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NUCLEAR AND CHEMICAL WASTE PROGRAMS
OAK RIDGE NATIONAL LABORATORY WASTE MANAGEMENT OPERATIONS PROGRAM

HAZARDOUS WASTE MINIMIZATION AT OAK RIDGE NATIONAL LABORATORY DURING 1987

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C. M. Kendrick

Prepared by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
P.O. Box X
Oak Ridge, Tennessee 37831
for the
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1. INTRODUCTION

Oak Ridge National Laboratory (ORNL) is a multipurpose research and development facility owned and operated by the Department of Energy (DOE) and managed under subcontract by Martin Marietta Energy Systems, Inc. Its primary role is the support of energy technology through applied research and engineering development and scientific research in basic and physical sciences. ORNL also is a valuable resource in the solution of problems of national importance, such as nuclear and chemical waste management. In addition, useful radioactive and stable isotopes which are unavailable from the private sector are produced at ORNL.

As a result of these activities, hazardous, radioactive, and mixed wastes are generated at ORNL. In contrast to the few, large waste streams typical of a production facility, ORNL generates numerous, small waste "streams." Illustrative of this fact is the large number, approximately 275, of waste streams identified in the annual hazardous waste report prepared to meet state and Environmental Protection Agency (EPA) requirements. The majority of these streams are discarded laboratory chemicals. The large number of diverse wastes complicates both their management and compliance with reporting requirements which are aimed at production facilities.

In recent years, increased effort has been devoted to the minimization of hazardous and radioactive wastes at ORNL. Policy statements supporting such efforts have been issued by both Energy Systems and ORNL managements. Motivation is found in federal regulations, DOE policies and guidelines, increased costs and liabilities associated with the management of wastes, and limited disposal options and facility capacities.

ORNL's waste minimization efforts have achieved marked success. Goals for reduction of concentrated liquid low-level radioactive wastes have been established, and the generation rate has been reduced by approximately 75% since 1984. Due to the diversity and predominantly nonroutine nature of ORNL's containerized wastes, goals for their reduction are more difficult to establish. Efforts continue to establish goals that account separately for wastes generated from laboratory cleanouts, to avoid a waste minimization "penalty" for this good housekeeping practice.

2. HAZARDOUS WASTE MINIMIZATION - ORNL WASTE NOS. 1-141 AND 146-275

A formal hazardous waste minimization program for ORNL was launched in mid-1985 in response to the requirements of Section 3002 of the Resource Conservation and Recovery Act (RCRA). A Waste Minimization Committee, composed of individuals from environmental and waste management organizations, was formed. At the request of the Laboratory Director, a representative was appointed from each division to serve as the contact point for waste minimization planning and implementation. The plan for waste minimization has been modified several times and continues to be dynamic. During 1986, a task plan was developed. The six major tasks include:

1. planning and implementation of a Laboratory-wide chemical inventory and the subsequent distribution, treatment, storage, and/or disposal (TSD) of unneeded chemicals;

2. establishment and implementation of a system for distributing surplus chemicals to other (internal and external) organizations;

3. training and communication functions necessary to inform and motivate Laboratory personnel;

4. evaluation of current procurement and tracking systems for hazardous materials and recommendation and implementation of improvements;

5. systematic review of applicable current and proposed ORNL procedures and ongoing and proposed activities for waste volume and/or toxicity reduction potential; and

6. establishment of criteria by which to measure progress and reporting of significant achievements.

Progress is being made toward completing these tasks and is described in this report.

In September 1987, Energy Systems presented to DOE-Oak Ridge Operations (ORO) a plan for the implementation of the corporate strategy for hazardous and mixed waste management (refs. 10 and 11). The Hazardous Waste Development Demonstration and Disposal (HAZWDDD) Program has been launched to develop and implement a coordinated corporate-wide hazardous and mixed waste management plan. During 1988, ORNL will develop an implementation plan, which will be integrated with that of other sites. The scope of the plan will include waste stream identification and evaluation, facilities assessments, identification of technology development and demonstration needs, treatment and disposal alternatives evaluation, and facilities planning and development. Waste minimization is an integral concern in each of these elements.

During 1987, goals for hazardous (including RCRA and nonRCRA, mixed radioactive and nonradioactive) waste generation were established for each division. Each division was encouraged to utilize waste minimization measures. However, many of the goals could not reflect reductions. (New programs and increased activities were responsible for constant or increased generation in some divisions. In others, where wastes are generated from a diversity of small-scale activities, process modifications were not deemed cost-effective.)

After establishing goals, divisional waste minimization representatives tracked monthly waste generation and recorded "nonroutine" wastes. Nonroutine wastes are generated from activities other than the normal work of the division and consist primarily of chemicals from laboratory cleanouts (further discussed in Sect. 2.6), which were encouraged during the past year. In addition, this year, approximately 141,107 kg (311,000 lb) of soil was disposed of as hazardous waste after it was excavated from construction sites. (Lead was the primary hazardous contaminant.)

Table 2.1 shows the total hazardous (RCRA and nonRCRA, mixed radioactive and nonradioactive) waste generated annually from 1984 through 1987. Estimates of the nonroutine fraction are included for 1986 and 1987. Table 2.2 further describes nonroutine waste generated in 1987.

Although 1987 total hazardous waste generation increased 72% over 1984 figures, routine waste generation remained approximately constant from 1986. Nonroutine waste increased over 370% from 1986 to 1987, due to the lead-contaminated soil excavated during construction activities. Construction activities are expected to continue to be a nonroutine source of hazardous waste (soil) generation in future years.

Table 2.1. ORNL hazardous waste[a] generation

Calendar year			Waste generation (kg/year)
1984			172,900
1985			182,400
1986			160,000
	routine	124,000	
	nonroutine	36,000	
1987			297,710
	routine	127,470	
	nonroutine	170,240	

[a]Includes mixed radioactive and nonradioactive, RCRA and nonRCRA wastes from ORNL facilities at the Y-12 Plant as well as those in Bethel and Melton Valleys.

Table 2.2. ORNL 1987 hazardous waste[a] generation

Waste category	Waste generated	
	lb	kg
Routine	280,950	127,470
Nonroutine	375,210	170,240
Construction (soil)	295,000	133,850
Cleanout	53,800	24,410
Spills	25,830	11,720
Other	580	260
Total	656,160	297,710

[a]Includes mixed radioactive and nonradioactive, RCRA and nonRCRA wastes from ORNL facilities at the Y-12 Plant as well as those in Bethel and Melton Valleys

2.1 REVIEW OF PROJECTS AND ACTIVITIES

ORNL has implemented, for a number of years, a program designed to provide National Environmental Policy Act (NEPA) documentation and address DOE requirements that environmental and personnel exposure during all activities be kept "as low as reasonably achievable" (ALARA). The program, which was tremendously expanded during 1985, includes three levels (Action Description Memoranda, Activities Description Memoranda, and Environmental ALARA Memoranda) of review for projects and activities. The reviews ensure that potential impacts on the environment are considered before action begins and call for measures which are considered necessary to protect human health and the environment. Wastes which will be generated are identified, and proper disposal procedures are outlined. During the review, opportunities for reduction of waste volume or toxicity by process modification, chemical substitution, or other methods are examined. The review program was expanded during 1985 to include existing, as well as new, activities. Efforts to work off the backlog of existing activities requiring review will continue for some time.

In addition to the activities described above, several divisions [Chemical Technology Division, Analytical Chemistry Division, Fuel Recycle Division, and Environmental Sciences Division (ESD)] have, on their own initiative, examined their major waste-generating activities for waste-reduction potential. As a result, a number of process or administrative changes have been made, and waste reductions have been realized. The ESD began implementing its own project waste management planning system for all types of wastes in August 1987. A "Mini Waste Management Plan" (Appendix A) is completed by the project manager and approved by the ESD Environmental Protection Officer and the Hazardous Waste Operations Group. This planning minimizes waste generation during the project's lifetime.

2.2 TRACKING SYSTEM FOR HAZARDOUS WASTE

A computerized data base is utilized for the tracking of hazardous wastes from the point of generation to ultimate disposal. Data originate from the "Request for Disposal" form completed by the generator and are logged into the data system by the Waste Operations Department. The data system has file maintenance capabilities, record query, and report generation functions which facilitate waste management. It is used primarily for record keeping, monthly billing of costs to waste generators, shipping manifest generation, disposal records, and report generation.

The primary contribution of the waste tracking system to the waste minimization effort is its establishment of generator accountability. The data base provides records of each division's waste and enables charging the generator for associated handling and disposal costs.

In addition to the waste tracking system discussed above, a data system exists at ORNL to track hazardous materials from procurement to the ultimate user. The procurement-end data system has not been put into operation due to difficulties in accessing the data from the procurement and stores organizations' data bases. Use of this system could theoretically enable tracking of hazardous materials from their entry into the Laboratory to ultimate disposal. However, tracking hazardous materials pathways during user possession poses numerous difficulties. Research activities mix and change the identity of many chemicals. The benefits and costs of implementing this hazardous materials tracking system are being explored.

2.3 CHARGE-BACK PROGRAM

Cost incentives provide the most effective motivation for waste minimization. Higher waste management and disposal costs encourage researchers to examine measures to reduce waste to enhance the economic viability of their research capabilities.

While costs for hazardous waste management have been charged to the generators since 1983, major revisions to the charge-back system were implemented in 1986. The current billing system includes cost differentials according to relative hazards of the wastes. Generators are charged higher rates for more toxic wastes. Therefore, motivation is provided to generate not only less waste but also less toxic waste.

Charges fall into two categories: on-site handling and off-site disposal. On-site handling costs include waste pickup, transport to storage, packaging, classification, storage, data base maintenance, auditing, training, procedures maintenance, safety and emergency response equipment, and on-site treatment, if applicable. Off-site charges are incurred if the waste is transported to a commercial disposal facility. Charges from the commercial disposal facility for each item are passed directly to the generator. The current rate schedule is shown in Table 2.3.

Since the FY 1989 DOE budget submission, costs for waste management have been officially included in initial task planning. Waste management costs, estimated from projections provided by the waste management organization, are itemized by waste category. This measure ensures that such costs, which have become substantial for many activities, are given serious consideration and encourage planning to reduce waste.

The ORNL charge-back system is the first of its kind in the DOE system. It has been used as a model for establishing similar programs at other DOE sites. In addition, papers describing the charge-back system and its role in waste minimization have been presented at several major waste management conferences and symposiums.

2.4 PROCUREMENT PRACTICES FOR HAZARDOUS MATERIALS

Control of the procurement of hazardous materials can prevent excessive inventories, which will eventually require disposal, and require consideration of the substitution of less hazardous chemicals where possible.

One of the most important elements of procurement control is the ordering of small units. Often chemicals are less expensive to buy in bulk quantities. However, the initial cost advantage is dwarfed by disposal costs of unneeded volumes. Researchers and purchasers have been advised to purchase only the needed quantities of chemicals and to procure them in the smallest units practical.

Because of the dynamic nature of ORNL's research, periodic reevaluation of standing orders for commonly used chemicals has been requested. This helps void continued procurement of chemicals after the "customer" research project has been terminated.

Table 2.3. ORNL hazardous waste management rate schedule

Waste category	On-site charges ($/lb)		Off-site charges ($/lb)	
	Lab pack	Bulk	Lab pack	Bulk
DOT hazardous substance	1.75	1.25	6.83	1.00
DOT poison B	2.25	1.25	6.50	1.00
Corrosive liquid	2.25	1.25	7.00	1.00
RCRA toxic substance	2.50	1.50	6.50	1.00
PCB-contaminated material	2.50	1.30	1.20	1.00
Nonhazardous substance	1.00	0.50	0.00	0.50
DOT flammable/combustible	1.75	1.25	8.86	0.80
Explosives	2.50	2.50	0.00	0.00
Reactive	2.50	2.50	9.30	9.30
Photographic	0.35	0.35	0.00	0.00
Gas cylinder	3.00	3.00	0.00	0.00
Recycle/reuse	0.35	0.35	0.00	0.00
RCRA acute hazardous	2.75	1.50	6.50	1.00
Hazardous nonspecific	2.75	1.25	6.25	1.25
E. P. toxic	2.50	1.25	5.95	1.00
RCRA ignitable	2.50	1.50	8.00	0.80
Mercury recycle	1.00	1.00	0.00	0.00
Scintillation fluid	1.50	1.50	0.00	1.00
Unknown	2.50	2.50	0.00	0.00

ORNL is a collection of over 350 individual laboratories. Often a chemical needed by one laboratory is surplus in another. Those approving purchase orders for hazardous materials for each division have been advised to check for the internal availability of chemicals before ordering. The search for available chemicals is facilitated by the distribution of lists of surplus materials, which is discussed in Sect. 2.5.

Each division has also been advised to consider the substitution, where practical, of less hazardous chemicals in processes and experiments. Often substitution threatens the viability of the research project and cannot be implemented. However, substitution where possible results in less toxic, and thus less costly, waste generation.

2.5 DISTRIBUTION OF SURPLUS CHEMICALS

One of the most successful endeavors of the waste minimization program at ORNL has been the distribution of surplus chemicals. Unused commercial chemicals have been estimated to constitute 90% of the waste chemicals collected at ORNL. Approximately 30% of these containers have been unopened. Since November 1985, over 31,750 kg (70,000 lb) of chemicals which were no longer needed by their owners have been transferred to new owners for use.

This achievement has largely been accomplished through the initiative of one individual in the Hazardous Waste Operations Group, who has internally circulated lists of reusable chemicals he has been asked to pick up. Response has been overwhelming; almost every item has been claimed. The original owner has benefited by avoiding the cost of disposal (which would have totaled over $250,000). The new owner has benefited by avoiding procurement costs.

Many surplus chemicals have been donated to educational institutions and to the Tennessee Department of General Services. During 1987, Energy Systems Central Staff halted the distribution of chemicals to outside organizations pending the outcome of an evaluation of associated liabilities. A draft corporate policy for off-site shipment of hazardous chemicals was issued. The policy allows continued distribution and calls for expanded communication and cooperation with and between DOE sites to utilize excess chemicals. During 1987, the amount of usable chemical relinquished to the Hazardous Waste Operations Group dramatically decreased. This trend is partially due to increased cooperation within and between ORNL divisions.

2.6 LABORATORY CLEANOUTS

Laboratory cleanout is a good housekeeping measure, which is encouraged for a number of reasons. First, clearing the work area of unneeded chemicals reduces health and safety risks. Some chemicals on laboratory shelves are as old as 40 years. Additional hazards are associated with aging of some chemicals, such as picric acid. Secondly, eliminating materials associated with expired research projects helps clear the waste generation record for current and future activities in the laboratory. One of the difficulties encountered in measuring progress in waste minimization is accounting for disposal of wastes from projects terminated in prior years. Including waste disposal costs in initial project planning, noted in Sect. 2.3, will help alleviate this problem in the future. Thirdly, disposal of unneeded chemicals will be more costly in the future than today. Delaying the cleanout and disposal will only increase the costs.

Of the approximately 297,710 kg (656,160 lb) of waste ORNL managed as hazardous (RCRA waste are a fraction of this amount) during 1987, approximately 24,410 kg (53,800 lb) were generated from the cleanout of laboratories. This amount has increased during the past few years as awareness of the need has escalated. During FY 1988, programmatic funding for the planning of a comprehensive laboratory cleanout has been provided. The task will propose funding schemes for the disposal of unneeded chemicals which cannot be transferred to new owners and will establish procedures to help prevent future buildup of excess chemical inventories. Implementation of the comprehensive cleanout will likely occur during FY 1989.

One of the difficulties associated with this good housekeeping practice is how to account separately for resulting wastes to avoid an apparent waste minimization "penalty." Divisional waste minimization representatives were asked to track generation and distinguish routine from nonroutine wastes. Their estimates are reflected in Table 2.2.

2.7 TRAINING AND COMMUNICATION

Shortly after his or her appointment in 1985, each division's waste minimization representative was individually interviewed and trained in waste minimization concepts by a member of the Hazardous Waste Minimization Committee. A number of meetings have since been held to exchange information and ideas and discuss progress. Each representative is responsible for passing on the information to other employees in his or her division and initiating the implementation of waste reduction measures.

An intensive campaign was launched in mid-1986 to educate generators of low-level radioactive solid waste to segregate hazardous materials from radioactive wastes. A 1- to 2-hour training course, which included an examination, has been given to over 400 employees from every division in the Laboratory. The course includes instruction in the identification of hazardous wastes, regulations for hazardous wastes, and how to segregate mixed (hazardous and radioactive) wastes from low-level waste packages. Staff participation in this course has greatly expanded the general awareness of proper hazardous waste management practices.

In 1986, more than 80 ORNL employees participated in the RCRA Regulations Course which is taught by Government Institutes, Inc. Three 2-day classes were provided for Energy Systems' employees in Oak Ridge. The course included a comprehensive description of RCRA and the regulatory program; requirements for generators, transporters, TSD facilities, and permitting; and identification of hazardous wastes. In addition, at least two ORNL employees participated in the "Hazardous and Solid Waste Minimization" course sponsored by Government Institutes, Inc., during the year.

In December 1987, the RCRA Regulations Course was again offered in Oak Ridge. Ten ORNL employees participated.

During November 1987, several ORNL employees participated in the 8th Symposium on Hazardous and Industrial Solid Waste Testing and Disposal, sponsored by ASTM, which focused on waste minimization. A paper on the ORNL charge-back system was presented at this symposium. Two ORNL employees participated in the companion meeting of the ASTM Subcommittee D34.10 on Waste Minimization. One employee was selected as the new subcommittee secretary.

In December 1987, two ORNL employees participated in the Y-12 Plant Waste Minimization Seminar. The seminar presented units on applicable regulations, waste audit procedures, minimization techniques, and waste minimization evaluation.

A waste minimization incentive program is planned for introduction in 1988. The program will include awards for employee suggestions, banners, posters, a training module, and other measures to increase awareness of waste minimization.

2.8 PROCESS MODIFICATIONS

As a result of cost incentives and the training and communication described in Sect. 2.7, a number of process changes have been effected to reduce waste generation. These include recycling of waste streams into the process, measures to prevent contamination of nonhazardous materials, and process streamlining.

Often waste minimization measures are very simple. The Solid State Division reduced its generation of solvent waste by increasing employee awareness of the needs to use it sparingly when cleaning. The Metals and Ceramics Division, in 1987, began the segregation of its solvent-laden oil from clean waste oils to reduce waste toxicity.

Some measures are more complex. The Solid State Division decreased its use of hazardous chemicals by developing a technique for producing arsenic and phosphorus ion beams, for use in research, starting from GaAs and GaP rather than the toxic gases AsH_3 and PH_3. The Metals and Ceramics Division is evaluating the replacement of eight stand-alone oil pumping systems, for creep/strain study equipment, with a central pumping station, which could reduce waste oil generation by up to 50%. The Health and Safety Research Division has instructed its researchers to prepare the minimum required quantities of chemical intermediates to complete the research task and to substitute binary systems of less toxic organic solvents in place of singular systems whenever possible.

2.9 MATERIAL RECOVERY

When deemed practical, ORNL recovers from hazardous waste streams valuable materials for reuse or sale. One process that has been previously operated at ORNL recovers marketable silver-bearing sludge from photographic wastes. The process, which was developed at ORNL, achieves a volume reduction of approximately 100:1 for the hazardous waste stream. The process was not operated during 1987 pending resolution of National Pollutant Discharge Elimination System (NPDES) permitting issues for the liquid effluent. However, approximately 120,000 lb of silver-bearing waste solution was shipped to a subcontractor for silver recovery. Resumption of on-site recovery should occur during 1988.

In addition to silver recovery, ORNL utilized over 3,500 kg (7,800 lb) of discarded charcoal as fuel in its steam plant. The activated charcoal was discarded when water filters in an aquatic laboratory were replaced.

3. RADIOACTIVE WASTE MINIMIZATION

3.1 LIQUID WASTE SYSTEMS (ORNL WASTE NO. 145)

Waste reduction efforts for mixed wastes at ORNL have focused on the liquid waste systems. ORNL has two liquid waste systems, the process waste (PW) system and the liquid low-level waste (LLLW) system. The two systems are interconnected. Concentrated regenerate solution from the ion-exchange columns at the Process Waste Treatment Plant (PWTP) feeds into the LLLW system, and condensate and cooling water from the LLLW evaporator are returned to the PW system. Historically, approximately 30% by volume and 80% by weight of the LLLW was generated by the regeneration of the PWTP ion-exchange columns.

The volume of LLLW generated has been reduced by 75% since 1984. The average weekly generation for LLLW for 1984, 1985, 1986, and 1987 is shown in Table 3.1. This reduction is attributable to (1) a serious commitment to achieve goals established in October 1985, (2) effective implementation of an aggressive plan to attain those goals, and (3) charge-back of waste management costs to generators.

The major driving force toward reduction of these wastes is the curtailment of hydrofracture for their ultimate disposal. Concentrated liquid wastes must be stored while alternative disposal technologies are studied and demonstrated. Since storage space is limited, volume reduction of currently generated waste is essential to allow time for careful selection of the alternative technology.

Table 3.1. Average weekly LLLW generation

Calendar year	LLLW generated (gal/week)
1984	25,350
1985	21,150
1986	10,865
1987	6,258

An aggressive LLLW volume reduction plan was developed in October 1985. The plan established goals in terms of volume available in storage tanks for LLLW concentrate. Despite several operational upsets, the actual volumes of concentrate have generally tracked the plan, as shown in Fig. 3.1.

Development of the LLLW volume reduction plan involved an intensive effort to identify potential improvements in both the process waste and LLLW systems. Tables 3.2 and 3.3 list projects which were included in the October 1985 plan and others which have since been added. A variety of waste minimization techniques, including process optimization, process modification, waste segregation, and recycle, are represented among the projects.

The decrease in concentrate volume is largely due to the reinstallation of the clarifier at the PWTP, which was completed in February 1986. This unit operation precipitates out calcium and magnesium ions ("hardness") prior to treatment of the wastewater by ion exchange. These ions compete with strontium and cesium for positions on the ion-exchange medium and cause much more frequent need for column regeneration. Less frequent regeneration results in a smaller regenerate stream, a major contributor to LLLW. Before the clarifier was reinstalled, columns treated an average of 150,000 gal of wastewater and operated for an average of 20 h between regenerations, compared to averages of 1,000,000 gal and 200 h after reinstallation. (One column treated over 4,000,000 gal and operated for over 800 h!)

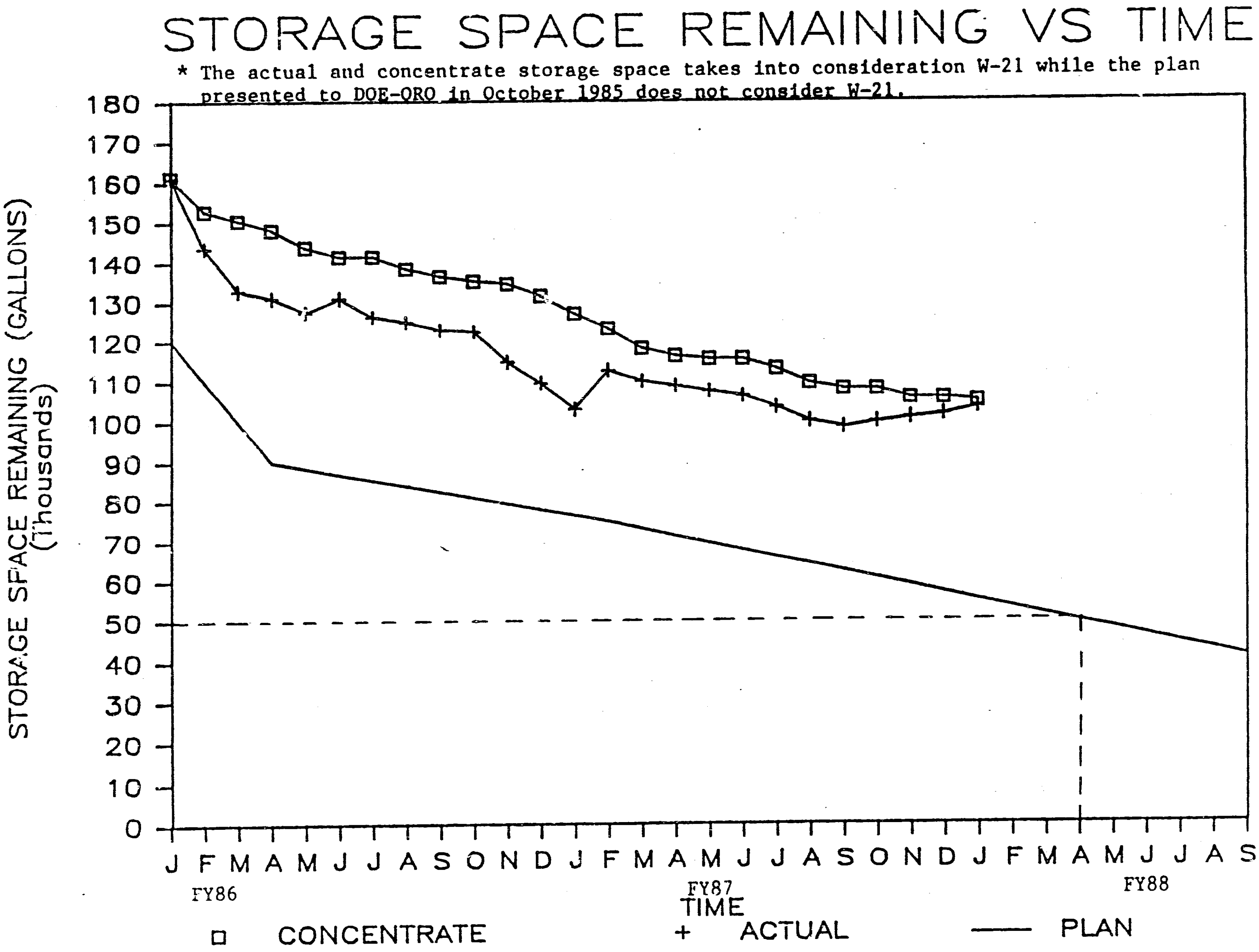
STORAGE SPACE REMAINING VS TIME
* The actual and concentrate storage space takes into consideration W-21 while the plan presented to DOE-ORO in October 1985 does not consider W-21.
STORAGE SPACE REMAINING (GALLONS)
(Thousands)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
FY86
FY87
FY88
TIME
CONCENTRATE
+ ACTUAL
PLAN

Fig. 3.1

Table 3.2. Projects which have reduced liquid waste generation

Project	Completion	Status
Decoupled PWTP from LLLW	Sept. 1990	88% stream volume reduction from 1984 to 1986
Stopped pumping groundwater from 3517 tank vault	Oct. 1985	42% stream volume reduction from 1984 to 1986
Improved operation of High Flux Isotope Reactor (HFIR); repaired filter pit at TRU; routed head tank overflow back to HFIR pool	Ongoing	57% stream volume reduction from 1984 to 1986
Improved operation of the Oak Ridge Research Reactor; repaired sump	Ongoing	90% stream volume reduction from 1984 to 1986
Improved operation of Isotopes Area; trained operators; replaced ventilation system; upgraded piping	May 1986	42% stream volume reduction from 1984 to 1986
Trained operators and added instrumentation at 2026	May 1986	100 gal/week reduction
Repaired steam valve on LLLW jet	Mar. 1986	100 gal/week reduction
Repaired potable water leak	Feb. 1986	30 gal/min reduction
Repaired pump seal leak, 3525	Mar. 1986	Minimal reduction
Eliminated groundwater inleakage to ORR sump	Aug. 1986	5 gal/min reduction

Table 3.2. Projects which have reduced liquid waste generation (cont.)

Project	Completion	Status
Installed new makeup demineralizers for reactors	Aug. 1986	Reduced pollutant loading on watershed
Upgrade cell ventilation ductwork at Fission Product Development Laboratory	Sep. 1986	1,000 gal/week reduction
Increase carbonate concentration in neutralized off-gas solutions at TRU	Jan. 1987	Complete; Reduced solids content
Replace decontamination sprayers with higher pressure sprayers in Isotopes Area and 3525	Mar. 1987	Sprayers received and in use; 100 gal/week reduction
Chemical Technology Division Performance Improvement Process (PIP) project	Dec. 1987	TRU scrubber process modified; 3019 pipe tunnel inleakage diverted; unneeded drains closed; total reduction - 45 gal/week
Analytical Chemistry Division - PIP	Mar. 1988	Leakage repaired; cooling water administratively reduced; tank rate level alarm and laboratory vacuum aspirator to be installed in March 1988. Would eliminate about 130 gal/week total

Table 3.3. Planned projects which will reduce liquid waste generation

Project	Completion	Status
Replace in-cell transfer equipment at 2026	Mar. 1988	Should eliminate about 50 gal/week
Segregate liquid TRU waste from other LLLW	TBD	To be evaluated
Solidify europium from isotopes production	TBD	On hold pending funding; program status uncertain
Divert steam condensate (3039 stack) from PW to storm sewer	Mar. 1987	Being evaluated; would eliminate about 5 gal/min
Closure of unneeded drains in 4501	July 1988	Eight completed; will eliminate total of about 40 gal/week
Upgrade process waste piping (GPP)	Aug. 1988	Under construction; would eliminate about 30 gal/min
Volume reduction to PWTP (GPP)	Sept. 1988	Under construction; would eliminate about 18 gal/min
3039 Stack scrubber solution	Dec. 1988	Alternatives evaluation under way
PWTP upgrade	Nov. 1990	Study and estimate completed
HFIR regenerant solution	TBD	Being evaulated
3517 pretreatment	TBD	Being evaluated

An important element in the liquid waste reduction campaign is the charge-back of waste management costs to the generating programs and activities. Formerly these costs were borne by DOE Defense Program accounts. To allow time for these charges to be reflected in program budget planning, the charge-back program is being phased in gradually. During FY 1986, the Isotopes Program, which passes along its costs to customers, was charged $3/gal for LLLW; other generators were charged $1.50/gal. During FY 1987, all generators were charged $4/gal; the charge increased to $5/gal in FY 1988. Charge-back has caused many generators to seriously examine their LLLW generating activities and effect reductions where practical.

3.2 CONTAINERIZED MIXED WASTES (INCLUDES ORNL WASTE NOS. 146-151, 194-199, 211-214, 216, 224, 263, 265-275)

During 1987, approximately 32,730 kg of containerized mixed wastes were generated (see Table 3.4). Scintillation fluids comprised the majority of these wastes. Until 1986, mixed wastes were stored on-site awaiting eventual treatment and/or disposal. In 1986, however, two shipments totaling 200 drums of scintillation fluids were sent to the Quadrex facility located in Gainesville, Florida. The facility crushes glass vials, separates the liquid from the glass, decontaminates and buries the crushed glass, and ships the liquid to a nearby incinerator. An incinerator at the Oak Ridge Gaseous Diffusion Plant (ORGDP), which is scheduled to begin operation in 1988, will destroy the radioactively contaminated solvents and oils, which are now being stored. Scintillation fluids will continue to be incinerated commercially until the ORGDP facility can accept ORNL wastes.

Table 3.4. Mixed waste[a] generation

Calendar year	Waste generated (kg/year)
1984	26,000
1985	15,100
1986	26,500
1987	32,730

[a]Includes both RCRA and nonRCRA wastes and waste generated at the ORNL facilities located at the Y-12 Plant.

The Waste Minimization Program elements described in Sect. 2 are also implemented for containerized mixed wastes. The major additional waste minimization measure applied to these streams is segregation of radioactive from hazardous materials. The combination of chemical and radioactive hazards creates a waste which is much more difficult and costly to manage. The training program described in Sect. 2.7 taught waste generators to identify and isolate hazardous from radioactive materials when possible.

The substitution of nonhazardous scintillation fluids for those currently utilized by ORNL researchers will be studied as part of a programmatically funded task during 1988. Researchers in the ESD have already been distributed samples of nonhazardous commercial cocktails for trial. If the study finds and researchers can be convinced that the new fluids will not degrade the quality of their data, the substitution will result in a waste stream which the EPA has approved for discharge into municipal sewer systems.

4. SUMMARY

The reduction of hazardous waste generation is an economically logical response to the rising costs and liabilities of waste management and disposal. Human health and the environment are best protected from hazardous wastes by prevention of their generation from the start. At ORNL, efforts to minimize hazardous waste have been mandated by federal regulations and DOE, Energy Systems, and internal policies. Real progress has been achieved, particularly in the reduction of liquid radioactive waste and the distribution of surplus chemicals. As researchers become increasingly aware of the advantages of improving the efficiency of their procedures and as divisions launch systematic evaluations of activities with reduction potential, further reductions will be achieved.

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8. C. M. Kendrick, "ORNL Waste Minimization Activities," presented to the Waste Management Advisory Committee Task Force, Oak Ridge, Tennessee, April 21, 1987

9. Letter from T. H. Row to L. J. Mezga, "Pilot Waste Minimization Projects," August 15, 1987

10. Letter from Lance J. Mezga to W. D. Adams, "Strategic Hazardous and Mixed Waste Management Plan for the Department of Energy Installations Operated by Martin Marietta Energy Systems, Inc.," August 28, 1987

11. Letter from K. Jarmolow to J. LaGrone, "Development of a Plan to Implement Strategy for Hazardous and Mixed Waste Management at Martin Marietta Energy Systems, Inc., Installations," September 30, 1987

12. J. B. Berry and F. J. Homan, "Charging Generators for Waste Management Costs," presented at the Oak Ridge Model Conference, Oak Ridge, Tennessee, October 13-16, 1987

13. J. B. Berry and F. J. Homan, "Charging Generators Motivates Generators to Optimize Waste Control at the Source," presented at the 8th Symposium on Hazardous and Industrial Solid Waste Testing and Disposal, Clearwater, Florida, November 12-13, 1987

APPENDIX A. ENVIRONMENTAL SCIENCES DIVISION
MINI WASTE MANAGEMENT PLAN

ESD MINI WASTE MANAGEMENT PLAN

PROJECT TITLE: ______________________________ DATE: __________

Waste characterization: Plan number: __________

Waste identification	Code	Qty (lbs/month)	Activity (Ci/unit wt)	Chemical characteristics	Dates from ... to

(Continue on the reverse side if needed.)

Have waste generating personnel been trained as RCRA inspectors? Y N

Will subcontractors be generating waste? Y N Will they be trained? Y N

(Attach a list of all personnel needing training and indicate training required.)

Will MIXED waste be generated? Y N If YES, can it be avoided? Y N

Who will be responsible for certifying radioactive waste? __________

Who will be responsible for proper segregation of waste types? __________

How will waste be packaged? ______________________________

____

Will large quantities or unusual types of waste be generated? Y N

Will the waste pose a significant health hazard to research or disposal personnel? Y N (If YES, then attach a listing of that waste.)

Have waste handling procedures been prepared? Y N (If YES, then attach.)

Has a Project Safety Plan been submitted? Y N

Approval Signatures:			More detailed plan required?
Principal Investigator: __________	Date: __________	YES	NO
ESD Section Head: __________	Date: __________	YES	NO
Operations Division: __________	Date: __________	YES	NO
ESD RCO/EPO: __________	Date: __________	YES	NO

July 17, 1987 (instructions on filling out this form are attached!)

ESD MINI WASTE MANAGEMENT PLAN

CONTINUATION SHEET

PROJECT TITLE: ______________________________ DATE: __________

Waste characterization: Plan number: __________

Waste identification	Code	Qty (lbs/month)	Activity (Ci/unit wt)	Chemical characteristics	Dates from ... to

ESD MINI WASTE MANAGEMENT PLAN

DIRECTIONS FOR FILLING OUT THE ESD MINI WASTE PLAN FORM

Please fill out this short form to document your plans for handling waste for the listed project. Fill in all blanks and answer all questions. Clarification or additional comments may be added on attached sheets of paper, and procedures describing waste handling can also be attached. Circle the Y (YES) or N (NO) to indicate your answer to the questions. The principal investigator and ESD section head must sign before the form is given to the ESD RCO/EPO. This plan will be reviewed by Operations Division, and their approval is required before waste can be disposed of. An annual review of this plan is recommended.

Further clarification of the Waste Characterization headings are given below:

Waste Identification: Identify the waste by name, e.g. chemical name, common name, isotope, etc. Examples: Sodium chloride, plastic shoe covers, soil, sulfur, beakers, compressed gas, lead brick, rubber gloves, carbon-14, etc.

Code: Use the codes listed below to further identify the waste:

CODE	MEANING
RN	Low-level solid noncompactible radioactive waste
RC	Low-level solid compactible radioactive waste
RNS	Suspect low-level solid noncompactible radioactive waste
RCS	Suspect low-level solid compactible radioactive waste
RL	Radioactive liquid waste
RG	Radioactive gaseous waste (e.g., compressed gas cylinders)
RO	Radioactive waste - other than listed above
MS	Mixed solid waste
ML	Mixed liquid waste
HS	RCRA hazardous solid waste (nonradioactive)
HL	RCRA hazardous liquid waste (nonradioactive)
HG	RCRA hazardous gaseous waste (nonradioactive)
HO	Other RCRA hazardous waste (nonradioactive)

Qty: Estimate and enter the quantity (pounds) of the waste that will be generated each month.

Activity: Estimate and enter the radioactivity of the waste in Curies per unit weight for each isotope.

Chemical Characteristics: Give information such as the pH of solutions, composition of chemical mixtures, hazardous properties (e.g. corrosive, carcinogenic, poison), etc.

Date: Enter the inclusive dates during which the waste will be generated.

END

DATE FILMED

03 / 06 / 91