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OAK RIDGE NATIONAL LABORATORY
OFFICE OF WASTE MANAGEMENT AND REMEDIAL ACTIONS
WASTE MANAGEMENT OPERATIONS PROGRAM
WASTE MANAGEMENT COORDINATION OFFICE

WASTE REDUCTION PROGRAM AT OAK RIDGE NATIONAL LABORATORY DURING CY 1989

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ACRONYM LIST

AcDM	Activities Description Memorandum
ADM	Action Description Memorandum
ALARA	as low as reasonable achievable
AVID	Accelerated Vendor Inventory Delivery (system)
CDS	Chemical Dispensing Station
CH	contact-handled
CY	calendar year
DOE	Department of Energy
EAM	Environmental ALARA Memorandum
EPA	Environmental Protection Agency
EPO	Environmental Protection Officers
ERDP	Environmental Review and Documentation Program
ESD	Environmental Sciences Division
F&M	Finance and Materials Division
FPDL	Fission Production Development Laboratory
FY	fiscal year
GCO	Generator Certification Official
GET	General Employee Training
HFIR	High Flux Isotope Reactor
HQ	Headquarters
HR	high-range
IDB	Integrated Data Base
LCO	Laboratory Certification Official
LGTTG	Liquid and Gaseous Treatment Technology Group
LLW	low-level waste
LLLW	liquid low-level waste
LLLWC	liquid low-level waste concentrate
LLLWT	liquid low-level waste treatment (system)
LR	low-range
LSA	low specific activity
NEPA	National Environmental Policy Act
NG	newly generated
NPDES	National Pollutant Discharge Elimination System
NRWTP	Nonradiological Wastewater Treatment Plant
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
PIP	Performance Improvement Process (Committee)
PPAP	Pollution Prevention Awareness Program
PW	process waste
PWTP	Process Waste Treatment Plant
RCRA	Resource Conservation and Recovery Act
R&D	research and development
REDC	Radiochemical Engineering Development Center
RH	remote-handled
RTR	real-time radiography
SLLW	solid low-level waste
SWIMS	Solid Waste Information Management System
TSA	Technical Safety Appraisal
TRU	transuranic waste
TSCA	Toxic Substances Control Act
WAC	waste acceptance criteria
WHPP	Waste Handling and Packaging Plant
WIPP	Waste Isolation Pilot Plant
WRR	Waste Reduction Representatives

1.0 INTRODUCTION

Oak Ridge National Laboratory is a multipurpose research and development facility owned and operated by the Department of Energy and managed under subcontract by Martin Marietta Energy Systems, Inc. ORNL's 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 quest to solve problems of national importance, such as nuclear and chemical waste management. In addition, ORNL produces useful radioactive and stable isotopes for medical and energy research that are unavailable from the private sector.

As a result of these activities, hazardous, radioactive, and mixed wastes are generated at ORNL. In contrast to the typical production facility's few large-volume waste "streams," ORNL has numerous small ones, including radioactive LLLW, liquid PW, solid radioactive waste (LLW and TRU waste), hazardous waste, industrial waste, and mixed waste (containing both hazardous and radioactive constituents). Illustrative of this fact is the large number of waste streams, approximately 300, identified in the 1988 annual hazardous waste report prepared to meet State and EPA requirements. The State of Tennessee has requested that ORNL organize the waste streams into approximately 30 generic categories for the CY 1989 report so the information is more manageable. The wide diversity of waste complicates both management and compliance with reporting requirements that are designed to apply to 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 Martin Marietta Energy Systems, Inc., and ORNL management. 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 some success. However, because of the diversity and predominantly nonroutine nature of ORNL's containerized wastes, goals for their reduction are 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. Generator evaluations to prioritize hazardous waste streams for waste minimization opportunities are planned for FY 1990. These are important first steps to enable the waste reduction program to assign realistic goals.

2.0 HAZARDOUS AND MIXED WASTE MINIMIZATION

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. (For the purpose of this report, hazardous wastes are considered to include those wastes regulated under RCRA. Wastes that are not regulated under RCRA, but which could present a hazard if improperly managed are also hazardous wastes. Mixed wastes, which are either RCRA or non-RCRA hazardous waste combined with radioactive waste are managed as hazardous radioactive wastes.) Each division at ORNL has appointed a WRR to serve as the primary contact for waste reduction planning and implementation. The ORNL waste reduction program is managed by the ORNL Waste Reduction Coordinator. The WRRs and the Waste Reduction Coordinator interact on a monthly basis to update the information on hazardous waste generation. Meetings are held semi-annually to allow the WRRs to exchange waste reduction ideas, discuss problems in their divisions, and receive current information on ORNL's waste reduction program. The WRRs and the Waste Reduction Coordinator have a good working relationship with the Hazardous Waste Operations Group.

The Waste Minimization Program elements described in this section apply to both hazardous and mixed wastes. The major additional waste minimization measure applied to mixed waste streams is segregation of radioactive from hazardous materials. The combination of chemical and radioactive hazards create a waste that is much more difficult and costly to manage. The training program described in Sect. 2.7 teaches waste generators to identify and isolate hazardous from radioactive materials when possible.

The divisional WRRs track monthly waste generation and record "nonroutine" wastes. Nonroutine wastes are generated from activities other than the normal work of the division and consist primarily of wastes from construction and remedial action projects and of chemicals from laboratory cleanouts (further discussed in Sect. 2.6).

Table 2.1 shows the total hazardous (RCRA and non-RCRA, both mixed radioactive and nonradioactive) waste generated annually from 1986 through 1989 (estimates of the nonroutine fraction are included). This is shown in schematic in Figure 2.1. Included in this bar chart are the annual generation rates for CYs 1984 and 1985. Data for the nonroutine categories were not available for these years and all waste was therefore indicated as generated from routine operations. Table 2.2 further describes nonroutine waste generated in CY 1989. The break down of the hazardous waste generated during CY 1989 is visually displayed in Figure 2.2. Table 2.3 quantifies the hazardous waste generated by each ORNL division during CY 1989.

Table 2.1. ORNL hazardous waste[a] generation

Calendar year	Waste generation (kg)
1986	
Routine	124,000
Nonroutine	36,000
Total	160,000
1987	
Routine	127,470
Nonroutine	170,240
Total	297,710
1988	
Routine	90,930
Nonroutine	70,490
Total	161,420
1989	
Routine	98,550
Nonroutine	71,730
Total	170,280

[a]Includes mixed radioactive and nonradioactive, RCRA and non-RCRA waste from ORNL facilities at the Y-12 Plant as well as the main ORNL site in Bethel and Melton Valleys.

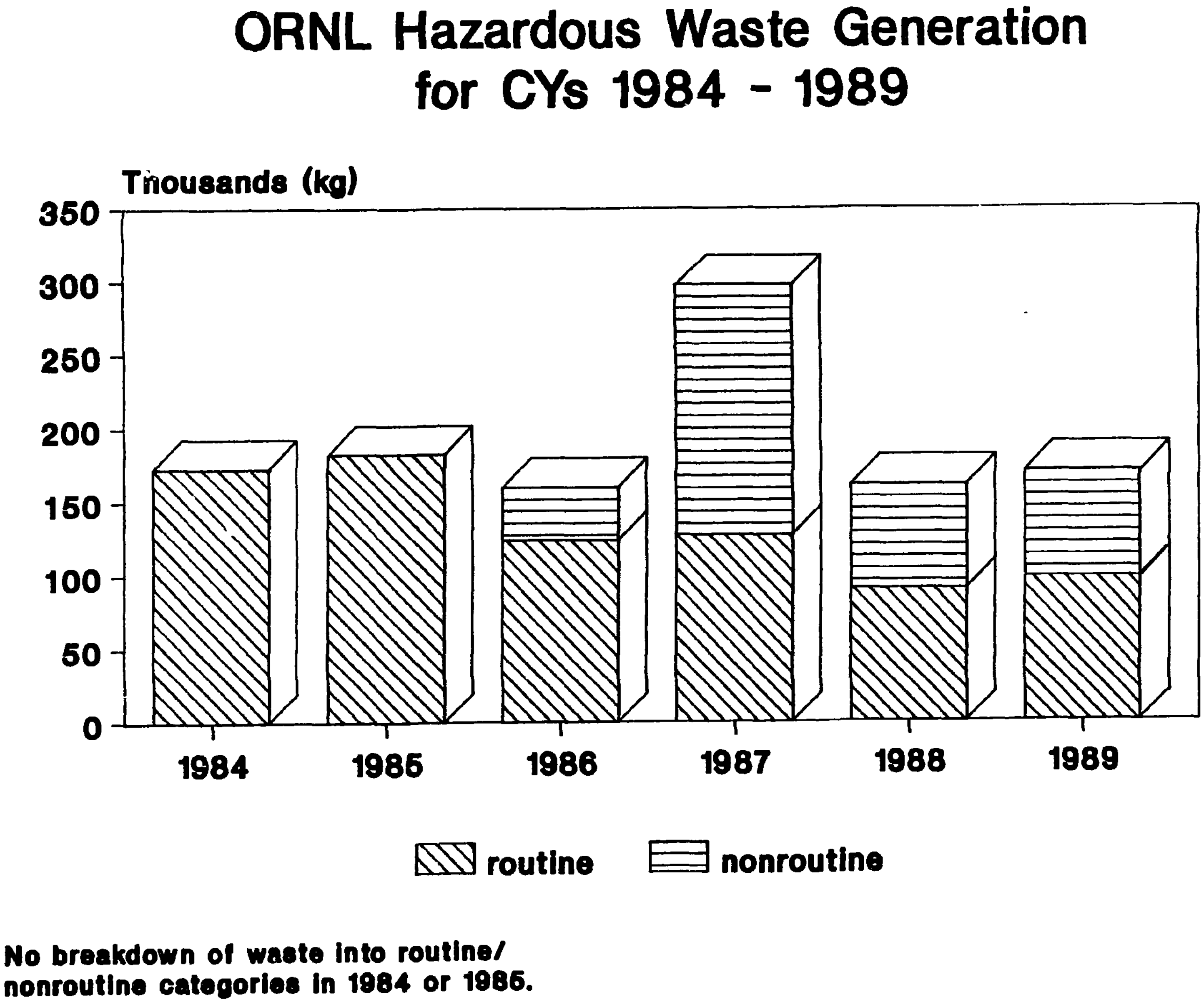

Fig. 2.1. Annual generation rates of hazardous waste at ORNL

Table 2.2. ORNL 1989 hazardous waste[a] generation

Waste category	Waste generated	
	lb	kg
Routine	216,810	98,549
Laboratory Cleanout	72,893	33,133
Orphaned Waste	60,434	27,470
Spills	5,867	2,667
Other	18,613	8,461
Nonroutine (total)	157,807	71,731
Total	374,617	170,280

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

The 1989 total hazardous waste generation shows an increase of approximately 5 percent (not statistically significant) from the 1988 total. In the nonroutine category, the laboratory cleanout waste generation decreased from 1988 and there was no recordable waste from construction activities in CY 1989. During CY 1989, 27,470 kg of orphaned waste was generated. Orphaned waste is usually waste from past operations that does not have an "owner" due to reorganization or other extenuating circumstances. In future years, laboratory cleanout should level off at a reduced amount and nonroutine waste from remediation should increase. Minor increases in the generation of routine wastes likely resulted from increased activity in some programs and increased awareness of potential problems associated with various wastes. Increased conservation regarding waste management can lead to increases in annual totals.

Hazardous wastes generated at ORNL are temporarily stored in approved areas on-site, until such time as they are either transported to off-site commercial facilities for treatment or disposal or are detonated on-site. Depending on the waste toxicity and classification, different treatment or disposal technologies may be employed. All mixed wastes, except for scintillation fluids, are stored on-site at the ORNL Mixed Waste Storage Facility.

During CY 1989, approximately 17,893 kg (39,365 lb) of containerized mixed wastes were generated (see Table 2.4). Scintillation fluids comprised the majority of these mixed wastes. The quantity of mixed wastes generated in CY 1989 was reduced 55 percent of the total generated in 1987 and represented a decrease of about one-third the total generated in 1988. This downward trend could be the result of generator training and increased awareness of waste minimization. During CY 1989, the mixed wastes generated were stored on-site awaiting the availability of treatment technologies.

The majority of ORNL's scintillation fluids are shipped to the Quadrex facility where glass and plastic vials are crushed, liquid is separated and sent to an incinerator, and crushed vials are rinsed and disposed of properly. In the future, the TSCA Incinerator at ORGDP may be used to treat these radioactively-contaminated scintillation fluids, as well as other mixed waste that are now being stored.

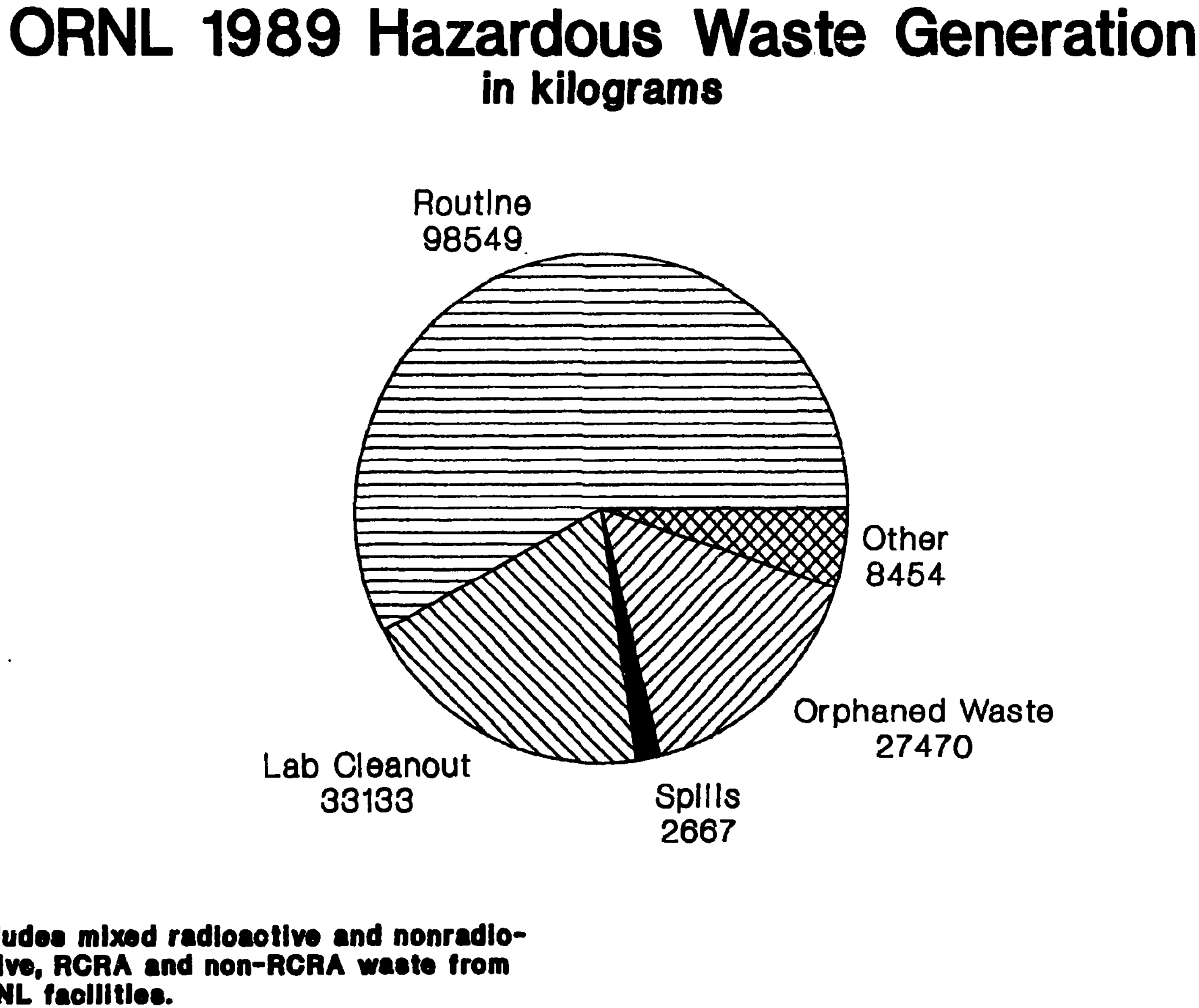

Fig. 2.2. Schematic of ORNL 1989 hazardous waste generation

Table 2.3 ORNL 1989 hazardous waste[a] generation by division

Division	(kg) Routine	Nonroutine	Total[b]
Analytical Chemistry	1,358	1,161	2,519
Biology	3,183	115	3,298
Central Management Office	429	20	449
Chemical Technology	3,113	6,364	9,477
Chemistry	637	1,491	2,128
Computing and Telecommunications	168	0	168
Energy	0	19	19
Engineering	91	0	91
Engineering Physics and Mathematics	1,077	261	1,338
Engineering Technology	0	26	26
Environmental and Health Protection	481	32,303	32,784
Environmental Sciences	4,468	1,534	6,002
Finance and Materials	0	4,299	4,299
Fuel Recycle	838	350	1,188
Fusion Energy	894	3,546	4,440
Graphics	23,087	0	23,087
Health	228	134	362
Health and Safety Research	336	1,770	2,106
Information Services	0	22	22
Instrumentation and Controls	6,944	250	7,194
Laboratory Protection	120	1	121
Metals and Ceramics	11,069	6,230	17,299
Physics	858	551	1,409
Plant and Equipment	34,409	2,156	36,565
Publications	2,083	0	2,083
Quality	980	273	1,253
Research Reactor	0	8,177	8,177
Solid State	1,698	678	2,376
TOTAL	98,549	71,731	170,280

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

[b]The total of the routine and nonroutine waste has been rounded off to the nearest kg.

Table 2.4. Mixed waste[a] generation

Calendar year	Waste generated (kg)
1986	26,540
1987	32,730
1988	27,190
1989	17,890

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

The substitution of non-RCRA regulated scintillation fluids for those RCRA-regulated ones currently used by ORNL researchers was studied as part of a programmatically funded task during 1988 and 1989 (ORNL/CF-89/31). At least one division at ORNL has already converted to the non-RCRA-regulated scintillation fluids. If the new fluids will not degrade the quality of research data, the substitution of a medium that is not regulated under RCRA for one that is regulated as a hazardous waste should enable ORNL to reduce mixed waste generation. Although the EPA has approved a number of these non-RCRA regulated solvents for discharge into municipal sewer systems, prior to discharge ORNL would need to evaluate possible impacts on its wastewater treatment system and the NPDES permit. To date, the non-RCRA solvents are still being containerized and managed in essentially the same manner as the RCRA-regulated solvents. Presently, the prime incentives for the switch are the reduced health and safety liabilities to workers using and handling the material.

2.1 REVIEW OF PROJECTS AND ACTIVITIES

Through coordination with on-going efforts in the ERDP, Pollution Prevention Awareness Program, the ALARA Program, and individual divisions, the Waste Reduction Program has benefited from review of projects and activities for waste reduction potential.

For a number of years, the ORNL Environmental Review and Documentation Program has provided NEPA documentation and addressed DOE requirements that environmental and personnel exposure during all activities be kept "as low as reasonably achievable." The ERDP Program, which was tremendously expanded during 1985, includes three levels (ADM, AcDM, and EAM) of review for projects and activities. The reviews ensure that potential impacts on the environment are evaluated before any action is taken, calling 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. Environmental documentation includes a paragraph directing project planners to include waste reduction in the planning process. The Waste Reduction Coordinator is active in this review process.

The ALARA Program at ORNL is expanding its traditional function of setting goals limiting radiation exposure to include nonradioactive functions as requested by DOE. The program is divided into three areas: Reactor ALARA, Non-Reactor ALARA, and Hazardous Chemicals ALARA. An ALARA steering committee meets quarterly to make decisions on ALARA issues and establish a charter. The steering committee consists of nine top members from key ORNL divisions. An ALARA working group meets monthly consisting of division members responsible for ALARA functions within their division. The ALARA program office has set radiation exposure goals and established an ALARA Suggestion Program.

The Pollution Prevention Awareness Program is setting up quarterly meetings with division EPOs to discuss the reasons for good pollution prevention awareness and to let them know that the program exists. There is a committee for PPAP which is setting up a PPAP slogan campaign. The division with the winning pollution prevention slogan would get an "environmental" award, (e.g., a picnic table, tree, or flower box) with a plaque indicating the winner responsible for this environmental improvement. It is also proposed that pollution prevention be part of the GET.

In addition to the activities described above, several divisions (Chemical Technology, Analytical Chemistry, Fuel Recycle, and Environmental Sciences) 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.

2.2 TRACKING SYSTEM FOR HAZARDOUS WASTE

A computerized data base is used for tracking ORNL hazardous wastes from the point of generation to ultimate disposal. Data originate from the "Request for Disposal" form completed by the generator (Appendix A) and are logged into the data system by the Documentation Management Center. 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 is not fully operational 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 have encouraged researchers to examine measures to reduce waste to enhance the economic viability of their research capabilities.

From 1983 to October 1989 generators were charged for the costs of hazardous waste management. The charge-back billing system included cost differentials according to the relative hazards of the wastes. With this costing system, generators were encouraged to generate not only less waste but also less toxic waste. The Environmental Restoration and Waste Management Five-Year Plan has eliminated the majority of the charge-back system and instead taxes programs at the DOE-HQ level. The amount of tax for programs in the FY 1990 budget was based on the levels of waste generated in 1989.

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 1989 rate schedule which was used for most of the CY is shown in Table 2.5 .

Table 2.5. 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	2.25	9.00	1.00
DOT poison B	2.25	2.25	9.00	1.00
Corrosive liquid	2.25	2.25	9.00	1.00
RCRA toxic substance	2.50	2.50	9.00	1.00
PCB-contaminated material	2.50	2.30	9.00	1.00
Nonhazardous substance	1.00	1.50	9.00	0.50
DOT flammable/combustible	1.75	2.25	9.00	0.80
Explosives	10.00	3.50	0.00	0.00
Reactive	2.50	3.50	9.30	9.30
Photographic	0.35	1.35	0.00	0.00
Gas cylinder	3.00	4.00	0.00	0.00
Recycle/reuse	0.35	1.35	0.00	0.00
RCRA acute hazardous	2.75	2.50	9.00	1.00
Hazardous nonspecific	2.75	2.25	9.00	1.25
E. P. toxic	2.50	2.25	9.00	1.00
RCRA ignitable	2.50	2.50	10.00	0.80
Mercury recycle	1.00	2.00	0.00	0.00
Scintillation fluid	1.50	2.50	0.00	1.00
Unknown	2.50	3.50	0.00	0.00

Costs for waste management are officially included in initial task planning as part of the budget cycle. 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, encouraging planning to reduce waste or recycle (recycling has substantially lower associated costs).

The ORNL charge-back system was the first of its kind in the DOE system. It was to be 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 (References 8, 12-14).

2.4 PROCUREMENT PRACTICES FOR HAZARDOUS MATERIALS

Control of hazardous materials procurement can prevent excessive inventories, which, if their shelf lives expire, will require disposal. Substitution of less hazardous chemicals, where possible, is also encouraged by a procurement control system.

One of the most important elements of procurement control is limiting the size of units being ordered. Often chemicals are less expensive to buy in bulk quantities. However, the initial cost advantage in purchasing larger sizes is dwarfed by the higher cost incurred in disposing of the unneeded volume. Researchers and purchasers have been advised to purchase only the necessary quantities of chemicals and to procure them in the smallest units practical.

As part of the AVID System, all hazardous chemicals Groups 3 and 4 require management approval before they can be purchased. Group 3 hazardous materials are on the DOE selected chemicals list, peroxidizables, and carcinogens not included in Group 4. Group 4 hazardous materials are identified by installation management as highly controlled/restricted from being brought on-site due to the significant risk and/or cost to remove generated waste. (See Reference 22 for full details on this new procedure.) ORNL is involved in a three-plant study of the Procurement System, including AVID, to evaluate system changes to optimize the procurement of needed chemicals. During CY 1990, ORNL will be upgrading the Hazardous Material Inventory System and conduct a Laboratory-wide inventory of chemicals in research laboratories, process areas, and storage areas. Personnel involved in the inventory and procurement efforts are trained in safety and waste minimization techniques.

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, therefore, less costly waste generation.

During 1988 a PIP Committee evaluated the potential for a CDS at ORNL. The final report was published in 1989. The CDS consist of a centrally located facility which would dispense chemicals in the quantities needed instead of bulk quantities. Full documentation of all chemicals dispensed would be provided. The CDS would be consistent with the ORNL waste minimization strategy. After the study of the feasibility of a CDS, the PIP committee recommended that a CDS not be established at this time. Even though CDS was found to be economically unjustified at this time, several action items were recommended for future consideration: (1) evaluate the interaction of AVID and a CDS, (2) identify the smallest quantities required for the chemicals dispensed, (3) determine number and types of chemicals to be handled by CDS, (4) do a more quantitative cost analysis of a CDS, and (5) investigate the possibility of requiring manufacturers to reduce the size of chemical packages.

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. At one time, unused commercial chemicals constituted 90 percent of the waste chemicals collected at ORNL. Approximately 30 percent of these containers had been unopened. Between November 1985 and December 1987, over 31,750 kg (70,000 lb) of chemicals, which were no longer needed by their owners, were transferred to new owners for use. This effort offers the potential of effective waste reduction because (1) the amount of hazardous waste generated by individual laboratories would be reduced by eliminating the stockpiling of leftover chemicals that will deteriorate over time and eventually require disposal and (2) those chemicals remaining following the completion of research activities in a given laboratory, which otherwise would become waste, will in effect, be "reused" by other laboratories.

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 CY 1989, the F&M Division received numerous chemicals, paint, roofing sealant, used cooking oil, outdated chemicals, and other hazardous materials. Instead of disposing of the hazardous materials at a cost of $300,000, F&M employees developed the idea of on-site sales and donations. Some of the paint was donated to Roane State Community College and some of the chemicals to the University of Tennessee. The remainder of the excess materials was purchased by local businesses at the on-site sale. This practice reduced not only generation of hazardous waste requiring disposal, but also raw materials required by the second-generation owners.

2.6 LABORATORY CLEANOUTS

Laboratory cleanout, the removal of old or unnecessary chemicals from a laboratory, is encouraged for a number of reasons, aside from being a good housekeeping measure. First, clearing the work area of unneeded chemicals reduces health and safety risks. Some chemicals found on laboratory shelves at ORNL are as old as 40 years. Additional hazards are associated with aging of some chemicals, such as picric acid and ethers, which can become explosive.

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. Also, 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 approximate 170,280 kg (374,616 lb) of waste ORNL managed as hazardous in CY 1989, approximately 33,133 kg (72,893 lb) were generated from the cleanout of laboratories. This amount has increased during the past few years as awareness of the need has escalated and better documentation has been implemented. The laboratory cleanout waste generation has decreased by 9,300 kg (20,460 lb) from 1988 numbers. This should be a continuing trend as better waste management practices are instituted. During CY 1990, a Laboratory-wide inventory of chemicals will identify chemicals whose shelf lives have expired. These will be disposed of using established and approved procedures.

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." WRRs were asked to track generation and distinguish routine from nonroutine wastes within their division. The results of their efforts are reflected in Table 2.3.

2.7 TRAINING AND COMMUNICATION

The Division WRRs and the Waste Reduction Coordinator communicate on a monthly basis concerning the generation of hazardous and mixed wastes. Information is exchanged to keep the routine/nonroutine status of the waste generated current. Semi-annually, a meeting of the WRRs is organized as a forum for exchanging waste reduction ideas, discussing problems, determining future direction of waste reduction at ORNL, and discussing regulatory requirements.

The waste generator training program includes several courses offered to programs and divisions which produce hazardous or radioactive wastes. In general, these training sessions are designed to instruct the waste generator personnel in the proper techniques for waste segregation, certification, minimization, packaging, and the applicable procedures and documentation for waste handling and disposal. This program was expanded during 1989 to include four training courses emphasizing, among other things, waste minimization techniques.

A training program specifically for waste minimization techniques was developed in 1988 and continued in 1989. This course describes some of the problems in waste management, explains the impetus behind implementing the waste minimization program, and includes a classroom exercise in identifying waste streams to which waste reduction techniques could be applied. Fifty-one employees attended this course in 1989. In the future the waste minimization module will be converted to a waste reduction workshop. The workshop will be required training as part of the overall waste certification program.

Another program is directed toward hazardous and mixed waste generators, describing the procedures and requirements for managing those wastes at ORNL. This training course addresses such topics as identification of hazardous waste, management of accumulation areas, and minimizing the amount of waste being generated. The program was developed in 1988 and was presented to a trial audience of 36 ORNL employees in December 1988. After making final corrections and adjustments to the training module, hazardous waste generator training was implemented in 1989 and 180 additional employees were trained through this module.

In addition to the formal training programs, an employee awareness program was implemented in 1989. The campaign to heighten sensitivity to waste minimization concerns includes promotional posters, announcements in internal publications, and publicity for programs or projects which have been successful in minimizing waste production. During 1989, over 100 waste minimization "incentive" posters were distributed and displayed at ORNL. A part of this campaign includes an incentive program which recognizes individual ORNL employees who provide waste minimization suggestions.

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.

Waste minimization measures vary from small scale modifications in some programs to broad changes in others. Since the ORNL waste generators are primarily numerous small laboratory or research programs, lowering the volume of waste being generated often involves reductions which, taken by themselves, are apparently small changes in the total volume. However, in terms of the quantity of waste produced from that particular program, the savings in waste volumes can be substantial. Conversely, there are programs wherein a large volume reduction can be achieved through a single process modification. The following are some examples:

- As a PIP Project, the Plant and Equipment Division is investigating the reuse of used motor oil. The spent oil from routine oil maintenance on ORNL vehicles would be burned for the heating value. During the winter months the used oil would be the fuel source for heaters at the ORNL garage.

- In 1989 as part of a systems analysis, Chemical Technology Division developed a pH segregation system to segregate metals-containing wastewater from "clean" wastewater. Using the pH segregation system could reduce the amount of wastewater treated for heavy metals at the NRWTP to about 15,000 gal/week, significantly reducing sludge production and reducing the hydraulic loading of the NRWTP. Using sludge production data from the pilot plant testing for the NRWTP, the pH segregation system will reduce sludge production by a factor of 100.

2.9 MATERIAL RECOVERY

When deemed practical, ORNL recovers valuable materials from hazardous waste streams for reuse or sale.

Wastes containing silver are sent to off-site commercial facilities where the silver is recovered.

A program for management of lead has also been instituted at ORNL. The training program described in Sect. 2.7 stresses the segregation of hazardous waste, particularly lead, from radioactive waste. The effectiveness of segregation is monitored by using RTR to examine LLW containers. The percentage of drums that were rejected because of lead being detected by X-ray examination was approximately 10 percent in 1987. With improved training and communication, the rejection rate was reduced to 4.5 percent in 1988 and 1 percent in 1989. By segregating lead from radioactive wastes, the uncontaminated metal can be recycled.

Other metals are also recycled through scrap metal sales. In this program, excess metals are sold to outside organizations for reuse. While not all of the material involved would be considered hazardous waste if it were to be discarded instead of recycled, some of the metals would be regulated by RCRA if they were being handled as waste products. This effort resulted in recycling 737 tons of scrap metal in 1987 and 825 tons in 1988. In 1989, largely as a result of cleanup activities in preparation for a Technical Safety Appraisal, this total increased to 1,004 tons.

3.0 TRANSURANIC WASTES

DOE Order 5820.2A defines TRU waste as radioactive waste without regard to source or form that is contaminated with alpha-emitting radionuclides that have an atomic number greater than 92, half-lives greater than twenty years, and an assay concentration greater than 100 nCi/g. ORNL handles waste contaminated with ^{233}U, ^{244}Cm, and ^{252}Cf as TRU waste, although they have not yet been formally declared as such by DOE-ORO.

The majority of TRU waste at ORNL was generated from past operations and is stored on-site. Since 1970, ORNL has been segregating and retrievably storing TRU waste pending the development of an approved strategy for permanent disposal. The Waste Isolation Pilot Plant, in New Mexico, is the planned central repository for all DOE TRU waste, including ORNL's.

3.1 TRU WASTE GENERATION

Wastes referred to as remote-handled TRU are wastes that have radiation dose rates greater than 200 millirem/h at the surface of the waste container. Remote handling of these wastes to minimize personnel radiation exposure is required. CH-TRU wastes have surface dose rates less than 200 millirem/h. The following is a list of ORNL facilities that produce NG CH- and RH-TRU wastes.

- Radiochemical Engineering Development Center (Building 7920 and 7930)
- High Flux Isotope Reactor (Building 7900)
- Radiochemical Processing Pilot Plant (Building 3019)
- High-Radiation-Level Analytical Laboratory (Building 2026)
- Mass Spectroscopy Laboratory at Y-12
- Isotope Operations (when operational)

Several other facilities produce small volumes of TRU wastes on an intermittent basis at ORNL. (See Reference 18 for a more complete explanation of these activities and volumes of stored TRU waste at ORNL.)

The annual generation rates for NG-TRU waste are listed in Table 3.1.

Table 3.1. Annual generation rates of TRU wastes from ORNL operations and activities

	Waste generation rate (m^3/year) for CY					
	1984	1985	1986	1987	1988	1989
TRU waste	118	70	45	26	35	50

The generation rate of TRU waste decreased steadily from 1984 to 1987. There was a slight increase in 1988 and in 1989. This slight increase appears to be due to clean-up efforts in Building 3019, the Radiochemical Processing Pilot Plant. These data are shown graphically in Figure 3.1.

3.2 TRACKING SYSTEM FOR TRU WASTES

The SWIMS is a data base for tracking SLLW and TRU waste. The data processed at ORNL in the SWIMS is included in the DOE-wide IDB. Tracking information for the SWIMS is obtained from the UCN-2822 form, "Request for Storage or Disposal of Radioactive Solid Waste or Special Materials," which generators must fill out before the waste is accepted.

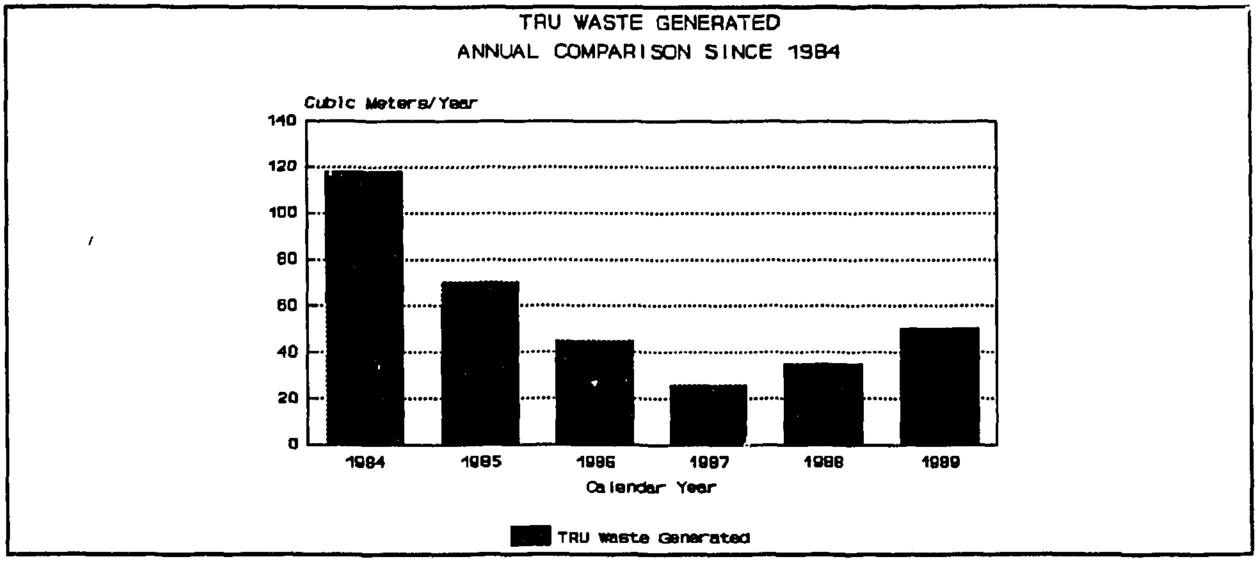

Fig. 3.1. Annual generation rates for TRU waste at ORNL.

3.3 TRU WASTE GENERATOR TRAINING

Certification training is provided to generators of TRU waste at ORNL. The purpose of this instruction is to familiarize generator personnel who handle and package radioactive waste with the applicable WAC of the receiving facilities which treat, store, or dispose of the waste. The WAC of these facilities specify the physical, chemical, and radiological properties that waste packages must conform to in order to be handled or processed. The specific requirements for each waste type as well as the general requirements for all waste types are presented in the training program. The re-certification period for TRU waste generators is two years. Waste reduction requirements and techniques are part of this certification training.

3.4 REDUCTION OF TRU WASTE

Segregation and isolation of TRU-contaminated waste from other waste are current methods of minimizing the volume of TRU waste which must be stored. Information communicated to generators during the training sessions is a source for waste reduction activities. Two FY 1992 environmental capital projects include waste reduction initiatives. The CH-TRU Waste Repackaging Facility will implement reduction of TRU waste by segregation and Pretreatment of REDC LLLW will segregate the TRU from the LLLW system.

The REDC (formerly Transuranium Processsing Plant), Building 7920, developed an in-cell melter used to melt primarily polyethylene bottles and tubing. The in-cell melter reduces the volume (by a factor of five) of plastic waste which is contaminated with TRU constituents.

4.0 SOLID LOW-LEVEL WASTE

As defined by DOE Order 5820.2A, LLW is radioactive waste that cannot be classified as high-level waste, TRU, spent nuclear fuel or a by product material. Radioactive waste containing less than 100 nCi/g of TRU radionuclides is also classified as LLW.

Currently ORNL SLLW is segregated into one of the following categories: LR-LLW, HR-LLW, uranium, biological, asbestos, and suspect.

4.1 SLLW WASTE GENERATION

The majority of SLLW at ORNL is generated as LR-LLW. This waste has a radiation dose rate at the surface of the container of less than 200 millirem/h and is typically slightly contaminated debris or sludges from the PWTP. LR-LLW is divided into three categories: (1) compactible LR-LLW, (2) non-compactible LR-LLW, and (3) sludges. The first two categories of waste are segregated and collected in separate repositories throughout ORNL. Most compactible waste has a surface dose rate less than 10 millirem/hr and consists of slightly contaminated plastic bags, blotter paper, glassware, etc. Non-compactible LR-LLW consists of heavy gauge metals items, wood and other debris that cannot be compacted by conventional methods. (More information on SLLW is available in Reference 19.)

As seen in Table 4.1, the annual generation rate of SLLW decreased from 1984 to 1987. There was a slight increase in 1988 and 1989. These increases are attributed to cleanout operations. The historical generation rates of SLLW shown graphically in Figure 4.1 for CY 1989 and monthly generation during CY 1989 is shown in Figure 4.2.

Table 4.1. Annual generation rates of solid low-level wastes from ORNL operations and activities

	Waste generation rate (m^3/year) for CY					
	1984	1985	1986	1987	1988	1989
SLLW	2407	2336	2191	1243	1474	1720

4.2 TRACKING SYSTEM FOR SLLW

The Solid Waste Information Management System is a data base for tracking SLLW and TRU waste. The data processed at ORNL in the SWIMS is included in the DOE-wide IDB. Tracking information for the SWIMS is obtained from the UCN-2822 form, "Request for Storage or Disposal of Radioactive Solid Waste or Special Materials," which generators must fill out before the waste is accepted.

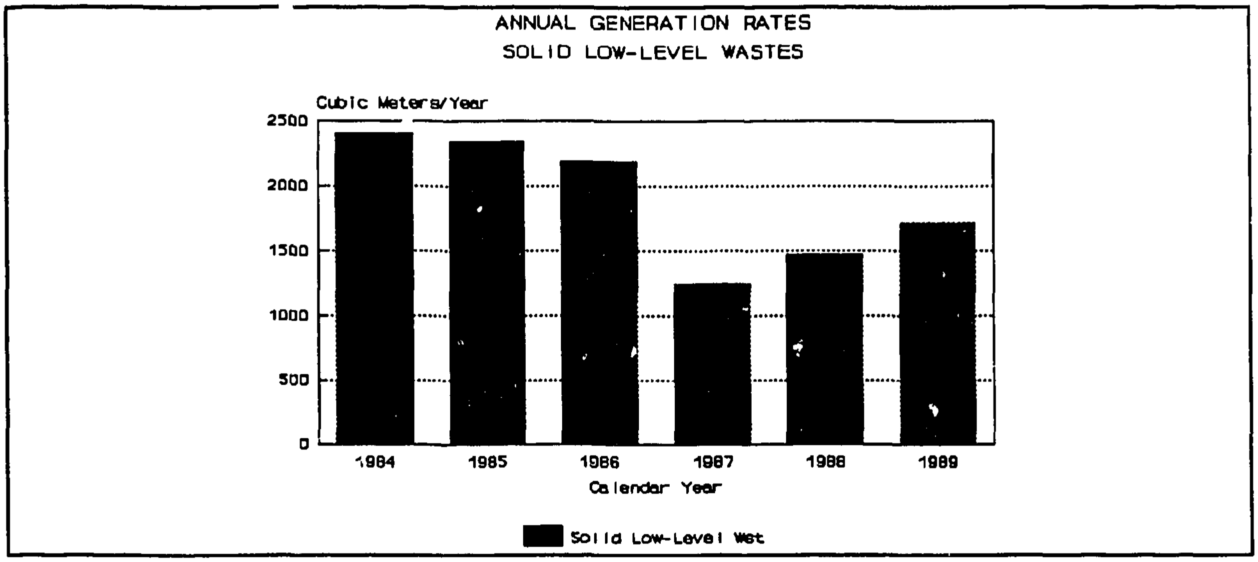

Fig. 4.1. SLLW generation annual comparison since 1984.

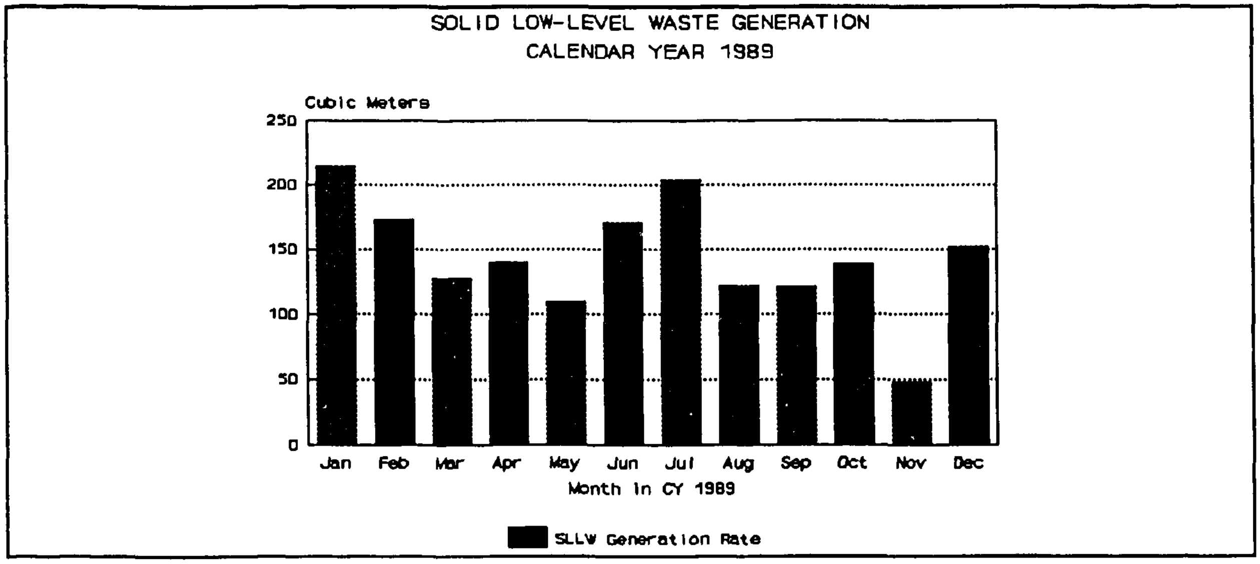

Fig. 4.2. SLLW generation rate for CY 1989.

4.3 SLLW GENERATOR TRAINING

Certification training is provided to generators of SLLW waste at ORNL. The purpose of this instruction is to familiarize generator personnel who handle and package radioactive waste with the applicable WAC of the receiving facilities which treat, store, or dispose of the waste. The WAC of these facilities specify the physical, chemical, and radiological properties that waste packages must conform to in order to be handled or processed. The specific requirements for each waste type as well as the general requirements for all waste types are presented in the training program. The re-certification period for SLLW waste generators is two years. Waste reduction requirements and techniques are part of this certification training.

4.4 REDUCTION OF SLLW

All DOE low-level generators are required by DOE Orders 5820.2A, 5400.1, and 5400.3 to establish waste reduction programs to assure that the amount of LLW generated and/or shipped for disposal is minimized. The following is a recent example of ORNL's effort to reduce the volume of SLLW.

A total of 472 55-gal drums of LSA waste material was supercompacted by a commercial vendor to reduce the volume of waste by 70 percent and better utilize the expensive and limited tumulus vault space. The drums of uncompacted waste would have occupied approximately 3,540 ft^3. Supercompacted drums and resulting solidified liquid occupy only 1,070 ft^3 of tumulus storage space. Including the cost of the vendor contract to compact the waste, this project saved approximately $224,500 and 2,470 ft^3 of tumulus storage space. Supercompaction is expected to be a continuing effort, with drums of LSA waste collected and supercompacted about once a year. ORNL has a generating rate of 600 LSA waste drums per year.

A FY 1992 planned capital project, "Certification and Segregation of Newly-Generated Solid Waste," is in part a waste reduction activity for SLLW. Segregation of SLLW from other waste is an important step in the minimization process.

5.0 LIQUID LOW-LEVEL WASTE

The LLLW system is a collection of 55 active underground tanks, associated transfer pipelines and ancillary equipment designed to collect, neutralize, concentrate, and store wastes prior to disposal. Prior to September 1984, the generated LLLW was disposed of on-site using the ORNL hydrofracture process. Today the stored LLLW is being treated using interim measures: solidification and in-tank evaporation. Starting in approximately FY 2000, the LLLW will be processed in the Waste Handling and Packaging Plant and disposed of off-site.

5.1 LLLW WASTE GENERATION

At ORNL, radioactively-contaminated liquid wastes are generated by various activities including R&D functions, decontamination activities, reactor operations, and waste treatment facilities operations. Of these generators of LLLW, waste treatment facility operations' wastes have accounted for approximately 34 percent of dilute LLLW generated, decontamination activities about 45 percent and other activities (including R&D activities and rainwater/groundwater infiltration) account for the remaining 21 percent. During the next 10 years, remedial action activities are expected to be a major LLLW generator. (More detailed explanation of the LLLW system can be found in References 19 and 20.)

Since 1984, generators of LLLW have significantly reduced their generation of LLLW. Increased efficiency of the waste treatment operations in the PWTP have also decreased the amount of LLLW concentrate produced. An explanation of the waste reduction activities for LLLW is given in Section 5.4.

Table 5.1 and Figures 5.1 show numerically and graphically the progress that has been made in the generation of LLLW. Figure 5.2 shows the LLLW generated in CY 1989. Because of its importance to the LLLW storage system, Figure 5.3 shows the LLLW concentrate generated during CY 1989.

Table 5.1 Annual generation rates of LLLW from ORNL operations and activities

	Waste generation rate (m^3/year) for CY					
	1984	1985	1986	1987	1988	1989
LLLW	4960	3985	2180	1450	1300	1270

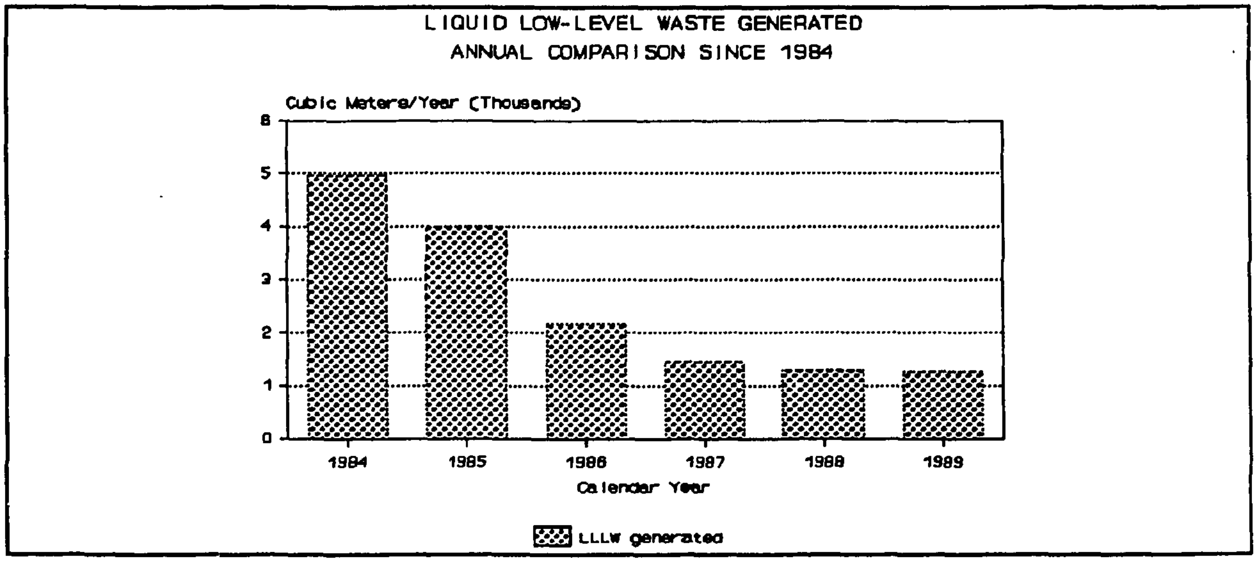

Fig. 5.1. LLLW generation rates since 1984.

5.2 TRACKING SYSTEM FOR LLLW

A data base has been developed to store, retrieve, and analyze information concerning the LLLW system at ORNL. Although the data base was developed in dBASE III, the end product is a user-friendly and does not require extensive knowledge of dBASE. The information contained in the data base includes: (1) LLLW generator information, (2) LLLW collection tank data, (3) evaporator/evaporation data, and (4) LLLW concentrate data.

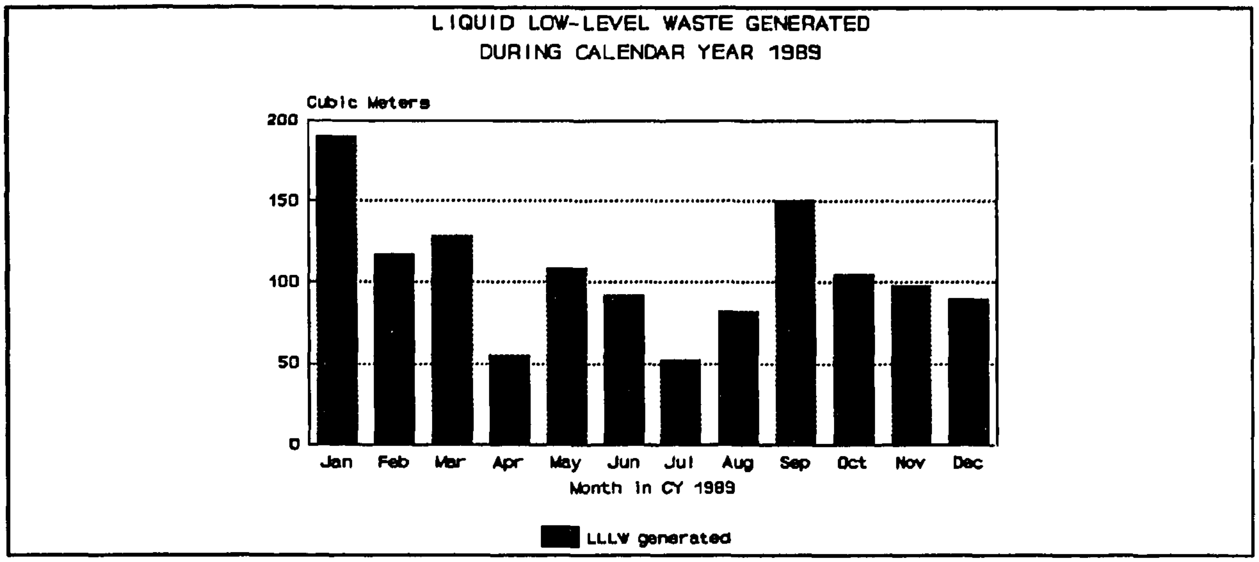

Fig. 5.2. LLLW generated during CY 1989.

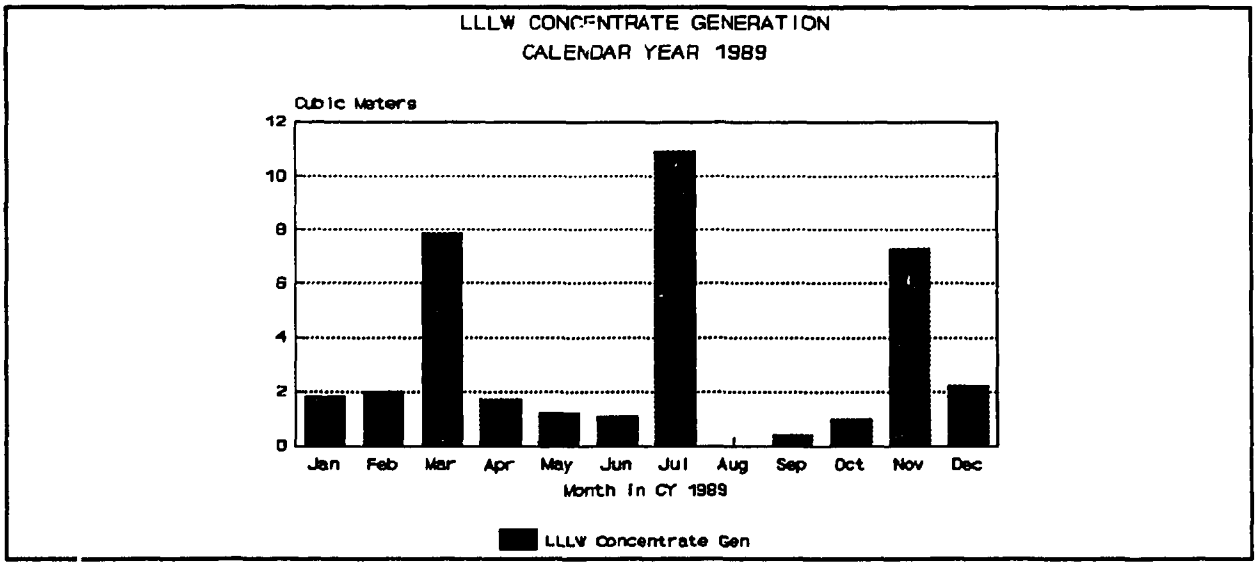

Fig. 5.3. LLLW concentrate generation during CY 1989.

The information provided by the Liquid Waste GCOs contained in the data base includes estimated LLLW generation volumes, waste contaminants, future estimated generation rates, if applicable, any waste pretreatment steps, and general descriptions of activities performed in their areas. Weekly summary reports published by the Liquid and Gaseous Waste Operations Group were used to enter daily LLLW collection volumes into the data base. Information concerning the evaporator and the evaporator service tanks was analyzed and entered into the data base. The evaporator campaign data was used to determine the major generators of LLLW concentrate and to calculate volume reduction factors. Volumes of LLLW concentrate generated as well as the liquid levels in the storage tanks are updated in the data base. Analytical results from samples performed on the contents of the Melton Valley Storage Tanks have also been recorded in the data base.

5.3 LLLW GENERATOR TRAINING

The WAC for LLW have been finalized, and a formal training program is being developed. Currently, frequent meetings are held with liquid GCOs regarding developments in liquid waste management programs.

5.4 REDUCTION OF LLLW

From 1985 to 1987, a waste minimization program reduced the generation rate of LLLW concentrate to approximately 25,000 gal/year. This was accomplished by a decrease in the generation rate of LLLW at the source and an increase in the evaporation efficiency of the LLLW evaporators from a volume reduction factor of about 9:1 in 1985 to 30:1 in 1987. These waste minimization efforts were accomplished by a series of projects and process changes. At a later date, a clarifier was added to the PWTP thus increasing the treatment efficiency further. The effects on the annual generation rate can be seen graphically in Figure 5.1.

The Liquid and Gaseous Treatment Technology Group is taking a unique approach to reduction of radioactive liquid wastes by developing the means to analyze the overall ORNL liquid waste system. By developing a model of the overall liquid waste system, the group has created a method to assess the impacts that each portion of the system has on composition and volume of final waste produced for permanent disposal at ORNL. This is a pioneering effort at ORNL to determine what effects each generator and treatment operation (whether at the source or in the centralized treatment facilities) has on the final waste form and to implement waste reduction projects accordingly.

The ORNL liquid radiological waste system actually consists of two interconnected treatment systems, the PWTP and the LLLWT systems, which consists of pH adjustment and evaporation. The system presently generates 4,000 ft^3/year of SLLW and 23,000 gal/year of LLLWC which are being stored for permanent disposal. Since LLLWC is no longer being disposed of by hydrofracture, storage capacity for LLLWC is quickly being depleted. Since new treatment methods will be much more expensive and cannot be implemented for several years (2000 is the presently scheduled start-up date), minimizing the production of LLLWC is imperative. The LGTTG's new approach is effectively reducing the total amount of waste generated by the liquid waste system, with particular emphasis on reduction of LLLWC.

The group performed a comprehensive survey of liquid waste generators to determine the amount and type of waste being generated at ORNL and where these streams are presently being routed for treatment. This information was coupled with a technical analysis of the PWTP and LLLWTs to determine where improvements could be made in the waste system which would result in major reduction in the final waste generation rates. Characterization and treatability studies are being performed to support implementation of such projects to reduce final waste generation rates by (1) treatment at the generation site, (2) modification of the processes generating the waste, and/or (3) improved operations at the centralized facilities.

Results of the systems analysis show that only three current operations at ORNL significantly impact the hazardous nature or the amount of LLLWC. The major contributors to the LLLWC (in descending order) are: (1) the PWTP, (2) Radiochemical Engineering Development Center facility, and (3) the Fission Product Division Laboratory facility. The LGTTG is focusing waste reduction efforts in these areas since they significantly affect LLLWC generation. Since the PWTP is the single largest contributor to the LLLWC, FY 1989 projects have emphasized the upgrade of this facility. Projects are also in progress which will reduce waste generation at the FPDL and REDC in the next few years.

The systems analyses established that installation of an extra holding tank in the PWTP evaporator loop will reduce the LLLWC by 4,000 gal/year. This $30,000 project is in the process of being implemented and will save $200,000/year in waste disposal costs.

The generator survey identified several once-through cooling water streams which are being feed to the PWTP for radionuclide removal. These streams account for 35 percent of the PWTP feed and a corresponding percentage of the secondary waste generated at the plant. Minor piping modifications are being made to segregate these waste streams which will reduce the SLLW production by 1,400 ft^3/year (33 percent of the present generation rate) and LLLWC by an additional 1,300 gal/year (from 4,000 gal/year to 2,700 gal/year). The cost savings for this project are estimated to be $120,000/year.

While many previous "waste reduction" projects have reduced the volume of waste entering a given phase of the liquid waste treatment system, they often have little impact on volumes or compositions of the final waste steams which must be treated for permanent disposal. The LGTTG's systems analysis approach is assuring that waste reduction projects are implemented which will be cost effective and significantly reduce the amount of waste being stored for ultimate disposal. Two projects being implemented this year will reduce ORNL liquid waste system LLLWC production by 25 percent and SLLW generation rates by 33 percent for a savings of $320,000/year in waste disposal costs.

The final rinsewater from regenerating the demineralizers at HFIR, which contains very low concentrations of radionuclides, was previously discharged to Melton Branch. With the current process wastewater collection system the water would be routed to the PWTP and then to the NRWTP. ^{60}Co in the rinsewater would not be removed in the PWTP and would probably concentrate in the activated carbon columns at NRWTP. In order to avoid this, the final rinsewater must currently be sent to the LLLW system, at a cost of $6/gal.

Installation of a 2,500 gal tank and associated piping would allow the final rinsewater to be saved and then used for backwash and initial rinsewater during the next regeneration. Fresh deionized water would be used for the final rinse and then saved again for the next regeneration. This system, which has been estimated to cost $50,000, would reduce the water sent to the LLLW system by 2,200 gal/generation (about 8,000 gal/year).

6.0 PROCESS WASTE

Process wastes consist of liquid wastes that contain slight levels of contamination of radionuclides or hazardous materials. This includes liquid waste streams that may periodically be contaminated. Process waste is generated from numerous small laboratories and the PWTP effluent which is the feed to the NRWTP. Liquid waste classified as process waste may contain small quantities of radionuclides, metals, anions, and cations. The process waste system consists of a series of holding tanks, the PWTP which is designed to remove cations by ion exchange, and the NRWTP.

6.1 PROCESS WASTE GENERATION

Process waste generated by laboratories throughout ORNL and by the PWTP is treated by ion exchange columns in the PWTP. Table 6.1 and Figures 6.1 and 6.2 show the process waste generation trends and generation during CY 1989.

Table 6.1. Annual generation rates of process wastes from ORNL operations and activities

	Waste generation rate (m^3/year x 1000) for CY					
	1984	1985	1986	1987	1988	1989
Process Waste	235	259	217	198	206	290

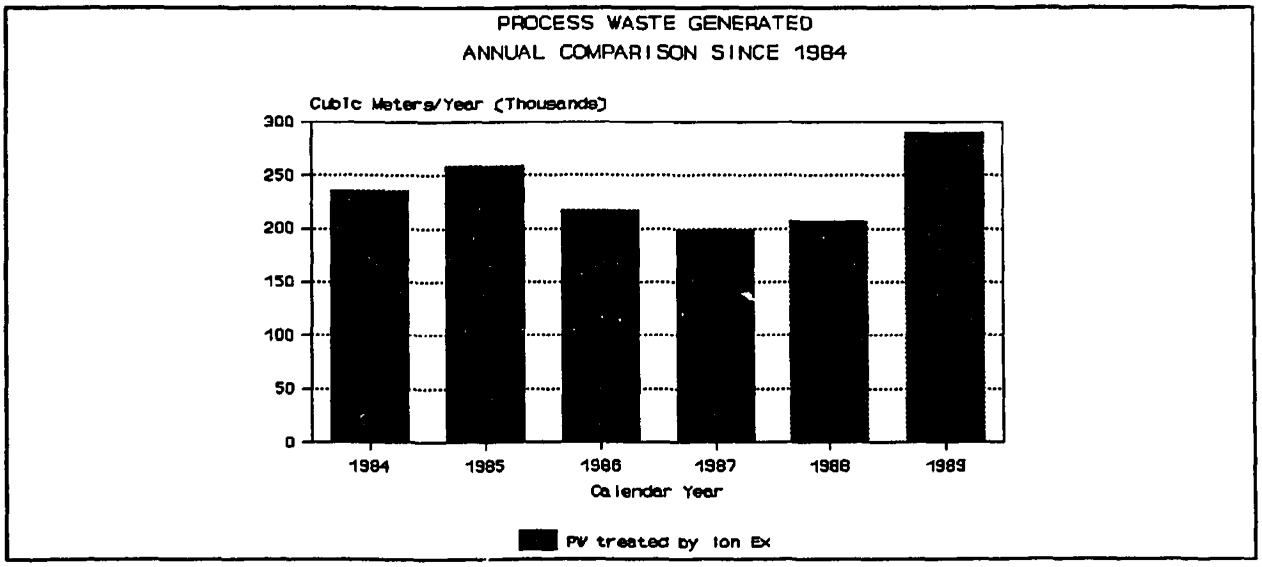

Fig. 6.1. Process waste generation rate since 1984.

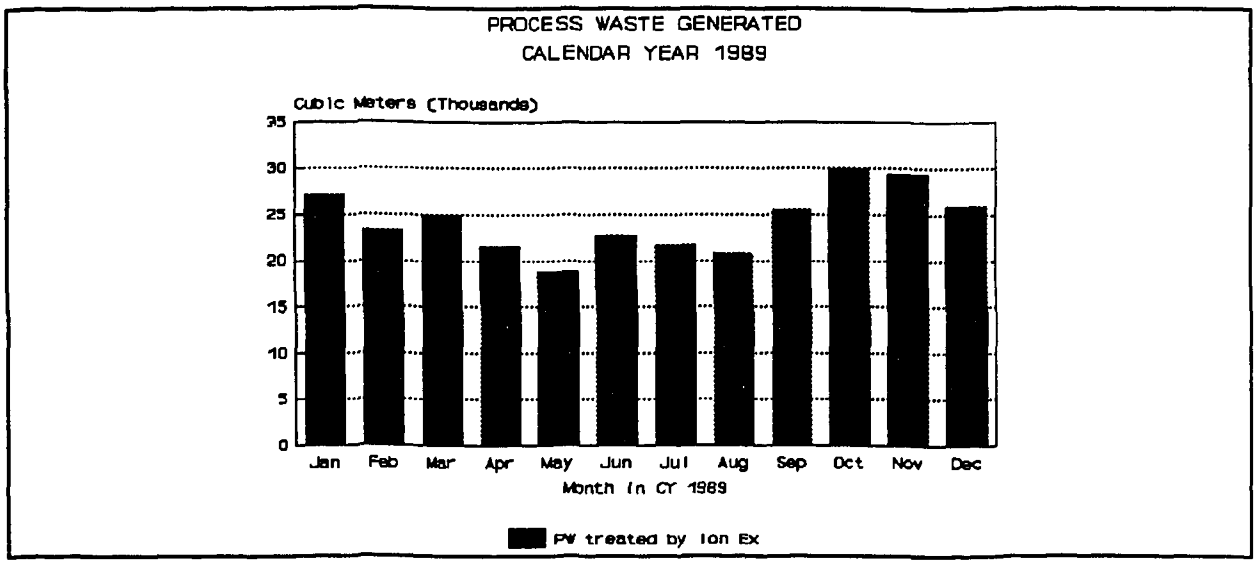

Fig. 6.2. Process waste generation rate during CY 1989.

6.2 TRACKING SYSTEM FOR PROCESS WASTE

The information available for the process waste is obtained from the weekly summary reports distributed by the Liquid and Gaseous Waste Operations Group. This data is summarized from daily volume data processed through the Waste Operations Central Control facility. Information was obtained from the Liquid GCO survey as mentioned in Sect. 5.2.

6.3 PROCESS WASTE GENERATOR TRAINING

There is at present no formal training for PW generators, but a draft lesson plan has been developed. Meetings are held with the Liquid GCOs to review developments in the liquid waste management programs.

6.4 REDUCTION OF PROCESS WASTE

Much of the waste collected by the Process Waste System is nonradioactive. After monitoring the waste stream if found to be free of contaminants or within acceptable limits, the stream can be discharged directly to the watershed or NRWTP. This is the case for the two process waste reduction projects that follow.

Although cooling water from Building 3001 requires no treatment prior to release, it traditionally has been discharged to the process waste system. Maintenance and surveillance personnel suggested and implemented valving changes to divert the cooling water from the process waste system. Elimination of this cooling water from the process waste system helped relieve the hydraulic loading on the PWTP. In addition to 100,000 gal/year of waste avoidance, the cost savings associated with this waste reduction suggestion was approximately $8,000 annually. (This project received the DOE-ORO Waste Minimization Award for 1989.)

In 1989 as part of a systems analysis, Chemical Technology Division developed a pH segregation system to segregate metals-containing wastewater from "clean" wastewater. Using the pH segregation system could reduce the amount of wastewater treated for heavy metals at the NRWTP to about 15,000 gal/week, significantly reducing sludge production and reducing th^ hydraulic loading of the NRWTP. Using sludge production data from the pilot plant testing for the NRWTP, the pH segregation system will reduce sludge production by a factor of 100.

7.0 SANITARY/INDUSTRIAL WASTE

Waste categorized as sanitary/industrial, sometimes referred to as conventional waste, includes both solid and liquid wastes generated from sanitary sewage treatment, steam plant operations, coal yard runoff, general refuse, and construction debris. As these wastes are generated, segregation of these wastes streams from radioactivity and hazardous wastes is important.

7.1 SANITARY/INDUSTRIAL WASTE GENERATION

Most of the generation information available concerns solid sanitary/industrial waste. The conventional liquid waste is processed through the process waste system or discharged to the watershed depending on the contaminants present. Segregation of process waste from non-process waste according to WAC is being implemented to improve waste treatment efficiency, ensuring that waste is treated by unit operations that remove the primary contaminants.

Steam plant ash, sludge from the ORNL Sewage Treatment Plant, filter cake from filtration of coal yard runoff, general office refuse, and wastes from construction and demolition activities are disposed of at the Y-12 Centralized Sanitary Landfill II.

Table 7.1 and Figures 7.1 and 7.2 indicate conventional waste generation for previous years and generation in CY 1989.

Table 7.1. Annual generation rates of sanitary/industrial wastes from ORNL operations and activities

	Waste generation rate (m^3/year) for CY					
	1984	1985	1986	1987	1988	1989
Sanitary/Ind Waste	8110	7760	8400	7810	10095	12075

7.2 TRACKING SYSTEM FOR SANITARY/INDUSTRIAL WASTE

The solid conventional waste volumes are estimated and reported in the Waste Management Operations Section monthly report and sent to Y-12 to be compared with Y-12 estimates of ORNL conventional waste volumes.

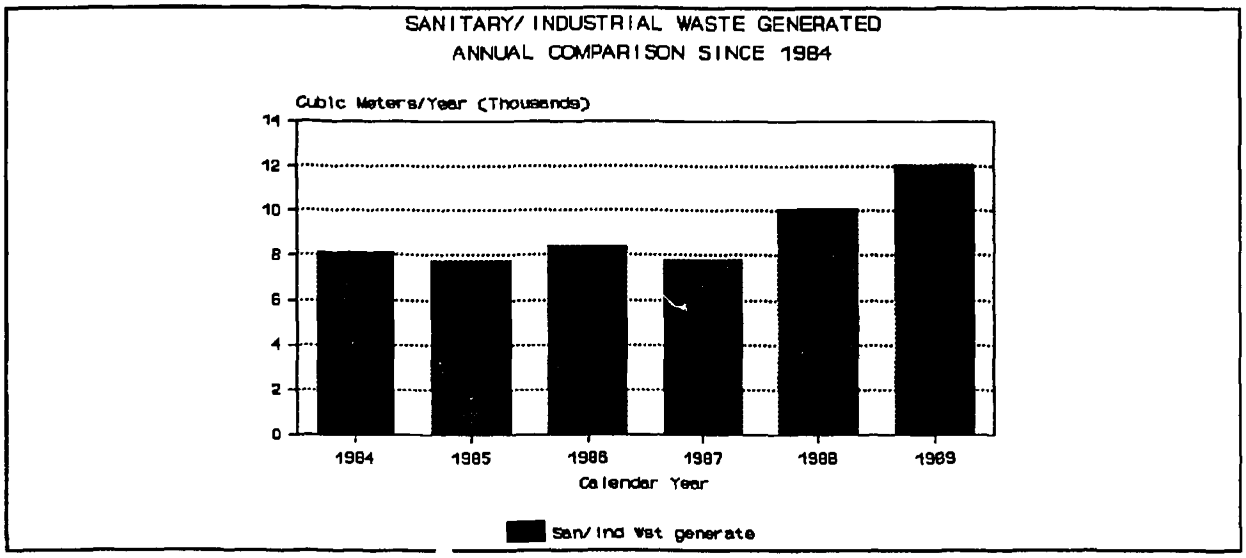

Fig. 7.1. Sanitary/industrial waste generated annually since 1984.

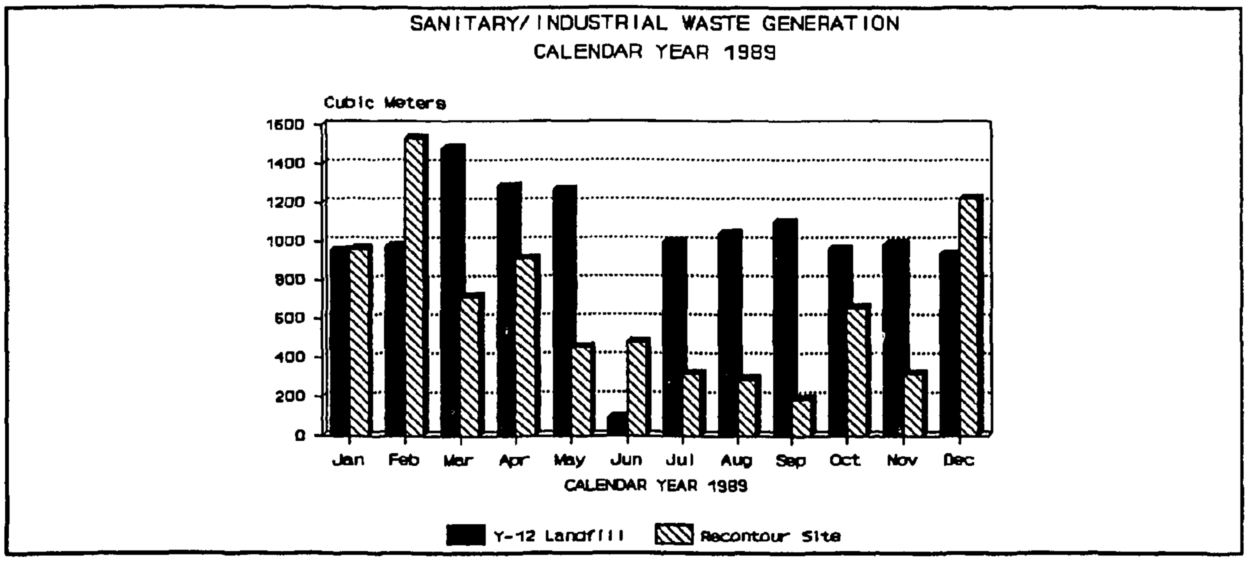

Fig. 7.2. Sanitary/industrial waste generated during CY 1989.

7.3 SANITARY/INDUSTRIAL WASTE GENERATOR TRAINING

At present, there is no formal training for generators of sanitary/industrial waste. Future developments of WAC for sanitary/industrial waste may necessitate training requirements.

7.4 REDUCTION OF SANITARY/INDUSTRIAL WASTE

Waste reduction has not been as important a factor for conventional waste as it has been for radioactive and hazardous waste because the cost for disposal per unit volume is significantly less. However, the cost for disposal per unit volume will continue to increase with time as a result of transportation, emplacement, monitoring, and new site development costs. Therefore, economic incentives to reduce volume will continue to grow, especially in the area of bulky general refuse.

Some 4,000 tons of potentially recyclable paper and approximately one ton of recyclable aluminum cans are disposed of each year in the sanitary landfill. These materials are filling up available landfill space. Investigation of recycling paper and aluminum cans at ORNL is ongoing. An implementation plan for aluminum recycling will be completed by August 1990. A letter report for paper recycling has been issued. It was recommended a study be conducted to identify the large users and disposers of paper at ORNL and identify centrally located collection areas for recyclable paper. Recyclable paper could be segregated at the office level. U.S. Government offices and their contractors could use recycled paper helping to create a market for recycled paper.

Implementation of an aluminum can recycling program at ORNL is making progress. Informational surveys were conducted to obtain data on quantities of aluminum cans which could be recycled at ORNL and employees' reactions to such a program. The Energy Systems' Value Committee is involved in this potential program. Collection of aluminum cans for recycle could be instituted in FY 1990.

As a PIP Project, the Environmental Sciences Division is investigating the substitution of 100 percent recycled paper for computer output paper instead of virgin paper. For three months (November 1989 to February 1990), ESD used recycled paper to ensure that it performs to the same level as the virgin paper. By substituting recycled paper for virgin paper, ESD is creating a market for recycled paper, conserving natural resources, and protecting the environment. The recycled paper has the added benefit of costing 1/3 the price of virgin paper. (This PIP Project received the Martin Marietta President's Award for Performance Improvement.)

8.0 SUMMARY

The reduction of all ORNL 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 all types of wastes by prevention of their generation from the start. At ORNL, efforts to minimize many wastes have been mandated by federal regulations and DOE, Energy Systems, and internal policies. Real progress has been achieved. 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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