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■ LOS ALAMOS
NATIONAL
LABORATORY

Waste Management at Los Alamos:

Protecting Our Environment

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■ CONTENTS

<i>Foreword: The Growth of the Waste Management Group</i>	<i>2</i>
<i>What We Do Today</i>	<i>3</i>
<i>The Mission of the Waste Management Group</i>	<i>5</i>
<i>The Liquid Waste Treatment Section</i>	<i>6</i>
<i>The Radioactive Liquid Waste Project Office</i>	<i>8</i>
<i>The Chemical Waste Section</i>	<i>9</i>
<i>The Radioactive Waste Section</i>	<i>11</i>
<i>The Technical Support Section</i>	<i>14</i>

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■ FOREWORD

The Laboratory and the Growth of the Waste Management Group

Los Alamos National Laboratory is a multidisciplinary research laboratory in Los Alamos County, New Mexico. The principal mission of the Laboratory is the design and development of weapons for the nation's nuclear arsenal; however, considerable research and development is directed toward developing the peaceful uses of nuclear energy, including research on controlled thermonuclear reactions, fission reactors, nuclear safeguards, laser fusion, and medium energy physics. Extensive basic research programs in physics, chemistry, metallurgy, mathematics and computers, earth sciences, and electronics support these efforts. Biomedical and environmental research includes programs in genetics, molecular biology, radiobiology, radio-ecology, and industrial hygiene. Expansion into nonnuclear areas is represented by applied technology development of solar and geothermal energy and superconducting power transmission lines.

These Laboratory activities in research and development are located in 33 technical areas (TAs) widely spread over the site, and each activity can generate wastes, depending on its function and program. Wastes generated at the sites include transuranic (TRU) wastes, low-level wastes (LLW), accelerator-produced radioactive material, and hazardous chemical wastes.

Low-level waste is the largest volume of radioactive waste generated at Los Alamos. Averages from the last several years indicate that approximately 90% of the total volume of radioactive solid waste volume is LLW and 10% is TRU waste. The volume of decontamination and decommissioning waste varies from project to project.

No high-level wastes are generated at Los Alamos.

The Waste Management Group was formed in 1948 as part of the Los Alamos Area Office of the Atomic Energy Commission to minimize the adverse effects of liquid radioactive wastes on the environment. Since then, many other responsibilities have been added to our charter: treating and disposing of liquid radioactive wastes and liquid chemical wastes, including plating solutions; managing solid radioactive wastes and investigating incineration for volume-reduction of radioactive solids; and managing all chemical wastes. Decontamination and decommissioning operations were done in the group from 1988 to 1993, when these functions were placed in a separate group.

What We Do Today

Today, the Waste Management Group conducts most operational activities in waste management at the Laboratory. We are primarily a service group composed of four sections, a project office, and a safety committee and compliance office. With a staff of 95 scientists, engineers, technicians, secretaries, students, and part-time employees, we are dedicated to managing all liquid and solid wastes, other than liquid sanitary wastes, generated at the Laboratory.

Our group operations are administered, audited, and controlled in compliance with regulations, directives, and orders of the Department of Energy (DOE); the Environmental Protection Agency (EPA); the Occupational Safety and Health Agency (OSHA); the Department of Transportation (DOT); and the New Mexico Environmental Department (NMED). Waste management regulations continue to become more stringent to ensure the protection of the health and safety of the public and the environment. We keep abreast of these regulations and ensure that our operations fully comply.

MISSION OF THE WASTE MANAGEMENT GROUP

Our mission is to manage Laboratory-generated liquid and solid wastes using state-of-the-art methods to prevent the release of radioactive and hazardous materials to the environment. To fulfill this mission, we have established the following objectives:

- to collect all radioactive liquid wastes and concentrate the radioactivity in a small volume of solid that we bury or store so that it cannot endanger the health and safety of employees and the public;
- to collect all liquid and solid hazardous wastes and manage them to reduce toxicity and prevent the

contamination of the environment so that the health and safety of employees and the public will be safeguarded;

- to collect all solid radioactive wastes, apply volume-reduction techniques, and bury or store them in controlled facilities so that they will not contaminate the environment; and

- to do research and development activities with the goal of volume reduction of solid and liquid radioactive and hazardous wastes so that storage and disposal operations are minimized.

Figure 1. Radioactive waste movement.

Figure 1 shows the movement of radioactive liquid and solid wastes from generation to storage or disposal.

We also manage a certification program for transuranic waste. Transuranic (TRU) wastes are those wastes containing radionuclides heavier than uranium, including uranium-233 and radium-226, at an alpha activity level exceeding 100 nanocuries per gram. The nuclides are primarily emitters of alpha radiation, and the wastes of concern are generated in US defense programs. Since 1970, federal guidelines have outlined requirements for packaging and storing these wastes, with the goal of eventual permanent disposal of the wastes in salt beds near Carlsbad, New Mexico, at the Waste Isolation Pilot Plant (WIPP).

The Waste Management Group Office is the Laboratory's focal point for waste certification of newly generated TRU wastes. We assist the generators in developing and maintaining a WIPP certification program meeting WIPP waste acceptance criteria. We use our quality assurance plan to verify the proper operation of the program. Internal auditors biannually audit our program, and the DOE audits it annually. We maintain databases for all TRU wastes to be shipped to the WIPP, and we submit the data annually to the DOE.

■ THE LIQUID WASTE TREATMENT SECTION

To ensure the safety of workers and to protect the environment, radiation protection personnel monitor the storage, treatment, and disposal sites. They also do environmental monitoring at old burial sites.

For more information about waste management, call the Waste Management Group Leader at 667-7391.

The laboratories, accelerators, reactors, and shops at the Laboratory annually generate about 8,000,000 gallons of dilute, low-level liquid radioactive waste and about 46,000 gallons of a slightly higher radioactive process liquid waste. Special double-contained, continuously monitored collection systems convey these wastes, which we categorize according to the treatment required, to our central processing area at Technical Area 50 (TA-50).

A separate treatment plant at DP Site treats wastes from operations at TA-21, DP West and DP East. We then pump the wastes through a line to the main plant at TA-50, where they are further processed and discharged

(Fig. 2). Since the plutonium recovery operations were moved from DP Site to TA-55 and because of the extensive efforts in decontaminating and decommissioning DP West, waste volumes from DP Site to the DP treatment plant have been reduced by more than 75% and the radioactivity levels by more than 90% since 1979.

Two collection systems for liquid waste operate full-time. The main system collects dilute low-level wastes, and a separate system collects the slightly higher radioactive process wastes from the plutonium processing facility. The wastes flow to separate storage facilities near the main treatment plant at TA-50, Building 1.

Since 1981, computer monitoring of flows at their sources has resulted in a 50% decrease in the amount of low-level radioactive liquid waste generated. This computer system allows us to monitor flow through the pipes, water levels in the storage tanks, and conditions within the treatment plant. It also allows us to remotely control valves and pumps throughout the waste treatment facility.

Figure 2. The outfall from the radioactive liquid waste treatment facility at TA-50.

Electronic sensors alert us of any liquid leakage into a manhole from a rupture in the pipeline or from infiltration by surface water through the walls or the tops of the manholes. Located no more than 500 feet apart, the manholes themselves have stainless steel piping, which is also equipped with sampling systems and valves that allow us to check for leaks in the pipelines between manholes. Personnel in the Central Alarm

Station monitor the computer alarm system 24 hours a day and notify us when an alarm sounds.

Radionuclides targeted for treatment are plutonium, americium, and uranium. Because other radionuclides are more difficult to remove from the waste stream, generators must limit their discharges by recycling and minimizing their water usage. Activity levels for the

nuclides are generally considerably below discharge standards, and the isotopes from mixed activation products and mixed fission products have short half-lives. Most of these short-lived isotopes are generated and treated at the Meson Physics Facility.

In a 250-gallon-per-minute treatment facility at TA-50-1 (Fig. 3), we use ferric hydroxide precipitation followed by filtration and pH adjustment to a pH of 6-9, according to the terms of the National Pollutant Discharge Elimination System (also called the NPDES). The concentrates, or sludge, are dewatered. We then package the dewatered concentrates from our treatment of the general waste stream in about 400 55-gallon drums per year. The similar, smaller facility at TA-21-257 generates about 30 drums of the precipitate per year. These drums are currently disposed of at TA-54, the solid radioactive waste management area, as a low-level solid waste.

The slightly higher radioactive waste process liquids originating at the plutonium processing facility are conveyed in separate double-contained pipelines to TA-50-66 for monitoring and storage. To concentrate the radionuclides, we then treat these wastes in a small, 25-gallon-per-minute ferric hydroxide precipitation facility in TA-50-1 (Fig. 4). We mix the concentrates with cement in a double drum-tumbler operation. About 15 55-gallon drums of the cement paste are produced per year. These drums are stored at TA-54 for future shipment to the Waste Isolation Pilot Plant (WIPP). Treated liquid is drained to TA-50-2 for further treatment in the large plant.

For more information about or assistance with liquid radioactive wastes, call the Liquid Waste Operations Section at 667-4301.

Figure 3. Main floor of the 250-gallons-per-minute treatment plant for radioactive waste, TA-50-1.

Figure 4. The 25-gallon-per-minute treatment plant for radioactive process waste, TA-50-1.

■ THE RADIOACTIVE LIQUID WASTE PROJECT OFFICE

The Radioactive Liquid Waste Project Office was established to ensure that the Laboratory has a long-range program for reliably collecting, monitoring, transporting, treating, storing, and disposing of radioactive liquid waste in compliance with laws and regulations that protect the environment, public health and safety, and Laboratory employees. The project will help manage radioactive liquid wastes that will be generated into the middle of the 21st century.

We are coordinating the design and construction of the new facility, which will allow us to treat all future radioactive and industrial liquid waste effectively and in a way that is environmentally sound. We will also support size reduction, waste certification, incineration, environmental restoration, and cleanup of the DOE complex by treating radioactive liquid waste generated by these activities and from laboratory functions in analytical chemistry.

Supporting the Laboratory's weapons program and other R&D programs, the proposed Radioactive Liquid Waste Treatment Plant will have areas for liquid waste treatment and analytical chemistry. The new facility

will be designed to be flexible so that it can respond to the needs of changing Laboratory missions and changing waste management technologies into the middle of the 21st century. To meet this latter requirement, the facility will have an area for characterizing new waste streams and for evaluating new waste management technologies.

As the Laboratory assumes its role as the lead laboratory for R&D in plutonium, uranium, and tritium, additional waste streams could be generated. The new facility will be designed with treatment flexibility in mind.

For further information about the Radioactive Liquid Waste Project Office or the new Radioactive Liquid Waste Treatment Facility, call 665-2784.

■ THE CHEMICAL WASTE SECTION

The proper management of hazardous chemical wastes has increased markedly throughout the United States in the last 20 years. Congress has provided billions of dollars to clean up old waste disposal sites and has empowered the EPA to regulate present and future hazardous waste management practices. Other federal regulations work to eliminate or mitigate the damage to the environment by waste disposal practices and work to correct the problems created by improper practices of the past. The Chemical Waste Operations Section plays the major role in managing chemical wastes at the Laboratory.

We in the Chemical Waste Section collect chemical wastes at the generators' sites and transport them to TA-54, Area L, for sorting, treating, and packaging. We store the drums of waste in roofed storage facilities where we segregate the wastes by type, such as corrosives, oxidizers, reactives, organics, and inorganics. Personnel package the wastes for transport, treatment, and disposal

off-site. We send the wastes to an EPA- and Laboratory-approved incineration facility for total destruction. However, if the wastes cannot be disposed of off-site (for example, mixed wastes, which have both hazardous and radioactive components), we store them for future treatment and disposal at permitted facilities here at the Laboratory.

Polychlorinated biphenyls (PCBs) are another waste that we manage. The Toxic Substances Control Act (TSCA) regulates use and storage of PCBs, whose destruction by heat can cause release of dioxins, one of the most toxic substances known. We safely store PCB oils and PCB-containing equipment, such as capacitors and transformers, in a separate building at Area L, and contractors periodically transport them for thermal destruction at EPA- and Laboratory-approved facilities (Fig. 5).

Figure 5. Drums of PCB waste ready for off-site treatment and disposal.

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Figure 6. Treatment tanks for chemical wastes, TA-54, Area G.

Glass or plastic vials (scintillation vials) containing a volatile liquid with a low level of radioactivity are classified as mixed waste. A vial crusher at Area L separates the scintillation liquids from the glass or plastic solids. We package and store the liquids at Area L for eventual incineration by the group, and we send the solids to our on-site disposal site for burial.

We treat some bulk chemical wastes at Area L in any of four surface-mounted, plastic-lined 1655-gallon tanks (Fig. 6). Among the wastes

treated are ammonium bifluoride cleaning solutions, lithium hydride solids, and barium in contaminated sand and debris generated in explosives testing.

We also temporarily store unusable gas cylinders of all common sizes and cylinders with known contents at the storage site.

For more information about or assistance with chemical waste, call 667-7579.

■ THE RADIOACTIVE WASTE SECTION

The Radioactive Waste Section manages disposal, storage, and volume-reduction of low-level radioactive solid wastes and transuranic wastes. We operate facilities for size reduction and inspection and are designing new facilities to help us manage other wastes. We also conduct studies of waste management sites and are revising a certification program for TRU wastes and developing a certification program for low-level radioactive waste.

Low-level radioactive solid wastes, primarily trash contaminated with less than 100 nanocuries per gram of transuranic elements (TRU), have been landfilled since 1957 in shafts and large pits at TA-54, Area G, the radioactive disposal and storage facility (Fig. 7).

Figure 7. Aerial view of the storage and burial site for solid radioactive waste, TA-54, Area G.

The shafts are 1-12 ft in diameter and up to 65 ft deep and may be lined or unlined. Wastes requiring special handling or more containment than that provided by burial in the pits are placed in the shafts. These wastes may include tritium; mixed fission products and mixed activation products; highly activated pieces of equipment; solid polychlorinated biphenyls (PCBs) and, occasionally, PCB-contaminated items; animal tissue wastes; beryllium; graphite powders; and high-efficiency particulate air filters not meeting the particulate requirements for disposal in the pits. If wastes are contaminated with high levels of tritium, we seal them in a hydrogenous material such as an asphaltic emulsion and place them in shafts lined with asphalted corrugated metal pipes and sealed at the top with roofing tar and concrete.

We place contact-handled waste directly into the pits, which are generally 400-600 ft long, 25-100 ft wide, and 25-65 ft deep (Fig. 8). At the end of a workday, we cover the combustible wastes with crushed tuff. We annually bury approximately 160,000 ft³ of low-level wastes at Area G.

One of the wastes we manage at Area G is transuranic (TRU) wastes. TRU elements are all radioactive and are products of artificial nuclear change. Although most TRU waste is no more radioactive than many low-level wastes, its long decay time (hundreds to thousands of years) and the type of radiation emitted put these wastes into a special category for determining safe methods of handling, transportation, and storage. Natural and depleted uranium wastes are exceptions and are not classified as TRU wastes.

Figure 8. Burial pit for low-level waste, TA-54, Area G.

Until we can transport packaged and certified TRU waste to the Waste Isolation Pilot Plant (WIPP), we store the wastes in 55-gallon steel drums or in large steel boxes. We currently store more than 21,000 uncertified packages and more than 1500 previously certified packages at Area G.

The present generation rate of TRU waste, much below the historical rate, is 7060 ft³ per year. Most of the previously generated uncertified TRU waste (about 261,300 ft³) is currently stored on three asphalt pads aboveground, in one pit belowground, and in several shafts or trenches. The pads are approximately 40 ft x 405 ft and, when filled, are covered with plywood sheets, nylon-reinforced vinyl, and crushed tuff. One pad has an expandable tension-support structure of reinforced vinyl on

aluminum I-beams to protect the waste packages. We store the previously WIPP-certified packages in this structure.

We also operate the Size-Reduction Facility (SRF) to repackage and reduce the volume of newly generated TRU metallic wastes such as gloveboxes, process equipment, and ductwork. The SRF treatment packages the waste in an appropriate container for eventual disposal at the WIPP. Plans are being developed to allow the SRF to remove lead from newly generated and stored low-level mixed waste gloveboxes and then, if the box is assayed and found to be TRU, to process it as TRU waste. If the assay indicates that the glovebox is still low-level waste, we can dispose of it at Area G.

Some of the stored TRU waste has been in storage for as long as 20 years. Some of the packages, especially the fiberglass-coated polyester plywood boxes and drums, are beginning to lose their integrity. We are designing new facilities to help us manage these wastes.

We store packages of solid low-level mixed waste in a self-supporting fabric dome; we plan to use ventilated storage sheds for storage of highly tritiated mixed waste.

We are designing a facility in which to characterize and reprocess approximately 25,000 uncertified TRU containers that we have stored since 1971 and to characterize and render the waste safe for continued storage at Los Alamos if the WIPP cannot receive Los Alamos waste for many years. We will also render the waste acceptable for final disposal or storage at the WIPP. The modular design of the facility will ensure that an accident in one module will not affect a nearby module.

The TRU Treatment Facility will have the following:

- a central change room module and heating module;
- saw facility for corrugated metal pipes,
- drum-venting system;
- advanced size-reduction facility;
- advanced nondestructive testing facility;
- enhanced transportation bay;
- processing and certification facility for old TRU wastes;
- decontamination capabilities; and
- remote-handled hot cell.

We are designing an engineered prolonged-storage facility that will be a nuclear storage facility to store all the TRU and mixed wastes for decades until solutions such as the WIPP and mixed waste treatment and disposal options are available at Los Alamos. The facility will allow storage in an environmentally sound manner and in compliance with state and federal regulations.

Other studies continue. An underground chemical plume from old chemical waste disposal shafts at Area L has caused concern that the area in the expanded Area G may not be available for future use as pits and shafts for disposing of low-level radioactive wastes. We are developing the potential for a new disposal site for radioactive waste elsewhere at the Laboratory. If another site is developed and available, the current Area G may be used primarily for storing mixed and TRU waste packages and for retrieving, certifying, and processing stored TRU wastes.

New federal guidelines will require certifying and packaging low-level waste even more stringently to ensure that no waste regulated by the Resource Conservation and Recovery Act (RCRA) is disposed of, to ensure the stability of the disposal site, to facilitate handling, and to protect the health and safety of personnel, the public, and the environment. To ensure compliance with these guidelines, we are enhancing certification programs for low-level and TRU radioactive waste and mixed waste storage and performing a radiation performance assessment to better ensure that the site will continue to protect the waste from harming the environment thousands of years in the future.

For more information about or assistance with managing solid low-level or TRU radioactive wastes, call 665-WAST (665-9278).

■ THE TECHNICAL SUPPORT SECTION

The Technical Support Section began as a small group of engineers and technicians dedicated to developing incineration as a viable technique for volume reduction of TRU solid wastes.

To develop incineration as a way to reduce the volume of radioactive wastes, a pilot controlled-air incinerator was constructed at TA-50 (Figs. 9 and 10). We have upgraded the incinerator facility several times to increase its capabilities, to improve the materials of construction of the off-gas equipment, and to improve safety conditions during maintenance and operation.

Since a successful demonstration in 1979 of incineration of TRU waste, the two-chamber unit has treated

low-level waste, beta-gamma waste, ion exchange resins, polychlorinated biphenyls, pentachlorophenol-treated wood, biological waste, carcinogens, mixed wastes, and other hazardous chemical wastes, both solid and liquid. Personnel from the State of New Mexico and the EPA have monitored the burns and external firms have sampled and analyzed the off-gases from the process. The agencies have found that removal of noxious elements from off-gases has been more than 99.999%.

We are now upgrading the system to provide routine thermal destruction of at least 1236 ft³ of TRU waste and about 530 ft³ of mixed waste annually at burn rates of 100 lb/h for solids and 200 lb/h for liquids. Our pilot unit is the only incinerator in the US

Figure 9. Ash end of the controlled-air incinerator, TA-50-37.

CN92-828

1. Multiple Energy Gamma Assay System (MEGAS)	13. Packed column scrubber	22. Facility and process vent stack
2. Micro-dose x-ray waste package scanner	14. Off-gas demister	23. Scrub water primary coolant heat exchanger
3. Waste receiving glovebox with air-lock entry	15. Off-gas superheater	24. Isolated secondary coolant loop heat exchanger
4. Side Ram Feeder	16. High Efficiency Particulate Air (HEPA) filters (first and second stages)	25. Scrub water hydrocyclone particulate separator
5. Main Ram Feeder	17. Activated carbon adsorber	26. Scrub water recirculating sump tank
6. Combustion Fuel/Air Supply Glovebox	18. High Efficiency Particulate Air (HEPA) filters (third stage)	27. Scrub water blowdown filters
7. Incinerator Ignition (primary) chamber	19. Off-gas monitoring (CO , CO_2 , H_2O) station	28. Facility liquid sump Tank and Transfer System
8. Inter chamber	20. Process exhaust blowers	29. Gravity ash removal hopper
9. Incinerator combustion (secondary) chamber	21. Continuous stack sample system	30. Ash removal valves
10. Incinerator chamber access gloveboxes		31. Ash removal drum system
11. Quench column		32. Process instrumentation and control panels
12. High energy venturi scrubber		

Figure 10. Schematic of the controlled-air incinerator.

permitted by the EPA to burn PCB oils contaminated with transuranics. We are also involved in research and development for other agencies. We have studied incineration of specific compounds for the DOE, the EPA, the US Army, and the US Navy.

Our responsibilities have increased. We now also provide process engineering assistance to other sections in the Waste Management Group and, in one instance, to the DOE. Areas in which we are currently active include designing

- new treatment systems for specific hazardous wastes and mixed waste,

- a new treatment process for liquid radioactive waste,

- a new treatment facility for hazardous and mixed wastes, and

- a system for recontainerizing gases in damaged gas cylinders and safely destroying damaged cylinders of unknown gases.

For further information about incineration or technical support in waste management, call 667-2245.

The Waste Management Group, EM-7, MS E517

<u>Section</u>	<u>Location</u>	<u>Phone</u>
Liquid Waste Treatment	TA-50-1	7-4301
Chemical Waste Operations	TA-54, Area L	7-7579
Radioactive Liquid Waste Project Office	TA-66	7-2784
Solid Radioactive Waste Operations	TA-54, Area G	7-6095
Technical Support	TA-50-37	7-2245

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