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WASTE VOLUME FORECAST

Revision 1

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Los Alamos
NATIONAL LABORATORY

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ACRONYM LIST

C	Chemistry Division
AAC	Actinide Analytical Chemistry
CFR	Code of Federal Regulations
CMR	Chemistry and Metallurgy Research
D&D	Decommissioning and Demolition
DOE	Department of Energy
DX	Dynamic Experimentation Division
EES	Earth and Environmental Sciences Division
EIP	e-p Instability Program
EM	Environmental Management
EPA	Environmental Protection Agency
ER	Environmental Remediation
ESA	Engineering Sciences and Applications Division
ESH	Environment Safety and Health Division (now HSR Division)
FWO	Facilities and Waste Operations Division
FY	Fiscal Year
HLW	High-Level Waste
HSR	Health, Safety, Radiation Division
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center Division
LIR	Laboratory Implementing Requirement
LLW	Low-Level Waste
LPY	Liters per Year
MLLW	Mixed Low-Level Waste
MST	Materials Science and Technology Division
NARS	Nitric Acid Recycle System
NMED	New Mexico Environment Department
NMT	Nuclear Materials Technology
OSR	Off-Site Source Recovery
OSRP	Off-Site Source Recovery Project
P	Physics Division
P2	Pollution Prevention
PCB	Polychlorinated Biphenyl
PM	Project Management
R&D	Research and Development
RCA	Radiological Control Area
RCRA	Resource Conservation and Recovery Act
RLW	Radioactive Liquid Waste
RLWTF	Radioactive Liquid Waste Treatment Facility

ACRONYM LIST (cont)

RRES	Risk Reduction and Environmental Stewardship
RRES-R	Risk Reduction and Environmental Stewardship—Remediation
SWEIS	Site-Wide Environmental Impact Statement
SWO	Solid Waste Operations
TA	Technical Area
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSTA	Tritium Systems Test Assembly
WIPP	Waste Isolation Pilot Plant

1.0 INTRODUCTION

This report presents a 5-year forecast of Los Alamos National Laboratory (LANL) 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 will also aid the Laboratory in targeting activities for waste minimization opportunities. The five-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 more confidently predicted.

Laboratory Implementing Requirement (LIR) 404-00-02.3 requires that waste generators provide waste forecasts on request for any treatment, storage, and disposal facility to which they discharge waste. The Department of Energy (DOE) also requires waste forecasts for the Integrated Database and the Baseline Environmental Management Report.

Abaxial Technology, Inc., on behalf of the Readiness in Technology Base and Facilities Program Office and in cooperation with LANL technical divisions, prepared this report. Waste management and program/project representatives from Nuclear Materials Technology (NMT), Materials Science and Technology (MST), the Los Alamos Neutron Science Center (LANSCE), Facilities and Waste Operations (FWO), Chemistry (C), and Risk Reduction and Environmental Stewardship (RRES) divisions provided information for this report. The Decommissioning and Demolition (D&D), Environmental Remediation (ER), Off-Site Source Recovery (OSR), and Transuranic (TRU) Waste Characterization (2010) projects also provided data used in this report.

This report describes the approach and process used in developing the volume forecasts and then presents a discussion of the volume forecast data and any potential impacts to LANL activities. The appendix includes additional details and assumptions for each of the waste categories based on the program/project interviews.

Projections were made based on historical data combined with both near- and longer-term program plans. It should be noted that the forecast is based on many assumptions. The near-term (1 – 2 year) forecasts rely on relatively good information from managers directing currently funded programs/projects. The longer-term (beyond 2 years) forecasts were based on program/project manager expectations of future funding. Forecasting is uncertain by nature, and thus, users are cautioned when using out-year forecasts. The near-term forecasts are likely to be more reliable than the longer-term forecasts. The data will be updated annually, and over time, the uncertainties should decrease and the usefulness of the information should improve. An attempt was made to tie projected waste generation to major programs within each division. The actual volumes will vary from this estimate; however, the forecasts provide a good basis for planning decisions.

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 simply forecast based on historical trends. Projections for ER and D&D wastes have been included in appropriate waste categories. In most cases, reductions for waste minimization activities have been factored into the totals. These contributions will be recognized as they occur in future updates to this report.

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 maximum and minimum waste quantity has been specified for each major waste type.

The reader is cautioned that the waste data reported here will not agree in detail with data reported in either the SWEIS yearbook or the Pollution Prevention Roadmap. The SWEIS yearbook reports on a calendar year basis and this forecast is based on fiscal years. The P2 Roadmap uses a database for TRU waste that tracks the year of TRU waste generation. The database used in this forecast tracks the year in which TRU waste is sent for disposition. Thus small differences in TRU waste volumes are likely.

2.0 FORECASTING

2.1. Data collection

Data were collected from the LANL divisions, programs, and projects. An initial query of existing data sources was performed to identify historical generation and to identify the divisions that generate most of the waste in FY03. Data sheets were prepared with historical trends and a preliminary forecast developed using the FWO-solid waste operations (SWO) waste database, the Remediation Services baseline database, Waste Management Facility Strategic Plan, the Ten Year Comprehensive Site Plan, various project plans and other sources.

Division waste management personnel reviewed the data sheets and the preliminary forecasts. The waste management representatives validated the historical data and identified the key programs/projects (or groups) responsible for the majority of the waste. The waste management representatives assigned a portion of the total division volume to each of the key programs/projects based on process knowledge or records where they exist. Generally, detailed records of waste volumes generated by program or project do not exist, and this assignment required judgment by the waste management professionals.

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, that is, they depended on events, which 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 but the program managers understand better the future of their activities. This approach combined the best information from both sources.

2.2. Data Structure

The data were collected by division but are reported by waste type. The waste types of interest include transuranic (TRU) waste, radioactive liquid waste (RLW), low-level waste (LLW), mixed low-level waste (MLLW), and chemical/hazardous waste. The data for each division are reported by key program/project. Additional data are supplied to document the program/project forecasts and interviews. The notes and assumptions also have been included in the report appendices.

3.0 WASTE PROJECTIONS

3.1. TRU Waste

3.1.1. Definition and Scope

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

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 periodically reported in the annual Pollution Prevention Roadmap and elsewhere. Two reasons exist for the data discrepancies between this report and the quarterly and annual pollution prevention (P2) reports. First, the P2 reports record waste in the year in which it was generated, whereas this report records waste in the year in which it was processed for disposal. Second, the P2 reports contain only routine waste data. 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 or recurring work that is considered ongoing in nature.

3.1.2. Historical Trends

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 MO_X program. If restarted in FY05 the MO_X program will generate about 2.5 times the waste it generated in FY03-04. In addition the volumes are growing as a result of process changes in NMT Division, such as discarding TRU scrap as waste rather than reprocessing it.

The FY02 Waste Volume Forecast predicted a total TRU waste generation of 218 m^3 while the actual generation was 235 m^3, an under prediction of about 8%. The largest part of this error was caused by under predicting vault workoff volumes.

The historical generation of TRU waste is shown by fiscal year in Fig. 3-1.

3.1.3. Generator Divisions

NMT, FWO, and RRES are the key divisions responsible for generating most of the TRU waste at LANL (see Fig. 3-2). C Division generates small amounts and they are expected to remain small in the future.

The FWO and RRES wastes are related to NMT program activities and to retrieval of legacy waste.

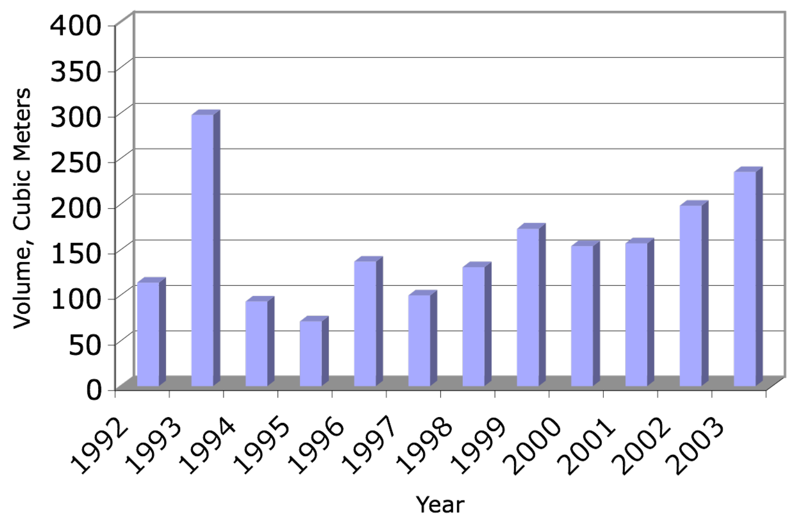


Fig. 3-1. Past TRU waste generation.

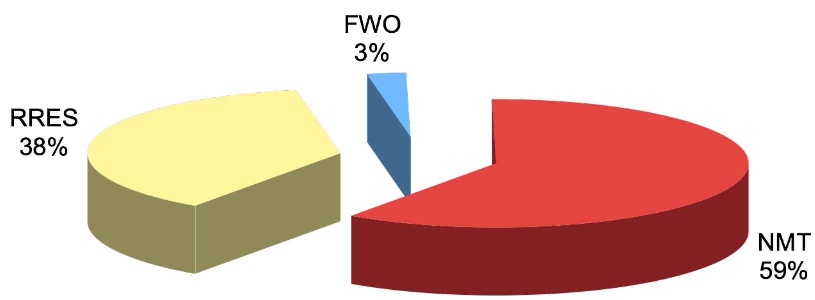


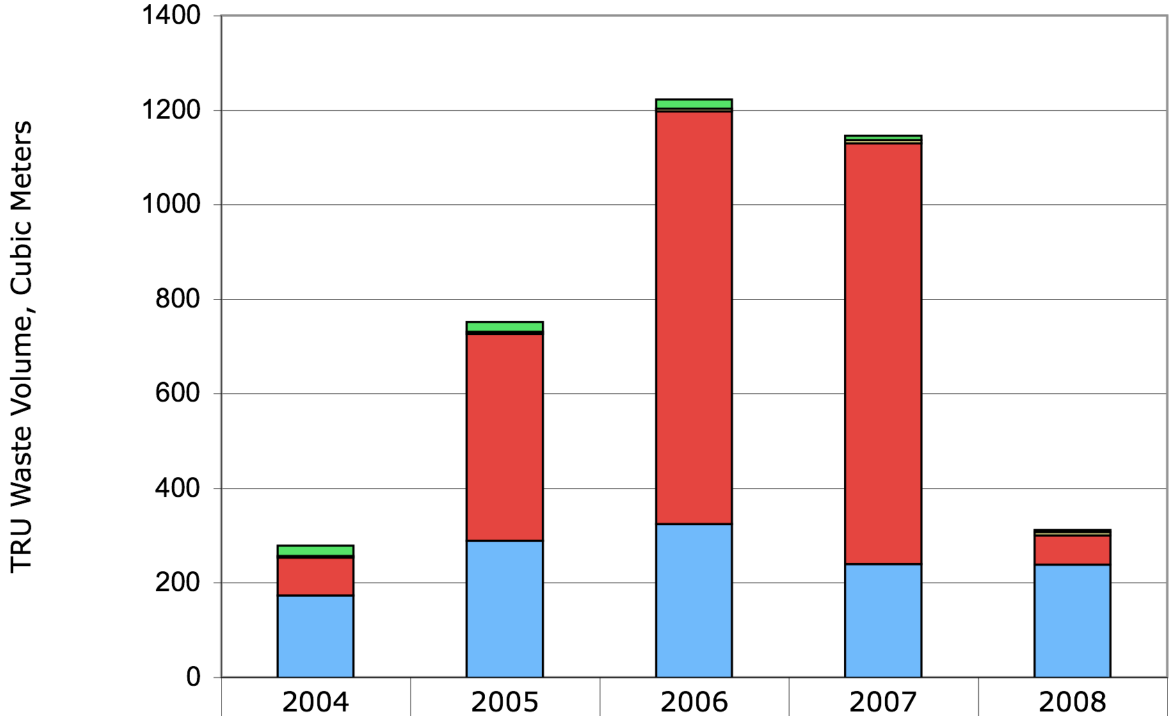
Fig. 3-2. TRU waste-generating divisions – FY03.

3.1.4. Key Programs/Projects

Key programs/projects that were responsible for generating TRU waste during FY03 have been identified and are described in Table 3-1.

Table 3-1. TRU Waste Generation by Division and Project

Program/Project	Organization	Volume FY03 (m^3)	Percentage
Pu-238 Operations (30%)	NMT-9	9	
Pit Fabrication	NMT-5, NMT-2, NMT-11, NMT-15	8	
Vault Workoff	NMT-2, NMT-4, NMT-6, NMT-11, NMT-15	35	
Plutonium R&D Support	NMT-2, NMT-5, NMT-6, NMT-76, NMT-15	33	
Cement Operations		36	
Other	Various	19	
NMT Subtotal		**140**	**59%**
Off-Site Source Recovery Project	RRES-WD	77	
Project 2010	RRES-WD	0*	
Environmental Restoration	RRES-RS	0	
Waste Characterization	RRES-CH	10	
RRES Subtotal		**88**	**38%**
Radioactive Liquid Waste Treatment Facility	FWO-WFM	.2	
Solid Waste Operations	FWO-SWO	5.8	
FWO Subtotal		**6**	**3%**
Actinide Research	C-INC	1	
C Subtotal		**1**	**0%**
Total		**235**	**100%**



	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. 3-3. TRU waste forecast by organization.

3.1.5. Forecast

Over the next 5 years, the dominant activity that will drive changes in the volume of TRU waste sent for disposition is Project 2010, an EM waste disposal project that will retrieve ~1800 m^3 of legacy waste currently located below ground at TA-54. The OSR Project will continue to retrieve sealed sources from around the country in preparation for treatment and disposal. Pit manufacturing, heat sources, and energy programs are expected to see a 40% increase in activity over the next several years and then to 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 high curie content and thus will require a greater packaging volume, which will add to the overall volume increase. A new practice of discarding TRU materials as waste instead of reprocessing them will add about 30m^3 to the TRU waste volumes each year for the next five years. The Laboratory also anticipates disposing of an additional 10 - 40m^3 per year of TRU waste from non-traditional sources in each of the next five years. These increases will be offset partially by increased waste minimization activities. Figure 3-3. presents the predicted maximum TRU volumes, by organization, through FY08.

The five-year forecast is subject to variations arising from a number of sources, such as funding, programmatic and schedule uncertainties. These uncertainties render the forecast TRU waste volumes imprecise. To represent the imprecision, the maximum and minimum volumes of TRU waste have been predicted for the next five years and are presented in Figure 5 along with actual volumes for the past five years.

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 2.5 times greater than the FY04 rate. The minimum case assumes that vault workoff rates after FY04 will only maintain available volume in the vault. The minimum case also assumes no MOx restart and that Project 2010 slips schedule by one year.

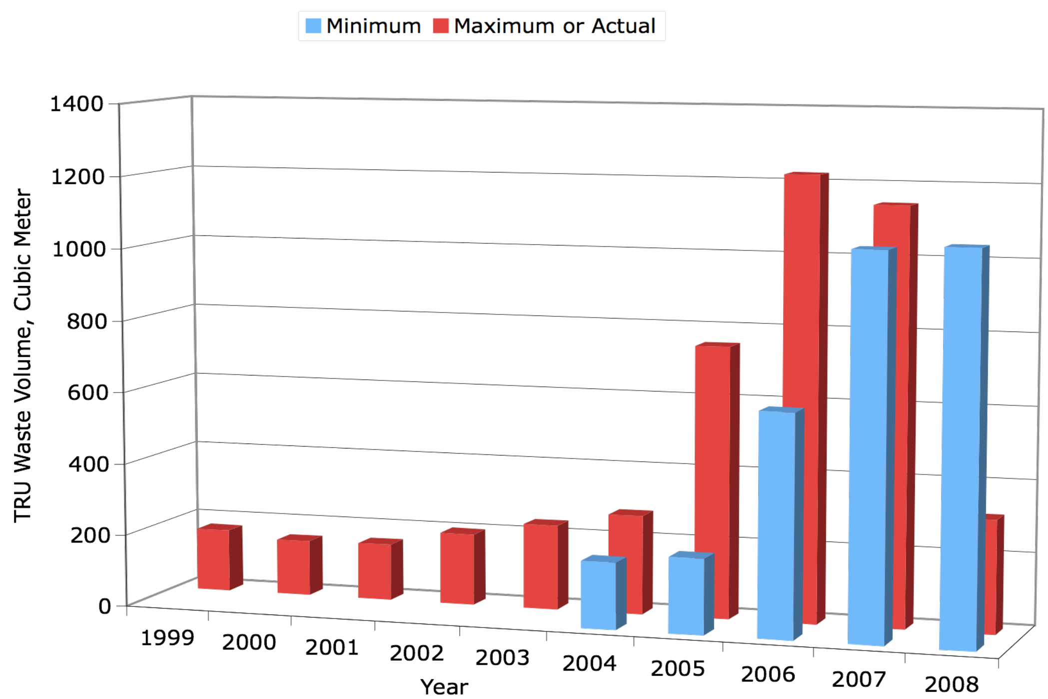


Figure 3-4. Maximum and minimum projected TRU waste volumes

The maximum case also assumes that the Remediation baseline underestimates the real waste volume by a factor of 2.0, which is the historic factor by which Remediation has exceeded their baseline projections. The minimum case assumes the baseline projections are correct. The maximum and minimum projected TRU volumes are shown in Figure 3-4.

3.1.6. Analysis

The primary issue related to TRU waste volumes is the limited aboveground storage capacity at LANL. From FY05 to FY07, large quantities of legacy TRU waste are scheduled to be retrieved from underground storage for processing, repackaging, and shipment to the Waste Isolation Pilot Plant (WIPP). These plans are, however, contingent on availability of storage space for the retrieved waste. The schedule is flexible, and although it is projected to begin in FY05 and take 3 years to complete, it can be delayed or 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 previously retrieved 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, LANL and NMT 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.

3.2. RADIOACTIVE LIQUID WASTE

3.2.1. Definition and Scope

For the purposes of this forecast, RLW is defined as all waste influent to the Radioactive Liquid Waste Treatment Facility (RLWTF) located at TA-50. There are three types of liquid waste discharged to the RLWTF. Industrial waste is discharged through the industrial/low level wastewater line. The liquid discharged to the industrial/low level wastewater 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 RLWTF. The acid waste line activity is about $6x10^{-5}$ Ci/l. Caustic waste activity is the greatest and averages about $4.5x\ 10^{-3}$ Ci/l.

The RLWTF has been treating aqueous low-level wastewaters from LANL 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/low level waste line, and any wastes from these areas are trucked to the TA-50 plant.

3.2.2. Historical Trends

The average generation of RLW waste over the past 10 years has been ~17 million liters per year (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 waste minimization practices are more widespread. These trends are shown in Fig. 3-5. The FY02 Waste Volume Forecast predicted an FY03 RLW influent of 12,345,736 l. The actual influent in FY03 was 12,156,083. The FY03 prediction over predicted actual generation by about 1.5%.

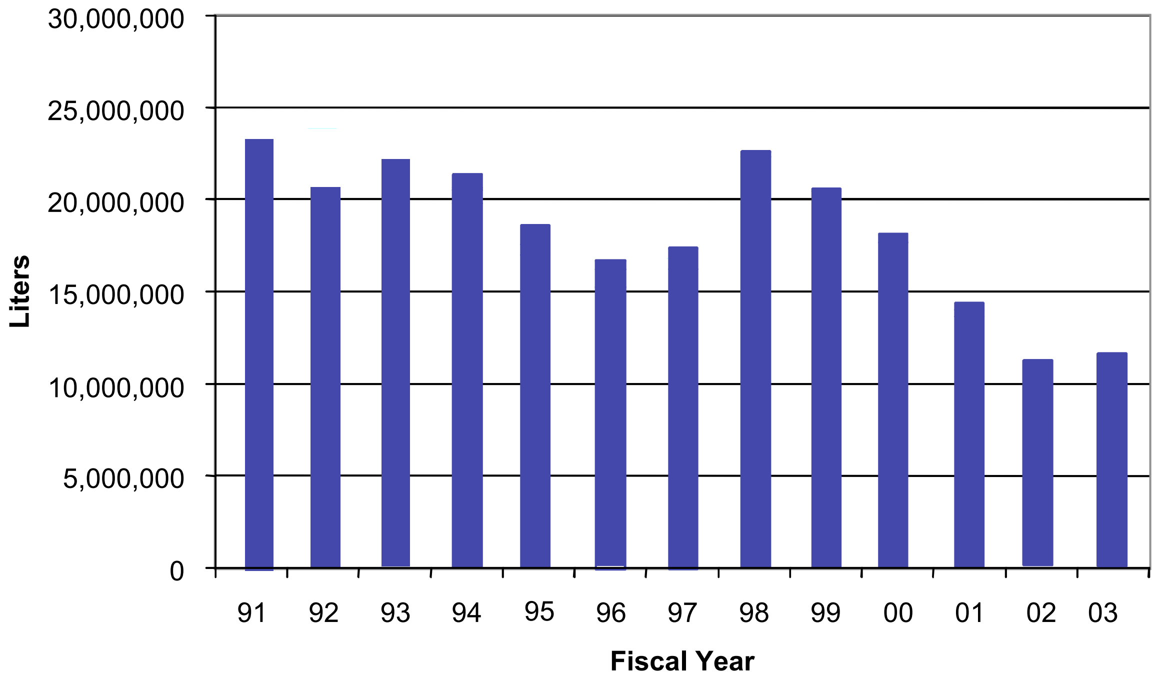


Fig. 3-5. Past generation of radioactive liquid waste.

3.2.3. Generator Divisions

NMT, MST and C divisions produced the majority of RLW at LANL in FY03. Other divisions, including Engineering Sciences and Applications (ESA) and Dynamic Experimentation (DX), produced smaller quantities of RLW.

In general, the flows reported above and throughout this section are not measured flows from individual facilities. Overall flows for the three influent lines, the industrial/low level line, the acid waste line and the caustic waste line, are derived from time dependent measurements of influent tankage levels. The assignment of flows to individual facilities and processes is made on the basis of generator records and expert knowledge. With few exceptions actual flow measurements are not made.

The three largest generator divisions remain the same as in FY03 although the relative volumes of RLW produced by these generators changed. C Division produced a greater discharge to the RLW industrial/low level waste line, largely through duct wash-down wastewater and NMT produced relatively less RLW through some curtailment of CMR discharges. The generators of RLW are shown in Fig. 3-6.

As much as 5,000,000 l/yr of the discharge to the RLW industrial/low level waste line is not due to programmatic activities at all. Relatively large volumes of wastewater are discharged to the RLWTF during periods when there are no operations at the Laboratory. During the Cerro Grande fire, wastewater was discharged to the industrial/low level waste line at an annualized rate of over 7,000,000 l/yr. During Christmas shutdowns wastewater is discharged at an annualized rate of between 4,000,000 and 6,000,000 l/yr. This discharge, in the absence of any programmatic activity, is attributed to leaks, malfunctioning equipment (i.e., boilers, deionizers, etc.) and left-open sources. With more than 1800 sources for the industrial/low level waste line, each source needs to produce only a few ml/min to reach the observed volumes. Since the Cerro

Grande fire, P2 activities have disconnected several large discharge sources from the industrial/low level waste line and reduced the base flow by about 2,000,000 l/yr.

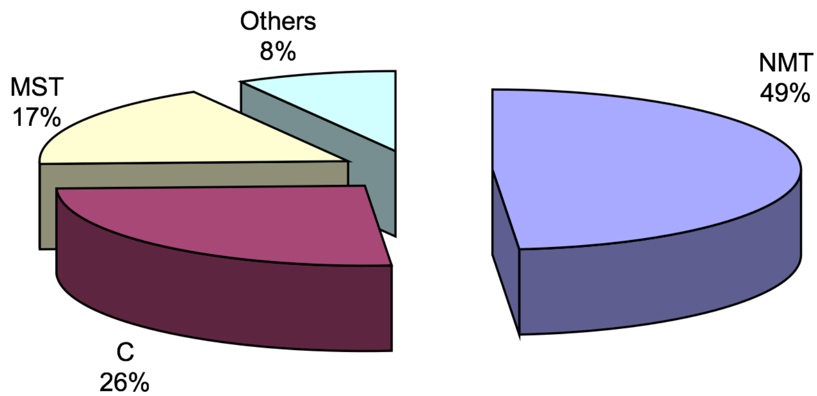


Fig. 3-6. Radioactive liquid waste generators.

3.2.4. Key Divisions/Locations

Since the RLW influent system is largely unmetered it is impossible to identify influent fractions with specific programs. It is, however, possible to estimate influent flows from knowledge of activities at various TAs and from monitoring influent tank levels. Key divisions/locations responsible for generating RLW waste during FY03 have been identified and are described in Table 3-2.

Influent line	Division	TA	Volume FY03 (liters)	Percentage
Industrial Waste Water				
	NMT/C at CMR	TA-3	3,800,000	31%
	MST	TA-3	2,100,000	17%
	ESA	TA-3	190,000	2%
	C	TA-48	3,100,000	26%
	NMT	TA-55	2,000,000	16.4%
	Others	Various	800,000	7%
Acid Line	NMT	TA-55	43,000	.3%
Caustic Line	NMT	TA-55	9,000	.1%
Reagent	FWO	TA-50	33,000	.2%
	Total		**12,075,000**	**100%**

Table 3.2. RLWTF influent sources

3.2.5. Forecast

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

The discharge to the Radioactive Liquid Waste Treatment Facility (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.

3.2.5.1 Industrial/Low-Level Waste Line

The industrial/low level waste line discharge comes primarily from TA-55, TA-48, CMR and the Sigma Facility. This discharge has a very small radioactive component and is about 4 orders of magnitude less than the acid and caustic lines. There are a number of constituents of the industrial/low level waste line discharge including both radioactive and non-radioactive components. Values for both the average and maximum isotopic concentrations were calculated for the industrial line. The results of these calculations are presented in Table 3-3. The table lists the radionuclide content in Ci/L.

Isotope	Average Conc., Ci/L	Maximum Conc., Ci/L
Pu-238	7.00E-09	1.50E-08
Pu-239	8.26E-09	5.10E-08
Am-241	3.20E-09	1.40E-08
Rb-83	4.00E-10	4.70E-09
Rb-84	4.20E-10	3.90E-09
SR-85	5.60E-10	3.30E-09
SR-89	2.10E-10	1.20E-09
SR-90	4.80E-11	2.50E-10
Cs-137	1.52E-11	1.70E-10

Table 3-3. Radioactive components of the Industrial/Low Level Waste

In addition to the radioactive components of the RLW there are non-radioactive components. A few of these typical components are and their average concentrations are listed in Table 3-4.

Constituent	Concentration, mg/L
Ca	25.3
Mg	9.6
Si	100
NO_3	40

Cl	124
Na	200
K	317
F	52
CO_3	62
TDS	933

Table 3-4. Non-radioactive components of the industrial/low-level waste

In some respects, the non-radioactive constituents are as problematic as the rad constituents. The drinking water limit for nitrate is 44 mg/L. If the laboratory generates 12 million liters per year of industrial liquid waste, it only requires the use of 8-2.5 L bottle of nitric acid weekly to meet this limit. If the volume is reduced to 6 million liter per year, the amount would reduce to only 4-2.5 L bottles per week. For a Laboratory that has actinide chemistry as a primary function this is an extremely low value. The Laboratory currently meets this standard by severely restricting discharges of nitrates. Failure to incorporate a treatment technology for this contaminant could severely restrict future operations. The total dissolved solids (TDS) value averages about 950 mg/L and the current discharge limit is 1500 mg/L. Other outfalls at the Laboratory are already restricted to 1000 mg/L indicating that this limit may also become problematic.

There are planned activities that 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 while others will increase them. Overall a reduction in industrial/low level waste line discharge volume is expected. Planned activities that will decrease RLW discharge are:

- P2 projects to identify and disconnect upstream sources are expected to reduce RLW discharge by between 2,800,000 and 3,200,000 l/yr. in FY05 and FY06. Further reductions may be possible in out years
- TA-48 plans to reduce duct washing by 2/3 in FY05. This will dramatically reduce the major source of discharge to the industrial/low level wastewater line.

Activities that could increase discharge volumes include:

- Increase in pit manufacture

  The degree to which a possible increase in pit production will increase discharge to the industrial/low level waste line is not known but is thought to be small. Pit fabrication is not a water intensive process and the increase in production to the current capacity of the facility could increase RLW discharge by a factor of two at most.

- A return to underground testing has the potential to increase RLW discharge from TA-48. Analytic testing of samples using perchloric acid would increase dramatically. This could result in more frequent duct washdown operations and potentially lead to large increases in industrial/low level waste line discharges. However, TA-48 personnel are confident that even in the event of return to testing the total RLW discharge from TA-48 can be held to current or lower discharge rates. The increased use of self-scrubbing fume hoods with perchlorate recycle along with other P2 projects will help accomplish this goal.

The Industrial/low level waste line discharge forecast is shown in Table 3-5.

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

Table 3-5. Industrial/low level waste line forecast

3.2.5.2 Acid and Caustic Waste

TA-55 generates both acidic and caustic wastes that are transferred to the RLWTF through waste lines. These lines are separate from the industrial/low level waste line through which the bulk of the TA-55 RLW is transferred.

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 includes

- Pu-238 Heat Sources
- 94-1 legacy waste stabilization
- newly-generated waste residue stabilization, and
- pit production

Efforts are underway to upgrade the throughput capabilities of the aqueous chloride process to handle the increased quantities of chloride residues that will result from the work off of legacy waste under the 94-1 Residue Stabilization Program. Caustic process liquids are transferred to the TA-50 RLWTF, Room 60, for final processing via the caustic waste line.

Caustic waste has a high radioactive content; it contains both Plutonium and Americium isotopes and the average concentration is 4.5×10^{-6} Ci/L. There are no data on concentrations of non-radioactive constituents of the caustic waste.

Table 3-6 summarizes the expected production of caustic waste over the next 5 years. The maximum case assumes that successful implementation of the TRU-CLEAR process starting in FY06 (the CLEAR process will dramatically decrease the rad loading of the discharge but will increase the volume of discharge), that Pu-238 processing resumes full processing levels by November 2004, that the 94-1 vault workoff will accelerate to an eight-year program ending in 2011, and the pit production program will increase caustic operations to the current capacity of Rm. 420.

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

The results of the max and min analysis for caustic waste are shown in Table 3-6.

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

Table 3-6. Caustic Waste Forecast

The caustic waste forecast is shown in Figure 3-7 below. This waste is exclusively NMT waste and so no organizational data tables are appended to the chart.

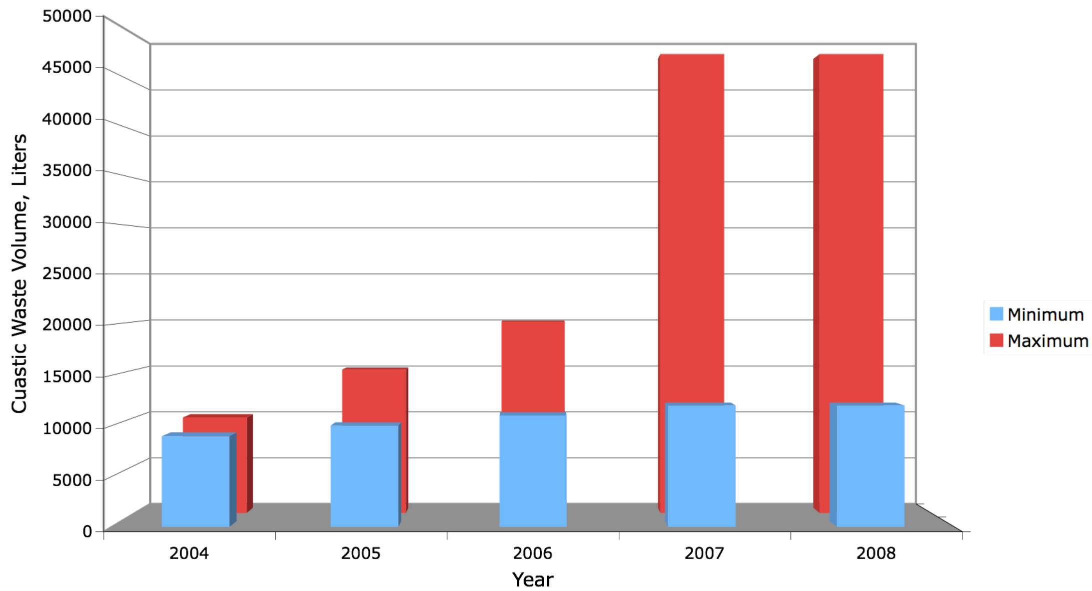


Figure 3-7. Caustic waste volume forecast

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 the addition of NaOH. The total effluent is increased because of the addition of neutralizing NaOH. Programs and projects that produce acid waste include:

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

The (MO_X) program is the largest producer of acid waste. The average concentration of radioactive components in acid waste is 6 x 10^{-5} Ci/l. The principal radioactive components in the acid waste are isotopes of Pu and Am. The non-radioactive components of the acid waste are tabulated below in Table 3-7.

Constituent	Concentration (mg/L) [a]
Chloride	667
Nitrate-N	43,300
Nitrite-N	14
Normality	5.2
Sulfate	284

Table 3-7. Non-radioactive components of acid waste

The acid waste stream is expected to remain nearly constant in FY04 and then increase dramatically beginning in FY05 as the MO_X program resumes at potentially two to 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. Use of existing metal will have no effect and processing of new metal in the oxide–to-metal line could be linear in its effect on acid waste. The metal may, of course come from both sources and the effect would then depend on the ratio of metals.

The Nitric Acid Recycle System (NARS) is likely to be completed in FY05 as well. Two things have to happen for the NARS acid to be more widely used in PF-4: it must be shown that recycled acid can be used in the MO_X program and 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 greatly reduced or eliminated. Table 3-4 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 Nitric Acid Recycle (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.

Table 3-8. shows the results of the forecast for the acid waste discharge to RLWTF.

Year	Acid Waste Volume Liters, Maximum	Acid Waste Volume 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

Table 3-8. Acid Waste Forecast

Figure 3-8 presents the acid waste projections in graphic format. . This waste is exclusively NMT waste and so no organizational data tables are appended to the chart.

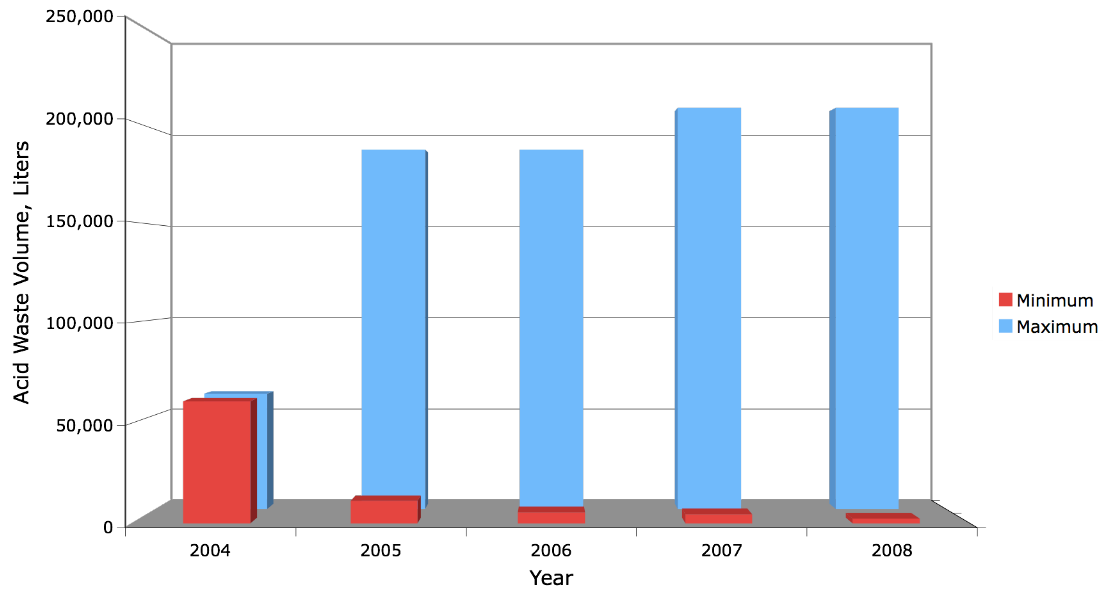


Figure 3-8. Acid Waste Volume Forecast

3.2.5.3 Total RLW Projection

The industrial/low level line forecast was combined with the acid and caustic forecasts and a total RLW forecast produced. This forecast predicts maximum and minimum discharges based on current information and on the range of possible discharge volumes. The details of the projection are presented in Appendix C.

Figure 3-9 presents the predicted maximum and minimum RLW volumes through FY08 as well as the volumes for the past five years.

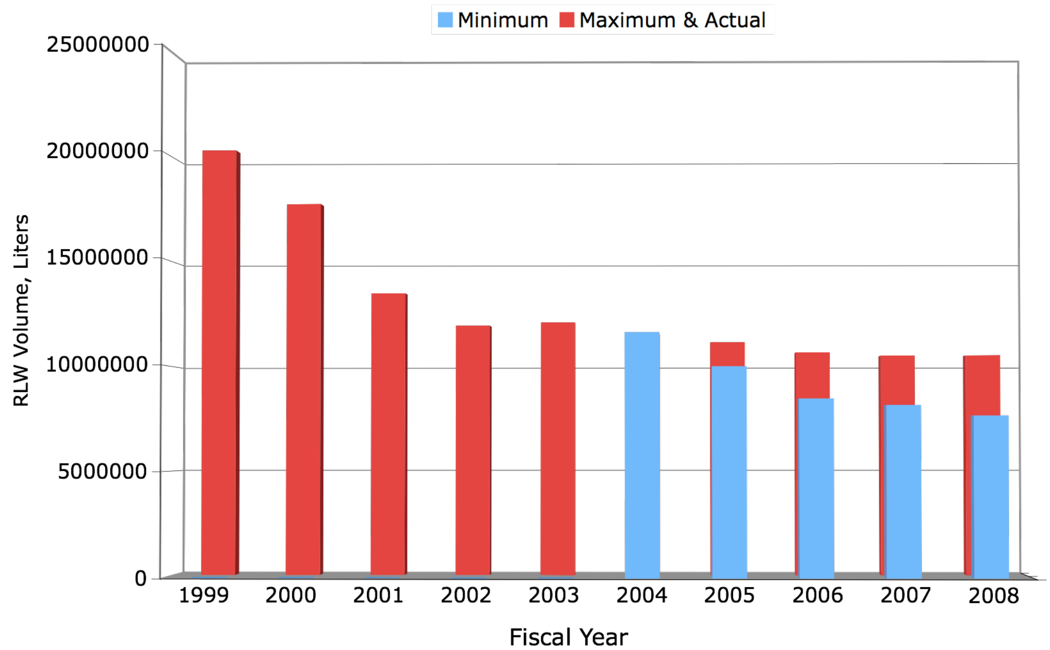


Figure 3-9. Total RLW Forecast

3.2.6 Analysis

It appears likely that P2 projects will reduce the RLW volumes by about 2M l/yr over the next two to four years. If the assumptions associated with the maximum forecast are accurate, the volumes will stabilize at around 10 -11 M l/yr. If the minimum case assumptions materialize the volume will be reduced to approximately 7 M l/yr. This depends critically on the success of the reduced duct washdown project at TA-48. In either event the volumes stabilize in the out years. This is not to say that the volumes cannot be reduced further. P2 projects have the potential to sharply reduce RLW flows below the 7M l/yr level, however, none are currently planned for the years beyond FY03-06.

Depending on future processing plans at the RLWTF it may not be desirable to reduce influent flows from the industrial/low level waste line too much. If RLWTF continues to use the reverse osmosis/ultrafiltration scheme, reducing flows is much less desirable since the larger industrial/low level waste water flows can be used as diluents prior to processing. If the RLWTF implements a dedicated evaporator as its primary treatment option, then it is desirable to reduce influent flows as much as possible. Decisions regarding influent reduction must consider future treatment options.

Superficially, it would seem that the current facility and strategy for collecting and treating RLW is adequate. In the recent past, the facility has handled ~20 million liters of RLW, about twice the current volume. The ~20 million liters was processed in a regulatory environment far different from the present environment. With today's more stringent regulatory requirements, the facility is only marginally adequate for current volumes and could operate at former volumes only with very great difficulty. It is questionable whether environmental compliance of the RLWTF effluent can be maintained in an aging, inflexible facility in an increasingly stringent regulatory environment, even at current volumes. The inflexible space at the present RLWTF will not accommodate process upgrades easily.

In addition, although the volume of acid and caustic wastes is small in comparison to the total, these waste streams account for about two-thirds of the radioactivity at the RLWTF. These streams are processed in a separate facility, Room 60, which has very limited throughput capability. Current acid waste discharge to the RLWTF has reached the limit of the Room 60 capability, and any further increases could well impact programmatic schedules.

Other issues at the RLWTF are related to the age of the facility. Maintenance costs are increasing, and waste treatment occurs in more than a dozen rooms on multiple levels, leading to operational complexity and inefficiency at the 40-year-old TA-50-01 facility. In addition, operational concerns exist with the existing facility, such as potential concerns resulting from the use of underground single-walled pipes and tanks, outside operation of the evaporator, and over-road shipping of evaporator bottoms from TA-55. The plant has performed well over the years and does a good job of waste treatment, however it is in need of reinvestment to sustain its reliability over the longer term.

3.3. LOW-LEVEL WASTE

3.3.1. Definition and Scope

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

3.3.2. Historical Trends

The average generation of LLW over the past 9 years has been 3197 m^3/yr. The total volumes have been fluctuating sharply for the past decade, primarily because environmental remediation (ER) activities vary year-to-year and the non-routine and ER LLW volumes show a pronounced increase in years in which there are enhanced remediation activities. Total LLW generation is driven by non-routine and ER wastes.

The FY02 Waste Volume Summary predicted a LLW generation of 10.826 m^3 in FY03. The actual generation was 5,172 m^3. The over prediction was 109% and arose because scheduled construction work at TA-50 was shifted from FY03 to FY04.

The historical trends in total LLW generation are shown in Fig. 3-10.

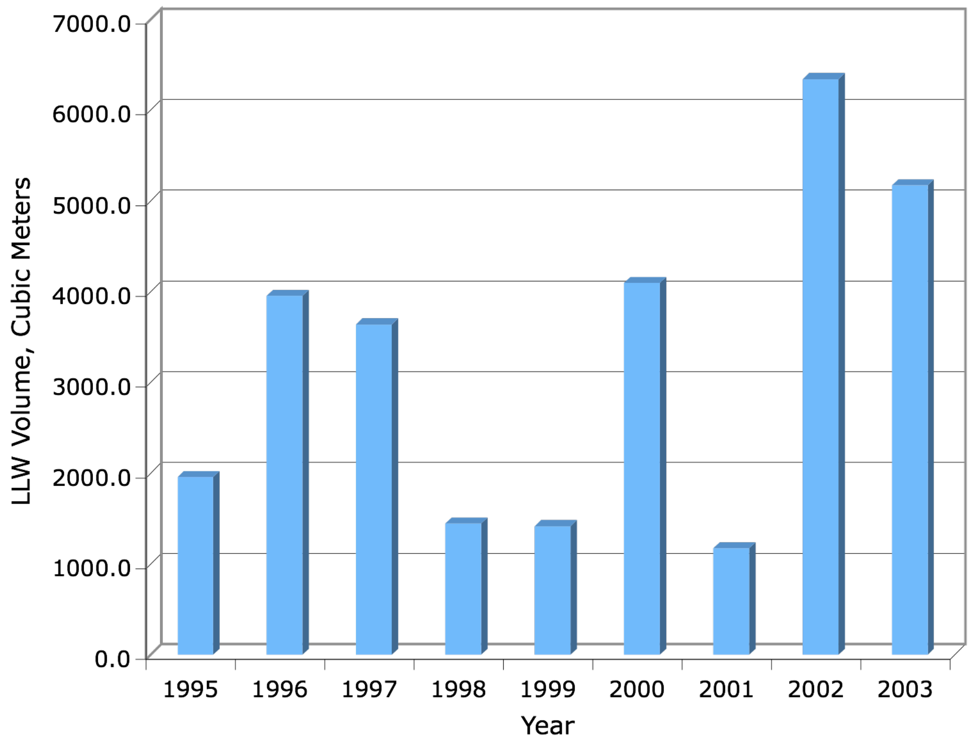


Fig. 3-10. Historical LLW generation

3.3.3. Low-Level Waste Generation by Type

LLW falls into four broad categories. These categories are construction waste, decommissioning and demolition waste, environmental restoration waste and operational waste. It is difficult to differentiate construction waste from D&D waste when they are sent to TA-54 or off-site for disposition. Therefore these two waste types are combined in the waste management database. Combining these two waste types in the database means that while we can project generation of construction and D&D waste separately we cannot report the historically generated waste volumes separately. In the following discussion of historical waste generation, construction waste has been included with D&D waste. The resulting categories are:

- Decommissioning and Demolition Waste. This is waste generated by decommissioning, deactivating and demolishing structures. FWO division generates the D&D waste. This category also includes construction waste.
- Environmental Restoration Waste. The environmental restoration activities at the Laboratory generate LLW, usually in the form of lightly contaminated bulk soils. RRES division generates this waste.
- Operational Waste. The LLW generated during Laboratory operations is packaged and sent to TA-54 for disposition. Several divisions generate operational waste.

The relative quantities of each waste type for FY 2003 are shown in Figure 3-11.

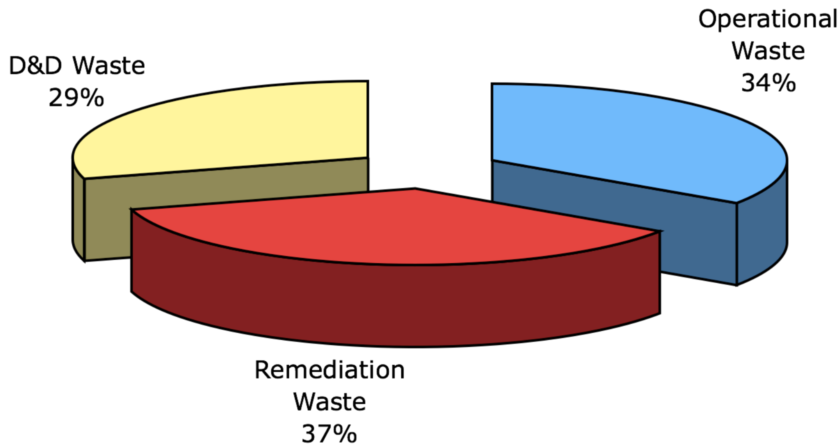


Figure 3-11. LLW generation by type

3.3.4. Operational LLW by Division and Program

NMT, RRES, FWO, DX, C and ESA divisions produced the majority of LLW at LANL in FY03. Other divisions, including B, EES, HSR and LANSCE divisions, produced small quantities of LLW. This generation of LLW by division is shown graphically in Fig. 3-12.

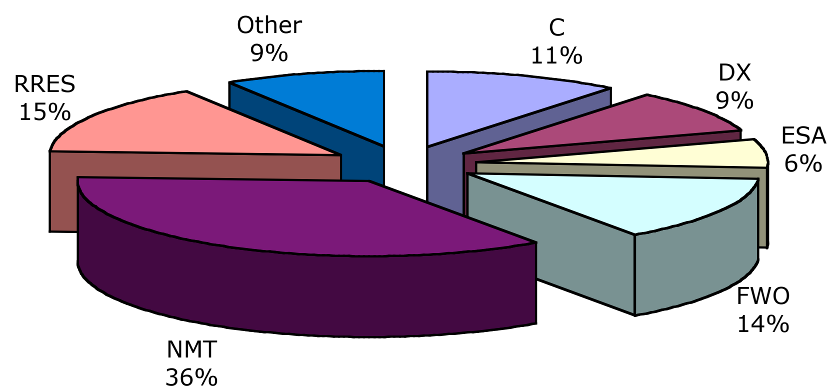


Fig. 3-12. Operational waste from LLW-generating divisions.

The C division LLW has in past years been quite small, averaging about 15m^3. The relatively large quantity of C division LLW generated in FY03 is due to a one-time event that generated large volumes of contaminated soils. The future generation of LLW by C division is expected to be near the historical average.

DX division waste generation increased in FY03 and is likely to more than double in outyears. The DX division LLW is being generated by hydrotest containment and debris. Hydrotests produce debris that contains both Beryllium and depleted Uranium (DU). This waste is trapped in a foam matrix and because of the DU component is classified as LLW. However since the matrix also contains Beryllium it cannot be compacted and thus large volumes of LLW are generated with each hydrotest.

3.3.5. Key Programs/Projects

Key programs/projects that were responsible for generating LLW during FY03 have been identified and are described in Table 3-9.

Table 3-9. LLW Generation by Division and Project

Organization	Program/Project	Volume FY03 (m^3)	Percentage
D&D Waste			
FWO	various FMUs	**1520.2**	**29%**
Remediation Waste			
RRES	Environmental Remediation	**1876.8**	**37%**
Operational Waste			
NMT-1	AAC	38.0	
NMT-2	Nuclear Material Stabilization and Packaging	53.2	
NMT-2	Actinide Processing and Recovery	22.8	
NMT-5	Pit Fabrication	82.3	
NMT-9	^{238}Pu Operations	5.7	
NMT-9	^{238}Pu Heat Sources	13.3	
NMT-6, 11	Pu R&D Support	96,3	
NMT-11	EM Technology Support	25.3	
NMT-11	Energy Programs	5.1	
NMT-15	Material Disposition	28.5	
NMT-15	Nonproliferation Technologies	3.2	
NMT-16	Pit Surveillance	44.3	
NMT-3,4,7,8,13	Infrastructure	215.3	
	NMT Subtotal	**633.3**	**12%**
RRES-AT	Nuclear Material Characterization	187.6	
RRES-AT	Other	82.5	
	RRES Subtotal	**270.1**	**5%**
FWO-SWO	Solid Waste Operations	213.7	
FWO RLWTF	Radioactive Liquid Waste	35.1	
	FWO Subtotal	**248.8**	**5%**
C-INC	Contaminated soil	162.0	
Various C Div. groups	Lab Trash	30.3	
	C Subtotal	**192.3**	**4%**
DX-4	Dual-Axis Radiographic Hydrotest Facility	101.6	
DX-2	Hydrotest debris	62.3	

	DX Subtotal	**163.9**	**3%**
ESA	Various Projects	109.3	**2%**
Other Projects	Various	157.0	**3%**
	Total	**5171.9**	**100%**

3.3.6. Forecast

Total LLW generation is predicted to remain volatile over the next 5 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 substantial higher in FY05 and FY08 with peak activity occurring in FY05.

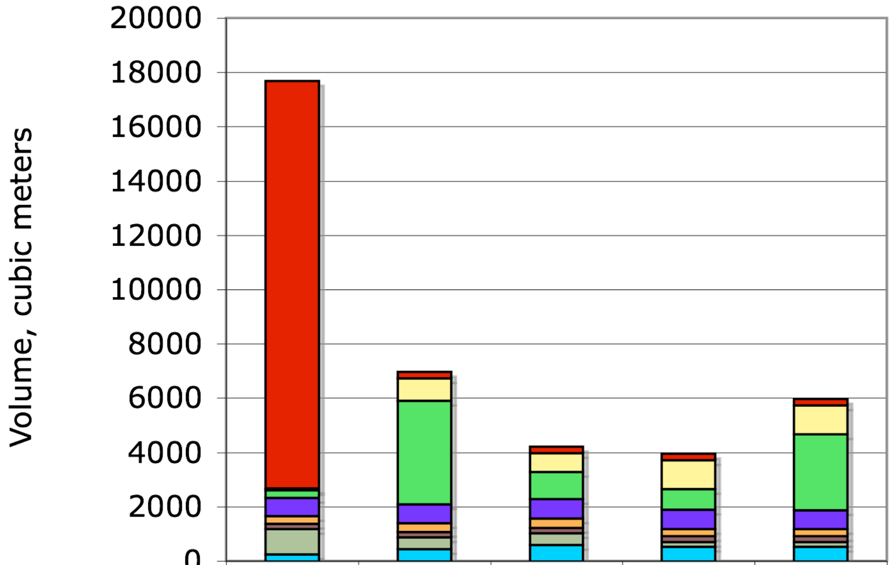
There are several D&D projects that are expected to generate relatively large quantities of LLW. These include the D&D of PHERMEX and potentially RLWTF.

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 and maintenance and possibly eventual D&D. The stabilization activities will generate ~ 380 m^3 of LLW total over FY 05 and FY06.

D&D of the RLWTF facility, 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.

In FY04 construction waste will be the largest single contributor to the total LLW generation. Construction of a tank farm at the RLWTF at TA-50 will result in the removal of ~ 15,000 m^3 of contaminated and potentially contaminated soil. The removal of potentially contaminated soil during construction will be a contributor in the future but is difficult to accurately forecast. Some construction will take place on or around Special Waste Management Units (SWMUs), areas that are legacy contaminated. It is not possible to identify the SWMUs until siting has taken place. SWMU identification typically takes place rather late in the construction process; usually in the year construction begins. There are nocontaminated sites identified with planned construction beyond FY04 but an average value of 250 m^3/yr. was assumed in the outyear projections.

Figure 3-13. presents the predicted maximum LLW volumes, by organization or activity, through FY08.



	2004	2005	2006	2007	2008
Total, cubic meters	17670	6971	4209	3952	5969
Construction	15000	250	250	250	250
D & D	71	815	693	1063	1063
Remediation	270	3817	986	756	2783
NMT	689	708	721	718	702
FWO	274	310	335	259	255
RRES	200	205	210	220	230
DX	920	425	425	175	175
Others	246	442	590	512	511

Year

Fig 3-13. LLW generation forecast.

The five-year forecast is subject to variations arising from a number of sources, such as funding, programmatic and schedule uncertainties. These uncertainties render the forecast LLW volumes imprecise. To represent the imprecision, the maximum and minimum volumes of LLW have been predicted for the next five years and are presented in Figure 3-14 along with actual volumes for the past five years.

The maximum projection assumes that the CMR legacy equipment cleanout will be funded for the years FY05 – FY08 and that 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 so for the next five years the maximum case is represented by the R&R case.

The maximum case also assumes that the Remediation baseline underestimates the real waste volume by a factor of 2.5, which is the historic factor by which Remediation has exceeded their baseline projections. The minimum case assumes the baseline projections are correct.

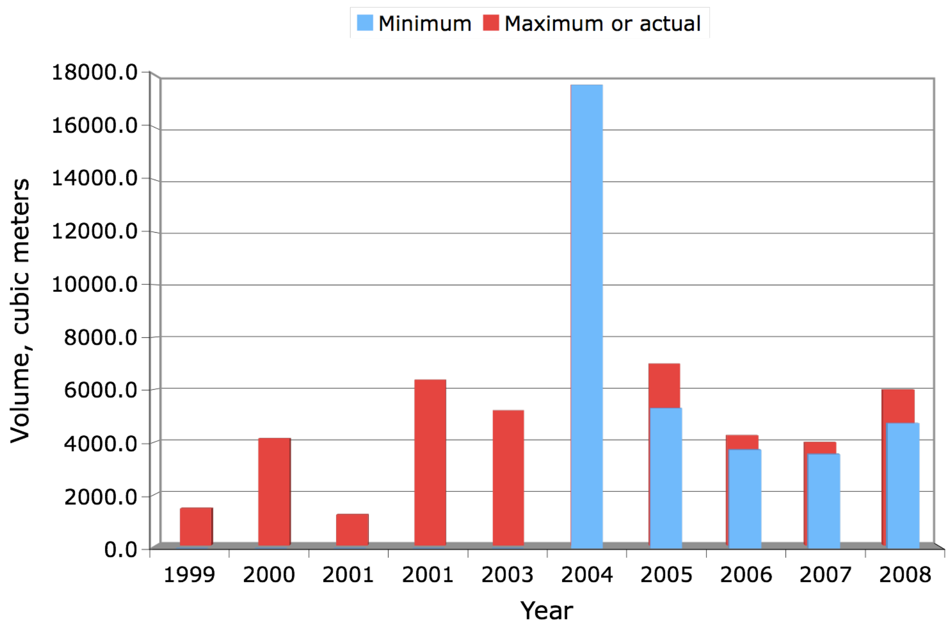


Figure 3-14. LLW generation forecast

3.3.7. Analysis

Solid LLW generated by the Laboratory's operating divisions is characterized and packaged for disposal at the on-site 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, largely lightly contaminated soils, and can be disposed of at the Envirocare site in Utah or at NTS. Because the 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 on-site 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. This would mean sending most of the LLW to Envirocare for disposal. the primary issue with shipping lower-activity LLW off site for disposal is cost.

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

3.4. MIXED LOW-LEVEL WASTE

3.4.1. Definition and Scope

For waste to be considered MLLW, it must contain Resource Conservation and Recovery Act (RCRA) materials and meet the definition of radioactive LLW. LLW is defined as waste that is radioactive and is not classified as 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 L operating permit, the Federal Facility Compliance Order/Site Treatment Plan provided by the New Mexico Environment Department (NMED), and the EPA.

3.4.2. Historical Trends

The average generation of MLLW over the past 10 years has been 80.1 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. MLLW historical generation rates are shown in Fig. 3-15. The MLLW produced at the Laboratory falls into two categories operational waste and bulk waste. Most of the operational MLLW, both routine and non-routine, results from stockpile stewardship and management and from R&D programs. The bulk MLLW results from ER and D&D operations and is generally in the form of contaminated soils and rubble. In FY03 the bulk MLLW was composed exclusively of D&D waste. The relative magnitudes of the MLLW types are shown in Figure 3-16.

The FY02 prediction for MLLW generation in FY03 was 25 m^3. The actual generation was 32 m^3, an under prediction of 28%. The error arose because the prediction did not properly account for FWO D&D activities in FY03.

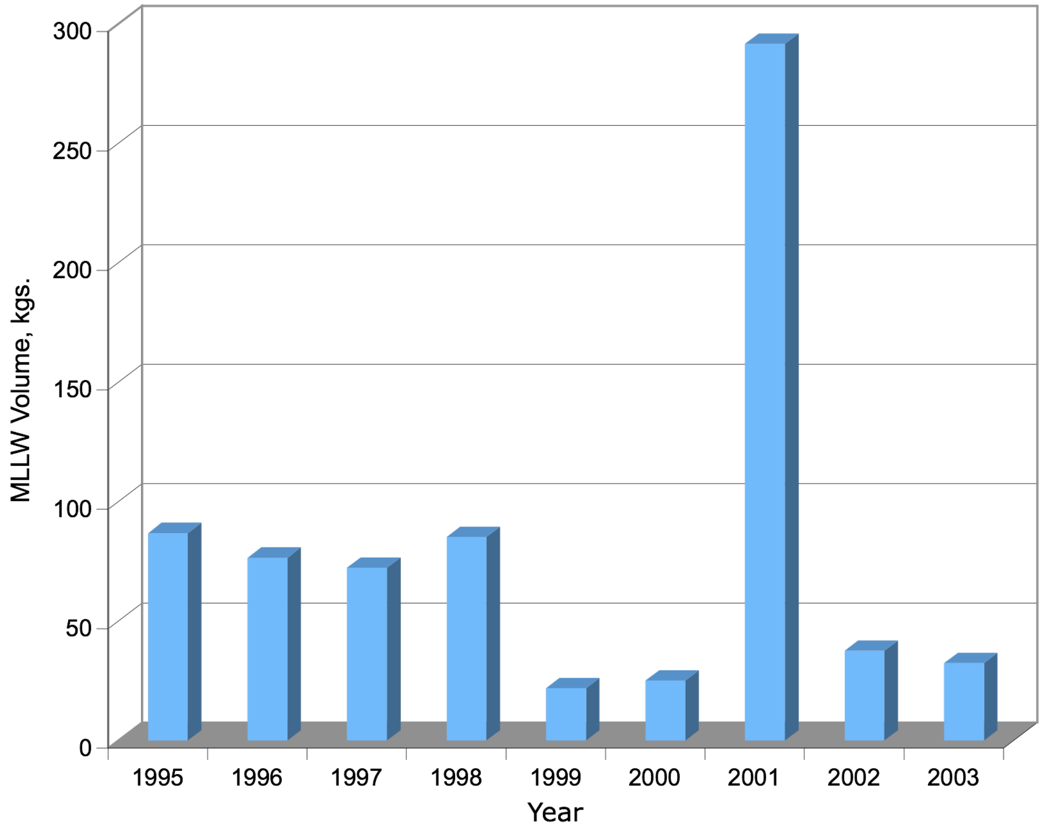


Fig. 3-15. MLLW historical generation.

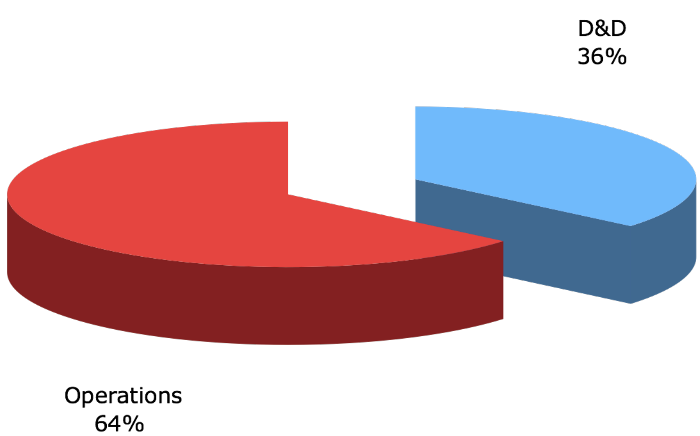


Fig 3-16. Types of MLLW

3.4.3. Generator Divisions

FWO, NMT, RRES and ESA are the key divisions responsible for generating most of the MLLW waste at LANL. Other divisions generate small volumes, generally < 1 m^3. These divisions typically include ESA, DX, C, Project Management (PM), and Earth and Environmental Sciences (EES) (see Fig. 3-17).

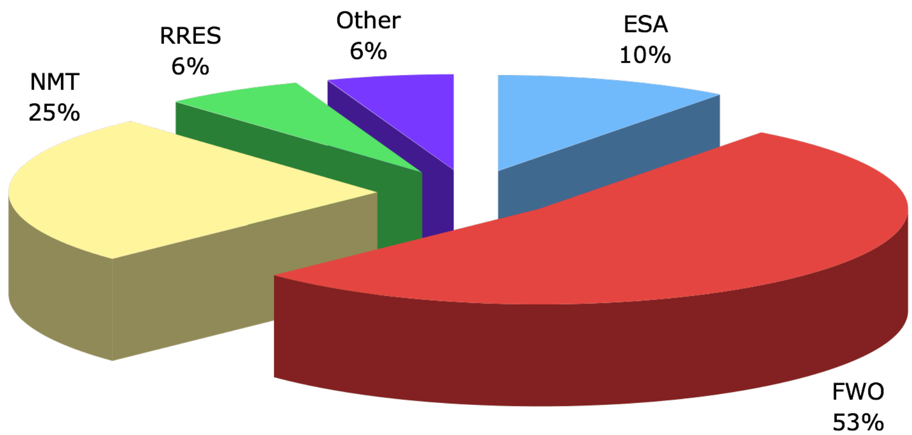


Fig. 3-17. MLLW generator divisions.

3.4.4. Key Programs/Projects

Key programs/projects that were responsible for generating operational MLLW during FY03 have been identified and are described in Table 3-10. FWO Division generated all D&D MLLW. Most of the MLLW generated in FY03 consisted of contaminated electronic components containing lead or lead/silver solder, contaminated copper pipe with lead solder and contaminated fluorescent bulbs. The preponderance of the waste was non-routine and resulted from cleanout or facility reconfiguration activities.

Table 3-10. MLLW Generation by Division and Program

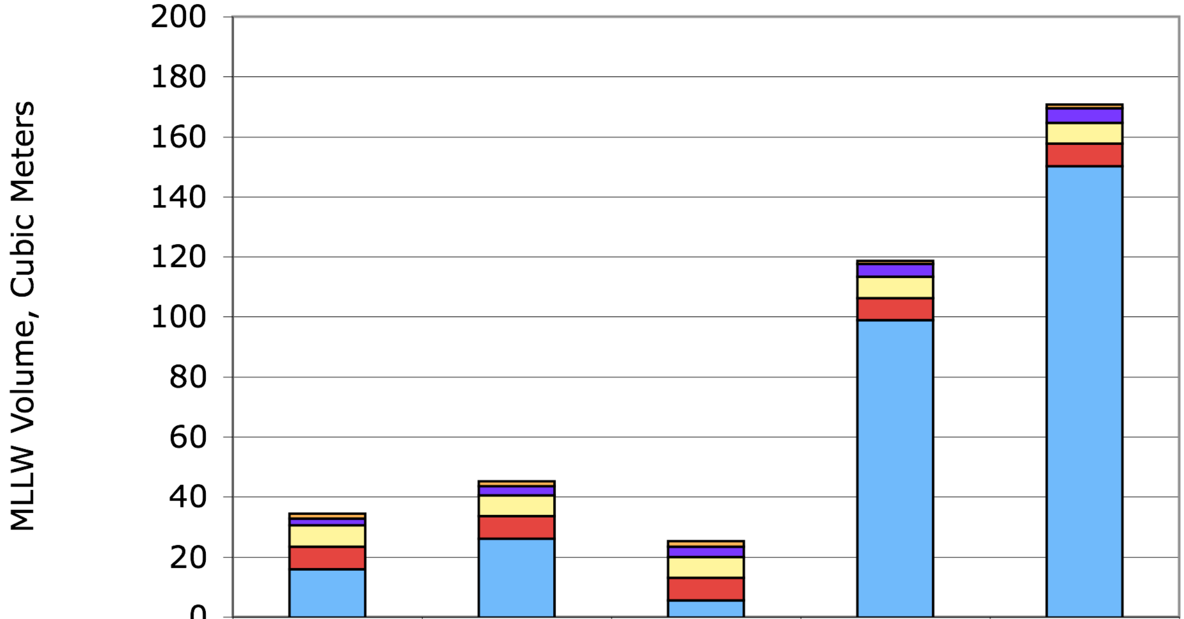
Organization	Program/Project	Volume FY03 (m^3)	Percentage
D&D Waste			
FWO	various FMUs	11.7	**36%**
Operational Waste			
RRES-AT	Electronics Sort and Segregate	0.4	

RRES-WDS	Electronics	0.8	
	RRES Subtotal	**1.2**	**4%**
NMT-7	Waste Management	3.7	
NMT-11	Actinide Chemistry R&D	1.4	
NMT-13	CMR Facilities Operation	0.1	
NMT-16	Nuclear Materials	0.1	
	NMT Subtotal	**5.3**	**16%**
FWO-WFM	Facilities Management	8.8	
FWO-East	Offsite Waste	1.7	
FWO-IP	Infrastructure Projects	0.4	
	FWO Subtotal	**10.9**	**34%**
ESA-TSE	Routine Maintenance Debris	2.1	
	ESA Subtotal	**2.1**	**7%**
Other (Various Divisions)	Various Projects	1.2	
	Other Subtotal	**1.2**	**3%**
	Total	**32.4**	**100%**

3.4.5. Forecast

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 3-18 presents the predicted MLLW volumes through FY08 by division.



	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

Figure 3-18. MLLW volume forecast by Division

Forecast of waste generation is by nature uncertain and that is particularly true of non-ER MLLW generation. The non-ER volumes are so small that even a moderate sized spill in a contaminated area could easily double the total non-ER generation. Because the forecast is problematic, maximum and minimum volumes have been predicted. The forecast MLLW maximum and minimum waste generation for the next five years, along with the actual waste generation for the past five years is presented in Figure 3-19.

3.4.6. Analysis

Routine MLLW is generated in radiological control areas (RCAs). Hazardous materials and equipment containing RCRA materials, as well as MLLW materials, are introduced into the RCAs as needed to accomplish specific activities. In the course of operations, hazardous materials become contaminated or activated and are designated as MLLW when they reach the end of their useful life 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 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 WM and Department of Transportation 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.

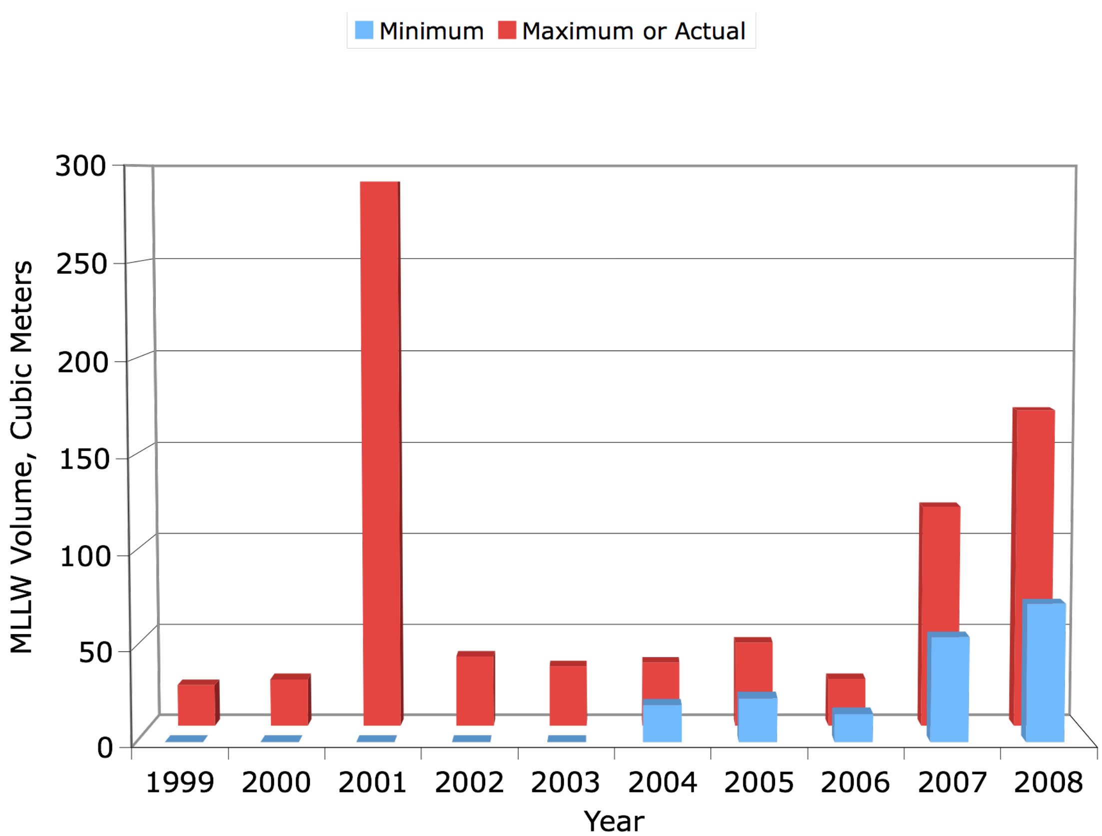


Figure 3-19. Maximum and minimum MLLW forecast

3.5. CHEMICAL/HAZARDOUS WASTE

3.5.1. Definition and Scope

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, LANL 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 NMED, define hazardous waste as any solid 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.

Non hazardous chemical waste is chemical waste that is not hazardous waste, as defined above, but which fails to meet the waste acceptance criteria for sanitary landfill burial or sanitary wastewater treatment. It is disposed of as hazardous waste.

3.5.2. Historical Trend

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 bulk waste generated by ER, D&D, and construction activities dominates the total chemical/hazardous waste generation, 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.

The historical generation rate for chemical/hazardous waste is shown in Fig. 3-20.

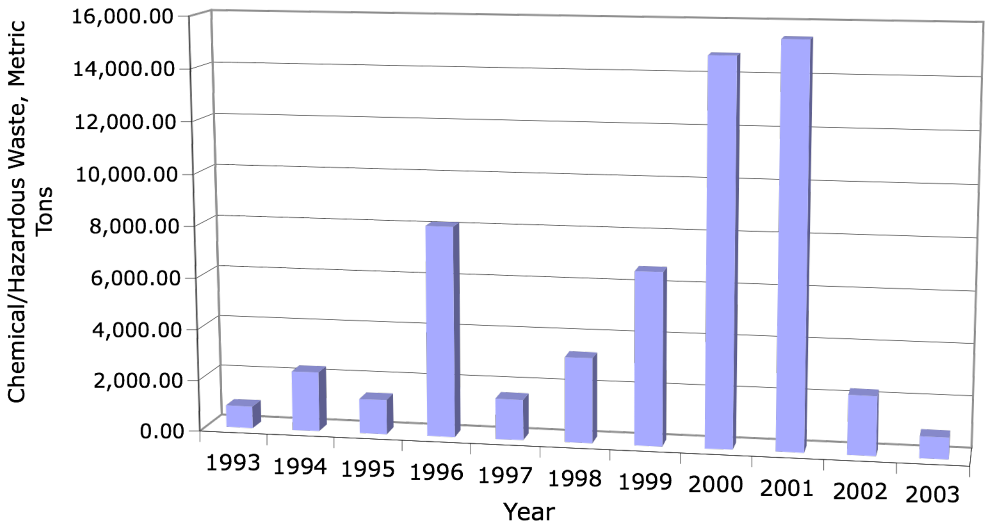


Fig. 3-20. Chemical/hazardous historic waste generation

Last year's prediction for FY03 chemical/hazardous waste generation was 595,501 kgs. The actual generation was 834,513 kgs. Most of the difference comes from unanticipated removal of legacy contaminated soil at a newly discovered contaminated site at TA-48. The under prediction was about 40% Without the C Division contaminated soil the prediction would have been about 15%. Chemical/hazardous waste generation increased in nearly every Division in FY03, in some Divisions by a factor of 3 or 4.

3.5.3. Generator Divisions

3.5.3.1. Bulk Chemical/Hazardous Waste

RRES and FWO are the key divisions responsible for generating most of the high volume chemical/hazardous waste at LANL (see Fig. 3-21). These two divisions produce 96% of all chemical/hazardous waste generated at LANL. Most of the RRES waste is in the form of lightly contaminated soils generated by environmental remediation. About 90% of the remediation waste is non-hazardous waste, such as drilling cores, that fail to meet the waste acceptance criteria for landfill burial. The FWO waste is composed mainly of asbestos waste from the demolition of Omega-West reactor and non-hazardous sludges generated yearly at the sanitary wastewater plant.

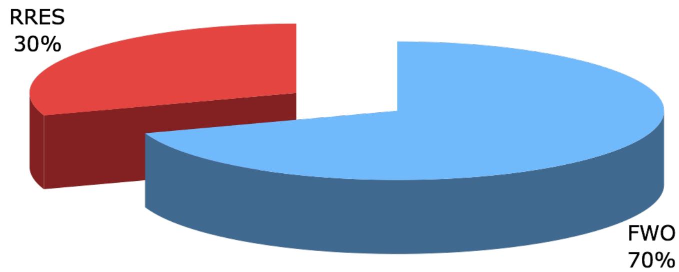


Fig. 3-21. Bulk chemical/hazardous waste generator divisions.

3.5.3.2. Other Chemical/Hazardous Waste

Other chemical/hazardous waste is generated in the course of Laboratory operations, including routine, nonroutine, and nonhazardous chemical waste. For the purposes of this discussion, these three types of lower volume chemical/hazardous waste have been aggregated.

The Laboratory generates hazardous and nonhazardous chemical waste as a result of research, development, and related operations. These wastes are usually generated at much lower volumes than the bulk wastes discussed previously. A total of 19 divisions produce such waste. The principal generators of this chemical/hazardous waste are ESA, MST, ESH, P BUS, C, and DX divisions, as shown in Fig. 3-22.

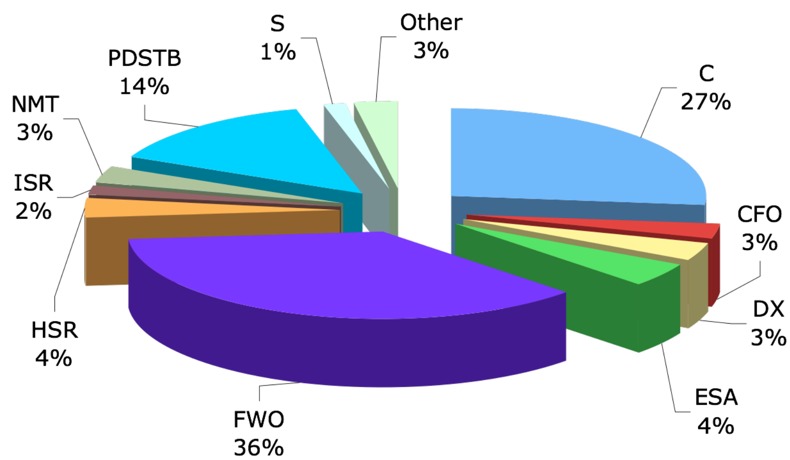


Fig. 3-22. Other chemical/hazardous waste generator divisions

3.5.4. Key Programs/Projects

3.5.4.1.Bulk Waste

Key programs/projects that were responsible for generating bulk chemical/hazardous waste during FY02 have been identified and are described in Tables 3-11 and 3-12.

Table 3-11. Bulk Chemical/Hazardous Waste by Division and Project

Organization	Program/Project	Weight FY03 (kg)	Percentage
RRES-R	Environmental Remediation	32,730.9	
	RRES Subtotal	**32,730.9**	**30%**
FWO-IP	Infrastructure Maintenance and Upgrades	67,854.7	
FWO- WFM	Aggregation of New Mexico Special Soils	7,227.3	
	FWO Subtotal	**75,082.03**	**60%**
	Total	**107,792.9**	**100%**

3.5.4.2.Other Chemical/Hazardous Waste

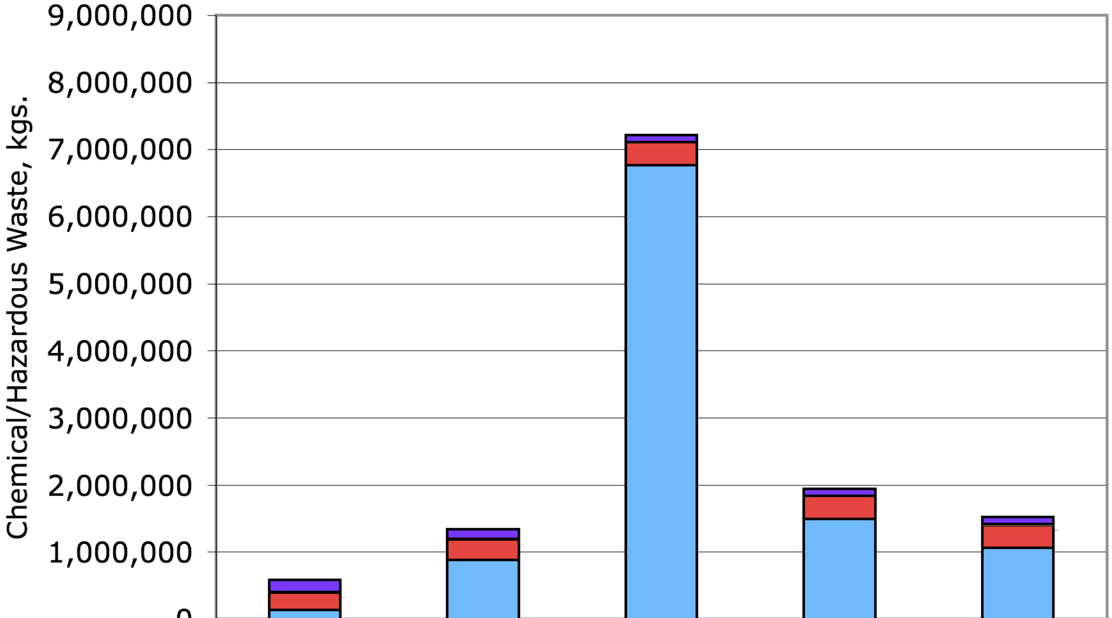
Nearly all divisions at the Laboratory generate chemical/hazardous waste. Specific programs generate some of this waste, but much of the waste is not traceable to specific program activities. For this reason, the non-bulk chemical/hazardous waste has been aggregated by division and not by program. The aggregated totals are shown in Table 3-12.

Table 3-12. Other Chemical/Hazardous Waste by Division

Organization	Program/Project	Weight FY03 (kg)	Percentage
FWO Division			
	FWO Subtotal	266,067.0	36%
ESA Division			
	ESA Subtotal	31,011.6	4%
DX Division			
	DX Subtotal	25,088.1	3%
CFO Division			
	CFO Subtotal	19,147.5	3%
C Division			
	C Subtotal	194,487.3	27%
S Division			
	S Subtotal	10,082.0	1%
DSTBP Office			
	DSTBP Subtotal	101,809.1	14%
NMT Division			
	NMT Subtotal	20,922.1	3%
ISR Division			
	ISR Subtotal	11,462.8	2%
HSR Division			
	HSR Subtotal	26,313.0	4%
Other Divisions			
	Other Subtotal	20551.1	3%
	Total	726,721.6	100%

3.5.5. Forecast

With the exception of FY99 and FY03, the generation of non-bulk chemical/hazardous waste has been steady over the last few years (back to FY96), and that 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 Figure 3-23.



	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

Figure 3-23. Forecast chemical/hazardous waste generation

The five-year forecast is subject to variations arising from a number of sources, such as funding, programmatic and schedule uncertainties. These uncertainties render the forecast chemical/hazardous waste quantities imprecise. To represent the imprecision, the maximum and minimum quantities of chemical/hazardous waste have been predicted for the next five years and are presented in Figure 3-24 along with actual volumes for the past five years.

The maximum projection assumes that the C-Division legacy chemical cleanouts are division wide and 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 baseline underestimates the real waste volume by a factor of 2.0, which is the historic factor by which Remediation has exceeded their baseline projections. The minimum case assumes the baseline projections are correct.

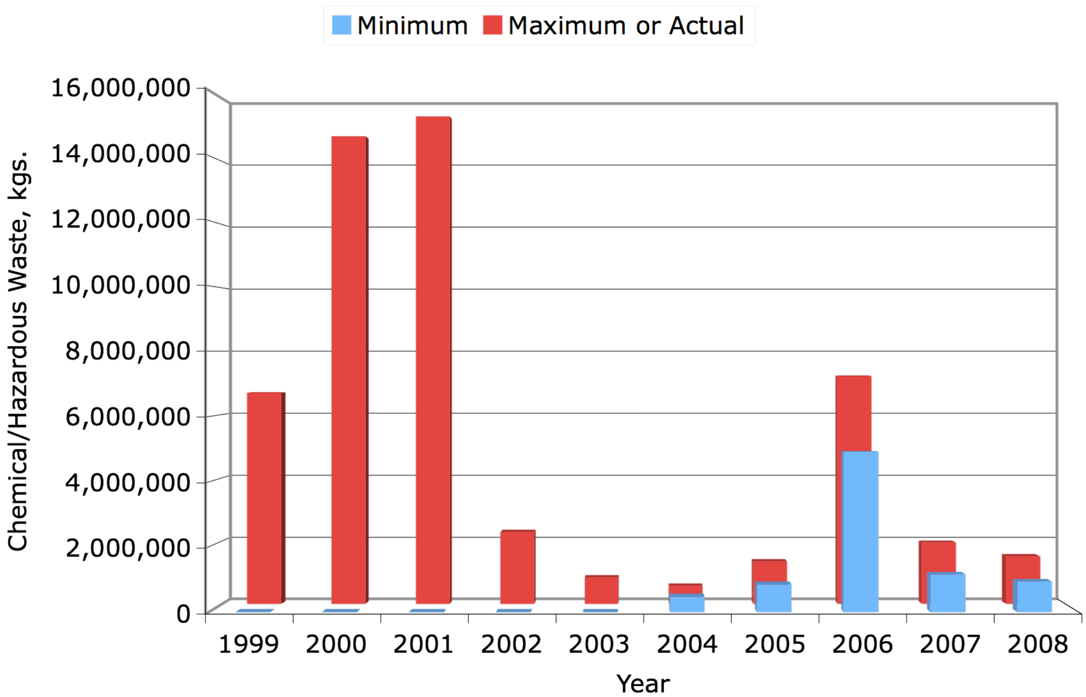


Fig. 3-24. Maximum and minimum waste forecast.

3.5.6. Analysis

Chemical/hazardous waste was previously stored onsite at Area L, TA-54, to await off-site 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 be accumulated for up to 90 days before direct shipment off site for disposal. 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. There is no foreseeable impact to Area L from chemical/hazardous waste volume increases. 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.

APPENDICES

Appendix A. Methodology

For each waste type, an FY03 waste volume was determined. The waste volumes were then further divided among the various programs that generated each particular waste type. The data for this waste determination were obtained from the SWOON database, division WM coordinators and waste operations team leaders. These data form the baseline for the 5-year projections. These baseline data then were reviewed and validated by division management and project leaders, as appropriate. Once the baseline data were validated, the group management was asked to project funding for the next 5 years. Although these projections will become more speculative in the out years, they represent the best thinking of those responsible for planning future and continuing projects. The projected budget changes then were converted to multiples of the current budgets called delta factors. The delta factors then were used to multiply the baseline waste volumes to obtain estimates of out-year waste volumes. This process implies a linear relationship between budget and waste generation. Although that assumption is probably accurate to the first order, serious caveats to the assumption exist. The assumption does not include known changes within programs; for example, the NMT 10-year vault work-off program will be processing high-curie "aged" metal and the waste volumes will necessarily increase per unit of processed metal relative to newly generated waste. The linear assumption does not account for planned reductions in waste due to minimization activities. For example, the NMT NARS will be expanded to include most of the PF-4 operations; thus, acid waste is expected to drop to very low values in the next few years. Nevertheless, the linear-budget/waste-volume relationship is a good first estimate.

Appendix B. TRU Waste

This appendix presents the data supporting the 5-year TRU waste volume forecast.

The solid TRU waste baseline for the 5-year projections is the waste generation profile for the first nine months of FY04. The NMT waste management coordinators felt that the FY 04 profile would more accurately represent the TRU waste going forward than the historic waste profiles. This waste profile is substantially different from the profile used last year and is organized somewhat differently. It emphasizes programs rather than groups because many NMT programs involve several groups. The data is displayed in Table B-4.

The FWO TRU waste generation arises from the operation of RLWTF and is therefore tied directly to NMT activities. To project the FWO TRU volumes, RLWTF personnel projected future wastes relative to the FY03 baseline, including known process changes and waste minimization efforts. The projected FWO TRU waste generation rate is presented in Table B-1.

Year	RLWTF Projection, m^3
2002	4.5
2003	4
2004	5
2005	6
2006	6
2007	6
2008	6

Table B-1. Projected FWO Division TRU Waste Generation

The ER project and the Off-Site Source Recovery Project (OSRP) generate RRES Division TRU waste.

RRES also is engaged in repackaging TRU waste for shipment to WIPP; however, this waste is not newly generated. The repackaging results in the generation of a small secondary TRU waste stream and an increase in the volume of TRU waste because the density is lowered for shipment. The repackaging volume expansion requires storage for a few months but has no long-term impact on storage capacity. The repackaged waste is included in the total because it does require interim storage.

The RRES project 2010 is a project to retrieve legacy TRU waste buried at TA-54 for characterizing, processing, and repackaging for shipment to WIPP. Very large quantities of TRU waste are involved in this retrieval operation. However, the project is not expected to greatly impact the availability of aboveground storage because the material will be retrieved only as storage becomes available. Storage capacity is expected to increase because of the transfer of previously stored materials to WIPP. The schedule for RRES-2010 is flexible; if necessary, it can be delayed beyond FY05 or extended beyond FY07. The actual schedule will be contingent on the rate at which the storage volume becomes available. Although the RRES-2010 project impact is expected to be small, the project totals are included in the overall projections because these large volumes will have to be accommodated by shipment of previously stored materials to

WIPP and because the resource load imposed by retrieval of such large volumes of waste is increased.

The total RRES TRU waste generation by year, as maxima and minima, is shown in Table B-2. The RRES Environmental Remediation project baseline projection and the 2010 project are projected to generate substantial quantities of TRU waste. In the maximum case the remediation waste volume is multiplied by 2, the historical factor by which remediation waste exceeds baseline projections. The Project 2010 waste retrieval is assumed to start in FY05 and the Quick-to-WIPP repackaging is assumed to result in a volume expansion of 80 m^3. In the minimum case, the remediation waste is the baseline forecast, Project 2010 begins in FY06 and the Quick-to-WIPP volume expansion is 80 m^3 over a two year period.

Year	RRES TRU Volume, m^3, Miaximum	RRES TRU Volume, m^3, Mimimum
2004	80	40
2005	437	40
2006	873	442
2007	891	887
2008	82	904

Table B-2. RRES-ER TRU Waste Forecast

The RRES-OSRP TRU waste generation by year, as estimated by L. Leonard (RRES-OSRP), is shown in Table B-3.

Year	OSRP Volume, m^3
2003	77
2004	22
2005	20
2006	20
2007	10
2008	5

Table B-3. RRES-OSRP TRU Waste Forecast

Because there are substantial uncertainties in the NMT TRU waste volume forecast, the outyear volumes are also presented as maxima and minima. Several factors contribute to the uncertainties including programmatic and funding uncertainties. For TRU waste the assumptions that underlie the maximum and minimum quantities are:

1. Maximum forecast

The maximum forecast assumes that an NMT vault workoff rate of:

Year	Vault items	Est. volume
2004	260	35
2005	1000	140
2006	1000	140
2007	400	54
2008	400	54

The forecast further assumes that $30m^3$/yr.of TRU materials will be discarded as waste rather than reprocessed and that up to $40m^3$/yr. of waste that is not normally handled will be discarded at LANL. The MO_x program is assumed to restart in FY06 with target production at 3.5 times the FY03-04 level. These generation rates are in addition to the baseline rates as escalated by programmatic increases (Delta factors).

2. Minimum forecast

The minimum TRU volume forecast assumes that the NMT vault workoff in FY05 and later years is 400 items per year or about $54m^3$/year. The minimum projection also assumes no MO_x restart, no offsite disposal and decreased vault workoff rates. As before, these generation rates are in addition to the baseline rates as escalated by programmatic increases.

Application of the assumptions (including projected programmatic growth) described above to the baseline TRU waste profile leads to the volumes forecast in Table B-4. These volumes represent the maximum forecast volumes.

Maximum

	Pu-238 Operations	Pit Fabrication	Vault Workoff	Plutonium R&D Support	Cement Operations	Offsite Disposal[3]	Other Programs	**Total**
2004	1.92	3.36	65.00	7.56	54.88	30	5.70	168.41
2005	6.54	3.92	170.00	7.56	54.88	40	6.22	289.12
2006	6.70	3.92	170.00	7.56	89.39	40	6.22	323.79
2007	6.86	4.48	84.00	7.56	89.39	40	6.73	239.03
2008	6.38	4.48	84.00	7.56	89.39	40	6.73	238.55

Minimum

	Pu-238 Operations	Pit Fabrication	Vault Workoff	Plutonium R&D Support	Cement Operations	Offsite Disposal[3]	Other Programs	**Total**
2004	1.92	3.36	45.00	7.56	54.88	0	6.22	118.94
2005	6.54	3.64	64	7.56	54.88	0	6.22	142.84
2006	6.70	3.92	64	7.56	54.88	0	6.73	143.80
2007	6.86	4.48	64	7.56	54.88	0	6.73	144.52
2008	6.38	4.48	64	7.56	54.88	0	6.73	144.04

Table B-4. NMT Division TRU waste forecast

Appendix C. Radioactive Liquid Waste

This appendix presents the data supporting the 5-year radioactive liquid waste volume forecast.

The RLWTF influent information for the past 5 years was obtained from facility records. The average of the last 2 years was taken as a baseline quantity for forecasting future influent volumes. The years 1998 through 2000 were excluded from the average because in 2001, permanent changes were made to the TA-48 boiler and the TSTA cooling tower that resulted in eliminating their discharge to the RLWTF industrial waste line. Because this change is permanent, it is inappropriate to average volumes across the time period before the change.

In addition to the main industrial waste line to the RLWTF, two separate lines (the acid waste line and the caustic waste line) connect TA-55 with the RLWTF at TA-50: the acid waste line and the caustic waste line. These lines typically carry small volumes of waste relative to the industrial waste line influent. The yearly influent (in liters) for 1998–2003 is shown in Table C-1.

Influent (Liters)	1999	2000	2001	2002	2003	Average
RLW Influent, industrial waste line	20,465,000.00	17,858,000.00	13,559,000.00	11,489,000.00	12,156,083.00	12,401,361.00
Caustic Waste Treated in Rm-60	7,931.00	3,816.00	11,607.00	1,684.00	9,000.00	6,807.60
Acid Waste Treated in Rm 60	40,364.00	11,847.00	15,500.00	33,719.00	76,000.00	35,486.00

Table C-1. RLWTF Influent by Year

Because the site generating RLW is usually known, it is sometimes possible to segregate the waste by division at sites where groups from only one division are present; however, in some cases, groups from more than one division are present at a site. Because the effluent from the entire site is metered, it is not possible to absolutely determine the contributions of the various divisions at the site. In those cases, estimates based on operational experience are made. For example, both NMT and C divisions contribute to the CMR RLW total; however, because the C Division contribution is small compared with the NMT total, all CMR waste is assigned to NMT. In cases where estimates can be made reasonably regarding waste volumes by division, they have been made.

The "Other" category is made up of small-quantity generators. The baseline FY03 volume assigned to "Other" is 1,158,063 LPY.

The resulting FY03 allocation of RLW by division is shown in Table C-2.

FY03 by Division	Division	Percent
NMT	5,800,000.00	48%
C	3,100,000.00	26%
MST	2,100,000.00	17%
Other	1,156,083.00	10%
Total	12,156,083.00	100%

.

Table C-2. TA-50 FY03 Influent by Division

Because of inherent uncertainties in the data, forecast of a single, unique value for future RLWTF generation is difficult. To better represent the uncertainties in future generation, the data are presented as maxima and minima.

For RLW, the assumptions regarding the maximum generation are:

1. Increased pit production will increase the industrial waste line discharge by 15%
2. Pending reductions in TA-48 washdowns will not be allowed
3. Over the next four years P2 RLW upstream reduction projects will reduce the total influent to TA-50 by up to 2 million liters.

For the minimum case the assumptions are:

1. TA-48 washdown reduction is approved.
2. MST and CMR discharges remain constant and pit manufacture increases discharge by only 10%.
3. Over the next four years P2 RLW upstream reduction projects will reduce the total influent to TA-50 by up to 2.5 million liters.

The resulting maximum and minimum forecast for RLW discharge to TA-50 is shown in Table C-3.

Maximum								
Year	**TA-55**	**CMR**	**MST**	**ESA**	**TA-48**	**Others**	**P2**	**Total**
2004	2,000,000	3,800,000	2,100,000	190,000	3,100,000	800,000	-500,000	11,490,000
2005	2,000,000	3,800,000	2,100,000	190,000	3,100,000	800,000	-1,000,000	10,990,000
2006	2,000,000	3,800,000	2,100,000	190,000	3,100,000	800,000	-1,500,000	10,490,000
2007	2,300,000	3,800,000	2,100,000	190,000	3,100,000	800,000	-2,000,000	10,290,000
2008	2,300,000	3,800,000	2,100,000	190,000	3,100,000	800,000	-2,000,000	10,290,000
Minimum								
Year	**TA-55**	**CMR**	**MST**	**ESA**	**TA-48**	**Others**	**P2**	**Total**
2004	2,000,000	3,800,000	2,100,000	190,000	3,100,000	800,000	-500,000	11,490,000
2005	2,000,000	3,800,000	2,100,000	190,000	2,033,000	800,000	-1,000,000	9,923,000
2006	2,000,000	3,800,000	2,100,000	190,000	1,033,000	800,000	-1,500,000	8,423,000
2007	2,200,000	3,800,000	2,100,000	190,000	1,033,000	800,000	-2,000,000	8,123,000
2008	2,200,000	3,800,000	2,100,000	190,000	1,033,000	800,000	-2,500,000	7,623,000

Table C-3. Maximum and Minimum projections for RLW

In addition to the industrial waste line, two other lines transfer RLW to the RLWTF: the acid line and the caustic line. The projections for the acid and caustic lines were obtained from RLWTF personnel and validated by the TA-55 waste operations team leader and group personnel. The maximum and minimum acid-line waste projections are presented in Table C-4.

The maximum case assumes that the MOx program is restarted in FY05 at 3.5 times the FY03-04 rate, that NARS cannot be used for the MOx program and that pit production increases triple the acid discharge from the 94-1 line.

The minimum case assumes that the MOx program does not restart in FY05, that NARS recycle is increased in FY05 and that full implementation of NARS, occurs in 2008. Pit production is not increased. Waste volumes include the NaOH neutralizer volumes. The real generation rate will, of course, lie between these extremes.

Year	Acid Waste Volume Liters, Maximum	Acid Waste Volume 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

Table C-4. Room 60 Acid Waste Forecast

The maximum and minimum caustic-line waste projections are presented in Table C-5.

The maximum case assumes that successful implementation of the TRU-CLEAR process will double the RLW caustic discharge volume starting in FY06, that the 94-1 vault workoff will accelerate to an eight year program ending in 2011, and the pit production program will increase caustic operations to the current capacity of Rm 420.

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

Year	Caustic Waste Volume Liters, Minimum	Caustic Waste Volume Liters, Maximum
2004	9000	10,000
2005	10,000	15,000
2006	11,000	20,000
2007	12,000	48,000
2008	12,000	48,000

Table C-5. Caustic line forecast

Appendix D. Low-Level Radioactive Waste

This appendix presents the data supporting the 5-year LLW volume forecast.

The LLW baseline for the 5-year projections is the FY03 generation profile and is shown in Table 3-9 of Section 3.3.5.There are four types of LLW generation: Remediation, Construction, Decontamination and Demolition (D&D) and Operational. Each LLW type has its own drivers and is forecast separately.

The Remediation LLW waste generation is not driven by budget as much as by the remediation schedule. The remediation schedule must be coordinated with the excess structures decommissioning and demolition schedule in order to achieve the maximum efficiency and best cost performance. Therefore, the RRES-RS estimates were developed in conversations with remediation project management. The estimates are provided in Table D-1.

Year	Baseline, m^3	Maximum, m^3
2004	120.00	270.00
2005	1696.23	3816.53
2006	438.04	985.59
2007	335.91	755.80
2008	1236.93	2783.09

Table D-1. RRES-R LLW Forecast

Construction LLW is generated when contaminated areas are used for new construction. This occurs most often in Special Waste Management Units (SWMUs) and other legacy contaminated sites. It is difficult to predict the volume of LLW that will be generated from construction in SWMUs since that can only be forecast after a construction site has been selected and checked for legacy contamination. The selection and checking tends to occur late in the construction process; often in the year construction is to begin. The outyear forecast for SWMU generation was assumed to be 250 m^3/year however this forecast is not associated with any specific construction projects but represents a reasonable average value. In FY04 the largest contributor to LLW generation is the 15,000 m^3 that will be generated from construction in TA-50. The construction LLW forecast is shown in Table D-2.

Year	Construction LLW
2004	15000
2005	250
2006	250
2007	250
2008	250

Table D-2. Construction LLW forecast

D&D LLW is generated when rad contaminated structures are decontaminated and /or removed. This LLW stream will be a large contributor to LLW generation at LANL for the next several years. However, because of programmatic and budgetary uncertainties the volume of waste generated could vary substantially, depending on outcomes.

For this reason the maximum and minimum quantities have been forecast for D&D LLW. These forecast volumes should bound the actual volumes and are presented in Table D-3.

Year	LLW, maximum, m^3	LLW, minimum, m^3
2004	71	71
2005	814.5	752
2006	692.5	630
2007	1062.5	1000
2008	1062.5	1115

Table D-3. Maximum and Minimum LLW volume forecast

The D&D LLW forecast assume that between FY04 and FY08 the following projects will be either be completed or that D&D will have started: TSTA/TSFF deactivation, CMR legacy equipment cleanout, PHERMEX firing site stabilization, Ion Beam Facility D&D and TA-21 D&D. The RLWTF replacement/renovation project will start up in FY08 if the renovation option is chosen and in FY10 if the replacement option is chosen.

Over the five year period in question the maximum and minimum volumes are quite close with the only substantial difference being the rate of CMR legacy equipment cleanout and the timing of certain other projects. Beyond the five year period the RLWTF and CMR replacement projects will cause a significant divergence of the maximum and minimum volumes.

Operational waste is not expected to vary very much over the FY04-FY08 interval. The primary effect will be the large quantities of LLW generated by DX Division. This waste is generated in conjunction with DAHRT testing. The volumes are expected to decrease in FY07 as fully contained testing is adopted. The forecast for operational LLW generation is shown in Table D-4

Year	Operational LLW, m^3
2004	2329
2005	2090
2006	2281
2007	1884
2008	1873

Table D-4. Operational LLW forecast

Appendix E. Mixed Low-Level Waste

This appendix presents the data supporting the 5-year MLLW volume forecast. These data were reviewed and validated by group leaders, project leaders and waste management coordinators.

The FY03 generation profile is shown in Table 3-2 of Section 3.4.4.

The RRES-RS MLLW waste generation is driven by the remediation schedule. As with RRES-RS-generated LLW, the RRES-RS MLLW estimates were developed from the remediation baseline document and from discussions with remediation project management. The estimates are shown in Table E-1.

Year	MLLW minimum, m^3	MLLW maximum, m^3
2004	6.4	16.0
2005	10.4	26.1
2006	2.2	5.5
2007	39.5	98.8
2008	60.0	150.1

Table E-1. RRES-RS MLLW Volume Forecast

The minimum values in Table E-1 correspond to the baseline document values while the maximum values are 2.5 times the baseline values. Historically, the volumes sent for disposal have been about 2.5 times the baseline value.

The historical data indicates that the volume of MLLW generated by NMT lies between 2.5 and 6.0 m^3 per year with the exception being FY02. The high volume of contaminated electronic in FY02 suggests cleanout or reconfiguration of RCAs. This is a periodic event and must be planned for on an appropriate cycle, about every 5 years. Therefore take the maximum to be a 5 year avg. of 7.5 m3 corresponding to the cleanout cycle and the minimum to be the average excluding FY02 or 4.4 m3. The forecast is shown in Table E-2.

Year	MLLW minimum, m^3	MLLW maximum, m^3
2003	4.3	7.5
2004	4.3	7.5
2005	4.3	7.5
2006	4.3	7.5
2007	4.3	7.5
2008	4.3	7.5

Table E-2. NMT Division MLLW forecast

The FWO MLLW waste generation arises primarily from facilities and maintenance operations and includes such items as activated fluorescent bulbs and lead-soldered copper joints from RCAs. This level of waste generation is predicted to continue into the next five years with some potential decrease due to the replacement of mercury-containing bulbs. The projected FWO MLLW waste generation rate is 7.0 m^3/year.

The history of RRES MLLW waste generation discussed here excludes RRES-RS waste. RRES-RS waste is associated exclusively with environmental remediation activities and is discussed separately above. Nearly all of the remaining RRES waste is contaminated electronics. The rate of generation has been accelerating over the last three years by about 0.7 m^3/year. The maximum and minimum volumes of RRES MLLW were forecast by assuming the minimum corresponds to the average of MLLW generation in the time period FY00 – FY03. The maximum forecast value assumes that the volumes will continue to escalate at the rate observed over the last four years. The results are shown in Table E-3.

Year	**MLLW minimum, m^3**	**MLLW maximum, m^3**
2004	0.4	2.2
2005	0.4	2.9
2006	0.4	3.5
2007	0.4	4.2
2008	0.4	4.9

Table E-3. RRES Division MLLW forecast

Appendix F. Chemical/Hazardous Waste

This appendix presents the data supporting the 5-year chemical/hazardous waste volume forecast.

The FY03 generation profile is shown in Section 3.5. That waste profile serves as the baseline for the 5-year projection.

Bulk Chemical/Hazardous Waste

Much of the bulk chemical/hazardous waste generated at the Laboratory is bulk waste generated by the ER Project and FWO Division. This waste predominantly comprises lightly contaminated soils, sludges and non-hazardous chemical wastes from the sanitary wastewater plant. These wastes are shipped directly off site for disposal.

The RRES-RS chemical/hazardous waste generation is driven by the remediation schedule. As with RRES-RS-generated LLW and MLLW, the estimates for chemical/hazardous waste volumes were developed in conversations from the remediation baseline and from discussions with remediation project management. The estimates are shown in Table F-1.

Year	Chem Waste, Maximum, kg	Chem Waste, Minimum, kg
2004	132,088	66,044
2005	881,144	440,572
2006	6,765,330	4,510,220
2007	1,491,424	745,712
2008	1,056,704	528,352

Table F-1. RRES-R Bulk Chemical/Hazardous Waste Forecast

FWO Division generates chemical/hazardous waste as a result of ongoing infrastructure maintenance, upgrades, and cleanouts and as a result of the operation of the sanitary wastewater plant. The waste predominantly comprises contaminated soils, wastewater, and sludges. The operations that produce these wastes are likely to continue at essentially the current level for the foreseeable future. Therefore, the forecast is for essentially constant volumes of FWO bulk chemical/hazardous waste (see Table F-2).

Year	Chem Waste, Maximum, kg
2004	260,000.00
2005	300,000.00
2006	340,000.00
2007	340,000.00
2008	340,000.00

Table F-2. FWO Bulk Chemical/Hazardous Waste Forecast

Other Chemical/Hazardous Waste

Many of the operational wastes are much more hazardous than the lightly contaminated bulk wastes. These wastes are generated as a result of R&D and laboratory operations and contain chemicals that are toxins, acute toxins, persistent bioaccumulative toxins, carcinogens, and teratogens. Approximately 48% of these wastes are non-hazardous chemical substances. Non-hazardous chemicals are substances that are not classified as hazardous by the EPA or the state but do not meet waste acceptance criteria for disposal at sanitary landfills or sanitary wastewater plants. The Hazardous Operations team in FWO-SWO disposes of these chemical wastes. The non-bulk chemical/hazardous waste forecast for nearly constant generation is shown for the major generating divisions in Table F-3.

Year	Chem Waste, Maximum, kg	Chem Waste, Minimum, kg
2004	186,550	140,000
2005	157,350	100,000
2006	112,350	60,000
2007	111,350	60,000
2008	120,350	60,000

Table F-3. Operational Chemical/Hazardous Waste Forecast

Much of the variability in the overall operational chemical/hazardous waste projections comes from C Division projections. Legacy chemical cleanouts for C Division are tentatively scheduled for FY05 and FY08. Historically, the volume of waste has risen significantly in cleanout years. The C Division forecast is shown in Fig. F-4.

Year	Chem Waste, Maximum, kg	Chem Waste, Minimum, kg
2004	2,200	2,200
2005	13,000	5,500
2006	8,000	7,000
2007	7,000	6,000
2008	16,000	7,000

Table F-4 C Division Chemical/Hazardous Waste Forecast

The difference between the forecast maximum and minimum value arise from assumptions regarding the size of the cleanouts. In the maximum case Division-wide cleanouts are assumed, in the minimum case smaller facility-wide cleanouts are projected.