NETAC

National Environmental Technology Applications Center

A Proposed Framework for Establishing Integrated Cost and Performance Criteria for Environmental Technologies

A Summary Report to the U.S. Department of Energy

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MASTER

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This document has not been reviewed by individuals interviewed during project research or participants who attended the workshop conducted under this project as described herein. Additionally, this document was not subject to the administrative review or approval of the EPA or the DOE.

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EXECUTIVE SUMMARY

Through an Interagency Agreement between the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE), EPA directed a project to establish a suite of standard cost and performance criteria to guide the evaluation of environmental cleanup technologies for DOE sites. Ideally, these criteria would be "generic" in that they could be used as a basis for evaluating any cleanup technology for any DOE site. To be most useful, however, these criteria would also reflect the interests of diverse decisionmakers (i.e., policymakers, developers, users, approvers, and other stakeholders) who influence DOE technology evaluation. The project was conducted by the National Environmental Technology Applications Center (NETAC), a nonprofit organization specializing in the development and commercialization of new and innovative environmental technologies for national and international markets.

To accomplish the project objective, NETAC (1) developed a data gathering questionnaire, (2) interviewed government and industry decisionmakers, (3) identified previous criteria development efforts, (4) conducted a workshop, (5) evaluated workshop discussions, and (6) applied its five years' experience in commercializing environmental technologies to analyze project findings.

Project findings include (1) decisionmakers have quite different perspectives with interests and information needs varying among decisionmaker groups, (2) previous criteria development efforts may be too narrowly focused to apply to all decisionmakers, (3) criteria must include the social/political/economic interests of decisionmakers as well as site-specific variations, and (4) there are five core questions that all decisionmakers are likely to ask when considering a technology for use at a site.

The project resulted in the development of a unique and comprehensive resource or tool to enhance communication among decisionmakers. This resource, a "Proposed Framework for Establishing Integrated Cost and Performance Criteria for Evaluating Environmental Cleanup Technologies for DOE Sites," offers decisionmakers a first-time comprehensive assessment of major technology evaluation issues by decisionmaker group.

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) has identified the need to undertake a project to establish a suite of standard cost and performance criteria to guide the evaluation of environmental cleanup technologies for DOE sites. Based on the U.S. Environmental Protection Agency's (EPA) substantial influence on environmental technology decisions, EPA assisted DOE by providing program direction through Interagency Agreement Number DE-A101-92EW50619.

The project was conducted by the National Environmental Technology Applications Center (NETAC) headquartered in Pittsburgh, Pennsylvania. Established in 1988 through a cooperative agreement between the EPA and the University of Pittsburgh Trust, NETAC is a nonprofit organization specializing in the development and commercialization of new and innovative environmental technologies for national and international markets.

This section presents the project objective, approach, findings, and summary of activities.

1.1 PROJECT OBJECTIVE

The objective of the project was to establish a suite of standard cost and performance criteria for evaluating environmental cleanup technologies for DOE sites. Ideally, these criteria would be "generic" in that they could be used as a basis for evaluating any cleanup technology for any DOE site. To be most useful, however, these criteria would reflect the interests and information needs of key decisionmakers influencing DOE's technology evaluation decisions. These decisionmakers included policymakers (on behalf of the taxpayer), technology developers, technology users, technology approvers, and other stakeholders (e.g., investors, the public), and are further discussed in Section 1.4.1.

1.2 PROJECT APPROACH

To accomplish the project objective, NETAC, in order:

- ▲ Developed a data gathering questionnaire (Appendix A) to enhance understanding of the interests and information needs of all decisionmakers
- ▲ Distributed the questionnaire to approximately 50 government and industry personnel representing one or more decisionmaker groups; conducted followup interviews with respondents to gather additional data
- ▲ Identified cost and performance criteria development efforts previously conducted or currently underway by government and industry; invited representatives to speak at a workshop
- ▲ Analyzed project research and developed a matrix to guide workshop small group discussions
- ▲ Conducted a workshop to promote interaction among diverse decisionmakers for the purpose of establishing standard cost and performance criteria for evaluating environmental cleanup technologies for DOE sites
- ▲ Evaluated the interaction and group dynamics that occurred in the workshop discussions
- ▲ Applied its 5 years' experience in commercializing environmental technologies to analyze project findings.

1.3 PROJECT FINDINGS

Project findings are summarized below.

- ▲ Decisionmakers have quite different perspectives with interests and information needs varying among decisionmaker groups.
- ▲ Previous cost and performance criteria development efforts may be too narrowly focused to apply to all decisionmakers. To be most useful, they need to be integrated to begin to reflect decisionmakers' diverse perspectives.
- ▲ Cost and performance criteria must include the social/political/economic interests of decisionmakers.
- ▲ Cost and performance criteria should also address site-specific variations. Each site presents unique challenges that impact technology decisions.

- ▲ The project identified *five generic core questions* that all decisionmakers are likely to ask about a technology when considering it for use at a site. These core questions focus on the application, effectiveness, economics, acceptance, and accessibility of a technology:

- How applicable is the technology to the site?
- How well will the technology work on the site?
- What are the economics of the technology?
- How acceptable is the technology?
- What is the availability of the technology?

Within each core question, more detailed questions for each decisionmaker group can be developed. For example, each decisionmaker group may ask several questions to understand if the technology is applicable to a site.

The following sections briefly describe the workshop small group discussion matrix, the decisionmakers and major information categories identified in the matrix, and the workshop small group process.

1.4 WORKSHOP SMALL GROUP DISCUSSION MATRIX

Based on project research findings, NETAC developed major categories of technology information needs for evaluating environmental cleanup technologies. These major categories assisted NETAC in developing a workshop small group discussion matrix (Table 1-1) organized by decisionmaker group (i.e., policymaker, developer, user, approver, and other stakeholders). The matrix was used at the workshop (Section 1.5) to guide small group discussions for the purpose of establishing standard cost and performance criteria and for building consistency in reporting between the small groups.

Table 1-1

Suggested Workshop Small Group Discussion Matrix

Category	Technology Application	Technology Effectiveness	Technology Cost/Economics	Technology Acceptance	Vendor Qualifications
Decisionmaker					
Policymaker					
Developer					
User					
Approver					
Other Stakeholders					

Summary definitions for decisionmakers and major information categories are provided below.

1.4.1 Decisionmakers

Decisionmakers are defined as key individuals or groups who influence DOE's evaluation of environmental cleanup technologies. Although decisionmakers may vary from site to site, project activities (and workshop participants) focused on six key decisionmaker groups. These decisionmakers, illustrated in Figure 1-1, pressure DOE to comprehensively and fairly evaluate environmental cleanup technologies--particularly of new or unproven technologies--to determine which ones are safer, more efficient, and cost-effective solutions for DOE's environmental needs.

Figure 1-1

Key Decisionmakers Influencing Environmental Technology Decisions at DOE Sites

Summary definitions for decisionmakers are as follows:

- ▲ *Policymaker.* A policymaker is an individual who serves on behalf of the taxpayer. Examples of policymakers include legislative and regulatory bodies, a State's Governor, the EPA Administrator, and the Secretary and Assistant Secretaries within the DOE.

- ▲ *Developer.* A developer is a public or private source of environmental cleanup technologies. Developers include DOE's Office of Technology Development, DOE and other national laboratories, universities, research organizations, and private-sector technology organizations.
- ▲ *User.* A user is a public- or private-sector customer for environmental cleanup technologies. Examples of users include: DOE's Office of Environmental Restoration (EM-40) and Office of Waste Management (EM-30) organizations, remediation contractors, and government and industry owners of contaminated sites.
- ▲ *Approver.* An approver is a federal, state, or local regulatory agency overseeing site activities and working towards timely, safe, and effective site cleanups. Approvers include EPA headquarter and regional personnel, state agencies, and local regulatory bodies.
- ▲ *Other Stakeholders.* A varied group of other stakeholders influences DOE technology decisions. Two stakeholder groups that were addressed during the project are investors and the public. *Investors* provide capital to environmental technology organizations; the *public* (e.g., local communities) is concerned with timely, safe, and effective site cleanups. Insurers were briefly mentioned during workshop discussions; however, findings could not be developed from these discussions.

1.4.2 Major Information Categories

Project research findings also identified a variety of approaches in grouping technology information needs. For example, the Battelle Seattle Research Center groups needs into four major categories (1) effectiveness, (2) environmental safety and health, (3) socio-political interests, and (4) regulatory objectives. As another example, the General Electric Company, an industry user, organizes information needs into six major categories (1) safety, (2) process effectiveness, (3) residual/emissions, (4) cost, (5) vendor, and (6) process maturity. Additional information on these and other government and industry criteria development efforts is provided in Appendix B, Workshop Presentation Summaries.

Focused on the project objective, NETAC developed major information categories that were consistent with project research findings. These categories are defined below. It is important to note that the definitions were intended to be sufficiently general to provide latitude for workshop participants during small group discussions. Representative examples of information needs (elements) within these categories are provided in Appendix C.

- ▲ *Technology Application* includes information needs relevant to site characteristics, cleanup standards and schedule, performance requirements, and how a technology works (technology principle).
- ▲ *Technology Effectiveness* includes information needs relevant to how well a technology works and how it compares to alternative technologies.
- ▲ *Technology Economics* includes information needs relevant to the cost of using a technology and compares this cost to that of alternative technologies.
- ▲ *Technology Acceptance* includes information needs relevant to public and regulatory acceptance of a technology as well as other nontechnical (e.g., liability issues) considerations.
- ▲ *Vendor Qualifications* include information needs relevant to the vendor's experience and capabilities.

1.4.3 Workshop Small Group Process

NETAC also developed a process that would allow the workshop small groups to build cost and performance criteria based on important information elements (i.e., needs) and their definitions. This process can be described as follows:

$$\text{Criteria} = \text{Information Elements} + \text{Definitions}$$

Criteria are standards on which a judgment or decision may be based (Merriam Webster 1993). *Information elements* are pieces of information needed to support the evaluation of an environmental cleanup technology. As previously stated, representative information elements are provided in Appendix C. *Definitions* are explanations of what is included in the information elements.

Workshop participants were asked to focus on the right side of the equation. That is, they were asked to first identify important information elements followed by their corresponding definitions. The following information elements and definitions were provided to workshop participants as examples.

Information Element: Contaminants/concentrations the technology can treat
Definition: The technology can treat the contaminants to the specific concentration levels.

Information Element: Versatility
Definition: The technology (1) can treat a wide range of contaminants, (2) can be applied to a wide range of media, and (3) is mobile.

1.5 THE WORKSHOP

A workshop was conducted on January 18-19, 1994 at the William F. Bolger Management Academy in Potomac, MD. The purpose of the workshop was to develop a suite of standard cost and performance criteria for evaluating environmental technologies. The workshop was facilitated by NETAC and attended by 30 participants (2-day total), representing one or more decisionmaker groups. These participants braved icy roads and arctic temperatures to hear presentations by government and industry on data collection and criteria development efforts and to work together to establish standard cost and performance criteria. The workshop agenda and participants list are provided in Appendices D and E, respectively.

Workshop discussions proved to be highly productive with diverse decisionmakers describing their information needs for evaluating environmental cleanup technologies. These participants also identified important information elements, one part of the criteria equation (criteria = information elements + definitions). The workshop was an effective forum for decisionmakers to interact.

Subsequent to the workshop, NETAC facilitators held three workshop debriefing/followup meetings to review and analyze workshop discussions. The project benefitted by these meetings in that NETAC was able to apply its five years' commercialization experience with workshop findings to develop a unique resource to enhance communication among decisionmakers. This resource, a "Proposed Framework for Establishing Integrated Cost and Performance Criteria for Evaluating Environmental Cleanup Technologies for DOE Sites," is presented in the following section.

2.0 PROPOSED FRAMEWORK FOR ESTABLISHING INTEGRATED COST AND PERFORMANCE CRITERIA

As previously stated, decisionmakers have quite different perspectives with interests and information needs varying among decisionmaker groups. As a result, cost and performance criteria that are generic and reflect decisionmakers' diverse perspectives will be difficult to establish. In addition, to integrate the diverse needs of decisionmakers, a process must be in place that allows decisionmakers sufficient time and continued opportunity to interact.

During analysis of workshop findings, NETAC applied its environmental technology commercialization experience to develop a unique and comprehensive resource to enhance communication among decisionmakers. This "Proposed Framework for Establishing Integrated Cost and Performance Criteria for Evaluating Environmental Cleanup Technologies for DOE Sites," facilitates decisionmakers' understanding of each others' interests and information needs. This section presents the proposed framework and its benefits.

2.1 DEVELOPMENT OF THE PROPOSED FRAMEWORK

Subsequent to the workshop, NETAC conducted three debriefing/followup meetings to review and analyze workshop discussions. Initially, enhancements were made to the workshop small group discussion matrix. For example, to address the need for decisionmakers to know *when* a technology can be used or deployed as well as a vendor's experiences and qualifications, the fifth information category was more accurately named "Technology Accessibility."

This initial modification was then followed by a more noteworthy finding. As NETAC conducted its analysis and searched for common areas, five generic questions surfaced as applicable to all decisionmakers. These five core questions (introduced in Section 1.3) are likely to be asked by all decisionmakers about a technology when considering it for a site. Interestingly, these core questions are consistent with the five major information categories and focus on the application, effectiveness, economics, acceptance, and accessibility of a technology:

- ▲ How applicable is the technology to the site?
- ▲ How well will the technology work on the site?

- ▲ What are the economics of the technology?
- ▲ How acceptable is the technology?
- ▲ What is the availability of the technology?

Once identified, each core question was then included in the workshop small group discussion matrix under its respective major information category. It soon became apparent that the discussion matrix, developed initially for use as a small group discussion guide, would also serve to effectively document project findings.

Finally, NETAC facilitators asked, "Are there more detailed questions that each decisionmaker asks within the five major information categories?" The facilitators continued their analysis to identify these subsets of questions. The matrix began to take shape and all 30 boxes (5 categories multiplied by 6 decisionmakers) were completed. The completed matrix, the proposed framework, is presented at the end of this section.

Individuals reviewing the proposed framework will find that, as each category is addressed by a specific decisionmaker perspective, there are some common areas among decisionmakers. For example, policymakers, users, approvers, investors, and the public may all ask a similar question to understand the effectiveness of a technology, "What data exist to substantiate a developer's (vendor's) claims?" There are also unique areas among decisionmakers. For example, where all decisionmakers may ask about the experience and qualifications of the developer (vendor), the public also asks about the experience and qualifications of the users and regulators involved in the decisionmaking process.

2.2 BENEFITS OF THE PROPOSED FRAMEWORK

The proposed framework will greatly benefit DOE and other decisionmakers by integrating cost and performance criteria to reflect the full range of decisionmakers' interests and information needs. The framework provides a valuable opportunity for each decisionmaker group to *communicate* their interests and information needs as well as to understand those of other decisionmaker groups. In addition, the proposed framework benefits decisionmakers by, for the first time:

- ▲ Providing a comprehensive assessment of all major issues influencing technology evaluation

- ▲ Identifying core questions common to all decisionmakers and delving further into subsets of questions applicable to each decisionmaker group
- ▲ Giving decisionmakers--particularly the developer and user communities--a unique and complete tool for conducting comparative assessments of major environmental cleanup technology evaluation issues.

With numerous DOE sites in various stages of cleanup, the following section provides recommendations for implementing the proposed framework.

Table 1-2

Proposed Framework for Establishing for Evaluating Environmental

<div>CATEGORY</div> <div>DECISIONMAKER</div>	TECHNOLOGY APPLICATION	TECHNOLOGY EFFECTIVENESS
CORE QUESTION	HOW APPLICABLE IS THE TECHNOLOGY TO THE SITE?	HOW WELL WILL THE TECHNOLOGY WORK ON THE SITE?
POLICYMAKER	<p>What is the problem on the site?</p> <p>What is the technology? How does it work?</p> <p>How will it work on the site?</p> <p>Can the technology be used at other sites?</p>	<p>What supporting data exist to substantiate vendor claims?</p> <p>Will the technology achieve cleanup standards and meet performance requirements on schedule?</p>
DEVELOPER	<p>What are the characteristics of the site?</p> <ul style="list-style-type: none"> - location - contaminants - media - geology - etc. <p>What are the cleanup standards, schedule, and performance requirements?</p>	<p>What supporting information is needed to prove the technology will achieve cleanup standards and meet performance requirements on schedule?</p> <p>How reliable is the information on site characteristics?</p>
USER	<p>What are the technology's performance characteristics?</p> <ul style="list-style-type: none"> - cleanup levels achievable - operating principle(s) - operating parameters - by-products and/or emissions generated - etc. <p>What limitations on the technology exist on the site?</p>	<p>Can the technology achieve the cleanup standards and meet the performance requirements on schedule?</p> <p>What data exist to substantiate vendor claims (e.g., reliability/availability/maintainability)?</p> <p>How does the technology's performance compare with alternative technologies?</p>

Integrated Cost and Performance Criteria Cleanup Technologies for DOE Sites

TECHNOLOGY ECONOMICS	TECHNOLOGY ACCEPTANCE	TECHNOLOGY ACCESSIBILITY
WHAT ARE THE ECONOMICS OF THE TECHNOLOGY?	HOW ACCEPTABLE IS THE TECHNOLOGY?	WHAT IS THE AVAILABILITY OF THE TECHNOLOGY?
<p>What will it cost to use the technology?</p> <p>How does the technology compare with alternative technologies?</p> <p>Can the technology provide overall savings (e.g., use at other sites)?</p>	<p>Is the technology safe for the short and long term?</p> <p>What are the short- and long-term benefits from using the technology?</p> <p>What opposition may exist for the technology?</p> <p>Will the technology reduce risks at the site?</p>	<p>How soon can the technology be deployed?</p> <p>How confident are we about the vendor's experience and capabilities?</p> <ul style="list-style-type: none"> - technical experience - financial strength - management skills - reputation with the public and regulators - etc.
<p>What is the site's cleanup budget?</p> <p>What costs are relevant?</p> <p>What costs are likely to be incurred in a decision-making process?</p> <p>Can I make a profit?</p>	<p>Are there public concerns about use of the technology?</p> <p>Is the technology acceptable to the federal/state/local regulators?</p> <p>Are there incentives to use the technology?</p> <p>What potential liabilities exist at the site?</p>	<p>How soon is the technology needed?</p> <p>What are the contractual requirements?</p> <ul style="list-style-type: none"> - buy/lease arrangements - vendor support - insurance requirements - site access requirements - etc.
<p>What are the life-cycle costs for use of a technology at the site?</p> <p>Capital operations storage/disposal mobilization/demobilization site preparation monitoring etc.</p> <p>How reliable are the cost estimates for a technology?</p> <p>How does the technology compare with the economics of alternative technologies?</p>	<p>What is the expected response from the community and regulators regarding the technology?</p> <p>Does the technology protect workers and the public?</p>	<p>How soon can the technology be deployed?</p> <p>What are the vendor's experience and capabilities?</p> <ul style="list-style-type: none"> - EH&S track record - technical experience - management skills - reputation with the public and regulators - etc.

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Proposed Framework for Establishing for Evaluating Environmental

CATEGORY DECISIONMAKER	TECHNOLOGY APPLICATION	TECHNOLOGY EFFECTIVENESS
CORE QUESTION	HOW APPLICABLE IS THE TECHNOLOGY TO THE SITE?	HOW WELL WILL THE TECHNOLOGY WORK ON THE SITE?
APPROVER	<p>How does the technology work?</p> <ul style="list-style-type: none"> - operating principle(s) - contaminants treated - operating parameters - by-products and/or emissions generated - etc. <p>What limitations on the technology exist on the site?</p>	<p>Will the technology meet the cleanup standards and performance requirements on schedule?</p> <p>What data exist to substantiate vendor claims? How reliable are the data?</p>
INVESTOR	<p>What is the problem on the site?</p> <p>What are the cleanup standards, schedule, and performance requirements?</p> <p>What is the extent of the problem at other sites?</p>	<p>What data exist to substantiate vendor claims? Was the data independently developed/verified?</p> <p>How does the technology's performance compare with alternative technologies'?</p>
PUBLIC	<p>What is the problem on the site?</p> <p>What are the cleanup standards, schedule, and performance requirements?</p> <p>How does the technology work?</p> <p>Is the technology consistent with regulatory requirements?</p>	<p>How well will the technology work?</p> <p>What data exist to support vendor claims? Were the data independently developed/verified?</p> <p>How does the technology's performance compare with alternative technologies'?</p>

Table 1-2

(continued)

Integrated Cost and Performance Criteria Cleanup Technologies for DOE Sites

TECHNOLOGY ECONOMICS	TECHNOLOGY ACCEPTANCE	TECHNOLOGY ACCESSIBILITY
WHAT ARE THE ECONOMICS OF THE TECHNOLOGY? What are the life-cycle costs for use of the technology at the site? capital operations storage/disposal mobilization/demobilization site preparation monitoring etc. How reliable are the cost estimates for the technology? How does the technology compare with the economics of alternative technologies?	HOW ACCEPTABLE IS THE TECHNOLOGY? Is the technology protective of human health and the environment? What is public sentiment towards the technology?	WHAT IS THE AVAILABILITY OF THE TECHNOLOGY? What are the capabilities and experience of the technology user and vendor? - technical experience - management skills - reputation with the public - etc.
What is the cleanup budget for the site? How much do I have to invest? What are the financial risks? What will be my return on investment (ROI)?	Are there public concerns about use of the technology? Is the technology acceptable to the federal/state/local regulators? Are there incentives for users to use the technology? What are the potential liabilities at the site?	What are the experiences and capabilities of the user and the vendor? - technical experience - financial strength - management skills - reputation with the public and regulators - etc.
What is the total cost to use the technology? How reliable are the cost estimates? How does the technology compare with the economics of alternative technologies? Who benefits economically from use of the technology?	What is the impact of the technology on human health and the environment? Will use of the technology negatively affect (e.g., noise) the community?	What are the experiences and capabilities of the developer, user, and regulators?

3.0 CONCLUSIONS AND RECOMMENDATIONS

Evaluating environmental cleanup technologies for use at DOE and other sites is typically a complex, time-consuming, and costly effort driven by the interests and information needs of diverse decisionmakers. In addition, this effort must also integrate technical and nontechnical considerations to satisfy these decisionmakers. Resources, such as the framework proposed in Section 2.0, that facilitate communication among decisionmakers promote timely and effective decisions--a benefit to all.

3.1 CONCLUSIONS

This project incorporated a process that brought diverse decisionmakers together to try to establish standard cost and performance criteria for evaluating environmental cleanup technologies for DOE sites. Key project findings include:

- ▲ Decisionmakers have quite different perspectives with interests and information needs varying among decisionmaker groups.
- ▲ Previous cost and performance criteria development efforts may be too narrowly focused to apply to all decisionmakers. To be most useful, they need to be integrated to begin to reflect decisionmakers' diverse perspectives.
- ▲ Cost and performance criteria must include the social/political/economic interests of decisionmakers.
- ▲ Cost and performance criteria should also address site-specific variations. Each site presents unique challenges that impact technology decisions.

Project findings assisted NETAC in developing a powerful resource for each of the decisionmaker groups to understand the interests and information needs of other groups. This unique resource, a "Proposed Framework for Establishing Integrated Cost and Performance Criteria for Evaluating Environmental Cleanup Technologies for DOE Sites," is intended to promote effective communication among all decisionmakers.

3.2 RECOMMENDATIONS

NETAC recommends that DOE identify one or more sites where the proposed framework could be tested by key decisionmakers to establish cost and performance criteria relevant to that site and acceptable to all. Any resulting refinements could be incorporated into the proposed framework and made available to interested parties.

In addition, the proposed framework could be applied in support of technology demonstration efforts. For example, the Western Governors' Association (WGA), in conjunction with DOE, the U.S. Department of Defense, and the U.S. Department of Interior, has 13 technology demonstrations planned and/or underway. In order to reap the greatest technical and management benefits from the demonstrations, WGA is investigating use of "value-added" projects focused on management/process enhancements. That is, where technology demonstrations are focused on technical issues, value-added projects are focused on improving management or process efficiencies in development, demonstration, testing, and commercialization of environmental technologies. Currently, three value-added projects are planned. They focus on (1) development of cost and performance criteria, (2) permit reciprocity, and (3) stakeholder participation. The proposed framework may prove beneficial to all three projects.

In summary, NETAC believes that this project provided tremendous value to DOE in that it resulted in a unique and powerful resource (proposed framework) for enhancing communication among diverse decisionmakers. This resource will facilitate successful development of acceptable cost and performance criteria appropriate to individual sites. The remainder of the report includes (1) an addendum that reiterates lessons learned in bringing diverse decisionmakers together and (2) appendices.

ADDENDUM

**OIL SPILL BIOREMEDIATION PRODUCTS TESTING PROTOCOL--
A CASE STUDY**

OIL SPILL BIOREMEDIATION PRODUCTS TESTING PROTOCOL-- A CASE STUDY

Opportunities to bring government and industry together are not new to NETAC. Since its inception in 1988, NETAC has served as a conduit in bringing government and industry together to achieve common objectives. Most notable of these efforts is NETAC's role in a highly visible and successful EPA project titled, Oil Spill Bioremediation Products Testing Protocol.

This case study provides a brief overview of lessons learned that could apply to all efforts focused on bringing diverse participants together.

Project Background

After the March 1989 Exxon-Valdez oil spill in Prince William Sound, Alaska, EPA and other federal and state agencies were overwhelmed with offers from bioremediation product producers who believed they could expedite cleanup by enhancing biodegradation of spilled crude oil. In response, EPA identified a commercialization need by developers, approvers, and users to (scientifically) determine how these alternative products and methods compared.

As a result, in December 1989, NETAC agreed to assemble a panel of bioremediation experts. The purpose of this panel was to develop basic criteria for determining the efficacy and environmental safety of products intended to accelerate biodegradation of spilled oil. This panel, and subsequent ones organized by NETAC, incorporated scientific expertise from various disciplines and representatives from government, industry, and academia.

Through several meetings, the panel established a tiered evaluation framework against which oil spill bioremediation products were evaluated for field testing in Alaska. The tier approach provides cost-effective vendor guidance and feedback. Vendors whose products have only limited success in earlier tiers could refine their product and resubmit it with minimal investment of time and resources. Thus, the protocol provides users and approvers with efficacy information while also assisting bioremediation product developers.

Lessons Learned

NETAC's success in facilitating development of the tiered evaluation framework was not without incident. NETAC learned early in the process that bringing diverse groups together to achieve a common objective is a complex effort. It is complicated by the varied interests, needs, and experiences of the participants. Lessons learned from this experience were critical to NETAC's growth as an organization, particularly in enhancing its role as a conduit between government, industry, and academia. Most notable of the lessons learned include:

- ▲ A collegial environment must be incorporated into a process that requires compromise on the part of diverse participants.
- ▲ Sufficient time and iterative opportunity must be available for participants to interact and build trust and commodore.
- ▲ Attention must be given to "task" and "process." That is, the process is equally as important as the task (objective).

Although these statements may seem basic, they are fundamental for individuals facilitating discussions among diverse participants.

APPENDIX A
DATA GATHERING QUESTIONNAIRE

**U.S. DEPARTMENT OF ENERGY
WORKSHOP ON PERFORMANCE AND COST
INFORMATION STANDARDS AND CRITERIA FOR
COMMUNICATION BETWEEN TECHNOLOGY DEVELOPERS AND USERS**

We would like to invite you to participate in a two-phase project aimed at deriving performance and cost information criteria and standards for communication between technology developers and users to assist DOE in its evaluation of environmental technologies for funding and application.

Ideally, your assistance will include participation in both phases of the project, including (1) a data gathering phase (Phase I) consisting of completion of this questionnaire and a brief telephone discussion that will help the project team (DOE, EPA, and NETAC) develop a "straw man" version of performance and cost information criteria and standards, and (2) attendance at a workshop (Phase II) where all participants will work together to refine, revise, and/or expand the "straw man" criteria and standards.

Please read on if you are interested in participating on this project.

APPROACH

This questionnaire is part of the Phase I data gathering activity. It is designed to (1) gather information about your needs in evaluating environmental technologies, and (2) make effective use of your time in participating on this project. For example, this questionnaire will take only 15 to 20 minutes to complete. Your completed questionnaire will assist the project team in developing the "straw man" performance and cost information criteria and standards.

After you complete this questionnaire, please forward it, by facsimile, to Christine Spanard, NETAC Project Manager, at (412) 826-5552. Following receipt of your questionnaire, a NETAC staff person will call you for a brief (20 minute) follow-up discussion to enhance the project team's understanding of your technology evaluation performance and cost information needs. The follow-up discussion will be conducted within two weeks of NETAC's receipt of your completed questionnaire.

Your completed questionnaire will be tabulated with the responses of other project participants. The project team will analyze the data and develop the "straw man" performance and cost information criteria and standards for evaluating environmental technologies. The "straw man" version will be presented at a workshop on January 18-19, 1994, at the Bolger Management Academy in Potomac, MD. The workshop will be formatted for workshop attendees to work together to refine, revise, and/or expand the "straw man" version presented.

The project will be completed by February 28, 1994. A final report describing the performance and cost information criteria and standards developed and agreed to by project participants will be prepared. It is anticipated that the report will aid project participants in communicating information needs to evaluate environmental technologies for DOE funding and application.

Please complete and forward this questionnaire, by facsimile, to Christine Spanard, NETAC Project Manager, at (412) 826-5552 by Friday, November 19, 1993. Thank you for your participation on this project.

PLEASE COMPLETE THE FOLLOWING INFORMATION.

Name	
Title	
Organization	
Address	
Telephone Number	
Facsimile Number	

1. In what stage of development are the environmental technologies you usually evaluate?

"✓" if applicable	Stage of Development
	Applied R&D
	Demonstration/DT&E
	Commercial
	Other (please identify)

Questions 2 through 4 focus on your minimum level of information needs/criteria in three areas--technology performance, cost/economics, and implementation--and rate the importance of these information needs. Answers will help the project team develop the "straw man" criteria/standards for presentation and discussion at the workshop on January 18-19, 1994 at the Bolger Management Academy in Potomac, MD.

TECHNICAL PERFORMANCE CONSIDERATIONS

2. What is the minimum technical performance information that you need to evaluate an environmental technology? Please indicate ("✓") where applicable and rate the information category based on its importance in technology evaluation.

"✓" if applicable	Information Category	Importance Rating (5 = high importance to 1 = low importance)				
		1	2	3	4	5
	Statement of technology principle (e.g., soil washing, vitrification)	1	2	3	4	5
	Description of process operation and schematic	1	2	3	4	5
	Unit capacity (e.g., pounds/hour, gallons/hour)	1	2	3	4	5
	Applicable media (e.g., soil, water, air)	1	2	3	4	5
	Contaminants treated	1	2	3	4	5
	Treatability data including initial and final contaminant concentrations	1	2	3	4	5
	Pre-treatment and post-treatment requirements (residual products)	1	2	3	4	5
	Maintenance requirements (e.g., parts replacement, equipment cleaning)	1	2	3	4	5
		1	2	3	4	5
		1	2	3	4	5
		1	2	3	4	5

TECHNOLOGY COST/ECONOMICS CONSIDERATIONS

3. What is the minimum cost/economic information that you need to evaluate an environmental technology? Please indicate ("✓") where applicable and rate the information category based on its importance in technology evaluation.

"✓" if applicable	Information Category	Importance Rating (5 = high importance to 1 = low importance)				
		1	2	3	4	5
	Capital equipment costs					
	Startup and fixed costs (e.g., to establish operating procedures, perform an initial shakedown)	1	2	3	4	5
	Raw material costs	1	2	3	4	5
	Utility/energy costs	1	2	3	4	5
	Permitting and regulatory costs	1	2	3	4	5
	Site preparation costs (e.g., to obtain access rights, utility connections, emergency and safety equipment)	1	2	3	4	5
	Labor costs	1	2	3	4	5
	Training costs	1	2	3	4	5
	Analytical costs	1	2	3	4	5
	Effluent monitoring and disposal costs	1	2	3	4	5
	Residuals and waste shipping, handling, and transportation costs	1	2	3	4	5
	Maintenance/equipment repair and replacement costs	1	2	3	4	5
	Site demobilization costs	1	2	3	4	5
		1	2	3	4	5
		1	2	3	4	5
		1	2	3	4	5

TECHNOLOGY IMPLEMENTATION CONSIDERATIONS

4. What is the minimum technology implementation information that you need to evaluate an environmental technology? Please indicate ("✓") where applicable and rate the information category based on its importance in technology evaluation.

"✓" if applicable	Information Category	Importance Rating (5 = high importance to 1 = low importance)				
	Mobility of technology (e.g, mobile, transportable or stationary)	1	2	3	4	5
	Development stage/availability of the technology (e.g., timing to market)	1	2	3	4	5
	Data on site characteristics (e.g., hydrogeological considerations, physical hindrances on the site, interference in the treatment process due to multiple media contamination)	1	2	3	4	5
	Personnel/labor requirements (e.g., number and type of personnel needed to set up, operate, and maintain the equipment)	1	2	3	4	5
	Schedule/timing requirements including startup time, actual remediation time, total elapsed time	1	2	3	4	5
	Services/support provided by vendor	1	2	3	4	5
	Permitting/regulatory requirements	1	2	3	4	5
	Public acceptance considerations	1	2	3	4	5
	Training ES&H requirements	1	2	3	4	5
	Liability considerations	1	2	3	4	5
		1	2	3	4	5
		1	2	3	4	5
		1	2	3	4	5

5. **Are there certain technology evaluation issues/needs that you would like to focus on during your follow-up discussion with NETAC?**

6. **Do you have a preferred day or time that you would like to conduct your follow-up discussion with NETAC? If so, please indicate below.**

7. **Can you attend the January 18-19, 1994 workshop at the Bolger Management Academy in Potomac, MD? The workshop will be designed to allow participants to work together to refine, revise, and/or expand the "straw man" performance and cost information criteria/standards developed under this data gathering effort.**

*Please fax your completed questionnaire to NETAC
to the attention of Christine Spanard, Project Manager,
at (412) 826-5552 by Friday, November 19, 1993.*

*A NETAC staff person will call you
for a brief follow-up discussion within two weeks
of NETAC's receipt of your completed questionnaire.*

*We appreciate your participation on this project and
will keep you informed of project developments.*

APPENDIX B
WORKSHOP PRESENTATION SUMMARIES

WORKSHOP PRESENTATION SUMMARIES

In conjunction with the background research conducted to prepare for the workshop and to build on previous work, individuals actively involved in cost and performance data collection and criteria development were requested to present information on their organization's efforts in these areas. The following section summarizes the presentations in the order presented. Contact information for the presenters is provided in **Appendix E**.

Michael L. Mastracci
U.S. Environmental Protection Agency
Office of Environmental Engineering and Technology Demonstration

"The DOE/EPA/WGA Partnership"

Under an interagency agreement, EPA provided program direction for the DOE workshop. As activities (e.g., background research, etc.) progressed to prepare for the workshop, the Western Governors' Association (WGA) expressed interest in the workshop objective. Specifically, WGA could consider the workshop findings and developed cost/performance criteria for application at one or more sites in the western states. WGA's Develop On-site Innovative Technologies (DOIT) committee is following proposed EPA policy for the application of innovative technologies at federal facilities and to encourage the use of federal facilities as test beds and demonstration sites. Ideally, the workshop-developed cost/performance criteria, reflecting the diverse needs of decisionmakers, would promote the consideration and use of innovative technologies at these sites. Currently, there are barriers to using new and innovative technologies at WGA and other sites. As stated in a report prepared by NETAC, findings of several key barriers to environmental technology innovation include (1) unpredictable commercialization and procurement pathways for developers and investors to adequately measure returns on investment, (2) a pronounced lack of entrepreneurial management in small and entrepreneurial environmental technology organizations, (3) inconsistent, multilevel permitting process impeding use of innovative technologies, (4) perceived liability exposure associated with site remediation activities, and (5) incomplete performance data and ill-defined success criteria. To overcome these barriers, the successful commercialization sequence must include cost-effective cleanups; more and better technologies; private-sector involvement and investment; adequate and predictable markets; and clear and defensible goals for technology developers, business, regulators, and users.

**Jon Carter
Carter, Brock & Hinman
for Western Governors' Association**

"Joint Federal/Western States Federal Advisory Committee to Develop On-site Innovative Technologies (DOIT Committee)"

In 1991, the WGA DOIT Committee was established as a cooperative effort between the DOE, EPA, Department of Defense (DoD), the Department of Interior (Dol), and WGA to research, develop, and demonstrate cost-effective environmental restoration and waste management technologies at federal lands and facilities in western states. The committee also promotes the exchange of information related to remediation and waste management. The DOIT Ad Hoc General Criteria Working Group developed guidelines for general acceptance criteria for projects and proposals; site selection criteria; technology selection criteria; and technical and process evaluation criteria. This group also formed various Waste Stream Working Groups to address: mixed radioactive/hazardous waste, abandoned mine waste, military munitions, and waste contaminants at military bases. The groups are focusing on specific waste problems including: petroleums, oils, and lubricants (POLs)/chlorinated hydrocarbons; energetics (explosives and propellant materials and associated by-products); buried waste; mixed waste; heavy metals; and decommissioning/decontamination.

**John Kingscott
U.S. Environmental Protection Agency
Technology Innovation Office**

"Proposed Strategy for Documenting Federal Cleanups - Cost and Performance Data"

The EPA is developing a new database that will provide complete summaries of federal remediation projects and make the information available in a standardized format to permit easy and equal comparisons of site, cost, and performance data. Key database information includes (1) standard industrial code, historical activity, and waste source; (2) management practice (i.e., aboveground storage tank, disposal pit, landfill, etc.); (3) contaminant groups - organics, inorganics, radon, explosives/propellants, organometallic; (4) media; (5) primary treatment systems; (6) supplemental treatment systems; and (7) documentation of methods (matrices of site and design/operating parameters versus innovative technologies).

**Colonel James Owendoff
U.S. Department of Defense
Headquarter USAF/CEVR**

"Technology Application Analysis" Reports

Examples of two Technology Application Analysis (TAA) reports prepared by the U.S. Army Environmental Center (USAEC) were provided to workshop participants. These TAA reports included one on pump and treat of contaminated groundwater at Twin Cities Army Ammunition Plant in New Brighton, Minnesota and one on windrow composting of explosives-contaminated soil at Umatilla Army Depot Activity in Hermiston, Oregon. The TAAs provide standardized profiles of remedial activities at Army sites. Each TAA details key site characteristics such as history, contaminants, extent of contamination, and site conditions; treatment method(s) and operating parameters; performance and cost data; regulatory issues; schedule; and lessons learned.

**Mac Lankford
U.S. Department of Energy
Office of Demonstration, Testing & Evaluation**

"EM Technology Development Data Needs"

The DOE's Office of Demonstration, Testing and Evaluation (EM-55) supports DOE's Office of Technology Development (EM-50) in their technology development, evaluation, and selection decisionmaking. By focusing on cost-benefit analyses, EM-55 estimates cost savings for selected technologies across the DOE complex and the return on investment for each selected technology. Cost estimates analyze the full costs of new technology from cradle to grave, including research, demonstration, testing, evaluation, and operations and maintenance costs; costs of baseline (conventional) alternatives; and the size of the problem. In addition, DOE is providing technology information to developers, users, regulators, industry, shareholders, and the public through databases, a hotline, and various technical publications. A Technology Summary on the Minimum Additive Waste Stabilization (MAWS) process was provided to workshop participants.

Steve Booth
Los Alamos National Laboratory

"Environmental Technology Cost-Savings Analysis Project (ETCAP)"

Through its ETCAP team, the Los Alamos National Laboratory provides DOE with expertise in engineering, science, and economics in collaboration with the University of New Mexico's Economic Department and ICF/Kaiser Engineering. Specifically, ETCAP offers DOE short-term decision support and technology screening for budget justification, selection of technical task plans, and quick turn-around decisions and detailed cost-effectiveness studies for close-out technology demonstration, technology transfer, and return on investment calculations. In its cost-effectiveness studies, ETCAP typically follows a series of steps that include (1) identification of new and baseline technologies, (2) definition of systems and scenarios, (3) characterization of a technology's performance, (4) development of life-cycle technology costs, (5) evaluation of cost effectiveness, and (6) estimation of expected savings at applicable sites.

Todd Peterson
Battelle Seattle Research Center

"Evaluating Technology Acceptance"

Through the VOC-arid integrated demonstration project at DOE's Hanford site in Washington, Battelle found that successful deployment of innovative technologies requires the early and ongoing participation of regulators, the public, and technology users to ensure that the development of these technologies considers stakeholders' issues and concerns. At Hanford, stakeholders were diverse, including: government officials, native Americans, regulators, educators, agricultural representatives, technology developers/users, business/labor representatives, and special interest groups. To hasten acceptance of the VOC-arid technology, a three-phase approach was tested. Phase I of the stakeholder involvement process included 40 interviews and 2 workshops to develop a list of innovative technology evaluation criteria that addressed: technology performance and effectiveness, environmental safety and health, sociopolitical interests, and regulatory objectives. Phase II used these criteria to design demonstration test plans that addressed stakeholder issues and concerns. Phase III, the final step of this process, will identify acceptability issues of stakeholders at other DOE arid sites where integrated demonstration technologies may be useful in future cleanup activities. Based on the VOC-arid integrated demonstration, Battelle has developed the following "steps to success"

that include (1) development of technology evaluation criteria, (2) preparation of a test plan, (3) technology demonstration, (4) preparation of separate reports on cost, technology performance, and stakeholder acceptance, (5) integration of three previous reports into a technology evaluation report, and (6) technology deployment.

Mark Sneeringer, Ph.D.
General Electric Company
Corporate Research and Development

"Innovative Technology Selection Criteria: A User/Developer's Perspective"

As a private corporation, GE's environmental research and development laboratory focuses on identifying cost control and reduction areas for remediation and process technologies and on developing a competitive advantage on its products. To date approximately 50 technology evaluations from design review to field pilots have been conducted using GE's criteria for safety, process effectiveness, residuals/emissions, cost, vendor, and process maturity. Technologies that successfully pass through this evaluation process can be presented to clients for consideration for their specific needs. Key elements of a technology presentation include: realistic process flow diagrams, realistic cost estimates, an understanding of process limitations and flexibility, and minimization of assumptions.

Eugene Berman
Molten Metal Technology, Inc.

"Technology Selection Criteria - Industry Developer Perspective"

Establishing an innovative environmental technology involves collaboration between "the jury" - regulators, community, and commercial and governmental users. Key factors in the jury's acceptance of innovative technology include: safety and environmental integrity, technical efficacy, economic benefit, customer satisfaction, pollution prevention hierarchy, technology-based requirements, and permitting and siting. As an example, Molten Metal detailed the growth and commercialization of its Catalytic Extraction Process (CEP) over the past four years. Patented in 1990, CEP is an elemental recycling process that recovers gases, inorganics, and metals. Actual construction of a CEP facility began in 1992 in Fall River, Massachusetts. Continuing dialogue with federal and state officials resulted in issuance of required permits throughout 1992 and 1993. Public meetings and an "open door" policy involved the community and local officials throughout the entire permitting and construction process. In 1994, Molten Metal plans to perform

treatability studies and submit an R & D recycling certification application to Massachusetts. Based on their experience, Molten Metal offered several suggestions to gain technology acceptance, including (1) work closely/early with regulators at all levels, (2) work closely/openly with the community, (3) establish alliances to assure necessary resources and acceptance, (4) work with prospective customers in technology development, and (5) build a full-scale demonstration facility and technology enhancement.

APPENDIX C

REPRESENTATIVE INFORMATION ELEMENTS FOR DEVELOPMENT OF STANDARD COST AND PERFORMANCE CRITERIA

**REPRESENTATIVE INFORMATION ELEMENTS FOR DEVELOPMENT OF
STANDARD COST/PERFORMANCE CRITERIA**

1. TECHNOLOGY APPLICATION	2. TECHNOLOGY EFFECTIVENESS
Characteristics of site to be treated Characteristics of waste to be processed Contaminants/concentrations the technology can treat Media (e.g, soil, water, air) the technology can process Site characteristics favorable to/limiting use of technology Volume of waste to be treated	Ability to meet cleanup standards Ability to meet site cleanup schedule(s) Description of process operation and schematic Flexibility Maintenance requirements Mobility of technology Mobilization time Personnel/labor requirements/ease of use Pre- and post-treatment requirements (residuals) Proof of effectiveness (e.g., treatability data) Robustness Statement of technology principle (e.g., vitrification) Strengths/limitations compared to alternative technologies Unit capacity (e.g., pounds/hour) Versatility
3. TECHNOLOGY ECONOMICS	4. TECHNOLOGY ACCEPTANCE
Analytical costs Capital equipment costs Comparison of competitor technology costs Cost per pound treated Effluent monitoring and disposal costs Energy/utility costs Labor costs Life cycle cost Maintenance/equipment repair and replacement costs Operation and maintenance costs Permitting/regulatory costs Raw material costs Residuals & waste shipping, handling, and transportation costs Site demobilization costs Site preparation costs Startup and fixed costs (e.g., initial shakedown) Training costs	Ability to integrate technology into overall treatment scheme Development stage/availability of the technology Environmental impacts ES&H training requirements Existing and potential markets Intellectual property considerations Liability considerations Permitting/regulatory considerations Previous permitting activity Previous technology demonstration experience Public health and safety issues Public perception/acceptance considerations Socio-economic interests Technical feasibility (scale-up potential) Tribal rights/future land uses Worker safety
5. VENDOR QUALIFICATIONS	
Compliance history Experience with other technologies Experience with public acceptance issues Experience (profile and client contact information) Liability Insurance Number of successful demonstrations Number of years of experience Strength of management team Vendor financial health Vendor resources available to support client needs (services)	

APPENDIX D
WORKSHOP AGENDA

**U.S. DEPARTMENT OF ENERGY
WORKSHOP ON COST AND PERFORMANCE
INFORMATION STANDARDS AND CRITERIA FOR
COMMUNICATION BETWEEN TECHNOLOGY DEVELOPERS AND USERS**

AGENDA

WORKSHOP OBJECTIVE: Establish a suite of priority standard cost/performance criteria essential to the various decisionmakers in environmental cleanup--policymakers on behalf of the taxpayer, technology developers, technology users, technology approvers, and stakeholders

JANUARY 18, 1994--FEDERAL AND STATE PARTICIPANTS

- 8:30 a.m. Registration/coffee service
- 9:00 a.m. Workshop Convenes
Susan Prestwich, U.S. Department of Energy, presiding
- Opening Remarks
Clyde Frank, U.S. Department of Energy
- 9:30 a.m. Workshop Goals and Objectives
Claire Sink, U.S. Department of Energy
- 9:40 a.m. DOE/EPA/WGA Partnership
Mike Mastracci, U.S. Environmental Protection Agency
- 9:55 a.m. WGA States' Activities
Jon Carter, Carter, Brock & Hinman
Tim Holeman, Holeman Consulting
- 10:15 a.m. PANEL: Ongoing Federal and Interagency Efforts in
Cost/Performance Data Collection,
Ed Berkey, NETAC, presiding
John Kingscott, U.S. Environmental Protection Agency
Colonel James Owendoff, U.S. Department of Defense
Mac Lankford, U.S. Department of Energy
Steve Booth, Los Alamos National Laboratory
- 11:15 a.m. BREAK/coffee service
- 11:30 a.m. Stakeholder Involvement in Evaluating Technology Acceptance
Todd Peterson, Battelle Seattle Research Center
- 12:00 p.m. LUNCH

JANUARY 18, 1994--FEDERAL AND STATE PARTICIPANTS (CONTINUED)

1:00 p.m. Presentation of Background Input from Participants
Christine Spanard, NETAC

Overview of Small Group Format--objective, introduction of facilitators, milestones, time limitations, and method to report small group findings
Christine Spanard, NETAC

1:30 p.m. Small Group Sessions

3:00 p.m. BREAK/coffee service

3:15 p.m. Small Group Sessions (Continue)

5:00 p.m. Wrap up for the Day
Ed Berkey, NETAC

5:15 p.m. MIXER/cash bar

**U.S. DEPARTMENT OF ENERGY
WORKSHOP ON COST AND PERFORMANCE
INFORMATION STANDARDS AND CRITERIA FOR
COMMUNICATION BETWEEN TECHNOLOGY DEVELOPERS AND USERS**

AGENDA

WORKSHOP OBJECTIVE: Establish a suite of priority standard cost/performance criteria essential to the various decisionmakers in environmental cleanup--policymakers on behalf of the taxpayer, technology developers, technology users, technology approvers, and stakeholders

JANUARY 19, 1994--FEDERAL, STATE, AND INDUSTRY PARTICIPANTS

- 8:30 a.m. Registration for Industry Participants/coffee service
- 9:00 a.m. Reconvene Workshop and Welcome Industry Participants
Claire Sink, U.S. Department of Energy, presiding
- 9:20 a.m. Report on First Day Discussions and Draft Criteria
Ed Berkey, NETAC
- 10:00 a.m. Technology Selection Criteria--Industry Perspectives
Introduction of Industry Presenters .
Mike Mastracci, U.S. Environmental Protection Agency
- Industry User Perspective
Mark Sneeringer, General Electric Company
- Industry Developer Perspective
Eugene Berman, Molten Metal Technology, Inc.
- 10:55 a.m. BREAK/coffee service
- 11:10 a.m. Continuation of Small Group Sessions/Recap of Small Group Approach
Christine Spanard, NETAC
- 12:00 p.m. LUNCH
- 1:00 p.m. Small Group Sessions (Continue)
- 2:45 p.m. Small Group Presentations
- 4:30 p.m. Closing Remarks
Claire Sink, U.S. Department of Energy

APPENDIX E
WORKSHOP PARTICIPANTS

U.S. DEPARTMENT OF ENERGY
COST/PERFORMANCE WORKSHOP
JANUARY 18-19, 1994

E-1

Workshop Participant	Organization	Mailing Address	Telephone	Facsimile
Berkey, Ed	NETAC	615 William Pitt Way Pittsburgh, PA 15238	(412) 826-5511	(412) 826-5552
Berman, Eugene	Molten Metal Technology	51 Sawyer Road Waltham, MA 02154	(617) 487-7622	(617) 487-7870
Booth, Steve	Los Alamos National Laboratory	MS - B299 Los Alamos, NM 87545	(505) 667-9422	(505) 665-5125
Brockbank, Brad	Colorado Center for Environmental Management	999 18th Street Suite 2750 Denver, CO 80202	(303) 297-0180	(303) 297-0188
Carter, Jon	Carter, Brock & Hinman	350 North Ninth Street P.O. Box 2632 Boise, ID 83701	(208) 336-1776	(208) 336-0003
Castle, Pete	U.S. Department of Energy EM-351 (Support from WINCO)	Room 408 20201 Century Boulevard Germantown, MD 20874	(301) 601-1408	(301) 601-1452
Chaise, Richard	Zapit Technology	14605 Snapdragon Circle North Potomac, MD 20878	(301) 258-5324	(301) 921-2786
Chee, Texas	U.S. Department of Energy EM-52	Trevion II Washington, DC 20585	(301) 903-7926	(301) 903-7238
Coyle, George	U.S. Department of Energy EM-54	1000 Independence Avenue, SW Washington, DC 20585	(202) 586-6382	(202) 586-6773
Duran, Arturo	U.S. Environmental Protection Agency Region 8	999 19th Street, Suite 500 Denver, CO 80202	(303) 294-1080	(303) 294-7559

U.S. DEPARTMENT OF ENERGY
COST/PERFORMANCE WORKSHOP
JANUARY 18-19, 1994

E-2

Workshop Participant	Organization	Mailing Address	Telephone	Facsimile
Frank, Barbara	GETF	c/o U.S. Department of Energy Trevion II Washington, DC 20585	(301) 903-7955	(301) 903-7238
Glaser, Dave	NETAC	615 William Pitt Way Pittsburgh, PA 15238	(412) 826-5511	(412) 826-5552
Greenman, Bill	Duratek Corporation	8955 Gullford Road, Suite 200 Columbia, MD 21046	(410) 312-5100	(301) 621-8211
Hnat, James	Vortec Corporation	3770 Ridge Pike Collegeville, PA 19426	(215) 489-2255	(215) 489-3185
Holeman, Tim	Holeman Consulting	1633 York Street Denver, CO 80206	(303) 355-5492	(303) 355-6323
Jackson, J. Payne	BDM Federal, Inc.	555 Quince Orchard Road Suite 400 Gaithersburg, MD 20878	(301) 212-6270	(301) 212-6252
Kaleba, Frank	Waste Policy Institute	555 Quince Orchard Road Suite 600 Gaithersburg, MD 20878	(301) 990-3008	(301) 990-4889
Kingscott, John	U.S. Environmental Protection Agency Technology Innovation Office (TIO)	401 M Street, SW 5102W Washington, DC 20460	(703) 308-8749	(703) 308-8528
Lankford, Mac	U.S. Department of Energy EM-55	Trevion II Washington, DC 20585	(301) 903-7294	(301) 903-7234
Lenhart, Robb	NETAC	615 William Pitt Way Pittsburgh, PA 15238	(412) 826-5511	(412) 826-5552

**U.S. DEPARTMENT OF ENERGY
COST/PERFORMANCE WORKSHOP
JANUARY 18-19, 1994**

E-3

Workshop Participant	Organization	Mailing Address	Telephone	Facsimile
Liedle, Steve	Bechtel Environmental	151 Lafayette Drive Oak Ridge, TN 37831	(615) 220-2969	(615) 220-2107
Lynne, Diane	U.S. Environmental Protection Agency	401 M Street, SW 0E2261 Washington, DC 20460	(202) 260-9755	(202) 260-9437
Mastracci, Mike	U.S. Environmental Protection Agency Office of Environmental Engineering and Technology Demonstration	Room 628, West Tower (RD681) 401 M Street, SW Washington, DC 20460	(202) 260-8933	(202) 260-3861
McFalls, Maureen	NETAC	615 William Pitt Way Pittsburgh, PA 15238	(412) 826-5511	(412) 826-5552
Mohiuddin, Jaffer	U.S. Department of Energy EM-55	Trevion II Washington, DC 20585	(301) 903-7965	(301) 903-7234
Ostheim, Steve	NETAC	615 William Pitt Way Pittsburgh, PA 15238	(412) 826-5511	(412) 826-5552
Owendoff, James (Col.)	U.S. Department of Defense Headquarter USAF/CEVR	1260 Air Force Pentagon Washington, DC 20330-1260	(703) 697-3534	(703) 697-3592
Peterson, Todd	Battelle Seattle Research Center	P.O. Box 5395 4000 NE 41st Street Seattle, WA 98105-5428	(206) 528-3274	(206) 528-3552
Sink, Claire	U.S. Department of Energy EM-521	Trevion II Washington, DC 20585	(301) 903-7928	(301) 903-7238
Sneeringer, Mark	General Electric Company	P.O. Box 8 K13C3 Schenectady, NY 12301	(518) 387-5334	(518) 387-7611

U.S. DEPARTMENT OF ENERGY
COST/PERFORMANCE WORKSHOP
JANUARY 18-19, 1994

Workshop Participant	Organization	Mailing Address	Telephone	Facsimile
Spanard, Christine	NETAC	615 William Pitt Way Pittsburgh, PA 15238	(412) 826-5511	(412) 826-5552
Tann, James	Purus, Inc.	2713 North First Street San Jose, CA 95134	(408) 955-1000	(408) 955-1023
van Loben Sels, Chris	Natural Resources Defense Council	1350 New York Avenue, NW Washington, DC 20005	(202) 783-7800	(202) 783-5917
Voelker, Gary	U.S. Department of Energy EM-50	Trevion II Washington, DC 20585	(301) 903-7230	(301) 903-7618
Waite, David	Ebasco Environmental Nuclear & Mixed Waste Program	10900 NE 8th Street Bellevue, WA 98004	(206) 451-4611	(206) 451-4691