Environmental Protection Department
Operations & Regulatory Affairs Division

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**Waste Minimization
and
Pollution Prevention Awareness
Plan**

May 31, 1991

**Enviromental Protection Department
Operations and Regulatory Affairs Division
Waste Minimization Program**

Lawrence Livermore National Laboratory

University of California Livermore, California 94551

MASTER

Lawrence Livermore National Laboratory

June 28, 1991

Mr. Warren W. Warner, Director
Laboratory Operations Division
Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, Ca. 94612

Subject: 1991 Waste Minimization Plan for Lawrence Livermore
National Laboratory.

Dear Wes,

I have enclosed the documentation required by the Implementation Guidance for DOE Order 5400.1, dated March 1990. As previously done, the Waste Minimization Plan includes a series of mini-plans that were prepared by each of the Departments and Programs.

The main section of the Plan follows the format prescribed by DOE's Model Waste Minimization and Pollution Prevention Awareness Plan. The mini-plans and Waste Reduction Activity Report follow the original formats given in the Guideline.

Sincerely,

Harry L. Galles
Department Head
Environmental Protection Department

HLC:JCD:prf

Copy to:
D. Fisher
S. Jackson

MASTER

**Lawrence Livermore National Laboratory
Waste Minimization Plan**

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Awareness Plan for LLNL**

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**WASTE MINIMIZATION
AND
POLLUTION PREVENTION AWARENESS
PLAN**

For Lawrence Livermore National Laboratory

May 31, 1991

Approved: Date 7/12/91
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Division Leader for Operations and Regulatory Affairs

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I. INTRODUCTION/BACKGROUND

A. Purpose of Plan

The purpose of this plan is to document the Lawrence Livermore National Laboratory (LLNL) Waste Minimization and Pollution Prevention Awareness Program. The plan specifies those activities and methods that are or will be employed to reduce the quantity and toxicity of wastes generated at the site. It is intended to satisfy Department of Energy (DOE) and other legal requirements that are discussed in Section C, below. The Pollution Prevention Awareness Program is included with the Waste Minimization Program as suggested by DOE Order 5400.1. The intent of this plan is to respond to and comply with the Department's policy and guidelines concerning the need for pollution prevention.

The Plan is composed of a LLNL Waste Minimization and Pollution Prevention Awareness Program Plan and, as attachments, Program- and Department-specific waste minimization plans. *This format reflects the fact that waste minimization is considered a line management responsibility and is to be addressed by each of the Programs and Departments.*

B. Scope of Plan

A waste minimization program is an organized, comprehensive, and continual effort to systematically reduce waste generation. The LLNL Waste Minimization and Pollution Prevention Awareness Program is designed to eliminate or minimize pollutants released as a consequence of the Laboratory's operation. Our purpose is to protect public health and the environment, as well as to:

- Reduce waste management and compliance costs
- Reduce resource usage
- Improve product yields
- Reduce or eliminate inventories and releases of hazardous chemicals reportable under the Emergency Planning and Community Right-to-Know Act
- Reduce or eliminate the Laboratory's civil and criminal liability under existing environmental laws

The program reflects the Laboratory's goals and policies for waste minimization, and represents an ongoing effort to incorporate pollution prevention and waste minimization into the site's operating philosophy. In accordance with DOE policy, a hierarchical approach to waste reduction has been adopted and is applied to all types of waste.

Waste minimization will be accomplished by eliminating or minimizing the generation of waste through source reduction. When possible, those potential waste materials that cannot be eliminated or minimized will be recycled (i.e., used, reused, or reclaimed). Any waste that is generated will be treated as appropriate to reduce volume, toxicity, or mobility before storage or disposal.

The scope of this plan is confined to source reduction, material substitution, and environmentally sound recycling. Methods for treatment of waste are covered in other directives.

The plan is a reference tool and guidance document for managers, operations personnel, and support staff. It contains the policy, objectives, strategy, and support activities of the Waste Minimization and Pollution Prevention Awareness Program. One way discussed is to raise the awareness of the employees concerning minimization techniques; another way is to train employees to reduce waste and still meet the programmatic requirements for quality, productivity, safety, and environmental compliance.

This plan applies to all site operations and associated support operations. It will be reviewed annually and revised as necessary. At a minimum, the plan will be updated every 3 years.

The plan will be available to affected employees and site contractors; and the policy, goals, objectives, and strategy of the plan will be communicated to all employees.

C. Legal and Policy Background

The Resource Conservation and Recovery Act (RCRA) requires hazardous waste generators to establish a program to reduce the volume or toxicity of waste to the degree determined by the generator to be "economically practicable." Hazardous waste generators must certify in their waste manifest that this requirement has been fulfilled. Generators must also identify in their biennial reports to the Environmental Protection Agency (EPA) and the State of California their efforts to reduce the volume and toxicity of waste and the changes in volume and toxicity actually achieved. Waste generators also have the option to report waste minimization results in their annual submission of toxic chemical release inventories to EPA.

DOE Orders 5400.1, 5400.3, and 5820.2A mandate that radioactive wastes and other pollutants shall be managed in a manner that minimizes the generation of such wastes.

DOE Order 5400.1 establishes environmental protection program requirements and responsibilities for assuring compliance with environmental protection laws. The Order requires the establishment of a waste minimization program "that will contain goals for minimizing the volume and toxicity of all wastes that are generated" and a Pollution Prevention Awareness Program. The Waste Minimization Program and the Pollution Prevention Awareness Programs are to be established through implementing plans.

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The implementing guidance permits the two programs and implementing plans to be consolidated.

DOE Order 5400.3 establishes DOE hazardous and radioactive mixed waste policies and requirements and implements the requirements of RCRA within the framework of the environmental programs established under DOE Order 5400.1. The Order states that it is DOE policy to "implement waste minimization measures as specified in RCRA for hazardous and radioactive mixed wastes." The Order requires the Heads of Field Organizations to "implement a waste minimization program for hazardous and radioactive mixed wastes."

DOE Order 5820.2A establishes policies, guidelines, and minimum requirements by which DOE manages its radioactive and mixed waste and contaminated facilities. It states that the "generation, treatment, storage, transportation, and/or disposal of radioactive wastes, and the other pollutants or hazardous substances they contain, shall be accomplished in a manner that minimizes the generation of such wastes across program office functions and complies with all applicable Federal, state, and local environmental, safety, and health laws and regulations and DOE requirements." The Order requires the preparation of a waste management plan for each site that generates, treats, stores, or disposes of DOE wastes. The waste management plan "will indicate actions (taken) to minimize hazardous waste generation."

DOE Order 5820.2A contains specific waste minimization requirements for management of high-level, transuranic, and low-level waste. These requirements include process modification, process optimization, and materials substitution.

DOE's Waste Reduction Policy Statement requires all DOE Program Offices and Field Operations to "institute a waste reduction policy to reduce the total amount of waste that is generated and disposed of by DOE operating facilities through waste minimization (source reduction and recycling) and waste treatment." The policy consolidates the requirements of DOE Orders 5400.1, 5400.3, and 5820.2A for either a waste minimization or a waste reduction plan and attaches guidance for satisfying the reporting requirements of those orders. The statement adopts the hierarchical approach to waste reduction and applies the policy to all types of waste. The policy requires waste reduction to be an important consideration in research activities, process design, and facility design and operations.

D. Mission and Site Description

The Lawrence Livermore National Laboratory is owned by the U.S. Government and is operated by the University of California under a prime operating contract, W-7405-Eng-48, with the U.S. Department of Energy (DOE).

The Laboratory has two sites, a main site (the Livermore site) and a hydrodynamics test range area referred to as Site 300. The main site, approximately one mile square, is located in Alameda County, California, near the city of Livermore (see Fig. 1), and

Fig. 1. Overview of the San Francisco Bay Area showing the LLNL Site and Site 300.

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employs approximately 10,000 people. A layout of the site is shown in Appendix A. Site 300 occupies an area of approximately 10 sq. miles, and is located about 15 miles southeast of the main site. When we refer to LLNL in this plan we are talking about both sites.

The Laboratory site was established in 1952 to carry out nuclear weapons research. Since then, activities have expanded to include research in such basic disciplines as chemistry and material science, engineering, geology, biology, computer science and technology, and physics. Site 300 is used for materials testing and high explosives diagnostics.

II. RESOURCES

A. Program Budget

In Appendix B, the budget for the Waste Minimization and Pollution Prevention Awareness Program itemizes the funds allocated to the various activities in the program. This information is derived from Activity Data Sheet (ADS) 1406,* dated March 1991. Funding to plan and implement waste characterization, process waste assessments and minimization comes from the various programs and is not included in the appendix. These expenditures are significant, especially for the programs that are large generators and those that have waste minimization committees.

B. Personnel

The number of full-time and part-time employees assigned to the Waste Minimization and Pollution Prevention Awareness Program is described in Appendix B. Programmatic Personnel assigned to waste minimization and process waste assessment activities are not shown.

III. POLICY

A. Statement of Management Support/Commitment

The Director of the laboratory, the Associate Directors, and the Chairman of the Environment, Safety and Health (ES&H) Council, are totally committed to minimizing the generation of waste through source reduction, material substitution, and

*Environmental Restoration and Waste Management Five-Year Plan, March 19, 1991.

environmentally sound recycling. Top management will provide resources and the required awareness and/or training on a continuing basis to ensure that the objectives of the Waste Minimization and Pollution Prevention Awareness Program are met.

B. Policy Statement

The Director has issued a written policy that establishes the Waste Minimization Program and states a waste minimization policy for LLNL. The policy is appended to this plan as Appendix C.

C. Relevant Site Directives or Guidance

The following LLNL documents govern the implementation of this plan and provide additional guidance:

M-078-92 "Hazardous Waste Management Quality Assurance Plan"

M-010 "LLNL Health And Safety Manual"

"LLNL Environmental Protection Handbook"

IV. OBJECTIVES, STRATEGY, AND GOALS

A. Program Objectives

The primary objective of the Waste Minimization and Pollution Prevention Awareness Program is to cause a significant reduction in the generation of radioactive, hazardous, and mixed wastes, and also non-hazardous solid wastes. It is also the objective of the Program to instill an attitude of pollution prevention into the day-to-day activities of the personnel at LLNL.

B. Strategy

The waste minimization program at LLNL places responsibility for waste minimization on the generators and the generator organizations. Essential elements of the strategy are: (1) an organization that comprises line and staff representatives who administer the waste minimization program within the programs, (2) a process that identifies targets for waste reduction, and (3) a method for tracking the performance and progress of the program. The strategy involves the distribution of responsibilities for providing support, planning, and implementing waste minimization measures. The strategy thus establishes the roles for the Waste Minimization Program Office (WMPO) and that of

the LLNL Waste Minimization Steering Committee (WMSC). This is described in detail in Section V of this report.

The strategy for achieving the Laboratory objectives will make use of, but will not be limited to, the following activities:

- Foster a philosophy to conserve resources and minimize waste generation and pollution in achieving programmatic objectives.
- Promote the use of nonhazardous materials in operations to minimize the potential risks to human health and the environment.
- Reduce or eliminate the generation of waste materials through input substitution, product reformulation, process modification, improved housekeeping, and onsite closed-loop recycling to achieve minimal adverse effects on the air, water, and land.
- Enhance communication of waste minimization objectives, goals, and ideas laterally and vertically among site organizations.
- Promote integration and coordination of waste generators and waste managers on waste minimization matters.
- Characterize waste streams and develop a baseline of waste generation data.
- Identify and implement methods and technologies for waste minimization.
- Target policies, procedures, or practices that may be barriers to waste minimization.
- Create incentives for pollution prevention.
- Develop and implement employee pollution prevention awareness and occupational training programs.
- Collect and exchange waste minimization information through technology transfer, outreach, and educational networks.
- Develop mechanisms for fully disseminating current technical information to site users.
- Enhance employee awareness of pollution prevention goals, objectives, and methods.
- Develop specific goals and schedules for waste minimization activities.
- Comply with federal and state regulations and DOE requirements for waste minimization.

C. Goals

Numerical goals for the minimization of certain types of wastes generated at LLNL are to be developed as results from our process waste assessment (PWA) efforts become available. The Director's goals are stated in Appendix C.

D. Schedule of Activities

A schedule of waste minimization activities is presented in Appendix D.

V. ORGANIZATION AND STAFF RESPONSIBILITIES

A. Description of the Waste Minimization Organization

Lawrence Livermore National Laboratory is managed through the organizational structure shown in Fig. 2. Responsibilities for ES&H and the programmatic activities of the Laboratory start with the Director and are delegated to Associate Directors and Program Leaders. Included in these responsibilities are pollution prevention and the implementation of waste minimization.

The Waste Minimization Program Office (WMPO) is part of the Environmental Protection Department of Plant Operations. This office is charged with providing coordination, guidance, cost and wastes accounting. In addition, it monitors the progress of the program, technology transfer, and technical support for the LLNL waste minimization effort. The WMPO is also responsible for establishing a pollution prevention awareness program and providing guidance to ensure that LLNL is in compliance with federal and state regulations associated with pollution prevention. The WMPO interacts Lab-wide via the Waste Minimization Steering Committee (WMSC) and through contacts with the individual waste minimization committees and coordinators. The office also interacts directly with generators to help carry out assessments, assist in evaluating technical and economic feasibility studies, and facilitate technology transfer.

The program's organizational structure is designed to maximize the dissemination and collection of waste minimization information, and to provide waste generating organizations with managerial responsibility for the development, design, construction, and implementation of waste minimization projects.

B. Waste Minimization Steering Committee (WMSC)

The WMSC is composed of senior management representatives from each of the Directorates and Programs. The WMSC develops and recommends waste minimization policies at LLNL.

Other functions of the WMSC include but are not limited to the identification of tasks to implement the program, providing a mechanism for communication within the site on waste minimization matters, and reviewing policy changes and the implementation of lab-wide waste minimization projects.

Lawrence Livermore National Laboratory

Date: May 31, 1979
 Contract: Request of the University
 of California
 Contract: No. W-7404-Eng-48
 Type of Contract: Research

John H. Nuckolls
 John H. Nuckolls, Director

The responsibilities of the WMSC members include:

- Supporting the organizational maintenance of the waste minimization program (in accordance with DOE Order 5400.1)
- Communicating waste minimization and pollution prevention objectives to the Directorates and Programs
- Obtaining waste generator support and input for the program
- Facilitating integration and coordinated interaction with waste generators
- Sponsoring ongoing employee awareness and training
- Coordinating participation of his/her organization with the WMPO
- Recommending options for management implementation
- Monitoring the progress of the waste minimization program
- Facilitating technology transfer and pollution prevention awareness

D. Waste Minimization Coordinators

Some of the generator organizations at LLNL have waste minimization coordinators and/or waste minimization committees. The committees are made up of mid-level managers and/or technical staff. The responsibilities of the committees and coordinators include the documentation of hazardous materials usage, waste streams and generating processes; taking part in carrying out process waste assessments; identifying targets of opportunity; and facilitating the implementation of waste minimization measures.

VI. COST ACCOUNTING

Costs associated with handling of wastes at the waste management yards, and the transportation and disposal of wastes have been estimated. These estimates are calculated in terms of unit mass or volume of waste. This information will be used in process waste assessments for economic analyses of waste minimization options.

VII. WASTE ASSESSMENTS

Process waste assessments (PWA) are being conducted as part of an ongoing program to identify, screen, and analyze options to reduce the generation of waste. A PWA determines the amount of material in a workplace that is disposed of as waste. It provides a summary of hazardous materials usage and waste production and identifies

those processes and operations that need to be improved or replaced to promote waste minimization. The assessment also provides a basis for prioritizing specific waste minimization options.

The hazardous waste generating activities at LLNL can be compared to those in a small industrial park with a multitude of small generators and a few larger generators. In such a situation, facility process flow diagrams can not be easily prepared. In the past, large aggregate waste streams have been identified and analyzed for waste minimization potential (see References). Future activity will focus on the identification of waste streams that account for 5% or more (by mass) of the total lab-wide hazardous waste production. The data for calendar year 1990 will be used in this process. Detailed process description and requirements, waste management activities, and process flow diagrams will be documented where possible for the identified processes.

Assessments of waste generating operations within the programs are an ongoing activity conducted by waste assessment teams organized by the line management of the respective organizations.

Waste minimization opportunities are evaluated within each organization. The evaluation results will lead to a list of options that are candidates for technical and economic evaluation. The potential technical success and economic cost/benefit of identified options are evaluated by the organizations. The options will then be ranked in order of preferred implementation. The highest priority normally will be given to source reduction followed by recycling. Waste Reduction Activity Reports (under DOE Order 5820.2a) have been prepared for CY1990. These reports include listings of implementations done in CY1990.

A schedule for conducting waste assessments is shown in Appendix D. The assessments will be conducted on a recurring basis.

VIII. WASTE MINIMIZATION TECHNIQUES

A. Scope

Waste minimization includes those activities that minimize or eliminate the generation of waste and recycling processes that use, reuse, or reclaim a material from a waste stream. Some activities commonly thought to be waste minimization are waste treatment. The following activities are not considered waste minimization:

- Transfer of hazardous constituents from one environmental medium to another
- Concentration conducted solely for reducing volume
- Dilution as a means of toxicity reduction, unless later recycling steps are involved

If the activity is to make the material more amenable for disposal (e.g., reduce volume or toxicity before storage or disposal) then the waste is being treated, not minimized.

B. Techniques

1. Inventory Management

Current methods to control the types and quantities of materials in the site inventory will be reviewed. Where necessary, inventory control techniques will be revised or expanded to reduce inventory size and hazardous chemical use while increasing inventory turnover. In particular, inventory control techniques will be used to reduce waste resulting from excess, out-of-date, and no-longer-used raw materials. Control techniques will also be developed to discourage the use of extremely hazardous materials and encourage the use of more easily manageable materials.

The review of inventory management techniques will include a study of how existing inventory management procedures can be applied more effectively, whether new techniques should be added to or substituted for current procedures, the need for review and evaluation approval procedures for the purchase of materials, and the need for additional employee awareness and/or training.

2. Maintenance Program

Waste streams generated within the site maintenance program have been identified and techniques leading to waste reduction have been implemented in certain areas with considerable success. The maintenance program is committed to seeking ways to use new technologies to reduce waste.

The site equipment preventive maintenance program for vacuum pumps and air conditioning equipment has been reviewed to determine whether improvements in corrective and preventive maintenance can reduce waste generation caused by equipment failure.

3. Material Change and Process Equipment Modification

The replacement, reformulation, reduction, or elimination of hazardous materials in production, maintenance, and cleaning processes is being examined. The effect on waste reduction by the installation of new equipment or the modification of existing equipment has been considered in several areas. Techniques such as segregation to separate hazardous wastes from the total waste stream are an accepted Laboratory practice. New applications are continually being explored. Those applications offering significant waste reduction or cost benefit will be implemented as funding allows.

4. Recycling and Reuse

Opportunities for reclamation and reuse of waste materials has been explored and is being practiced whenever practical. Decontamination of tools, equipment, and materials for reuse or recycle has been ongoing for a number of years. LLNL will look for other opportunities where recycling and reuse may be found practicable to minimize the amount of waste for disposal.

Reclamation of scrap metals (ferrous and non-ferrous), cardboard, tires, and most recently office paper has proven successful at LLNL.

IX. TRAINING, AWARENESS, AND INCENTIVES

A. Training Goals

One of the most important elements of a waste minimization program is training. Goals of the training program are to: 1) make each employee aware of waste generation, 2) have employees understand the impact of wastes on the site and the environment, and 3) to provide information on ways (including technologies) to reduce waste and prevent pollution.

B. Specialized Training Program

A multilayer training program is being developed. At the management level, employees will be instructed on policy and procedures as well as techniques for encouraging and fostering pollution prevention within their immediate groups. Key individuals identified by their line management will be given specialized, intensive training on waste minimization methods, tools, and sources of information. Other generators will receive generalized training on policy and procedures, waste minimization methods and techniques, environmental awareness, and sources of help and information.

C. Pollution Prevention Awareness

The Pollution Prevention Awareness Program required by DOE Order 5400.1 has been incorporated into the Waste Minimization Program. The purpose of the Pollution Prevention Awareness Program is to foster the philosophy that prevention is necessary and should be a part of our routine daily activities. The goal of the program is to incorporate pollution prevention into the decision-making process at every level throughout the organization. The Pollution Prevention Awareness Program has the following objectives:

- Make employees aware of general environmental activities at the Lab and waste minimization program requirements, goals, and accomplishments

- Inform employees of specific environmental issues
- Inform employees on their responsibilities in pollution prevention
- Recognize employees for efforts to improve environmental conditions through pollution prevention
- Encourage employees to participate in pollution prevention
- Publicize success stories

The program consists of three elements: (1) pollution prevention awareness functions, (2) peer recognition, (3) and information exchange.

The pollution prevention awareness functions make extensive use of site newsletters, bulletin boards, signs, and slogans to enhance employee awareness of and participation in pollution prevention. As examples, during 1990-1991:

- The publication of *Waste Notes*—a waste minimization bulletin was initiated
- A poster session was held during Earth Week 1991, at LLNL
- Posters have been regularly placed on bulletin boards
- The cafeteria service has sold over 7,500 reusable-plastic beverage cups and given a discount on refills (19,000 refills to date)

The pollution prevention awareness program may also develop an orientation program for new employees. The orientation program would include the following elements:

- The need for, and benefits to be derived from, waste minimization and pollution prevention
- The contribution each employee can make to an improved working and living environment
- Emphasis of management commitment to waste minimization and site waste minimization policy
- Overview of policy and regulations
- Solicitation of waste minimization and pollution prevention ideas

D. Incentive Awards and Recognition

A program to give peer recognition to individuals involved in waste minimization and pollution prevention achievements is carried out through the use of *Waste Notes* and the Lab newspaper—*Newsline*. The potential for developing an awards system for successful projects will be considered at a later time.

X. TRACKING AND REPORTING SYSTEMS

A. Tracking From Point of Generation to Point of Disposition

There will be two computerized systems involved in tracking hazardous materials at LLNL. One, a chemical tracking system, will track identified hazardous materials from point-of-site entry to the final location of use, and record the quantities of hazardous constituents. The date and location of final consumption will also be recorded.

A separate waste tracking system is operated by the Hazardous Waste Management Division of EPD. This system collects data on the location and date when wastes are prepared for transfer to a waste accumulation area. It also records the quantity, the waste description, the generator of the waste, the associated hazardous waste codes, and final disposition of the waste.

The information that can be extracted from each of these systems will allow the Project office to track hazardous materials before they become a waste, and track wastes for monitoring and reporting purposes.

B. Procurement Control System

The control and purchase of hazardous chemicals or other materials will be reviewed by the Project office to determine what improvements in those procedures can be made to achieve waste minimization goals.

C. Program Activity Tracking

Several laboratory programs have a computer based tracking system that outlines the types of activities going on in their respective areas and indicates where waste minimization implementations have been made.

D. Federal and State Reporting Requirements

Tracking systems developed under this program are being designed to facilitate the reporting of waste minimization data and accomplishments to the Department of Energy, the Environmental Protection Agency, and the California Department of Health Services.

XI. QUALITY ASSURANCE

Guidance implementing DOE Order 5820.2A stresses quality assurance in conducting waste reduction activities. The order indicates that waste reduction programs are

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required to "retain an appropriate level of documentation and accountability. The documentation of these programs should be designed to satisfy all requirements of the Waste Operations Quality Assurance Program at each field office."

A. Quality Assurance Program Plan

A QA program plan has been developed for the management of the Waste Minimization Program as required for all programs by DOE Order 5700.6B. The plan will be revised to be consistent with the Waste Operations Quality Assurance Program of DOE-SAN. The plan will specify documentation that will enable verification of data reported in the Hazardous Waste Management database.

B. Quality Assurance Training

Training on QA methods for waste minimization procedures and documentation will be given to appropriate Project office staff members. Other employees will be briefed on policies and procedures.

XII. INFORMATION EXCHANGE AND OUTREACH

All program staff participate in and encourage others to make regular use of the EPA database (PIES) and the DOE Waste Information Network. The Project office fosters participation in business, education, and government forums that are designed to provide technical assistance and exchange waste minimization information. The Secretary of the WMSC selects representatives to attend the semiannual DOE Workshop on Waste Minimization. Appropriate LLNL staff regularly participate or communicate with technology groups and agencies, including:

- California DHS-Toxic Substances Control Program, Alternative Technology Division
- Alameda and Contra Costa counties waste management workshops
- Local Government Commissions Pollution Prevention Program
- EPA Office of Research and Development Center for Environmental Research Information.

XIII. TECHNOLOGY TRANSFER

The transfer of federally developed technology between laboratories and potential users is a contractual responsibility of DOE facilities and laboratories. Opportunities for transfer of technologies specific to waste minimization programs develop from

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information exchange systems, workshops, or topical conferences. Direct exchanges of process technology between facilities are encouraged, but institutional support services will be used where appropriate. Technology projects that are identified and implemented shall be coordinated with the Headquarter's Office of Technology Development.

XIV. RESEARCH AND DEVELOPMENT

Proposals for research and development (R&D) would be expected to arise from the WMPO efforts in assessments of waste streams and waste minimization options. Some options will require development work before being implemented. Requests for R&D funding listed in Appendix E., have been made. Specific proposals for R&D work are coordinated through the Associate Department Head for Research and Development of LLNL's Environmental Protection Department.

XV. PROGRAM EVALUATION

An annual report on the LLNL Waste Minimization and Pollution Prevention Awareness Program will be prepared. All major activities will be included. The report will document the effectiveness of waste minimization efforts, describe program achievements, and identify new goals.

Criteria for demonstrating the effectiveness of waste minimization efforts will be established. It is expected that the criteria will include:

- Reduced amounts of hazardous waste
- Reduced amounts of all waste
- Reduced waste management costs

(Note: The PWA assessment teams will use the criteria when evaluating waste minimization options. An accurate assessment for each of the appropriate criteria will be provided in evaluating the success of all waste minimization options that have been implemented.)

APPENDICES
APPENDIX A. SITE MAP

APPENDIX B. PROGRAM BUDGET

Waste Minimization & Pollution Prevention Program Budget—ADS1406		March 1, 1991
Budget for Fiscal Year 1992	\$K	Personnel
Program Management	300.0	2.0
Pollution Prevention Awareness	150.0	1.0
Non-Hazardous Solids Recycling	150.0	1.0
Technical Assistance to Generators	575.0	3.5
Training	200.0	1.0
Technology Transfer	150.0	1.0
Program Monitoring & Documentation	200.0	1.0
Regulatory Compliance (documentation & reporting)	225.0	1.5
Total Program Budget	1950.0	12.0

The budget above is only for the Waste Minimization Project Office of the Environmental Protection Department. The individual programs and departments at LLNL expend additional operating and capital funds in support of waste minimization activities, including reporting, assessments, implementations, and general project management.

APPENDIX C. WASTE MINIMIZATION POLICY

February 27, 1989

DIRECTOR'S STATEMENT ON WASTE MINIMIZATION

It is important that the Laboratory make a strong commitment to waste minimization—particularly to hazardous and radioactive waste minimization. Our goal is to reduce the Laboratory's hazardous/radioactive waste streams by a major factor in the next three to five years by reducing generation and increasing recycling. We will implement an incentive system where each Laboratory program will pay the costs associated with the handling and disposal of its waste. Each program will establish waste minimization goals and develop plans and assign responsibility for achieving these goals. Waste minimization will be incorporated in the design of new projects.

John H. Nuckolls

Director

APPENDIX D. DETAILED SCHEDULE FOR WASTE MINIMIZATION AND POLLUTION PREVENTION AWARENESS PROGRAM ACTIVITIES

<u>ELEMENTS</u>	<u>RESPONSIBILITY</u>	<u>SCHEDULE</u>
Budget		
1. Complete Waste Minimization Program Itemized Budget	WMPO ¹	March 1992
2. Requirements Definition	EPD ² & WMPO	February 1992
3. Verification and Acceptance of Budget	EPD	March 1992
Employee Achievements and Incentives		
1. Submit Thank You Letters	WMPO	Continuing activity
2. Submit items to Waste Notes	WMPO	Continuing activity
3. Submit stories to Newslane	WMPO	Continuing activity
Employee Awareness		
1. Awareness Activities	WMPO	Continuing activity
2. General Environmental seminars	WMPO	Continuing activity
3. Waste Notes Articles	WMPO	Continuing activity
4. Newslane Articles	WMPO	Continuing activity

¹ Waste Minimization Program Office

² Environmental Protection Dept.

ELEMENTS**RESPONSIBILITY****SCHEDULE****Information Exchange**

1. DOE HAZWRAP Workshop	WMPO	Continuing activity
2. DOE Contractor Committees	WMPO	TBD
3. Forum Meetings	WMPO	Continuing activity

Management Support

1. Assist programs in maintaining management support	WMPO	TBD
2. LLNL Waste Min. Steering Committee Meetings	WMPO	Continuing activity

Policy and Plans

1. Publish Waste Minimization Policy	Director	March 1989
2. Publish Waste Minimization and Pollution Prevention Awareness Plan	WMPO	June 1991

Procedures and Practices

1. Review Procurement, and Maintenance Practices	Programs	March 1992

Program Evaluation

1. Develop Program Evaluation Plan and Procedures	WMPO	December 1991
2. Complete Program Evaluation	WMPO	February 1992
3. Complete Report to WMSC	WMPO	October 1992

ELEMENTS**RESPONSIBILITY****SCHEDULE****Quality Assurance**

<u>ELEMENTS</u>	<u>RESPONSIBILITY</u>	<u>SCHEDULE</u>
Quality Assurance		
1. Complete Quality Assurance Plan	WMPO/EPD	TBD
2. Develop Q/A Training Module on Waste Minimization	WMPO/EPD	TBD
Reporting		
1. Compilation of Report Data	WMPO	Continuing activity
2. Submittal of Quarterly Report to DOE	WMPO	Continuing activity
3. Distribution of Trends and data to Program Management	WMPO	Continuing activity
4. Submittal of California report- SB-14	WMPO	September 1991
5. Submittal of Federal Pollution Prev. Act Reports	WMPO	March 1992.
Training and Awareness		
1. Determine Training Course needs	EPD/Programs	Occurring presently
2. Develop Orientation Program	EPD/WMPO	TBD
3. Develop Specialized Training program.	EPD/WMPO	TSD
Waste Generation: Baseline		
1. Compile Data from Waste Stream Assessments (CY1990)	Programs/WMPO	April 1991
2. Develop Waste Generation Baseline Data (CY1990)	WMPO	June 1991

ELEMENTS**RESPONSIBILITY****SCHEDULE****Waste Minimization Assessments (5% Waste Streams)**

1. Establish Assessment Teams	Programs	May 1991
2. Perform Assessments	Programs	Start June 1991
3. Develop Waste Min. Options	Programs	Start June 1991
4. Screen Waste Min. Options	Programs	Start June 1991
5. Evaluate Waste Min.Options	Programs	August 1991
6. Rank and Prioritize Waste Min. Options	Programs	August 1991
7. Complete Report on Waste Min. Options	Programs	August 1991
8. Implement Waste Min. Options	Programs	TBD

Technology Transfer

1. Execute Technology Transfer	WMPO	Continuing activity
2. Visit Facilities & Other Sites	WMPO	Continuing activity

Waste Streams Goals

1. Establish Goals for LLR, RAD, Mixed Wastes	WMSC	October 1991
2. Establish Goals for Other Waste	WMSC	March 1992
3. Compare Results vs. Goals	WMPO	Continuing activity

ELEMENTS**RESPONSIBILITY****SCHEDULE****Waste Minimization Database**

1. Project Initiation	WMPO	Occurring presently
2. Requirements Definition	WMPO	October 1991
3. Computer System Devl.	EPD	March 1992
4. Verification and Acceptance	WMPO	June 1992

APPENDIX E. WASTE MINIMIZATION TECHNOLOGY PROJECTS

R & D Proposals for the following two projects have been submitted:

1. Substituting Conductive Polymers for Lead-bearing Materials in Microelectronic Applications.

Funding Profile	FY92	FY93	FY94
	\$199,639	\$198,422	\$198,626

2. Recycling of Solvents from Mixed Waste Sludges Using High Frequency Radio Wave Separation Techniques.

Funding Profile	FY92	FY93
	\$200,000	\$200,000

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Biomedical and Environmental
Research Program

**Waste
Minimization
Plan**

April 1991

WASTE MINIMIZATION PLAN

Biomedical and Environmental Research Program

I. INTRODUCTION/BACKGROUND

1. BER Research Facilities

The Biomedical and Environmental Research Program includes two research divisions that operate in 32 buildings and trailers scattered over the LLNL site. Buildings used for research, as opposed to storage and office buildings, are:

A. Biomedical Sciences Division

- Building 361 - General research, major facility
- Building 363 - Carcinogen use
- Building 364 - Hemopoiesis research and animal use
- Building 365 - Carcinogen exposure
- Building 366 - Food mutagen research

B. Environmental Sciences Division

- Building 362 - Accelerator mass spectrometry
- Building 377 - Soil assay
- Building 378 - Radiochemical research
- Building 379 - Radioactivity counting
- Building 412 - General research, major facility
- Building 592 - Soil processing
- Building 593 - Environmental sample processing
- Building 594 - General, non-hazardous

2. BER Missions

A. Biomedical Sciences Division

The Biomedical Sciences Division conducts basic and applied research directed toward understanding and measuring the critical biological effects of nuclear and nonnuclear energy agents in the environment. The major emphasis is on understanding the human genome at the molecular level and on genetic toxicology. Technological emphasis is on analytical cytology - the quantitative study of cells and cellular organelles with optical and other physical/chemical probes.

B. Environmental Sciences Division

The mission of the Environmental Sciences Division is to perform fundamental research in the environmental sciences in support of Department of Energy objectives: development and testing of nuclear weapons; development of high-risk energy technologies; remediation of waste-contaminated soil and ground water. Our target disciplines are risk analysis and aquatic, terrestrial, and measurement sciences. Our general approach is to develop basic research projects to elucidate underlying processes of transport, metabolism, and effects of compounds of interest and to formulate predictive models to use for assessment purposes.

II. WASTE MINIMIZATION PROGRAM OBJECTIVES

1. Management Support

The Biomedical and Environmental Research Program is fully committed to the national goals of reducing the amount of hazardous waste produced and to reducing the impact on the environment of the disposal of wastes that are produced. It will take the actions necessary to achieve these goals by reducing the volume and toxicity of the materials used and wastes generated through Program activities, to the extent that is economically feasible.

2. Waste Minimization Policy

Waste minimization is a primary responsibility of line management, but is also the responsibility of every employee, who will manage his/her research so as to minimize the generation of hazardous waste. To do this, each principal investigator is required to consider alternative non-hazardous chemicals in his/her procedures and to establish waste minimization as a part of his/her planning process. The Waste Minimization Committee will provide guidance in this area and will monitor waste minimization activities.

However, BER Program policy is also to make conservative judgements about the hazardous nature of waste generated during Program research. For example, unless it is directly determined that in a specific procedure no toxic materials are in use or generated, culture fluids and other materials that are exposed to toxic materials will be disposed of with the assumption that the toxic materials are present. Mutagens, carcinogens, and presumptive carcinogens at any concentration will be disposed of as hazardous waste; there is no method to otherwise determine the risk of their disposal.

3. Objectives and Numerical Goals

The BER Program is currently establishing a method of determining the amount of hazardous waste generated in the Program. This is difficult to do; volume is not necessarily a good indicator of the amount of a toxic chemical that is present. We are establishing a data base of hazardous materials that are brought into the Program, through purchase orders, which will allow us to track the kinds and amounts of hazardous materials received. We can then set goals for reduction. After the data base on waste exported from the Program is completed, we can set goals for reducing the amount of extraneous material that leaves the Program as hazardous waste. In the meantime, all personnel have been advised to reduce their purchases to the minimum acceptable and to be particularly careful about disposing of nonhazardous waste in the hazardous waste stream.

III. WASTE MINIMIZATION PROGRAM

1. Strategy for Organization, Implementation and Schedule

- **Organization** - The Associate Director of the Biomedical and Environmental Research Program has appointed an ES&H Assurance Manager whose responsibilities include forming and directing the activities of a Waste Minimization Committee. This Committee, with representation from all major facilities within the Program, is responsible for forming the BER Waste Management Plan.
- **Implementation** - The operations of the BER Program are performed under Facilities Safety Procedures (FSP's) and Operational Safety Procedures (OSP's) developed by the Program with the guidance of the Hazards Control and Environmental Protection

Departments. When each of the FSP's comes due for renewal, sections explaining the rationale for minimization of waste production and examples of activities that minimize waste or reduce its toxicity, will be incorporated. Approval of new OSP's and revisions of old OSP's requires that the amount and types of waste generated have been reviewed for minimization and that substitutes for processes or materials have been considered and adopted where possible. Other areas that will be addressed as methods of implementing waste minimization practices include: 1) Monitoring of purchase orders to assure that chemicals are not ordered when the requested chemicals are already present and available within the Program.; 2) Recycling - New users will be sought for surplus chemicals that would otherwise be waste. This effort will include segregation of used materials.; 3) Audits - Summaries of wastes produced by each working group, obtained from the Hazardous Waste Management Group.

- Schedule - The scheduling of waste minimization activities is a continuing process, entirely dependent on progress made. The gathering of data occurs monthly as waste reports are generated. The implementation of the purchase order tracking system is dependent on the LLNL purchasing department completing its computerization process. We will continue to track orders within the Program manually. Education is an important part of the waste minimization process. All BER Program personnel are required to take an annual waste generators class taught by the Waste Management Group of the Environmental Protection Department. They also take an annual ES&H Orientation course which includes a discussion of waste minimization principles. In addition, all employees receive on the job training from their supervisors.

2. Strategy for Program Budget

We do not yet have enough data to determine the true cost of our waste minimization program. We expect to have sufficient data by the end of FY91 to develop a budget.

3. Strategy for Hazard Evaluation and Tracking

The BER Program is currently preparing a Hazard Evaluation Form to be used in lieu of an OSP. This form will include a description of the materials to be used including amounts and concentrations, possible substitutions, processes to be followed, and hazards to people and the environment. This form is designed to follow the material throughout its stay at LLNL, from purchase to disposal.

4. Accounting/Waste Management Cost

It is a major task to determine the true costs of monitoring, collecting, handling, packaging, storing and disposal of hazardous wastes. As the Hazardous Waste Management Group begins to charge for its services, part of these costs will become easier to track. Additional costs are incurred in permitting, record keeping, and accounting. Some of these costs are being tracked by the Program ES&H Assurance office with the assistance of the Resource Manager.

5. Quality Assurance

Quality Assurance will be incorporated in the following areas under the direction of the Waste Minimization Committee:

- Management support
- Data Base compliance

- Corrective action

The implementation of quality assurance principles will be monitored by the Program Assurance Office.

IV. WASTE MINIMIZATION ACTIVITIES TO DATE AND PLANNED ACTIVITIES

1. Employee Training and Awareness Program

Training in the principles of waste minimization will focus on issues specific to the BER Program and will augment training already provided by the Environmental Protection Department and the Hazards Control Department. This will be accomplished primarily through the Health and Safety Orientation Course that is tailored to the needs of the Program, but will also depend heavily on on-the-job training. This training is required of all personnel who use hazardous materials or generate hazardous waste. Attendance at these classes is reported as a factor to be considered in performance evaluations.

2. Employee Incentive/Awards Program

The BER Program Incentives and Awards Program will follow the program being developed by the Laboratory. It is expected to include awards, plaques, and other forms of recognition to encourage employees cooperation and participation.

3. Waste Minimization Assessment

The Waste Minimization Committee will perform annual reviews of waste minimization efforts and identify opportunities for additional waste minimization or elimination. The assessment will determine how well individuals (generators) are following their waste management plans. Items to be assessed include:

- Amount and kinds of waste generated
- Waste reductions that have been accomplished
- New chemicals added to the waste stream
- Substitutions that have been made
- Inventory management
- Recycling efforts
- Material conservation

The Committee will evaluate the results of the assessment and make changes in the Waste Minimization Plan where required.

4. Waste Minimization Accomplishments

During FY91, the BER Program implemented a data base to keep track of all hazardous chemicals in the Program. The data base, maintained as a public file on a networked personal computer, is checked for availability before any hazardous chemical is ordered. Our program of finding nonhazardous substitutes for many materials has resulted in the use of nontoxic scintillation liquids. We have found two methods that together have eliminated all mixed waste from radioactive labeling studies. One of the substitutes is Univasol, a nontoxic solvent. Another is "Ready Cap" manufactured by Beckman. The latter is a device that allows the counting of samples in the dry state. This combination of methods has resulted in the elimination of over 6 gallons of mixed waste per month and has had a significant affect on the total amount of mixed waste generated in the Program. This effort

is continuing, with the aim of eliminating the generation of mixed waste in the BER Program.

V. INFORMATION TRANSFER

The BER Program depends on the professionals in Hazardous Waste Management for expertise and advice in waste minimization. Additional sources of information that will be used to aid us in this effort are:

- Waste Management Workshops
- EPA Waste Minimization bulletins
- Office of Environmental Restoration
- California Department of Alternative Technologies for Recycling and Treatment of Hazardous Wastes.
- Relevant publications
- Other sources

All members of the staff of the BER Program participate in generating ideas for hazardous waste minimization, primarily through interaction with the Waste Minimization Committee. The Committee disseminates information through special topical seminars, as a part of regular Section and Division meetings, and through the Program Safety Newsletter.

V. PROGRAM PERFORMANCE EVALUATION

Progress in hazardous waste minimization in the BER Program will be reviewed annually by the Waste Minimization Committee.

Chemistry & Material Sciences
Directorate

Waste Minimization Plan

May 31, 1991

CHEMISTRY and MATERIALS SCIENCE WASTE MINIMIZATION PLAN

I. INTRODUCTION AND BACKGROUND

A. Need for a Waste Minimization Program and Plan

Waste minimization is an umbrella term that includes 2 of 4 categories of the Environmental Protection Agency's (EPA) preferred hazardous waste management strategies, i.e.:

- *Source Reduction - The reduction in the amount of waste at the source through substitution or changes to procedures or processes.*
- *Recycling - The reuse of wastes through material recovery or energy production.*

Waste minimization is becoming an increasingly important national consideration which applies to Research and Development (R&D) activities at LLNL. Legislation has made it difficult and expensive to dispose of hazardous wastes and some wastes have been banned from land disposal. This adds impetus to the need to reduce the amount of waste generated. Waste minimization carries with it numerous benefits including reduced environmental impact, reduction in liabilities associated with waste generation, improved public image and economic advantages

As part of the overall LLNL environmental policy, waste minimization has received top management attention. In February, 1989, the LLNL Director made a statement including strong support for waste minimization activities Laboratory-wide. As part of DOE Order 5400.1 which requires each DOE facility to prepare a facility wide waste minimization plan (WMP), Chemistry and Materials Science (C&MS) is generating a WMP with goals for minimizing the volume and toxicity of wastes generated by the directorate.

B. C&MS Site Descriptions

The C&MS Directorate (Department) is a support organization serving the needs of numerous LLNL programs and directorates. The Department is responsible for waste minimization activities in the following buildings: 222 complex, 232, 235, 241, 331, 332. It also participates in waste minimization activities in the C&MS areas in 191 and at Site 300.

C. C&MS Department Missions

As a multi-disciplinary Department the mission of C&MS is to provide scientific and technical expertise and leadership in the chemical and materials sciences and to support the Laboratory's many programs. In accomplishing this mission, the Department seeks to advance the frontiers of science, develop a qualified and responsive scientific and technical staff, be innovative in advancing technologies with end applications, and increase its interactions with scientists in universities, government laboratories and industry. Each Division and Facility focuses its programs on this departmental mission.

The Chemical Sciences Division (CSD) includes scientific staff who support the weapons, laser fusion, laser isotope separation, energy, and special projects programs and conducts research in a variety of areas. The Division provides research on new explosives and explosives compositions for the Laboratory's nuclear and non-nuclear programs, focuses on the initiation, performance, and hazards and vulnerability of energetic materials, develops and characterizes advanced polymeric materials, performs tritium R&D activities for weapons and fusion energy, develops computer models simulating chemical reactions and processes, participates in the oil shale project, and provides expertise in theoretical and experimental atomic and molecular physics, molecular dynamics, thermodynamics and modeling of chemical reactions.

The Condensed Matter and Analytical Sciences Division (CMAS) is a multi-disciplinary organization of chemists, physicists and materials scientists which provides expertise and experimental facilities to solve a broad spectrum of programmatic problems. Specifically, CMAS is responsible for chemical analysis and materials characterization for many of the laboratory programs. The Division fosters the development of a fundamental understanding of the measurement sciences and the discovery and exploration of new knowledge in this area. The Division research interests explore fundamental problems in atomic spectroscopy, combustion, chemical reaction theory, catalysis, electron and atomic structural properties of matter such as radiation effects, local order and phase stability plus alloy theory, superconductivity and magnetism.

The Materials Division (MD) comprises a broad spectrum of activities and disciplines. It is responsible for R&D on metals, ceramics, salts, and a variety of polymer matrix composites needed for program support. It develops and implements processes in the areas of metal forming, bonding, joining, coating, powder processing and a variety of methods to produce materials with useful properties and configurations. Efforts range from the most basic research on phase transformation to actual fabrication of special components.

The Tritium Facility (B-331) provides ICF fills and is involved in low Z hydride development and cryogenic heavy hydrogen research. Equipment includes pumps, presses, laser spectroscopy and below liquid helium temperature magnetic resonance. The staff that handles tritium resides in the building and so can concentrate solely on safe tritium handling.

The Plutonium Facility (B-332) handles plutonium-based materials and plutonium-containing assemblies in support of LLNL R&D programs. The function of the facility management and the facility operations staff is to provide programmatic users with an effectively operated physical plant, a safe and secure working environment, and an emergency-response capability. The facility operations staff also provides consultation and guidance to the programmatic users so that programmatic tasks can be performed safely and effectively.

The variety of hazardous wastes generated at the facilities throughout the C&MS Department include organic and inorganic waste, radioactive waste, and mixed waste in varying amounts and concentrations. In addition there are non hazardous solid wastes, air emissions, and waste water discharges. The importance of minimizing all waste generation through source reduction, process modification, and/or recycling has been acknowledged by Department management. This recognized need for waste minimization is being translated into an ongoing assessment of our waste streams and identification of individual projects that may offer opportunities for waste minimization. As these projects and waste streams are identified they will be investigated for alternative approaches to carrying out the same work which generate less toxic or reduced quantities of wastes. The implementation of this approach will gradually result in achieving the waste reduction necessary for a successful WMP.

II. PROGRAM OBJECTIVES

A. Statement of Management Support

The C&MS Department is committed to having a waste minimization program in place that is informed, comprehensive, and continual and which will focus on reducing the volume and toxicity of materials used and wastes generated or acquired through program and service activities to the extent that is economically practical.

B. Waste Minimization Policy Statement

Environmental protection is a primary management responsibility as well as the responsibility of every employee. This responsibility takes precedence over programmatic activities and responsibilities.

The C&MS Department is committed to actions aimed at achieving reduction of hazardous wastes generated and a lessening of the hazardous properties of the waste. This commitment is coupled with advanced planning of new experimental designs and review of existing projects producing significant hazardous waste. The Department is also committed to reviewing opportunities for reducing the volumes of mixed and radioactive waste. In keeping with this policy to reduce waste and achieve minimal adverse impact on the air, water and land through environmental controls, each program manager, project manager or principle investigator is requested to consider waste minimization for relevant activities and establish goals where applicable. Management has authorized its Waste Minimization Committee (WMC) to provide guidance, and to direct and monitor waste minimization activities. Success depends on the active participation of every member of the Department.

C. Statement of Objectives and Numerical Goals

It is intended that projects and experiments being performed by C&MS scientists and producing significant amounts of hazardous waste be identified and reviewed for appropriate waste minimization techniques. It is expected that all staff members will contribute in some way to this effort, enabling the Department to keep wastes for individual projects at a minimum. However, since C&MS functions in the dual role of performing both Departmental R&D activities and providing services to other LLNL departments, quantities and types of waste streams are subject to external controls which complicate establishing numerical goals for our waste generation.

III. DESCRIPTION OF THE WASTE MINIMIZATION PROGRAM

A. Organization and Responsibilities, Programmatic Implementation and Schedule

1. Organization

C&MS has placed waste minimization as a high priority within its programmatic activities. The Associate Director for C&MS appointed a Deputy Associate Director of Operations & Assurances (DADOA). One of the functions the DADOA was charged with was the development, implementation and oversight of the WMP for the Department. (Figure 1) On March 15, 1990, the DADOA established a Waste Minimization Committee (WMC) made up of members representing all facilities and several programs within the Department.

2. Implementation

The WMC began work by developing this WMP and estimating waste streams generated by our researchers. It is currently focusing on the identification and assessment of significant waste streams generated by the wide variety of programmatic experiments throughout the Department. The WMC is responsible for:

- Collecting process and facility data
- Developing a set of assessment parameters that will permit targeting of waste streams for waste minimization consideration
- Identifying and prioritizing high volume/highly toxic streams
- Reviewing data and inspecting sites of identified targets
- Generating options
- Establishing new project questionnaires addressing waste minimization concerns
- Establishing a program for educating the Department staff
- Assisting in the preparation of Waste Minimization Reports for the DOE and the DoHS.

3. Schedule

the WMC has estimated the quantities of waste streams and their level of toxicity for the 1989 Base Year. These were determined for buildings assigned to the C&MS Directorate: the 222 complex, 232, 235, 241, 331, 332, 825, 826, and the 827 complex. Several waste minimization activities were initiated during 1989 and 1990. The waste requisition records for 1990 are currently being examined to identify targets of opportunity for waste minimization in 1991.

Figure 2 identifies waste minimization activities and gives the 1990-91 schedule for carrying them out for the C&MS Directorate.

B. Program Budget

As those activities required to implement the WMP become clearer and associated costs are more fully defined, programmatic budgets will be expanded to include them.

C. Coordination

Technical decisions as to the classification of hazardous materials and wastes requires qualified personnel and should be based on accurate information concerning the chemicals or chemical groups. Deciding what types of hazardous materials are being disposed of is the responsibility of the generator. To that end, C&MS is developing a 'front end' review process and questionnaire for new programs, projects, or experiments which involve the use of extremely toxic chemicals or which will have more than a 5% impact on the current waste stream. This review process will identify the initial hazardous materials projected to be used together with estimates of concentrations of both the starting materials and the wastes produced. The possibility for chemical substitution, process changes, and recycling will be investigated. The questionnaire and review process may also be used for current major waste producing procedures as determined by the WMC.

D. Waste Tracking

The Laboratory is developing a system for tracking chemical containers from time of purchase to time of disposal. The goal is to track hazardous materials from time of purchase until they are consumed or disposed of. A Laboratory waste tracking system is also being developed. Procedural steps for Department chemical and waste tracking will be developed and coordinated with the Laboratory-wide tracking systems as they are developed.

E. Accounting

The waste management costs of monitoring, collecting, handling, accumulating, packaging, storing, transporting and disposing of hazardous wastes incurred by the Department are each significant elements. Additional costs are associated with permitting, record-keeping, accounting and personnel. A mechanism is required for assessing the true expenditures. The computerized waste tracking system under development by the Environmental Protection Department (EPD) can aid in accounting for these costs associated with waste monitoring. At this time, waste management costs are a function of EPD.

F. Quality Assurance

Waste minimization quality assurance is to be incorporated in the WMP, management support, oversight by the DADOA and the WMC, use of the Laboratory Deficiency Tracking System, and corrective actions.

IV. WASTE MINIMIZATION STATUS AND SCHEDULE

A. Employee Training and Awareness Program

Discussions on the education and training of the C&MS Department personnel have been initiated. It is expected that a C&MS waste minimization awareness program will be developed which will focus on those elements specific to the Department and which will complement the planned Lab-wide EPD waste minimization training. Waste minimization elements will be incorporated into identified experimental procedures and design considerations when appropriate. Employees at all levels will be involved in waste minimization, whether it's project planning, looking at alternatives, accounting for hazardous by-products of R&D activities, or participating in Laboratory wide programs such as white paper recycling. All personnel handling hazardous starting materials or waste streams are required to have appropriate training. It is hoped that employee performance evaluations can be tied to attendance at training classes needed to safely and responsibly carry out R&D activities.

B. Employee Incentives/Awards Program

A C&MS Employee Incentives and Awards Program will be developed in conjunction with the LLNL Lab-wide plan. In this program awards, plaques and other forms of recognition will be used to boost employee cooperation and participation.

C. Waste Minimization Assessment (Periodic Internal Reviews)

A report of wastes generated by C&MS Department building activities will be reviewed annually by the WMC to identify opportunities for additional minimization or elimination of wastes generated. This annual report of wastes will be provided by EPD. The objective of each review is to look at changes in waste streams, identify the large generators for the previous year, and review their procedures for opportunities for waste reduction. The focus of the first review (1990 waste streams) will be on identifying the:

- High volume waste streams
- Highly regulated wastes (chlorinated solvents, acutely hazardous)
- Land banned wastes
- Extremely toxic chemicals and troublesome compounds and any by-products or waste their use generates

Following these reviews, control strategies will be evaluated which consider: material conservation, material substitution, inventory management, recycling, segregation, and process modifications.

High priority waste streams will be ranked and then analyzed for potential reduction strategies. Where strategies are identified, studies will be made of the costs and benefits. Recommended changes will then concentrate on methods which will not affect the quality of the experiment, process or product.

Wastewater, air emissions and other sources of toxic releases will be assessed as guidance is provided.

D. Implemented Waste Minimization Technologies

Please refer to Appendix A.

V. TECHNOLOGY TRANSFER

Exchange of applicable technical information on waste minimization from other sources will facilitate C&MS waste minimization. Sources of such information can come from:

- Waste Minimization Project Office of EPD
- California Department of Alternative Technologies for Recycling and Treatment of Hazardous Wastes
- Office of Environmental Restoration
- Waste Management Workshops
- EPA Waste Minimization bulletin board reprints
- Other sources of information yet to be assembled

It is the intent of the WMC to acquire applicable alternative technologies pertinent to specific operations and to distribute the factual information throughout the Department . It is planned that this will occur via periodic seminars, workshops, newsletters and other methods yet to be determined. The objective is to develop a mechanism to obtain and disseminate information both inter and intra the C&MS & LLNL facilities.

VI. PROGRAM PERFORMANCE EVALUATION

The WMC assists in the preparations of reports on C&MS waste minimization activities for the DOE and DoHS. These reports offer a vehicle for evaluating the performance of the waste minimization efforts in the Department.

DIRECTOR'S STATEMENT ON WASTE MINIMIZATION

It is important that the Laboratory make a strong commitment to waste minimization -- particularly to hazardous and radioactive waste minimization. Our goal is to reduce the Laboratory's hazardous/radioactive waste streams by a major factor in the next three to five years by reducing generation and increasing recycling. We will implement an incentive system where each Laboratory program will pay the costs associated with its waste. Each program will establish waste minimization goals and develop plans and assign responsibility for achieving these goals. Waste minimization will be incorporated in the design of new projects.

John H. Nuckolls

Director

March 8, 1989

Computations
Directorate

Waste Minimization Plan

May 31, 1991

Interdepartmental Letterhead

Mail Station: L-67
Ext: 2-4304

Computation Assurances Office

9 May 1991
AO0002

TO: Julio Diaz

FROM: Owen Brovont

SUBJECT: Directorate Waste Minimization Plan

Attached is the Computation Directorate Waste Minimization Plan. Please contact my office if you need further information.

H. Owen Brovont, Manager
Computation Assurances

**Waste Minimization Plan
for the
Computation Directorate**

February 1990

The Computation Directorate at Lawrence Livermore National Laboratory, has reviewed its research goals and operations, and has formulated a plan of action that will allow its staff to contribute to the minimization of wastes produced at the Laboratory. This plan is in keeping with the national priority to reduce the amount of hazardous waste produced by our nation, and to reduce the impact on the environment of the disposal of wastes that are produced. The approach primarily utilizes procedures established within the Directorate, but also relies upon the waste requisition data resources of the Laboratory's Hazardous Waste Management Group. The primary components of the plan, education and administrative controls, will ensure that careful review of the nature and volume of wastes generated in our operations occurs on a regular basis, that new operations are carefully scrutinized for waste minimization options, and that successful approaches to waste minimization are shared with all staff to maximize their impact. It is expected that these actions will have the additional benefit of helping to control the costs of waste disposal.

The nature of the activities of the Directorate, with the exception of the LCC Photo Lab facility, do not inherently develop toxic waste in any significant quantity. Our operations include research groups, Computer Center Operations and support, individual consulting, and the matrixed assignment of key personnel in support of Laboratory Programs. Generation of wastes containing toxic materials, radioactive materials, biohazardous materials, and mixtures of these is unlikely to nonexistent because of the character of the work performed. Waste generation is inherently limited to the operation of the LCC photo laboratory, and in the handling, use, and disposition of developer and toner cartridges associated with Laser printers and similar equipment. We will work, however, to identify and adopt new practices and new technologies that permit reduction of the amount of waste generated wherever a change in activities or equipments warrants such a practice or procedure change.

It is Directorate policy to make conservative judgements about the hazardous nature of any waste generated in our research or operations.

The plan outlined below identifies both administrative controls and educational programs that will help ensure that minimization of waste occurs when possible and that these efforts are documented.

THE PLAN

Administrative Controls

Guidance Documents:

The operations of the Directorate are performed under Facilities Safety Procedures (FSPs) and Operational Safety Procedures (OSPs) developed by the responsible Department with the guidance of the Hazards Control and Environmental Protection Departments. When each of the FSPs comes due for revision, sections explaining the rationale for minimization of waste production and examples of activities that minimize waste or reduce its toxicity, will be incorporated. Approval of new OSPs, and renewal of old OSPs, will require that the amount and types of waste generated have been reviewed for minimization, and that substitutes for processes or materials have been considered and adopted where possible.

Ordering:

Where it is possible, redundancy, waste and toxicity of chemicals will be reduced.

(1) Orders of any chemicals whose handling and disposal require special care, will require confirmation that the requested items are not currently available in satisfactory form elsewhere on site, and that proper storage and handling facilities and procedures are in place within the Department placing the order.

(2) During inventories of storerooms, it will be determined if there are items that are being discarded due to expiration of useful shelf life. If so, the amount of these items ordered will be reduced.

(3) Whenever possible, when less toxic substitutes of stock items become available, they will be substituted, even if these are not available through the Central Supply Department.

Recycling:

New users will be sought for surplus chemicals that would otherwise become waste. Departments will segregate materials that the Laboratory has determined can be recycled.

Audits:

Summaries of the wastes produced by each waste producing group, made possible by recovery of data from the Waste Requisition Forms developed by the Hazardous Waste Management Group, will be shared with the appropriate Department personnel to alert them to the types and volumes of materials generated. Successful methods of reducing either the volume or the toxicity of waste will be shared with each generator so that each may determine the relevance of these approaches to his/her operations and activities.

Individuals can have the greatest effect on the amount of waste generated if they are aware of the impact of their actions. It is necessary that they understand the value of reduction of the toxicity of waste generated, of segregation of wastes, as well

as the overall reduction of volume of waste. The costs of disposal or treatment of different types of waste will be distributed to all waste generators. When known, changes in disposal practices that affect the cost of waste disposal will also be shared with Directorate personnel.

Training:

There are currently several formal training courses offered on site to explain and encourage waste minimization practices. Departments will incorporate the relevant courses into their overall training plans to insure that mandatory courses are taken by all personnel for whom such training is required, and that special courses for individuals associated with specific waste producing operations are attended and documented for key personnel.

In addition, periodic memos are to be distributed to all our staff that draw attention to new technologies or products whose adoption can lead to the reduction of waste.

Summary

This plan for minimization of waste generation in the Computation Directorate will permit the staff and administration to continue its operations in support of Laboratory research in a responsible manner.

Energy Program
Earth Sciences Department

Waste Minimization Plan

May 31, 1991

Energy Program/Earth Sciences Department Waste Minimization Plan

I. Introduction and Background

Waste minimization is an umbrella term that includes 2 of 4 categories of the Environmental Protection Agency's (EPA) preferred hazardous waste management strategies, i.e.:

- Source Reduction - The reduction in the amount of waste at the source through substitution or changes to procedures or processes.
- Recycling - The reuse of wastes through material recovery or energy production.

As part of the overall LLNL environmental policy, waste minimization has received top management attention. In February, 1989, the LLNL Director made a statement including strong support for waste minimization activities Laboratory-wide. As part of DOE Order 5400.1 which requires each DOE facility to prepare a facility wide waste minimization plan, (WMP), Energy Program/Earth Sciences is developing a WMP with goals for minimizing the volume and toxicity of wastes generated by the Directorate.

Site Descriptions

The Energy Program/Earth Sciences Department is a support organization serving the needs of numerous LLNL programs and directorates. They are responsible for waste minimization activities in the following buildings: 243, 410, and the T1400 complex.

Mission Statement

The Energy Program conducts research and development to meet the nation's long-term energy needs. It looks for unique solutions to problems that impede the use of energy resources, and they seek to develop more efficient processes for converting resources to useful energy and for managing waste products of energy use.

The Earth Sciences Department provides support in geology, geochemistry, geophysics, seismology, geologic engineering, hydrology, and shock physics to a number of LLNL programs, including Nuclear Test-Experimental Science, Treaty Verification, Nuclear Waste Management, Hazardous Waste, Fossil Energy, and Weapons. In addition, a geosciences research effort is supported by the Office of Basic Energy Sciences.

II Program Objectives

Statement of Management Support

The Energy Program/Earth Sciences Department is committed to having a waste minimization program in place that is informed, comprehensive, and continual, and which will focus on reducing the volume and toxicity of materials used and wastes generated or acquired through program and service activities to the extent that is economically practical.

Waste Minimization Policy Statement

Environmental protection is a primary management responsibility as well as the responsibility of every employee. This responsibility takes precedence over programmatic activities and responsibilities. Energy Program/Earth Sciences Department is committed to actions aimed at achieving reduction of hazardous wastes generated and a lessening of the hazardous properties of the waste.

Statement of Objectives and Numerical Goals

It is intended that projects and experiments being performed that produce significant amounts of hazardous waste be identified and reviewed for appropriate waste minimization techniques. It is expected that all staff members will contribute in some way to this effort, enabling the Directorate to keep wastes at a minimum. However, since the Directorate functions in the dual role of performing both Departmental R&D activities and providing services to other LLNL departments, quantities and types of waste are subject to external controls which complicate establishing numerical goals for our waste generation.

III. Description of the Waste Minimization Program

Organization and Responsibilities, Programmatic Implementation and Schedule:

Organization: Energy Program/Earth Sciences Department has placed waste minimization as a high priority. The Energy Program Leader has appointed an Associate for Operations & Assurances, and a Department WM Administrator.

Implementation

The WM Administrator began by appointing a WM Coordinator who estimated waste generated in the organization's facilities. The WM Administrator worked with the WM Coordinator to develop a Waste Minimization Plan for the Energy Program/Earth Sciences Department. This plan was reviewed and approved by the Earth Sciences Department Head and the Energy Program Associate for Operations & Assurances.

Schedule

An estimate of the quantity of waste generated and their level of toxicity for the 1989 Base Year has been made for the buildings assigned to the Directorate. This includes Bldg. 243, Bldg. 410, and the Trailer 1400 Complex (1401, 1402, 1403, 1404, 1405, 1406, 1413, 1452, 1456, & 1478). A review will take place each year to identify targets of opportunity for waste minimization.

Program Budget

Activities required to implement the WMP and associated costs are covered by the Earth Sciences Department burden budget. No additional funds have been received to carry out the tasks associated with waste minimization.

Coordination

Technical decisions as to the classification of hazardous materials and wastes requires qualified personnel and should be based on accurate information concerning the chemicals or chemical groups. Deciding what types of hazardous materials are being disposed of is the responsibility of the generator. To that end, a "front end" review process is being developed for new programs, projects and/or experiments which involve the use of extremely toxic chemicals or which will have more than a 5% impact on the current waste stream. The process will identify the initial hazardous materials projected to be used together with estimates of concentrations of both the starting materials and the wastes produced. The possibility for chemical substitution, process changes, and recycling will be investigated.

Waste Tracking

The Laboratory is developing a system for tracking chemical containers. The goal is to track hazardous materials from purchase until consumption or disposal. A Laboratory waste tracking system is also being developed. Procedural steps for Department chemical and waste tracking will be coordinated with the Laboratory-wide tracking systems as they are developed.

Accounting

A computerized waste tracking system is being developed by the Environmental Protection Department (EPD) which will aid in accounting for the costs associated with waste monitoring. At this time, waste management costs are a function of EPD.

Quality Assurance

Waste minimization quality assurance is to be incorporated in the WMP, management support, oversight by the WMP Administrator, and Coordinator, and the Energy Program Associate for Operations and Assurances, use of the Laboratory Deficiency Tracking System, and corrective actions.

IV. Waste Minimization Status and Schedule

Employee Training and Awareness Program

Discussions on the education and training of personnel have been initiated. It is expected that a waste minimization awareness program will be developed which will focus on those elements specific to the Program/Department and which will complement the planned Lab-wide EPD waste minimization training. Employees at all levels will be involved in waste minimization, whether it's project planning, looking at alternatives, accounting for hazardous by-products of R&D activities, or participating in Laboratory wide programs such as white paper recycling. All personnel handling hazardous starting materials or waste streams are required to have appropriate training.

Employee Incentive/Awards Program

There will be internal recognition of employee's cooperation and participation. Any incentive/award program outlined in the Lab-wide plan will be implemented internally.

Waste Minimization Assessment (Internal Reviews) and Technologies

A report of wastes generated by the Program/Department building activities will be reviewed annually to identify opportunities for additional minimization or elimination of wastes generated. This annual report will be provided by EPD. The objective of each review is to look at changes in waste streams, identify the large generators, and review procedures for opportunities for waste reduction. Wastewater, air emissions, and other sources of toxic releases will be assessed as guidance is provided.

Following a review, control strategies will be evaluated which consider: material conservation, material substitution, inventory management, recycling, segregation, and process modifications. Where strategies are identified, studies will be made of the costs and benefits. Recommended changes will then concentrate on methods which will not affect the quality of the experiment, process or product.

V. Technology Transfer

Exchange of applicable technical information on waste minimization from other sources will facilitate the Program/Department waste minimization. Sources of such information can come from:

- Waste Minimization Project Office of EPD
- California Department of Alternate Technologies for Recycling and Treatment of Hazardous Wastes
- Office of Environmental Restoration
- Waste Management Workshops
- EPA Waste Minimization bulletin board reprints
- Other sources of information yet to be assembled

VI. Program Performance Evaluation

The Associate for Operations & Assurances, WM Administrator, and WM Coordinator assist in the preparation of reports on the Program/Department waste minimization activities. These reports offer a vehicle for evaluating the performance of the waste minimization efforts.

May, 1991

Engineering Directorate Waste Minimization Plan

May 1991
Engineering Directorate
Lawrence Livermore National Laboratory

ENGINEERING DIRECTORATE WASTE MINIMIZATION PLAN

EXECUTIVE SUMMARY

Waste minimization has been given the highest priority at Lawrence Livermore National Laboratory. The Engineering Directorate shares fully in this commitment and has developed the following waste minimization plan for implementation throughout all activities under its charge.

All waste streams in the Directorate have been assessed, and waste reduction measures have been instituted. The assessment shows that there are two Engineering units realistically affected by the waste minimization concerns—Electronic Manufacturing Group's Special Processing Facility in Building 141 and Materials Fabrication Division's Plating Shop in Building 322. Details of the waste minimization programs both in place and planned for these units are presented in the main text and the appendix of this plan.

It is the objective of the Engineering Directorate to attain full compliance with environmental, health, and safety regulations and, wherever possible, to implement appropriate substitute processes, chemicals, and materials that will minimize hazardous waste production and approach zero hazardous waste discharge.

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ENGINEERING DIRECTORATE WASTE MINIMIZATION PLAN

I INTRODUCTION/BACKGROUND

A. Need for Waste Minimization Plan

Waste minimization is recognized as an important national consideration and as an important concern for the LLNL Engineering Directorate. Legislation has made it increasingly difficult and expensive to dispose of hazardous waste, while some wastes (e.g., liquid hazardous wastes) have been banned entirely from land disposal. Additionally, increasing pressure from government (Federal, State, and local) and from regulatory agencies (EPA, State, etc.) has been placed on waste generators to reduce the quantities of waste generated. Examples of these legislative and regulatory pronouncements include the following:

- Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) (1984)
- DOE Order 5820.2A, *Radioactive Waste Management* (1988)
- DOE Order 5400.1, *General Environmental Protection Program* (1988)
- State of California's Hazardous Waste Reduction and Management Act of 1989 (SB-14)

In accordance with the above, waste minimization has been made an integral part of the LLNL mission, to which the Engineering Directorate subscribes without reservation.

B. Engineering Directorate Mission

The LLNL Engineering Directorate is a support organization serving the needs of numerous LLNL programs and directorates. Additionally, the Directorate conducts research and development in preparation for future Laboratory needs.

All waste streams in the Directorate have been assessed, and waste reduction measures have been instituted. The assessment shows that there are two Engineering units realistically affected by the waste minimization concerns—Electronic Manufacturing Group's Special Processing Facility in Building 141 and Materials Fabrication Division's Plating Shop in Building 322. Both Special Processing and the Plating Shop provide on-site services for experimentation, one-

of-a-kind, and prototype products for various LLNL programs. The processes in Special Processing that generate hazardous wastes are printed wiring board fabrication, chemical milling, and metal finishing. The processes provided by the Plating Shop include electroplating, electrolysis plating, anodizing, cleaning, etching, electroforming, and chemical milling.

II PROGRAM OBJECTIVES

A. Management Commitment

The high level of management commitment to waste minimization was established by the LLNL Director in an administrative memo dated March 8, 1989:

"It is important that the Laboratory make a strong commitment to waste minimization—particularly to hazardous and radioactive waste minimization. Our goal is to reduce the Laboratory's hazardous/radioactive waste streams by a major factor in the next three to five years by reducing generation and increasing recycling. We will implement an incentive system where each Laboratory program will pay the costs associated with the handling and disposal of its waste. Each program will establish waste minimization goals and develop plans and assign responsibility for achieving these goals. Waste minimization will be incorporated in the design of new products."

This commitment has been endorsed by the Associate Director for Engineering in various statements, including the following:

"Engineering is committed to supporting the Environmental Policy of the Laboratory. As part of this policy, environmental risks will be reduced to levels as low as reasonably achievable. Environmental, Health and Safety (ES&H) will have top priority. Waste minimization is a very important part of the overall ES&H program. I strongly support waste minimization and encourage all employees to review their work areas and actively pursue new ideas and techniques to reduce or eliminate waste wherever possible."

Similarly, the Division Management of the Materials Fabrication Division has issued statements of commitment, including the following:

"MFD is committed to excellence and leadership in protecting the environment. Environmental protection is a primary responsibility of every employee as well as a matter of special management emphasis. In keeping with this policy, we will minimize our waste generation and avoid any adverse impact on the air, water, or land around us....Minimizing or eliminating the generation of waste is a prime

consideration in all aspects of research, process design, manufacturing, and general operation. It has the same importance as safety considerations."

B. Waste Minimization Policy Statement

Hazardous and toxic wastes are among the greatest threats to our natural environment and are the most difficult and expensive waste forms to treat and dispose of. In an effort to combat this issue, Congress mandated a waste minimization policy in the 1984 Hazardous and Solid Wastes Amendments to the Resource Conservation and Recovery Act (RCRA). In accordance with this policy, the LLNL Engineering Directorate has adopted an aggressive waste minimization philosophy and is actively committed to reducing waste generation.

In the working definition currently used by the EPA, waste minimization consists of *source reduction* and *recycling*. *Source reduction* is defined as any activity that reduces or eliminates the generation of hazardous waste at the source, usually within a process. *Recycling* is the use, reuse, or reclamation of a material. Of the two methods, *source reduction* is preferable from an environmental perspective.

It is common to think of waste minimization in terms of hazardous waste. However, it is important that all pollutant emissions to air, land, and water be considered in a waste minimization program. The transfer of pollutants from one medium to another is not waste minimization. For example, the removal of organics from waste water using activated carbon is not, in and of itself, waste minimization since the pollutants are merely transferred from one medium (waste water) to another (carbon) as a solid waste.

By pursuing an active waste minimization program, the Engineer Directorate will realize a number of positive results, including:

- Protecting worker health and safety, public health, and the environment
- Meeting national, state, and local waste minimization goals
- Reducing potential environmental liabilities
- Saving money by reducing waste treatment and disposal costs, raw material purchases, and other operating costs.

The Engineering Directorate accepts it as a mandate that all employees will participate to the fullest extent possible in waste minimization.

C Statement of Objectives/Numerical Goals

It is the objective of the Engineering Directorate to attain full compliance with environmental, health, and safety regulations and, wherever possible, to implement appropriate substitute processes, chemicals, and materials that will minimize hazardous waste production and approach zero hazardous waste discharge. Because the Directorate, in addition to its research and development mission, serves the needs of numerous LLNL programs and directorates, the quantities of waste streams can be varying, dependent upon factors beyond the control of the Directorate. As a result, specific numerical goals are determined for each process, and averages will be developed over a period of time.

III. DESCRIPTION OF PROGRAM

A. Organization/Responsibilities and Implementation Strategy/Schedule

Administration of waste minimization activities in the Engineering Directorate parallels line management as shown in the Engineering organizational chart on page 4 of the Appendix. The facilities and operations of the Engineering Directorate are widely distributed around the LLNL Livermore site and Site 300. Each of the operations is an independent unit under the direction of an operations or group manager, and may be located in a number of buildings. The operations or group managers are responsible to the Engineering Directorate organization; in addition, they routinely interact with other directorates in providing their services or in obtaining the services of others (e.g., environmental protection, procurement, plant maintenance, hazardous waste disposal, etc.). Each facility operates within the prescribed limitations and procedures of a Facility Safety Procedure (FSP). When a specific project or experiment does not fall within the specifications of the FSP, an Operational Safety Procedure (OSP) is developed.

Each operation and facility within the Engineering Directorate has established waste minimization goals and developed plans for achieving these goals. Specific programs are in place, and each area has reduced or eliminated hazardous waste wherever possible (e.g., printed circuit boards, electronic fabrication, plating/metal surface finishing, machine shops, plastic shops, and photo processing). In addition, Engineering has contracted an outside consulting firm (Jacobs Engineering Group, Inc., of Pasadena, California) to do a global and detailed assessment of waste minimization activities and opportunities with the Engineering Directorate.

B. Program Budget

At present, costs associated with waste minimization are largely undefined. It is recognized that the budget will have to support the costs of assessing and monitoring waste; implementing programs for employee awareness and training;

and record keeping, accounting, and personnel. As these costs become more clearly defined, the necessary budget will be determined and allocated.

C Interaction/Coordination

Continuous interaction and coordination among the production staff (waste generators), the waste management staff, and outside agencies are critical elements in pursuing waste minimization. The LLNL Waste Minimization Steering Committee, composed of representatives from each directorate and the Environmental Protection Department, is at the hub of the network in providing guidance, direction, and information sharing. Waste generators will also continue to interface with industry through publications, research, and conferences to exchange findings on new materials and technology that will enhance the reduction or elimination of waste. The Engineering Directorate will also maintain its contacts with the several government agencies sharing the common concern of waste management.

D Waste Tracking

The Engineering Directorate maintains a record of all hazardous waste generated in each facility. A responsible individual is assigned to each waste accumulation area to make certain that all waste is packaged properly, records are kept in order, and the guidelines for waste accumulation areas are followed.

Hazardous Waste Management (HWM) maintains a data base of all waste streams within the Laboratory. The Engineering Directorate uses this data base to continually review its operations and to explore new waste reduction techniques that become available.

The Environmental Protection Department (EPD) is also developing a Laboratory-wide chemical tracking system. When this Lab-wide system is defined, the Engineering Directorate will develop and coordinate its own procedures in accordance with that system.

E Accounting for Waste Management Costs

Costs associated with waste management are currently budgeted through the Environmental Protection Department (EPD). Initially, the Engineering Directorate funded the waste stream assessments and the on-the-job training of employees necessary to implement changes in equipment and procedures.

F Quality Assurance

Quality assurance for waste minimization will be incorporated into the waste minimization plans.

IV. WASTE MINIMIZATION STATUS AND SCHEDULE

A. Employee Awareness Program

The Engineering Directorate will instill and reinforce employee awareness of the significance of waste minimization through a variety of means, including briefings by the Associate Director for Engineering and/or waste minimization manager, and bulletins/memoranda from those parties to employees. A major vehicle for communicating waste minimization information will continue to be the bi-monthly newsletter *Waste Notes*, dedicated as it is to waste minimization, recycling, hazardous waste management, and regulatory requirements.

B. Employee Training Program

The employee training program at LLNL is justly recognized for its extensive and wide-ranging curricula and the effectiveness of its offerings. Training is provided to employees based on their job requirements and responsibilities. It has long been the rule and practice, with regard to hazardous waste management, that training is provided to operations/shop supervisors and their staff who handle hazardous wastes. Specific training for waste minimization is currently in development by the Environmental Protection Department (EPD) and will be implemented by that body. As these training courses come on line, the Engineering Directorate, exercising criteria similar to that in place for assignment of hazardous waste handling training, will ensure the attendance of its personnel.

Additionally, those means cited above as elements of employee awareness—i.e., briefings and bulletins and especially the *Waste Notes* newsletter—will be used for informal employee training.

C. Employee Incentives/Awards Program

The Engineering Directorate endorses the importance of recognizing the waste minimization efforts of its employees. Such recognition will take the form of awards such as plaques and certificates, verbal and written commendations from the Directorate leadership and commendatory profiles in publications such as *Waste Notes*.

Significant effort and successful accomplishments related to waste minimization will be credited to job performance.

D. Waste Minimization Assessments

Thorough waste minimization assessments have been performed throughout the Special Processing Facility (Building 141), the Plating Shop (Building 322), the MFD Complex, and Building 131 to identify and analyze all waste sources in the Directorate. Details of these assessments for the calendar year 1990—addressing

waste streams assessed, planned assessments, amounts of waste generated, and source reduction techniques implemented—are set forth in the *Engineering Directorate Waste Reduction Report 1990*, submitted to the Department of Energy in response to DOE Order 5820.2A and attached to this plan as the Appendix. All such activities are correlated with the ES&H Self-Assessment Compliance Code.

The Engineering Directorate has also contracted with the Jacobs Engineering Group, Inc., (251 South Lake Avenue, Pasadena, CA 91101) to have Jacobs assist in a waste minimization study and plan development as required by the State of California's Hazardous Waste Reduction and Management Act of 1989 (SB-14). It is anticipated that this study will independently reassess and validate those areas previously assessed as well as explore for any items previously overlooked. Any new findings will be incorporated into this present plan.

Finally, the Engineering Directorate cooperated with the Graduate School of Management, University of California, Davis, California, in a management policy study class project in which a group of U.C. Davis graduate students developed a Hazardous Waste Minimization Strategic Plan for the Engineering Directorate.

E Waste Minimization Technologies Implemented

The Engineering Directorate has implemented a number of waste minimization technologies and techniques, resulting in very substantial reductions in waste and considerable cost savings. These technologies include the following:

- Special Processing and the Electroplating and Metal Finishing Facility joined efforts to evaluate, procure, and install a vacuum distillation system to recover and recycle their rinse water. More than 90% of the waste discharged from these facilities is water, and the vacuum distillation system reduces the discharge volume by 90%.
- A new sulfuric-peroxide etcher was installed to replace the chromic-sulfuric etcher, eliminating generation of chromic acid waste and enabling the recovery of what was formerly a copper waste and the production of a chemical feedstock.
- A new metal-finishing line was installed to replace the trichloroethane degreaser with a soap-soak cleaner, and the large vapor degreaser was eliminated from the Plating Shop. The latter used about 700 gallons of perchlorethylene per year and also created waste that had to be disposed of via Hazardous Waste Management, while the new unit is a water-pressure cleaning system that recycles the water.

- A special filter system was designed and put in place to filter out the contaminated particulates produced in the high-pressure water-jet cutter used in the assembly area. This system eliminated the hazardous waste water produced, resulting in a cost savings of \$140,000/yr.
- A plasma etch system—installed for surface conditioning of plastic and other surfaces for subsequent metal coatings—has eliminated the need for several hazardous, concentrated chemicals, such as concentrated sulfuric and hydrofluoric acids. The outlet vapors from the plasma etcher are passed through a flue scrubber that neutralized the vapors in a sodium bicarbonate solution.
- Two coolant recycling systems for machine tool coolant have reduced machine tool coolant waste by 85%. Each system consists of dirty and clean coolant reservoirs, an automatic coolant proportioning pump, an oil belt skimmer, a sump-cleaning vacuum, and a high-speed centrifuge that removes machine tool lubricant to less than 0.5% concentration and solid matter to 5 microns or less.

The following table shows some examples of Engineering Directorate's waste minimization technology applications (including items 3, 4, and 6 above) and the cost savings they are yielding (over \$500,000 annually):

Item	Work Center	Savings (\$/year)
Relocating cyanide solutions	Plating	320,000
Eliminating chromium plating	Plating	25,000
Changing rinsing practice	Plating	7,000
Eliminating vapor degreaser	Plating	2,300
Water-jet water treatment	Assembly	140,000
Treating machining coolant	Main Bay	37,000
Oil/water separation	LODTM	7,000
Pump oil replacement	VPL	1,500

V. TECHNOLOGY TRANSFER ACTIVITIES

The Engineering Directorate is committed to continuing the identification and application of waste minimization technologies and techniques and the sharing of such with interested parties wherever possible.

Exchange of information on waste minimization will be accomplished through several avenues, including the following:

- LLNL Waste Minimization Steering Committee
- CLEEN Committee
- Waste Minimization Project Office of EPD
- California Department of Health Services, Toxics Control Program
- Jacobs Engineering Group project
- EPA Waste Minimization bulletin reprints
- Seminars and workshops on waste management and environmental protection.

VI. PROGRAM PERFORMANCE EVALUATION

The performance of the Engineering Directorate's waste minimization program is subject to evaluation by several individuals and units, including the following:

- Department of Energy
- Environmental Protection Service (State and Federal)
- Department of Health Services
- Environmental Protection and Hazardous Control Departments
- Engineering Directorate Facilities and Assurances Manager and Engineering Assurance Officer.

Laser Program

Waste Minimization Plan

May 31, 1991

Laser Programs Waste Minimization Plan

February 1990

Approved by:

V. Alan Mode

Deputy Associate Director
Laser Programs Assurances

LAWRENCE LIVERMORE NATIONAL LABORATORY
University of California • Livermore, California • 94550

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1. Introduction

The Laser Programs Waste Minimization Plan establishes the policy and assigns responsibility for minimizing wastes from Laser Programs operations at the Lawrence Livermore National Laboratory (LLNL). The policy is consistent with the intent of Environmental Protection Agency (EPA) policy, Department of Energy (DOE) requirements, overall LLNL policy, and good waste management practices. The policy applies to research, technology development, engineering demonstration, and technology deployment activities of the Laser Programs. In particular, it applies to the five Programmatic elements under the direction of the Associate Director for Lasers: Special Isotope Separation (SIS); Uranium Atomic Vapor Laser Isotope Separation (U-AVLIS); Laser Technology; Inertial Confinement Fusion (ICF), and Advanced Applications (AA). It also applies to the Operations function of the Laser Programs. These activities cover a broad range of scientific disciplines, and generate various forms and amounts of hazardous, radioactive, and mixed wastes.

This Plan supplements and provides implementation guidance for the Laser Programs Waste Minimization Policy Statement issued by the Associate Director for Lasers.¹ The Plan is responsive to the Waste Minimization Policy Statement of the LLNL Director dated March 8, 1989,² and has been written to conform to both LLNL guidance and EPA guidelines for waste minimization plans contained in the Federal Register.³

1.1 Need for Plan

Waste minimization is becoming an increasingly important national consideration in many activities, and this concern applies to research and development activities at LLNL. Legislation [e.g., the 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA)] has made it increasingly difficult and expensive to dispose of hazardous wastes. Some wastes (e.g., liquid wastes) have been or will be banned from land disposal entirely. Restrictions on waste disposal have resulted in a reduction in the availability of sites that can accept waste. Overall waste disposal costs have gone up significantly and are expected to continue to increase in the coming years.

In parallel with the growing constraints on waste disposal, there is increasing official pressure from governments (federal, state, and local) and from regulatory agencies (EPA, state, etc.) on waste generators to

reduce the quantities of waste generated. In the 1984 Hazardous and Solid Waste Amendments to RCRA, Congress established the following policy:

"The Congress hereby declares that it is to be a national policy of the United States that, where feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste material generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment."⁴

In addition, HSWA required that hazardous waste generators establish a waste program and certify on their waste shipment manifests that such a program is in place.

In 1988, DOE issued Order 5820.2A, *Radioactive Waste Management* and implementation guidance, which required that DOE facilities develop and implement waste minimization plans.^{5,6} Also in 1988, DOE issued order 5400.1, *General Environmental Protection Program*, which required that each DOE facility prepare a waste minimization program, with goals for minimizing the volume and/or toxicity of all wastes generated, with annual reductions if programmatic requirements allow.⁷ In 1989, EPA published guidance on the elements of a waste minimization program.⁸ Also in 1989, EPA made it clear that having a waste minimization plan in effect at LLNL was a necessary condition for renewal or issuance of further permits for waste treatment at LLNL.⁸

1.2 Purpose and Objectives of the Plan

LLNL is preparing a waste minimization plan covering activities at both the Livermore Site and Site 300; a draft of the plan was issued in 1989. (Ref. 9) All LLNL programs, including Lasers, are required to prepare individual program plans or mini-plans for inclusion in the overall LLNL Plan.

This *Laser Programs Waste Minimization Plan* is intended to be used not only as an insert to the overall *LLNL Waste Minimization Program Plan* but also as a stand-alone guidance document for use by the Laser Programs at LLNL.

The *Laser Programs Waste Minimization Plan* is intended to be flexible and adaptable in order to address the diversity of projects within the Laser Programs. For current operations, the amounts and characteristics of wastes generated are to be defined, generators identified, processes described, waste minimization alternatives identified, and waste minimization activities implemented. The Plan incorporates three principal overall objectives: (1) to instill in Laser Programs personnel a continuing

awareness of the importance of waste reduction in program activities; (2) to consider waste minimization in the advance planning of new projects or activities, and to try to incorporate waste minimization considerations in the design and operation of new activities; and (3) to achieve overall net reductions in the levels of waste generated by the Laser Programs as a function of the level of program activity. At the same time, the Plan recognizes that, in some instances, wastes may actually increase. When new projects are started, when existing projects are expanded or changed, when major demonstrations are conducted, or when new experiments are added, the absolute level of wastes generated may increase on an interim basis. Notwithstanding the fact that this plan recognizes that, for certain projects, absolute quantities of waste generated from a given program area may temporarily increase, the plan requires that such activities be planned and conducted in a manner to minimize the waste generated to the extent that it is environmentally and programmatically practical.

This *Laser Programs Waste Minimization Plan* is intended to be used to support ongoing and planned Laser Programs activities including operation of the Nova laser, the Laser Demonstration Facility (LDF), the Engineering Demonstration System (EDS), and UDS, as well as selected support activities including analytical laboratories.

2. Laser Programs Policy on Waste Minimization

February 5, 1990

LASER PROGRAMS POLICY STATEMENT ON WASTE MINIMIZATION

Laser Programs is strongly committed to minimizing the generation of hazardous and radioactive wastes in Laser Programs activities. Its goal is to minimize hazardous and radioactive waste streams through careful planning, reduced generation, increased recycling, process changes, employee awareness and administrative controls.

Each major program or project should establish waste minimization goals, develop plans, and assign responsibilities for achieving these goals. A waste minimization committee, with members from each Laser Programs element, will provide guidance and monitor progress. The success of waste minimization will depend on active participation and contribution from every member of Laser Programs. New projects will incorporate waste minimization considerations in their design and operations.

The Laser Programs' effort supports the Director's statement on Waste Minimization.

J. I. Davis
Associate Director for Lasers

3. Elements of the Plan

There are seven elements to the *Laser Programs Waste*

Minimization Plan:

- Top management support.
- Characterization of waste generation.
- Waste minimization assessments.
- Cost allocation system.
- Technology transfer.
- Program evaluation.
- Quality assurance.

The Plan is intended to address applicable DOE^{5,6} and EPA³ guidance. It follows the EPA format suggested in Reference 3, which contains the first six elements above. The seventh element, quality assurance, has been added to highlight the importance of the QA function for waste minimization and to address explicitly a DOE requirement.^{4,6}

3.1 Top Management Support

Laser Programs management has placed waste minimization in program activities as a high priority. In 1989, the Program Leader of the Laser Isotope Separation (LIS) Program assigned personnel to begin work on a waste minimization program for LIS. A parallel effort was also initiated in the ICF Program. In early September 1989, the Associate Director for Lasers called a meeting of Laser Programs managers to discuss the importance of compliance with applicable health, safety, and environmental requirements, including waste considerations. The following week, as part of a Laser Programs reorganization, he established at the Deputy Associate Director (DAD) level an Assurances function with responsibility for development and oversight of a waste minimization program for the Laser Programs.

Other manifestations of top management support for waste minimization include the following:

- Issuance of a Laser Programs Policy Statement on Waste Minimization (February 1990).
- Membership on LLNL Waste Minimization Steering Committee (starting in May 1989).
- Establishment of a Laser Programs Waste Minimization Committee (January 1990).
- Establishment of a Waste Manager position for the Laser Programs (December 1989). (Ref. 10)

- Obtaining contract support for waste management and waste minimization (October 1989).
- Scheduling waste management training for over 300 Laser Programs personnel (August 1989).

3.1.1 Training and Awareness

Laser Programs personnel, from management to operators and including contractors, must be aware that waste minimization is part of everyday business and is everyone's concern. Employee awareness of waste minimization may range from what they read in the Laboratory newspaper to mandatory attendance at formal training sessions and to specific information contained in guidance documents. All Laser personnel handling feed materials or waste streams, or involved in process operations are required to attend formal training sessions. Traditionally, formal training sessions have been conducted by the Environmental Protection Department (EPD). For example, selected Laser Programs personnel were recently trained in "Hazardous Waste Handling." Other classes available through EPD are "Guidelines for Waste Accumulation Areas" and "Preparation Guide for Generators of Hazardous Chemicals and Radioactive Waste at LLNL." An attendance record is maintained to assure that all personnel receive appropriate training, with periodic refresher classes as needed. Waste minimization information from the published literature, vendor information, or trade shows is disseminated through informal briefings by managers or supervisors.

3.1.2 Responsibilities

Laser Programs management, beginning with the Associate Director, is committed to the achievement of waste minimization objectives and compliance with applicable environmental requirements. In particular, the Laser Programs subscribe to the statement about waste minimization in the LLNL Environmental Policy Statement,¹¹ which makes strong support for waste minimization a Laboratory policy.

The Associate Director for Lasers holds his deputies and subordinate managers responsible for implementation of this Plan and of the Laser Programs Policy Statement on Waste Minimization.

3.2 Characterization of Waste Generation

Data on waste generated by the Laser Programs is captured in a data base maintained by the Hazardous Waste Management (HWM) Division of

the EDP. In 1989, the Laser Programs requested several reports from this data base on selected program activities for analysis of waste generation forms, quantities, locations, and generators. In 1989, this effort focused on copper and process laser operations.

In 1990, the Laser Programs waste characterization effort will be expanded to the entire Laser Programs. The other Laser Programs whose waste generation forms, levels, and patterns will be characterized are the non-laser portions of the U-AVLIS and SIS Programs, the ICF Program, and the Advanced Applications Program. In addition, waste generation data for copper and process lasers in the Laser Technology Program will be updated.

Also in 1990, anticipated waste generation levels for the planned EDS and UDS demonstrations will be characterized and waste minimization considerations will be factored, as practical, into plans for the design and operations of these demonstrations.

3.3 Waste Minimization Assessments

3.3.1 Performance Assessments

The Laser Programs initiated a program of waste management assessments in 1989. An Assessments Manager position has been created and staffed in the Laser Program Assurances office, and the focus of work in this position to date has been on waste management practices in the Laser Programs. The Assessments Manager prepares reports of his findings and line management is tasked for corrective action. Corrective actions are subsequently reviewed for adequacy. In 1990, this ongoing assessment effort will be supplemented by contract help with expertise in waste minimization. In addition, there are multiple surveillances, assessments, and appraisals of laser waste management practices performed by the LLNL Environmental Protection Department and Hazards Control Department. The findings are communicated to the Laser Assurances Organization and to cognizant line managers who are responsible for corrective action. A responsibility of the Laser Program Waste Manager position will be to develop and oversee waste minimization assessments, and to maintain records of waste minimization assessments conducted.

An Assurances data base containing information on a broad range of internal and external health, safety, and environmental appraisals will be established in 1990. This data base will facilitate both the program assessment and the program evaluation (see Section 3.6) functions.

3.3.2 Analytic Assessments

In addition, one of the responsibilities of the Laser Programs Waste Minimization Committee will be to perform waste minimization analyses of selected program activities. Included in these analyses, assessments will be performed to track materials that end up as waste from the time of receipt, if possible, to the point at which they become a waste. Part of the intent of these broad assessments will be to identify targets of opportunity at points in a process where materials can be prevented from becoming a waste (e.g. by using less material, recycling, finding substitutes, or making equipment changes).

3.4 Cost Allocation System

Laser Programs representatives on the LLNL Waste Minimization Steering Committee were very active in helping develop a proposed Laboratory-wide recharge system for waste generators in FY89. The LLNL recharge system, targeted for implementation on October 1, 1989, has not been implemented because of expected changes in the DOE waste management program, which would cause waste management functions at DOE sites to be funded directly as a program by DOE.

Because cost is an important factor in waste management efforts, the analytic waste minimization assessments described in Section 3.3.2 will include waste management costs as a consideration in developing suggestions for improvements in waste minimization.

3.5 Technology Transfer

Exchange of technical information on waste minimization is an important constituent of the Laser Programs Waste Minimization Plan. In 1989, such exchanges were fostered through the following avenues:

- Participation of Laser Programs personnel in Laboratory-wide waste minimization activities (e.g., memberships on LLNL Waste Minimization Steering Committee).
 - Participation of Laser Programs personnel in DOE-wide waste minimization activities [e.g. membership in reduced waste generation working group of the Materials Management Exchange Committee (MMEC)].
 - Formation of a Waste Minimization Committee within the LIS Program with representation from each major technology area.
 - Attendance at professional meetings on waste management and environmental protection.
-

- Hiring consultants with waste minimization expertise.
- Sponsoring the development of new or modified technology to help reduce identified waste streams.
- Frequent contact with the technical staff of the Environmental Protection Department and its Hazardous Waste Management Division.

All of the above avenues for technology transfer will continue in 1990. The LIS Waste Minimization Committee has been expanded and reorganized as a Laser Programs-wide committee.

3.6 Program Evaluation

The *Laser Programs Waste Minimization Plan* is subject to several levels of program evaluation. They include:

- Performance assessments by the Assessment Manager.
- Evaluation of program implementations by Waste Minimization Committee.
- Oversight by the Laser Assurances Office.
- Reviews and assessments by the Environmental Protection and Hazardous Control Departments.
- Reviews and assessments by DOE.
- Annual Laser Programs input to annual LLNL summary of waste reduction activities (submitted as an appendix to the *LLNL Waste Management Plan* by the LLNL Waste Program Manager).

All these types of review and evaluations are expected to take place in 1990.

3.7 Quality Assurance

The constituents of the Quality Assurance Program for waste minimization are incorporated in the waste minimization elements described above. For ease of reference, they are listed below:

- Waste Minimization Plans.
- Management support.
- Oversight by Assessment Manager, Laser Programs Waste Minimization Committee, Laser Assurances Office, and by Hazards Control and Environmental Protection Departments.
- Compliance data base.
- Corrective action.

4. General Guidance on Waste Minimization

Over a period of time, a hazardous waste management hierarchy has evolved and has been accepted as a standard by waste management experts (see Table 1).⁹ The hierarchy recognizes a range of practices and technologies to reduce waste generation. The priority system embodied in the hazardous waste management hierarchy has been adopted by the Laboratory.⁹ The highest priority is to reduce the generation of all wastes at the source—source reduction. All wastes have some potential for source reduction through such activities as good housekeeping practices, product changes, chemical substitution, and process changes. The second priority is to recycle remaining wastes wherever possible. Both off-site and on-site recycling have been applied to such wastes as solvents, oils, metals, acids, and empty containers. Third, wastes which cannot be eliminated or recycled may be treated to minimize the volume.

Laser personnel should use the standard hierarchy, evaluating the appropriateness of each method and selecting those which are suitable. Some are being adopted; others have already been incorporated.

The success of source reduction within Laser Programs will depend on personnel becoming better educated and more conscious of environmental issues. The learning process and implementation will follow an orderly phased progression which has been successful in similar (commercial, industrial) off-site applications. Good housekeeping, the first step, generally produces significant reductions at small costs. Following this initial phase, formal operating procedure improvements produce additional waste reduction. The third phase is process modifications or changes, wherein new equipment may be installed and/or actual process stream components are changed or modified. This third phase usually requires significant engineering effort, capital equipment investment, and possible building modifications—all requiring significant expenditure of both time and money.

Methods	Activities	Waste streams
Source reduction (highest priority)	Good housekeeping practices (production management) <ul style="list-style-type: none"> • Training • Waste stream segregation • Inventory control • Employee involvement • Spill/leak prevention Product change (switching to products that are less hazardous to produce) Chemical substitution (substituting less hazardous chemicals) Technology modification <ul style="list-style-type: none"> • Improved production management (reducing spills, leaks, evaporation, mixture errors, and bad product runs) • Process change (production changes resulting in less and/or safer chemical use) • Equipment change/redesign • Energy/water conservation 	All wastes have some potential for source reduction
On-site/off-site recycling	<ul style="list-style-type: none"> • Reuse • Reclamation 	Solvents, oils, metals, acids, developers, empty containers
Treatment (lowest priority)	<ul style="list-style-type: none"> • Neutralization • Precipitation • Filtration • Evaporation • Incineration 	Acids, bases, cyanides, plating wastes

Table 1. The hazardous waste management hierarchy.

4.1 Methods Used to Minimize Waste

The methods used to minimize waste⁴ usually fall into one of the following categories:

- Improve housekeeping practices.
- Segregate wastes.
- Reduce wastewater flows.
- Change materials purchasing and methods.
- Substitute less toxic materials.
- Change production methods.
- Delist wastes that are not toxic.
- Recycle or reclaim wastes.
- Treat waste to reduce volume and/or toxicity.

The first four categories are typical good housekeeping practices. Sloppy housekeeping generally results in excess waste generation; good housekeeping tends to minimize waste generation. For instance, chemical leaks from a pump because of improper maintenance procedures may result in a large volume of waste, which includes the chemical itself and possibly a larger volume of other chemicals and materials used in the cleanup. Leaks may be kept at a minimum through proper and periodic scheduled maintenance.

Waste segregation provides many benefits. For instance, when a hazardous waste is mixed with a non-hazardous waste, the mixture becomes hazardous. Through segregation, only the hazardous waste is generated. Similarly, segregation of two hazardous wastes where each is recyclable is preferred to mixing them into a non-recyclable hazardous mixture.

Processes using rinse waters may be modified so that a smaller volume of more concentrated rinse water is generated. Useful materials may be recovered more economically from the concentrate.

Volume and toxicity of wastes may be controlled through front end materials purchasing and control. Fewer types of chemicals purchased in bulk effectively reduces the range of wastes produced and the number of chemical containers that must be disposed. A smaller chemical and material inventory reduces the amount of expired shelf-life chemicals sent to disposal.

Substitution of less toxic or non-toxic chemicals in the feed streams effectively reduces the toxicity of waste streams. Other benefits are improvements to operators' health and safety. Changes in production methods or processes are typically the most difficult to implement because of conversion costs and perturbations in operations, but, if well planned and

justified on technical and cost-benefit bases, they can offer substantial waste reduction potential.

Waste recycling not only reduces the amount of waste that must be sent to disposal, but also the amount of virgin materials purchased. Laser Programs wastes that must be treated are sent to the Hazardous Waste Management Division.

A more general description of these methods as well as examples of their application are found in Reference 4.

4.2 Responsibilities and Implementation

It is incumbent on each person working in the Laser Programs to endeavor to minimize the hazardous or radioactive waste that may be generated as a result of activities in which he or she is involved.

All operations with hazardous materials require an Operational Safety Procedure (OSP) that must be approved by program management. All Laser Programs OSPs are required to have a section discussing wastes generated from operations and steps taken to minimize such wastes. OSPs approved prior to the issuing of a formal *LLNL Waste Minimization Program Plan* will be required to add a waste minimization section by the next annual review.

The overall goal is to reduce the volume of waste generated over the next several years when considered as a function of the overall level of program activity. Using the general guidance provided by this plan and by the Laboratory, each directorate, program, project, or activity, as appropriate, should define its own waste minimization goals. Responsibilities at each level are described below.

4.2.1 Laser Programs Office

Waste minimization responsibilities of the Laser Programs Office are the following:

- Issues Laser Programs Policy Statement on Waste Minimization.
- Issues and updates Laser Programs Waste Minimization Plan.
- Conducts waste minimization performance assessments, maintains records.
- Oversees waste minimization training, keeps training records.
- Chairs Laser Programs Waste Minimization Committee.
- Is the point of contact with other organizations on waste minimization (e.g., DOE, EPA, LLNL's Environmental Protection Department and Hazards Control Department).
- Approves specific waste minimization plans.

4.2.2 Line Management

Waste minimization responsibilities of line management are the following:

- Implements Laser Programs waste minimization policy and plan.
- Sets goals for waste minimization in their programs.
- Assigns responsibilities and allocates resources to achieve the waste minimization goals.
- Considers waste minimization objectives up front in new projects and selects process alternatives that contribute to achieving waste minimization goals.
- Develops specific waste minimization plans for major programs and projects under their cognizance (e.g., U-AVLIS, Laser Technology, UDS, EDS).
- Appoints representatives to Laser Programs Waste Minimization Committee.

4.2.3 Waste Minimization Committee

Waste minimization responsibilities of the Waste Management Committee are the following:

- Reviews and recommends approval of specific waste minimization plans prepared by line organizations.
- Evaluates implementation of the overall *Laser Programs Waste Minimization Plan* and specific waste minimization plans prepared by line organizations.
- Evaluates candidate waste minimization proposals, including process changes.
- Conducts waste minimization analytical assessments.
- Provides advice and guidance to Laser Programs line organizations on waste minimization.

5. Glossary¹²

AEA: Atomic Energy Act of 1954, as amended. Establishes requirements for managing radioactive materials and waste.

EPA: U.S. Environmental Protection Agency. Federal Agency responsible for enforcing environmental laws. Although some of this responsibility may be delegated to state and local regulatory agencies, EPA retains oversight authority to ensure protection of human health and the environment. EPA administers the Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA), or Superfund, as it is commonly known, and works with state and local agencies to provide technical oversight for cleanup activities at federal facilities regulated by the Superfund program.

EPD: Environmental Protection Department (LLNL).

Hazardous wastes: wastes exhibiting any of the following characteristics: ignitability, corrosivity, reactivity, or EP-toxicity (yielding toxic constituents in a leaching test). In addition, EPA has listed as hazardous other wastes that do not necessarily exhibit these characteristics. Although the legal definition of hazardous waste is complex, the term more generally refers to any waste that EPA believes could pose a threat to human health and the environment if managed improperly. RCRA regulations set strict controls on the management of hazardous wastes.

HSWA: Hazardous and Solid Waste Amendments of 1984 to RCRA. These amendments to RCRA greatly expanded the scope of hazardous waste regulation. In HSWA, Congress directed EPA to take measures to further reduce the risks to human health and the environment caused by hazardous wastes.

HWM: Hazardous Waste Management Division of the Environmental Protection Department (LLNL).

Land Ban: a regulatory program that identifies hazardous wastes that are restricted from land disposal. The regulations incorporate a phasing-in of restrictions in three stages.

LLW: low-level radioactive waste.

NEPA: National Environmental Policy Act of 1969. A federal statute that imposed the first requirements on federal agencies to consider the environmental effects that may result from agency actions. One provision of NEPA requires the preparation of an Environmental Impact Statement by federal agencies when "major" actions are taken.

Radioactive mixed waste: waste containing both radioactive and hazardous components regulated by the AEA and RCRA, respectively. The term "radioactive component" refers only to the actual radionuclides dispersed or suspended in the waste substance.

Radioactive waste: solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

RCRA: Resource Conservation and Recovery Act of 1976. RCRA is an amendment to the first federal solid waste legislation, the Solid Waste Disposal Act of 1965. In RCRA, Congress established initial directives and guidelines for EPA to regulate hazardous wastes.

TRU: transuranic (containing transuranium nuclides).

Waste management: the planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities (DOE Order 5820.2A).

Waste minimization: the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed of. It includes any source reduction or recycling activities undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste, or (2) the reduction of toxicity of the hazardous waste, or both, so long as such reduction is consistent with the goal of minimizing present and future threats to human health and the environment (EPA's Report to Congress, 1986, EPA/530-SW-86-033).

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Magnetic Fusion Energy
Directorate

**Waste
Minimization
Plan**

Interdepartmental letterhead

Mail Station L 640

Ext 24390

MEMORANDUM

June 7, 1991

TO: Distribution

FROM: Ernie Southwick

SUBJECT: MFE Hazardous Waste Minimization Plan - Rev. 3

This latest version includes some minor text revisions and an improved MFE facility site plan. There is no significant change in content or intent of the plan. Please review it and respond with comments and suggestions for improvements to either the plan or the Program's implementation processes.

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HAZARDOUS WASTE MINIMIZATION PLAN

Magnetic Fusion Energy Program

Prepared by

**Ernest W. Southwick
MFE Hazardous Waste Reduction Coordinator**

**Samuel F. Eccles
Chairman, MFE ES&H/QA Committee**

Revision 3: June 1991

MAGNETIC FUSION ENERGY PROGRAM HAZARDOUS WASTE MINIMIZATION PLAN

REVISION 3: JUNE 1991

I. INTRODUCTION

The Magnetic Fusion Energy (MFE) Program is engaged in research leading to applications of magnetically-confined fusion plasmas. This research is characteristically performed using a few very large experimental machines with relatively long service lives. Two generic kinds of hazardous waste streams result: Operation and support of these machines generate small but continuous waste streams. Decommissioning an experiment at the end of its life happens infrequently, but could generate a large amount of hazardous waste in a relatively short time.

Both conventional and technical facilities in the MFE complex vary greatly in age. Most office buildings and light laboratory spaces are 10 years old or less, while most of the major technical buildings are 30 to 40 years old, including the oldest laboratory building at the Livermore site. The experimental machines and support equipment are from 1 to 15 years old. The Program's pulsed electrical energy capacity requirement is larger than that of the rest of the Laboratory combined, so we have a very large collection of heavy electrical equipment. Its age ranges from 10 to more than 30 years.

The MFE Program does not currently generate any radioactive waste streams. This Plan therefore confines itself to discussion of hazardous waste, and does not address radioactive waste or non-hazardous waste.

II. PROGRAM OBJECTIVES

The Director of LLNL has committed the Laboratory to a policy of hazardous waste minimization. In this Plan, the MFE Program commits to a real reduction in its flow of hazardous waste and/or in the potential biological hazard it represents. The Associate Director (AD) for Magnetic Fusion Energy is responsible for this reduction of waste generation by the Program. The AD has chartered the MFE Environmental, Safety, and

Health (ES&H/QA) Assurance Committee to assure compliance with this Plan, and this Committee has in turn appointed a Hazardous Waste Reduction Coordinator (Ernie Southwick) for the Program. A representative from the ES&H/QA Assurance Committee serves on the LLNL Waste Minimization Steering Committee.

Waste from several streams that are generated within the MFE Program is collected at a single Waste Accumulation Area, located south of B432.

This Plan is confined in its geographic scope to the MFE complex outlined in Figure 1 (Site Map).

This Plan is incorporated within the LLNL Waste Minimization Program Plan. The Program will comply with all provisions of the LLNL Plan that are not covered in detail by this Plan.

III. DESCRIPTION OF PROGRAM

- a. Responsibility for hazardous waste minimization is delegated from the AD to people responsible for the experiments, and to supervisors of the various support groups. Each experimental program's Lead Experimenter is responsible for assessing the hazardous waste products of his or her experiment and for adopting alternative materials or procedures, consistent with the scientific objectives, that will reduce them. The supervisors of machine shops and assembly areas that support the experimental programs have the responsibility for assessing their waste streams and determining which alternate processes will reduce hazardous waste products. The experimenters and supervisors are responsible for motivating their employees to implement the measures selected, and for achieving waste reduction.

The MFE ES&H/QA Assurance Committee or its representatives will oversee the Programs' hazardous waste streams and help motivate employees to implement waste minimization measures selected and approved by the Lead Experimenters and support supervisors. The Committee will target specific

major contributors to the Program's operational waste stream. The Committee may institute source controls for certain materials so that the fraction that later becomes hazardous waste can be identified.

Personnel affected by newly adopted waste minimization procedures will be trained in their implementation. This training will be in the form of classes given either by the Program or by the Hazards Control and Environmental Protection Departments.

Once trained, all personnel will be accountable to the AD for implementation of the LLNL Waste Minimization Program Plan. Training records will be maintained in the MFE Program Office.

- b. The initial and continuing costs of implementation and maintaining this plan have been assigned to the MFE ES&H/QA budget. The FY 1991 budget is a direct program cost of approximately \$500k. Waste minimization costs are estimated at about 10% of that total, and have been used primarily in establishing employee awareness training and the identification and substitution of alternate materials in Program processes of opportunity.
- c. The MFE Waste Accumulation Area (WAA) Facility Manager has been assigned the authority and responsibility for processing and maintaining records of the hazardous waste generated within the MFE experimental facilities. A high level of cooperation and support has been advanced by the program personnel at all levels. The interaction between the Hazardous Waste Management field personnel and the MFE Program personnel has been encouraged and is ongoing.

The MFE ES&H/QA Committee provides a continuous oversight of program activities and facility operations. The WAA Facility Manager is audited monthly as a part of the Program self-assessment activities. This provides the opportunity to examine his continuing performance, to discuss any concerns

related to program personnel and Laboratory interactions, and to forward plans and progress for minimizing particular waste stream elements.

d. The MFE Program generates two characteristic kinds of hazardous waste streams:

1. A more-or-less continuous flow of waste results from operating its experimental machines and from support operations. Of the support areas, the local area machine shop is the dominant contributor. Its waste output varies greatly and depends on whether the experimental machines are operating (small output) or are shut down for modification (larger output). These waste streams lend themselves to minimization, and will be identified hereafter simply as "operational" hazardous waste.
2. Infrequent but massive amounts of waste may be created when a major experimental machine and/or conventional facility is demolished or undergoes a major reconfiguration. These waste loads are not subject to minimization, and will be identified hereafter as "one-time" hazardous waste. These machines and facilities were built long before there was concern with waste minimization and before some materials used in their construction were identified as hazardous. When facilities in use contain materials determined to be hazardous, or as these facilities are dismantled or modified, we will deal with such waste material promptly; but always within the constraints of available funding.

The LLNL Hazardous Waste Management (HWM) Waste Disposal Requisition database shows that the MFE operational waste streams contribute only 1 to 2% of the LLNL total. They have historically consisted of:

- Oils - cutting oils from machine shop operations (declining usage) and hydrocarbon vacuum pump oils (synthetic oils are very expensive and have always been recycled)

- Solvents used for degreasing and incidental cleaning
- Fluorocarbon dielectric coolant from operation of the ETA-II induction linear accelerator
- Copper sulfate from accelerator load resistors
- Oil-filled capacitors, transformers, and similar electrical equipment
- Chips and dust from machining structural laminates made of reinforced resins - fiberglass/epoxy is most prevalent
- Miscellaneous chemicals (unused paint, alcohol, etc.)
- Miscellaneous solids (lead, beryllium, mercury, fiberglass, etc.)

The following MFE experimental and support facilities are currently in operation, and they are the sources of the Program's operational waste streams:

- ETA-II (a high power linear induction accelerator)
- MTX (a tokamak, sometimes operated in conjunction with ETA-II)
- High Field Test Facility (a superconducting magnet research facility)
- RACE (the Ring Accelerator Experiment)
- DDT (the Davis Diverted Tokamak)
- A 10,000-square foot main machine shop and six small shops with light machining capability.
- A magnet coil fabrication shop
- A high-vacuum laboratory
- A clean room assembly area and adjacent parts cleaning facility

It is not possible to predict all the hazardous waste that might be discovered when an old experimental machine is disassembled or an old building demolished. A survey of the expected contributions would be prepared shortly before starting a particular disassembly. The following might be expected in sizable quantities:

- Oil-filled capacitors, transformers, and similar electrical equipment, some of which might contain dilute PCB's

- Dielectric cooling systems employing fluorocarbon coolants
- Mercury diffusion vacuum pumps
- Oil-filled and/or mercury-contaminated mechanical vacuum pumps and piping, some of which might contain dilute PCB's
- Components coated with loosely-bound titanium metal
- Reinforced resin structural laminates
- Plastic foam insulation of various types
- Asbestos pipe lagging, structural fireproofing, and building siding panels

(A one-time waste load is illustrated by the removal, packaging, and disposal by the MFE Program in 1990 of 5,500 PCB-filled capacitors and associated equipment (330,000 pounds), and the cleanup of the building containing them, at a cost of about \$700k.)

- e. The Program's main objectives are to achieve real reductions, to the extent feasible, in the quantities generated and the hazard levels represented by its operational hazardous waste, and to minimize the costs of managing it.

The Program's goal for the first year following formal implementation of this Hazardous Waste is to determine the volumes, masses, categories, and costs of operational hazardous waste generated. These will be the baselines for each category to which future generation rates and costs will be compared.

Continuing waste minimization activity should enable the Program to reduce the operational waste generation rates at the end of the fifth year by 25% to 30% of the baseline rates determined in the first year. Expressing this goal in terms of generation rates instead of absolute quantities should be a more accurate measure of the effectiveness of the waste reduction efforts even as our waste-generating workload fluctuates. Adoption of this reduction goal instead of a more ambitious one is supported by an operational waste output that is already relatively small, and by the fact that gains are hard to achieve in older facilities. The major technical buildings are thirty to forty years old, and MFE's Building 431, built in 1950, is the oldest dedicated laboratory building at the Livermore site. The

MFE experimental machines, some of which are not currently operating, range in age from 2 to 15 years.

An additional goal in the succeeding years will be to reduce the cost recharges due to hazardous waste disposal compared to recharges incurred in the first year, and to avoid offsetting the savings with increases in associated Programmatic administration costs and costs of substituted materials.

While hazardous waste generation is usually measured simply in terms of total mass and volume, the Program might accept increases in absolute quantities of operational hazardous wastes if the net result is a true reduction in potential biological hazard posed by the waste.

One-time hazardous wastes resulting from demolishing or reconfiguring our old facilities may temporarily overshadow the Programs' operational waste streams. Their timing depends on a number of issues, including the Programs' future scientific objectives, and available funding, and cannot now be predicted in detail.

If the main objectives of true hazardous waste minimization and of cost reduction are met, then additional benefits should follow, namely, reduced occupational health and accident risks, reduced adverse environmental impact, improved operating efficiency, and improved relations with the community outside the Laboratory.

f. Quality Assurance Considerations

The Hazardous Waste Reduction Coordinator will review and prepare an annual written report on the effectiveness of the Program's waste minimization effort. The review will address, as a minimum, progress toward the Program's waste minimization goal as stated in this Plan, compliance with current laws and regulations, the impact of waste minimization procedures on the Program's scientific and support work, the cost savings or increases attributable to the waste minimization effort, changes needed in this Plan, and recommendations for changes in the LLNL Waste Minimization Plan.

The report will be reviewed and approved by the ES&H/QA Assurance Committee, and then be distributed to everyone in the Program who has accountability for execution for a part of this Plan, and to the LLNL Waste Minimization Steering Committee, the Hazards Control Department, and the Environmental Protection Department. A master file will be maintained in the ES&H/QA records library in the MFE Program Office.

The ES&H/QA Assurance Committee will coordinate audits and respond to inquiries about waste minimization from outside the Programs.

IV. DESCRIPTION OF WASTE MINIMIZATION ACTIVITIES TO-DATE AND SCHEDULE OF PLANNED ACTIVITIES

- a. The MFE Program Facility and Operations ES&H/QA Policy document, a MFE Program FSP, states succinctly, "It is the responsibility of all personnel in the Program to carry out the objectives (of the MFE Waste Minimization Plan) and to consider waste minimization in all activities."

- b. Every MFE Program employee has been given a copy of this plan. Every MFE Program employee who is involved in the handling and management of hazardous waste has successfully completed a hazardous waste training program and is charged to keep such training current.

Experiment leaders and supervisors share the responsibility for employee training on ES&H/QA, which includes waste minimization as a subset.

- c. No employee incentives or awards program exists within the MFE Directorate as yet. Given Laboratory guidance and policy in the future, the Program will take whatever measures are consistent with and commensurate to that future directive.
- d. Waste minimization assessments are a part of the "Good Management Practices" element in the MFE Program Self-Assessment Plan. That element is applicable to the MFE Experiments which are in turn, principles in the generation of the

operational waste stream. These Experimental Facilities are scheduled for assessments biennially, with the first such activity to occur during the second quarter of calendar year 1991.

Waste minimization assessment of other MFE facilities, such as the B432 machine shop, will be incorporated in the scheduled self-assessment planned activities operational as waste stream components are better identified, tracked and controlled. To this date, one-time cleanup and disposal activities and materials have overwhelmed handling and tracking capabilities.

V. TECHNOLOGY TRANSFER ACTIVITIES

Sources of ideas for new waste reduction strategies come from employees, from data bases and informational publications at LLNL, from other laboratories, and from industry. These sources will be monitored by the Hazardous Waste Reduction Coordinator for new processes and procedures. (Example: investigating ongoing research seeking replacements for chlorofluorocarbons by LLNL's Atmospheric and Geophysical Sciences Division, reported in *The LLNL Daily Clips*.) Any new waste minimization process we devise will be made available throughout LLNL and to the DOE community at large. Conferences and workshops will be a major forum for exchange and we plan to be represented where appropriate to the Program.

VI. PROGRAM PERFORMANCE EVALUATION

The Magnetic Fusion Energy Program is a very minor contributor to operational waste generation at the Laboratory. (1 to 2% of the total LLNL waste.) These comments apply only to recurring MFE waste generation, and do not include facility clean-ups or reactivations.

1. There has been a decrease in drum quantity epoxy, solvent, and other contaminated liquid wastes. This is a result of employee awareness and sensitivity to waste identification and its proper disposal. Epoxy and solvents are ordered as needed in gallon and 5 gallon containers rather than 55 gallon drums. Bulk storage has been discouraged, and for the most part, discontinued.
2. Recycling has been increased -- the machine shop personnel in B432 send their oily rags back to the vendor for laundering and reuse rather than disposing them as waste. Fluorinert dielectric was drained from the ETA-II accelerator and replaced with diala oil. Electronics technicians recover the Shell diala insulating oil which is then recycled by the manufacturer.
3. We will continue to establish our data base for "normal" operations and the resulting waste stream. This past year has seen a tremendous amount of "one time only" waste from clean-up of old abandoned MFE experimental facilities, including mercury contaminated pumps, piping, shelving and concrete.

MFE FACILITIES

Military Applications
Directorate

Waste Minimization Plan

May 31, 1991

Weaponization Program

Waste Minimization Plan

The Weaponization Program at Lawrence Livermore National Laboratory operates facilities in Livermore and at Site 300. The personnel in these facilities support a wide variety of engineering activities for the development of weapons systems.

The Program is actively identifying its waste stream, reviewing methods for reducing the inventory of hazardous and radioactive material, providing employee awareness through training/orientation, funding equipment upgrades, and incorporating administrative controls to ensure the Program's efforts are consistent with the Director's Waste Minimization policy statement. Many of the features outlined in the plan are in place already; some will be modified as we find new ways to improve them.

In general, the Program's activities require a small inventory of hazardous materials such as oils, solvents and hazardous chemicals for machining, cleaning, and assembly operations that take place in our facilities. In recent years, the inventory of these materials, including waste products, has been reduced because of an improvement in housekeeping and some changes in methodology to match the Program's and Environmental Protection Department's changing requirements.

Education

Educating our employees to the benefits of prudent hazardous materials' minimization and waste product removal is an extremely important feature in our plan. The group leaders are responsible for assuring that their employees receive training consistent with recommendations from the Environmental Protection and Hazards Control Departments. The group leaders are also responsible for documenting training activities and maintaining the training files. The group leaders will utilize current Environmental Protection Department training courses, distribute related literature and informational films to their employees for review, and discuss the subject in group meetings to expand the employees' awareness and encourage their active participation. It is particularly important that the employees understand and appreciate the cost implications and difficulties associated with waste removal.

Administrative

Weaponization Program activities involving hazardous materials are limited in scope by the facilities' safety procedures and special operating safety procedures. It is the group leader's responsibility to review each of these documents as they are drafted, or when they require renewal to ensure that the minimization and hazardous material handling issues are addressed and conform to the Laboratory's goals. Changes in process methodology, or choosing substitute materials are to be considered at this time to further reduce the waste stream.

It is the group leader's responsibility to ensure that minimal hazardous materials are proposed during all aspects of a systems development. Cost considerations for the disposal of the waste products, consistent with Environmental Protection Department requirements, are to be discussed to determine the best choice of materials to meet the minimization goals and to more accurately project the Program's budget. The group leader will also encourage the utilization of alternate system evaluation and assembly methods to achieve the same goals.

Centralizing the procurement of hazardous chemicals/materials and oils has merit; however, because the project teams work independently with different requirements and schedules, the coordination efforts may be too cumbersome to be practical. Further review is in order to evaluate this option.

Accomplishments

We have incorporated several changes in our operations to reduce hazardous materials and improve waste product handling practices in our facilities in recent years. For example, all of our 55 gallon storage racks containing our supply of oils and solvents were removed approximately 4 years ago to reduce the inventory and to avoid the possibility of a large spill. A new system was incorporated wherein our stock of these materials is limited to only that necessary to accomplish the task at hand, wherever possible. The materials, in unbreakable containers, are stored in fire safety cabinets in the work areas and limited to small quantities, typically less than 1 gallon.

Waste products such as contaminated Kimwipes, rags, commercial absorbant materials, and spent liquids are appropriately packaged, tagged and stored in the facilities' waste accumulation area until processed by Hazardous Waste Management personnel.

In the past 3 years, we have upgraded two closed-loop systems containing hazardous fluids that had the potential to produce large amounts of waste as a result of leaks, or catastrophic failure. Following design reviews, we established guidelines for improving the equipment's maintenance practices, and funded extensive mechanical upgrades to reduce the risk of a sizable release.

We improved our waste product handling and removal system at both sites by installing waste accumulation areas conforming to the Environmental Protection Department guidelines. Frequent documented inspections are required to record the facilities' status and activity. Upgrades to the Livermore waste accumulation areas are currently under review to meet the buildings' changing requirements.

Summary

We believe our plan is a very workable method for assisting us to meet the Laboratory's commitment to reduce the hazardous materials waste stream. Thus far, a great deal of progress has been shown because many of its features have been in place for some time. Modifications of this plan are anticipated to address future situations.

DWH:nm/q0019

Defense Systems and
Nuclear Design

Waste Minimization Plan

May 31, 1991

Lawrence Livermore National Laboratory

**Nuclear Design Program
Waste Minimization Program
1990 Progress Report**

April 1991

WASTE MINIMIZATION PROGRAM PLAN

Preface

The following Waste Minimization Program Plan has been prepared to reduce the volume and/or toxicity of hazardous, mixed, and radioactive wastes generated as a result of Nuclear Design (ND) activities. This Plan also addresses the minimization of nonhazardous industrial wastes, in particular those wastestreams that cannot be released to the environment or to sewer systems without treatment and, therefore, are processed as if they were hazardous. The goals, management support, roles and responsibilities, waste targets, information transfer and reporting, and evaluation and auditing elements of the ND Waste Minimization Program are included.

LLNL's ND management endorses this Plan, and will include its elements in its existing and new activities.

Eugene C. Draney
Deputy Associate Director
for Assurances
Nuclear Design Program

Executive Summary

Waste minimization has received top management support at LLNL. A Waste Minimization Program Plan has been developed for the LLNL Nuclear Design Program (NDP), and it is being implemented by the programs, divisions, and support organizations operating under its purview.

Four major ND wastestreams have been identified. They are: (1) classified solid mixed wastes generated from Livermore Site Chemistry and Engineering operations, (2) debris generated from Site 300 high explosives firing table operations; (3) wastes from Livermore Site and Site 300 high explosive formulation, processing, and testing operations; and (4) miscellaneous wastes resulting from dynamic/physical and particle beam testing operations conducted at Site 300, and from chemistry laboratory, machine shop, and general facility and equipment maintenance activities that take place at both sites. Identification of potential alternatives for reducing these characterized wastestreams is an ongoing activity. In several areas, alternatives have already been selected and implemented.

LLNL ND management has established a waste reduction goal of 25% reduction over the next 3 to 5 years, with the proposed base year being CY 1988. It is ND's intent to give priority to source reduction and recycling over treatment of wastes, employing methods that are technically feasible and economically practicable.

NUCLEAR DESIGN WASTE MINIMIZATION PROGRAM PLAN

Waste Minimization Organization

The Waste Minimization Policy Statement of March 8, 1989 (Attachment 1), issued by the LLNL Laboratory Director, reflects the strong commitment by top management to implement waste minimization efforts at LLNL. To reinforce the Director's policy, NDP management has developed this plan and is requiring that it be incorporated in ND program operations and at all ND facilities.

As illustrated in Figures 1a, 1b, 1c, and 1d, several LLNL organizations have roles and responsibilities in carrying out the ND Waste Minimization Program. The ND Deputy Associate Director (DAD) for Assurances has the responsibility for management of safety and environmental programs, as delegated by the Associate Director for ND. ND Program Leaders and Facility Managers have the responsibility for daily oversight of safety and environmental programs. Knowledge of environmental compliance and operational safety requirements and implementation of these requirements is the responsibility of the programs and support organizations operating each facility or complex. Work is performed at these facilities in accordance with established Operational Safety Procedures and in compliance with environmental regulations. The DAD/ND, ND Program Leaders and Facility Managers, and operational support managers receive guidance and assistance in implementation from safety and environmental specialists assigned to ND.

With respect to waste minimization, the DAD/ND provides the system for reviewing and auditing programmatic and support activities to ensure that waste minimization goals are being addressed. ND Program Leaders and Facility Managers provide the oversight to ensure that routine operations receive the proper review to ensure that both LLNL and Site 300 waste minimization policies are being incorporated into activities. The ND Waste Minimization Coordinator coordinates assessment and implementation activities of all ND operations and ensures that ND

Figure 1a. Functional Organization Chart – Site 300 Waste Minimization Program

Solid lines denote lines of responsibility. Broken lines denote support organizations.

Figure 1b. Functional Organization Chart – R-Program Waste Minimization Program

Solid lines denote lines of responsibility. Broken lines denote support organizations.

Figure 1c. Functional Organization Chart – A-Program Waste Minimization Program

Solid lines denote lines of responsibility. Broken lines denote support organizations.

Figure 1d. Functional Organization Chart – B-Program Waste Minimization Program

Solid lines denote lines of responsibility. Broken lines denote support organizations.

waste minimization information is communicated between ND personnel and LLNL/DOE Waste Minimization Program personnel. Each ND program and support organization manager establishes specific waste minimization goals and plans, and identifies and assigns responsibility for achieving these goals to a specific Waste Reduction Coordinator (WRC). In addition, program and support organization managers are responsible for ensuring that formal training of personnel in waste minimization and hazardous waste management practices is provided, and that required recordkeeping systems are implemented and maintained.

The safety and environmental specialists from the Hazards Control Department (HC) and the Environmental Protection Department (EPD), respectively, are responsible for providing interpretations of codes, standards, and DOE Orders, and for conducting training courses, evaluations, and audits, as requested by the DAD/ND. In addition, the Hazardous Waste Management Division Leader of LLNL's EPD is responsible for ensuring that waste minimization records and certifications required by 40 CFR 264.73 (b) (9) are maintained as required.

Waste Minimization Goals

LLNL ND management has established a waste reduction goal of 25% reduction over the next 3 to 5 years, with the proposed base year being CY1988.

Waste Minimization Assessments and Proposals

ND waste minimization assessments shall include three major steps: (1) information gathering; (2) identification and screening of potential waste minimization options; and (3) evaluation of technical and economic aspects of potential options. Implementation of the recommended options shall follow the assessment process. ND's waste minimization assessment process shall be an on-going program, not a one-time effort. The DAD/ND shall arrange for an annual audit to identify additional opportunities for source reduction and recycling. These annual reviews will emphasize the application of new technologies for waste reduction as they become known, with priority being given to source reduction and recycling over treatment of wastes, as illustrated by the example shown in Figure 2.

Figure 2

Waste Minimization Strategy

The Hazardous Waste Division of EPD develops and maintains a waste accounting system to track the types, amounts, composition, and generation dates of all hazardous wastes. The Facility Hazardous Waste Report is based on data extracted from the HWM data base. The four major wastestreams generated by the NDP are: (1) classified solid mixed waste, (2) debris from Site 300 high explosives firing table operations; (3) wastes from high explosive formulation, processing, and testing operations; and (4) miscellaneous wastes resulting from dynamic/physical and particle beam testing operations, and from chemistry laboratory, machine shop, and general facility and equipment maintenance activities. Nuclear Design waste generation flow sheets are shown in Figures 3a, 3b, 3c, and 3d. Tables 1a, 1b, 1c, and 1d display proposed and implemented waste minimization activities for Nuclear Design wastestreams.

Reduction activities for each wastestream is receiving high management priority and will be undertaken to the degree determined to be technically feasible and economically practicable.

Cost Allocation System

HWM has been studying the feasibility of implementing a hazardous waste cost recharge system for all LLNL programs and support organizations, and is discussing funding and implementation issues with LLNL program and support groups and the DOE. After these funding and implementation issues are resolved, the approved LLNL system shall be incorporated into the ND Waste Minimization Program Plan.

In addition, the DAD/ND is evaluating positive incentive alternatives to reward those employees and/or groups who suggest waste reduction techniques that are adopted as part of the ND Waste Minimization Program.

Note: ¹ Packing materials may contain solid Cadmium (D006) and/or chromium (D007) components. Kimwipes and cloth may also contain traces of organic solvents (F001-F003, F005).

Figure 3a. Waste Generation Data – High Explosives Formulation, Processing and Testing Operations

Figure 3b. Waste Generation Data – High Explosives Firing Table Operations

Figure 3c. Waste Generation Data – Miscellaneous Wastes

Figure 3d. Waste Generation Data – R Program Solid Waste Stream

Table 1.a
High Explosive (HE) Formulation, Processing and Testing Wastes

Process waste	Minimization proposal	Cost	Schedule	Comments
HE fines	Recycle HE fines on-site for reuse in high explosives testing operations.	To be evaluated	CY90	Technology modification, process changes required.
HE bulk	Technology modification, production changes.	To be evaluated	CY90	Training and procedure implementation required.
HE-contaminated solid wastes (packing material, Kimwipes, etc.)	Good house keeping practices, waste stream segregation, training, inventory control, and spill prevention.	Acceptable costs	CY90	Training required.

Table 1.b
Debris from Site 300 HE Firing Table Operations

Process waste	Minimization proposal	Cost	Schedule	Comments
Debris	Materials substitution, using non-hazardous materials in place of hazardous material.	Acceptable	Initiated in CY89 (on-going)	Administrative controls have been placed on the use of lead in experiments. Since lead was the constituent that made the debris a RCRA waste, its control has resulted in a waste stream that is most often characterized as low-level radioactive, rather than mixed.
	Technology modification on design of firing table tents	Acceptable	In-place CY89	New type of structure used, resulting in a significant reduction in the volume of waste generated.

Table 1.c
Miscellaneous Wastes from Dynamic/Thermal and Beam Research Operations,
Chemistry Laboratory, Machine Shops, and Maintenance Operations

Process waste	Minimization proposal	Cost	Schedule	Comments
Ignitable waste	Good housekeeping practices, training, employee involvement, waste stream segregation, inventory control.	Acceptable	CY90	Training required.
Halogenated	Chemical substitution, process changes, production technology modification.	To be evaluated	Initiate in CY90	Studies required to ascertain technical feasibility, adverse impacts on product quality.
Miscellaneous	Good housekeeping practices, waste stream segregation, spill prevention, inventory control	Acceptable	CY90	Training required.

Table 1.d
R Program Solid Waste

Waste	Minimization Proposal	Cost	Schedule	Comment
experiment material	limit new materials	tbd	FY90-91	reduces program options
	improve quality (reduce reject)	tbd	FY90-91	
	reduce variety of materials	tbd	FY90-91	reduces program options
	segregate & chemically declassify & recycle *	tbd	FY90-91	not applicable to all materials
packaging & worker protection items	develop technology for declassifying and certifying to be non-hazardous & non-radioactive; then common landfill disposal possible *	tbd	FY90-91	no benefit if waste can continue to be incinerated as mixed waste
metal tooling, piping, & ducting	develop methods for declassifying & decontaminating; then recycle (salvage) *	tbd	FY90-91	generates waste cleaning materials
HEPA filters	improve pre-filtering to extend HEPA life *	tbd	FY90-91	mixed waste HEPA filters present special disposal problem

*denotes items that significantly reduce mixed waste

Technology Transfer

Nuclear Design programs and support organizations interact with other DOE, trade, and academic organizations to obtain information on waste reduction technologies and strategies through the ND Waste Minimization Coordinator. A conscientious effort is made to network with those organizations who have common waste reduction needs. Information related to waste reduction techniques is maintained in the Site 300 Administration Library (Building 871, Room 115) and in the ND Conference Room (Building 111, Room 701).

Waste minimization techniques and strategies developed and implemented at LLNL by ND personnel are transferred via established DOE information transfer systems, through professional publications, and through presentations at technical conferences.

Program Evaluation and Audits

The DAD/ND shall establish a Quality Assurance Program to audit the implementation of the ND Waste Minimization Program Plan. A report shall be prepared to document annual progress on meeting reduction goals and to identify potential areas for improved waste minimization.

administrative MEMO

Policy and Procedure

Vol. 19, No. 6

March 8, 1989

DIRECTOR'S STATEMENT ON WASTE MINIMIZATION

It is important that the Laboratory make a strong commitment to waste minimization--particularly to hazardous and radioactive waste minimization. Our goal is to reduce the Laboratory's hazardous/radioactive waste streams by a major factor in the next three to five years by reducing generation and increasing recycling. We will implement an incentive system where each Laboratory program will pay the costs associated with the handling and disposal of its waste. Each program will establish waste minimization goals and develop plans and assign responsibility for achieving these goals. Waste minimization will be incorporated in the design of new projects.

John H. Nuckolls
Director

Nuclear Test-Experimental
Science Directorate

Waste Minimization Plan

May 31, 1991

Interim Waste Minimization Plan

May 1991

*Nuclear Test
Experimental Science*

Nuclear Test-Experiment Science Interim Waste Minimization Plan

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NUCLEAR TEST-EXPERIMENTAL SCIENCE DIRECTORATE
INTERIM WASTE MINIMIZATION PLAN
MAY, 1991

INTRODUCTION

DOE order 5400.1 requires that each DOE facility prepare a Waste Minimization Plan. In turn the LLNL Environmental Protection Department, which is preparing the Laboratory Waste Minimization Plan, has requested that each Directorate prepare a waste minimization plan to be incorporated into the Laboratory plan. This interim plan identifies the efforts that Nuclear Test-Experimental Science (NTES) has made and plans to make in identifying and minimizing hazardous, radioactive, and mixed wastes.

The NTES Directorate consists of three divisions: L-Division, Nuclear Chemistry Division (NCD), and Nuclear Test Operations Department (NTOD). This plan covers the activities of NCD and L-Division. NTOD is located at Mercury, Nevada, at the Nevada Test Site and is primarily an administrative and support organization which produces small amounts of hazardous waste. The waste is handled by the principal NTS contractor whose overall plan is approved by the DOE Nevada Operations Office.

L-Division chiefly supports the programmatic mission of obtaining experimental data important to understanding the physics of nuclear weapons. The division designs, assembles, and calibrates instruments for application on nuclear tests at the Nevada Test Site. The division also maintains physics laboratories wherein nuclear weapons conditions may be simulated and studied, and where advanced diagnostic development may be accomplished. The division's physical plant includes electronic and mechanical assembly and calibration laboratories, machine shops, small accelerators, x-ray generating equipment, laser laboratories, and photo labs. They are located in Building 121 and portions of Building 174, 212, and 255.

Nuclear Chemistry Division has a diverse mission: The quantification of radionuclides produced in nuclear tests, the quantification of radionuclides in the environment, and research into nuclear properties and processes. NCD operations are located in Buildings 151, 154, 251, 281 and 282.

PROGRAM OBJECTIVES

On March 8, 1989, the LLNL Director issued the following statement on waste minimization:

It is important that the Laboratory make a strong commitment to waste minimization--particularly to hazardous and radioactive waste minimization. Our goal is to reduce the Laboratory's hazardous/radioactive waste streams by a major factor in the next three to five years by reducing generation and increasing recycling. ... Each program will establish waste minimization goals and develop plans and assign responsibility for achieving these goals. Waste minimization will be incorporated in the design of new projects.

The NTES Directorate subscribes fully to this policy and is working toward implementing a pro-active approach to reduce the amount of hazardous waste produced in its operations, where possible, thus lessening the impact on the

environment. The goal is to reduce the total level of hazardous, mixed, and radioactive waste by 25% from the base year of June, 1987-May, 1988 by the end of the calendar year 1993. The strategies being encouraged are source reduction through chemical inventories, waste segregation, substitution, or changes to procedures, and to a lesser extent, recycling.

DESCRIPTION OF PROGRAM

The responsibility for waste minimization has been delegated by the Associate Director for NTES to the Division Leaders of Nuclear Chemistry and L-Divisions. The Deputy Associate Director for Assurances (DAD/Assurances) provides oversight of the waste minimization effort to ensure that objectives will be met.

The DAD/Assurances has appointed a Waste Minimization Coordinator for the Directorate. Nuclear Chemistry and L-Division have each appointed a Waste Reduction Coordinator. These three individuals constitute the Waste Minimization Committee (WMC) for the Directorate. The WMC, will conduct assessments of the waste streams identified in the Table on page 4 in accordance with the schedule indicated. Where waste minimization opportunities are identified, the WMC will develop and present plans for implementation. The Division Leaders will ensure that the assessments are completed, that members of the staff provide input as necessary and will evaluate the merits of identified waste minimization procedures.

DESCRIPTION OF WASTE MINIMIZATION ACTIVITIES TO-DATE AND PLANNED ACTIVITIES

The NTES Programs have reviewed their programmatic and research goals and their operations, and are working in a manner to accomplish their missions and minimize waste at the same time. In order to minimize the generation of wastes, the divisions have determined to:

- Obtain and review annual reports of waste generated.
- Factor waste minimization requirements into operational plans and procedures.
- Identify opportunities to reduce the volume and/or toxicity of wastes.
- Establish methods to minimize unintentional waste generation
- Separate wastes where appropriate
- Provide hazardous waste training to waste generators.

The nature and volume of wastes generated by the operations of the Divisions will be reviewed on an annual basis by the Waste Reduction Coordinator. The source of data for this review will be reports from the Hazardous Waste Management Division (HWM) of the Environmental Protection Department. New operations will be screened for waste minimization options, and successful methods will be shared with all staff.

The scientific staff have been asked to review their processes and waste streams for waste minimization targets of opportunity, paying particular attention to unintentional waste generation. Many have provided flow diagrams of their processes which will be retained by the Division Waste Reduction Coordinator. Strategies are being implemented which require minimal efforts and budgetary demands. As part of the preparation and review of Operational Safety Procedures (OSPs), waste reduction opportunities are being considered.

L-Division generates small amounts of wastes from the use of solvents, laser dyes, photo chemicals, oils, adhesives, etc. No radioactive or mixed wastes are generated in routine operations. The Division Waste Reduction Coordinator will emphasize identification of waste-generating materials and processes, will evaluate the use of substitute materials, will monitor and minimize the inventory of waste-generating materials on hand in the facilities, and will separate wastes to enhance recycling and minimize disposal costs. Each laboratory will maintain a list of hazardous waste generating chemicals. Non-routine operations involving hazardous materials require Operational Safety Procedures (OSPs). The scientist will address hazardous waste generation and opportunities for minimization as part of the development of his process and OSP.

In the Nuclear Chemistry Division the majority of activities that generate wastes involve the use of radioactive materials, chemical reagents, and solvents. The division will focus on control of chemical inventory and usage, and on segregation of radioactive and non-radioactive waste. Each laboratory will maintain a list of chemicals. The division management will review this inventory to determine if there is excessive duplication and work to correct it. Currently, flammable chemicals have been consolidated in central locations. The Hazardous Waste Generator class for NCD emphasizes the need to segregate non-hazardous wastes from hazardous wastes and to avoid the generation of mixed waste. It should be noted however, that it has been and will be the practice of NCD to avoid the inadvertent addition of radioactive waste to non-radioactive waste even if this results in increased amounts of low level radioactive waste. In other words, if there is any question about radioactive content, NCD will consider it to be radioactive waste. All bench top experiments and pilot-scale experimental simulations requiring an OSP will be reviewed for waste minimization opportunities. This review process is formal in the 251 facility, and informal otherwise. Any experiment that generates more than ten (10) gallons or ten (10) pounds of extremely hazardous waste in a 12 month period will be reviewed by Division management. The mixed waste that NCD generates in its operations is sent for treatment to reduce the volume before it is stored.

The Laboratory is working on the development of an employee awareness program. NTES will participate in the Laboratory program once it is developed. Currently, each employee receives a copy of the publication *Waste Notes* which highlights waste minimization efforts for the entire Laboratory.

Employees who work in our laboratories and handle hazardous chemicals and hazardous, radioactive, or mixed waste are required to take a Hazardous Waste Generator course annually. (EP0006). This course addresses some waste minimization opportunities, primarily through proper segregation and handling of wastes.

Some of our scientists are developing research proposals to look at the chemistries and minimize wastes created in Nuclear Chemistry operations. These proposals will be beneficial, not only to the Nuclear Chemistry Division, but to the DOE complex as a whole. NTES management encourages this interest and will endeavor to help them get the necessary funding.

DESCRIPTION OF TECHNOLOGY TRANSFER ACTIVITIES

Technologies developed for substitution, process modifications, and other waste minimization opportunities developed within NTES will be shared with other members of the NTES staff. In addition they will be brought to the attention of the Laboratory Waste Minimization Steering Committee, the EPD Waste Minimization Office and submitted for publication in *Waste Notes*. If applicable, the Technology Transfer Office will be contacted.

DESCRIPTION OF PROGRAM PERFORMANCE EVALUATION

A Waste Reduction Report will be prepared annually by the Waste Minimization Committee in March in accordance with DOE Order 5400.1. The Division Leaders and DAD/Assurances will ensure that this report is completed in a timely manner. In conjunction with the preparation of the Waste Reduction Report, this Waste Minimization Plan will be evaluated and reviewed.

Table 1 - Identified Waste Stream & Assessment Schedule

<u>Stream #</u>	<u>Location, Bldg/Room</u>	<u>Program</u>	<u>Process</u>	<u>Types of Waste</u>	<u>Assessment Schedule</u>
1a,1b,1c	151/1043	NCD-Test	NTS Core Sample Dissolution	Rad, Haz, Mixed	3Q FY91
2a,2b	151/2109	NCD-Test	Initial Separations (Chemical)	Rad, Mixed	4Q FY91
3a,3b	151/2302A	NCD-Test	Rare Earth Separations	Rad, Mixed	4Q FY91
4a,4b	151/1033	NCD-Test	Large Core Extractions	Rad, Mixed	1Q FY92
5a,5b	151/2308,2312,2318 151/2322,2326,2330	NCD-Test	Multiple Chemical Separations (Zr, Nb, As, Au, Ag, Rh, Sc)	Rad, Mixed	1Q FY92
6a,6b	151/1922,1926,1930 251/1211,1117	NCD-Test	Heavy Elements Separations	Rad, Mixed	2Q FY92
7a,7b	151/1133, 251/1212	NCD-Test	Isotope Measurements	Rad, Mixed	2Q FY92
8a	251/1235,1027,1035,1047	NCD-Test	Tracer Fabrication	TRU	3Q FY92
9a,9b	151/2117	Environ. Mtrng.	Environmental (Chemical) Analysis	Haz, Low-level	3Q FY92
10a,10b	281/1323,1319,1311	YMP,HRMP	Chemical Separations	Haz, Low-level	4Q FY92
11	281	NCD Mach. Shops	Solvents, Turnings, Oils	Haz	3Q FY91
12	121, 151, 251	L-Div Mach. Shops	Solvents, Turnings, Oils	Haz	3Q FY91
13	121/1250,1250a,1250b 121/1248,1248a	L-Div Test	Photo Darkroom Operation	Haz	4Q FY91
14	121/1126,1162,1258a	L-Div Test	Laser Dyes & Solvents	Haz	1Q FY92
15	151,251,281/various	NCD-Test	Excess or out-of-date chem. reagents	Haz	4Q FY92

Nuclear Test-Experimental Science Waste Minimization Organization Chart

Physics
Directorate

Waste Minimization Plan

Edward G. English
Deputy Associate Director
for
Physics Operations
May 31, 1991

I. INTRODUCTION/BACKGROUND

The Physics Department is engaged in both theoretical and laboratory research. It is within these laboratories that the major portion of hazardous wastes are generated. These laboratories are located in various buildings at LLNL that range in age from the oldest at LLNL to some of the newest. Processes in these facilities typically generate normal industrial wastes resulting from the maintenance of equipment and the construction of precision instruments. Small amounts of chemical wastes are generated as part of the semiconductor processing within O Program facilities. Occasionally there is some radioactive waste generated in conjunction with accelerator activities. Finally there is an increasing source of wastes related to the chemicals used in office equipment (such as toner cartridges). This plan is the Physics Department's implementation of the directions given by John Nuckolls in his March 8, 1989 Administrative Memo on waste minimization (Attachment 1).

The Physics Department is organized into 8 Divisions/Groups that conduct theoretical and experimental programs within LLNL. In addition there are 3 institutes which conduct projects jointly with organizations outside LLNL (See organization chart Attachment 2). A variety of facilities including accelerators , light laboratories, chemical processing labs, and offices are operated to support these projects.

Those building with experimental facilities are:

- Building 190, Center for Accelerator Mass Spectrometry
- Building 194-5, Electron Accelerator
- Buildings 182 ,197-8, and 1879, Semiconductor Fab and labs
- Building 212, Laboratories and Gas Gun Facility
- Buildings 292 and 294, Detector Test Lab

II. PROGRAM OBJECTIVES

A. Management Commitment

The Physics Department is committed to creating a safe and healthy work environment, including the minimization of waste generation, as outlined in its policy statement (Attachment 3). Department management believes it is important that all of its

organizations and individuals recognize the inherent health, safety and environmental problems associated with hazardous waste generation and that they contribute towards the minimization of hazardous waste generation.

B. Waste Minimization Policy

Environmental protection is a primary management responsibility as well as that of every employee. This responsibility takes precedence over programmatic activities and responsibilities.

The Physics Department is aggressively committed to achieving a significant reduction in the quantity of hazardous and radioactive waste generated throughout the Department through advanced planning of experimental design within the Department. This commitment is coupled with additional actions aimed at achieving a net reduction of hazardous waste generated and/or a lessening of the hazardous properties of the waste produced. In keeping with this policy to reduce waste and achieve minimal adverse impact on the air, water and land through environmental controls, it is incumbent upon every experimenter to incorporate efficiencies within their operations to assure that the lowest reasonable amount of waste is generated.

The success of the Physics Waste Minimization Program depends on the active participation of every member of the Department.

C. Waste Minimization Objectives

Through the systematic review and improvements in its operations, it is the intent of Physics to achieve a continuing reduction in hazardous waste generation through the use of recycling, efficiency improvements within process streams, and reduction of inventory volumes within the next five years. Through training and awareness, Physics will concentrate on better source management. This strategy enables controlling generation at the most effective point of waste minimization, the sources before they are brought into the department.

III. WASTE MINIMIZATION PROGRAM

A. Waste Minimization Strategy

1. Organization

As can be seen in its policy statement, Physics has placed a high priority on waste minimization. The Associate Director for Physics appointed an Assurance Officer for Physics under the Deputy Associate Director for Operations(DAD) to oversee ES&H issues including the waste minimization. for the Department. Division Leaders have also established ES&H representatives who conduct safety meetings to assess there operations including the minimization of waste generation.

2. Staff Responsibility

The Lead Experimenter will be responsible for an assessment of the methods and alternatives to reduce any hazardous waste streams generated by his operations. Physics is also requiring that actions necessary to assure the minimization of waste generation be incorporated in Operational Safety Procedures. Within the office environment, the responsibility for communicating the importance of hazardous waste minimization rests with each organization's senior administrator.

3. Implementation Strategy

In both the laboratory and the office environment, the responsible individuals will work with the designated facility waste coordinator to assure the safe packaging, handling, and disposition of wastes generated within their operations. Typically this facility waste coordinator will be the building coordinator unless the volumes generated dictate the need for assignment to an individual with those exclusive responsibilities (such as within O Program). Generated wastes will be properly contained on an interim basis within the generators facility and then transported by the designated facility coordinator to the appropriate Waste Accumulation Area (north of B-197 and east of B-212).

4. Schedule

The management organization is in place and the strategy has been implemented. The process of identifying waste streams and finding ways to minimize them is an ongoing one as is education and training.

B. Waste Minimization Budget

As those activities required to implement the Waste Minimization Program are identified in the various projects of the Physics Department budgets will be developed to support them.

C Staff coordination for Waste Minimization

Division/Program safety meetings will contain discussion between experimenters and managers on progress in waste reduction, alternatives, and how to motivate employees to implement minimization measures. These meetings will also be used to communicate Laboratory-wide programs and solutions to minimize waste .

D. Method of Tracking Waste from Generator to Discharge/Disposal

The ultimate goal is to track the amounts and constituents of the hazardous and radioactive wastes from their time of purchase through the final disposal. Procedural steps for waste tracking will be coordinated with the Lab wide tracking system.

E. Method of Accounting/Waste Management Costs.

The waste management costs of monitoring, collecting, handling, accumulating, packaging, storing, transportation and disposal incurred by the Department are each significant elements and will require a mechanism for assessing the true expenditures. Additional costs will be associated with permitting, training personnel, record-keeping and accounting. Procedural steps for tracking waste management costs will be coordinated with a Lab wide tracking system.

F. Waste Minimization Quality Assurance

Waste Minimization Quality Assurance is to be incorporated in the elements listed below:

- Physics Waste Minimization Plans
- Management Support
- Oversight by the Assurance Officer
- Oversight by the Division Safety Committee
- Corrective Action

The Division Safety Committee shall prepare a report documenting annual progress on meeting waste minimization goals and identifying areas for improvement.

IV. THE WASTE MINIMIZATION ACTIVITIES

A. Employee Awareness and Training Program

Physics Department personnel, from management to experimenters, must be aware that waste minimization is part of everyday business and is everyone's concern. Employee awareness of waste minimization may range from what they read in the Laboratory newspaper to mandatory attendance at formal training sessions and to specific information contained in guidance documents. All Laser personnel handling feed materials or waste streams, or involved in process operations are required to attend formal training sessions. Traditionally, formal training sessions have been conducted by the Environmental Protection Department (EPD). For example, selected Physics personnel were recently trained in "Hazardous Waste Handling." Other classes available through EPD are "Guidelines for Waste Accumulation Areas" and "Preparation Guide for Generators of Hazardous Chemicals and Radioactive Waste at LLNL." An attendance record is maintained to assure that all personnel receive appropriate training, with periodic refresher classes as needed. Waste minimization information from the published literature, vendor information, or trade shows is disseminated through informal briefings by managers or supervisors and is also available from the library of the Waste Minimization Project. Finally, Division/Program safety meetings will contain discussion between experimenters and managers on progress in waste reduction, alternatives, and how to motivate employees to implement minimization measures. These meetings will also be used to

communicate Laboratory-wide programs and solutions to minimize waste

B. Waste Minimization Assessment (Periodic Internal Audits)

Individual experiments/facilities will be reviewed/audited semi-annually as part of the ES&H self-assessment process and the *Operational Safety Procedure review to identify opportunities for additional minimization or elimination of waste generated*. The objective of each audit will be to determine any possible reductions in the volume and/or toxicity of the wastes and to reduce or eliminate mixed waste streams. The focus of the first audit was on identifying the

- extremely toxic chemicals and/or troublesome compounds and any by-products or waste their use generates
- high volume waste streams
- highly regulated wastes (chlorinated solvents, RCRA, acutely hazardous)
- land banned wastes
- wastewater, air emissions and other sources of toxic releases

Following that audit, control strategies will be evaluated to consider

- material conservation
- material substitution
- inventory management
- recycling/segregation
- process modifications
- waste treatment/detoxification

High priority waste streams will be analyzed for potential reduction strategies. Where strategies are identified, a detailed study will be made of the costs and benefits. Recommended changes will then concentrate on the use of equivalent and readily available substitutes which will not affect the quality of the experiment, process or product.

C. Waste Minimization Technologies Implemented

Physics has worked with Engineering to assure that their policies, procedures, and processes are being followed in the "area shops".

Laboratory areas are adopting the use of recycled rags. This has a particularly large effect in minimizing waste generated during the cleaning of the two stage gas guns.

Inventories of hazardous materials are kept to a minimum level to discourage the over use of substances.

Specific actions which relate to H, C, and O programs are discussed in their "micro"-plans included as addenda.

V. DESCRIPTION OF TECHNOLOGY TRANSFER

Exchange of applicable technical information on waste minimization from other sources will facilitate Physics waste minimization.

Sources of such information can come from

- California Department of Alternative Technologies for Recycling and Treatment of Hazardous Wastes
- Office of Environmental Restoration
- Waste Management Workshops
- EPA Waste Minimization bulletin board reprints
- Other sources of information yet to be assembled.

It is the intent of Physics Department to be responsible for acquiring applicable alternative technologies pertinent to specific operations and then to distribute the factual information throughout the Department. It is planned that this will occur via discussions and literature disseminated at the Division/Program safety meetings. The objective will be to develop a mechanism to obtain and disseminate information both inter and intra the Physics & LLNL facilities.

VI. PROGRAM PERFORMANCE EVALUATION

Progress of the Physics Waste Minimization program effort will be reviewed semi-annually by the Safety Committee. These reviews will evaluate the procedural flow, deal with any problems and assess the application of new technologies.

**administrative
MEMO**

Policy and Procedure

Vol. 19, No . 6

March 8, 1989

DIRECTOR'S STATEMENT ON WASTE MINIMIZATION

It is important that the Laboratory make a strong commitment to waste minimization--particularly to hazardous and radioactive waste minimization. Our goal is to reduce the Laboratory's hazardous/radioactive waste streams by a major factor in the next three to five years by reducing generation and increasing recycling. We will implement an incentive system where each Laboratory program will pay the costs associated with the handling and disposal of its waste. Each program will establish waste minimization goals and develop plans and assign responsibility for achieving these goals. Waste minimization will be incorporated in the design of new projects.

John H. Nuckolls
Director

Physics Department

**Physics Department:
Safety Policy**

Issued: November 28, 1989

PREFACE

The Physics Program's basic safety policy is to take every reasonable precaution in the performance of our work to protect the health and safety of employees and the public while minimizing the possibility of damage to property and the environment. Research and development frequently involves working at the limits of technical understanding and can generate unique risks. The safety challenge is to identify those risks and to manage them. The responsibility for safety resides with the Physics Program and is delegated through the line organization to each employee.

The Physics Program Safety Policy statement covers all operations performed by personnel under the direction of the AD for Physics, regardless of the source of funding. It also applies to all facilities under the administrative direction of the AD for Physics. Each major facility or facility complex which houses experiments must be covered under a Facility Safety Procedure (FSP). This procedure will identify a "Facility Manager" who coordinates the use of the Facility and must concur in all operations within it. Each experiment conducted by Physics personnel or within a Physics facility must conform to the safety criteria and guides set forth in the LLNL Health and Safety Manual or applicable FSP. A non-conforming operation must be covered by an up-to-date Operational Safety Procedure (OSP) which addresses the procedures to handle the special hazards which are at a variance with the published guides. Finally, all personnel who engage in experimental activities must be properly qualified to perform such work. This requires documentation of appropriate training or certification of equivalent educational experience.

This Safety Policy will work if cooperation, trust, and planning exist among program management, program employees, and health, safety and environmental support personnel. It is essential that all individuals involved in experiments work proactively to anticipate issues and manage risk so that experiments occur in a timely manner and at a reasonable cost, and in compliance with health, safety, environmental, and waste minimization requirements.

Safety is thus viewed as everyone's responsibility. Our intent is that this be recognized throughout Physics and that every effort be made to create a safe working environment.

This Program Safety Policy has been approved by:

C. Bruce Tarter
Associate Director for Physics

Attachment:
Safety Responsibilities

SAFETY RESPONSIBILITIES

The following people are responsible for ensuring that all work is performed in compliance with this policy and the LLNL Health and Safety Manual:

Associate Director for Physics has overall safety responsibility for all programmatic activities. The Deputy Associate Director for Operations is the designated alternate.

Leaders of the following organizations have line responsibility for the safety within their respective programs:

E-Division	T-Group
G-Division	C-Group
H-Division	P-Group
O-Division	IGPP
V-Division	CAMS
X-Division	PPRI
CP-Division	

Each leader should have a designated alternate who can act in their behalf. The person in charge of each experiment, facility, or area is responsible for safety as assigned.

Management

All members of Physics Program management are responsible for maintaining a low-risk work environment in the areas under their control. Program management refers to all individuals with assigned responsibility for supervising others in the course of conducting an experiment. Management responsibility is fulfilled by:

- Assuring that all equipment, experiments, and operations meet the requirements of the LLNL Health and Safety Manual or an

approved Operational Safety Procedure (OSP) or Facility Safety Procedure (FSP).

- Assuring that the written Operational Safety Procedures fully address the hazards in special operations or experiments not covered by LLNL safety rules and regulations and that those OSP's are revised promptly to reflect substantive experimental or personnel changes.
- Concurring in all OSPs and FSPs prior to their authorization by the AD for Physics or the DAD for Physics Operations, acting as his alternate.
- Maintaining surveillance of the work environment and establishing measures to control or eliminate the hazards associated with any experiment, operation, or equipment and to minimize the generation of wastes.
- Investigating, determining cause, and taking appropriate corrective action whenever an incident occurs which causes or could cause damage to property or injury or illness to personnel.
- Developing in their employees an attitude and awareness that will lead them to take safe action when faced with situations that are not covered by established regulations and practices.
- Assuring employees: (a) are qualified to perform assigned work, including having the necessary documentation of training, and (b) know the potential hazards associated with an operation and the methods established to control them.
- Controlling activities during an emergency until the Laboratory's emergency response personnel arrive.

- Keeping Hazards Control and Environmental Protection representative informed of activities which could pose health and safety risks.

Employee

Physics employees are responsible for their own safety and for the safety of others with whom they work. Specifically, each employee is responsible for:

- Bringing to the supervisor's attention any behavior or condition which may cause injury or illness to others or which could cause unacceptable damage to property.
- Stopping any operation whenever there is reason to believe that continuing it will lead to injury, illness, or unacceptable damage to property.
- Undertaking training necessary to assure the capability to perform assigned responsibilities.
- Learning and following the standards and procedures that apply to each job assignment.
- Employing good housekeeping and industrial safety practices in the workplace.
- Wearing and utilizing the protective equipment that is needed for a particular job assignment.
- Immediately reporting to the supervisor and the Health Service any occupational injury or illness or significant toxic material exposure.

Hazards Control and Environmental Protection Departments

These organizations are assigned the responsibility for providing safety guidance and services as needed by the Program. Physics expects that they will:

- Provide the Program information needed to formulate safety and environmental policies, directives, and standards and concur in all OSP's and FSP's.
- Assist Program personnel in establishing a low-risk work environment and monitor operations to provide Program personnel with feedback on performance.
- Provide necessary emergency response capability.
- Maintain a staff of specialists knowledgeable in all health, safety and environmental areas necessary to the conduct of operations at LLNL.
- Maintain an ongoing research program to improve surveillance of the work environment and control of hazards.
- Prepare and maintain the Laboratory Health and Safety Manual and Environmental Policies..
- Specify proper protective equipment for issue to employees.
- Provide necessary health, safety and environmental training services.
- Maintain safety and environmental records.

O Division
Supplement
for
**Waste
Minimization
Plan**

Joe R. Simpson
Health and Safety Officer

Overview

O Division is engaged in several areas of physical research projects sponsored by DOE, IR&D, and DOD funds. The research on various areas of semiconductor processing and packaging produces the largest volume of hazardous use and waste generation.

The following describes the actions we have taken to minimize the waste generated by O Division.

Source Stream

Different laboratory areas have been ordering and stocking each area separately. We are moving to combine the ordering and stocking to avoid duplication of materials and having excess materials on hand. This also avoids contribution to the waste stream by overstocking which produces outdated materials.

We have placed limits on the amount of liquid quantities that are stocked. This also helps the potential waste stream by reducing the opportunity for breakage.

There is a limitation on the sizes of toxic gas cylinders used in the semiconductor wafer processing. This not only reduces the safety risk but also the potential waste generated. We have a "no stock" policy for these toxic cylinders. Usage of the toxic gases are monitored and orders are placed so that the replacement cylinder is received just before the current cylinder is exhausted.

We have converted, where possible, any land ban materials such as changing from our previous use of methanol to isopropyl alcohol.

Process Operations

We have designed and/or purchased equipment that makes use of turbomolecular vacuum pumps instead of diffusion pumps. This eliminates the DP oil contribution to the waste stream.

We are using the cutting fluid, "Trim Sol", in the B194 machine shop to make use of the recycling system used in the B321 and reprocess the fluid on site.

In the cleaning and rinsing of the semiconductor wafers, we use the solvents until they are expended. Where possible we reuse the solvents passing a used solvent to progressively dirtier operations.

We have two systems to generate de-ionized water. Each system uses resin columns to polish the input water. The cleaning and resin replacement has been contracted to an outside company.

Output Stream

We have three processes that have toxic gases sent through Combustion Decomposition and Oxidation units (CDO) to detoxify the output gas flow. The particulates formed after the decomposition is trapped in a water spray and the resultant waste water is collected in holding tanks. These CDO water outputs, slightly acid, are then neutralized and then dumped to the sewer. Due to recent modifications to the main toxic gas exhaust system, Hazards Control Department has recommended that the use of the CDOs be discontinued. This will decrease a significant portion of the division's volume into the waste stream and reduce the need for onsite treatment.

We have converted, at additional expense, to the use of synthetic oils in the mechanical vacuum pumps. These oils are collected returned to the manufacturer for offsite reprocessing.

Monitoring

Brent Ives, through Don Hirzel, will check authorized stocking levels of unused chemicals and gases. He will keep up to date inventories of hazardous materials.

Oversight

O Division will establish a "Hazardous Substance Oversight Committee". This committee will set local stocking limits, review material inventories, review hazardous waste policies, review hazardous waste handling procedures, review training requirements, set waste minimization goals. This committee will be made up of group leaders, lead scientists who are responsible for the generation of the wastes, and the Health and Safety Officer for the division..

H & C Division
Supplements
for
**Waste
Minimization
Plan**

Thomas Phillips
Health and Safety Assurance Officer

Overview

H-Division and C-Group within the Physics Department are engaged in several areas of physical research on the high pressure behavior of materials. These projects use explosively driven gas guns which produce some hazardous wastes as described below. This plan is also being followed for the Bldg 212 Gas Gun operation.

WASTE MINIMIZATION PLAN (H-DIVISION AND C-GROUP)

BLDG 341 Gas Gun Facility

There are several areas in Bldg 341 that generate contaminated waste. These areas include, but are not limited to, the following:

	Room
Tech Area	1119
Tech Area	1123
Machine Shop	1116
Vapor Deposition Lab	1106
Two-Stage Gas Gun	1200
Light Lab	1128
Dark Room	1134-A
Measurement Lab	1100-A
Quarter Scale Gun	1009

Waste presently generated:

Chlorinated solvents
Non-chlorinated solvents
Non-PCB oils
Paper Wipes Cloth rags contaminated with oils, solvents and chemicals
Photographic developer and fixer
Two-Stage Gas Gun shot debris
Quarter Scale Gun shot debris

The waste most likely to be generated in the technician areas (rooms 1119 and 1123) are solvents, paper wipes and small amounts of epoxi resins.

The waste generated in the machine shop are cutting oils and fluids, solvents, cloth rags, paper wipes, and absorbents used for fluid spills.

The waste most likely to be found in our laboratories are solvents, photographic chemical, vacuum pump oil and cloth, paper wipes, and

contaminated gloves.

The two-stage gas gun and quarter-scale gun both generate solvents, lubricants (WD-40), paper and cloth wipes, vacuum pump oil, gun test shot debris, contaminated shop coats and gloves.

Waste Handling and Minimization:

A waste accumulation area (WAA) has been established outside of Bldg 341 (west).

A resident technician and backup have been trained to assist others with documentation, packaging, shipping and storage of waste.

All mechanical technicians have had training to properly dispose of all waste they generate including training class EP0006 Hazardous Waste Handling Practices and Industrial Toxicology HS-422.

The use of cloth rags and paper wipes is being minimized or eliminated by converting a "vendor" towel service.

Three of the machine shop machines have coolant recovery systems using water-soluble oil solution for cutting. The fluid is recovered and used again creating little or no waste.

The dark room automatic film developer has been decommissioned and emptied of chemicals and will be recommissioned only when necessary.

The machine shop parts cleaner has been replaced with a "vendor" cleaner and chemical replacement service.

All paints and solvent inventory has been reduced and used at a minimum.

Solvent storage is now being shared with another facility using their storage building.

Gun debris is collected in large plastic lined wooden crates until full, then processed through the Hazardous Waste Management system.

Plant Operations
Directorate

Waste Minimization Plan

May 31, 1991

Interdepartmental letterhead

Mail Station L-30

Ext: 2-3343

637-1
ESS
J. D. H.
C. H. H.

ENVIRONMENTAL
PROTECTION
DEPARTMENT

1991 MAY -7 A 8:21

May 2, 1991

TO: Harry Galles
FROM: Dennis K. Fisher
SUBJECT: Transmittal of the Plant Operations' Directorate CY 1990 Waste Minimization Plan

Attached is the Plant Operations Directorate "Waste Minimization Program Plan" for calendar year 1991. This Plan is submitted in accordance with instructions in DOE Order 5400.1, *General Environmental Protection Program*.

The report's contents reflect instructions and assistance from your Waste Minimization Program Office (WMPO) and have been coordinated with both Julio Diaz and Mike Meltzer from that office.

When the final report for Plant Operations is prepared, please forward a copy to Joe Lambert, L-657, the Chairman of the PO Waste Minimization Committee.

Dennis K. Fisher
Associate Director
Plant Operations

Attachment:
Plant Operations Directorate "Waste Minimization Program Plan"

ADDklWjkl

University of California

Lawrence Livermore
National Laboratory

Plant Operations Directorate
Waste Minimization Program Plan

April 30, 1991

Lawrence Livermore National Laboratory
University of California, Livermore, CA. 94550

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I. Introduction

In September 1990 the LLNL Director, John Nuckolls, announced the formation of the Plant Operations (PO) Directorate. This directorate's focus is to provide the leadership and management to the several organizations providing key support services to the diverse LLNL Programs and bring together under the cognizance of a single associate director the major LLNL organizations responsible for supporting the Laboratory's environmental (Environmental Protection Department), safety (Hazards Control Department), health (Health Services Department), and quality assurance (Quality Assurance Office) programs. Two other organizations with broad lab-wide support missions that are also assigned to the directorate are Administrative Information Services and Plant Engineering.

II. Program Objectives

a. Statement of management support/commitment: The Associate Director, Plant Operations (PO) is committed to a policy to aggressively seek and implement ways to effectively minimize within his directorate the generation of waste material and to establish and achieve reduction goals. The directorate's Waste Minimization Program has been structured to implement the guidance reflected below by the Director in his February 1989 statement on waste minimization.

b. Waste minimization policy statement: The following statement on waste minimization was issued by John H. Nuckolls, Director, LLNL in February 1989:

It is important that the Laboratory make a strong commitment to waste minimization -- to substantially reduce waste generation and increase recycling. Our goal is to achieve a significant overall reduction in the next few years. We plan to implement an incentive system where each Laboratory program will pay the costs associated with its wastes. Each program will also establish waste minimization goals and develop plans and assign responsibility for achieving these goals.

c. Statement of objectives and numerical goals: The objectives of the Plant Operation Directorate's Waste Minimization Program are to:

1.) Develop and implement employee training programs germane to waste minimization, enhance PO directorate awareness of the importance of waste minimization related activities, and actively seek ideas from PO employees on ways to minimize waste,

2.) Identify all individually generated hazardous/radiological/mixed streams,

- 3.) Fully understand the processes generating the waste streams,
- 4.) Identify those waste streams that are both best suited to apply *minimization techniques/technologies* and that make the most fiscal and/or operational sense,
- 5.) Aggressively seek ways to minimize the waste generated by those streams and, as applicable, seek the resources necessary to minimize the streams, and
- 6.) Implement waste minimization technologies and track and document all applicable activities.

The Plant Operations Directorate has not established numerical waste minimization goals. Rather, it has targeted to have by the end of CY 1991 a series of waste minimization goals for each of the organizations within the directorate that generate waste. The plan is to aggressively evaluate each waste stream in search of additional targets for waste minimization (reduction, recycling, or treatment). When each stream has been carefully examined as to its possibilities with existing technologies and/or known procedures/options and analyzed as to its candidacy for minimization, numerical goals will be determined. Depending on the results of this effort, longer range goals will be established.

During this next year, working closely with the technical staff of the Environmental Protection Department's Waste Minimization Program Office and others as appropriate, technologies that may offer opportunities for additional minimization successes will be evaluated as to their possible application to existing waste streams. We plan to incorporate the technologies into the overall directorate waste minimization activities.

A goal for CY 1991 is to implement a PO policy that every new process or modification to an existing process planned by a PO organization that is expected to generate a waste stream will be reviewed prior to project initiation. The purpose of the review is to assure that waste minimization has been consciously addressed and incorporated into the process, if appropriate.

III. Description of Program

a. Organization and responsibilities of staff and implementation strategy and schedule: Plant Operation organizations generating hazardous waste streams, including that organization responsible to manage the overall LLNL Hazardous Waste on-site treatment or off-site shipment, are shown in Figure 1.

A brief narrative of the waste generating activities in each follows:

Environmental Protection Department (EPD) - The EPD's Hazardous Waste Management (HWM) Division is not generally considered a waste

generator. It does, however, have a LLNL-wide responsibility to properly transport, store, treat, and ship waste. The EPD is also involved in four lab-wide investigations or corrections which generate waste and involve soil and ground water.

Hazards Control Department (HC) - HC laboratories have 17 waste streams that generate small amounts of waste from its bio-assay analysis, within its Chemistry Labs and its Radiation Counting Lab.

Health Services Department (HSD) - HSD, in performing routine physical examinations for current and prospective employees and medical treatment of minor injuries and illnesses, generates both hazardous and bio-hazardous wastes. The hazardous wastes are in the form of x-ray developer and fixer and the bio-hazardous in forms including "sharps" (needles, immunizations vials, blades) from the clinical laboratory and the treatment area, blood and blood tubes from the clinical laboratory, and blood-contaminated paper waste from the clinical laboratory and the treatment area.

Information Systems Technical Information Department (TID) - TID generates four modest-size waste streams in support of Laboratory-wide activities. The principal waste streams are the film fixative solutions generated in the Building 551W photo laboratory and output center and the Trailer 2776 photo laboratory. Secondary waste streams include empty spray cans from art/composite and press cleaning solvents.

Plant Engineering's Maintenance and Operations Department - This department generates 18 streams of various amounts and types of waste: The department:

- 1.) Operates the Laboratory-wide Low Conductivity Water Cooling System, a system that generates significant wastes associated with its operation and maintenance.
- 2.) Has various craft shops that either generate large volumes of rinse waters in the paint spray booths or wastes from other cleaning and maintenance operations.

The administrative structure for PO waste minimization is shown in Figure 2. The AD, PO has activated a PO Waste Minimization Committee (POWMC) with representatives from each PO organization generating waste streams (Figure 3) to focus the activities within PO to implement the policy and to define goals as stated in the Director's statement. This committee is the Director's focal point for coordinating overall PO and individual organizational objectives relating to waste minimization. The chairperson reports directly to the AD, PO on directorate-wide waste minimization activities. In addition, he/she is the PO directorate representative to the LLNL-wide Waste Minimization Steering Committee (WMSC) -- the Steering Committee activities are not directly addressed in the PO mini-plan.

The representatives from the various PO organizations are the focal points

within their organizations for information on the wide range of activities associated with the minimization of the waste for which their organization is the generator. They collect information for both reporting purposes and to provide related staff support to their management.

b. Program budget: Information on the overall program budget is included in the main body of the LLNL Waste Minimization Report.

c. Interaction/coordination between PO production staff (waste generators) and waste management staff and other DOE program staff, i.e., EM's R&D staff: Production staff personnel call upon personnel in the Environmental Protection Department (EPD)'s Waste Minimization Project Office (WMPO) for technological advice relating to such items as the procedures or processes that may be seen as feasible to adopt to reduce, recycle, or treat waste generated by their waste streams (see Figure 2). The POWMC members provide liaison with the waste generators and the LLNL WMSC through the AD's WMC. The entire organizational structure provides a clean line of communication for the waste generator to seek approvals from line managers, to obtain technological advice or information through the EPD WMPO, and to exchange information on changes in the regulations or directions of the overall program through the WMSC. Although not shown in the figure, contacts with DOE staff on waste minimization issues are normally made through the LLNL Waste Minimization Program Office within the Environmental Protection Department.

d. Method of tracking waste throughout the production process to point of discharge, treatment, storage, or disposal: The POWMC has assembled information to identify all of the waste streams generated within PO. The POWMC members, working with the stream generators, have or are developing the necessary information to ascertain (1) the types and amounts of materials that go into the process that generates waste streams and (2) a full understanding of the process that eventually leads to the accumulation of the waste(s) that is a by-product of the process. Some information is available on the quantity of input materials to the process. Eventual correlation of that information versus the amount of waste generated may provide the waste stream generator with a numerical peg-point to use during efforts to determine quantitative reductions.

For the most part, the committee members and waste stream generators understand their respective waste stream generating processes; are able to define the type of waste generated by that process; and are knowledgeable in the procedures that are followed to appropriately prepare the wastes for eventual treatment, recycling, or disposal. Gaps in committee member knowledge are being filled as quickly as time permits. In summation, each organization has either adequately treated generated waste at the point of discharge to allow it to legally enter the sanitary sewage system or be discharged to the ground or air, or has arranged to have the waste analyzed and subsequently prepared, per LLNL standard procedures, for transport to the Laboratory's Hazardous Waste Management Unit for on-site treatment and/or off-site shipment.

An area in the existing PO waste minimization program that needs additional

attention is that of determining the amounts of wastes generated by the streams in PO organizations. Laboratory analysis will normally provide sufficient information to identify the substance and, where applicable, give concentrations; however, definitive information on the amounts generated and disposed of is not very often available. PO organizations rely on the Hazardous Waste Management Unit to provide data on the disposed amount, but this is not an easy task for that organization, especially when like wastes from various organizations are combined for treatment or disposal. The problem is a large bookkeeping one. Nevertheless, for organizations to identify the results of their waste minimization efforts, they must have information on the quantities of generated and disposed of wastes.

e. Method of accounting for waste management costs: Information on this topic is included in the main body of the LLNL Waste Minimization Report.

f. Quality assurance considerations: This subject will be addressed by the POWMC in CY 1991. The committee will seek the assistance of the LLNL QA Office and intends to develop for the AD, PO's use QA guidelines for the organizations within his directorate that generate waste.

IV. Description of Waste Minimization Activities To Date and Schedule of Planned Activities

a. Employee awareness program: Organizational representatives to the POWMC have worked diligently with the waste stream generators in their respective organizations to heighten their level of awareness to the strong commitment of the Associate Director, PO and the LLNL Director to a.) first reduce, b.) then recycle, and c.) if neither of these prove effective means to achieve waste minimization, to treat the waste prior to disposal. These same WMC members have worked with the generators to search out new ideas or technologies to reduce or otherwise minimize the levels of the waste. Technologies or procedures that have any semblance of being feasible are discussed with the "experts" in the Waste Minimization Program Office to determine what may be the next step.

In general, there has not been a formal program developed in PO to address the enhancement of employee awareness as it relates to hazardous, radioactive, or mixed waste minimization. In CY1991 this subject will receive considerable attention within the PO ES&H Committee (formerly the PO Safety Committee), and a committee goal is to develop a Waste Minimization Awareness Program.

b. Employee training program: There are presently no specific waste minimization training courses available at LLNL. However, the EPD's Training Office is vigorously developing a two-tier training program for LLNL-wide use. Actual training for the targeted audience is expected to begin this CY.

c. Employee incentives/awards program: There is presently no incentives/awards program at LLNL that includes waste minimization suggestions. However, the PO ES&H Committee referred to in a. above intends to explore the

possibility of incorporating within the existing Safety Awards Program an opportunity for LLNL employees to reap the benefits for worthy waste minimization ideas.

d. Waste minimization assessments/audits performed: Assessments with various degrees of rigorousness have been performed on 42 of the 44 listed waste streams.

e. Waste minimization technologies implemented: In 30 of the assessed waste streams in CY 1990, some procedural change or new technology was used to have some effect on the waste stream. As the waste minimization program becomes more formal and line management's influence has a stronger hold, more complete information on the results both of the assessments and technology implementation will be available.

V. Description of Technology Transfer Activities

The PO waste minimization activities include several technology transfer dimensions. These activities are undertaken throughout the various organizations at the LLNL and at different management levels. High level management personnel are involved in the LLNL Waste Minimization Steering Committee and are members of various ES&H working groups and other groups seeking to assure LLNL compliance with various environmental-related rules, guidelines, or orders. Also, PO personnel have attended professional meetings on subjects such as environmental law and waste management.

PO personnel keep informed of technical advances via membership in services such as DOE's Waste Information Network, EPA's EIES (Electronic Information Exchange System), and the Superfund/Solid Waste Technology Transfer Electronic Bulletin Board. In addition, personnel throughout the Directorate interact heavily with state, local, trade, and academic organizations on waste management and minimization.

VI. Description of Program Performance Evaluation

The PO waste minimization effort will be reviewed annually to identify additional opportunities for source reduction and recycling. These annual reviews will emphasize the application of new technologies for waste reduction "pollution prevention" as they become known, keeping in mind the options for reducing wastes using the waste management hierarchy reflected in figure 4.

Plant Operations Waste Minimization

Figure 1

Administration of Waste Minimization Activities in Plant Operations

Figure 2

P. O. Waste Minimization Program Functional Responsibilities

Figure 3

Reducing Waste Using the Hazardous Waste Management Hierarchy

METHODS

ACTIVITIES

WASTE STREAMS

Figure 4

Special Projects

Waste Minimization Plan

May 31, 1991

Interdepartmental letterhead

Mail Station: L 389

Ext 2-5006

May 16, 1991

To: Distribution
From: Jim Hadley
Subject: Waste Minimization Plan

Attached you will find an updated version of the Special Projects Program's Waste Minimization Plan, which is a part of the overall LLNL Waste Minimization Plan.

Would you please ensure that people in the organizations for which you are responsible are aware of the plan and encouraged to support it.

Distribution:

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University of California

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National Laboratory

Special Projects Program

WASTE MINIMIZATION PROGRAM PLAN

May 16, 1991

Special Projects Program

WASTE MINIMIZATION PROGRAM PLAN

I. INTRODUCTION AND BACKGROUND

The Special Projects Program conducts the Laboratory's intelligence program under the DOE's aegis. Special Projects analyzes foreign intelligence information to assist the U.S. Government, and it provides intelligence information to the Laboratory for guidance in setting programmatic directions. In addition, it makes LLNL's technological capabilities available in support of U.S. Intelligence Community agency requirements.

Special Projects also conducts the Laboratory's Treaty Verification program, providing analysis and technical advice to the U.S. Government as well as development of technological means for treaty monitoring.

In addition, Special Projects manages LLNL's Emergency Preparedness and Response (EP&R) Program, furnishing technical services to DOE in support of Government response to emergencies involving nuclear materials. It also manages the Laboratory's on-site self-help and preparedness program, supporting LLNL readiness to deal with local emergencies.

II. PROGRAM OBJECTIVES

In consonance with the LLNL Director's policy, the Special Projects Program is committed to a strong effort to reduce waste generation and increase recycling. Special Projects' goal is to achieve significant reductions of waste generation wherever possible throughout the Program, with a major part of these reductions to be apparent within one to two years.

With the exception of photoprocessing chemicals, Special Projects' sources of waste are distributed over a variety of small R&D projects, each (in general) of limited duration. We have no routine production processes, that might be subject to analysis and redesign to accomplish waste reduction. Consequently we expect to achieve substantial first-year reductions simply through heightened awareness of the issue, supported by common-sense reductions in the wasteful use of miscellaneous materials.

Later reductions dependent on technical improvements will be accomplished through learning and analysis, and we expect that this process will be playing an important role by the end of the second year. We do not yet have enough information and

experience to be able to set a meaningful percentage goal. Such goals will be incorporated in updates of this Plan.

The waste impact of new projects undertaken by Special Projects will be assessed to the extent possible before each project is started. Material purchases will be screened to identify potential hazardous waste generators, and the need for these will be evaluated. Quantities of stored materials will be limited to those needed within the short term.

III. DESCRIPTION OF PROGRAM

The overall organization of the Special Projects Directorate is shown in the organization chart on the next page, and is elaborated with respect to lines of responsibility in the Special Projects Administrative Procedures Manual and in its Environmental, Safety and Health Self-Assessment Plan of April, 1991. In brief, the Program Leader delegates, through every direct line of management, the responsibility for program execution as well as compliance with LLNL ES&H policy and good practice, including the responsibility for waste reduction.

Activities and Facilities

Z Division conducts intelligence analysis. Its product is information, and it generates essentially no waste except for paper and other information media.

J Division conducts technological R&D in a variety of fields, but with a preponderance of the work in information processing, electronics, and electro-optics. There is a substantial effort in sensitive chemical analysis techniques, and some activity devoted to radiation measurements. Expended materials (aside from office supplies) that involve potential waste reduction tend to be miscellaneous solvents, acids, batteries, mechanical shop oily wastes, and various compounds that are incidental to benchtop-scale R&D in the areas named above. J Division's programs have durations of a few months to a few years, with limited continuity of activity.

The Emergency Preparedness and Response Program (EP&RP) conducts administrative activities and maintains specialized emergency-response equipment. The amount of waste that it generates aside from office supplies is minor.

The Treaty Verification Program (TVP) is engaged entirely in office work. Its waste stream is paper and office supplies.

Program Operations (Ops) conducts administrative activities and produces publications. Its waste stream is comprised of a small quantity of residual graphics art

supplies, expended photochemicals in the amount of around 100 gallons per year, and a small volume of paper wipes used with solvents for cleaning printing presses.

The main Special Projects facility is a permanent building (B-261), surrounded by a group of trailer complexes. This facility contains office and laboratory space for most activities carried on by Z Division, EP&R, Ops, and some of J Division's R&D work.

A subsidiary facility at a different location on the LLNL site is dedicated to light laboratory use by J Division, predominantly in the field of sensitive chemical analysis. It consists of a permanent building (B-345) adjoined by a triplex trailer office complex.

Waste Minimization Particulars

Several areas have been identified that offer opportunities to reduce the overall quantity of waste generated, or to convert from hazardous to non-hazardous waste.

The B-261 machine shop uses solvents and cutting oils. We will attempt to find substitutes for any that are on the land-ban list. We will seek to transfer machine shop waste reduction methods from the LLNL Materials Fabrication Division to our shop.

Cleaning solvents are used in our electro-optics and electronics research projects. Substitutes will be sought and employed for any solvents that are on the land-ban list. We will work with Y Division laser personnel and the Electronics Engineering Department to learn how they are implementing solvent waste minimization. Where solvent substitutes cannot be found, as may be the case with laser dyes, we will ensure that excess material is properly segregated, and recycled if possible.

The photographic processing and phototypesetting activities in the Special Projects Program produce spent developer and fixer. Most of the equipment used is different from that used by the central Technical Information Department facilities, so we are limited in the amount of their experience that we can utilize. However, we will consult equipment manufacturers to seek non-hazardous-waste-generating chemicals.

For R&D work that is performed on site for us by other organizations, or by us in facilities managed by other organizations, we will work closely with those organizations to ensure compliance with their waste minimization programs.

Waste Minimization Management, Budget, and QA

Waste management and minimization, as responsibilities of every Program element, are handled as part of programmatic activity. Because of the limited amount of material involved, it is not practical to budget or account for their costs separately from other work.

Except for the photoprocessing lab, waste generation occurs randomly throughout the organization. Generators work with the WAA Coordinators and Contacts for assistance as needed in packaging waste and moving it to the WAA's in the B-261 and B-345 facilities. The WAA Coordinator and Contact for B-261 are Jeff Johnson and Eddie Governor, respectively. In B-345 those responsibilities are held by Brian Andresen and Rodney Eagle. Waste management costs are too minor to justify tracking them.

QA in management of the WAA is accomplished through regular weekly inspections by a member of Hazards Control Team 3, supplemented by informal daily visits by the WAA Coordinators or Contacts.

IV. DESCRIPTION OF WASTE MINIMIZATION ACTIVITIES TO DATE AND SCHEDULE OF PLANNED ACTIVITIES

Activity

The waste minimization particulars described under Part III above are being implemented, with a substantial degree of success. Quantitative measures of improvement are not available yet.

Employee Awareness and Training

The WAA Coordinators and Contacts are required to take the Hazardous Waste Handling Practices course EP0006 and its yearly refresher, EP0006R. The Environmental Protection Department is preparing to develop a course or courses in Waste Minimization, and we will establish attendance requirements when the course contents become clear.

Employee awareness of waste minimization issues is developed through various Laboratory-wide information transfer activities such as in-house newspaper articles, as well as Program management staff meetings and monthly meetings for all personnel, and bimonthly meetings of the Program's ES&H Committee.

An incentive toward waste minimization is established through attention in yearly performance appraisals to each employee's adherence to ES&H guidelines and good practice.

Waste Minimization Assessment

Information is being collected on the detailed composition of Special Projects Program's hazardous waste stream throughout 1990. This will provide a basis for determination of improvements made in 1991 and succeeding years.

V. TECHNOLOGY TRANSFER ACTIVITIES

The principal channels for technology transfer are through representation on the Laboratory's Waste Minimization Committee and advice from the Technician and the Environmental Analyst attached to Hazards Control Team 3. Other information is obtained on an ad hoc basis: for example, from the Mechanical Engineering Department for issues concerning coolants and lubricants in the mechanical shop.

VI. DESCRIPTION OF PROGRAM PERFORMANCE EVALUATION

Progress of the Special Projects waste minimization efforts will be assessed yearly by the Assurance Manager.