

COMMERCIAL RADIOACTIVE WASTE MINIMIZATION
PROGRAM DEVELOPMENT GUIDANCE

D. K. Fischer

Published January 1991

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Prepared for the
U.S. Department of Energy
Idaho Operations Office
Under DOE Contract No. DE-AC07-76ID01570

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

ABSTRACT

This document is one of two prepared by the EG&G Idaho, Inc., Waste Management Technical Support Program Group, National Low-Level Waste Management Program Unit. One of several Department of Energy responsibilities stated in the Amendments Act of 1985 is to provide technical assistance to compact regions, Host States, and nonmember States (to the extent provided in appropriations acts) in establishing waste minimization program plans. Technical assistance includes, among other things, the development of technical guidelines for volume reduction options. Pursuant to this defined responsibility, the Department of Energy (through EG&G Idaho, Inc.) has prepared this report, which includes guidance on defining a program, State/compact commission participation, and waste minimization program plans.

EXECUTIVE SUMMARY

This document is one of two prepared by the EG&G Idaho, Inc., Waste Management Technical Support Program Group, National Low-Level Waste Management Program Unit. It was prepared in response to a request from the Commonwealth of Massachusetts for technical assistance in the form of guidance in developing a Radioactive Waste Minimization Program. The basis for the concepts and guidance given herein was derived from the documents listed in the Bibliography. Specifically, the series of guidebooks available on request from the California Department of Health Services, Toxic Substances Control Division - Alternative Technology Section, offers a wealth of practical information related to developing hazardous waste minimization programs. This information, in a generic sense, is also applicable to radioactive waste minimization programs.

The Low-Level Radioactive Waste Policy Amendments Act of 1985 (The Act), Public Law 99-240, reaffirmed the policies stated in the 1980 Low-Level Radioactive Waste Policy Act, Public Law 96-573, and further delineated the responsibilities of the States and the Federal government.

The U.S. Department of Energy Office of Environmental Restoration and Waste Management, Office of Waste Operations - Technical Support Division (EM-35) is responsible for developing and implementing a nationwide system to manage commercially generated low-level radioactive waste. The Idaho Operations Office of the Department of Energy is the program office and EG&G Idaho, Inc., has been assigned the responsibility of lead laboratory for technical management and implementation of this nationwide system.

One of several Department of Energy responsibilities stated in the Amendments Act of 1985 is to provide technical assistance to compact regions, Host States, and nonmember States to the extent provided in appropriations acts. Technical assistance includes, among other things, the development of technical guidelines for volume reduction options; consequently, the Department of Energy (through EG&G Idaho, Inc.) has prepared this report.

CONTENTS

ABSTRACT	fii
EXECUTIVE SUMMARY	v
DEVELOPING A WASTE MINIMIZATION PROGRAM	1
Waste Minimization Definitions	2
State/Compact Commission Participation	5
Program Development Team	6
Educational Outreach	7
Information Exchange	10
Technical Assistance	13
Financial Guidance	15
Regulatory Actions	16
Waste Minimization Program Plan	20
Company/Institution Policy	20
Preparing a Program Plan	21
REFERENCES	28
BIBLIOGRAPHY	29

COMMERCIAL RADIOACTIVE WASTE MINIMIZATION PROGRAM DEVELOPMENT GUIDANCE

DEVELOPING A WASTE MINIMIZATION PROGRAM

This document provides guidance for each Host State, nonmember State, or compact region interested in developing a radioactive waste minimization program. The intent is to describe the elements of a generic program. Each State/compact commission may identify other elements or select from, modify, or delete these elements, as desired, to develop a program that will meet its needs and the needs of the radioactive material users within its jurisdiction.

The principal goal of a waste minimization program is to protect public health and safety and the environment by encouraging and supporting the efforts of radioactive material users to produce less waste. In addition to being consistent with U. S. Nuclear Regulatory Commission (NRC) and Congressional requirements, such a program serves to educate the general public and radioactive material users. The program emphasizes the positive impacts on the entire waste management process that are gained by producing less waste, which reduces the amount of waste requiring treatment and disposal. Also, reducing the amount of waste generated means that less waste must be shipped off site, thereby allowing the radioactive material user to reduce costs associated with packaging, potential treatment, transportation, and disposal. Well characterized waste material (a by-product of the waste minimization effort) and smaller volumes for disposal reduce liabilities, conserve disposal capacity, and facilitate better management by the disposal site operator. These improvements translate into greater public confidence in the low-level radioactive waste (LLW) program.

Many radioactive material users nationwide, in response to the Amendments Act of 1985 (Public Law 99-240, 1985) and increasing disposal costs, have independently instituted waste minimization and treatment practices to reduce the amount of waste requiring disposal. The *draft*

1989 State-by-State Assessment of Low-Level Radioactive Wastes Received at Commercial Disposal Sites, states the following:

"The volume of LLRW disposed of at commercial disposal sites exceeded 3.7 million cubic feet in 1980. ...From 1981 through 1989 the volume of LLRW being disposed of at commercial disposal sites has declined. In 1989 the reported volume of LLRW received for disposal at commercial sites was 1,627,813 cubic feet."
(DOE, 1990)¹

This downward trend in disposed volumes is expected to continue as radioactive material users improve existing waste minimization practices and develop new ones.

WASTE MINIMIZATION DEFINITIONS

The definitions and usage of terms such as waste minimization, waste reduction, waste avoidance, and pollution prevention have caused considerable misunderstanding and confusion within the waste management community. The Department of Energy (DOE), Environmental Protection Agency (EPA), and some States/compact commissions have all independently developed definitions for activities concerned with reducing waste production to the maximum extent possible and processing waste to decrease its volume and toxicity. As an example, DOE Defense Programs definition for waste minimization encompasses radioactive, radioactive-hazardous (mixed), and hazardous wastes. It is defined as "any action that minimizes the volume or toxicity of waste by avoiding its generation or by recycling or reuse".² The term "waste reduction" is "waste minimization plus any waste treatment that reduces the volume or toxicity of waste requiring disposal" (see Reference 2). DOE considers waste treatment an activity separate from waste minimization and defines it as "any method, technique, or process designed to change the physical or chemical character of waste to render it less hazardous, safer to transport, store or dispose of, or reduced in volume"³. (It is important to note that DOE does not specifically address storage for decay. According to the above definitions, storage for decay would be considered a treatment and therefore part of the overall waste reduction process.)

The EPA definition for hazardous waste minimization, recently replaced by the phrase "pollution prevention", is comparable to the DOE definition because it also focuses on preventing waste production at the source (waste avoidance), followed by recycling and reuse. Because of the inherent characteristics of hazardous waste, treatment is considered a separate process to be performed after the waste has been generated but before disposal.

States/compact commissions have, or should, develop definitions addressing those activities associated with reducing the production of radioactive waste. For example, the Massachusetts low-level radioactive waste law (Chapter 111H of the General Laws) contains the following pertinent definitions:⁴

- Source minimization: defined as "minimizing the volume of radioactivity of low-level radioactive waste prior to its generation by such methods as (1) avoiding unnecessary contamination of items during the use of radioactive materials; (2) carefully segregating radioactive waste from non-radioactive trash; or (3) substituting non-radioactive isotopes or radioisotopes with shorter half-lives where practicable."
- Treatment: defined as "any method, technique, or process, including source minimization, volume minimization, and storage-for-decay, designed to change the physical, radioactive, chemical, or biological characteristics or composition of low-level radioactive waste in order to render such waste safer for management, amenable for recovery, convertible to another usable material, or reduced in volume."
- Volume minimization: defined as "treatment of low-level radioactive waste after its generation in order to minimize the physical dimensions of the waste and the space required for disposal."

States/compact commissions are encouraged to carefully consider the terminology and the intent of the definitions when developing their waste minimization programs; particularly the relationship between pregeneration (waste avoidance) activities and postgeneration (treatment) activities. To avoid further misunderstanding and confusion, terminology and definitions adopted by each State/compact commission should be compatible, as much as possible, with those published by others in the waste management community. Entities charged with the management of radioactive waste and those charged with managing hazardous waste in each state/compact region should understand the others' program planning and implementation efforts. This could lead to a cooperative overall waste minimization effort that may reduce costs for the regulating agencies, radioactive material users, and hazardous waste generators. In addition, a unified approach to waste minimization would make it easier for the general public to recognize the resultant public health, safety, and environmental accomplishments.

A Radioactive Waste Minimization Program, as defined for this guidance document, is a program that facilitates the development and implementation of pregeneration (waste avoidance) practices intended to prevent or reduce the production of radioactive waste. However, because radioisotopes become nonradioactive over time, one postgeneration activity (storage for decay) is acknowledged to be a viable waste minimization practice for radioactive material users that use very short-lived radioisotopes or have the capability to safely store LLW until the radioisotopes have sufficiently decayed. In general, radioactive material users with adequate storage space and monitoring capabilities should consider holding radionuclides with half-lives of up to 90 days on site.

NOTE: On a case-by-case basis, radioisotopes with half-lives up to 180 days may be candidates for the storage-for-decay option.

A waste minimization program, as suggested in this document, will not completely prevent the generation of radioactive wastes, nor will it be feasible for all waste producing processes. Treatment, long-term storage (beyond five years), and disposal will continue to play major roles in

radioactive waste management. However, these activities are outside the scope of this guidance.

Waste minimization programs for both Federal and commercial waste material generators are being developed nationwide. The DOE waste minimization program includes all radioactive, radioactive mixed, and hazardous waste generated by DOE contractors; the EPA and corresponding State/county (e.g., California/Ventura County) programs address hazardous waste. In all the programs investigated, the waste material generators are developing and implementing process-specific waste minimization programs tailored to their individual needs. The governing body (e.g., DOE, EPA, State/county agency) provides oversight, coordination, assistance, and regulation.

STATE/COMPACT COMMISSION PARTICIPATION

The state/compact commission should serve as a facilitator in support of low-level waste minimization programs undertaken by radioactive material users within the state/compact region. Its participation would include coordination, monitoring user-developed waste minimization programs, information exchange, regulatory guidance, and possibly monetary incentives. Recipients would be users with waste minimization programs in place, those needing assistance developing a waste minimization program plan, those willing to help others develop programs, and those researching innovative technologies determined by the state/compact commission to have extensive application for radioactive material users within the region.

Individual waste minimization program plans developed and implemented by the radioactive material users are a principal component of this state/compact region-wide program; these plans are described in detail later in this report. This section of the guidance report suggests program elements that a state/compact commission may be able to implement in order to assist radioactive material users in developing their program plans and meeting the goals specified in those plans.

Program Development Team

For a waste minimization program to be successful, it must have the direct support of the radioactive material users. One effective way to involve the user community is to form a program development team to evaluate potential program elements that the state/compact commission could implement.

For example, state/compact commission participation may include one or more of the following elements if the program development team so elected:

- Educational Outreach--Increases the public's understanding of the positive impact radioactive waste minimization has on issues related to managing radioactive waste (i.e., public health and safety, storage, treatment, transportation, and disposal).
- Information Exchange--Provides the insight needed to determine state/compact commission participation. It also establishes a forum to disseminate general technical and financial information useful to radioactive material users who are developing their individual waste minimization programs.
- Technical Assistance--Provides radioactive material user assistance on an individual basis or by user type. Trained personnel, who are able to resolve specific issues, are required.
- Financial Guidance--Provides radioactive material user with professional assistance in obtaining funding to initiate the program.
- Regulatory Actions--Provides direct regulatory requirements, indirect regulatory inducements, and positive incentives to facilitate the program.

The program elements identified above introduce several suggestions for participation by a state/compact commission. The following discussion illustrates how each element may be applied to aid the development of a waste minimization program.

NOTE: The use of these elements, in total or in part, is optional and should be considered in relation to specific program needs.

Educational Outreach

The educational outreach element serves the general public, news media, staff regulators, policymakers, and law makers. In addition, it can serve as a resource for in-house employee training programs developed by radioactive material users. The goal is to disseminate factual, unbiased information so that the public sector and others will be equipped to evaluate the waste minimization program and other radioactive waste issues from a position of knowledge. Media advertising and news coverage, public service announcements, direct mailings to concerned citizen groups, newsletters, and bulletin boards could be used to encourage the intended audience to take advantage of the services described below and to suggest others that would be beneficial.

- Radioactive Waste Minimization Library--The library is a resource center for workshops, public briefings, and topical studies. It should include (a) introductory information regarding overall waste management concept and policy, technical issues, benefits, constraints, etc., affecting radioactive waste management; (b) technical information on specific waste minimization technologies and techniques, journal articles, qualified consultants list, etc.; (c) interaction with national information exchange services; and (d) cost/benefit case histories, including financing options.
- Open Forums--Open forums bring the public, radioactive material users, and regulators together in an informal

atmosphere to share information and voice concerns. The forums would be scheduled at various locations statewide at times convenient for the public. They could also be given in schools as part of an environmental studies program. The agenda may include topics preselected by the public, information about local radioactive material users' activities, a "state-of-the-state" message about waste management, specific waste minimization programs developed by the user community, benefits and detriments of products and services using radionuclides, etc. To be most effective, the forums need to be conducted on a regular basis. In time, the public will gain an understanding of radioactive waste issues and come to view the forum as a way to make their concerns known and to contribute to the decisionmaking process.

- Facility tours--Tours offer the public a visual experience that enhances their understanding of radioactive waste generation and management. The ability to relate to specific waste minimization efforts in the work place fosters a positive attitude and recognition for the radioactive material user hosting the tour. Recent DOE policy decisions have made such tours daily events at DOE facilities; these may serve as models for working through the logistics of developing a tour program. The state/compact commission may function as a coordinator to arrange tours as part of the open forum meetings.
- Fact Sheets--These are short, one- or two-page discussions of specific waste management issues (including waste minimization techniques that have proved successful) that are an effective means of disseminating information. These would be available to news media science editors, and distributed at the open forum meetings, facility tours, and

other radioactive waste meetings open to the public. They would also be available in public libraries and on request.

- Newsletter--A monthly or quarterly newsletter would communicate radioactive waste management program activities, newsworthy waste minimization technologies/techniques recently instituted by radioactive material users, and advertise the products and services available through the Educational Outreach element. The mailing list would include schools with science or environmental curricula, concerned citizens/groups, the news media, involved regulators, policymakers, lawmakers, and radioactive material users. Excerpts from the technical portion of the newsletter could be published in the science sections of newspapers throughout the state.

Educational outreach can be administered at a low cost relative to the value returned if the logistic activities are performed by existing staff whose work assignments most nearly match the required needs. The educational products and services will, in most cases, require technical expertise to develop but not to disseminate. Therefore, the major financial commitment is a function of the degree of involvement by paid technical experts.

Technical and/or financial help may be provided in several ways, including the following:

- Steering Committee--The steering committee establishes policy and authorizes specific outreach activities. Members should include individuals from the state/compact commission, other state and federal agencies having waste minimization responsibilities, concerned citizen groups, and radioactive material users.

- Radioactive Material Users Association--Members of this group identify educational outreach opportunities, develop products and services of benefit to the public and other radioactive material users, and serve as forum speakers. This activity would use the Information Exchange activity described below as one of its resources.
- Waste Processors--By developing a cooperative program with this group, the public will begin to understand how much is currently being done to reduce disposed waste volumes. Also, radioactive material users will gain valuable information on waste reduction and waste handling techniques that may be adapted to reduce waste at the source.
- Academic and other organizations--Professional societies, universities, community colleges, and citizen organizations such as the League of Women Voters and various local environmental groups often have the resources to conduct seminars, perform studies, provide handout materials, and promote public awareness. These groups, together with the Radioactive Material Users Association, could develop and provide an array of educational outreach opportunities.
- Volunteer staff--Volunteers recruited from retired professionals and professional societies can supplement paid personnel in many of the implementation tasks. Skills required include public relations, communications, and radiological science.

Information Exchange

Principal requirements of developing a state/compact region waste minimization program are knowledge and understanding of the waste streams that are generated in the region and determining their potential as waste

minimization candidates. To accomplish this, current radioactive waste generation practices must be investigated (i.e., all radioactive material users identified, waste-producing processes analyzed, waste streams characterized, volumes/year known). To facilitate measuring the benefits derived from a comprehensive waste minimization program, baseline data (i.e., current health and safety performance statistics, current waste minimization practices, present onsite storage needs, treatment activities and requirements, disposal practices) must be compiled. In addition, the degree of technical assistance needed and the amount/type of financial assistance that may be required must be determined.

By forming groups to share information and expertise, the radioactive material users within the state/compact region could provide the information identified above, evaluate waste minimization opportunities, and formulate a state/compact commission program plan. Each group would be invited to elect representatives willing to participate in the information exchange element. The following are examples of appropriate representatives:

- Users of Specific Radionuclides--Specific radionuclides that are common to several users' waste streams, or user processes that produce similar waste streams, provide an opportunity to focus on mutual waste minimization problems. Grouping users by (a) industrial operations that use radioactive materials, (b) health care institutions, including hospitals and clinics, (c) educational and research institutions, and (d) electric power utilities, facilitates the sharing of ideas and suggestions that help define the state/compact commission's role.
- Large-Volume Generators--Usually, the more waste that is produced, the more opportunities there are to institute waste minimization. Most large-volume generators (e.g., utilities) have waste minimization programs in place and can provide valuable insights that will aid in developing a state/compact commission program. Also, the composition of

the waste streams and baseline data are available. These may serve as a model when trying to determine what information is required from other radioactive material users.

- Related Industries--Related Industries, as defined for this guidance document, are industries with principal services or products not directly related to the nuclear industry. As such, they may not feel the need to participate in a waste minimization program. Knowledge gained by sharing information and recognizing potential health, safety, and economic advantages may provide the impetus to practice waste minimization. Also, information needed to determine the level of involvement of a State/compact commission program would be generated.
- Small or New Businesses--These businesses, although probably not individually generating large volumes of waste, are the most likely to need technical or financial help to identify their waste minimization potential and develop a waste minimization program plan. Interaction with this group will identify how the state/compact commission program can help.

Knowledge gained from the information exchange element will

- Provide clear direction regarding state/compact commission participation needed to help radioactive material users develop their waste minimization programs
- Serve as a resource to support the Educational Outreach element described above
- Establish a basis for coordination with the NRC, and cooperation with the EPA and others concerned with waste management issues.

Help determine the resources (personnel, finances, equipment/materials) needed to permit the state/compact commission to function as a resource for radioactive material users

Identify and acknowledge constraints and limitations inherent in the waste minimization effort

Demonstrate to the public that waste minimization is a comprehensive effort.

Technical Assistance

A technical assistance program offers in-depth, direct assistance to radioactive material users on a one-on-one basis. These programs require the services of technically competent individuals who are able to address specific waste minimization issues. For example, the following are four potential areas for direct technical assistance:

- Onsite Waste Minimization Consultations--Upon request from the radioactive material user, a cognizant consultant would visit the user's facility to help identify and evaluate specific waste minimization opportunities. This assistance is offered as a "helping hand" and not as a mandate for change.
- Financial Guidance--Upon request from the radioactive material user, a financial guidance committee would evaluate the user's funding needs and suggest alternative methods to finance a viable waste minimization program. Acceptance by the radioactive material user is optional.
- Regulatory Assistance--The state/compact commission would provide guidance for compliance with any regulatory issues that may influence waste minimization.

- Consultation--The radioactive material users themselves are a principal resource for technical assistance. In exchange for tax credits, disposal cost rebates, or other incentives, users may be willing to help each other determine where and how specific waste minimization efforts might be focused. The state/compact commission may also be able to provide consultation services either by drawing on expertise within its own purview, contracting with a cognizant consulting firm, or through cooperative agreements with other agencies.

Consultant teams with expertise specific to a requestor's waste stream would, with no cost to the requesting user, investigate the user's waste generation process. The requesting user would evaluate the resulting waste minimization recommendation(s) and, if acceptable, prepare and implement a task plan. A task plan is intended to resolve a specific, well-defined issue within a specified period of time. In contrast, a program plan (described later in this guidance) delineates an overall effort that is implemented by a series of task plans. Typically, a task plan will include the following information:

- Description--Topics include products or services produced, waste stream characterization data (including a radionuclide inventory), previous and projected volumes, and a description of the specific waste-producing process or service investigated.
- Material Handling Methods--This section is a detailed evaluation of how the materials, supplies, and equipment that are used for, or in conjunction with, the process or service are handled and controlled. Suggestions are provided on how to avoid or reduce contamination.
- Process evaluation--This section examines the work process in detail to identify waste generation sources. Suggestions are given on possible measures to avoid or reduce the waste.

- Corrective Action--Based on the requesting user's evaluation of the recommendations, specific process/service changes, anticipated results, necessary resources (i.e., personnel, equipment, materials), schedule, and cost are specified.

In return for this user-specific help, the state/compact commission may request annual reports stating the results of the corrective action in terms of meeting the anticipated results given in the task plan.

Financial Guidance

Many radioactive material users have significant waste minimization potential but lack the funds to initiate the necessary actions. Knowledgeable volunteers from the banking and finance community may volunteer to serve on a financial guidance committee as a way to identify potential lending opportunities and the need for new financial aid programs. Upon request from a radioactive material user, the committee would investigate the requesting user's proposed waste minimization plan and financial needs and suggest financing options. The requesting user will evaluate and/or modify the suggested options and select one that meets his needs. The committee would then help secure the funding. For example, the committee may provide the following assistance:

- Help the requesting user qualify for and obtain a Small Business Administration loan
- Help the user qualify for a commercial loan
- Work with an existing community foundation, or establish a new nonprofit organization, if significant waste avoidance is anticipated
- Develop a new kind of bank loan

- Encourage a cooperative effort with other radioactive material users that have a similar waste stream.

The state/compact commission may be willing to consider developing a mechanism for tax credits, disposal fee reductions, fee rebates, or grants. These should be developed to meet specific needs (e.g., a grant program could be developed to encourage projects that have broad application, are innovative, or would be applicable for a particularly troublesome waste stream).

Regulatory Actions

Another potential element for participation is the adoption of regulations intended to ensure that waste minimization is an integral part of every radioactive material user's waste management program. These regulations may take the form of direct requirements, indirect inducements, or positive incentives.

Direct Requirements. Direct requirements are policy directives or regulations that mandate specific actions to reduce the generation of waste. Three examples of such mandates could be requiring waste minimization plans, instituting time-tested techniques, and training employees.

- **Waste Minimization Plans**--These documents are published by the radioactive material users. They must be approved by the highest official of the company or institution and include a statement committing to a defined implementation schedule. The directive or regulation may require compliance by all radioactive material users or only those planning new or expanded operations. The state/compact commission would determine, and be responsible for, the method of enforcement.

Possible options include the following:

- A written statement from an officer of the company stating that a plan has been prepared and implemented. Nontechnical staff could be used to perform spot checks and verify compliance.
 - A plan with independent review and concurrence by technically competent personnel. Nontechnical staff could be used to perform spot checks and verify compliance.
 - A plan with initial concurrence by the state/compact commission after review by technically competent personnel. This would be followed by in-depth reviews of the updated plans on a random basis.
 - A plan written to meet predetermined criteria. This would require concurrence by the state/compact commission, followed by annual performance evaluations. Candidates subject to this option may include new or expanding companies, those with compliance problems, or users with problematic waste streams.
-
- Time-Tested Techniques--A number of administrative and housekeeping techniques and practices are routinely used in the nuclear utility industry. They could serve as models for other radioactive waste generating processes. Radioactive material users could be required to practice those time-tested techniques applicable to their waste generating process.
 - Employee Training--The people best able to effect change are those who work with the waste-generating process or activity on a daily basis. Employees should be trained in basic waste minimization concepts and existing techniques. Waste

minimization performance criteria could require that training plans and sample course materials be submitted to the state/compact commission for approval.

Indirect Inducements. These directives and regulations do not impose new requirements but rather expand, or more actively enforce, existing laws. In this context, the radioactive material user may find that waste minimization is a cost-effective alternative.

States/compact commissions may elect to expand on existing regulations to meet waste generation concerns unique to their respective jurisdictions. Waste stream data from the annual survey and information from the Radioactive Material Users Association (see Educational Outreach section) would provide input and guidance for developing expanded requirements.

Enforcement would be the responsibility of the state/compact commission, but monitoring could be a cooperative effort among various state, county, and city agencies. For example, a city inspector principally concerned with fire protection could be trained to recognize improper waste management practices. During the normal course of an onsite fire protection inspection, waste management practices perceived improper by the inspector would be noted in the inspection report. Neither the inspector nor the city would take any direct action, but would transmit the noted potential violations to the state/compact commission for resolution. If the local agencies are hesitant due to possible added costs, a cooperative agreement of cost-sharing or supplemental financial support may be necessary.

Positive Incentives. Positive incentives are various direct and indirect monetary advantages that can be incorporated into the regulatory structure to encourage waste minimization. Three possible incentives are described below; the Radioactive Material User Association could help identify others.

Modified Fee Structures--Permit/license fees should be structured to promote waste minimization activities. For example, a fee based solely on the size of the firm (i.e., number of employees, gross revenues) and not related to waste generation, does not provide any incentive to reduce waste. However, a fee based on the radionuclides in the waste, the volume or radioactivity of the waste generated, or the volume or radioactivity of waste shipped off site, would offer a positive motivation to reduce these factors as much as possible.

Several things should be considered when selecting a fee methodology. A fee savings based on a reduction in the amount of waste generated may be attractive to large generators but may not offset the process modification costs for a small generator. Smaller generators may prefer a fee savings based on the amount of waste shipped off site. This would allow credit for recycling and storage for decay as well as source reduction. Ideally, the fee should reflect the radioactive component of the waste or possibly its mass, but not the gross volume of the material packaged for disposal. However, in many cases this is difficult to do, which makes volume-based fees a practical alternative. Another concern is that fees structured to decrease as waste minimization increases will at some point result in the program's not having sufficient funds for administration and other program related activities. A possible solution would be a two-part fee system, one part determined by the program operating costs and the other part directly related to waste minimization performance. In this manner, a minimum fixed fee would always be charged to ensure that the program can remain viable.

Reduced Procedural Requirements--Inherently, regulations governing radioactive waste management require radioactive material users to conduct and report monitoring, sampling, and other activities on a regular basis. If the waste generated has been significantly reduced, the frequency of these activities may be safely decreased, saving the user a considerable amount of money. Also, the number of inspections required may be reduced. If the user is charged for each inspection, this would add to the potential cost savings.

Reduced Fines and Penalties--Radioactive material users found in violation of certain regulations (those not based on health and safety thresholds), but who agreed to pursue a waste minimization program, would be granted a reduced fine or be allowed to invest the fine monies to develop the program. The use of these monies would be authorized after the user has made the corrections necessary to comply with regulations. An audit, conducted by technically competent personnel and resulting in specified actions documented by a comprehensive waste minimization plan and implementation schedule, could be another designated use for these funds.

WASTE MINIMIZATION PROGRAM PLAN

Considering the diversity of processes that use radioisotopes and the number of radioactive material users, active participation by these users is the only way radioactive waste minimization will become a reality. All radioactive material users should be encouraged to develop and institute waste minimization programs predicated on detailed program plans. The elements of a generic plan are described in this section. All elements may not be applicable to a given radioactive material user's needs, but are included to enhance a user's awareness of program plan considerations.

Waste minimization program plans are the baseline documents used by radioactive material users to carry out waste minimization and by state/compact commissions to monitor the radioactive material users' activities and progress. They focus on the processes and services unique to the user.

Company/Institution Policy

Radioactive material users that have the most successful waste minimization programs are those that follow a clearly articulated policy statement from the highest level manager. The importance of this message should not be underestimated; it must alert all managers and workers that the

company or institution will practice waste minimization as a standard way of doing business.

The company or institution policy will not only support the concept of waste minimization, but will also state an overall goal. The accountability necessary to accomplish this overall goal must be established by assigning lead responsibility and authority to a governing body or individual that will be recognized company/institution-wide.

Preparing a Program Plan

Given the policy statement and overall goal, a plan that addresses how the waste minimization program will be initiated should follow. Typically, the plan includes a detailed description delineating a logical sequence of tasks (scope of work) needed to develop and implement the program (usually a logic diagram is used to help illustrate the sequence of tasks). This is followed by a detailed schedule showing each task identified in the logic, its duration, and start and finish dates. A resource-task matrix is prepared in order to identify personnel, materials, and equipment requirements; then a cost estimate based on the above factors is developed. Once this plan is reviewed and approved by company or institution management (the State/compact commission may also wish to review the plan), it becomes a living document by which to manage the program. As the program progresses, this plan must be revised periodically to reflect actual accomplishments, costs, and updated planning. The activities discussed below should be considered when developing the scope of work for a waste minimization program plan.

Organize a Task Force. Because a waste minimization program will affect a number of functions within the company or institution, it is recommended that a task force, with representatives from each of the affected departments or groups, be formed at the outset of the development phase of the program. The task force will serve as a governing body authorized by the highest level manager to implement waste minimization. The members will evaluate and select opportunities for waste minimization, establish goals and objectives, develop

the plan, and ensure that the plan is implemented by their respective departments or groups.

Goal setting is a principal activity for the task force. The goals should be measurable over time so that they serve as a clear indicator of the degree of success achieved by the program. The goals must also be acceptable to those working to accomplish them, flexible and adaptable to changing requirements, motivational, understandable, and achievable with reasonable effort. Once goals are identified, specific objectives that can be accomplished within the imposed technical and cost constraints are given for each goal. Goal setting is predicated on the results of an operational assessment.

Conduct an Operational Assessment. An operational assessment is a systematic review of processes, technologies, procedures, and cost requirements. Its purpose is to identify waste minimization opportunities by performing an options assessment, a technical analysis, and an economic analysis. This produces a comprehensive report that evaluates information, provides implementation recommendations, and serves as the key reference when obtaining funding. Assessment data collected and compiled to prepare the report should, as a minimum, answer the following questions:

- What waste streams are generated and what are the characteristics of the constituent components of the waste?
- How much waste is generated (noncompacted volume) over a prescribed period of time (e.g., one year)?
- How much radioactivity (curies per unit volume) is present in the volume of waste identified above, and what are the principal and subordinate radionuclides?
- Are there any hazardous constituents in the waste that would qualify the waste as mixed waste?

- What processes or operations contribute to the generation of waste?
- What housekeeping practices are currently used that may cause or minimize waste generation?
- What process controls are currently in place to reduce or avoid waste production?
- What technique and technology options are suitable; how do they compare to each other and to existing practices; and what benefits or detriments can be expected?
- How much, and for how long, will the technique and technology options disrupt the process or service before they become routine?
- What are the economic options, and how do they compare with established economic criteria (e.g., payback period, return on investment)?

Operational assessments can be conducted in house by the company's staff or by an independent consulting firm. Either way, active participation by management, purchasing, maintenance, production, and engineering is required. In general, the activities required for an assessment are as follows:

- Become familiar with the facility and the process or service that generates the waste. This may be accomplished by reviewing design, operation, and maintenance documentation.
- Identify and characterize the waste stream(s) resulting from the process or service. Process flow diagrams, analytical test data, waste shipment manifests, radioactive material purchase and inventory records, etc. are potential sources of information.

- Prioritize the waste streams and select one or more for waste minimization. Concerns to be addressed when making this selection include
 - Minimization potential
 - Reclassification potential
 - Compliance with current and future regulations
 - Potential liability
 - Volume and activity of the waste
 - Cost/benefit relationship.

- Analyze and select a technically feasible technique or technology. The process or service that generates the waste must be analyzed relative to candidate techniques and technologies. Knowledgeable resources include
 - In-house expertise
 - Trade associations
 - University radiological departments
 - Published literature
 - State agencies
 - Industrial suppliers
 - Consultants.

- Analyze the direct and indirect capital costs and operating costs associated with the change compared to onsite storage and increasing disposal costs. These must be considered relative to available funds, payback period, return on investment, etc.

- Determine and evaluate both tangible and intangible benefits and detriments. Projects are not always accepted on just their technical merits; alternatives or modifications must also be explored.

Evaluate the progress and success of the waste minimization effort. This is a follow-up action to be done periodically after the changes are instituted.

- Conduct an operational assessment whenever a new product or substantial change in service is being considered.

Implement the Selected Option(s). Implementing the selected option(s) involves obtaining funds, installing or initiating the new process or service, and demonstrating and measuring performance.

Funding--The assessment report, developed above, is an important tool in the quest for funding. This report, together with a presentation to the appropriate level of management, is the first step. The presenters must be able to state past experience with the recommended waste minimization option(s), what others are doing to minimize waste generation, how the recommended option(s) complements the company's business strategy and values, and advantages of funding waste minimization over other proposed projects.

Even with management acceptance, corporate funding may not be available. In this event, private sector financing (e.g., bank loans) and government assisted funding (e.g., Small Business Administration loans) should be investigated. Although not likely, loan guarantees or other financial assistance may be available through the State/compact commission.

Initiating the Action or Service--A waste minimization option that involves a service or operational, procedural, or material changes requiring only minimal funding may be initiated by publishing a management directive. Projects involving equipment modifications or new equipment require planning, design, procurement, and construction just as any other capital improvement project.

In addition to the physical plant and waste generation process changes, the accounting methods should be revised to segregate those costs that are

related to managing the waste. Such costs would include permit fees, treatment and disposal, a percentage of the liability insurance, handling and storage, etc. Charging these costs to the department responsible for generating the waste, and providing an incentive to reduce these costs would sensitize the responsible manager and workers to waste minimization opportunities.

Performance--The easiest way to measure the results and determine if less waste is being produced is by recording the volume of waste before and after the waste minimization practice was implemented. To ensure that the results are meaningful over a period of time, correction factors must be applied for unplanned changes to the process, abnormal production or usage rates, product changes, and similar perturbations. Radioactivity in curies per unit volume is another parameter that is determinable. However, it is also subject to the correction factors.

The overall benefit to the company or institution can be determined by conducting a follow-up operational assessment and comparing the results to the baseline information from the initial assessment. The ideal results would be to reduce both the gross volume and the radioactivity per unit volume, while maintaining or increasing net profit.

Train Employees. In many cases where waste minimization programs are in place, only work leaders or managers are trained; others may not even be aware that such a program has been instituted. Employees working with the process or service on a daily basis are a major factor in influencing how much waste is generated (i.e., improved housekeeping practices) and should be trained to a degree commensurate with their job function.

Training may be offered in three stages, including (a) awareness training for all employees so that everyone has a basic knowledge of common waste problems in the state and minimization techniques that can be used to avoid LLW generation in the workplace, (b) training in administratively controlled procedures for all personnel assigned to a process or service, and (c) specific and advanced technique/technology training to ensure that

everyone who could effect changes to the process or service is an informed participant.

Subsequent to the training, participation in fostering waste minimization could be encouraged by soliciting employee suggestions, forming teams to evaluate work processes, and developing a reward system (e.g., prizes, bonus, recognition) as a way of advertising employee creativity and encouraging further participation.

Share Information. Experience gained from planning and implementing a radioactive waste minimization program should be made available to others. All radioactive material users need to share information, both within the organization and with other users. Large companies, in particular, need formal information exchange procedures in place to ensure that all entities of the organization benefit from lessons learned. Radioactive material users with similar waste streams benefit from a program of mutual cooperation (provided protection for proprietary data is integral to the process) by being able to adapt proven technologies or techniques to their operations without extensive research. Academic institutions, through work-study programs and consultation services, could be both providers and recipients of experience-based information.

Plan for the Future. Waste minimization should be institutionalized as one of the criteria by which the company evaluates its future business plans. Important decisions such as developing new products or services, devising new processes or operations, and designing new facilities or equipment must include potential waste minimization opportunities.

REFERENCES

1. R.L. Fuchs, K. Culbertson-Arendts, *1989 State-by-State Assessment of Low-Level Radioactive Wastes Received at Commercial Disposal Sites*, Idaho National Engineering Laboratory, DOE/LLW-107, December 1990.
2. S.P. Mathur, "Waste Minimization Policies, Regulations, and Practices within the U.S. Department of Energy Defense Programs," *Proceedings of the Eleventh Annual DOE Low-Level Waste Management Conference, August 22 - 24, 1989, Pittsburgh, Pennsylvania*, CONF-890854-Vol. III.
3. U.S. Department of Energy, "Radioactive Waste Management," DOE Order 5820.2A, Office of Defense Waste and Transportation Management, September 26, 1988.
4. C.C. Amick, Executive Director, The Commonwealth of Massachusetts Low-Level Radioactive Waste Management Board to D.K. Fischer, National Low-Level Waste Management Program, EG&G Idaho, Inc., personal communication, September 1, 1990.

BIBLIOGRAPHY

1. State of California, Department of Health Services, Toxic Substances Control Division, Alternative Technology Section:
2. *Hazardous Waste Reduction Guidelines for Environmental Health Programs*, prepared by Ventura County Environmental Health Department, May, 1987.
3. *Minimizing Hazardous Wastes, Regulatory Options for Local Governments*, prepared by the Local Government Commission, December, 1988.
4. *Low Cost Ways to Promote Hazardous Waste Minimization, A Resource Guide for Local Governments*, prepared by the Local Government Commission, October, 1988.
5. *Low Cost Ways to Promote Hazardous Waste Minimization, Resource Appendix B*, prepared by the Local Government Commission, October, 1988.
6. U.S. Department of Energy, (Draft) *Implementation Guidance for DOE Order 5400.1, Waste Minimization Plan*, Environmental Guidance Division, EH-231, September 1989.
7. U.S. Environmental Protection Agency, *Waste Minimization Opportunity Assessment Manual*, EPA/625/7-88/003, July 1988.
8. M.M. Perkins, Hewlett-Packard Company, "Waste Minimization Program Corner Stones," paper presented at the *INEL Waste Generator Meeting, April 25, 1990*.
9. T. Wett, "Successful Source Reduction Means a New State of Mind About Waste," *Chemical Processing*, March 1990.
10. P.A. Comella, R.W. Rittmeyer, "Waste Minimization/Pollution Prevention," *Pollution Engineering*, April 1990.
11. J. Newton, "Setting Up a Waste Minimization Program," *Pollution Engineering*, April 1990.
12. S.P. Mathur, "Waste Minimization Policies, Regulations, and Practices within the U.S. Department of Energy Defense Programs," *Eleventh Annual DOE Low-Level Waste Management Conference - August 22, 23, 24, 1989, Pittsburgh, Pennsylvania, CONF-890854-Vol. III*.

END

**DATE
FILMED**

7 / 9 / 93

