

**PROPOSED SUCCESS DEMONSTRATION CRITERIA
FOR THE DEPARTMENT OF ENERGY'S WASTE REDUCTION EFFORTS**

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ABSTRACT

Seven proposed criteria for demonstration of success in waste reduction have been developed: reduced amount of hazardous waste, reduced waste management cost, improved regulatory compliance, reduced health risk, increased production efficiency, reduced accident risk, and improved public relations. A detailed description of each of the criteria is presented along with a discussion for each of the mechanisms for measurement, required commitments, strengths, and weaknesses.

INTRODUCTION

In November 1988 the Department of Energy (DOE) issued DOE Order 5400.1, "General Environmental Protection Program," (1) requiring all DOE operating facilities to develop a waste minimization program and plan for hazardous, radioactive, and mixed waste within 18 months of the Order. The Order directs DOE operating facilities to (1) develop specific numerical goals for minimizing the volume and toxicity of all wastes generated, directed toward annual reductions within programmatic requirements to track and compare annual changes in waste volume and toxicity and (2) identify and report on proposed source reduction and recycling methods that are technically and economically practicable for waste minimization.

The Secretary of Energy added his personal commitment to the Order in a March 23, 1989, letter to Congressman Robert A. Rowe, Chairman of the Committee on Science, Space, and Technology. In that letter, he said: "My objective is to pursue vigorously a four-pronged research program to develop new technologies and management concepts to: 1. Minimize waste in current production through control and chemical substitution; . . ." He continued, "Our mid-range and long-term goals are to significantly replace the current generation process through process chemical substitution, and facility modernization, and to develop new technologies that will not only solve today's problems, but will reduce the overall cost of the remediation."

DOE's initiative is very much in tune with current and developing national thinking, which is oriented more and more strongly toward preventing pollution (as opposed to cleaning up after pollutants have been released to the environment). The Environmental Protection Agency (EPA) articulated its definition of "pollution prevention" to be a hierarchy of activities: source reduction, recycle, treatment, storage, and disposal, with the greatest emphasis on source reduction and recycle. DOE's terminology for its initiatives has been "waste reduction"; that term has been defined to include source reduction, recycle, and treatment. Although

the words DOE used are different from those chosen by EPA, the agencies' approaches are very much in parallel.

As a fundamental part of waste reduction planning, and as a part of a broad interagency cooperative effort, DOE developed several draft criteria by which the success of waste reduction efforts might be evaluated. Success demonstration is of great importance to the waste reduction/pollution prevention effort because waste reduction represents real change in process and procedures; to succeed it must be willingly adopted by all personnel, from top management to production-line workers. Success demonstration provides critical feedback.

The draft criteria presented will not be universally applicable, nor are they all the reporting needed for waste reduction. Use of these criteria will, of necessity, be on a case-by-case basis. In some instances, several criteria may be usable; in others only one may be. Indirect measurements may be necessary to protect classified or sensitive information. Descriptive material will need to be developed in some situations where waste reduction does not lend itself to quantitative measurement. Descriptive material will also be a critical part of technology transfer among components of DOE and with federal and private sector industries wishing to benefit from DOE's experiences.

Seven success demonstration criteria have been proposed and evaluated as indicators of the effectiveness of DOE's planned waste reduction efforts. The proposed criteria apply to all aspects of DOE processes, including research, design, procurement, operations, waste management, and waste disposal. These criteria were developed from three basic sources. The document Serious Reduction of Hazardous Waste, published by the Office of Technology Assessment in 1986 (2), was used as a guideline for currently accepted methodology and definition. Waste reduction experience and history in DOE and the Department of Defense were used to provide practical guidance on the evaluation of waste reduction.

The seven criteria cover the range of beneficial aspects associated with waste reduction -- social, economic, legal/regulatory, environmental, and production benefits.

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Each criterion, along with the primary benefit associated with it, follow: (1) Reduced Amount of Hazardous Waste (environmental), (2) Reduced Waste Management Cost (economic), (3) Improved Regulatory Compliance (legal/regulatory), (4) Reduced Health Risks (social/legal), (5) Increased Production Efficiency (production), (6) Reduced Accident Risk (social/legal), and (7) Improved Public Relations (social).

Characteristics of each criterion, which are discussed in detail in the next section, are described below:

- The **Detailed Description** provides a definition of the criterion as it applies to DOE operations.
- The **Mechanism for Measurement** describes methods for demonstrating performance.
- **Required Commitments** are those required of DOE management to use the criterion.
- **Strengths** describes the principal advantages of using the criterion.
- **Weaknesses** describes the difficulties and limitations in using the criterion.
- **Additional Comments** includes any other pertinent information needed to describe the criterion, its applicability to DOE, and its use.

The discussions identify sources of information and assess the reliability and precision of the data necessary to quantify each criterion. Most of the information can be obtained from available data sources. The remaining data would need to be collected specifically to support these criteria. In all cases, the additional data can be used to support other DOE programs, such as Quality Assurance and Safety. Accordingly, no sole-purpose data bases need to be developed. In organizing the data, it will be necessary to set up data systems to allow retrieval according to the mechanism used, that is, source reduction, recycling, treatment, storage, and disposal.

THE CRITERIA

Criterion 1 - Reduced Amount of Hazardous Waste

Detailed Description

The mass reduction of hazardous waste per unit of production of any of the four categories of waste [radwaste, mixed waste, Resource Conservation and Recovery Act (RCRA) hazardous waste, and special waste] once waste reduction has been implemented compared with a defined reference time before implementation.

Mechanism for Measurement

Measurement is performed by determining the total mass of waste generated per unit of production. Various methods can be employed to measure the total mass of waste produced, including direct measures of mass and

measurements of volume, flow, and concentration. To confirm that all waste is accounted for, a material balance should be performed. A material balance accounts for masses and flows into and out of the process. This information can be aggregated to process, facility, and site, and also to the programs (such as Nuclear Materials Production and Weapons) to demonstrate performance at these levels.

Required Commitment

The information needed to carry out a successful process analysis exists at the sites and in environmental documentation but must be compiled and analyzed to support the use of this criterion. This information includes detailed characterizations of waste streams (including volume, composition, and concentration) and processes.

Strengths

This criterion is a direct and readily quantifiable measure of waste reduction. Moreover, reduction in waste mass is an easily understood indicator of social, economic, legal/regulatory, production, and environmental benefits.

Weaknesses

For some processes, this criterion may be difficult or impossible to measure directly (e.g., processing plutonium scrap) but can still be estimated using standard engineering techniques with sufficient accuracy to be a useful indicator of success.

Additional Comments

The criterion is a direct measure of waste reduction. Reliable data to implement this criterion are available or obtainable within DOE. The criterion indirectly measures the extent of liability reduction associated with the remediation of disposal sites. Results need to be categorized by the type of techniques used, that is, source reduction, recycle, treatment, storage, or disposal.

Criterion 2 - Reduced Waste Management Cost

Detailed Description

Waste management costs include off-site and on-site waste handling, storage, transport, and disposal, as well as waste treatment operating and capital expenses. This criterion compares the cost of waste management before and after waste reduction options are implemented.

Mechanism of Measurement

Cost reporting data and/or standard engineering estimates can be used to compare waste management costs before waste minimization is implemented with costs after implementation. These costs must be normalized to account

for inflation and changes in production levels and regulatory requirements.

Required Commitment

Resources may be required to document the effect of waste reduction activities on waste management costs that current cost reporting data do not capture. This could imply modifications of cost reporting data format.

Strengths

Much of the required information is easily obtainable and is easily understood.

Weaknesses

Waste management cost data are accurate at the facility level. If records of waste codes and amounts are kept by specific process operators, cost data could be calculated for them. In instances where waste code and amount data are not kept by process-level operators, costs will be difficult to allocate to individual processes with precision. This limits the use of this criterion at the process level. Engineering estimates may be needed to supplement cost data at the process level.

Additional Comments

The present DOE cost reporting system can be accessed to provide the data needed to evaluate this criterion at the facility level. Reliability is limited by the accuracy of cost allocation to individual processes.

Criterion 3 - Improved Regulatory Compliance

Detailed Description

Waste reduction results in a decreased mass of waste to be disposed of. Additional results are reduced volumes of wastes discharged to on-site and off-site treatment plants and to the atmosphere. Consequently, facilities that aggressively implement waste reduction procedures will have greater flexibility and responsiveness in operating conditions within current discharge standards.

Mechanism for Measurement

Measurement will vary with the media involved. With air and water, decreases in concentration of discharge relative to applicable standards and reductions in the frequency and severity of excursions from the standards after implementation of waste reduction can be measured. With hazardous waste, reduction in RCRA storage violations can be tabulated. Data from internal regulatory compliance reviews, discharge monitoring reports, and periodic RCRA facility inspection reports and state reviews can be used to determine compliance.

Required Commitment

Resources will be required to compile existing data and

to produce accurate and objective compliance assessment reports.

Strengths

This criterion is easily measured at low cost.

Weaknesses

Compliance status may not correlate well with waste reduction actions.

Additional Comments

No new data need be developed to support the implementation of this criterion.

Criterion 4 - Reduced Health Risks

Detailed Description

Waste reduction, including materials substitutions, process changes, improved hazardous materials-handling practices, and reduced generation of waste, reduces worker exposure to hazardous and radioactive materials. Accordingly, health risks to the labor force will be reduced.

Mechanism for Measurement

The DOE Incident Reporting System documents non-routine exposures to hazardous and radioactive materials. Chronic exposure data are available as a part of the Industrial Hygiene and Health Physics Monitoring Programs and are indicators of the long-term health risks associated with industrial operations. Radiation exposure is constantly monitored for all personnel at sites where radioactive materials are present. Decreases in exposure reflected in these data are indicators of decreased health risks to the affected populations.

Required Commitment

Available data will require extraction, reduction, and analysis. Industrial hygiene programs will need to be expanded and standardized among the DOE sites.

Strengths

This criterion represents, along with protection of the environment, the fundamental tenets of effective environmental stewardship. It can serve as a strong motivating factor for employee involvement in waste reduction.

Weaknesses

Health risk may not correlate well with waste reduction. Existing industrial hygiene data are not as sophisticated as health physics data and may not provide the detail necessary to evaluate the effects of waste reduction.

Additional Comments

The necessary radiological and incident data are readily available within DOE. Use of this criterion is con-

sistent with and complementary to DOE's ongoing initiatives in Industrial Hygiene.

Criterion 5 - Increased Production Efficiency

Detailed Description

Increased production efficiency, including increased output per unit input, more efficient use of labor, energy conservation, improved product quality, and more efficient use of scarce resources, can result from the successful implementation of a waste reduction program.

Mechanism for Measurement

The best measure of overall production efficiency is the change in unit cost. Other indicators of production efficiency include such things as reduced reject and rework rate and demonstrated ability to meet stringent product specifications.

Required Commitment

Additional time may be required to compile existing data. Additional data gathering in areas such as reject and rework rates may be required.

Strengths

This criterion is easily measured at low cost, and it demonstrates DOE commitment to efficient stewardship of resources in accomplishing its mission.

Weaknesses

Changes in production efficiency may not correlate well with waste reduction. Product specification changes and pulsed production schedules can mask the effect of waste reduction efforts.

Additional Comments

DOE's present cost reporting system will provide most of the data needed to implement this criterion.

Criterion 6 - Reduced Accident Risk

Detailed Description

Accidents are defined here as events that result in uncontrolled releases of hazardous and/or radioactive materials to the environment. Waste reduction results in the reduction of use of hazardous materials and the generation of less waste. The reduced presence of these materials will decrease risk from accidents of various types.

Methods of Measurement

The DOE Incident Reporting System documents accidents of this type. Data from this system can be used to evaluate accident risk and the effect of waste reduction on that risk. This will be done by establishing a baseline of

frequency and consequences of accidents and then correlating future data with waste reduction efforts.

Required Commitment

Personnel and resources will be required to extract and analyze the needed data from the DOE Incident Reporting System.

Strengths

Needed information can be drawn from existing data bases, resulting in a relatively low cost for implementation. Reduced accident risk will be a strong motivational force to involve Health and Safety personnel and the general work force with waste reduction.

Weaknesses

Risks from accidents may not correlate well with progress made in waste reduction.

Additional Comments

This criterion is an indicator of the progress DOE is making toward protecting human health and the environment and is complementary to and consistent with DOE's ongoing safety initiatives.

Criterion 7 - Improved Public Relations

Detailed Description

Improved public image can result from the successful implementation of a waste reduction program.

Mechanism for Measurement

The most direct measure of this criterion is through surveys of public attitudes such as media surveys and representative opinion polls.

Required Commitment

The evaluation of this criterion requires that public attitude surveys be conducted.

Strengths

The use of this criterion is complementary to DOE's Public Affairs program.

Weaknesses

Public opinion is very difficult to quantify and to correlate with waste minimization.

Additional Comments

This criterion may be of special interest to DOE because public awareness and opinion of its programs will be mirrored in the attitudes of congressional members and

other public officials who influence, direct, or control DOE's programs.

ACTIONS

Actions to Date

The draft criteria were presented and discussed at the Third DOE Waste Reduction Workshop, which was held in Burlingame, California, in August 1989. Subsequently, detailed comments were received from several of the workshop participants. As a result of those discussions and comments, the seventh criterion, "Improved Public Relations," was dropped from consideration. The principal difficulty with the criterion is that public relations effects due to waste reduction efforts are felt to be too confounded with effects from other agency activities to be measured accurately.

Detailed comments received from several of the DOE sites and from the EPA Pollution Prevention Office are being incorporated into the draft criteria. As might be expected from an organization as large and complex as the Agency, there are a great many instances where any general criteria such as these have to be "fine tuned" to specific situations.

Future Actions

Based on responses to date, it appears that these success demonstration criteria are usable. The key to their use

is effective baselining, the definition of conditions extant before the incorporation of waste reduction options. Activities are currently under way to incorporate the success demonstration criteria into the design of process assessments.

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