental remediation waste. The Environmental Remediation (ER)/D&D program 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 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 FY04, all Laboratory operations were shut down to address safety and security issues, which reduced TRU waste generation rates.

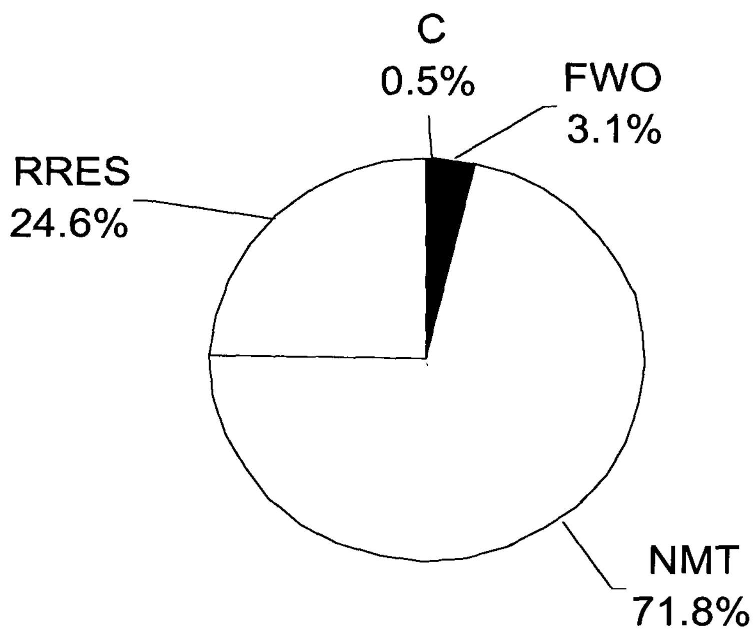


Fig. 2-2. TRU and MTRU waste generating organizations.

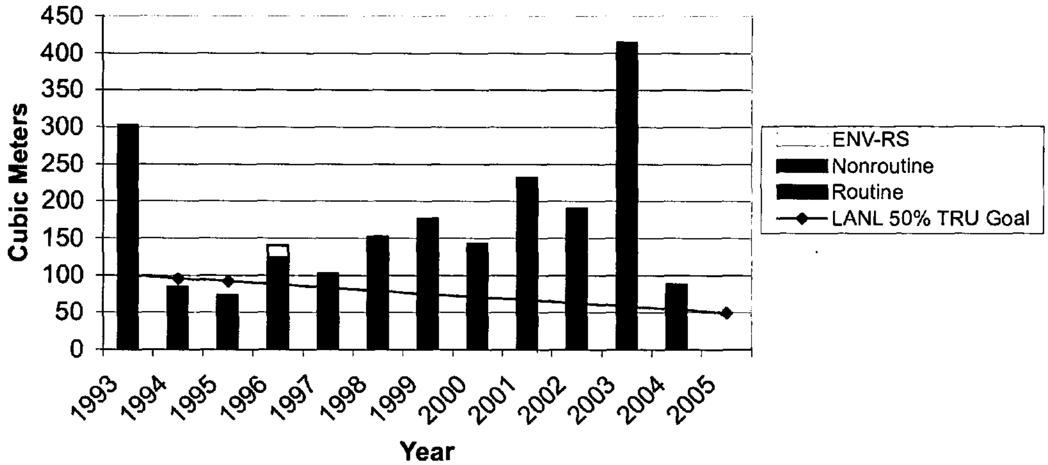


Fig. 2-3. Generation rates for TRU waste at the Laboratory.*

*All data are for FYs. Data for 1995 obtained from Environmental Stewardship Division, Remediation Services (ENV/RS): 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 "twilight.saic" database. Data for 1999 to 2004 were obtained from the solid-waste operation (SWO) database "swoon."

2.3.2. TRU WMIN PERFORMANCE

The DOE 2005 PP 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 50 m^3 from a baseline of 100 m^3 (see Fig. 2-3).

Future Goal Compliance

In FY01, NMT Division prepared an integrated TRU WMin 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 calendar-year (CY)03. Both plans made assumptions regarding annual funding levels and programmatic priorities.

Since the development of NMT Division Waste Management Program Plan, funding for WMin projects has not materialized and WMin is secondary to the programmatic goals for new projects. Ongoing waste generation reduction projects may not necessarily result in lower waste volumes. For example, Defense Nuclear Facilities Safety Board (DNFSB) recommendation

94-1 requires that much of the special nuclear material (SNM) formerly held in the PF-4 vault for reprocessing be discarded as TRU waste. Although that material is discarded as nonroutine waste, SNM material generated from ongoing activities that would have been held in the vault for reprocessing also is being discarded as routine TRU waste. Because of the actinide concentration of these waste items, only a few can be packaged in each drum before the SNM limit of the drum is reached. Although the volume of the actual waste is quite small, the volume of the shipping container (drum or SWB) is used to calculate waste volume. Figure 2-4 shows the significant increase in SNM contained in TRU waste. Thus, a few small waste items are reported as a volume of 0.208 m^3 (55 gal.) of waste. Most of the "waste volume" is air. In addition, some waste items are being packaged in 55-gal. 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 one-sixth of the actual container volume. Minimizing the waste volume further results in an even smaller volume of waste going into each drum.

2.3.3. Waste Stream Analysis

TRU wastes are generated within RCAs. These areas also are material balance areas (MBAs) used for security and safeguards to prevent the potential diversion of SNM. TRU and MTRU wastes are reported separately because of the different characterization requirements for the wastes. These requirements are detailed in the RCRA and the FFCO/STP—New Mexico 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 WMin strategy for both waste types is the same. As shown in Fig. 2-5, MTRU waste is ~65% of the routine TRU waste stream.

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. 2-6.

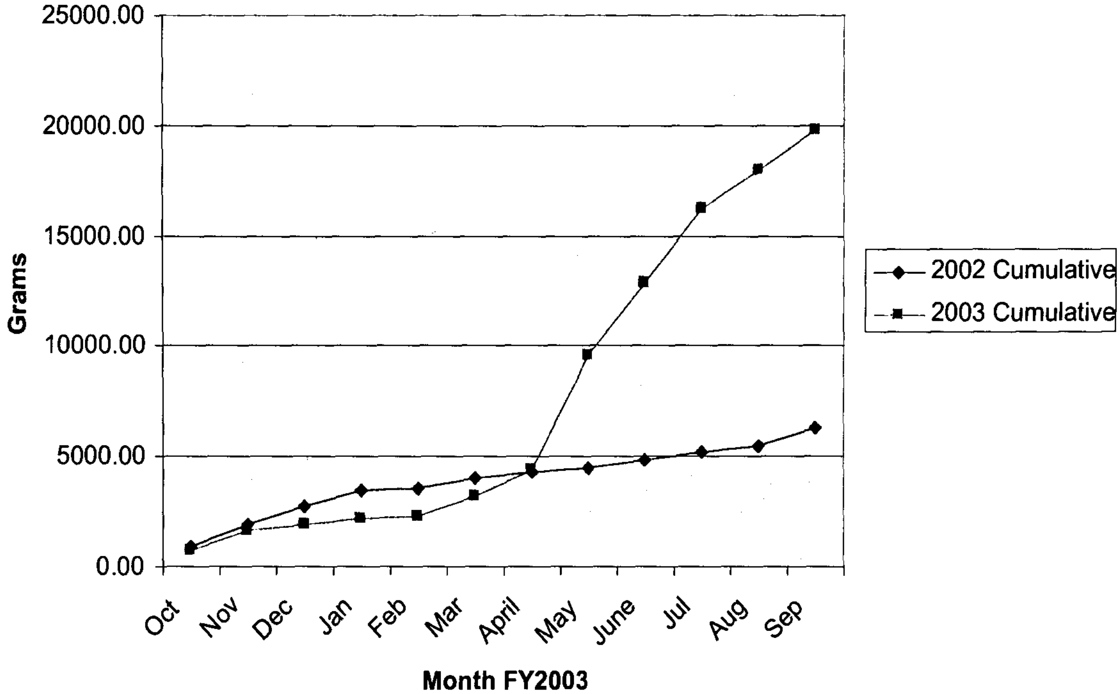


Fig. 2-4. SNM content of TRU waste expressed in fissile gram equivalents.

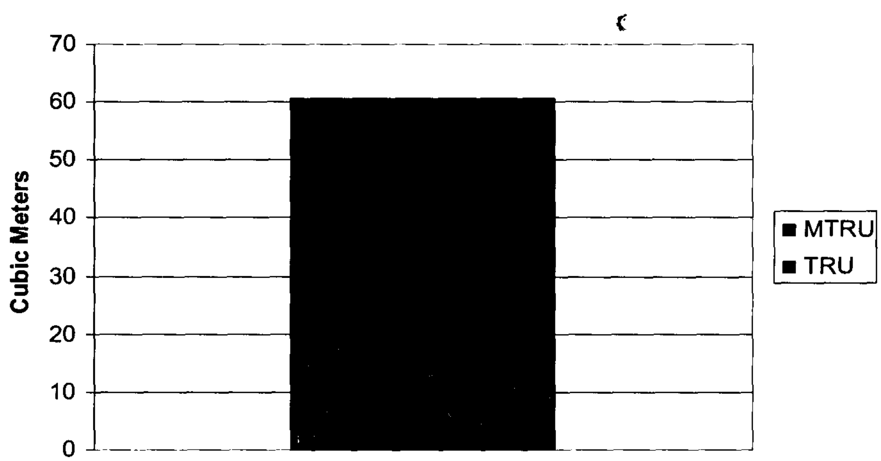


Fig. 2-5. The proportion of Laboratory-generated MTRU waste.

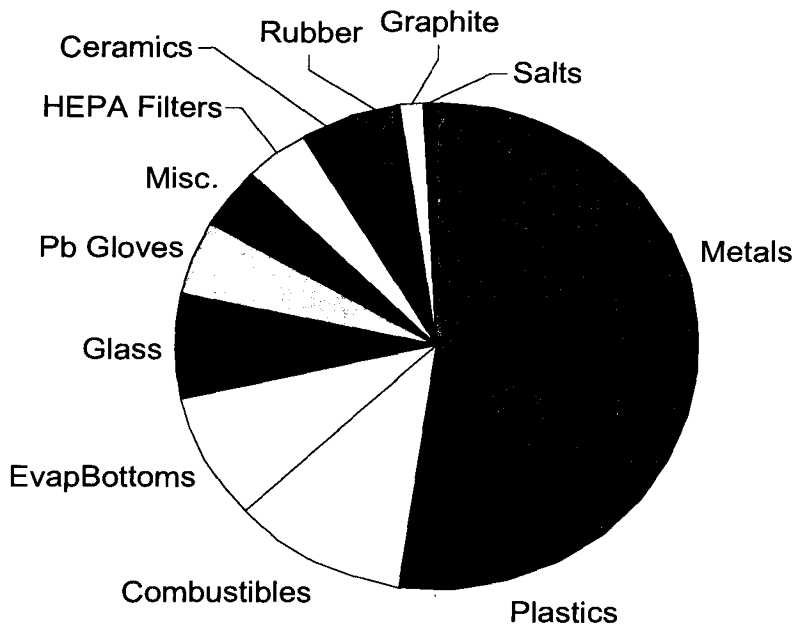


Fig. 2-6. Composition of solid TRU waste from NMT Division, FY04.

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, and 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 safeguards temination limits (STLs) but that contain 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 a 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).

2.3.4. 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 WMin 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 were funded in the previous FY and currently are undergoing evaluation for funding in FY05. These TRU WMin and avoidance projects typically are funded by the PP Office, generator set-aside fee (GSAF) Programs, and operating funds.

Small-Scale Granulator and Compactor for PF-4 TRU Waste (T). This project proposes to use WMin to reduce the volume of the current inventory of radioactive-contaminated plastic bottles and ceramics by at least 60%. During 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 in a reasonable time at TA-55. Focusing on a smaller granulator will ensure fast and safe deployment of a small and efficient granulation and compactor system into an existing glovebox that will fit in the space allocated at TA-55.

Vitrification System (T). The PP Office 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.

2.4. Low-Level Waste

2.4.1. Introduction

LLW is defined as waste that is radioactive and is not classified as HLW, TRU waste, spent nuclear fuel, or by-product materials (e.g., uranium or thorium mill tailings). Test specimens of fissionable material irradiated only for research and development 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.

Disposal of LLW is governed at the Laboratory by its WAC, which also drives LLW reporting requirements. These criteria place limits on the physical, chemical, and radiological characteristics of acceptable LLW and are developed from DOE Orders, federal and state laws and requirements, and site characteristics. Laboratory Implementation Requirement (LIR) 404-00-05.1, *Managing Radioactive Waste,* provides guidance specific to LLW, and LIR 404-0002.2, *General Waste Management Requirements,* contains WMin requirements.

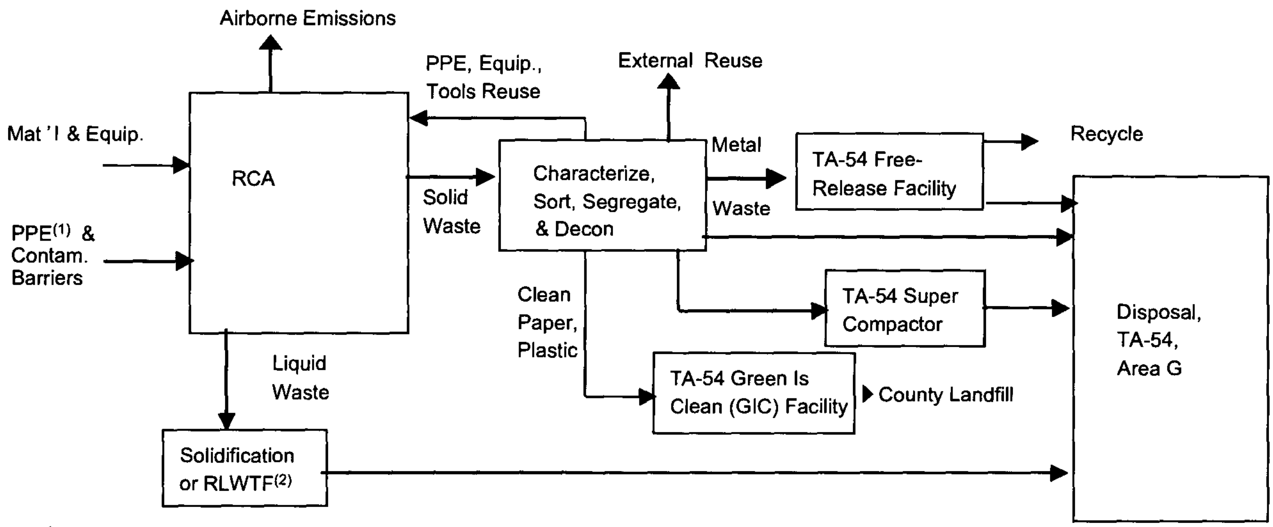
Figure 2-7 depicts the process map for LLW generation at the Laboratory.

Routine LLW generation by division is depicted in the pie chart in Fig. 2-8. NMT Division and FWO Division generate the largest quantities of routine LLW. The routine solid LLW generation values for each division are listed in Table 2-2.

2.4.2. Low-Level-Waste Performance

The DOE has implemented goals for WMin. Its environmental leadership program will go beyond compliance requirements and will be based on continuous and cost-effective improvements. To achieve these goals, the Laboratory will use an Environmental Management System (EMS) to evaluate environmental hazards and define the highest-priority hazards and the most cost-effective solutions to reduce the environmental impacts from these hazards.

As required by the DOE, the LLW reduction goal for FY05 is to reduce waste from routine operations by 80% by 2005, which will be calculated using CY93 as the baseline. Figure 2-9 shows the Laboratory's LLW generation since 1993. Values for the volume of routine waste subsequent to FY01 include reductions due to compaction. In previous years, the values did not include these reductions.



[1]PPE = personnel protective equipment.
[2]RLWTF = Radioactive Liquid Waste Treatment Facility.

Fig. 2-7. Top-level LLW process map and waste stream chart.

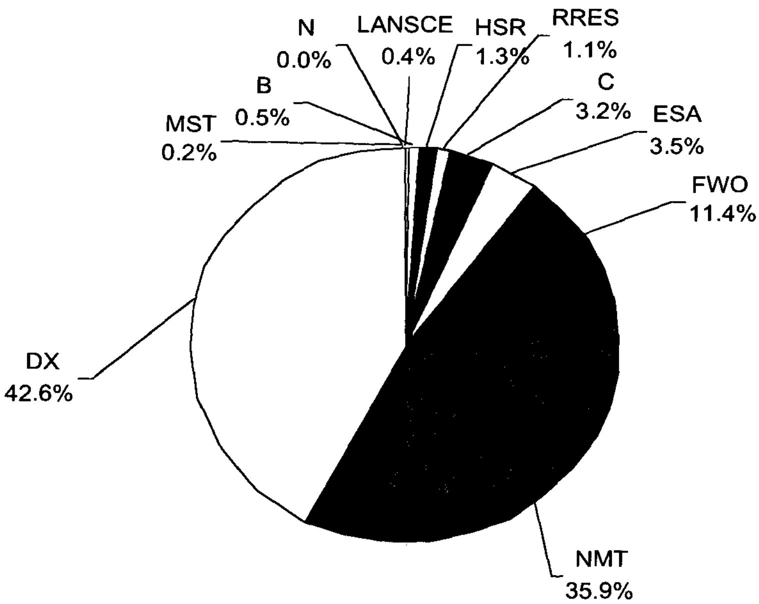


Fig. 2-8. Routine waste generation by division.

Table 2-2. Routine LLW Generation by Division

Division	Total (m^3)
B (Bioscience)	3.84
ENV (Environmental Stewardship)	8.50
NMT (Nuclear Materials Technology)	282.34
N (Nuclear Nonproliferation)	0.06
LANSCE (Los Alamos Neutron Science Center)	3.26
MST (Materials Science and Technology)	1.84
C (Chemistry)	25.26
ESA (Engineering Sciences and Applications)	27.48
HSR (Health, Safety, and Radiation Protection)	10.21
DX (Dynamic Experimentation)	334.97
FWO (Facility & Waste Operations)	89.35
Total	787.11

The graph shows that the Laboratory has met the FY05 waste reduction goal in previous years. However, in FY03, the Laboratory has experienced a sharp increase in LLW generation. This increase was caused by the factors listed below.

- Cost codes have been used in recent years to determine if waste generation is routine or nonroutine. Unfortunately, for divisions that have integrated their waste management activities, all waste is disposed of under a single cost code. Using single cost codes makes it impossible to determine if the waste generation was routine or nonroutine in the majority of cases. In FY04, NMT Division generated 243 m^3 of noncompactable LLW. A large portion of this waste was generated from legacy cleanouts to make room for new activities and from facility reconfiguration activities. As much as 100 m^3 of this waste should have been designated as nonroutine. Unfortunately, these activities are scheduled to continue in FY05.
- DX Division generated 352.38 m^3 of LLW. A total of 122.50 m^3 of this waste was generated because of a new requirement to confine testing activities, and the remainder was generated from other firing site activities. These activities are expected to continue into FY05.

Waste generation activities in NMT and DX divisions are resulting in waste generation values significantly above FY02 waste generation values. Specific projects to reduce NMT and DX division wastes will be required to return the waste generation values to FY02 levels and to meet the DOE FY05 goals.

2.4.3. Waste Stream Analysis

Materials, hardware, equipment, personnel protective equipment (PPE), and contamination barriers (paper and plastic) are used in RCAs. After these items are no longer needed, they leave the RCA after being sorted, segregated, and, if possible, decontaminated. Some PPE, equipment, and tools are reused at the Laboratory, whereas other equipment is sent off site for reuse. Compactable waste is sent to TA-54, Area-G compactor for volume reduction before disposal. Much of the waste leaving RCAs is not radiologically contaminated and can be surveyed to determine if the waste meets the radiological release criteria. If so, it is recycled or disposed of as sanitary waste. Low-density waste is sent to the GIC Facility at TA-54, Area G for verification that it meets the radiological release criteria. It then is sent to the County Landfill for disposal. The LLW streams are broken down by percent in Fig. 2-10.

Solid LLW generated by the Laboratory's operating divisions is characterized and packaged for disposal at the onsite LLW disposal facility at TA-54, Area G. LLW minimization strategies are intended to reduce the environmental impact associated with LLW operations and waste disposal by reducing the amount of LLW generated and/or by minimizing the volume of LLW that will require storage or disposal on site. LLW minimization is driven by the finite capacity of the onsite disposal facility and by the requirements of DOE Order 435.1 and other federal regulations and DOE Orders.

Liquid LLW typically is generated at the same facilities that generate solid LLW. It is transferred through a system of pipes and by tanker trucks to the RLWTF at TA-50, Building 1. The radioactive components are removed and disposed of as solid LLW. The remaining liquid is discharged to a permitted outfall.

Unlike other waste, waste produced from decommissioning and ER projects will be disposed of either at the Envirocare site in Utah, in situ, or at Area G and is not addressed in this LLW section.

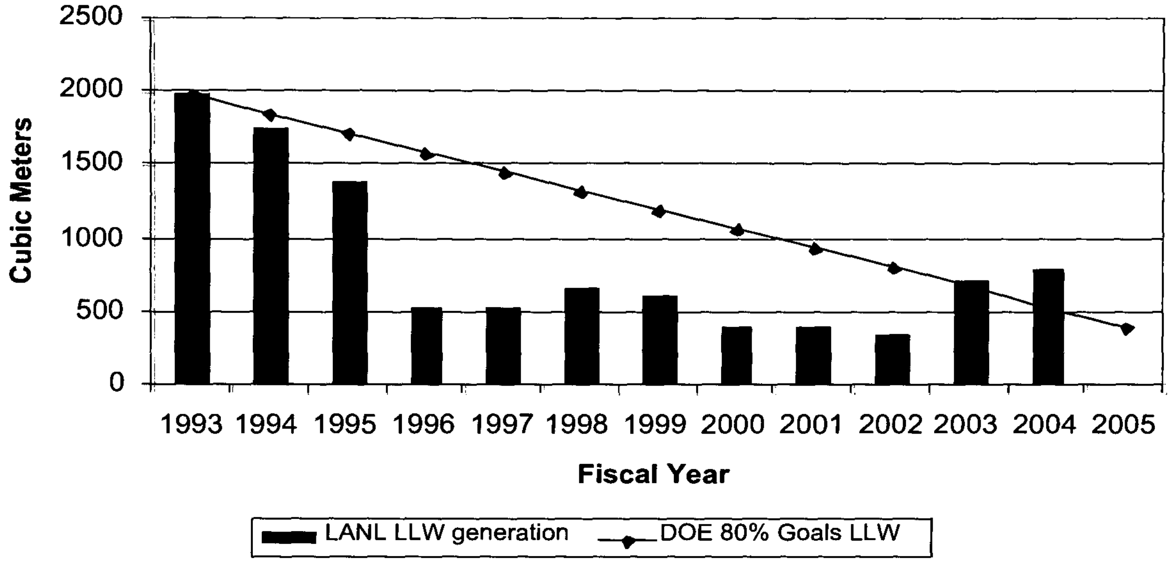


Fig. 2-9. Routine LLW generation and DOE goal.

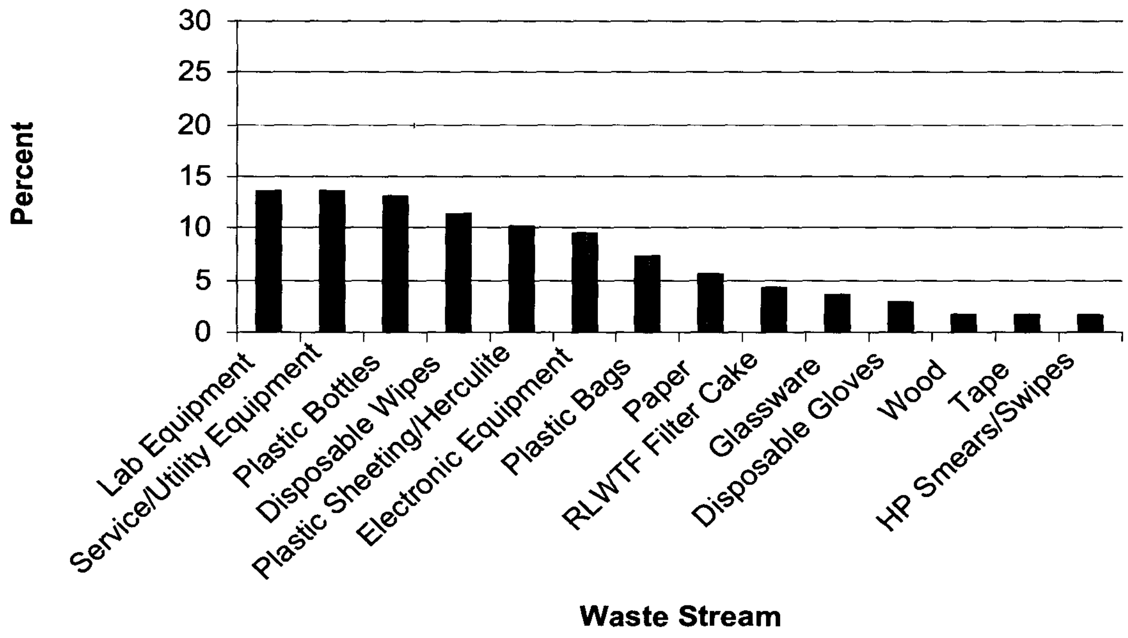


Fig. 2-10. Routine LLW streams.

Solid LLW comprises various waste streams that are categorized as combustible LLW, non-combustible LLW, and scrap-metal LLW. LLW is generated when materials, equipment, air, and water brought into RCAs to assist in performing work are contaminated radiologically and then removed from the facility in the form of air emissions, solid LLW, or aqueous LLW.

The LLW streams at the Laboratory arise from processes at various Laboratory sites and are interrelated in some cases. For example, significant quantities of Laboratory equipment (e.g., computers) contain circuit boards that must be disposed of as MLLW. The goal of the TRU program is to lower the radiation levels of gloveboxes from TRU to LLW levels through decontamination; the goal of the LLW program is to use all means possible to release the maximum materials for recycle, reuse, or sanitary waste disposal. LLW streams are categorized in the following subsections as combustible, non-combustible, or scrap metal. The categorized waste streams and their definitions follow.

2.4.3.1. Combustible Waste Streams

Materials from combustible waste streams used to accomplish programmatic work in RCAs are processed as LLW when they are removed. Combustible materials make up ~55% of the routine LLW produced at the Laboratory annually. Combustible LLW streams and their definitions follow in descending order by volume.

Plastic Bottles. Plastic bottles are used to contain aqueous samples and move aqueous material from one RCA to another.

Disposable Wipes. Disposable wipes consist of any absorbent product (paper towels, wipes, cheese cloth, etc.) used as a cleaning aid or to absorb aqueous materials. Most of these wipes either are used as laboratory aids or are contaminated during cleanup activities.

Plastic Sheeting/Herculite. Plastic sheeting is used for contamination barriers. Typically, it is placed on the floor areas or used to build containment structures around equipment to prevent the spread of radioactive contamination and to ease cleanup activities.

Plastic Bags. Plastic bags are used to package waste for disposal and to transport materials from one RCA to another.

Paper. Office paper is used for recording data, working procedures, etc. Other forms of paper, such as brown wrapping paper, are used as temporary contamination barriers to prevent the spread of contamination and to ease cleanup activities.

RLWTF Filter Cake. The RLWTF uses a ferric chloride flocculation agent to precipitate contaminates as part of the treatment process for the radioactive liquid effluent. This waste stream consists of the filter cake that results from this process.

Disposable Gloves. Disposable gloves are an essential PPE requirement when working in RCAs. Disposable gloves offer a high level of dexterity. If more protection is required, a heavier, more launderable pair of gloves can be worn over the disposable gloves.

Wood. Wood is used as a construction material to erect temporary containment structures. It is introduced into RCAs in the form of wooden pallets, scaffolding planks, and ladders. Wood also is used to support heavy objects being packaged for disposal to ensure that the objects do not shift in their packing container during transport.

Tape. Tape serves many purposes within RCAs, such as to seal PPE. It is also used to fix plastic and paper contamination barriers in place.

HP Smears/Swipes. This material consists of filter paper and large "masslin" swipes used to monitor removable contamination levels within RCAs.

Noncombustible Waste Streams. Noncombustible materials make up ~45% of the routine LLW produced at the Laboratory annually. Noncombustible LLW streams are defined in the following list.

Laboratory Equipment. This waste stream consists of a variety of laboratory equipment that is either outdated, no longer functional, or unusable. This waste stream consists of hot plates, furnaces, centrifuges, computers, and a variety of miscellaneous analytical instrumentation.

Building Service/Utility Equipment and Tools. This waste stream consists of a variety of work tools, as well as equipment used to provide basic facility services, such as pumps, ventilation units, and compressors. This equipment generally is removed during facility maintenance or upgrade activities.

Electronic Equipment. This waste stream consists of a variety of equipment, including computer, miscellaneous laboratory and building services, and utilities electronic equipment. This equipment is expensive to dispose of because it is difficult to characterize and because many of the components are classified as hazardous waste; therefore, this equipment must be either disposed of as MLLW or recycled.

Glassware. This waste stream consists of laboratory glassware that no longer can be used because it cannot be cleaned well enough to prevent the cross contamination of samples.

2.4.4. Improvement Projects

The following projects have been identified as potential corrective measures for the LLW type. Projects are characterized by type: source reduction (SR), sort and segregate (SS), reuse/recycle (RR), treatment (T), or disposal (D). These projects have been funded and currently are being executed. All of the ongoing LLW projects are funded by PP Discretionary Funds and the GSAF Program.

GIC (SS). It is estimated that 50% of the LLW stream is not contaminated. Through the use of acceptable knowledge and segregation techniques, a large portion of this waste stream can be eliminated. A verification facility with sophisticated counting instrumentation was established at TA-54 to perform verification surveys on waste that was segregated based on acceptable knowledge before it was disposed of as sanitary waste. In addition, sitewide implementation procedures were developed. The PP still supports this project as part of its base program activities. Support consists of working with generators to define acceptable knowledge and segregation techniques better. In FY02, a GSAF project was initiated to enhance the throughput of the GIC waste verification facility from 50 to 100 m^3 annually.

Launderable Product Substitution (SR). This project increases the use of launderable PPE at the Laboratory to eliminate disposable PPE. The PP Office still is supporting this project as part of its base program to encourage the use of launderable wipes, mops, bags, and contamination barriers to eliminate further the use of disposable products. In FY02, a GSAF project to implement the use of launderables for minimizing job control waste at TA-55 was funded.

Job Control WMin (SR). Large quantities of paper and plastic waste are generated during operational and maintenance activities at the Laboratory and must be disposed of as LLW. Typically, the floor of the room surrounding the work activity is covered with plastic sheeting. In many cases, a temporary wall is built with wooden 2-in. x 4-in. studs and covered with plastic sheeting for additional contamination control. After the work activity is completed, all of this material is disposed of as LLW. This project consists of two elements: a job control WMin project within NMT Division and a broader glovebag/enclosure element that includes the use of glovebags at TA-54 as well as at NMT. The NMT project is a 2002 GSAF award project. This project minimizes job control waste by substituting launderable materials, glovebags, and other job control WMin techniques for single-use waste-control items.

The broader project is deploying containment systems that have been in wide use elsewhere for years. These containment systems consist of everything from small glovebags, built from plastic sheeting, that are designed to fit around a specific work activity to large plastic tent-like structures for larger work activities. The tent-like structure can be erected easily and then disassembled and stored for future use if it is not contaminated. Otherwise, the plastic tent can be disposed of and the tent structure reused. The small-glovebag systems generally are disposed of after a single use. In either case, the amount of LLW generated is significantly less than the waste generated by protecting the entire area around a work activity.

Compactor Box Deployment to RCAs (T). LLW is placed in 2-ft^3 cardboard boxes or large (96-ft^3 or 48-ft^3) steel waste containers for disposal. Large amounts of job control waste and other compactable waste are placed in the large steel containers (B-25 boxes) because they are too large to fit in the small cardboard containers. These materials cannot be compacted. Use of the steel compactor boxes is not possible because these boxes cannot be certified for transportation on a public highway. This project will fund the design for new compactor boxes that meets the transportation requirements so that these large materials can be compacted and the volume of the LLW stream can be reduced. In addition to meeting the transportation requirements, the new boxes will be designed to meet the security (lockable) requirements for TA-55.

DX Firing Sites Waste (SR). New requirements for the confinement of DX Division tests have resulted in a significant increase in LLW generated by this division. This project development activity will concentrate on identifying alternatives to the current confinement methods to reduce waste generation and to seek funding for these alternatives.

2.5. *Mixed Low-Level Waste*

2.5.1. Introduction

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

Most of the Laboratory's routine MLLW results from stockpile stewardship and management and from R&D programs. Most of the nonroutine waste is generated by off-normal events such as spills in legacy-contaminated areas. 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 2-11 shows the process map for MLLW generation at the Laboratory.

Routine waste generation by division is displayed in Fig. 2-12.

NMT and C divisions were the largest producers of routine MLLW in FY04. The largest generators to NMT Division waste volumes were used oil, lead and lead debris, trichloroethylene (TCE), and copper solder joints. Fluorescent light bulbs and spent chemical waste were the largest constituents to the C-Division waste volumes.

Routine MLLW generation is shown by year in Fig. 2-13.

2.5.2. MLLW Minimization Performance

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

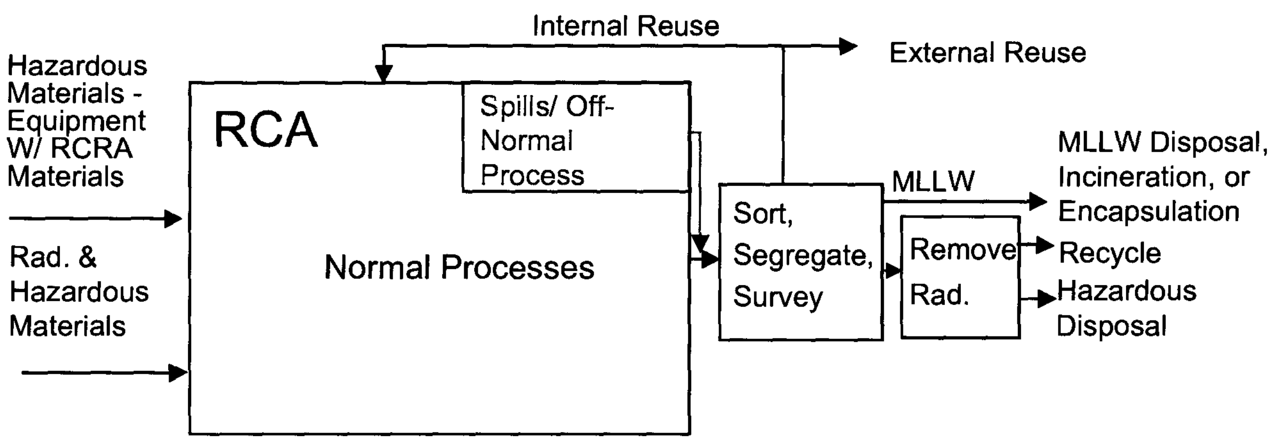


Fig. 2-11. Top-level MLLW process map.

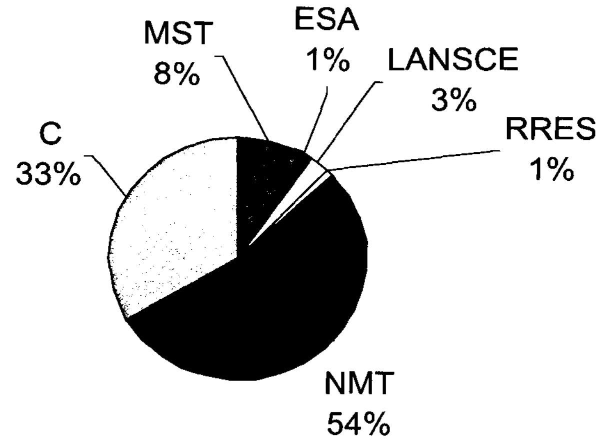


Fig. 2-12. Total MLLW generation by division.

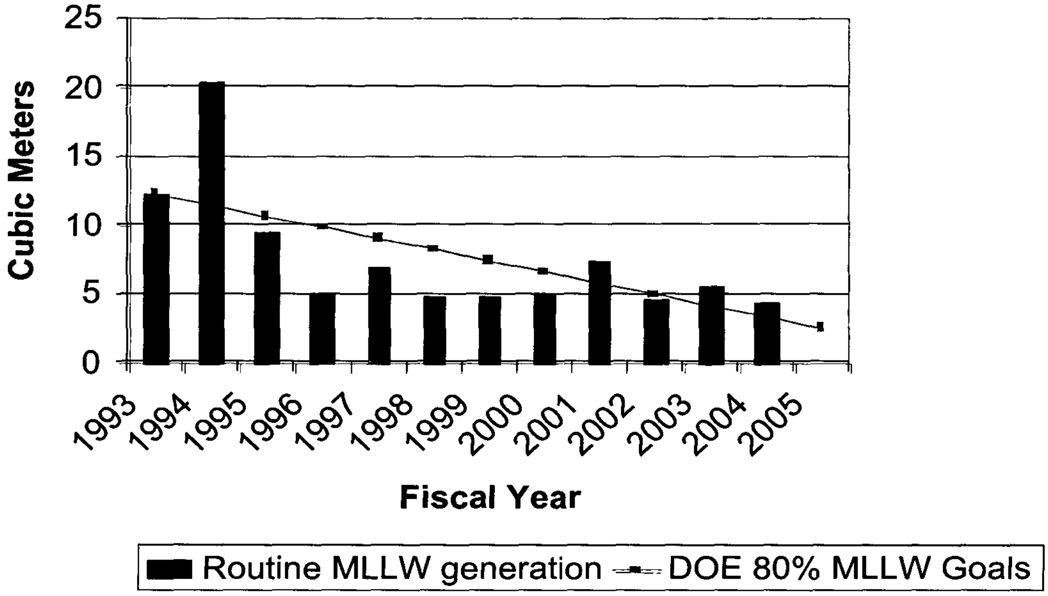


Fig. 2-13. Routine waste generation.

Figure 2-14 shows the Laboratory's progress toward achieving this goal. For the past 3 years, the Laboratory has averaged ~5 m^3 of MLLW generation. The spike in waste generation of 7.45 m^3 that occurred in FY01 was caused by FY99 and FY00 waste that was placed in the STP but not yet received at the disposal site at TA-54, Area G. All of this waste was added to the FY01 generation rate to avoid further complication of the waste accounting system.

2.5.3. Waste Stream Analysis

Routine MLLW is generated in RCAs. Hazardous materials and equipment containing RCRA materials, as well as MLLW materials, are introduced into the RCA as needed to accomplish specific activities. In the course of operations, hazardous materials become contaminated with LLW or become activated, 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, 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 its 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 m^3). This waste consists of used fluorescent light bulbs.

Lead and Lead Debris (0.866 m^3). This waste consists of lead used for radiological shielding and other miscellaneous lead waste.

Copper Solder Joints (0.757 m^3). This waste consists of the lead solder joints formed during the construction of copper piping systems.

Used Oil (0.72 m^3). This waste consists of used vacuum-pump and other equipment oil. This waste stream has been reduced significantly in recent years by replacing oil-filled vacuum pumps with oilless vacuum pumps.

Trichloroethylene (TCE) (0.416 m^3). This waste consists of spent TCE solvent.

Miscellaneous Chemical Waste (0.336 m^3). This waste is generated by a variety of analytical chemistry and other processes.

Unused/Unspent Chemicals (0.06 m^3). 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. 2-14.

Efforts to substitute alternatives and improve sorting and segregation of these waste streams will reduce these volumes dramatically in the coming years. The Laboratory has implemented the use 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 currently are 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 cost an average of $42.13/kg to characterize, treat, and dispose of in FY04. Waste is disposed of either by incineration or by macroencapsulation and land disposal. Macroencapsulation 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.

2.6. *Hazardous and State Waste*

2.6.1. Introduction

For the purposes of reporting hazardous waste generation and minimization at the Laboratory to multiple parties, the definitions of the waste types considered are listed in this section. The primary focus of this section for the NMED and the DOE is on hazardous waste, as defined by the RCRA. Data also are provided on New Mexico State special solid (State) waste for the DOE. Any information other than that regulated by the New Mexico Hazardous Waste Regulations is provided to the NMED for informational purposes only.

For the purposes of reporting routine WMin for the DOE, the Laboratory distinguishes between routine and nonroutine waste generation. Routine generation results from production, analytical, and/or other R&D laboratory operations; treatment, storage, and disposal operations; and "work for others" or any other periodic and recurring work considered to be ongoing. Nonroutine waste is cleanup stabilization waste and relates mostly to the legacy from previous site operations or any other waste stream not considered to be generated on a routine basis. The amount of nonroutine waste often varies significantly from year to year, especially when ENV-RS projects are taking place, because ENV-RS projects can create large quantities of waste. Therefore, focusing on the change in the amount of routine waste generated over time is a

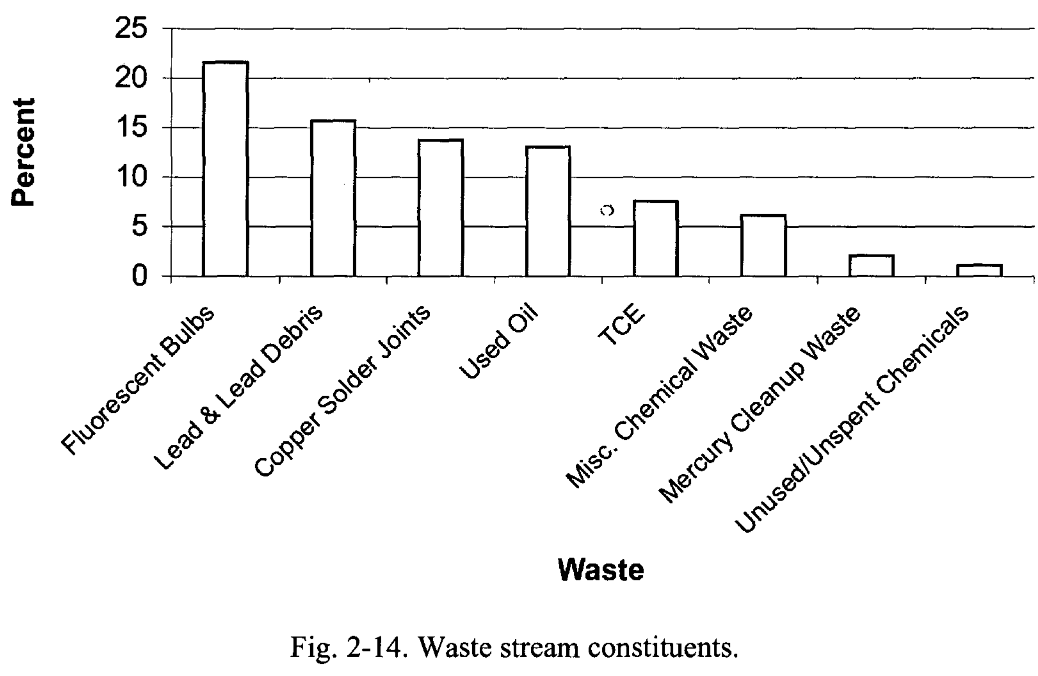


Fig. 2-14. Waste stream constituents.

better reflection of the ongoing PP and WMin efforts taking place at the Laboratory.

In brief, 40 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 1000 ppm of total halogens.

State waste is special waste regulated by the State of New Mexico as required by the New Mexico Solid Waste Act of 1990 (State of New Mexico) and as defined by the most recent New Mexico Solid Waste Management Regulations, 20NMAC 9.1 (NMED), or current revisions. This determination includes the following types of solid wastes that require unique handling, transportation, or disposal to ensure protection of the environment and public health, welfare, and safety:

- treated formerly characteristic hazardous wastes;
- packing house and killing-plant offal;
- asbestos waste;
- ash;
- infectious waste;
- sludge (except compost, which meets the provisions of 40 CFR 503);
- industrial solid waste;
- spill of a chemical substance or commercial product;
- dry chemicals that, when wetted, become characteristically hazardous; and
- petroleum-contaminated soils.

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 (HE) wastewater treatment plants also qualify as hazardous waste.

The Toxic Substances Control Act (TSCA) regulates waste such as asbestos-containing construction material removed as part of the abatement program and old capacitors or other equipment that contain polychlorinated biphenyls (PCBs). No new materials or equipment that contains asbestos or PCBs is being purchased at the Laboratory; thus, eventually no TSCA waste will be generated at the Laboratory. Because the removal of asbestos and PCB-contaminated items results from nonroutine replacement activities, TSCA waste is considered nonroutine and will not be discussed further in this report.

Most hazardous wastes are disposed of through Duratek Federal Services, a Laboratory subcontractor. This company sends waste to permitted treatment, storage, or treatment storage 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 SWO and offsite disposal is $6.49/kg.[2-2] Figure 2-15 shows a process map for waste generation at the Laboratory.

The quantity of routine and nonroutine hazardous waste that was generated at the Laboratory and the amount that was recycled during FY04 are shown in Fig. 2-16. The amount of routine State waste generated during the same period at the Laboratory also is included in Fig. 2-16.

The divisions that produced the most routine hazardous waste at the Laboratory during FY04 were NMT, B, MST, C, DX, and ESA. The routine hazardous waste generation by division is shown in the pie chart in Fig. 2-17.

2.6.2. *Hazardous WMin Performance*

The DOE Secretarial PP/Energy Efficiency 2005 goal is to reduce hazardous and State waste from routine operations by 90%, using a CY93 baseline. The Laboratory's CY93 baseline quantity was 307,000 kg; therefore, the FY05 target becomes 30,700 kg.

The trend over the last several years has been good, with the FY05 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 Fig. 2-18.

Routine hazardous waste decreased sharply from FY98 because the Laboratory began excluding recycled hazardous waste from the haz-

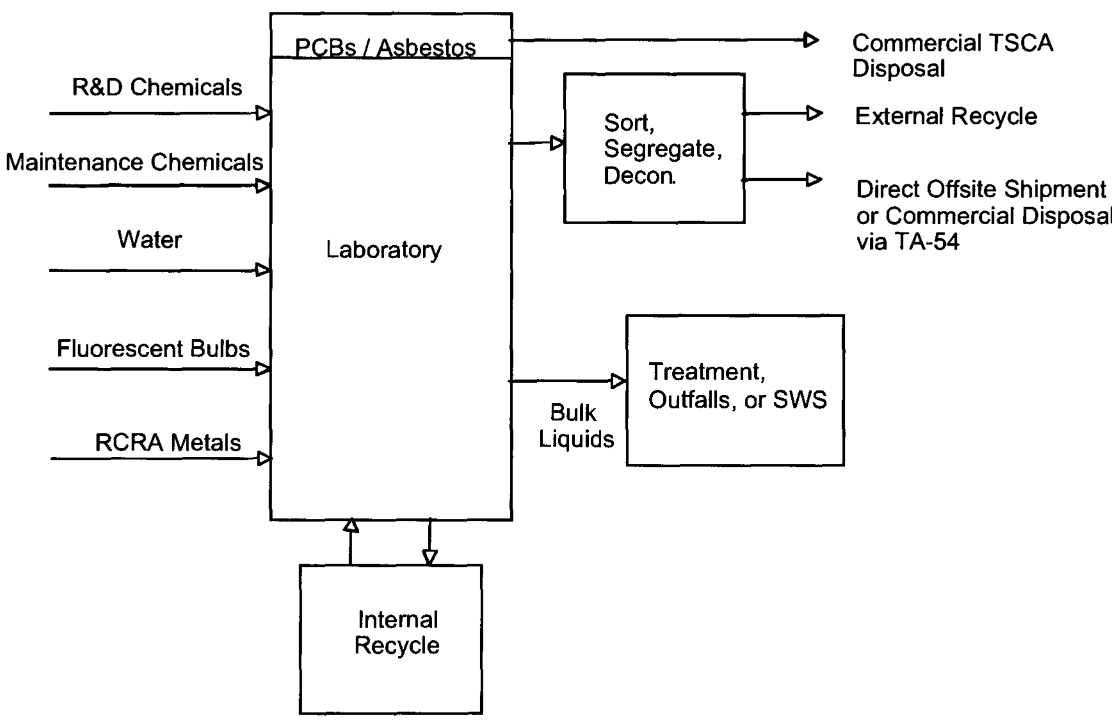


Fig. 2-15. Waste process map.

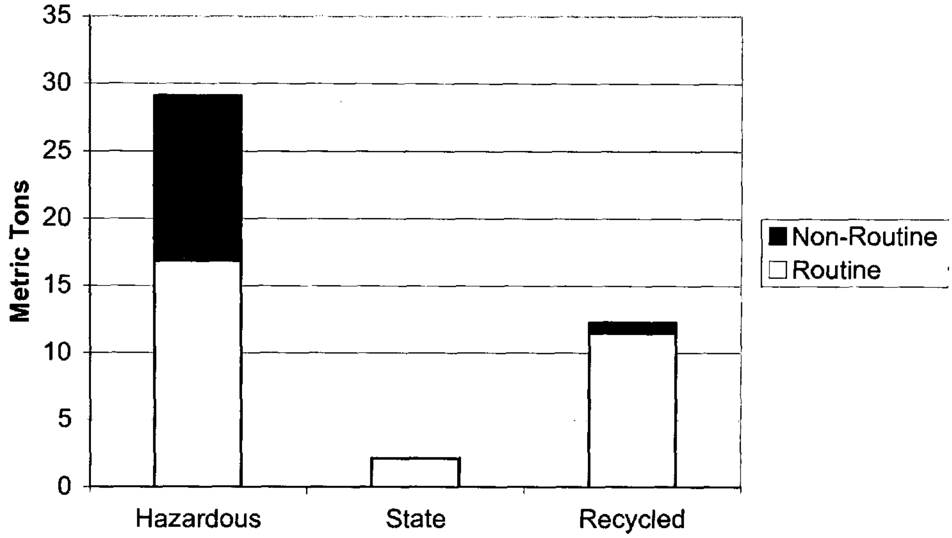


Fig. 2-16. Relative weights of waste by type generated during FY04.

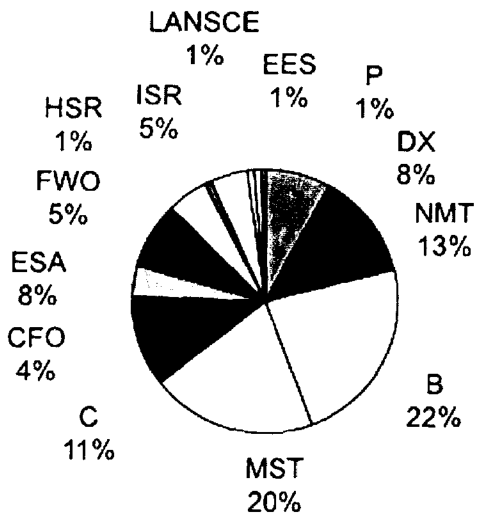


Fig. 2-17. Routine hazardous waste by division during FY04.

ardous 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 WMin 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 since been recycled.

2.6.3. *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 then is either shipped directly to offsite TSDFs or transshipped to Area L, TA-54, from which the waste gets shipped to an offsite TSDF. ER project waste typically is shipped directly from ER 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. This list excludes ENV-RS waste because this material is considered to be nonroutine and the quantity of this material generated each year can vary widely. The Laboratory also has HE and HE waste water that are treated on site; these are not included in 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. Nontoxic 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 still are required for many procedures, and solvents persist as a large component of the Laboratory's routine hazardous waste stream.

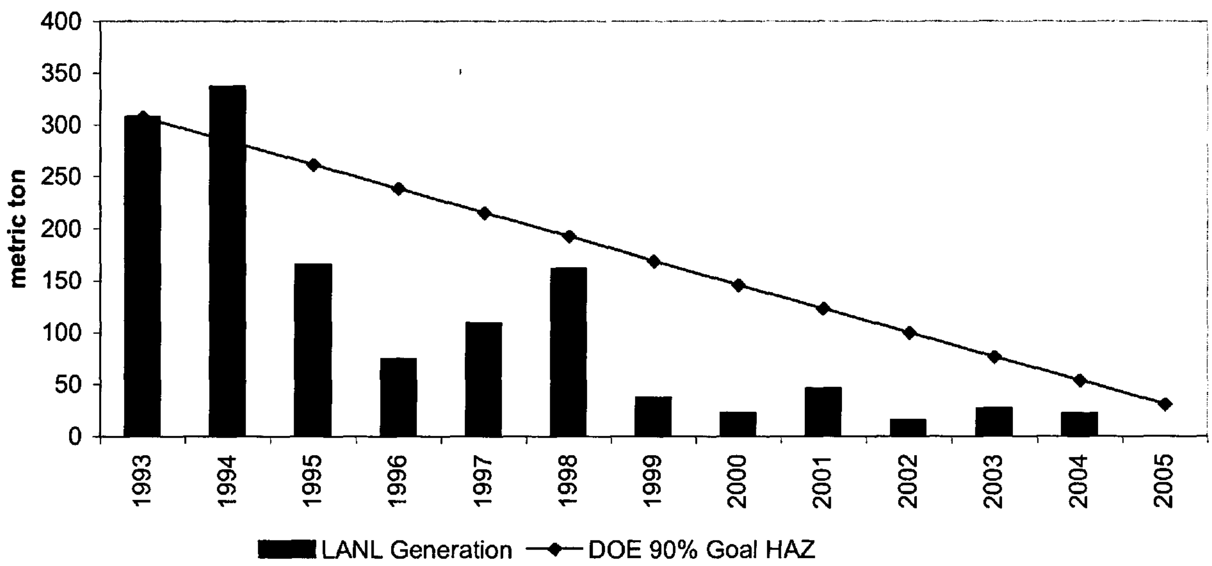


Fig. 2-18. Routine hazardous and State waste generation compared with the DOE's FY05 hazardous and State Waste 90% reduction goal.

Unused/Unspent Chemicals. When chemicals pass their manufacturer's stated expiration date, they are no longer useful for research at the Laboratory. A product is classified as hazardous waste if it has components that require the use of EPA-listed or characteristic waste codes. The volume of unused and unspent chemicals varies each year, but this waste stream usually composes a significant fraction of the Laboratory's total hazardous waste. Researchers are encouraged not to buy more of any chemical than they are certain to need for the next several months to avoid having any unused amount. The Laboratory always is 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 used routinely 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 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 nonhazardous substitutes.

Rags and Spill Cleanup. 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 oil or other nonhazardous 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. 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 and are no longer needed for the experiment. The total volume of laboratory trash decreases when new procedures are developed to perform experiments with very small quantities of chemicals and when appropriate nonhazardous 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, nonrecycled hazardous waste in Fig. 2-19. 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.

Routine State waste was not included in Fig. 2-19. During FY04, ~45% of the routine State waste generated at the Laboratory was composed of absorbent pads and material that had been used to clean up oil or other nonhazardous liquids. Approximately 53% of the routine State waste was composed of items associated with biomedical procedures, such as sharps, personal protective equipment such as gloves and hospital gowns, sawdust and other absorbents for cleaning up blood or other biological fluids, empty vessels that contained biological specimens, and glass slides or other objects that came into contact with biological samples.

2.6.4. WMIN

The Laboratory requires chemicals to perform R&D experiments, properly maintain its facilities, and produce materials and items related to mission activities. The Laboratory gives its employees extensive training to work safely with chemicals and minimize the amount of waste generated. The Laboratory always is looking for new equipment or new 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.

The Laboratory has implemented many projects to reduce the amount of hazardous waste that it generates. During FY04, the Laboratory adopted an environmental policy statement, which will be the mission statement used for the EMS currently being developed at the Laboratory for enhancing its environmental performance. The Laboratory's environmental policy statement is given as follows.

It is the policy of the 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;

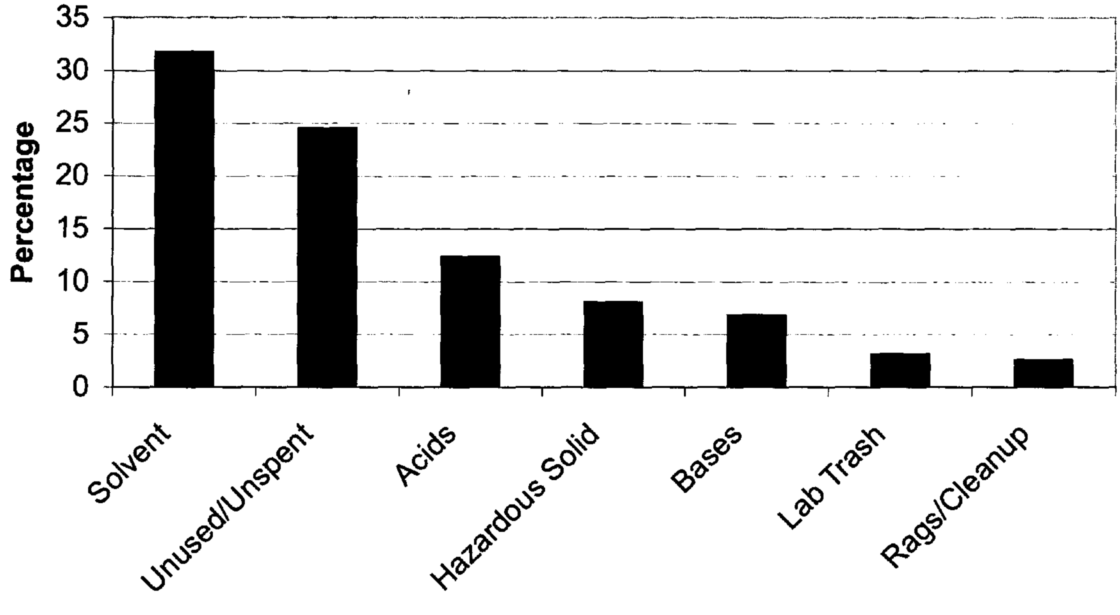


Fig. 2-19. FY04 routine hazardous waste stream components.

prevent pollution; foster sustainable use of natural resources; and work to increase the body of knowledge regarding our environment.[2-3]

2.6.4.1. Training and Incentives

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 sanitary waste generated at the Laboratory. The Waste Generator Overview course, which is mandatory for all employees who generate nonsanitary waste, includes a section on hazardous WMin. The Radworker II course, which is mandatory for all employees who come in contact with radioactive wastes, includes a section on minimization of LLW, MLLW, and TRU waste.

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

The PP team holds a PP awards ceremony every year in conjunction with other Earth Day activities. All Laboratory employees can submit descriptions of projects they have completed during the past year that contributed to waste reduction at the Laboratory. At the awards ceremony, each participating individual and team is recognized for their efforts with award certificates. Winning University of California (UC) employees also receive a cash bonus.

Each year the PP team also invites organizations that generate waste 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 GSAF Program, and the funds for these grants are collected by means of a small tax on the organization generating each waste item.

The PP team reviews the GSAF proposals and distributes the available funds to the projects. If not enough money is available 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 continually to 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 could 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; thus, researchers have multiple incentives to minimize waste.

2.6.4.2. External Sources of Information

The PP 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 come from these external sources.

The PP program manager serves on the Governing Board of the Green Chemistry Institute and is also a member of the US Green Building Council. Three team members belong to the New Mexico Recycling Coalition, and one serves on their board. Two team members serve on the Los Alamos County Solid Waste Advisory Board, and one is the vice chairperson. 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 PP team worked with a local environmental group called the Pajarito Environmental Education Center to sponsor Earth Day activities for the community. The PP team obtains information on waste source reduction and recycling from local environmental organizations, as well as ideas from other DOE environmental managers.

Various vendors visit the Laboratory and 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. Scientists can try promising new equipment or technologies at the Laboratory, depending on the cost and availability of funding. The PP team provides the necessary funds for some of the equipment that can reduce waste through the GSAF Program.

2.6.4.3. Hindrances to Hazardous Waste Source Reduction

One significant component of the hazardous waste stream at the Laboratory is unused and unspent chemicals. Researchers do not use chemicals past their expiration dates, and full or partially used bottles of chemicals are sent for disposal once they have expired. 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. However, this situation is not practical at the Laboratory because the research sites are very spread out. Transporting the chemicals on public roads would require special permits and vehicles, and 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 because additional full-time employees would be required to manage the pharmacy, coordinate shipping, and drive the chemicals safely from one site to another. The additional permits and vehicles that would be required to transfer chemicals between sites would increase the cost of this program further.

FY04 was unusual because of 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 examined closely to find potential sources of risk, 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. Once implemented, the RCRA Cost Analysis Program will require all cost packages to incorporate appropriate life-cycle costing to cover the disposition of wastes, excess equipment, and facilities. Because waste costs will have a higher profile with all researchers at the Laboratory in the near future, it is expected that more WMin and PP projects will take place to reduce costs.

2.6.5. Improvement Projects

The PP team constantly is looking for new projects to implement that have the potential to reduce waste generation and increase recycling at the Laboratory. The GSAF Program provides funds to researchers for equipment or validation of new procedures that could 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 PP team also generates many of the project ideas. PP team members frequently assist waste generators with the implementation of these projects.

2.6.5.1. Completed Projects

The following lists are titles of GSAF projects and the amounts of funding that they received during the past 5 years. Descriptions of these projects are available on the Laboratory's PP website.[2-4]

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-Gal. 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)
- MLLW 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 MLLW and LLW 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 Nonradioactive 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)
- Nonhazardous 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)

2.6.5.2. 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 PP website.[2-4]

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 Depleted Uranium (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 following projects have been funded and currently are being executed. In some cases, the remedies are administrative actions that have been taken to resolve conflicting goals. The DOE defense programs (DP), the GSAF Program, and various mission programs fund the hazardous waste reduction projects.

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 its stored lead reserves. Uncontaminated lead that no longer can be used anywhere at the Laboratory can be recycled off site or recast into new shapes for internal reuse.

Lead Substitution and Removal. Several Laboratory divisions have examined nonhazardous 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 formerly protected valves from tampering.

During FY04, ~1600 kg of electronic equipment with lead-containing cathode ray tubes was removed from RCAs. The items were surveyed carefully for contamination, and when none was found, they were sent away for disposal as non-routine hazardous waste. By removing these items from RCAs, the potential for creating MLLW, which is much more difficult to handle than hazardous waste, was reduced significantly.

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 often are 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.

Nonhazardous Scintillation Fluid. Nonhazardous 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 nonhazardous or LLW. No hazardous waste or MLLW 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 its impact to the environment.

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

The GIC program has been in effect for ~5 years. The GIC program works by requiring all workers entering RCAs to make a complete list of all items that are necessary for their tasks that day. Workers are allowed to take only the items on the list into the RCA with them. All unnecessary equipment is left outside the entrance, and all unnecessary packaging is recycled or handled as sanitary waste. By the end of FY04, the GIC program helped the Laboratory avoid over 100 m^3 of LLW. This source segregation system also prevents unnecessary chemicals from entering RCAs and potentially becoming hazardous waste or MLLW.

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 RCAs so that the generation of MLLW can be avoided. The mercury in replaced thermometers and in other obsolete mercury-containing equipment is 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 ~90% of the acid used, and over 400 kg of hazardous waste acid is eliminated every year.

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

Solvent Waste Reduction and Recycling. Many projects have been implemented at the Laboratory to reduce the use of solvents because solvents consistently have 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 generating waste, this process is time consuming and expensive. Two organic synthesis laboratories 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 maintenance shop previously 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 does solvent. The hot-water parts washer saves time for employees, decreases their chemical exposure, and has reduced hazardous waste solvent generation by ~4000 kg annually.

The Material Testing Laboratory 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 hazardous waste by ~400 kg annually.

In B 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 before sequencing. Eliminating formamide reduces hazardous waste solvent and laboratory trash, thereby reducing paperwork and costs. The National Nuclear Security Administration (NNSA) gave this project a best-in-class PP award in 2004.

The C-Division organic synthesis team once performed experimental chemical synthesis activities in 25-mL to 2-L macroscale glassware reaction vessels. Now the researchers use reaction vessel sizes of 5 mL or less, which reduces the volume of solvent used. Typical solvents include toluene, methylene chloride, tetrahydrofuran, and ethanol.

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

Spill Waste Recycling and Reduction. One of the largest sources of routine State waste in the past was oil-contaminated soil generated 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 was 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 PP award in 2004.

Chemical Pharmacy in Chemistry Division. The Applied Chemical Technology (C-ACT) group has one of the largest chemical inventories at the Laboratory. Maintenance of large chemical inventories is time consuming and expensive; however, 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 laboratories does not occur often. 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 laboratories 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.

2.6.5.3. 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 currently are 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 100-lb reporting threshold. Historically, the Laboratory has used lead bullets during training and qualification for Protection Technology Los Alamos (PTLA, a Laboratory subcontractor) security force personnel exercises at the small-arms range. Because of increased security requirements in 2002, PTLA personnel released nearly 10,000 lb of lead into the environment from ammunition used at the small-arms range, which constituted the Laboratory's largest reportable TRI release to the environment. 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.

Identification and Cleanout of Mercury-Contaminated Drains. This project is intended to identify and clean out drains contaminated with mercury. The identification phase was completed in FY01. Based on survey results, an estimated 9% of the drains at the Laboratory might be contaminated with mercury. The total scope of this project is to survey drains throughout the Laboratory, identify those that are contaminated with mercury, effectively clean the contaminated drains, and manage the resulting waste appropriately.

Methyl Ethyl Ketone (MEK) Recycle Plant. 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 ~300 gal. of hazardous waste solvent annually. If the MEK distillation project is successful, DX Division may consider recycling other types of solvents, as well.

2.7. *Solid Sanitary Waste*

2.7.1. Introduction

Most material brought into the Laboratory will leave as solid sanitary waste if it cannot be sold for reuse, salvage, or recycle. Sanitary waste is excess material that is neither radioactive nor hazardous and that can be disposed of in the DOE-owned, Los Alamos County-operated landfill (County landfill, or landfill) according to the WAC of that landfill and the State of New Mexico Solid Waste Act and regulations. Solid sanitary waste includes paper, cardboard, office supplies and furniture, food waste, wood, brush, and construction/demolition waste. Figure 2-20 is the process map for sanitary waste generation at the Laboratory. FWO-SWO is responsible for collecting, recycling, and managing the Laboratory's solid sanitary waste stream.

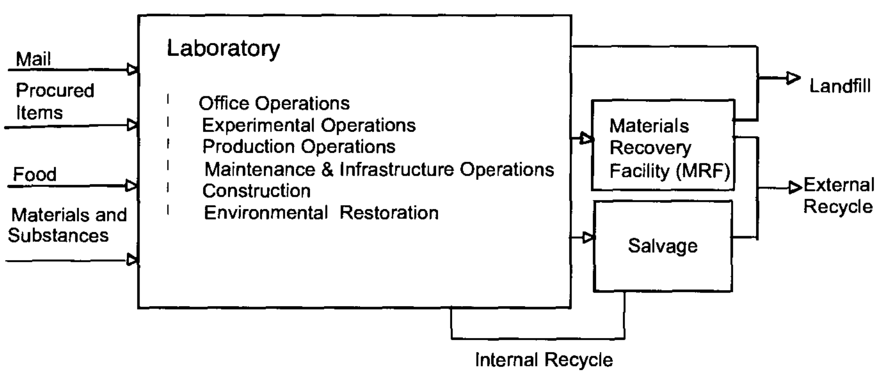


Fig. 2-20. Top-level sanitary waste process map.

Materials come into the Laboratory as required by Laboratory operations. Mail includes both internally and externally generated mail. Many items, such as copiers, computers, office supplies, experimental apparatus, and furniture, are procured as part of the Laboratory's operations. Food is brought into the Laboratory as part of the cafeteria operations and from homes and restaurants. Materials and substances, such as building materials and chemicals, are used in construction, maintenance, research, and infrastructure operations.

After items either have reached the end of their useful life or are no longer needed, they are discarded. Many are salvaged or placed in recycle bins. Salvaged items can be recycled either internally or externally. Some items are discarded and end up in dumpsters. These items go to the Material Recycle Facility (MRF), which is operated by FWO-SWO. At the MRF, items that can be recycled are segregated from the dumpster waste and sent to recycle. Items that cannot be recycled are sent to the landfill. Some items, such as firing-site glass and nonrecyclable construction waste, go directly to the landfill. Thus, virtually every nonradioactive, nonhazardous item brought to the Laboratory eventually is either recycled or buried at the landfill. Reducing the volume of sanitary waste being buried at the landfill requires either reducing the quantity of materials flowing into the Laboratory (source reduction) or increasing the quantity of materials recycled.

The Laboratory generated 5789 tonnes of sanitary waste in FY04. The total amount of sanitary waste generated in FY04 is ~2500 tonnes less than the total generated in FY03 due to a decrease in construction activities resulting from the Laboratory-wide work suspension imposed in July 2004. Of this total, 3847 tonnes was recycled, which comprised 1963 tonnes of nonroutine construction wastes and 1747 tonnes of routine sanitary wastes, such as paper, cardboard, metal, and wood pallets. The remaining wastes were disposed of and comprised 466 tonnes of nonroutine construction wastes and 1476 tonnes of routine sanitary waste, the vast majority of which came from Laboratory dumpsters.

Figure 2-21 displays the relative volumes of construction, routine, and recycle materials in the sanitary waste stream.

The routine sanitary waste stream has three components: dumpster waste, waste diverted from the hazardous waste stream by FWO-SWO at TA-54, and other waste. The dumpster waste is composed of anything that is discarded in desk-side trashcans, trash receptacles, or dumpsters. The FWO-SWO waste is nonhazardous solid waste that is generated as process waste and is managed at TA-54.

Dumpster waste is the largest component of routine sanitary waste and includes virtually all discarded items that are not initially recycled or are not recovered at the MRF. The major constituents of the dumpster waste stream are cardboard, paper, food waste, wood, plastic, Styrofoam™, glass, and metals. Figure 2-22 shows the relative weights of the components of the routine sanitary waste stream.

2.7.2. Sanitary WMin Performance

The DOE has implemented goals for waste minimization. The DOE proposes that solid sanitary waste generated from routine operations be reduced by 75% by 2005 and by 80% by 2010, using CY93 as the baseline. Routine waste is defined as waste generated by any type of production, analytical, and/or R&D Laboratory operations; work for others; or any periodic and recurring or ongoing work. The Laboratory's performance toward this goal is shown in Fig. 2-23. (Total yearly waste generation is calculated as the sum of disposed waste and recycled volumes—only the yearly amount disposed of is represented in the graph.)

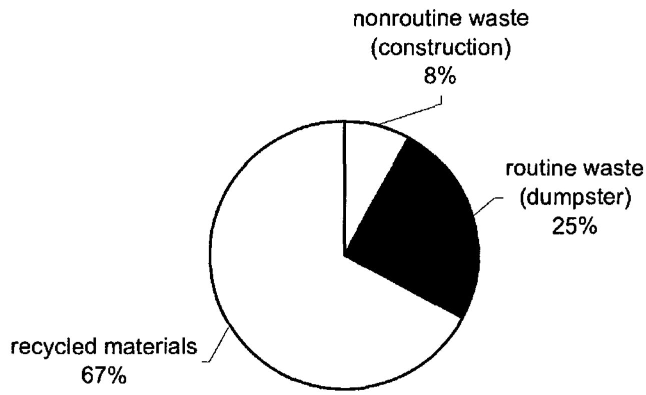


Fig. 2-21. Sanitary waste disposal and recycling.

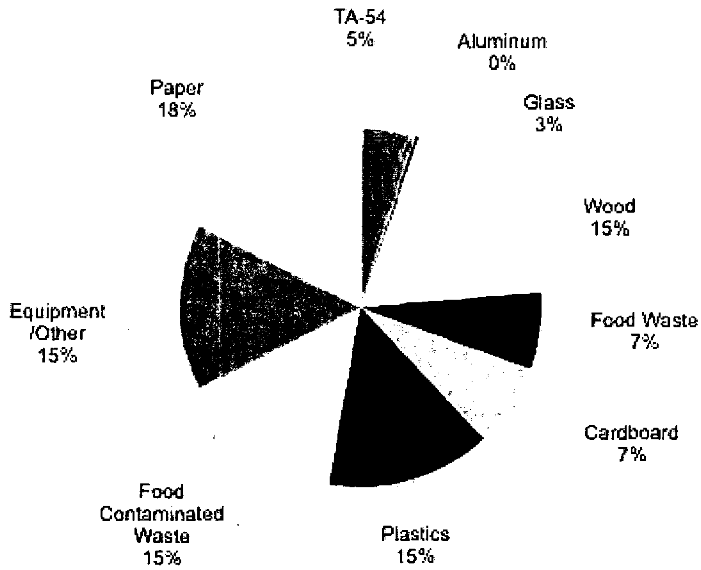


Fig. 2-22. Routine sanitary waste by type.

The DOE approved a modified sanitary waste reduction goal of 55% per capita, using the 1993 baseline of 264 kg/person/year rather than the previously mandated 75% total weight reduction by 2005. The goal was normalized to a per-capita rate to remove the waste generation effects associated with an increased mission scope since 1993. To give a better perspective, the Laboratory has doubled its budget since 1993, with a 33% increase in staffing. The revised goal is now 119 kg/person/year. The Laboratory has made good progress to date in avoiding and diverting sanitary waste since the baseline year of 1993; the per-capita waste generation rate for FY03 was 111 kg/person/year.

For FY04, the per-capita waste generation rate dropped to 109 kg/person/year, which meets the revised goal. This reduction is the outcome of aggressive waste minimization programs that include recycling of white paper, junk mail,

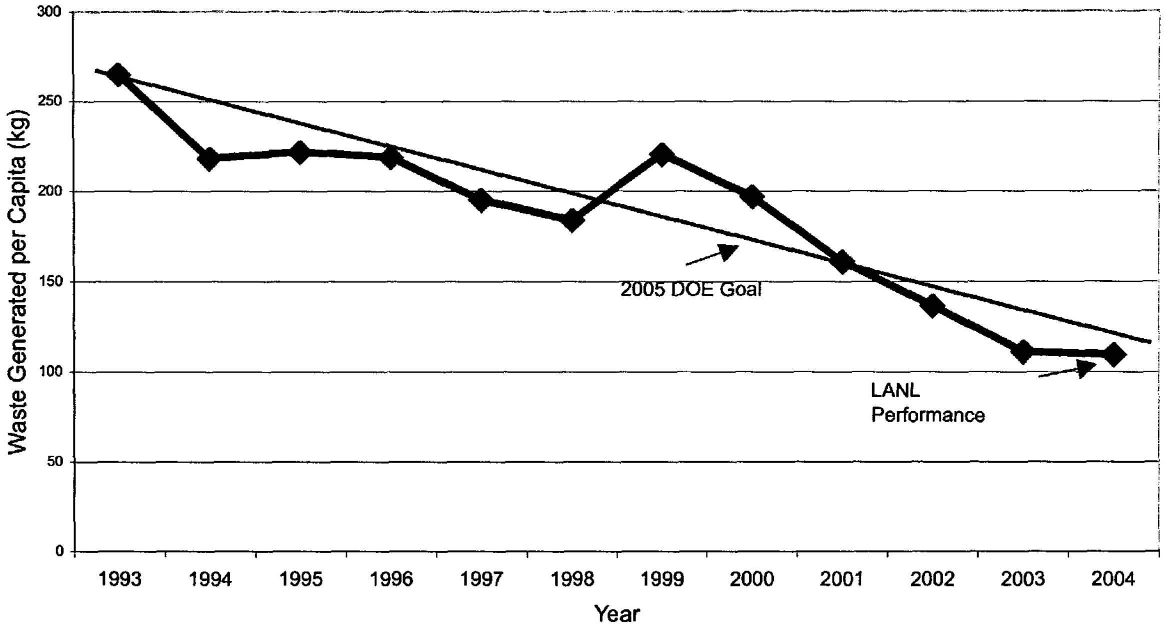


Fig. 2-23. Laboratory performance against the 2005 DOE PP goal for sanitary waste reduction.

colored office paper, catalogs, cardboard, Styrfoam™, pallets, scrap wood, and metal and source reduction efforts such as the Stop Mail program. The Laboratory also increased outreach and awareness efforts to increase the use of the recycling centers. Most major sanitary waste streams at the Laboratory have a recycling pathway. The DOE also requires that 45% of the sanitary waste from all operations (both routine and nonroutine) be recycled by 2005 and that 50% of the waste be recycled by 2010. The recycling rate is calculated as

$$\frac{\text{amount recycled}}{(\text{amount recycled}) + (\text{amount disposed of})} = \text{overall recycling rate.}$$

As part of revising the sanitary waste generation goal, the Laboratory committed to meeting the DOE's 2010 goal by 2005. The Laboratory's performance toward this goal for sanitary waste is shown in Fig. 2-24. The recycle of total (routine + nonroutine) sanitary waste currently stands at 67%.

2.7.3. Waste Stream Analysis

Almost every item that enters the Laboratory (other than radioactive material, hazardous material, and materials that become radioactive) leaves the Laboratory in the sanitary waste stream at the end of its useful life. At that point, the item is recycled, reused (salvaged), or buried in the landfill. Materials disposed of include construction waste, food and food-contaminated wastes, paper products, glass, and Styrofoam™.

The waste stream analysis addresses wastes that were not recycled during FY04. Expanded recycling and source reduction initiatives are being instituted to reduce these waste streams further.

2.7.3.1. Nonroutine Waste Streams

Construction/Demolition Waste (466 tonnes sent for disposal). Historically, the largest sanitary waste stream at the Laboratory was the construction/demolition waste stream. The total amount of construction waste generated in FY04 decreased by 33% from FY03. Some of this

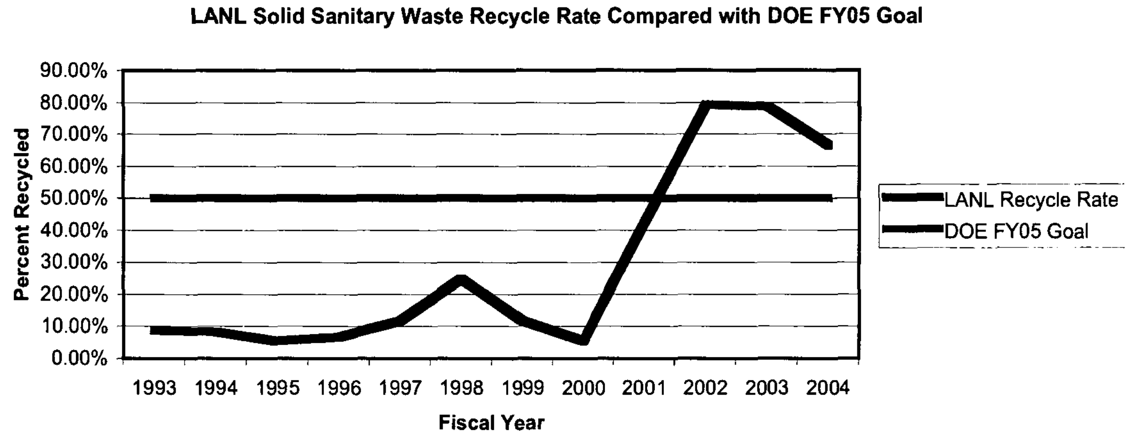


Fig. 2-24. Laboratory performance against the 2005 DOE PP goal for sanitary waste recycling.

waste generation decrease is related to the improved use of the Laboratory's construction waste recycle system. Another contributing factor is the overall decrease in construction activity. Construction/demolition waste is gener-ated during the Laboratory's projects to build new facilities, upgrade existing facilities, or demolish facilities that are no longer needed. Construction/demolition projects require that raw materials and equipment be brought onto the site, along with utilities (especially water). The waste generated by these projects is varied and consists primarily of dirt, concrete, asphalt, some wood items, and various metal objects; the three largest components of this waste are used asphalt, concrete rubble, and dirt. This waste stream is growing and will continue to do so as planned new construction and renovation projects begin.

Recycling programs were established in FY01 for concrete, asphalt, dirt, and brush. In FY04, these recycling programs diverted 1253 tonnes of concrete and asphalt, 710 tonnes of soil, and 113 tonnes of brush. A local construction company was hired to recycle the materials as part of creating small-business economic development opportunities in northern New Mexico.

2.7.3.2. Routine Waste Streams

Cardboard (110 tonnes sent for disposal). Cardboard enters the Laboratory in one of two ways: as packaging materials or as newly purchased moving boxes. Some of the cardboard, particularly cardboard moving boxes, is recycled for reuse routinely. Other cardboard is discarded to either the dedicated cardboard collection roll-offs or the trash dumpsters. Dumpster trash is taken to the MRF and sorted, and recyclable cardboard is recovered. Wet or food-contaminated cardboard is sent to the landfill for disposal.

Paper Products (258 tonnes sent for disposal). The Laboratory purchases ~600 tonnes of paper products each year. These products are used in a variety of ways, but mostly in offices for printing, copying, faxing, and other office support uses. Paper is used to produce unclassified, classified, and sensitive documents, and each type of document has a different path to disposal. Unclassified documents normally are disposed of in either green desk-side bins, which are taken directly to recycle or to trash bins. Approximately 150 tonnes of unclassified material is sent to storage or to archiving. This material is held in storage for varying periods before it is disposed of. Some unclassified material may be distributed to RCAs, where it is subject to radioactive contamination and disposal as LLW. Uncontaminated paper material from RCAs may be disposed of in GIC bins and is sent to TA-54 to be characterized and disposed of. Every year the Laboratory receives and distributes more than 400 tonnes of mail. This mail includes junk and business mail, catalogs, phone directories, and various documents. The Laboratory distributes mail, including internally generated mail. Most of this material can be recycled after use.

Food and Food-Contaminated Materials (317 tonnes sent for disposal). Food products enter the Laboratory waste streams either through food service from one of the four cafeterias or from food brought into the Laboratory from off site. The total food waste stream is estimated to be ~100 tonnes/year. All of the food and food-contaminated wastes generated at the Laboratory are sent to the landfill. Currently, no composting pathways are available for food or food-contaminated wastes. However, proposed changes in the NMED solid waste regulations may encourage food composting, and other recycling pathways may become available. Food waste from trash bins and kitchen areas around the Laboratory is particularly intractable because it cannot be collected easily and contaminates other recyclable materials with which it comes into contact as a result of compaction during collection. Approximately 217 tonnes of paper, cardboard, Styrofoam™, plastic, and other materials is rendered unrecyclable because of food contamination through commingling of food and other wastes in the trash.

Plastics (220 tonnes sent for disposal). Plastics and foam are used for many purposes at the Laboratory and constitute the third largest component of dumpster waste. The waste stream consists primarily of food/beverage containers, shrink-wrap, plastic bags, and packaging materials. No local outlets for mixed plastics recycling are available in the region. The Laboratory has recently begun to recycle Styrofoam™ by sending it to a company that produces RASTRA®. RASTRA® is a concrete form system made of a lightweight material called THASTYRON, which provides a permanent framework for a grid of reinforced concrete that forms load-bearing walls, shear walls, stem walls, lintels, retaining walls, and other components of a building. It is anticipated that 20 tonnes of Styrofoam™ can be diverted through this program.

Wood (226 tonnes sent for disposal). The Laboratory produces waste wood through the discarding of wooden pallets and clearing areas of vegetation. The wood contained in dumpsters also includes a significant quantity of construction wood waste that has been disposed of improperly. To the extent possible, brush and wood waste are recycled for the Laboratory by Los Alamos County. A new contract for pallet recycling with a sawmill in Peñasco, New Mexico, is in development. This contract is estimated to divert 250 tonnes of scrap wood and pallets in FY05.

Glass (48 tonnes sent for disposal). Glass products enter the Laboratory either as purchased items (e.g., beakers, flasks, and pipettes) or as containers. Although many chemicals are purchased in glass bottles, a significant source of glass is beverage containers, either purchased through the food services on site or brought in from outside the Laboratory and disposed of on site. Limited opportunities exist for recycling this waste stream because of a lack of market demand and because of high transportation costs. Glass currently is disposed of at the landfill. A pilot program for glass was initiated in FY03 but was not successful because too many contaminants such as plastics were commingled with the glass, rendering it unrecyclable. Improvements were made, and it is estimated that as much as 20 tonnes of glass will be diverted annually through this effort. The glass recycling project is limited only to certain areas because of collection and handling costs.

Aluminum Cans (4 tonnes sent for disposal). An estimated 4 tonnes of used aluminum cans is disposed of each year; these cans are commingled with trash and cannot be removed safely at the MRF. In FY04, ~4 tonnes of aluminum cans was recycled.

Other Waste (221 tonnes sent for disposal). Many materials are disposed of, including unsalvageable and unrecyclable equipment, filters, leaves, glass, metal pieces, office supplies, furniture, and other materials that cannot be recovered safely or economically.

TA-54 Routine Sanitary Waste (72 tonnes sent for disposal). The Laboratory generates ~72 tonnes of nonhazardous, nonregulated sanitary waste from Laboratory research processes. These wastes are managed through the TA-54 management system and are disposed of at an industrial landfill.

2.7.4. Improvement Projects

The projects intended to mitigate the effects of sanitary waste on the environment are shown in the following subsections. The projects are classified as ongoing or unfunded.

2.7.4.1. Ongoing Projects

The following projects are ongoing.

Material Recovery Facility. The Laboratory completed the construction and began initial operation of an MRF to recover recyclable items from trash dumpsters. Dumpsters are emptied and their contents sorted at the MRF. This operation results in the recovery of ~40% of waste that otherwise would be disposed of. Using a new baler has increased the efficiency of the MRF operation greatly.

Paper and Document Recycle. The Laboratory recycles paper, mail, and publications through the following three programs.

- Green Desk-Side Bin Recycle. Most unclassified white paper can be deposited in green desk-side bins for recycle. Sensitive materials are shredded before being recycled as unclassified waste. In FY04, 290 tonnes of white paper was recycled, up from 232 tonnes in FY03.

- MS A1000. Junk mail, books, transparencies, newsprint (newspapers), magazines, fliers, brochures, catalogs, binders, colored paper, and folders are recycled at the Laboratory by sending unwanted materials to MS A1000. Phone books are recycled annually at MS A1000. This program won a White House Closing the Circle Award in FY00. Approximately 183 tonnes of sanitary waste was recycled through the MS A1000 program in FY04, up from 182 tonnes in FY03.

- MS J568—"Stop Mail." MS A1000 provides a mechanism for recycling unwanted paper or documents, but the "Stop Mail" program provides a mechanism for stopping unwanted mail from ever entering the mail system. Employees receiving unwanted mail at the Laboratory may send that mail to MS J568 so that their names can be removed from mailing lists.

Construction Debris Inspection/Recycle (Truck Turnaround Program). A program has been implemented to inspect all construction debris for recyclable content. Sorting and segregation of reusable items occur at the construction site before the debris is loaded. Trucks containing construction debris then are dispatched to the salvage yard for inspection. If the trucks are found to contain recyclable or reusable items, those items are removed.

Concrete Crushing. The crushing and reuse program diverted 1253 tonnes of concrete and asphalt. A local small business was used to crush and recycle the concrete and asphalt. The concrete and asphalt recycle system was greatly improved in FY03 through establishment of a staging and recycling area on site. In FY02, these materials were staged at the Los Alamos County landfill. Staging the materials on the Laboratory property saved $92,000 in disposal fees.

Dirt Recycling. All uncontaminated dirt is sent off site to be used as fill material. In FY04, dirt started being staged at Sigma Mesa for reuse on site. In FY04, 710 tonnes of soil was reused on site.

Brush Recycling. Brush and branches from construction projects are sent to the Los Alamos County Landfill, where they are chipped and distributed as mulch to County residents. In FY04, 113 tonnes of brush was recycled, up from 100 tonnes in FY03.

Salvage and Reuse. Items that have been replaced or are no longer needed but have some useful life left can be reused within the Laboratory through the Laboratory salvage program or sold to individuals, organizations, or vendors off site for recycling.

Metal Recycle. Metals and scrap wire are recycled through FWO-SWO. All bins are serviced by FWO-SWO, resulting in quicker service and better customer service in FY03. Containers are picked up by the recycler at a centralized staging area. All metal must be clean and suitable for public release (i.e., no radioactive or chemical contamination). In FY04, 1042 tonnes of metal was recycled.

Styrofoam™ Recycling. The Laboratory has recently begun to recycle Styrofoam™ by sending it to a company that produces RASTRA®. RASTRA® is a concrete form system made of a lightweight material called THASTYRON, which provides a permanent framework for a grid of reinforced concrete that forms load-bearing walls, shear walls, stem walls, lintels, retaining walls, and other components of a building. In addition, the MRF team pulls large pieces of Styrofoam™ out of the trash for baling. The MRF team gathers enough Styrofoam to compile four bales monthly. Yearly, this saves over 100 yd^3 of landfill space.

Outreach and Education. Recycling pathways have been developed for most waste streams. An education and awareness campaign was initiated in FY03 to ensure that the Laboratory staff is fully using recycling systems that are available to them. It is estimated that up to 200 tonnes of waste was diverted through the expanded use of existing systems.

Paper Use Reduction. An outreach program to encourage the reduction of paper use through double-sided copying and printing will be conducted this year. Outreach information and reminders will be distributed to encourage employees to reduce paper use. It is estimated that up to 100 tonnes of paper use will be avoided through this program.

Sitewide Excess Cleanup. A sitewide clean up effort was initiated in FY04. The Laboratory has ~10,000 tonnes of mostly unusable excess equipment stored outdoors. Because this material is exposed to rain and snow, it is polluted significantly with stormwater. In addition, some of the material is flammable and represents a fire hazard if stored near structures or other combustible materials such as grass or trees. The excess material also may serve as a shelter for mice, rats, and other small mammals. An effort to reduce or eliminate this material could reduce the pollution potential dramatically, as well as reduce the fire and health risks. The funding may be increased as a result of Director

Nanos's attention to improving housekeeping at the Laboratory.

2.7.4.2. Unfunded Projects and Pilots

These projects have an environmental aspect but currently are unfunded or are being examined.

Composting. Compostable materials include cafeteria food waste, food-contaminated paper or cardboard, and pulverized paper (for security purposes). Currently, no recycling service providers hold permits for food waste composting. Proposed changes to NMED Solid Waste Management regulations may encourage composting. The Laboratory will monitor the regulatory changes and explore composting options. A pilot project to compost the pulverized paper with horse manure and brush at the Los Alamos County Landfill will be conducted in FY05.

Reusable Wood Pallets: Approximately 100 tonnes of pallets comes through the Just In Time (JIT) system annually. A pilot to require JIT vendors to purchase and use reusable pallets will be conducted in FY05.

2.8. Affirmative Procurement at Los Alamos National Laboratory

The Federal government is the nation's single largest consumer of goods and services. The government developed executive orders (EOs) in 1998 that are collectively known as "Greening the Government." EO 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition," specifically promotes the purchase of environmentally preferable products by all government organizations whenever possible. "Environmentally preferable" means that the product contains recycled material, is recyclable, is biodegradable, or is nonhazardous. This EO is designed to minimize the negative environmental impact of the government as much as possible. By creating this market for environmentally preferable products, more companies have an incentive to manufacture these products. Subsequently, environmentally preferable items become more common and readily available to the general public, as well. The process of purchasing environmentally preferable products that contain recycled content is known as "affirmative procurement."

The Laboratory began its affirmative procurement program in FY96. The Laboratory maintains an online catalog of common office products from various vendors, and any employee can use this online catalog to search for products. All products that contain recycled content are marked with the recycling logo and appear first in lists of products created by keyword searches. Products that do not contain recycled content are marked with a yield sign if a comparable product that does contain recycled material is available in the online catalog. A product marked with a yield sign can be purchased only if the person placing the order checks a box agreeing that the comparable item with recycled content will not meet their particular need, is significantly more expensive than a comparable product with recycled content, or is not available in a timely manner. More than 1800 items with recycled content are currently available in the online catalog. As more products that contain recycled material become available, they are added to the online catalog.

In FY04, the Laboratory had greater than a 99% rate of affirmative procurement purchases from the online catalog. The Laboratory has sustained this high percentage of affirmative procurement for several years, and the ultimate goal is still 100%. Because not all purchases at the Laboratory are made through the online catalog, the PP Team currently is examining ways to track affirmative procurement purchases made with credit cards or purchase orders. The affirmative procurement rate is shown in Fig. 2-25.

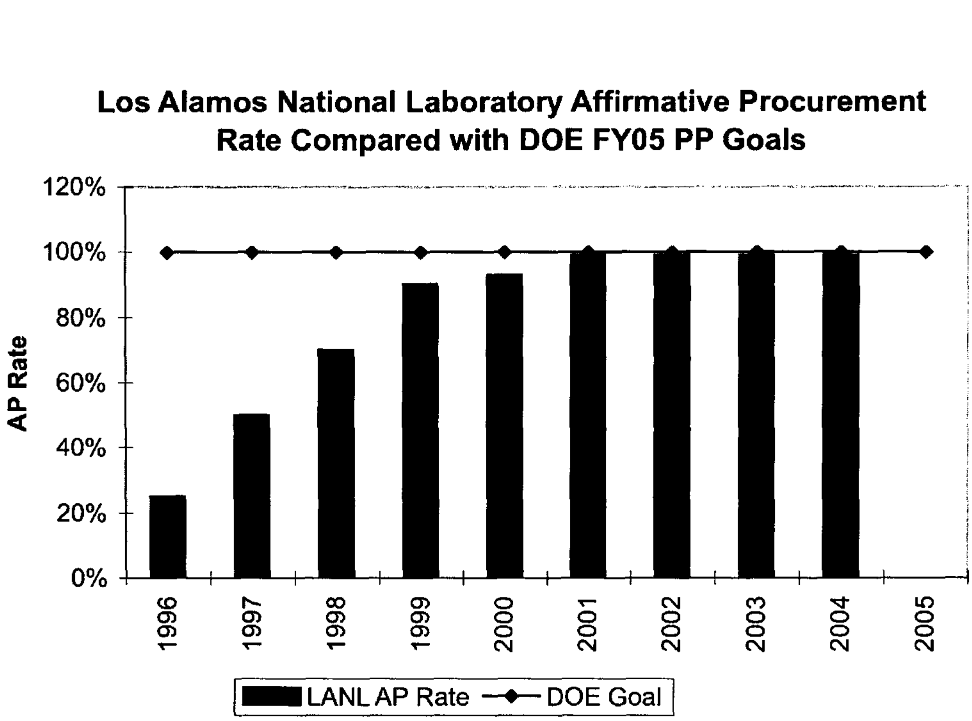


Fig. 2-25. Affirmative procurement rate and goals.

2.9. *Energy Use and Conservation*

2.9.1. INTRODUCTION

The continued growth of the Laboratory has required and will continue to require increased energy consumption. The addition of various facilities at the Laboratory, such as the Strategic Computing Complex's (SCC's) and the Dual Axis Radiographic Hydrodynamics Test (DARHT) Facility's second axis, has increased demand significantly. Future projects dramatically will increase the demand for electrical energy and for increased load-following capability.[2-5] Access to adequate, reliable power supplies is critical to the continued growth of the Laboratory and particularly to the ability to develop large experimental programs and computing facilities. The consumption of energy at the Laboratory clearly has reached the point where careful planning for the future will be required if growth is to be sustained. The Facility and Waste Operations Utilities and Infrastructure Group (FWO/UI) is responsible for energy planning and energy use management at the Laboratory. This group is also responsible for the Laboratory's energy conservation program.

The current power demand challenges the existing system capacity; thus, any future growth of the Laboratory depends on finding practical and cost-effective solutions to the electrical supply and usage problems. Two avenues for improving the energy supply are conservation and increases in power import or generation capability. Of these two options, conservation is the easiest to implement, will have more immediate results, and will minimize the impact of energy usage on the environment. However, increasing the supply will have a much larger effect on energy availability, as well as on the environment. The Laboratory has been addressing these problems for the last decade and has taken significant actions to resolve them, including studying options to increase the power supply and implementing Laboratory-wide conservation programs. This section investigates the trends in energy use over time, examines the constraints on such usage, defines problem areas, and explores issues and options for improved performance.

The Laboratory's power supply problems are exacerbated by regional and national situations. Regionally, the northern New Mexico power grid is operating near capacity. If demand increases much beyond current levels, some load shedding may be required across the entire grid. These power supply problems mean that the Los Alamos Power Pool (LAPP) could be required to shed its load by curtailing electrical use and shutting down operation in one or more facilities. Nationally, the available generating capacity has not kept pace with demand, which, combined with deregulation, has led to volatility in electrical energy costs. Costs on the open market have varied from ~\$25/MWh to ~\$55/MWh. If this trend persists, the cost of electrical energy could alter the strategy for ensuring future energy supplies. At the higher energy costs, a premium is placed on conservation and onsite generation. At lower energy costs, the purchase of offsite power to make up shortfalls is preferred.

The utility system (water, natural gas, and electricity supply) at the Laboratory is driven by the demand for electrical energy. As energy requirements go up, the demand for cooling water for onsite generation and the volume of effluent discharged at outfalls increase. Most of the Laboratory's consumption of electrical energy manifests itself as heat that must be removed and dissipated. In fact, ~60% of the Laboratory's water is used in cooling towers. Although the electrical supply can be increased by implementing one or more options, the critical component of the energy/water cycle (i.e., the availability of water) cannot be increased easily. The parameter most likely to limit Laboratory growth is the availability of water. Although the Laboratory currently is far from that limit, additional electrical demand brings the limit closer. Projected increased reliance on the power plant for load-following will have a pronounced effect on water use at the Laboratory. The TA-3 power plant most often is used as a power-peaking facility. The facility is aging and is inefficient by modern standards; therefore, its water consumption is large relative to the energy it produces.

The system diagram for the Laboratory's consumption of energy and water is shown in Fig. 2-26.

Laboratory operation requires the consumption of water, natural gas, and electricity. Air emissions and effluent discharges result from this consumption. The use of energy and water at the Laboratory is closely coupled. Therefore, the electrical supply system at the Laboratory will be analyzed in this section.

In July 2004, Laboratory Director Peter G. Nanos ordered a work suspension of all Laboratory employees as a result of several safety and security incidents. Because of this temporary work suspension, the Laboratory's energy and water consumption for the months to follow was less than normal. The figures in this chapter reflect the lower-than-average consumption trends during the months of July, August, and September.

The largest users of electrical energy at the Laboratory are shown in Table 2-3. The top four consumers account for up to 51 MW at coincidental peaks.

The peak electrical demand tends to be seasonal but nearly always is greatest when LANSCE is operating. The peak demand for the last 3 years is shown in Fig. 2-27.

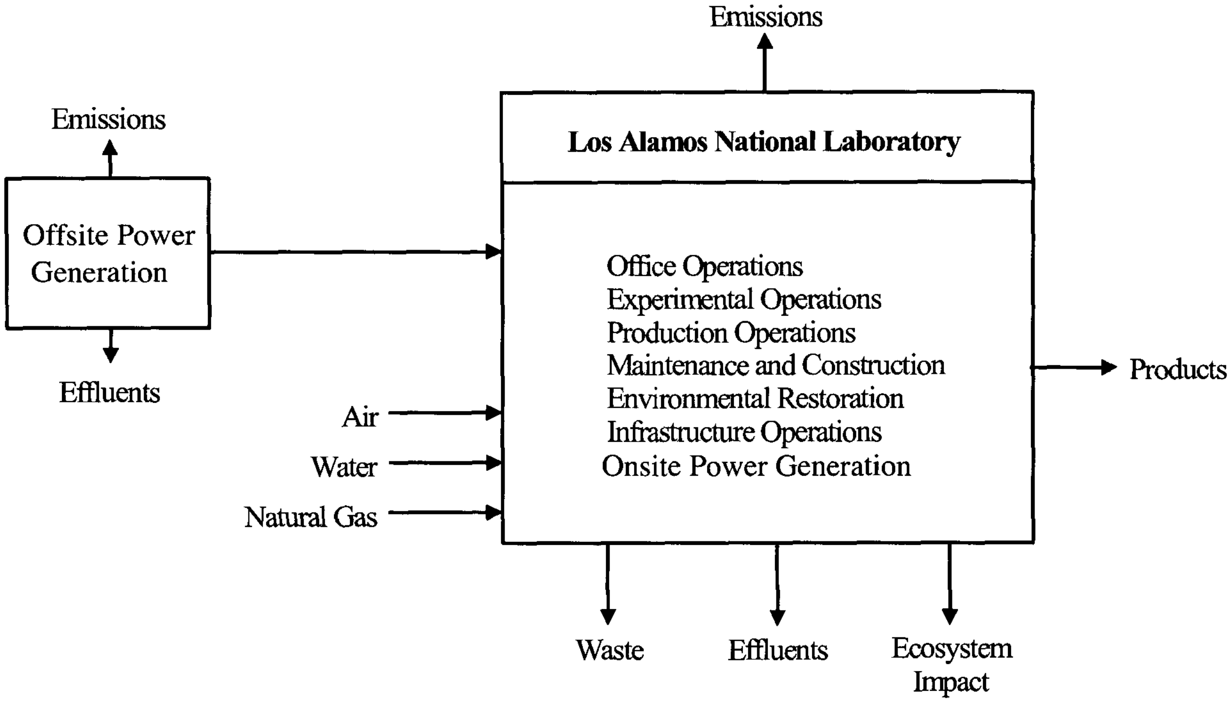


Fig. 2-26. Energy process map for the Laboratory.

Table 2-3. Electrical Energy Usage at the Laboratory

Facility	Electrical Load (MW)	Duration
LANSCE—peak demand	25–32	24 h/d during operation
LANSCE—base load	5–7	24 h/d
SCC	3–5	24 h/d
Computing (CCF[a] and LDCC[b])	4–5	24 h/d
TA-3[c]	10	5 d/week
TA-55	2–3.6	24 h/d

[a]CCF = Central Computing Facility.
[b]LDCC = Laboratory Data Communications Center.
[c]The above total for TA-3 does not include the 5 MW for the LDCC/CCF. Computing at TA-3 is separate. A 10-MW, Laboratory-wide peak load swing occurs during weekends and holidays.

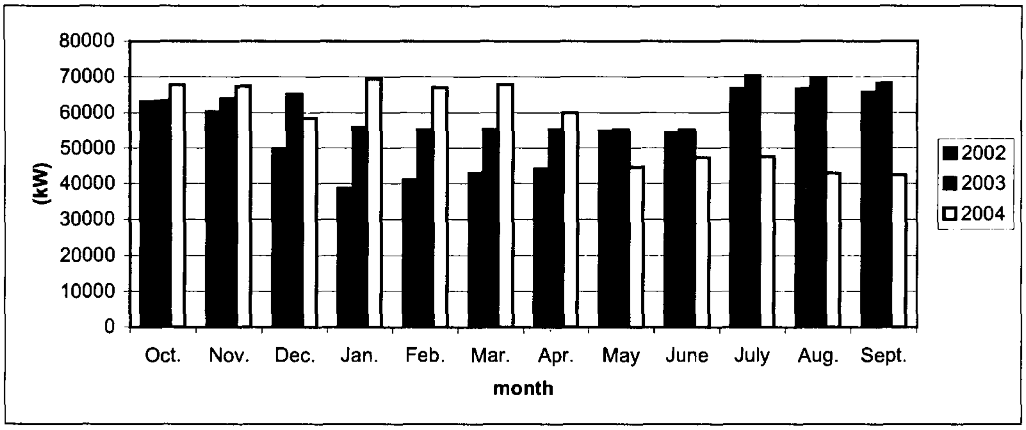


Fig. 2-27. Peak electrical demand.

The peak demand is important in planning for electrical supply because the LAPP has a firm load-serving capability that is limited to 82 MW. The portion of the LAPP power supply that relies on regional hydropower is seasonal and, during the winter months, falls to zero. If the load demand exceeds the load-serving capability, onsite generation is required to make up the deficit. If the LAPP power supply is inadequate for the load demand, LAPP can either buy power on the open market or generate additional power on site. The limitations and options for a power supply are critical to the long-term power supply planning process and also may influence the dispatch of power on an hourly basis.

The monthly consumption of electricity at the Laboratory for the past 3 years is shown in Fig. 2-28. The FY04 average monthly peak demand increased from FY02, and trends show that FY04 would have been higher than FY03 if the work suspension had not occurred. In particular, LANSCE has adjusted its load so that the LANSCE peak demand is not coincident with the Laboratory's base-infrastructure peak-demand period. Shifting loads to off-peak hours has reduced the daily peak demand.

The data shown in Fig. 2-28 include the LANSCE usage. The Laboratory's usage without LANSCE is shown in Fig. 2-29.

2.9.2. Energy Conservation Performance

Energy usage is not regulated, but the government has established guidelines for government facilities in the *Energy Policy Act of 1992* and in EO 12902, *Energy Efficiency and Water Conservation at Federal Facilities* (March 8, 1994) EO 12902 mandates a 30% reduction in energy use for agencies by FY05 as compared with FY85.

Utility loads associated with the operations of LANSCE (defined as experimental processes) are excluded from this measure. The measure is based on a reduction in energy usage from FY85 levels in British thermal units per gross square feet of building, expressed as a percentage of FY85 energy usage. The total energy sources include electricity, natural gas, and liquefied petroleum gas. The available data for energy consumption do not allow the reliable estimation of consumption by division or by user other than the largest users, nor does the performance measure require it. Therefore, no detailed breakdown of energy consumption occurs.

Laboratory electrical consumption is shown by year in Fig. 2-30.

The Laboratory's use of natural gas is limited and tends to be seasonal. The principal use of

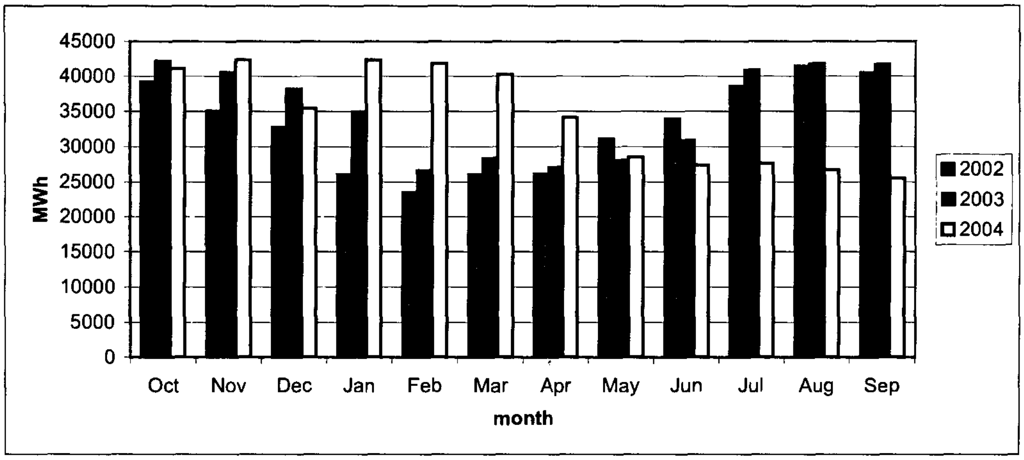


Fig. 2-28. The Laboratory's monthly electricity usage.

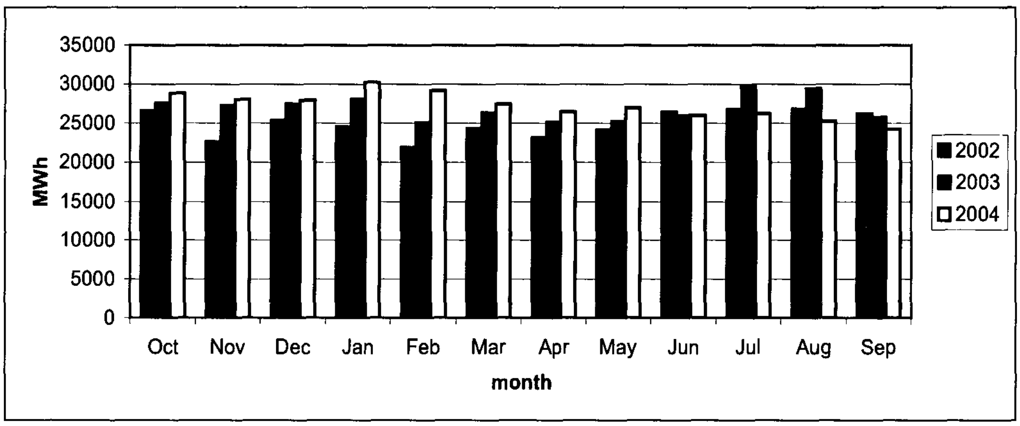


Fig. 2-29. The Laboratory's electricity usage without LANSCE.

natural gas is for space heating, although natural gas is burned by the power plant. Natural gas usage is shown for the last three FYs in Fig. 2-31.

2.9.3. Waste Stream Analysis

The impact of electricity usage by the Laboratory is at least regional and arguably global. Regional coal and water resources are affected by the necessity to generate power for the Laboratory; emissions from this generation of power, although small in an absolute sense, nevertheless contribute to pollution of the global atmosphere. The Laboratory cannot function with a significant reduction in electrical usage; in fact, the Laboratory will require more electrical power in the future. The increased use of power directly impacts not only the waste streams associated with power generation, but also water consumption and wastewater discharge. Electricity use is a complex system at the Laboratory and is coupled strongly to the consumption of water and the emission of pollutants.

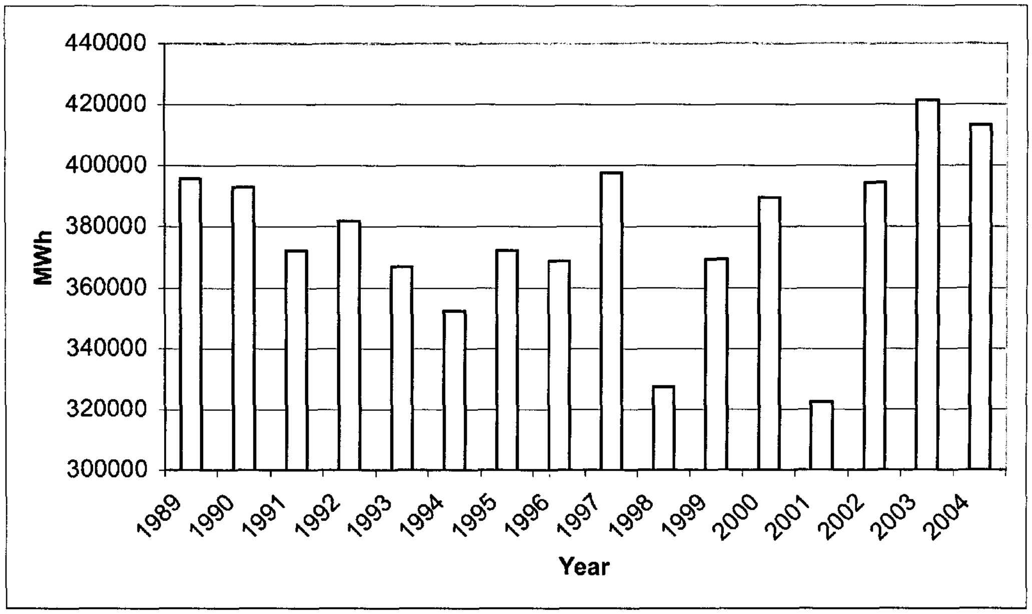


Fig. 2-30. The Laboratory's electrical usage.

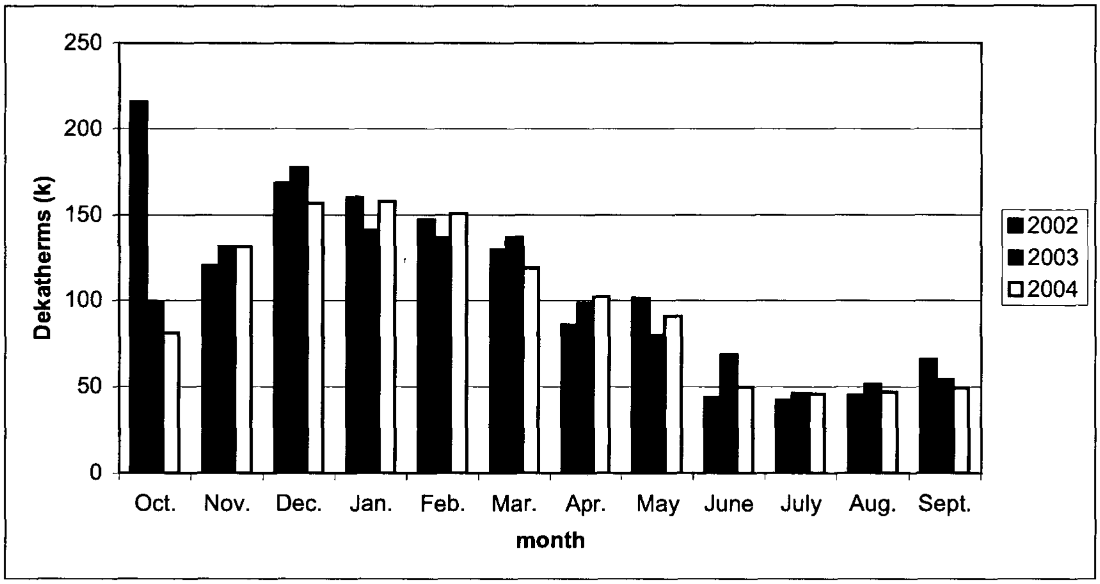


Fig. 2-31. Natural gas consumption at the Laboratory.

Electricity is imported into the Laboratory from offsite sources; however, because peak coincidental demand can exceed the import capacity, it sometimes is necessary to generate power at TA-3 by burning fuel oil or natural gas. Natural gas also is burned to produce steam and hot water for space heating and process support.

The waste streams associated with the use of energy at the Laboratory are emissions in the form of industrial gases and wastewater effluent from various cooling towers. Emissions occur on site when the TA-3 power plant is operating and as the result of Laboratory consumption of electricity imported from off site. Emergency power generation and portable generators also produce emissions. The process map element for energy use is shown in Fig. 2-26.

With the exception of water use in conjunction with onsite generation, the sizes of the waste streams associated with Laboratory electrical usage are not known.

2.9.4. Improvement Projects

The following projects were identified as potential measures for improving the energy generation, import, conservation, distribution, and reliability at the Laboratory. These projects are divided into three categories: (1) projects completed in the last year, (2) projects currently funded and ongoing, and (3) unfunded proposed projects.

2.9.4.1. Completed Projects

These projects have been completed and/or implemented in the last year.

Combustion Turbine Procurement. The Laboratory has completed procurement of a 20-MW, simple-cycle, gas-fired turbine for onsite power generation. Installation will be complete by FY05.

Stack Gas Recirculation System at the Power Plant. A stack gas recirculation system was added to the power plant. This addition will improve efficiency and reduce the emission of criteria industrial gases.

Additional Turbine Refurbishment. The Laboratory performed a study to establish the cost and feasibility of refurbishing another turbine at the power plant. The 10-MW turbine/generator unit now is being refurbished, which will greatly improve its efficiency.

2.9.4.2. Ongoing Projects

These projects have been funded and currently are being executed.

Southern Technical Area (STA) Substation Enhancement. A new substation will be built at the STA site in FY05. The new substation will provide the flexibility to transmit power from the Public Service Company of New Mexico's (PNM's) Reeves Substation in Albuquerque to either the Eastern Technical Area (ETA) Substation or to the Western Technical Area (WTA) Substation. This enhancement will provide the backup source of power to the Laboratory in case the main ETA and TA-3 substations are lost.

Conservation. An operational incentive is in place to conserve electricity. As much as 72 to 168 MWh of use could be avoided by implementing simple conservation measures such as "Energy Star" computing. For that reason, the Laboratory has had a conservation program in place for some time.[2-6] Significant savings have been realized as a result of this program. Further savings will be realized, without additional cost, through projects already planned. The LANSCE 201-MHz upgrade will result in a savings of ~1 MW/yr. Although conservation can never solve the peak-demand problem completely, these measures may be a very effective, short-term remedy. A reduction in demand through conservation will mean that near-term growth will not challenge the firm load-serving capability of offsite import and will reduce the frequency of TA-3 power plant operation. The power plant is a particularly inefficient power producer, and its use has been increasing in response to the growth of peak coincidental demand. It may be possible to save as much as 10 MW in peak demand through combined conservation efforts.

TA-9 Energy Study. An in-house energy management study is being conducted at TA-9. Part of the study to conserve energy and water will be to convert steam heat to gas heat. The steam heat system at the Laboratory is old and has many leaks, thus wasting energy and water.

Expanded Metering. Numerous meters have been installed at the largest energy consuming facilities, and the meter installation program is continuing. The installation of meters allows better reporting and analysis of energy data.

*2.9.4.3. **Proposed Projects***

These projects or actions have been proposed to allow further increases in efficiency and reliability. Some currently are unfunded. If implemented, they will provide an additional margin against unexpected and unplanned increases in energy consumption.

Energy Savings Performance Contract (ESPC). Implementation of the DOE's Super ESPC program at the Laboratory has been approved. This program will be the Laboratory's main vehicle for improving energy efficiency in existing facilities laboratory wide. The initial size of the program will be in the range of $5M–$10M for a wide range of projects. This program will continue for the next 10 years, and the resulting savings in energy is projected to be $3M per year. Preliminary energy audits currently are being performed on 10 facilities.

Alternative-Fuel-Vehicle Fueling Station. A 1994 EO states that by 2005, federal fleets must be composed of 75% alternative-fuel-capable vehicles using either compressed natural gas or regular fuel. In addition, the alternative fuel usage rate in these alternative-fuel-capable vehicles must reach 75% by 2005 and 90% by 2010. To satisfy this order, ENV Division bought two fuel tanks with the intention of garnering additional monies to install the fuel tanks and operate a B20 (20% biodiesel and 80% regular fuel) and E-85 (ethanol blended fuel) filling station. Funding has not been identified for the installation process of the project. Currently, only 20% of the Laboratory's fleet is alternative-fuel capable.

Continued Chiller Replacement. Replacement is underway for a significant number of chillers at the Laboratory. Modern chillers are twice as efficient as the older chillers; thus, the use of modern chillers represents a significant savings.

The existing data and the volatile nature of energy consumption at the Laboratory do not allow reliable comparison of FY05 projected consumption with and without conservation project implementation. However, the implementation of the previously mentioned projects will reduce peak demand by a minimum of 21 MW.

2.10. Water Use and Conservation

The utility system (water, natural gas, and electrical supply) at the Laboratory is driven by the demand for electrical energy and by the increasing Laboratory population. As energy requirements increase, the demand for cooling water and the volume of effluent discharged at outfalls increase. Most of the Laboratory's consumption of electrical energy manifests itself as heat that must be removed and dissipated. In fact, ~60% of the Laboratory's water is used in cooling towers. Although the electrical supply can be increased by implementing one or more options, the critical component of the energy/water cycle (i.e., the availability of water) cannot easily be increased.

The Laboratory is targeted to use no more than 30% of the total Los Alamos County water rights, or 542 million gal. per year. Water demand at the Laboratory is projected to grow as a result of new mission requirements. With water conservation projects now being implemented, the Laboratory has sufficient water resources to operate current and planned facilities. If the Laboratory significantly increases operation of present facilities or constructs additional ones, its historical water usage could be exceeded. Although Los Alamos County, which supplies water to the Laboratory, has unused water rights, a significant increase in Laboratory or County water use could exceed current water resources. Consequently, it is in the Laboratory's and the County's best interests to pursue an aggressive, cost-effective, water-conservation and gray-water-reuse program. It is also in their joint interest to develop additional water resources to accommodate future growth. Water use and planning at the Laboratory is the responsibility of the Utilities and Infrastructure group in the Facilities and Waste Operations Division (FWO/UI). This group tracks water use and manages improvements and repairs to the infrastructure that reduce water use at the Laboratory. The newly formed Water Conservation Committee, chaired through FWO Waste Facilities Management (WFM), will represent the Laboratory on all water conservation issues and will have interactions on the Laboratory/University of California (UC) institution, Los Alamos County, the Department of Energy (DOE), and regional, state, and national levels. The Water Conservation Committee provides leadership in two areas. The first is in direction, integration, and coordination to promote responsible stewardship in regard to activities that potentially affect regional water resources. Such activities may include, but are not limited to, understanding the legal bases of Los Alamos County and DOE water rights; reviewing water availability issues related to future DOE and Los Alamos County plans; compiling and maintaining an accurate yearly record of actual water use; developing water use forecasts; anticipating and promoting local, state, and federal water conservation goals and practices; and recommending water conservation technologies. The second area of responsibility is the tracking of and participation in regional water planning initiatives outside of Los Alamos County that may affect water availability and/or use.

The Laboratory used ~337 million gal. in fiscal year (FY)02, 355 million gal. in FY03, and 370 million gal. in FY04. The source of this water is a series of deep wells that draw water from the Rio Grande aquifer. Approximately 60% of Laboratory water flows into cooling towers. Without the cooling-tower-water efficiency upgrades, this flow may increase by as much as 70% by 2005 because of new facilities that are being built. Approximately half of this water evaporates; the remainder is released into the Laboratory sanitary system or surrounding canyons through National-Pollutant-Discharge-Elimination-System (NPDES)-permitted outfalls and ground-water (GW) permits. Water is consumed at the Laboratory for many purposes, including cooling-tower uses, operations, domestic use, landscaping, and temperature control. The water eventually is discharged in the form of sanitary water effluent, outfalls, evaporation, or leakage losses. The water supply system and water balance for the Laboratory are shown in Fig. 2-32.

The Laboratory's largest water discharge is to the environment. These discharges are regulated through NPDES, GW, and/or storm-water permits.

- Water from cooling towers is discharged directly to NPDES/GW-permitted outfalls or is sent to the Laboratory sanitary system.
- Water used for industrial and domestic purposes is discharged to the Laboratory's sanitary system if it meets the waste acceptance criteria (WAC).
- Treated sanitary wastewater is discharged either directly to NPDES/GW-permitted outfalls or to cooling towers for reuse.
- Water used in construction processes is discharged to the environment and is regulated by a storm-water permit.

The only unregulated discharges of water to the environment are leaks and potable water used for landscaping.

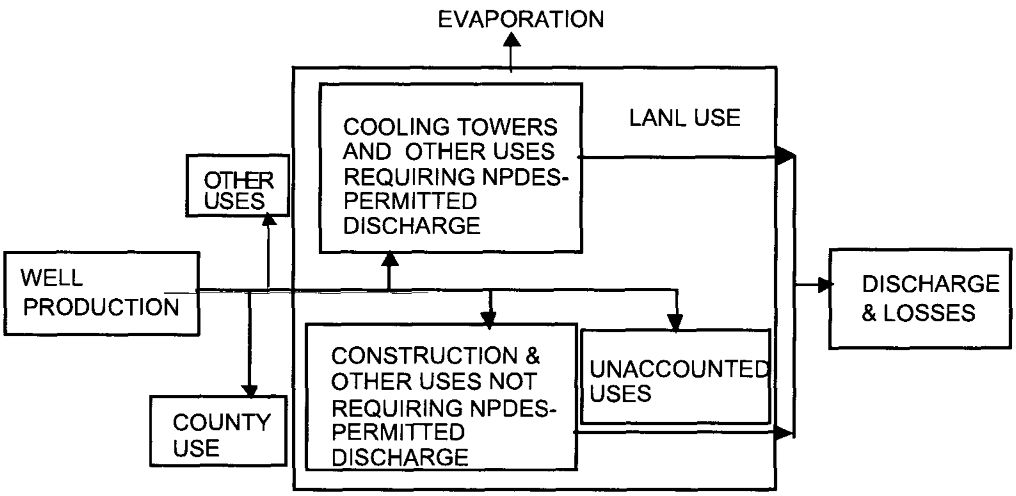


Fig. 2-32. The Laboratory water system.

The largest use of water at the Laboratory is cooling. The various cooling towers that operate at the Laboratory consume 58% of the total water usage. The largest cooling towers, by volume of water consumed, are the LANSCE towers at Technical Area (TA)-53 and the TA-3 towers associated with the large computer facilities [the Central Computing Facility (CCF), the Laboratory Data Communications Center (LDCC), the Nicholas Metropolis Center, and the TA-3 Power Plant]. The major constraint on the water efficiency of the cooling towers is silica concentrations in the cooling water. The concentration of silica in the local GW is ~88 ppm. Because silica will begin to precipitate out and foul heat-exchanger surfaces at ~200 ppm, the concentration must be controlled below that level. Currently, the silica concentration is controlled by operating the towers at 1.5 to 2.0 cycles of concentration.

However, the Laboratory is addressing this problem and will deploy water treatment technologies that will allow cooling-tower operation at higher cycles of concentration.

The overall consumption of water at the Laboratory in FY02, FY03, and FY04 is shown by month in Fig. 2-33. The trend in water consumption is somewhat seasonal, with the largest volumes being consumed in the summer. Because summer is the period of hottest weather and therefore frequently has the highest electrical demand, water usage at the Laboratory correlates to electrical demand. Because LANSCE is the largest single consumer of electrical energy on site, water use is dependent on the LANSCE run cycle.

During the past few years, LANSCE run cycles have been shortened as compared with previous years. Thus, a strong correlation between LANSCE-run energy consumption and overall water consumption is not immediately evident. However, when LANSCE resumes a full 7- to 9-month operation cycle, the effect on water consumption will be more pronounced.

2.10.1. Water Conservation Performance

The Laboratory has not established water conservation performance goals. However, EO 13123, "Greening the Government through Energy Efficiency Management," mandates the development of such water goals. In advance of these goals, the Laboratory has committed to an

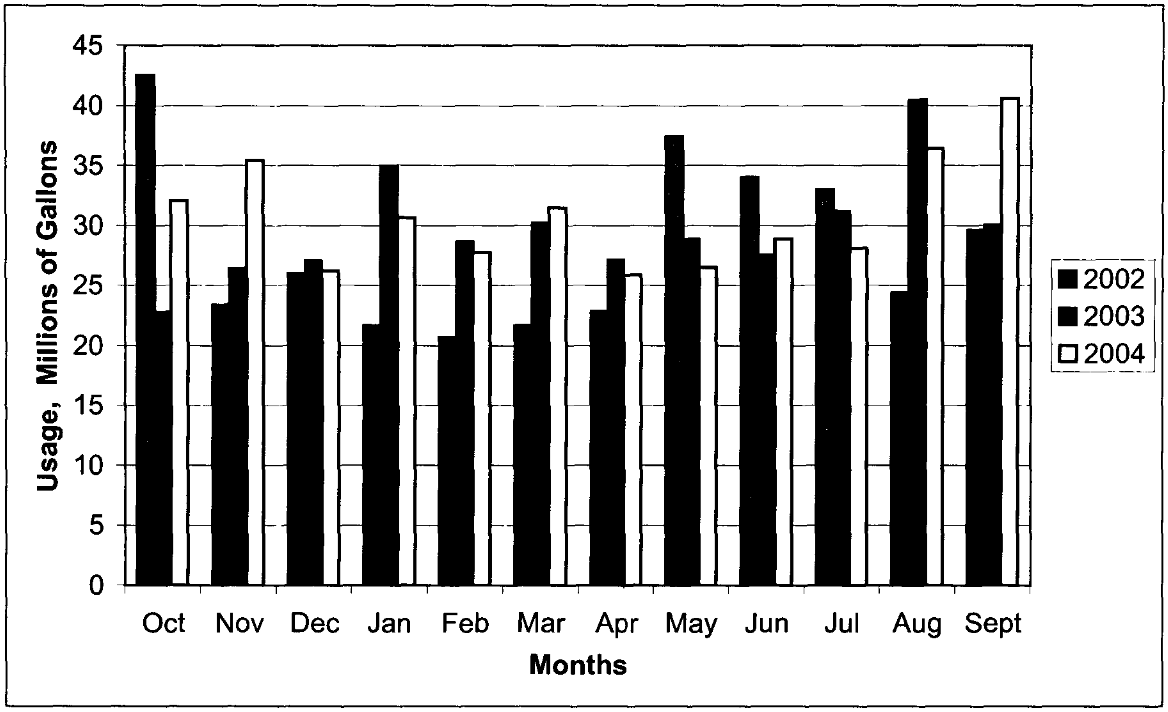


Fig. 2-33. FY02, FY03, and FY04 Laboratory overall water consumption.

aggressive water conservation program. The consumption of water at the Laboratory (by year) for recent years is shown in Fig. 2-34.

The data for years before 1999 are approximate because of many factors, including incomplete metering at the Laboratory, unknown system losses, and uncertainty in distribution. No reliable data are available for FY98 because in that year, operation of the Los Alamos water supply and distribution system was transferred from the DOE to Los Alamos County. The different techniques for measuring and estimating water used at these two entities lead to greater-than-normal uncertainty in the estimate of water use.

There is no strong trend in water use at the Laboratory. A pronounced reduction occurred in the mid-1990s, but consumption then rose again. Consumption has decreased over the last 3 years, in part because of an aggressive leak repair program and attention to cooling-tower operations. LANSCE has installed new cooling towers and improved the cooling-tower control systems. These projects at LANSCE have reduced water consumption by several million gallons per year. The Nicholas Metropolis Center has been upgraded to modern, efficient, cooling-tower control systems and is using Sanitary Wastewater System (SWS) water. Improved cooling-tower control systems have been installed at TA-35. The effect of these improvements has been to lower water consumption at the Laboratory markedly. Construction is underway on the Cooling-Tower Water Conservation (CTWC) project and the TA-48 cooling-tower control systems upgrade. When these projects are finished, the Laboratory's consumption of water will be reduced a further 40 million gal. per year.

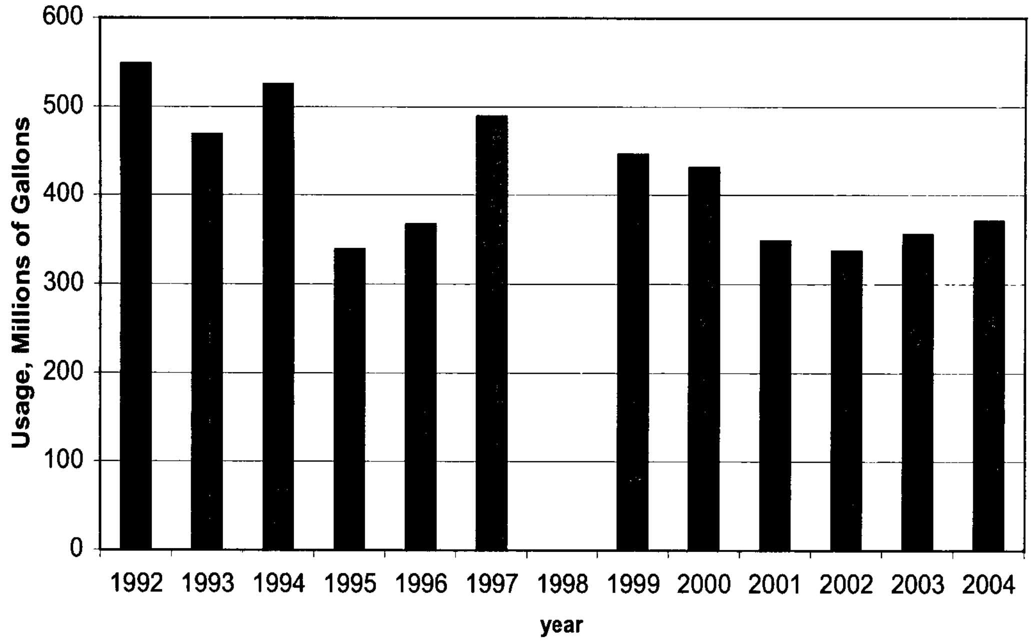


Fig. 2-34. Water usage by year.

2.10.2. Waste Stream Analysis

Consumptive use of water leads to evaporation or discharge following use. At the Laboratory, NPDES and GW permits control most discharges of wastewater. Of all the water that comes onto the site, approximately half evaporates. The water that does not evaporate eventually is discharged. Of the discharged water, 88% is regulated by NPDES/GW permits. The remaining 12% of discharges is not regulated. Figure 2-35 shows the distribution of water discharge and loss at the Laboratory.

The following wastewater streams are associated with water use at the Laboratory.

- Evaporation—Many water uses at the Laboratory involve some evaporation. Some uses, such as cooling towers, involve large losses through evaporation.
- NPDES-Regulated Discharges—These discharges originate from cooling towers, cafeterias, domestic use, research activities, laboratories, steam plants, etc. Much of this water is treated before discharge, either within the SWS plant or in a specialized treatment plant such as the High Explosives Wastewater Treatment Plant.

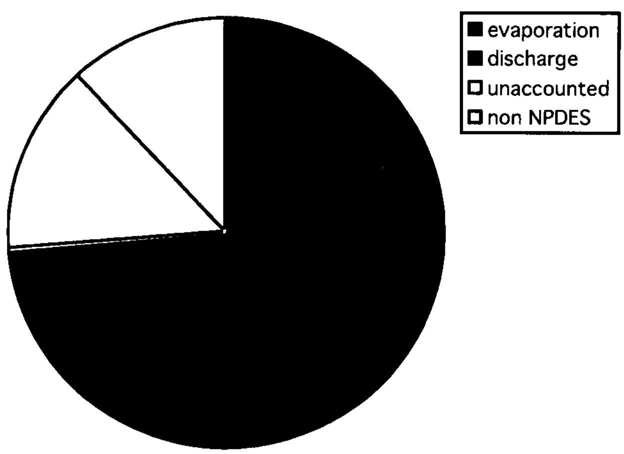


Fig. 2-35. Water discharge and losses.

- Non-NPDES-Regulated Discharges—These discharges occur through those activities exempted from the NPDES. They include discharges from landscaping and construction.
- Unaccounted Use—This waste stream is water that is drawn from the water supply but that either does not enter a Laboratory-consumptive-use process or is not accounted for in that use. The quantity of water drawn from wells is reasonably well known, and the water use at the Laboratory can be estimated. Usually, ~10% to 15% of the water drawn from the water supply cannot be accounted for. The sources of this apparent loss could be inaccuracies in the use estimates, leaks in the distribution system, or a combination of these and other uncertainties. With the current metering system, we find that it is not possible to estimate the size of this stream reliably or to find the source of the losses.

2.10.3. Improvement Projects

Several measures could be implemented to reduce the quantities of water used, improve the life of the aquifer, and reduce the environmental impact from water use. The projects, which are intended to reduce water consumption and increase the efficiency of use, are classified as completed or ongoing.

2.10.3.1. Completed Projects

Leak Detection Project. FWO/UI is funding a project to detect leaks better in water lines. A contractor will be conducting leak detection and pinpointing surveys on water mains throughout the Laboratory. The contractor will be performing a water system audit and, based on the findings, providing a cost-effective recommendation for corrective action. Flow meters will be used to monitor flows, and electrosonic and advanced correlation instruments will be used to detect and pinpoint underground leaks. By using this type of advanced technology, millions of gallons of water could be saved each month.

Survey and Repair Leaks in the Piping in the Water Drainage System. The Laboratory has conducted camera inspections of the 50 miles of sewer lines and has concluded that as much as 25% of the lines may be subject to leakage. No measurements have been taken to date of the losses to leakage from the sewer system.

2.10.3.2. Ongoing and New FY03 Projects

TA-9 Energy Study. An in-house energy management study is being conducted at TA-9. Part of the study to conserve energy and water will be to convert steam heat to gas heat. The steam heat system at the Laboratory is old and has many leaks, therefore wasting energy and water.

Small-Cooling-Tower Upgrades. The PP Office has funded cooling-tower control system upgrades for TA-35 and TA-48. The upgrades have been completed for TA-35. More than 30 other small cooling towers at the Laboratory must be assessed and upgraded to increase water efficiencies. Implementing the new requirements in the Cooling-Tower Operation and Maintenance Manual[2-7] and the Engineering Manual[2-8] will be a step toward implementing these upgrades.

Waterless Urinals Project. This project will pilot the use of waterless urinals for new construction and retrofit projects at the Laboratory. The pilot will be conducted at TA-16-901 and -946. Retrofitting existing urinals with waterless models will save more than 31,000 gal. of water per year. Additional interest has been generated in installing other units within the Laboratory. A request has been made to install some units in the Administration Building. This request has raised additional issues regarding plumbing code compliance. FWO is recommending that no additional units be installed until a study is made. FWO is proposing to revise the Laboratory design standards to include the installation of waterless urinals. Currently, the urinals are being monitored for a 12-month period.

CTWC Project. The CTWC project, funded by the Infrastructure, Facilities, and Construction Office, is a $4.5 million program that was initiated to seek the best commercial technologies for improving cooling-tower-water use. The Laboratory issued a Request for Proposal (RFP) to industry to pilot water conservation technologies on large-scale cooling towers with both potable and treated sanitary wastewater. The pilot phase is complete, and the results have been evaluated. The Laboratory will construct a building containing water filtration/treatment process equipment. This equipment will remove particulates from treated sanitary wastewater in the sewage treatment plant at TA-46 for reuse in cooling towers at TA-3. Phase I of the project will supply filtered water to the Nicholas Metropolis Center. Table 2-4 presents the amount of water used at the Laboratory with and without the treatment facility.

A water savings of this magnitude means that water to outfalls will be reduced. The FY03 phase of the CTWC project reduces the water to the NPDES/GW-permitted outfalls to less than 20% and will have no impact on the wetlands supported by the outfalls. The wetlands impacts must be evaluated before Phase II of the CTWC project is implemented. Recent estimates are slightly different from those provided by the Laboratory Sitewide Environmental Impact Statement (SWEIS).[2-9] The estimates are based on the most recent operating experience; however, it should be understood that those provided in the SWEIS are the official projections.

Use of Treated Sanitary Wastewater in the Nicholas Metropolis Center Cooling Towers. The Nicholas Metropolis Center came online in January 2002. Because of the significant water required to cool the computers in this facility, the center has committed to using treated sanitary wastewater in the cooling towers. The center will not increase the Laboratory's net water use. After the CTWC project comes on line, the Nicholas Metropolis Center will use filtered treated sanitary wastewater, thus improving the efficiencies of the cooling towers.

Table 2-4. Laboratory Water Use without the Treatment Facility (Mgal.[a]) (Assumes Two Cycles of Concentration)

Cooling Tower	Current		FY03–04	
	Without Facility	With Facility	Without Facility	With Facility
Nicholas Metropolis Center	103	103	51	0
LANSCE	111	111	111	111
LEDA[b]	21	21	21	21
LDCC/CCF	28	28	28	15
Power Plant 29-Mgal. Boiler Makeup 53-Mgal. Cooling Tower	82	82	82	82
General Usage	318	318	318	318
Subtotal	663	663	611	547
SWS Reuse	53	53	53	72
Total	610	610	558	475

[a]Mgal. = millions of gallons.
[b]LEDA = Low-Energy Demonstration Accelerator.

Use of Environmentally Beneficial Plantings. Environmentally beneficial and economical landscaping is required, where appropriate, by EO 13123. The Laboratory currently has no plans to replace existing plantings; however, the Engineering Manual[2-8] requires that all new construction projects use native vegetation landscaping. This project will not reduce current water usage but will limit future growth in water use.

Water Metering Project. The Laboratory has few water meters installed on facilities or systems. To understand the water use at the Laboratory better, the Water Metering project is underway. This project will meter significant water users, such as large cooling towers. The project is ongoing and will not in itself save water, but it will allow more efficient management of water resources.

2.11. SUSTAINABLE DESIGN

Sustainable design may be defined as activities to "site, design, deconstruct, construct, renovate, operate, and maintain state buildings that are models of energy, water, and materials efficiency; while providing healthy, productive and comfortable indoor environments and long-term benefits . . .".[2-10] The Laboratory is committed to a holistic approach to sustainable design where the definition of sustainable design is expanded to include safety, security, building flexibility, productivity improvements, and waste minimization opportunities of the operations going into a new facility, as well as the materials used to construct the facility.

Design decisions will dictate environmental and productivity impacts of infrastructures for decades. Implementation of sustainable design practices in all construction will support the following Laboratory institutional and business goals.

- Build the agile workforce for the future.
- Modernize and consolidate facilities/infrastructure to support safe, secure, and efficient Laboratory operations.
- Institute an integrated corporate approach to plan, allocate, and manage Laboratory resources to maximize the accomplishment of the Laboratory mission.
- Employ those business practices that best serve our trusted, competitive, and scientific solutions.
- Improve the efficiency with which we achieve regulatory compliance.
- Manage the risk to support operational excellence.

The past decade has seen stunning technical advances in designing and constructing buildings to maximize the performance of their occupants while minimizing resource consumption and environmental impact. Such advances have achieved significant life-cycle savings without necessarily increasing up-front construction costs. The key Laboratory benefits from incorporating sustainable design practices are the following.

- minimizing environmental impacts,
- protecting workers,
- improving mission capabilities,
- decreasing mission vulnerabilities,
- creating a positive work environment for the workers (e.g., daylighting),
- providing flexibility to address the ever-changing regulatory requirements and mission changes,
- increasing staff productivity,

- lowering maintenance costs,
- efficiently using resources and raw materials,
- decreasing security risks,
- sustaining efficient operation for at least 50 years,
- optimizing efficiency of entire buildings,
- improving the Laboratory's public image, and
- reducing waste management costs.

During the past few years, both the Department of Energy (DOE) and the University of California (UC) have been reviewing and implementing requirements for sustainable design in new and refurbished buildings.

On January 15, 2003, the DOE implemented EO 450.1 for an Environmental Protection Program, which requires contractors to implement various EOs, such as EO 13123, "Greening the Government through Efficient Energy Management," conduct operational assessments for PP opportunities, and procure environmentally preferable products.

In July 2003, the UC Board of Regents adopted a policy for green buildings and clean energy standards. The UC will be required to create an internal certification process based on the Leadership in Energy and Environmental Design (LEED^{TM}), which evaluates the environmental sustainability of buildings. Significant renovations of existing buildings also will be required to apply sustainability principles. The UC also will develop a strategic plan for implementing energy efficiency projects for existing buildings and infrastructure to reduce system-wide nonrenewable energy consumption, with an initial goal of reducing energy consumption by 10% or more by 2014.

In addition, several DOE and internal drivers exist for sustainable design. They are listed in the following table.

2.11.1. *Improvement Projects*

In fiscal-year (FY)02 and FY03, the Laboratory began to assess opportunities for sustainable design implementation. Currently, nine strategic facility plans are in progress at the Labora tory.[2-11] For FY04, a coalition of Laboratory organizations has proposed a systematic approach to new construction to ensure the maximum return to the Laboratory in terms of life-cycle facility costs, environmental impact, resources consumption, and, most importantly, staff productivity.

2.11.1.1. Completed Projects

Sustainable Design Guide. Project Management Division's Site and Project Planning group (PM-1) provides institutional land use and facilities planning services to support Laboratory programs and divisions. The group's planning capabilities support long-range facility planning issues and transition to the development of new projects. The Laboratory's sustainable design guide[2-12] presents a specific planning and design process for creating and meeting Laboratory sustainability goals, including energy reduction, indoor environmental quality, water quality, and site preservation; guiding the planners, designers, contractors, and groups responsible for the physical development of the Laboratory; providing a tangible process for evaluating progress toward sustainability in the long-range physical development of the Laboratory; and providing leadership to the DOE laboratory system, as well as to the nation, for maintaining energy security and economic growth through sustainable design principles and practices.[2-13]

Leadership in Energy and Environmental Design (LEED^{TM}). Although green and sustainable designs long have been a concern, building designers have lacked some of the tools needed to achieve successful green building design. The LEED™ Green Building Rating System fills a need by providing a clear definition for a green building and a yardstick for measuring the relative sustainability of projects. LEED™ has been developed by the United States (US) Green Building Council (GBC), a nonprofit consortium of organizations involved in the design and construction of buildings. The US GBC includes architects, engineers, contractors, developers, product manufacturers, environmental groups, and government agencies. Major funding for the LEED™ pilot program was provided by the DOE.[2-14] The four levels of LEED™ certification are

LEED™ Certified	26–32 points
Silver Level	33–38 points
Gold Level	39–51 points
Platinum Level	52+ points (69 possible)

In FY03, the PP Program funded a LEED™ evaluation of two General Plant Projects, which are facilities (usually office buildings) with a $5M cap to design and construct the facility. The first evaluation was performed for the Chemistry (C) Division Office Building, which provides space for 100 employees and is approximately 21,000 ft². The second evaluation was performed for the Laboratory's Security Systems Support (S-3) Building, which provides space for 65 employees and is approximately 20,000 ft². These buildings were determined to score approximately 10 to 12 points. A detailed report for each building is available on the PP Program website at http://emeso.lanl.gov/useful_info/publications/ publications.html.

DRIVERS FOR SUSTAINABLE DESIGN FACILITIES	
LPR 220-06-00 Program and Project Management for the Acquisition of Capital Assets Design and construction management considers integrated safety management, integrated safeguards and security management, quality assurance, maintainability, operability, waste minimization, sustainable building design, pollution prevention, and life-cycle cost.	DOE Order 430.1A Life Cycle Asset Management The management of physical assets from acquisition through operations and disposition shall be an integrated and seamless process linking the various life-cycle phases.
DOE Order 430.2A Departmental Energy and Utilities Management DOE facilities must have a documented energy management program and an energy management plan.	LIR 220-01-01 Construction Project Management Project plans for value engineering, life-cycle costing, waste minimization, energy conservation, pollution prevention, and sustainable building design shall be documented in the Project Execution Plan.
LPR 300-00-00 Integrated Safety Management Accomplish its mission cost effectively while striving for an injury-free workplace, minimizing waste streams, and avoiding adverse impacts to the environment from its operations.	DOE Order 413.3 Program and Project Management for the Acquisition of Capital Assets Sustainable building design principles must be applied to the siting, design, and construction of new facilities.

Greening of the Laboratory's Engineering Standards. FWO Division's Design Engineering and Construction Services group made considerable additions to the Engineering Standards Manual OST220-03-01 for the Laboratory to enhance its energy efficiency requirements, increase the required recycled content of certain building materials, and add sustainable design guidance. The changes to the engineering standards affect the construction of new buildings and the modification of existing buildings. This activity will continue in FY05. These standards are online at http://www.lanl.gov/f6stds/pubf6stds/New_Home.html.

Waste Stream Elimination Case Study. A sustainable design evaluation integrating waste management issues with high-performance building requirements was developed using the High-Explosives (HE) Characterization (HEC)[2-15] (previously called the High Energetic Materials Laboratory Building),[2-16] which is being proposed as part of the Dynamic Experimentation (DX) Strategic Facility Plan. This case study was undertaken to ascertain if sustainable building design significantly could reduce or eliminate waste streams and over the lifetime of the building lead to substantial cost savings and increased worker productivity. Previously, building sustainability concerns were limited to the structural use of materials and resources (e.g., LEED™ criteria). The methodology used in this case study is based on life-cycle operations: combining buildings, operational equipment, and, most importantly, people. The results of this study indicate that examining DX's ability to process the HE wastewater and designing flexibility into a future building could provide significant benefits to the Laboratory. The cumulative results show an expected discounted life-cycle savings (50-year life expectancy) of about $2.2 million by the processing of this HE wastewater stream through treatment and reuse or evaporation. This savings has a payback time of approximately 9 years. In addition, ENV's PP/Solid Waste Regulatory Compliance (SWRC) Group and Project Management (PM)-1 worked with DX-2 to help develop tools to incorporate sustainable design elements into the future functional and operating requirements. These tools are the following:

- A floor plan used as a tool to gather input from the building users (scientists, technicians, and maintenance employees),
- A waste elimination case study used to establish a business case for sustainable design (showed cost savings and increased worker productivity),
- A PP opportunity assessment used to identify key DX-2 mission operations that generate waste and methods to eliminate the waste,
- High-performance and sustainable design concepts from the Green Building Council Leadership Energy and sites. This information was used to help find solutions to operations, security, safety, environment, productivity, and maintenance issues,
- Sustainable design website covering resources, progress to date, and contact information at (http://p2.lanl.gov/source/orgs/p/p2/PreventionProgramProjects/SustainableDesign/index.shtml), and
- A high-performance group established with Sandia National Laboratories to share knowledge about our sustainable design programs.

The information from the tools and resources listed above was incorporated into a Risk Assessment Database. This database was used to develop the high-performance functional and operating requirements (F&ORs). The database included security, safety, health, environment, and intelligent workspace issues (design options used to improve productivity). The F&ORs document is a list of all the requirements for the building space. This document is generated with input from building owners, users, and the help of the PM Division. This document then is used to develop the RFP that is sent out to architectural and engineer firms. These firms will create a building design and bid on the project. The hired firm must satisfy all requirements specified in the RFP. The HEC Project is planning to be complete with the construction of the new facility by 2011.

2.11.1.2. Ongoing Projects

Review of Engineering Standards. In FY04, the PP Program began voting participation in the Laboratory's Engineering Standards Review Board. The program is reviewing and revising all engineering standards, and the participation of the PP Program has speeded inclusion of sustainable design issues into the standards.

LEED™ Evaluations. Results of the LEED™ evaluations conducted in FY03 established a baseline for sustainable design. In FY04, the PP Program will continue this evaluation process.

Radioactive Liquid Waste Treatment Facility (RLWTF) Design Charrette. An outside consultant will facilitate a design charrette for the RLWTF, with the active participation of waste generators, facility operators, and facility managers, to explore design alternatives and options.

2.11.1.3. Proposed Projects

The PP Program has submitted a general and administrative reinvestment proposal to further the implementation of sustainable design practices at the Laboratory. If funding is not obtained, other sources for funding will be sought.

Early Consultations. Sustainable design is implemented most effectively when applied at the earliest possible stages of the design process. Early planning for the nine strategic facility plans will provide opportunities to establish an integrated building design based on efficiently combined systems of coordinated and environmentally sound products, systems, and design elements. This design includes the creation of a vision for the project and development of design performance goals.

Design Charrettes. By assembling a multidisciplinary project and design and construction team, all stakeholders can commit to the project vision and goals through an integrated, whole-building design approach. This approach also includes the performance of value engineering and life-cycle costing for each building.

LEED™ Certification Workshop. LEED™ certification of Laboratory building projects likely will be a consideration for those attempting to incorporate sustainable design. To provide guidance, a workshop will be held at the Laboratory to allow employees to obtain certification.

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Chapter 3: Remediation Services

3.1. Introduction

This chapter presents the WMin and pollution prevention (PP) awareness plan for the Laboratory's Environmental Stewardship (ENV)-Remediation Services (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). The requirements for this permit are shown in Table 3-1.

3.1.1. *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 during site cleanups and thus is faced with the responsibility and challenge of minimizing the amounts of waste that will require subsequent management or disposal. Minimization is necessary because of the high

Table 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 2.0
Section B.1. (a)(2)	Employee Training	Section 6.3
Section B.1. (a)(2)	Incentives	Section 6.10
Section B.1. (a)(3)	Past and Planned Source Reduction and Recycling	Section 5.4
Section B.1. (a)(4)	Itemized Capital Expenditures	Section 5.4
Section B.1. (a)(5)	Barriers to Implementation	Section 7.0
Section B.1. (a)(6)	Sources of Information	Section 6.4
Section B.1. (a)(7)	Investigation of Additional WMin Efforts	Section 6.2
Section B.1. (a)(8)	Utilization of Hazardous Materials	Section 5.2
Section B.1. (a)(9)	Justification of Waste Generation	Section 5.0
Section B.1. (a)(10)(a)	Site Lead Inventory Program	Section 6.11
Section B.1. (a)(10)(b)	Steel for Lead Substitution Program	Section 6.11
Section B.1. (a)(10)(c)	Lead Shielding Coating Program	Section 6.11
Section B.1. (a)(10)(d)	Lead Decontamination Program	Section 6.6
Section B.1. (a)(10)(e)	Scintillation Cocktail Substitution Program	Section 5.2
Section B.1. (a)(10)(f)	Radioactive Waste Segregation Program	Section 6.6

cost of waste management; the limited capacity for onsite or offsite waste treatment, storage, or disposal; and the desire to minimize the associated liability.

The DOE Office of the Secretary also requires a PP program as outlined in the "1996 Pollution Prevention Program Plan" (DOE/S-0118).[3-1] The DOE plan has specific program requirements for every waste generator, including evaluating WMin options as early in the planning process as possible. The DOE plan also places responsibility for WMin/PP implementation with the waste generating program. In a November 12, 1999, memorandum, the Secretary of Energy set an annual 10% reduction goal for all wastes generated from facility decommissioning and site stabilization activities.[3-2] The Laboratory's approach to achieving the 10% reduction goal is addressed later in this document.

3.1.2. 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 routinely will be employed to prevent or reduce waste generation in fiscal-year (FY)05, and it reports FY04 waste generation quantities and significant WMin 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 is designed to fulfill the WMin requirements of Resource Conservation and Recovery Act (RCRA)/Hazardous and Solid Waste Amendments, as implemented in Module VIII, Section B.1, of the Laboratory's Hazardous Waste Facility Permit (NM0890010515-1).

This plan addresses all waste classifications generated by the ENV-RS project during the course of planning and conducting the investigation and remediation of environmental media 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 generated contaminated material or environmental media that were 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 waste derived from investigative activities [e.g., personal protective equipment (PPE), sampling waste, and 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); mixed low-level waste (MLLW); transuranic (TRU) radioactive waste; chemical wastes [which include 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 that are expected to be generated and on the feasibility of waste reduction for those waste streams.

3.2. 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 PP and WMin programs is documented in the Laboratory's waste management requirements. Additionally, the ENV-RS project mandates WMin techniques in several of its standard operating procedures.

The ENV Division PP Program (ENV-PP) also 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. 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). 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.

3.3. ORGANIZATIONAL STRUCTURE AND STAFF RESPONSIBILITIES

The ENV-RS project is subject to all Laboratory and ENV Division policies and requirements. The project is operating under the organizational structure shown in Fig. 3-1.

The organizational structure for developing and implementing WMin/PP programs is outlined as follows.

- 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 is the focal point for planning and implementing WMin activities and reporting WMin successes and lessons learned for the ENV-RS Program. ENV-RS project leaders and 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 is technically and economically feasible.

- The ENV-RS project waste management coordinators are responsible for coordinating WMin activities, coordinating proposals for WMin implementation projects, advising project leaders on Wmin/PP technologies and techniques, recommending ENV-RS project-wide policy, and compiling waste generation and minimization data.

3.4. GOALS AND PERFORMANCE MEASURES

DOE Headquarters established an annual DOE complex-wide 10% reduction goal for environmental restoration activities based on overall

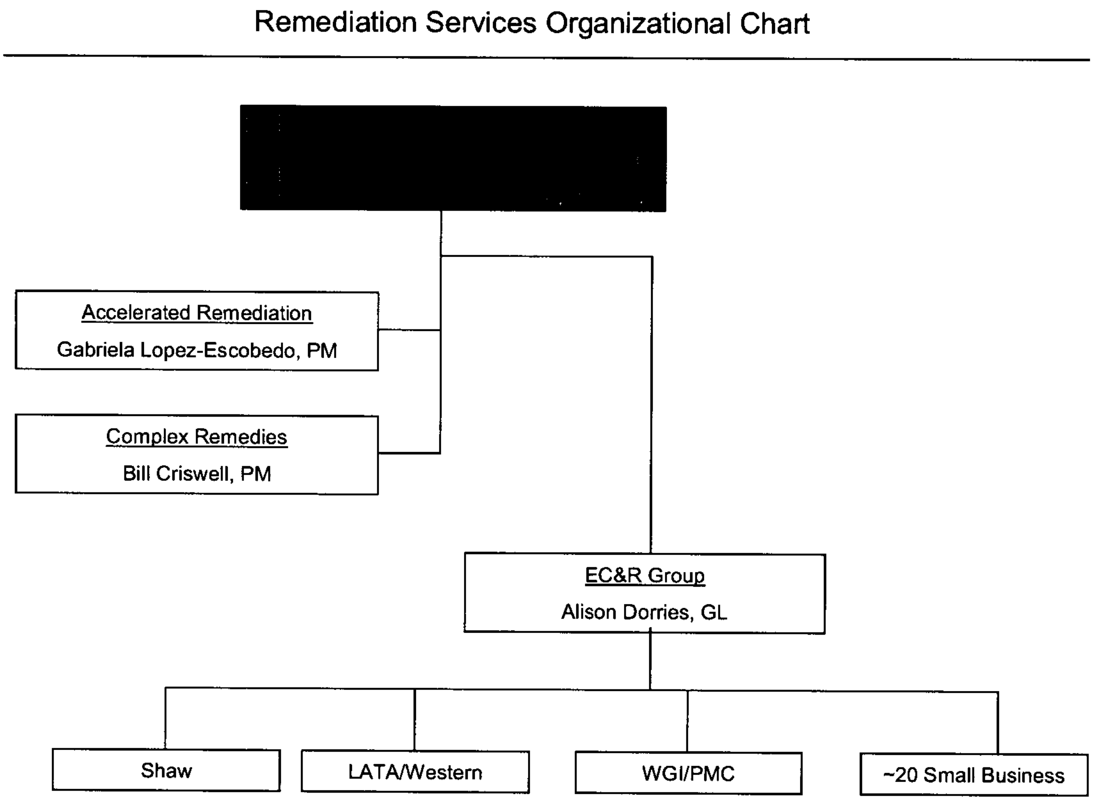


Fig. 3-1. ENV-RS project organization chart.

waste projections. Additionally, the University of California's (UC's) 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 WMin principles into the remedial planning process;
- recycling and reusing materials;
- using material substitution as appropriate;
- developing subcontractor WMin incentives through contract specifications;
- dedicating WMin resources to assist with large remedial actions; and
- tracking, projecting, and analyzing waste data to improve waste management economies of scale.

Figure 3-2 shows the environmental hierarchy for ENV-RS project wastes. Although source reduction is preferred, the ENV-RS WMin/PP approach recognizes that limited opportunity for source reduction of primary wastes is available. Potential environmental concerns may require removal of contaminated material. When appropriate, sources of primary wastes will be reduced through (1) the application of risk-based cleanup criteria and associated land-use scenarios, (2) the consideration of *in situ* or non-

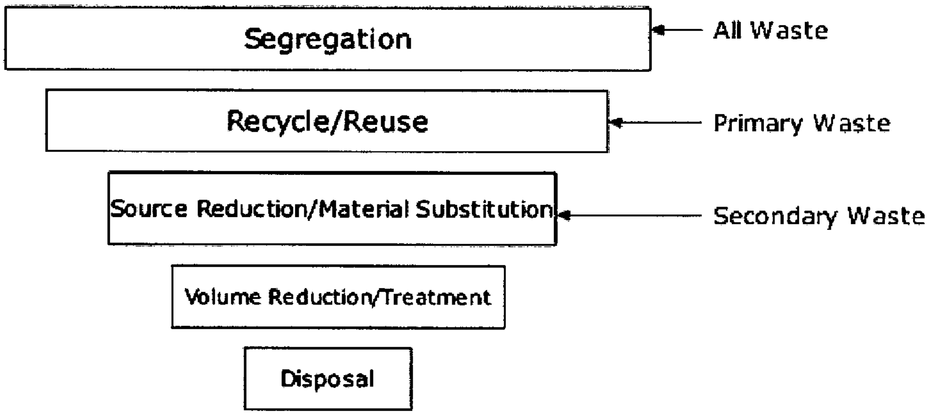


Fig. 3-2. Environmental management hierarchy within the ENV-RS project.

intrusive remediation technologies during project planning and negotiation stages, and (3) improved characterization and segregation during the execution of field activities. Sources of secondary wastes will be reduced 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 that cannot be recycled and for which generation cannot be avoided.

The WMin/PP approaches outlined above are consistent with the waste reduction priorities established by the Laboratory's sitewide WMin plan, which recognizes the severe limitations of onsite disposal capacity for radioactive LLW and onsite storage capacity for MLLW. In addition, the approach was adopted to address the variable and nonrecurring nature of wastes resulting from ENV-RS activities.

3.5. *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. It should be noted that 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) also may 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.

3.5.1. 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 as follows.

Federal Statutes and Executive Orders

Resource Conservation and Recovery Act

- Pollution Prevention Act
- Executive Order 12873—Federal Acquisition, Recycling, and Waste Prevention
- Executive Order 12856—Federal Compliance with Right-to-Know Laws and Pollution Prevention
- Executive Order 13148—Greening the Government through Leadership in Environmental Management

Federal Regulations

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

State of New Mexico Statutes

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

Los Alamos National Laboratory Directives and Policies

- T. P. Starke et al., "Los Alamos National Laboratory 2001 Environmental Stewardship Roadmap," LA-UR-01-6634, December 2001
- Laboratory waste management requirements

3.5.2. Justification for the Use of Hazardous Materials

ENV-RS project activities currently introduce only small amounts of hazardous materials into field and support operations. In previous years, most use of hazardous materials has been replaced 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 the Environmental Protection Agency (EPA), private companies, and universities for potential alternative

processes and material substitution. The use of hazardous chemicals for sample preservation currently is viewed as necessary. In addition, hazardous chemicals are used in field screening tests but are consumed by the process and do not result in the generation of hazardous waste.

3.5.3. FY03 WASTE GENERATION SUMMARY

The ENV-RS program FY03 waste generation and WMin summary is listed in Table 3-2.

Waste projections and reduction goals for FY05 are listed in Table 3-3.

3.5.4. WMIN 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 typically are difficult to track and quantify because the data used to measure the amount of waste reduced (as a direct result of a WMin/PP activity) are often not available and are not extrapolated easily. In addition, many WMin practices employed during previous years are incorporated into standard operating procedures and are no longer reported. Operating expenses of approximately $50,000 are provided annually to evaluate optimal management approaches, source reduction, and recycling options.

Table3-2. Fiscal Year 2004 Waste Generation Summary

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

Table 3-3. 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

Activities performed in FY04 were related primarily to investigations and did not result in high-volume waste streams. The WMin/PP techniques used in FY04 to reduce these investigation-related waste streams led to the following accomplishments:

- the ENV-RS High-Explosives (HE) Production Sites team offered excess chemicals needed for analyses through the Laboratory's chemical exchange program, and
- dry decontamination techniques were used to reduce the volume of liquid decontamination waste.

3.6. WMin PROGRAM ELEMENTS

Listed in the following sections are the Laboratory's ENV-RS project WMin 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 they are economically and technically feasible.

3.6.1. 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 WMin waste management coordinator(s) will provide WMin/PP tools and practices to the ENV-RS Program 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.

3.6.2. 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 and 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 that could impact a project. This process incorporates evaluation of potential waste generating activities before project startup and includes review by a WMin/PP 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 affords an opportunity to 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 an 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 them into the strategy.

3.6.3. EMPLOYEE TRAINING AND AWARENESS

WMin implementation is most effective when all employees consider WMin/PP part of their job responsibilities. To accomplish this objective, a planned approach to building WMin 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 that are 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 environmental, safety, and health issues, including WMin and PP awareness.

3.6.4. Information and Technology Introduction

The introduction of new technologies for WMin/PP and waste management approaches is important in minimizing wastes. To support technology exchange, the WMin 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 Laboratories, Richland, Washington;
- EPA, Superfund Innovative Technology Evaluation (SITE) Database;
- DOE, Technology Information Exchanges Conferences and Abstract Summaries;
- EPA, PP 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 PP Technical Library Web Site;
- State of Kentucky, Kentucky PP Center Web Site; and
- DOE Oak Ridge National Laboratory (ORNL), ORNL Pollution Prevention Web Site.

3.6.5. Tracking and Reporting

The routine collection of data regarding WMin was established in FY96. Project managers are asked to provide documentation of accomplishments as they occur, with a formal quarterly data consolidation effort.

3.6.6. Sort, Decontaminate, and Segregate

This task currently is 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 and lead) 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 the Laboratory 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.

3.6.7. 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.

3.6.8. Survey and Release

Past practices conservatively have classified nonindigenous investigation-derived waste (e.g., PPE and 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 policy 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.

3.6.9. Risk Assessment

Risk assessments routinely are conducted for ENV-RS projects, as prescribed in the Laboratory's Installation Work Plan.[3-3] Risk assessments allow the ENV-RS project to plan remediation activities on the basis of the future risk to human health and the environment. Current and reasonably foreseeable future land use is considered in deriving the risk. Often, results of 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 opportunity is 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 the generation of far less waste than cleanup standards based on residential exposure scenarios.

3.6.10. Incentives

The ENV-PP program administers 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. However, this incentive program is focused on routine waste generation rather than waste from remediation efforts.

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

3.6.11. Lead-Handling Procedures

The ENV-RS project does not procure or use lead or handle excess lead routinely. 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 for steel in place of lead when possible.
- Projects will specify the use of strippable or washable coatings for any lead materials that must be used and that could 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 (SWO) Group for the appropriate handling and disposition of radioactively contaminated lead that cannot be decontaminated or redistributed.

3.6.12. Equipment Reuse

The reuse of equipment and materials (after proper decontamination to prevent cross contamination), such as plastic gloves, sampling scoops, plastic sheeting, and PPE, 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 the generation of liquid decontamination wastes.

In addition, the Laboratory has initiated an equipment-exchange program, which identifies surplus or inactive equipment that is available for use. This program not only eliminates the cost of purchasing the equipment but also delays the point at which the equipment is no longer needed and must be disposed of.

3.7. BARRIERS TO WMin IMPLEMENTATION

In some instances, levels of WMin that were achieved fell below potentially achievable levels based on site conditions. For example, the ENV-RS HE 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 FY04, NMED is expected to select the remedy for the eighth disposal area, 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.

3.8. References

3-1. US Department of Energy, "Pollution Prevention Program Plan 1996," US Department of Energy Office of the Secretary, DOE/S-0118, Washington, DC (May 1996), http://tis.eh.doe.gov/p2/p2inte gratedhome page/p2plan.asp.

3-2. B. Richardson, "Pollution Prevention and Energy Efficiency Leadership Goals for Fiscal Year 2000 and Beyond," Memorandum for Heads of Departmental Elements, US Department of Energy, Washington, DC (November 12, 1999).

3-3. Los Alamos National Laboratory, "Installation Work Plan for Environmental Restoration Project," Revision 7, Los Alamos National Laboratory document LA-UR-98-4652 (November 1998).

Chapter 4: Roadmap—Future Waste Projections

4.1. Introduction

This chapter presents a 5-year forecast of Los Alamos National Laboratory's (the Laboratory's) hazardous and radioactive waste volumes. The waste volume forecast was prepared to support strategic planning for waste management operations and facilities. Knowledge of expected waste volumes will aid waste generators, program managers, and waste management operational organizations in long-term planning and will help ensure that the Laboratory has the right capabilities in place to support programmatic operations. This information also will aid the Laboratory in targeting activities for waste minimization opportunities. The 5-year forecast horizon was chosen because the quality of the forecast deteriorates rapidly beyond the funding horizon. Five years represents a period in which funding and programmatic activity can be predicted more confidently.

Laboratory Implementing Requirement (LIR) 404-00-02.3[4-1] requires that waste generators provide waste forecasts on request 'for any treatment, storage, and disposal facility to which they discharge waste.

The approach used in this study was to identify the organizations, programs, and projects that are responsible for the majority (>80%) of the waste by type. These activities were selected for detailed inquiry and modeling. The remaining organizations were extended based simply on historical trends.

Because of programmatic uncertainties, it is difficult to forecast the quantities of generated waste with precision. For that reason, this forecast predicts ranges of probable generation rather than specific quantities. In particular, a minimum and maximum waste quantity has been specified for each major waste type.

4.1.1. Data Collection

Data were collected from the Laboratory's divisions, programs, and projects. An initial query of existing data sources was performed to identify historical generation and the divisions that generate most of the waste in fiscal-year (FY)03. Data sheets were prepared with historical trends and a preliminary forecast developed using the Facility and Waste Operations Division (FWO)-Solid Waste Operation (SWO) waste database, Remediation Services baseline database, Waste Management Facility Strategic Plan,[4-2] Ten-Year Comprehensive Site Plan,[4-3] various project plans, and other sources.

After the waste-generating activities were identified and a baseline volume was established, program/project contacts were identified. The responsible managers for each key program/project then were interviewed regarding their out-year programmatic projections. Based on these interviews, relative values (delta factors) of program-waste-generating activity were developed. These values measured future program activity relative to the baseline year. In many cases, the out-year programmatic projections were contingent on events that are currently uncertain. These uncertainties formed the basis for the maximum and minimum predicted waste quantities.

This approach provides a reasonable way to formulate waste volumes based on out-year program plans. Generally, the waste management professionals understand the historical volumes; however, the program managers understand better the future of their activities. This approach combined the best information from both sources.

4.2. *Transuranic (TRU) Waste*

4.2.1. Forecast and Analysis

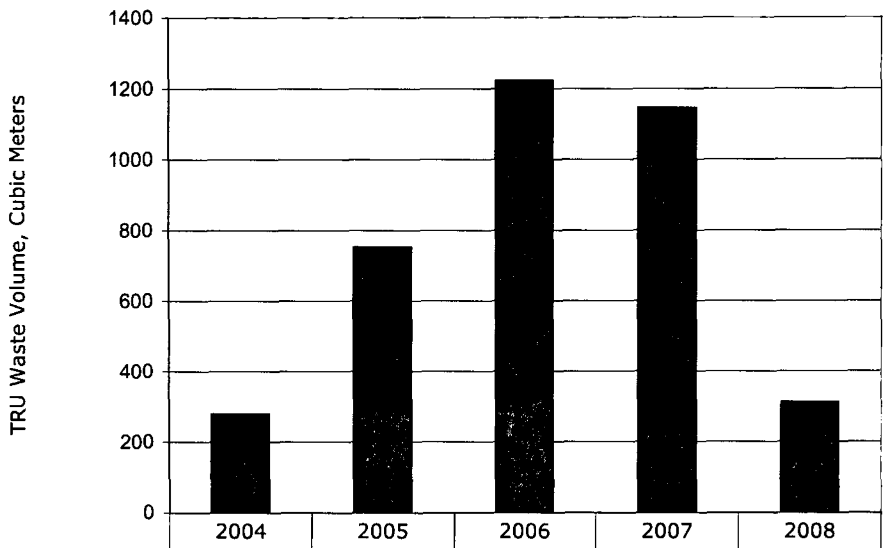
The TRU waste volumes reported by year in this projection include routine, nonroutine, newly generated, and legacy TRU wastes; thus, totals will not agree with TRU waste generation volumes reported in the TRU Waste section of Chapter 2. Chapter 2 reports only routine waste data. Routine waste is defined as waste produced by 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 or recurring work that is considered ongoing in nature. Nonroutine waste is defined as one-time operations waste: wastes produced from environmental restoration (ER) program activities, including primary and secondary wastes associated with retrieval and remediation operations; legacy wastes; and decontamination and decommissioning (D&D)/transition operations.

The average generation of TRU waste over the past 10 years has been 145 m^3/yr. Volumes have been trending higher for the past decade as the Laboratory's nuclear materials mission at Technical Area (TA)-55 has expanded and as legacy materials are processed. The growth of TRU waste generation over the next few years will be driven by enhanced vault workoff and program growth, especially in the mixed-oxide (MOX) program. If restarted in FY05, the MOX program will generate approximately 2.5 times the waste it generated in FY03–04. In addition, the volumes are growing as a result of process changes in Nuclear Materials Technology (NMT) Division, such as discarding rather than reprocessing TRU scrap.

TRU waste generation is predicted to increase over the next 5 years. The dominant activity that will drive changes in the volume of waste sent for disposition is the environmental management (EM) waste disposal project that will retrieve ~1800 m^3 of legacy waste currently located below ground at TA-54. The Offsite Source Recovery Project (OSRP) will continue to retrieve sealed sources from around the country in preparation for treatment and disposal. The Nuclear Material Stabilization Project will see increasing activity through the first half of the decade and then a tapering off in the second half. Pit manufacturing, heat sources, and energy programs are expected to see a 40% increase in activity over the next several years and then continue at elevated levels through the remainder of the decade. Volumes of TRU waste will be increased by the cleanout of legacy waste from the NMT vault.

The older vault material has a high curie content and thus will require a greater packaging volume, which will add to the overall volume increase. These increases will be offset partially by increased waste minimization activities. Events such as the hiatus in Waste Isolation Pilot Plant (WIPP) shipments and the delayed resumption of TA-50 operation could affect the generation of TRU waste profoundly in FY05. These events could impact TA-55 operations by impeding disposition of TRU waste generated at TA-55. Total, routine, nonroutine, and projected TRU waste volumes, based on normal TA-55 operations, are shown in Figs. 4-1 and 4-2.

The maximum projection assumes that the NMT vault workoff accelerates for FY05–FY06 and thereafter maintains a workoff rate that results in a constant available vault volume. The maximum case also assumes that the MOX program will resume production in FY06 at a rate 3.5 times greater than the FY04 rate. The minimum case assumes that vault workoff rates after FY04 will maintain only the available volume in the vault. The minimum case also assumes (1) no MOX restart and (2) the delay of Project 2010 by 1 year.



	2004	2005	2006	2007	2008
Total, m3	279	751	1223	1146	312
■ OSRP	22	20	20	10	5
□ FWO	4	5	6	6	6
■ RRES	80	437	873	891	62
■ NMT	173	289	324	239	239

Year

Fig. 4-1. Maximum TRU waste forecast by organization.

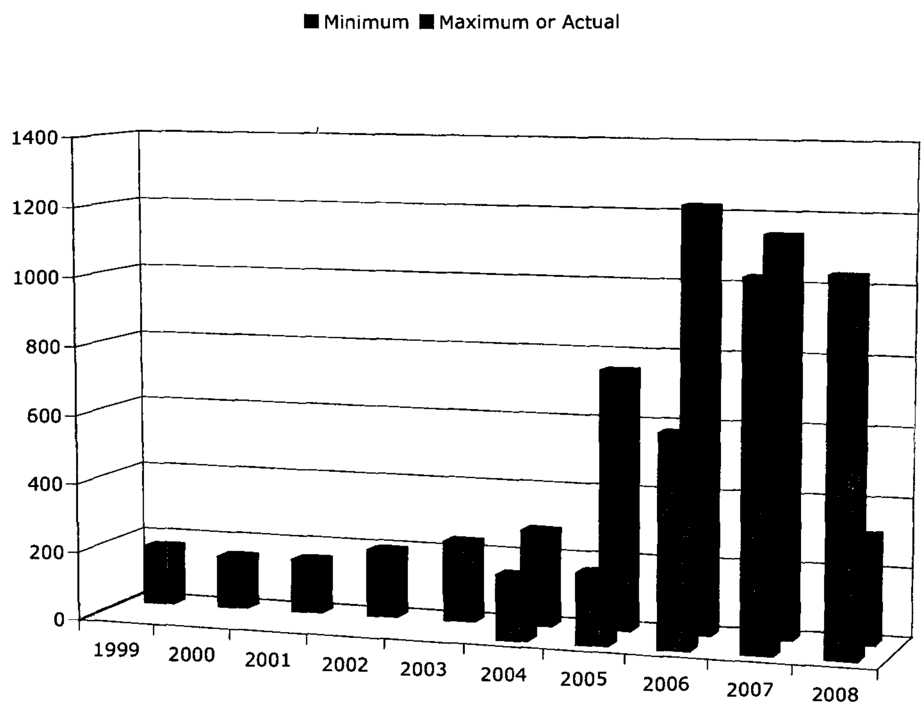


Fig. 4-2. Minimum and maximum projected TRU waste volumes.

The maximum case also assumes that the Remediation Services baseline underestimates the real waste volume by a factor of 2.0, which is the historic factor by which Remediation Services has exceeded its baseline projections. The minimum case assumes that the baseline projections are correct.

The primary issue related to TRU waste volumes is the limited above-ground storage capacity at the Laboratory. From FY05 to FY07, large quantities of legacy TRU waste are scheduled to be retrieved from underground storage for processing, repackaging, and shipment to WIPP. It is not expected that this waste will impact the Laboratory's storage facilities significantly because the waste will not be retrieved until sufficient storage space has been created by TRU shipping operations. Further, the schedule is flexible, and although it is projected to begin in FY05 and take 3 years to complete, it can be delayed, extended, or both to adjust to the availability of storage space. However, retrieving the legacy waste will require new and modified capabilities for the retrieval operation itself because this waste is located deeper underground than waste that has been retrieved previously and because it is packaged in various containers of unknown integrity.

The general short-term trend is toward increased waste volumes due to expanded NMT program activities; thus, the Laboratory and NMT Division will need to find additional opportunities for waste minimization. The DOE Secretary's goal for waste minimization requires overall reductions in the quantity of newly generated routine TRU waste sent to TA-54 by 2005. It seems likely that this goal will not be met because of increasing mission-related activity and process changes, unless TA-55 operations are curtailed because of waste disposal issues.

4.3. Low-Level Waste (LLW)

4.3.1. Forecast and Analysis

The LLW waste volumes reported by year in this projection include routine, nonroutine, newly generated, and legacy wastes; thus, totals will not agree with waste generation volumes reported in the Low-Level Waste section of Chapter 2. Chapter 2 reports only routine waste data. Routine waste is defined as waste produced from any type of production operation, analytical, and/or R&D laboratory operations; treatment, storage, and disposition facility operations; "work for others"; or any other periodic or recurring work that is considered ongoing in nature. Nonroutine waste is defined as one-time operations waste: wastes produced from ER program activities, including primary and secondary wastes associated with retrieval and remediation operations, legacy wastes, and D&D/transition operations.

The average generation of LLW over the past 9 years has been 3197 m^3/yr. The total volumes have been fluctuating strongly for the past decade, primarily because the nonroutine and ER volumes increase sharply in years in which decontamination, demolition, and remediation activities increase. The generation of routine LLW has been trending downward over the past few years; however, it sharply increased in FY03 and FY04.

Total LLW generation is predicted to remain volatile over the next 10 years. The activities that will drive the volatility in total waste volume are the Environmental Remediation project and, to a much lesser extent, construction and D&D projects. The volumes of waste generated by the ER project will be substantially higher in FY05 and FY08, with peak activity occurring in FY05. Several D&D projects are expected to generate relatively large quantities of LLW. These projects include the D&D of the Pulsed High-Energy Radiographic Machine Emitting X-Rays (PHERMEX) Facility and, potentially, the Radioactive Liquid Waste Treatment Facility (RLWTF).

The PHERMEX Facility at TA-15 was commissioned in 1963 and was used as a diagnostic facility for hydro and other tests. The facility will be stabilized and turned over for surveillance, maintenance, and possibly eventual D&D. The stabilization activities will generate ~380 m^3 of LLW total during FY05 and FY06.

D&D of the RLWTF, which also was built in 1963, will generate relatively large volumes of LLW but will not begin until FY10, which is outside the time frame of this forecast. An alternative to the D&D of the RLWTF is repair and renovation of the existing facility, which could begin in FY08 but which will produce a much smaller volume of LLW.

Figure 4-3 presents the predicted maximum LLW volumes, by organization or activity, through FY08.

The 5-year forecast is subject to variations arising from several sources, such as funding, programmatic, and schedule uncertainties.

These uncertainties render the forecast LLW volumes imprecise. To represent the imprecision, the minimum and maximum volumes of LLW have been predicted for the next 5 years and are presented in Fig. 4-3, along with actual volumes for the past 5 years.

The maximum projection assumes that the Chemistry and Metallurgy Research (CMR) Facility legacy equipment cleanout will be funded for FY05–08 and that the RLWTF will be repaired and renovated (R&R) beginning in FY08. If the RLWTF D&D option is chosen, larger quantities of waste will be produced starting in FY10; thus, for the next 5 years, the maximum case is represented by the R&R case. The maximum case also assumes that the Remediation Services baseline underestimates the real waste volume by a factor of 2.5, which is the historic factor by which Remediation Services has exceeded its baseline projections. The minimum case assumes that the baseline projections are correct.

Solid LLW generated by the Laboratory's operating divisions is characterized and packaged for disposal at the onsite LLW disposal facility at TA-54, Area G. Area G has a limited useable volume. The ER project plans the generation of very large volumes of contaminated soil waste over the next few years. When packaged LLW, low-level construction waste, and low-level D&D waste are added to the ER LLW, the planned volume will exceed the remaining disposal volume by FY04–05. Waste produced from D&D and ER projects are low-activity wastes, are largely lightly contaminated soils, and can be disposed of at the Envirocare site in Utah or at Nevada Test Site (NTS). Because the Sitewide Environmental Impact Statement (SWEIS) (through a DOE Record of Decision in the fourth quarter of 1999) has received regulatory approval, construction of additional disposal sites now is allowed. Additional sites for LLW disposal near Area G could provide onsite disposal for many years. However, the preferred option may be to reserve the new burial sites for higher-activity LLW that cannot travel over the highway. Thus, most of the LLW would be sent to Envirocare for disposal. The primary issue with shipping lower-activity LLW off site for disposal is cost.

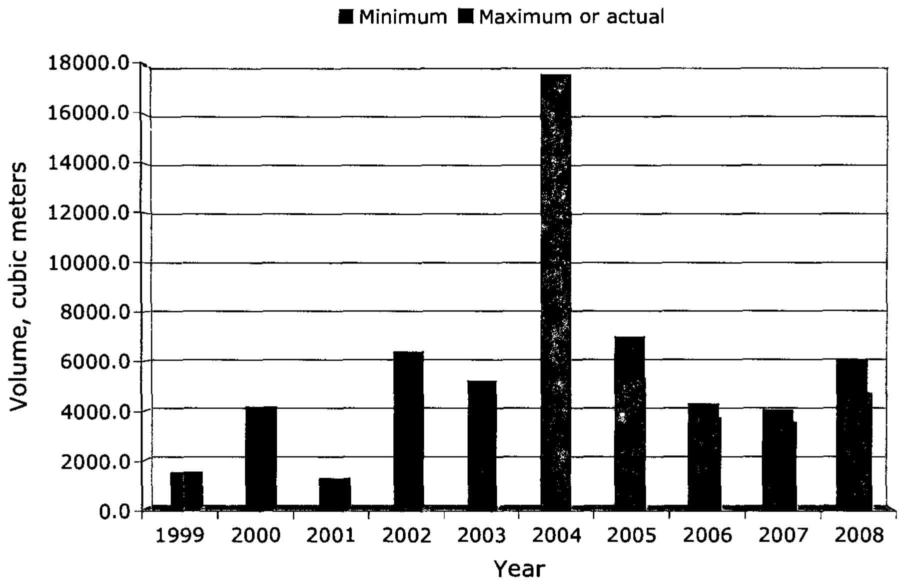


Fig. 4-3. LLW generation forecast.

The 5-year average of all projected LLW, based on the maximum projection, is 3880 m^3/yr. If bulk soils are removed from the total, the 5-year average projected waste is 2380 m^3/yr.

4.4. *Mixed Low-Level Waste (MLLW)*

4.4.1. Forecast and Analysis

Most of the Laboratory's routine MLLW results from stockpile stewardship and management and from R&D programs. Most of the nonroutine MLLW is generated by off-normal events, such as spills in legacy-contaminated areas. ER and waste management legacy operations also produce MLLW.

The average generation of MLLW over the past 9 years has been 81.1 m^3/yr. Total volumes have fluctuated for the past decade primarily because of the strong variation in nonroutine and ER volumes. Routine MLLW generation has trended lower over the same time period. The MLLW produced at the Laboratory falls into two categories: operational waste and bulk waste. Most of the operational MLLW, both routine and nonroutine, results from stockpile stewardship and management and from R&D programs. The bulk MLLW results from ER and D&D operations and generally is found in the form of contaminated soils and rubble. In FY03, the bulk MLLW was composed exclusively of D&D waste.

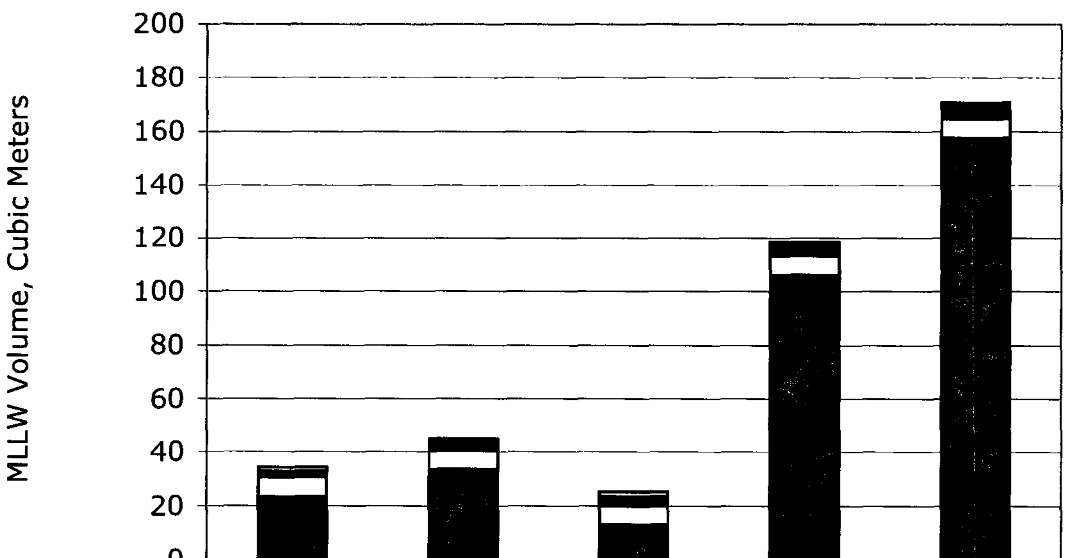
The generation of routine MLLW has been trending downward over the past few years, and that trend is expected to continue. However, the total MLLW generation has been volatile and is predicted to remain somewhat volatile over the next 5 years. The activity that will drive the volatility in total MLLW volume is the ER project. As with LLW, the volumes of waste generated by the ER project will be substantial through FY08, with peak activity occurring in FY07 and FY08. Although small changes in non-ER waste generation are projected to occur, the total non-ER waste volume is expected to remain relatively constant or to decrease slightly. Details of this forecast can be found in the appendices to this report.

Figure 4-4 presents the predicted MLLW volumes through FY08 by division.

The forecast of waste generation is uncertain by nature; this is particularly true of non-ER MLLW generation. The non-ER volumes are so small that even a moderately sized spill in a contaminated area easily could double the total non-ER generation. Because the forecast is problematic, minimum and maximum volumes have been predicted. The forecasted MLLW minimum and maximum waste generation for the next 5 years, along with the actual waste generation for the past 5 years, is presented in Fig. 4-5.

Routine MLLW is generated in radiological control areas (RCAs). Hazardous materials and equipment containing Resource Conservation and Recovery Act (RCRA) materials, as well as MLLW materials, are introduced into the RCAs as needed to perform specific activities. During operations, hazardous materials become contaminated or activated and are designated as MLLW when they reach the end of their lives and are declared 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



	2004	2005	2006	2007	2008
Total, m3	34	45	25	119	171
□ Other	2	2	2	1	1
■ RRES	2	3	4	4	5
□ FWO	7	7	7	7	7
■ NMT	8	8	8	8	8
■ ER	16	26	5	99	150

Year

Fig. 4-4. MLLW volume forecast by division.

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 (WM) and Department of Transportation (DOT) requirements and shipped to TA-54. From TA-54, MLLW is sent to commercial or DOE treatment and disposal facilities. The waste is treated/disposed of by various processes (e.g., segregation of hazardous components and macroencapsulation or incineration).

Because virtually all MLLW is shipped off site for treatment and disposal, the consequence of increased MLLW generation for the Laboratory is increased cost. However, the current projections call for nearly stable generation rates, except in mid-decade. No significant impact to infrastructures or operations is forecast.

4.5. *Radioactive Liquid Waste (RLW)*

4.5.1. Forecast and Analysis

For the purposes of this forecast, RLW is defined as all waste influent to the RLWTF located at TA-50. Three types of liquid waste are discharged to the RLWTF. Industrial waste is discharged through the industrial/low-level wastewater line. The liquid discharged to this

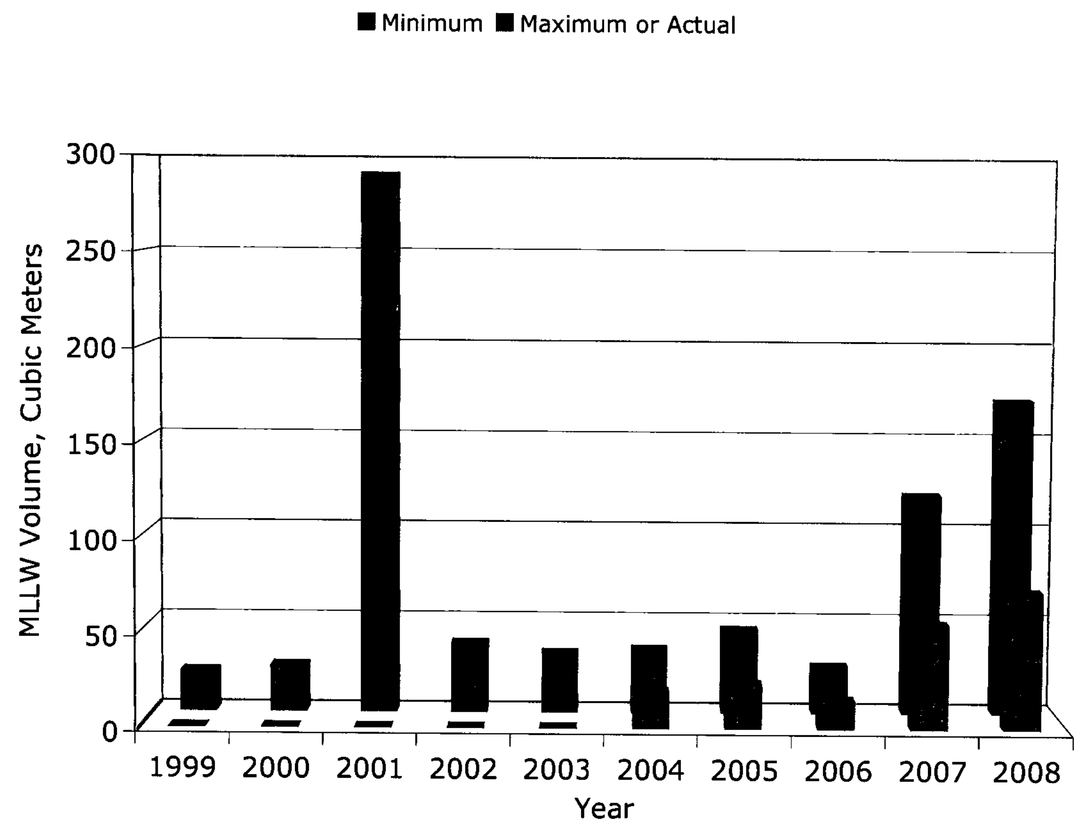


Fig. 4-5. Minimum and maximum MLLW forecast.

line has a very small radioactive component (on the order of 10^{-10} Ci/L). Acid waste and caustic waste are discharged through separate lines to the RLWTF and contain most of the radioactive material processed at the RLWTF. The acid-waste-line activity is ~6 × 10^{-5} Ci/L. Caustic waste activity is the greatest and averages ~4.5 × 10^{-3} Ci/L.

The RLWTF has been treating aqueous low-level wastewaters from the Laboratory's facilities since 1963. The plant is capable of treating in excess of 20,000,000 liters per year (LPY) of wastewater. Some 1800 drains and other sources attached to the RLW industrial/low-level collection system connect 15 TAs, 13 facility management units, and 62 buildings to the TA-50 plant. Some facilities do not have direct connections to the main RLW industrial/LLW line, and any wastes from these areas are trucked to the TA-50 plant.

The average generation of RLW waste over the past 10 years has been ~17 million LPY. Volumes have been trending lower for the past 5 years because the Laboratory's waste minimization program removed several nonradioactive sources from the RLW collection system and because waste minimization practices are more widespread.

Because the uncertainties are large, forecast of a single precise value for future RLW discharge volumes is difficult. This forecast will predict minimum and maximum discharges based on current information and on the range of possible discharge volumes. The projections will be limited to 5 years because funding and programmatic planning horizons are relatively short in many cases and because it is difficult to predict meaningfully beyond them.

The discharge to the RLWTF comes from three principle sources: the industrial/low-level wastewater line, the caustic waste line, and the acid waste line. The caustic and acid waste lines originate in TA-55. The industrial/low-level wastewater line is connected to several TAs with over 1800 sources.

4.5.2. Industrial Waste Stream

The industrial/LLW line discharge comes primarily from TA-55, TA-48, the CMR Facility, and the Sigma Facility. Planned activities will affect the industrial/low-level waste line discharge of RLW over the next several years. Unfortunately, the volumes of RLW generated as a result of these activities are uncertain. Some activities will reduce volumes, whereas others will increase them. Overall, a reduction in the industrial/low-level waste-line discharge volume is expected. The industrial/low-level waste-line discharge forecast is shown in Table 4-1.

Table 4-1. Industrial/Low-Level Waste-Line Forecast

Year	Industrial Line Volume in Liters, Minimum	Industrial Line Volume in Liters, Maximum
2004	10,790,000	11,390,000
2005	8,723,000	10,990,000
2006	6,723,000	9,990,000
2007	6,923,000	10,290,000
2008	6,923,000	10,290,000

4.5.3. Caustic Waste Stream

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 a relatively high chloride content. Projects that produce caustic waste include

- ^{238}Pu heat sources,
- 94-1 legacy waste stabilization,

- newly generated waste residue stabilization, and
- pit production.

Caustic process liquids are transferred to the TA-50 RLWTF, Room 60, for final processing via the caustic waste line. Table 4-2 summarizes the expected production of caustic waste over the next 5 years. The maximum case assumes that (1) successful implementation of the TRU-Chloride Extraction for Actinide Recovery (CLEAR) process will start in FY06 (the CLEAR process will dramatically decrease the radioactive loading of the discharge but will increase the volume of discharge); (2) ^{238}Pu processing will resume full operational levels by November 2004; (3) the 94-1 vault workoff will accelerate to an 8-year program ending in 2011; and (4) the pit production program will increase caustic operations to the current capacity of TA-55, Room 420.

The minimum case assumes that the TRU-CLEAR process is not implemented, that 94-1 workoff maintains the current 10-year schedule, and that pit production does not increase.

Table 4-2. Caustic Waste Forecast

Year	Caustic Waste Volume in Liters, Minimum	Caustic Waste Volume in Liters, Maximum
2004	9000	10,000
2005	10,000	15,000
2006	11,000	20,000
2007	11,000	48,000
2008	11,000	48,000

4.5.4. Acid Waste Stream

Acidic liquid waste is derived from processing plutonium feedstock using nitric acid for matrix dissolution. Following oxalate precipitation, the effluent is sent to the evaporator, where the overheads are removed and sent via the acid waste line to TA-50 RLWTF, Room 60, for final processing. The acid waste stream must be neutralized before treatment, which requires adding sodium hydroxide. The total effluent is increased as a result of adding the neutralizing sodium hydroxide.

Programs and projects that produce acid waste include

- actinide processing and recovery,
- pit fabrication, and
- the mixed-oxide (MOX) fuel program.

The acid waste stream is expected to remain nearly constant in FY04 and then to increase dramatically beginning in FY05 as the MOX program resumes at potentially three times its current level. The effect of pit production on acid waste generation could range from no effect to a linear effect, depending on the source of the metal for the pits. Using existing metal will have no effect, and processing new metal in the oxide-to-metal line could be linear in effect on acid waste. The metal certainly may come from multiple sources, and the effect then would depend on the ratio of the metals.

The Nitric Acid Recycle System (NARS) is likely to be completed in FY05 as well. For the NARS acid to be used more widely in PF-4, (1) it must be shown that recycled acid can be used in the MOX program, and (2) plumbing of the recycled nitric line must be completed so that it is more widely available in PF-4. When the NARS upgrade is complete, this volume will be either greatly reduced or eliminated. Table 4-3 shows the expected volumes of acid waste over the next 5 years.

The maximum case assumes that the MOX program is restarted in FY05 with a production goal of 3.5 times the FY03–04 goal, that NARS cannot be used for MOX production, and that pit production triples the acid waste discharge.

The minimum case assumes no MOX restart and a staged implementation of NARS.

4.5.5. *TOTAL RLW PROJECTION*

The industrial/low-level line forecast was combined with the acid and caustic forecasts, and a total RLW forecast was produced. This forecast predicts minimum and maximum discharges based on current information and on the range of possible discharge volumes.

Table 4-3. Acid Waste Forecast

Year	Acid Waste Volume in Liters, Maximum	Acid Waste Volume in Liters, Minimum
2004	60,768	60,768
2005	189,568	11,088
2006	189,568	5,544
2007	211,744	4,435
2008	211,744	2,218

Figure 4-6 presents the predicted minimum and maximum RLW volumes through FY08, as well as the volumes for the previous 5 years.

4.6. Hazardous Chemical Waste

4.6.1. *FORECAST AND ANALYSIS*

The scope of this section includes both hazardous waste and nonhazardous chemical waste.

Hazardous waste is divided into three waste types: RCRA waste, Toxic Substances Control Act (TSCA) waste, and State special solid waste. For the purposes of reporting the waste minimization, the Laboratory distinguishes between routine and nonroutine waste generation. Routine generation results from production, analytical, and/or other R&D laboratory operations; treatment, storage, and disposal operations; and "work for others" or any other periodic and recurring work that is considered to be ongoing. Nonroutine waste is cleanup stabilization waste and relates mostly to the legacy from previous site operations.

The RCRA and 40 CFR 261.3, as adopted by the New Mexico Environment Department (NMED), define hazardous waste as any solid

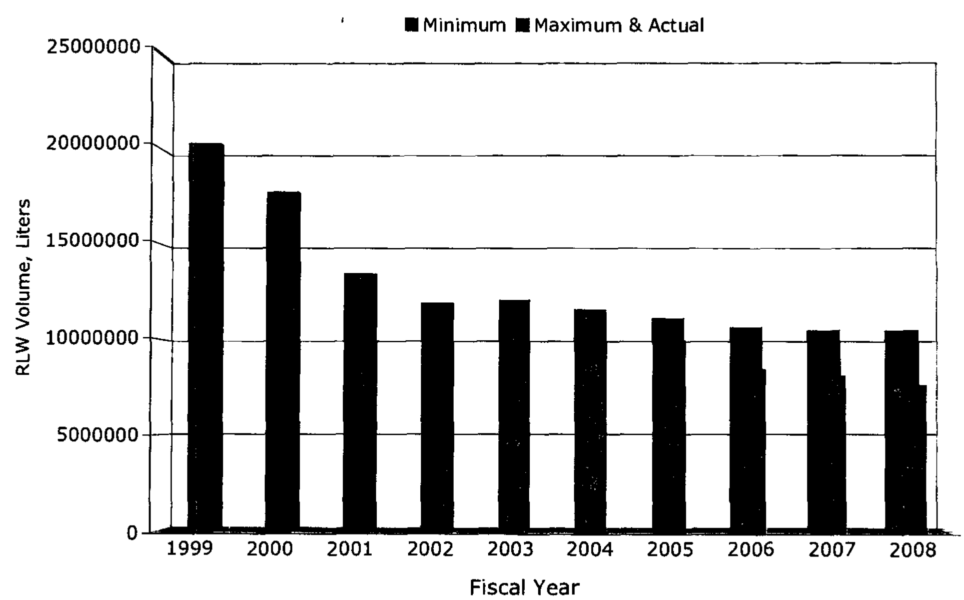


Fig. 4-6. Total RLW forecast.

waste that

- is generally hazardous if not specifically excluded from the regulations as a 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), or
- is a mixture of solid and hazardous waste.

Hazardous waste also includes substances regulated under the TSCA, such as polychlorinated biphenyls (PCBs) and asbestos.

Finally, a material is hazardous if it is regulated as a special waste by the State of New Mexico as required by the New Mexico Solid Waste Act of 1990 (State of New Mexico) and defined by the most recent New Mexico Solid Waste Management Regulations, 20NMAC 9.1 (NMED), or current revisions.

Hazardous waste commonly generated at the Laboratory includes many types of laboratory research chemicals, solvents, acids, bases, compressed gases, metals, and other solid waste contaminated with hazardous materials. 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). Also included are asbestos waste from the abatement program, wastes from the removal of PCB components, contaminated soils, and contaminated wastewaters that cannot be sent to the sanitary wastewater system or wastewater treatment plants.

Some hazardous wastes are disposed of through Duratek Federal Services, a Laboratory subcontractor. This company sends waste to permitted treatment, storage, or treatment-storage-disposal facilities; 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). Much of the hazardous waste is shipped by the generators directly off site for disposal.

Nonhazardous chemical waste is chemical waste that is not hazardous waste, as defined previously, but which fails to meet the waste acceptance criteria for sanitary landfill burial or sanitary wastewater treatment.

Total chemical/hazardous waste volumes have fluctuated for the past decade primarily because of the strong variation in nonroutine and ER volumes. This strong variation is expected to continue in the future. Because the total chemical/hazardous waste generation is dominated by the bulk waste generated by ER, D&D, and construction activities, it is more informative to discuss bulk and other wastes separately. Bulk wastes are mostly contaminated soils; other chemical/hazardous wastes are lower-volume, higher-risk wastes.

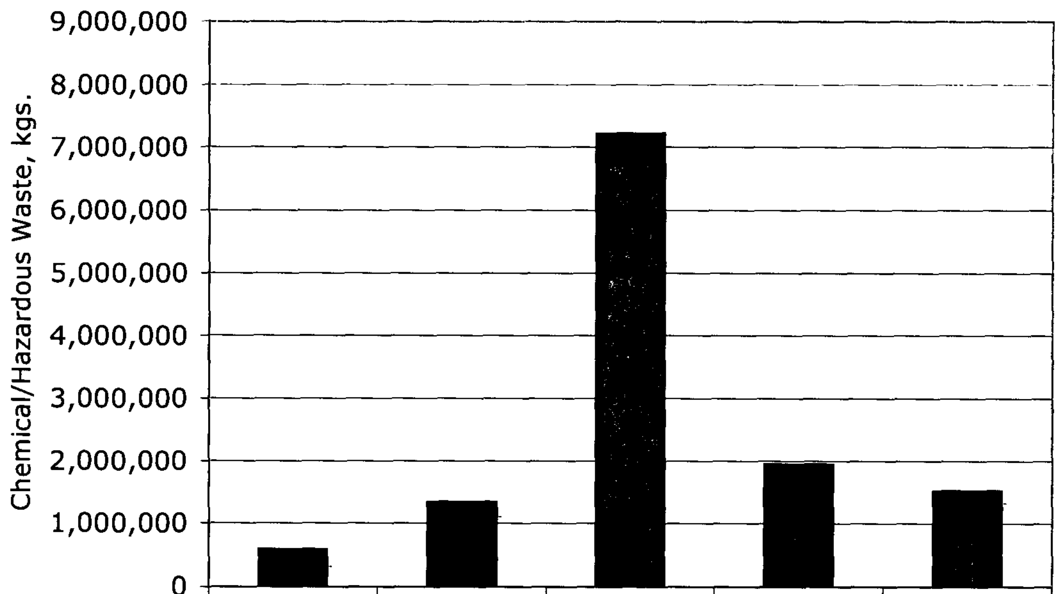
With the exception of FY99 and FY03, the generation of nonbulk chemical/hazardous waste has been steady over the last few years (back to FY96); this trend is expected to continue over the next 5 years. Routine waste has been trending downward, but nonroutine waste volumes are more variable. Total chemical/hazardous waste generation has been very volatile and is predicted to remain somewhat volatile over the next 5 years. The activity that will drive the volatility in total chemical/hazardous waste volume is the ER project. The volumes of bulk waste generated by the ER project will be substantial through FY08, with peak activity occurring in FY06. The forecast quantities of chemical/hazardous waste are shown in Fig. 4-7.

The 5-year forecast is subject to variations arising from several sources, such as funding, programmatic, and schedule uncertainties. These uncertainties render the forecast chemical/hazardous waste quantities imprecise. To represent the imprecision, the minimum and maximum quantities of chemical/hazardous waste have been predicted for the next 5 years and are presented in Fig. 4-8, along with actual volumes for the past 5 years.

The maximum projection assumes that the C-Division legacy chemical cleanouts are division wide and will occur in FY05 and FY08. The minimum case assumes that the C-Division legacy chemical cleanouts are selective rather than division wide but still occur in FY05 and FY08.

The maximum case also assumes that the Remediation Services baseline underestimates the real waste volume by a factor of 2.0, which is the historic factor by which Remediation Services has exceeded its baseline projections. The minimum case assumes that the baseline projections are correct.

Chemical/hazardous waste was previously stored on site at Area L, TA-54, to await offsite



	2004	2005	2006	2007	2008
Total, kgs.	578,638	1,338,494	7,212,180	1,937,974	1,517,054
■ Other	181,950	141,350	100,350	100,350	100,350
■ ESA	2,400	3,000	4,000	4,000	4,000
C	2,200	13,000	2,500	2,200	16,000
■ FWO	260,000	300,000	340,000	340,000	340,000
■ ER	132,088	881,144	6,765,330	1,491,424	1,056,704

Year

Fig. 4-7. Forecast of chemical/hazardous waste generation.

disposal. The Laboratory has taken measures to limit the size of the Area L storage site. The Laboratory has chosen to develop a series of consolidated waste storage facilities where waste can accumulate for up to 90 days before being directly shipped off site for disposal. Currently, four such sites exist at the Laboratory, and two more are planned. Over 90% of all chemical/hazardous waste now is shipped directly off site for treatment and disposal, and that fraction is likely to increase in the future. No impact to Area L from chemical/hazardous waste volume increases is foreseen. Very large increases in waste volumes could have a small impact on hazardous waste operations at TA-54 in terms of increased record keeping and other administrative efforts. However, a recent reduction in required paper work will minimize the impact on administration.

4.7. References

4-1. Los Alamos National Laboratory, "General Waste Management Requirements," Laboratory Implementation Requirement LIR404-00-02.3 (November 30, 2000).

4-2. FWO-WFM, "Waste Management Facility Strategic Plan," Los Alamos National Laboratory report PLAN-WFM-043, Rev. 1.0 (September 30, 2003).

4-3. PM-1, "Ten-Year Comprehensive Site Plan," Los Alamos National Laboratory report LA-CP-01-374 (September 26, 2001).

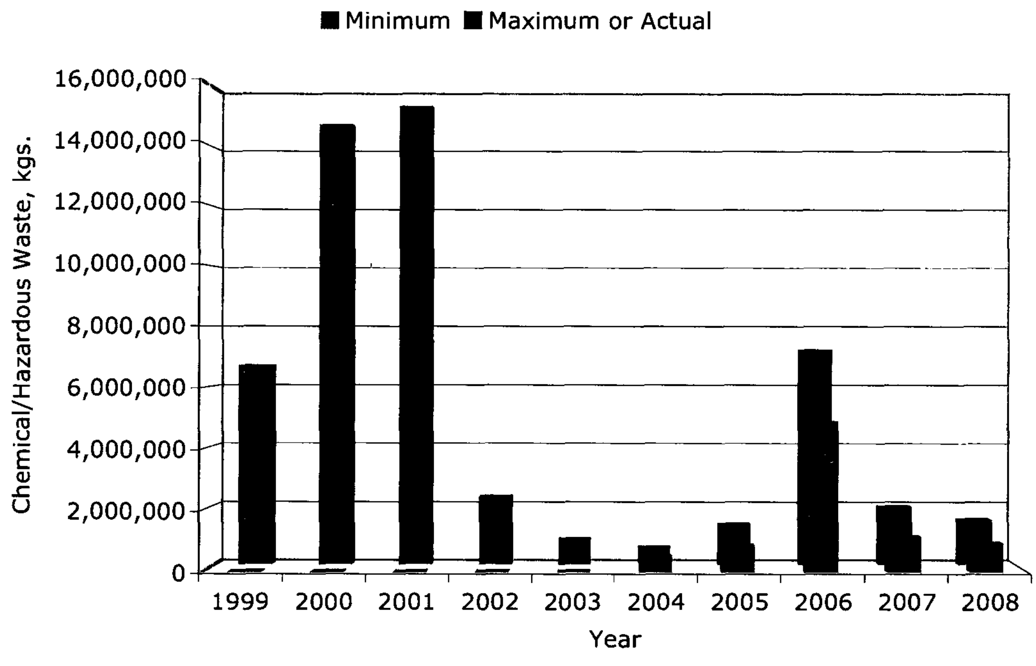


Fig. 4-8. Minimum and maximum waste forecast.

Chapter 5: Prevention Accomplishments

5.1. Accomplishments

The pollution prevention (PP) program comprises four major programs designed to eliminate priority waste streams and promote waste minimization practices at the division, group, and individual levels. These programs are the Environmental Management System (EMS), the Generator Set-Aside Fee (GSAF) program, the PP awards program, and the sustainable design program.

In fiscal-year (FY)04, the PP program took the lead in developing a prevention, performance-based EMS for the Laboratory. The EMS provides a framework for policy, planning, implementation, checking, and corrective action and management review. Over 40 Los Alamos National Laboratory (Laboratory) staff members from 14 divisions participated in the EMS committee.

The GSAF program funds research, development, and demonstration of new approaches to waste minimization. These are year-long projects that are selected by peer review and conducted by the Laboratory organization that owns the problem waste stream. In FY04, the GSAF program was expanded to include radioactive liquid waste (RLW). The RLW GSAF program will be deployed in FY05.

The PP awards program is an annual competition to select team and individual projects that have done the most to minimize waste during the year. The proposals are peer-reviewed. Senior management presents the awards at an annual ceremony, along with a small cash award. The total cost savings to the Laboratory was over $2 million in FY04.

The PP program also supports sustainable design efforts at the Laboratory. This effort is key to ensuring that sustainability and prevention are incorporated at the design phase, where the greatest cost benefit may be achieved.

The GSAF, PP awards, and sustainable design programs have been integrated into the EMS to encourage prevention approaches to meet improvement targets and objectives.

Key FY04 EMS milestones included the following.

- The Laboratory Governing Policy was revised to include EMS-compliant language, including PP and continual improvement.
- A Senior Management EMS Steering Committee representing all Laboratory directorates and their divisions, the Department of Energy (DOE) Los Alamos Site Office (LASO), and the University of California (UC) was convened by the director and is being chaired by the deputy director. The Steering Committee will oversee the EMS process.
- Institutional EMS procedures were developed, including aspects and impacts identification, legal, work control, emergency management, checking and corrective action, training, and management review.
- A communications plan detailing internal and external communication pathways was developed.
- A Memorandum of Agreement (MOA) was approved between the Laboratory and major subcontractors to ensure site-wide coordination of EMS development.
- EMS environmental aspects and impacts have been integrated into the automated job-hazard-analysis tool that is being inaugurated under Phase II of the Laboratory's In-

tegrated Work Management (IWM) program. Over 20 environment subject-matter experts were engaged in this integration process. Future work approval will require the evaluation of environmental hazards, controls, and PP opportunities to meet many DOE O 450.1 and International Standards Organization (ISO) 14001 EMS requirements.

- A Laboratory-wide IWM Integrated Management Procedure was issued, which includes EMS requirements for work control.
- The EMS was included as a key Laboratory operation efficiency improvement project in the Cultural and Operations Model Plan and Surety Systems (COMPASS) project.

GSAF projects approved for FY04:

- Recycling of Lead from Radiological Control Areas (RCAs)
- Contaminated Lead/Scrap Metal Abatement
- Solvent Reuse
- Barium Removal Using Ion Exchange at the High-Explosives Water Treatment Facility (HEWTF)
- Implementation of Compaction/Granulation Technology at TA-55
- Radioactive Liquid Waste Treatment Facility (RLWTF) Waste Inventory Tracking System (WITS)
- Oil-free vacuum pumps at the Los Alamos Neutron Science Center Experiment (LANSCE) Lujan Target
- Cable Stripper for Depleted Uranium (DU)-Contaminated Firing Site Cables
- PF-4 Blower and Vacuum Cleaner Pre-Filters
- Reengineering of the Noncompactable Low-Level Waste Stream Management Process
- Development of Bench-Scale Molten Salt Oxidation Processes for Treating ^{238}Pu-Contaminated Combustible Waste
- Green Bullets—Reducing Lead at the Guard Force Firing Range [Toxic Release Inventory (TRI) Waste]
- Chemistry Division, Applied Chemical Technology (C-ACT) Dry Machining Uranium [Mixed Low-Level (MLLW) and Transuranic (TRU) Waste]
- C Division—Oil-Free Vacuum Pumps (LLW)
- Nuclear Materials Technology Division NMT-7 Waste Bag Project (LLW)

The FY04 Laboratory and National Nuclear Security Administration (NNSA) PP awards accomplishments included the following.

- The annual PP awards ceremony was held on April 29, 2004, to honor 229 awardees for 30 different awards. The program was hosted by Laboratory Deputy Operations Deputy Director Barbara Stine. Twenty-three different Laboratory divisions and seven contract organizations received awards. The total savings to the Laboratory was $2,274,274.
- On April 15, 2004, NNSA Administrator Linton Brooks was at the Laboratory to award two NNSA PP awards. He was joined by Laboratory Director G. Peter Nanos, Deputy Director Mangeng, and an array of

Laboratory senior managers to recognize the awardees:

- Formamide Replacement in Genetic Sequencing by Lynn Goodwin and her team in Bioscience (B) Division.

- PP at the Heavy Equipment Maintenance Shop by John Keene and his Kellogg Shaw Los Alamos Technical Associates (LATA) team.

PP sustainable design accomplishments included the following.

- Completed all available Chemistry and Metallurgy Research Replacement (CMRR) project documentation reviews and provided revisions for incorporation of Leadership in Energy and Environmental Design (LEED™) requirements and sustainable design.

- Completed all available Laboratory Standards Engineering Manual chapter reviews and provided revisions for incorporation of LEED™ requirements and sustainable design. In addition, co-developed a new sustainable design chapter for the engineering manual.

- Participated in the Laboratory's Standards Program Commissioning Committee. Provided revisions for incorporation of LEED™ commissioning requirements into the draft engineering manual.

- Prepared LEED™-specific functional and operational requirements for use in developing High-Explosives Characterization (HEC) facility procurement documentation.

- Developed and submitted LEED™ requirements for performance specifications and design criteria in Information Management Division Operations (IMDO)'s general plant project (GPP) building procurement documentation to facilitate LEED™ certification.

- Worked with P-Division staff on the LEED™ rating system, as well as coordinated a tour of a Sandia National Laboratories' LEED™-certifiable laboratory facility.

- The PP team organized and hosted a design charrette for the RLWTF Upgrade project. This process used sustainable building principles to bring end users, plant operators, waste management staff, PP staff, and construction engineering staff together to determine best practices for building design.

In addition, one key PP program accomplishment included the following.

- Replaced ozone-depleting substances (ODS) chillers at LANSCE; this action fulfills the PP goal requirements for chlorofluorcarbon (CFC) replacement. The CFC replacement project already has begun making progress on chillers listed in the DOE 2010 ODS goals. The Laboratory has met the DOE goals over 1 year ahead of schedule.

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