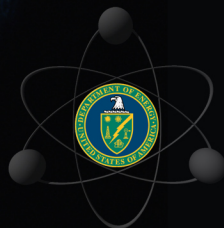


**U.S. Department of Energy
Office of Environmental Management**

**DOE/ID-10840
April 2001**

**Office of Science and Technology
Basic and Applied Research
Fiscal Years 2001–2005 Multiyear Program Plan**



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**OFFICE OF SCIENCE AND TECHNOLOGY -
BASIC AND APPLIED RESEARCH
FY 2001-2005 MULTIYEAR PROGRAM PLAN**

SIGNATURE PAGE



Approved by:
DOE-ID, Office of Research and Development, Yevgeny Macheret

Date: 4/3/01



Approved by:
Office of Basic and Applied Research, EM-52, Mark Gilbertson

Date: 4/2/01



Approved by:
Office of Science, Roland Hirsch

Date: 4/3/01



Approved by:
National Energy Technology Laboratory, Bob Bedick

Date: 4/6/01

CONTENTS

EXECUTIVE SUMMARY.....	1
1 PROGRAM BACKGROUND.....	3
1.1 PROBLEM DESCRIPTION.....	3
1.2 NEED FOR BASIC AND APPLIED RESEARCH.....	3
1.3 RESEARCH LINKED TO EM PROBLEM AREAS.....	4
1.4 MAJOR ACCOMPLISHMENTS.....	6
1.4.1 Environmental Management Science Program.....	6
1.4.2 Environmental Management Science Program Research Portfolio Distribution.....	7
1.4.3 Applied Research Accomplishments.....	7
2 VISION AND MISSION.....	9
2.1 THE BASIC AND APPLIED RESEARCH VISION.....	9
2.2 THE MISSION OF THE OFFICE OF BASIC AND APPLIED RESEARCH.....	9
2.2.1 Environmental Management Science Program Mission.....	9
2.2.2 Applied Research Mission.....	9
3 GOALS AND STRATEGIES.....	10
3.1 EM RESEARCH GOALS.....	10
3.2 DEPLOYMENT STRATEGY/TACTICS.....	10
3.3 RESEARCH NEEDS AND FUTURE SOLICITATIONS.....	10
3.3.1 Applied Research.....	10
3.3.2 Basic Research.....	12
3.4 STRATEGIES FOR DEVELOPMENT OF AREAS OF RESEARCH.....	12
3.4.1 Integration of Stakeholder Input.....	13
3.4.2 Use of Long-Term Research Agendas.....	13
3.4.3 Use of Advisory Groups.....	13
3.4.4 Science and Technology Roadmaps.....	14
3.5 INTEGRATION OF RESEARCH.....	14
3.5.1 Use of Workshops, Conferences, and Technical Review Meetings.....	14
3.5.2 Integration with Laboratory-Directed Research and Development.....	15
3.5.3 Leveraging the EM Lead-Laboratory Programs.....	15
3.5.4 Integration with Potential Research Users Outside EM.....	15
3.5.5 Integration with the Focus Area Lead Laboratories.....	16
3.6 BUDGET TABLES.....	16
4 TECHNICAL PROGRAM.....	17
4.1 BASIC RESEARCH TECHNICAL PROGRAM.....	18
4.2 APPLIED RESEARCH TECHNICAL PROGRAM.....	19
4.2.1 National Energy Technology Laboratory--Applied Research Calls.....	19
4.2.2 INEEL Activities as the EM National Laboratory.....	19
4.2.3 Industry Programs.....	20
4.2.4 University Programs.....	20
4.2.5 Small Business Innovative Research Program.....	21
4.2.6 Strategic Environmental Research and Development Program.....	21
4.2.7 Natural and Accelerated Bioremediation Research and Low Dose Radiation Programs.....	21
4.3 FY 2001 PROPOSED ACTIVITIES.....	21
4.3.1 Basic Research Activities.....	21
4.3.2 Applied Research Activities.....	22
4.4 COMMUNICATIONS.....	23

APPENDIX A: BASIC AND APPLIED RESEARCH KEY PERSONNEL/ORGANIZATIONA-1
APPENDIX B: MAJOR MILESTONES AND FY 2001 RESEARCH INTEGRATION ACTIVITIESB-1
ADDENDUM: FY 2001 ANNUAL PERFORMANCE PLAN.....APP-1

EXECUTIVE SUMMARY

The Department of Energy (DOE) Environmental Management (EM) Program is responsible for cleaning up the environmental problems resulting from the United States' nuclear weapons research and production. The estimated cost of this cleanup is more than \$150 billion dollars. DOE needs scientific and technical breakthroughs to reduce the cost, risk, and time to complete this cleanup. This document, the *Office of Basic and Applied Research Fiscal Year 2001-2005 Multiyear Program Plan (MYPP)*, describes some of the basic and applied research activities targeted at improving DOE's cleanup program.

The Office of Science and Technology

Within the EM program, the EM Office of Science and Technology (OST) focus areas are responsible for the science and technology investments that support cleanup. Investment in research provides information for technology development and a body of knowledge that enhances decision making on cleanup issues. The Office of Basic and Applied Research within OST has the mission of supporting the focus areas by investing in and coordinating the research needed by the EM program to reduce costs and cleanup risk.

The basic research area has two primary components. The majority of EM targeted basic research is funded through the Environmental Management Science Program (EMSP). The EMSP, initiated in 1996, has funded over 300 basic research projects, which are being conducted at 97 universities, 13 national laboratories, and 20 other governmental and private laboratories in 40 states and 8 countries. These projects have already resulted in 12 commercializations, 2 deployments, 12 field tests, and the transfer of 4 projects from basic research to applied research within the focus areas and crosscutting programs. These activities, coupled with the over 1,600 publications or presentations that report the research results to the scientific community, provide an outstanding opportunity to further DOE's cleanup efforts. The Laboratory-Directed Research and Development Program (LDRD) funds research at the various DOE National Laboratories. While LDRD funding is discretionary for each National Laboratory, the Office of Basic and Applied Research plays a coordinating role that supports integrating EM-funded LDRD into the EM program.

Many basic research projects have reached the stage where they are ready to become applied research, which can subsequently be tested at DOE cleanup sites. The applied research program focuses on specific solutions and is carried out primarily through the OST focus areas. Each focus area evaluates basic research for its potential to provide a solution to a cleanup problem. Basic research that shows promise moves into applied research or, in some cases, provides insight that leads to breakthroughs or improvements in technologies further along in the maturation cycle. For this reason some basic research skips the applied research phase and moves directly to actual technology development or field application. The National Energy Technology Laboratory (NETL) manages the focus area competitive proposal calls for applied research with the Industry and University Programs playing a significant role in this function.

Congress designated the Idaho National Engineering and Environmental Laboratory (INEEL) as the National Laboratory for environmental management. In this role, the INEEL is responsible for developing and coordinating enhancements of capabilities in subsurface and waste management science and transitioning basic research into the DOE national laboratory system. The INEEL also coordinates science and technology for long-term environmental stewardship within the DOE national laboratory system.

Office of Basic and Applied Research Goals and Outcomes

The goal of the Office of Basic and Applied Research is to provide research to meet high-priority cleanup needs. Funding for basic science will rise from \$37 million in 2001 to \$50 million in 2003 and remain constant for the next two years. The applied research budget grows steadily to support transition of basic research into technical development. In the next year, new research projects will focus on high-level waste and deactivation and decommissioning. Additional basic research to be funded in the outyears includes subsurface contamination, long-term stewardship, transuranic and mixed waste, and nuclear materials. Applied research new starts defined by the OST focus areas will address essential problems for each focus area. The products of the basic and applied research programs are as follows:

- Scientific solutions to EM cleanup issues – breakthrough alternatives to current cleanup baselines or better data for decision making
- Expanded knowledge in EM problem areas – embodied by increased peer-reviewed journal articles, refereed papers, etc., addressing EM cleanup issues
- Increased skills relevant to cleanup – increased numbers of researchers, graduate students, and commercial entities applying resources to EM problems.

Table ES-1. Basic and applied research outyear funding totals. *

Dollars in Millions	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Basic Research	\$37	\$40**	\$50	\$50	\$50
Applied Research	\$26	\$28	\$31	\$35	\$39

*Funding totals do not include LDRD or any focus area-applied research that is being conducted through the University and Industry Programs, managed by the National Energy Technology Laboratory.

** Based on Target Level, Planning Level is \$50.

1 PROGRAM BACKGROUND

1.1 Problem Description

In *Status Report on Paths to Closure* (hereinafter referred to as *Paths to Closure*), DOE estimates that cleanup of the weapons complex will cost approximately \$151–195 billion and take several decades to complete. The immensity of the cleanup effort in the face of decreasing federal funding accentuates the need for research to achieve cleanup within a reasonable time. EM funds basic research relevant to EM's cleanup mission. The Office of Basic and Applied Research develops research targeted toward the EM cleanup problem areas identified in the *EM Research and Development Program Plan* (November 1998).

“To reduce these [cleanup stewardship] costs and successfully address these long-term problems, investments in science and technology are critical. Life-cycle cost analysis is helping to focus some of the program’s science and technology investments. . . . More than two-thirds of the EM life-cycle cost estimate is expected to be incurred after 2006. . . . The long time frame for spending is a major reason for DOE’s continuing need to make science and technology investments that can reduce life-cycle costs.”

Status Report on Paths to Closure

1.2 Need for Basic and Applied Research

The EM program is responsible for cleanup and long-term stewardship of the environmental legacy of nuclear weapons research, production, and testing. These activities produced large quantities of radioactive and hazardous materials, resulting in contaminated facilities, groundwater, and soils at 113 sites across the country. EM manages some of the most complex and technically challenging cleanup issues in the world. The Office of Science and Technology established waste type specific focus areas to lead its science and technology initiatives. Targeted basic and applied research is necessary to support development of technologies to meet these challenges and to develop a body of knowledge to make better decisions regarding cleanup.

DOE groups the science and technology being developed to address EM cleanup into what is known as its Environmental Quality business line. Recent studies by independent groups of subject matter experts have concluded additional research is necessary. In September 2000, DOE issued a report titled *Adequacy Analysis of the Environmental Quality Research and Development Portfolio*. DOE chartered the Strategic Laboratory Council, representing the DOE national laboratory system, to lead this assessment to determine the adequacy of the portfolio to achieve the strategic goal and objectives of the Environmental Quality business line.

Recommendation 1 stated that “Additional R&D funding is warranted for priority investments. The highest priority areas are

- Environmental Restoration
- Managing High-Level Waste
- Deactivation/Decommissioning
- Long-Term Stewardship.”

Part of Recommendation 2 states that “Part of the R&D portfolio needs to focus on the long-term mission to provide fundamental information that will allow for better understanding and definition of larger more difficult problems that will not be solved in the next 5–10 years.”

In addition, recommendations by the National Research Council of the National Academy of Science in the recently published *Research Needs in Subsurface Science* states, “The committee concluded that

subsurface contamination is an enormously difficult problem that represents a potentially large future mortgage for the nation. This mortgage, however, could be reduced significantly through the development and application of new and improved technologies. The development of such technologies will require advances in basic understanding of the complex natural systems at DOE sites and the nature of the contaminants there.”

1.3 Research Linked to EM Problem Areas

The Office of Basic and Applied Research focuses research on the key EM problem areas defined in the *EM Research and Development Program Plan*. These problem areas are grouped by waste area, representing the scope of cleanup facing EM. Additional information on science linkages is available on the EMSP homepage at <http://emsp.doe.gov>. These areas are the basis for developing science and technology investments. The focus areas link both research and technology development to these problem areas. The research developed and managed by this office will address the following:

1. Environmental Restoration (including subsurface contamination and the vadose zone):

- Site characterization and predictive modeling
- Caps and barriers
- Fluid flow and contaminant transport
- Mineral surface physical processes
- Natural attenuation and bioremediation phenomena.

“The committee identified significant knowledge gaps in the following process steps...

- Location and characterization of subsurface contaminants and characterization of the subsurface
- Conceptual modeling
- Containment and stabilization
- Monitoring and validation.”

—National Academy of Science-
Research Needs in Subsurface Science, 2000

2. High-Level Waste:

- The box below identifies the current research needs reported in a study conducted by the National Academy of Sciences National Research Council.

“It is the judgement of the Committee that some HLW-related problems will require further research and development to minimize risk and program cost and to improve the effectiveness of cleanup. . . .

- Long-term issues relating to tank closure and characterization of surrounding areas...
- High-efficiency, high-throughput separation methods...
- Robust, high loading, immobilization methods and materials that provide enhancements or alternatives to current immobilization strategies...
- Innovative methods to achieve real-time, and, when practical in situ characterization data for HLW...”

—National Research Council- *Interim Report on Long Range High Level Waste Research Needs*,
November 2, 2000

3. Transuranic, Mixed, and Low-Level Waste:
 - Alternatives to incineration
 - Nondestructive characterization and monitoring
 - Research on development of new hydrogen getter technology
 - Biodegradation of mixed wastes.
4. Deactivation and Decommissioning:
 - Real time and in situ characterization and sensors
 - Remote systems, including robotics
 - Surface decontamination, size reduction, and solutions chemistry
 - Specific contaminants of interest include tritium, technetium-99, plutonium-239 and other actinides, beryllium, mercury, asbestos, and PCBs.

“The committee has identified, preliminarily, three areas where it feels present technology is inadequate and where it believes EMSP funded research could make significant contributions. These areas are characterization, decontamination, and remote systems.”

—National Research Council- Interim Report on Long Range D&D Research Needs,

December 5, 2000

5. Nuclear Material (Plutonium, Special Nuclear Materials):
 - Chemical and physical properties of actinides and radionuclides to support safe storage
 - Thermodynamics and kinetics of fissile metals.
6. Spent Nuclear Fuel:
 - Processes contributing to corrosion, degradation, and release
 - Better understanding of the behavior of long-lived radionuclides.
7. Another overarching area of concern is long-term stewardship—a relatively new category covering the activities taking place at closed DOE sites where unrestricted use is not possible. Areas of research in support of long-term stewardship are similar to site closure activities covered under the environmental restoration/subsurface problem area and include
 - Environmental sensors research
 - Containment research, including caps and performance validation
 - Characterization and modeling.
8. The Office of Basic and Applied Research also supports research in the area of health, ecology, and risk. Risk research areas include the effects of low-dose radiation and end-state issues, such as how clean is clean.

1.4 Major Accomplishments

1.4.1 Environmental Management Science Program

As the EMSP enters its fourth year, several indicators point to early success, including applications of research into the field to support cleanup. The program publishes accomplishments biannually in the EMSP Accomplishments Report.

The EMSP has funded over 300 basic research projects at 97 universities, 13 national laboratories, and 20 other governmental and private laboratories in 40 states and 8 countries. The first round of research awarded in 1996 is now complete. Many of these projects have generated sufficient technical data and identified specific, potential field applications to warrant movement into the applied R&D arena. A survey of EMSP accomplishments prepared by DOE-ID on a semi-annual basis (*Research Accomplishments for the Environmental Management Science Program*) identified the following general examples of EMSP leadership in the area of EM targeted basic research:

- Over 90 collaborations between researchers and end users at DOE sites or within industry
- Fourteen actual site deployments or commercializations
- Over 500 new undergraduate, graduate, and postgraduates focused on EM research needs
- Over 1500 published papers, journal articles, press releases, or presentations vastly expanding the current body of knowledge for EM cleanup issues.

EM-sponsored research is supporting cleanup operations at DOE sites. Research has influenced cleanup decisions positively at sites, including Idaho where a CERCLA Record of Decision was revised and cleanup costs were lowered. EMSP-sponsored research has lowered costs for worker protection at Fernald through a state-of-the-art personal and environmental exposure assessment instruments for measuring inhaled radionuclides that have been deployed for about 1 year. A new antifoam developed by the Illinois Institute of Technology, as the result of EMSP-sponsored research, is expected to be deployed at the Defense Waste Processing Facility at SRS. This material is also expected to have broad application in waste tank remediation throughout the DOE complex. EMSP-sponsored research is also supporting decisions regarding tank wastes at Savannah River. Research collaborations are ongoing with problem holders at numerous sites, including Hanford, Oak Ridge, Idaho, and Los Alamos. The National Spent Nuclear Fuel Program is also integrating EMSP research into its work.

Focus areas and crosscutting programs have already transitioned four basic research projects, started under the EMSP, into their applied research efforts. These projects include the demonstration of "Laboratory-on-a-Chip" by the Deactivation and Decommissioning Focus Area, demonstration of a miniature spectrometer for groundwater monitoring by the Subsurface Contamination Focus Area, and two separate demonstrations of Crown Ethers for Cesium Separation at the Savannah River Site and Oak Ridge National Laboratory by the Tanks Focus Area. This latter separation process has also been commercialized and shows great promise of becoming the technology of choice for cesium separation. As more research is transitioned into applied research and technology development, the Office of Basic and Applied Research anticipates significant positive impacts to risk, costs, and scheduled baselines. A recent independent review of the program identified 15 projects with the potential for achieving significantly lower costs and/or reduced risks for cleanup of the DOE complex. Other promising research areas include the following:

- Innovative research in the sensors and micro-sensor technology areas
- Advances in efficient separation of radionuclides from process waste streams

"The EM Science Program has a valuable role to play in this effort by improving the scientific basis for EM decision-making and building a solid foundation to develop new technologies."

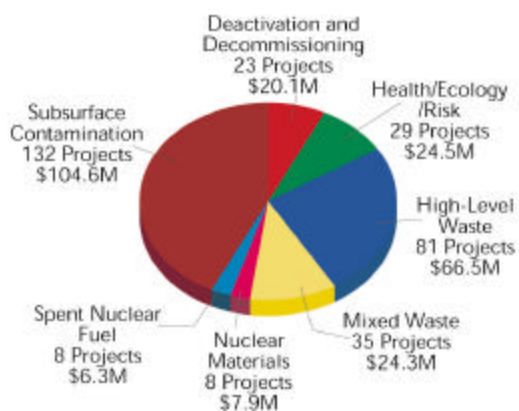
—EM Assistant Secretary
2nd EMSP National Workshop

- Collaborating with the EM national laboratory on new waste minimizing methods for surface decontamination
- Developing advanced real-time characterization methods for cleanup operations
- Corrosion research for the National Spent Nuclear Fuel Program
- Collaborations with Los Alamos on innovative tank waste treatment
- Integrating research with environmental restoration activities at Hanford
- Bioremediation and sensor technologies ready for field testing at Oak Ridge.

1.4.2 Environmental Management Science Program Research Portfolio Distribution

The charts below show problem areas and science category breakdowns for the EMSP portfolio.

Projects by Environmental Problem



Projects by Science Category

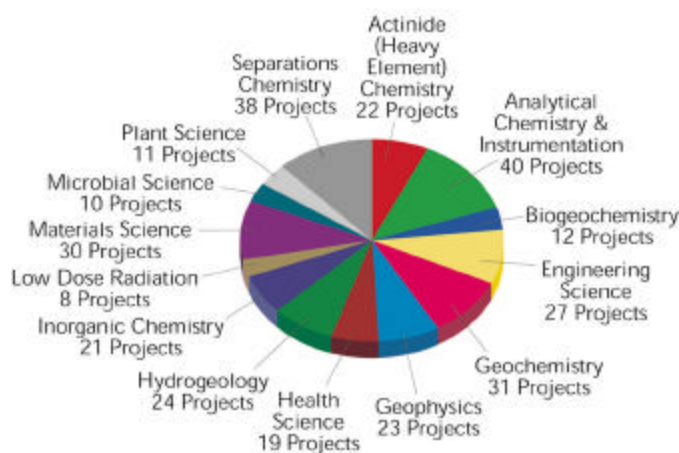


Figure 1. EMSP research project funding distributed by environmental problem and science category.

1.4.3 Applied Research Accomplishments

The applied research programs are relatively less mature than the basic research programs in terms of portfolio size and progress. The EM national laboratory functions commenced in 1999 under very little initial funding. Areas such as the focus area applied research and the science and technology components for long-term environmental stewardship are in their first year. Now that EM basic research is maturing, more emphasis is on applied research and technical maturation. The Environmental Systems and Research Analysis (ESRA) program (formerly known as the INEEL Verification and Validation [V&V] program) was initiated in 1998 to enhance research core capabilities in subsurface and waste management science. Although relatively new, applied research accomplishments have already made a significant impact in cleanup operations. Some examples are listed below:

- Specific successes of the ESRA program to date have primarily occurred in the characterization science element of the program. The Idaho National Engineering and Environmental Laboratory (INEEL) transuranic (TRU) waste management program is using new and improved gamma spectroscopy data produced by the program to enhance its effort to certify waste for the Waste Isolation Pilot Plant (WIPP). The research portfolio for the ESRA program has a Subsurface Science

activity that will include the following projects: *Meso-scale Investigations of Vadose Zone Carbon Cycles*; *“Next generation” Predictive Models of Vadose Zone Flow and Transport*; *Investigation of Interfacial Chemistry of Microorganisms*; *Spatial and Temporal Characterization of the Vadose Zone Interfacial Processes Controlling Fate and Mobility of Actinides, Fission Products, and Other Contaminants*; *Upscaling, Averaging, and Modeling of Coupled Subsurface Processes*; *Geomicrobiology of Subsurface Environments*; *Vadose Zone Roadmapping*. *The Waste Management Science portion of the ESRA portfolio includes the following tasks: Non-Destructive Assay Science and Systems, Nuclear Structure Data, Biocorrosion of Spent Nuclear Fuel.*

- The characterization science effort has refined artificial intelligence tools. These tools were combined with activities supported by the Transuranic and Mixed Waste Focus Area to produce an expert system for neutron counting data validation. This expert system was recently deployed for data validation of WIPP-bound waste.
- The Idaho Long-Term Stewardship Program recently issued its draft framework for a complex-wide science and technology roadmap.
- A draft DOE complex-wide vadose zone science and technology roadmap framework was developed and issued for review and comment.

In addition to the ESRA program for applied research the Office of Science and Technology also is a party to the Small Business Innovative Research (SBIR) Program and has an advisory role with respect to needs with the Laboratory-Directed Research and Development (LDRD) carried out by the national laboratories. In FY 1999, the EM related research under SBIR involved 36 projects in the areas of Environmental Management and Biological and Environmental Research. The FY 2001 SBIR program solicitation, covering 44 different areas of research and development, was made available on November 20, 2000. The two EM topics are:

- Monitoring of DOE Sites, Facilities, and Personnel
- Technologies for Transuranic and Mixed Waste Management

The LDRD programs at the national laboratories are investigating new methods for:

- Immobilizing heavy metal contaminants through the use of microbes to stimulate the growth of calcium carbonate crystals which preferentially attract heavy metals
- Building better absorbers for radionuclides and heavy metals in wastewater through improvements in the manufacturing processes for sorbent granules
- Improving the understanding of the behavior of underground water to facilitate groundwater and vadose zone cleanup
- Providing accurate real-time radiation detection to improve worker safety

2 VISION AND MISSION

EM was founded with a three-fold mission—manage waste processing from ongoing production activities, take stewardship of existing waste currently in storage from past weapons complex operations, and clean up environmental contamination. The Office of Science and Technology has charged its focus areas to develop new technologies where existing ones were deemed unsuitable, too costly, or to involve high degrees of risk. EM basic and applied research supports these missions by providing the scientific underpinning for decision support and technology development necessary to EM activities.

“Science and technology investments functioning as an integral part of the EM Programs will provide the scientific foundation, technical assistance, new approaches, and new technologies that bring about significant reductions in risk, cost, and schedule for completion of the EM mission. The strongest advocates of EM science and technology activities will be the EM cleanup project managers, regulatory agencies, and community groups.”

—Vision statement from the
*EM Strategic Plan for
Science and Technology*

2.1 The Basic and Applied Research Vision

EM-funded targeted research provides the scientific underpinning to support decision analysis or technology development that reduces risks, costs, or schedules for EM cleanup.

This vision includes developing research that feeds the EM technology maturity spectrum and advances new technologies to make environmental cleanup safer, faster, and cheaper. EM research also provides a database of knowledge that informs decisions regarding health and ecological risk, regulatory compliance, land use, and selection of cleanup technology.

2.2 The Mission of the Office of Basic and Applied Research

The Office of Basic and Applied Research is responsible for establishing, managing, and directing a targeted research agenda that addresses EM problems. Targeted research will provide transformational approaches that will significantly reduce both cleanup costs and risks to workers and the public. The Office of Basic and Applied Research must bridge the gap between broad fundamental research, such as that performed in the DOE Office of Science, and needs-driven applied technology required and supported by EM. Further, the Office will work to focus the nation’s science/research infrastructure on critical environmental management problems.

2.2.1 Environmental Management Science Program Mission

The mission of the EMSP is to develop and fund a targeted long-term basic research program that will result in transformational or breakthrough approaches for solving the Department’s environmental problems. The EMSP will support research that seeks scientific understanding leading to reduced remediation risks, costs, or schedules, and helping to solve currently intractable problems. The sites will use the understanding gained through EMSP-supported research to improve their cleanup efforts. Implementing these approaches will lead to reductions in cleanup costs, as well as reductions in risks to workers and the public.

2.2.2 Applied Research Mission

The applied research mission within the Office of Basic and Applied Research charter is to test the feasibility of new or innovative concepts and to encourage further focus area development of promising concepts, ideas, theories, and technologies.

3 GOALS AND STRATEGIES

3.1 EM Research Goals

The Office of Basic and Applied Research affects current cleanup baselines through the following goals:

- Solicit and support world-class basic research having potential to lead to significant improvements in understanding scientific principles and phenomena in areas of interest to the EM mission
- Validate existing technical solutions to complex problems
- Provide technical solutions where none currently exist
- Lead to reductions in risk, cost, or time
- Bridge the gap between basic research and technology development
- Focus more fundamental research on key EM cleanup issues
- Ensure continuity exists between research, technology development, and deployment.

“EM’s investment portfolio must provide a balance across a full spectrum of science and technology – research through deployment. The portfolio must also balance investments across each of the problem areas.”

—EM Research and Development Program Plan

3.2 Deployment Strategy/Tactics

Basic and applied research supports the EM cleanup mission by providing the focus areas’ research on key EM problems. The result is research that supports development of innovative cleanup technologies or adds to a body of knowledge for making cleanup decisions. This is accomplished by developing a diversified research portfolio based on EM science needs, linked through the focus areas to EM site cleanup problems, and integrated into EM through workshops, site visits, etc., to ensure that the research maintains relevancy. Future research areas are determined in conjunction with the focus areas. Priorities identified through the technical responses developed as part of the *Paths to Closure* planning and budget process drive future solicitation subject areas.

3.3 Research Needs and Future Solicitations

3.3.1 Applied Research

With the assistance of the focus areas, the Office of Basic and Applied Research has assembled a current list of basic and applied research needs. Table 1 lists applied research needs by focus area and the estimated fiscal year that the solicitation addressing the needs will occur. The implementation of the applied research program is carried out by the focus areas. The National Energy Technology Laboratory manages the applied science solicitations for the focus areas. The Web site with information on these calls for proposals is <http://www.netl.doe.gov/business.html>. Specific research topics for applied and basic research will be similar. These are general descriptions of research needs and will be used to support future program solicitations by both the Office of Basic and Applied Research and the focus areas.

Table 1. Focus Area-applied research needs.

FOCUS AREA	FY 2001	FY 2002	FY 2003	FY 2004
Nuclear Materials Focus Area	<ol style="list-style-type: none"> 1. Nuclear Isotopic Dilution of Highly Enriched Uranium by Dry Blending 2. SNF Remote Moisture Monitor 3. Standardized Spent Nuclear Fuel Packaging 	Consideration of Funding Remaining FY 2001 Proposals	<ol style="list-style-type: none"> 1. Capsule Integrity Assessment Method for Waste Encapsulation and Storage Facility (WESF) at Hanford 2. Cesium/Strontium Capsule Leak Detection System for WESF 	<ol style="list-style-type: none"> 1. Actinide Product and Waste Stabilization 2. Detect and Mitigate Microbial Induced Corrosion in Spent Nuclear Fuel Dry Storage Containers
Deactivation and Decommissioning Focus Area	<ol style="list-style-type: none"> 1. Next-Generation Decontamination Technologies 2. Characterization and Monitoring Technologies 3. Improved Size Reduction and Demolition Techniques 4. Worker Health and Safety Remote/Robotic Deployment and Manipulation Systems 	Consideration of Funding Remaining FY 2001 Proposals	<ol style="list-style-type: none"> 1. Tritium Removal by Laser Heating 2. Characterization of Liquids in Equipment (e.g., Tanks) and Pipes for CDI. 3. General Use Remote Tools that can Handle Small Items such as Pliers or Hooking to Rigging 	<ol style="list-style-type: none"> 1. Mercury Removal from Metal and Porous Surfaces 2. Decontamination of Small Components
Tanks Focus Area	<ol style="list-style-type: none"> 1. Higher Capacity Ion Exchange Materials 2. Characterization of Tank Solids and Immobilized Waste Forms without Dissolution 3. Waste Tank Leak Plugging and Repair 	Consideration of Funding Remaining FY 2001 Proposals	<ol style="list-style-type: none"> 1. Increase In Applicability/Efficiency of High-Level Waste Planning Tool 2. Tank Sludge and Supernatant Separations 	<ol style="list-style-type: none"> 1. Tank Supernatant Pretreatment 2. Technetium-99 Analysis in Hanford Tank Waste and Contaminated Tank Farm Areas
TRU/Mixed Waste Focus Area	<ol style="list-style-type: none"> 1. Characterization of Radionuclides and RCRA Materials in Remote Handled Waste Containers 2. Understanding Generation Mechanisms of Dioxins and Furans in Non-Thermal Treatment 3. Separation and Extraction of Plutonium in Transuranic Mixed Waste 4. Next Generation Hydrogen Gas Getters 5. Emissions Control and Monitoring for Thermal Treatment Facilities 	Consideration of Funding Remaining FY 2001 Proposals	<ol style="list-style-type: none"> 1. Characterization of Radionuclides in Remote Handled Waste Containers 2. Prediction of Long-Term Behavior Using Short-Term Performance Testing 3. Generation of Dioxins and Furans in Nonthermal Treatment Facilities 4. Separation and Extraction Decontamination (alternatives to incineration) of Organics in Transuranic and Mixed Waste 	<ol style="list-style-type: none"> 1. Development of New Hydrogen Getter Materials 2. Selection of Materials for Use in Extreme Conditions 3. Emissions Control and Monitoring for Non-Thermal Treatment Facilities 4. Generation of Dioxins and Furans in Thermal Treatment Facilities 5. Emissions Control and Monitoring for Thermal Treatment Facilities
Subsurface Contamination Focus Area	<ol style="list-style-type: none"> 1. Characterizing, Monitoring, Modeling and Analysis 2. Separations and Reactive Treatments in the Subsurface 3. Validation, Verification, and Long-term Monitoring of Contaminants and Treatment 	Consideration of Funding Remaining FY 2001 Proposals	<ol style="list-style-type: none"> 1. Alternative Sample Collection and Well Installation Technology that Eliminates or Significantly Reduces Aqueous or Nonaqueous Investigative Derived Waste 2. Detection, Handling, and Treatment of Pyrophoric Materials in Burial Grounds 3. Hydrologic Containment and Control 	<ol style="list-style-type: none"> 1. In Situ Treatment of TNT/RDX contaminated soil 2. Long-Term Monitoring Technologies

3.3.2 Basic Research

Funding available for future solicitations depends on both annual funding appropriations and the funding required to cover ongoing research. The FY 2000 solicitation was designed to support the maturing of some current EMSP basic research toward more applied research. As funding for applied research and exploratory development increases within the focus areas, solicitations will concentrate on open calls for targeted basic research. Current information on basic research calls for proposals is at <http://emsp.em.doe.gov>. Anticipated areas for future basic research include the following:

- *FY 2001: Deactivation and Decommissioning/High Level Waste.* These solicitations seek to build upon scientific foundations developed by the 1998 EMSP awards. Following the recommendations of the National Academy of Sciences, the subject areas include robotic/remote system, real-time characterization for both D&D and HLW, enhanced surface decontamination, high-efficiency, high-throughput HLW separations, robust high loading HLW immobilization, and long-term issues related to tank closure for HLW.
- *FY 2002: Subsurface Contamination/Vadose Zone/Long-Term Stewardship.* These calls will focus on targeted fundamental research such as characterization and monitoring, predictive modeling, and in situ treatment. These calls will be based on recommendations from the long-term stewardship research agenda in conjunction with the EM Lead Lab science and technology roadmap for long-term stewardship. These will likely focus on issues pertaining to enhanced characterization, modeling, containment, and verification capabilities
- *FY 2003 TRU and Mixed Waste/Long-Term Stewardship/Nuclear Materials.* The Transuranic and Mixed Waste Focus Area (TMFA) subject areas include alternatives to incineration and issues currently being addressed by a blue ribbon panel that will report in 2002. Long-Term Stewardship will continue to focus on enhanced characterization, modeling, containment, and verification capabilities and will include nuclear materials characterization/nondestructive examination and assay.
- *FY 2004: Deactivation and Decommissioning/High-Level Waste.* These calls for proposals will be open calls focusing on targeted fundamental research within the subject areas. Research areas will depend on findings generated by strategic planning tools and focus area input.
- *FY 2005: Subsurface Contamination/Vadose Zone/Long-Term Stewardship.* Specific subject areas will be determined later.

3.4 Strategies for Development of Areas of Research

Areas of research are identified by using an assortment of both internal and independent tools. This ensures that the program considers both shorter-term site operations compliance-type goals and longer term (5–10 years and longer) when developing a research agenda. This strategy ensures a balanced research portfolio that develops research within a timeframe applicable to EM issues.

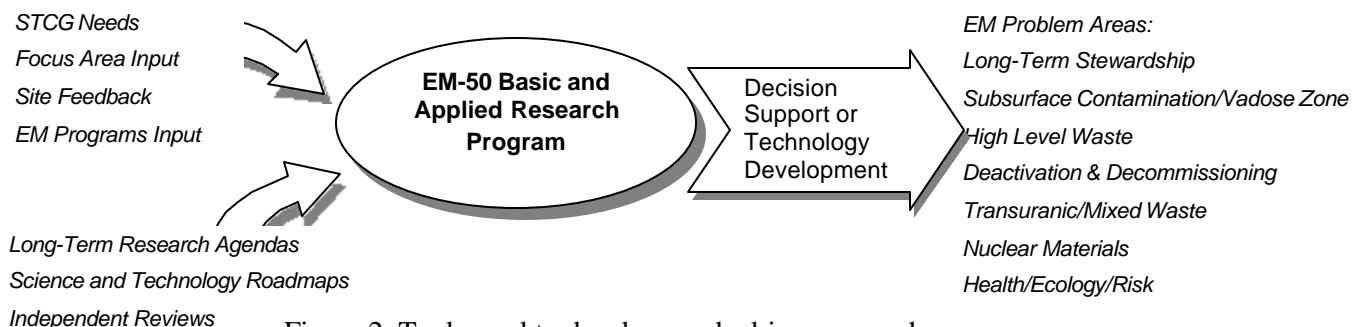


Figure 2. Tools used to develop needs-driven research

3.4.1 Integration of Stakeholder Input

Stakeholder groups support defining DOE site-specific and complex-wide research needs. Stakeholders also collaborate with the program to develop solicitations, evaluate research proposals, and work directly with researchers to focus on site-specific issues. These groups include the following:

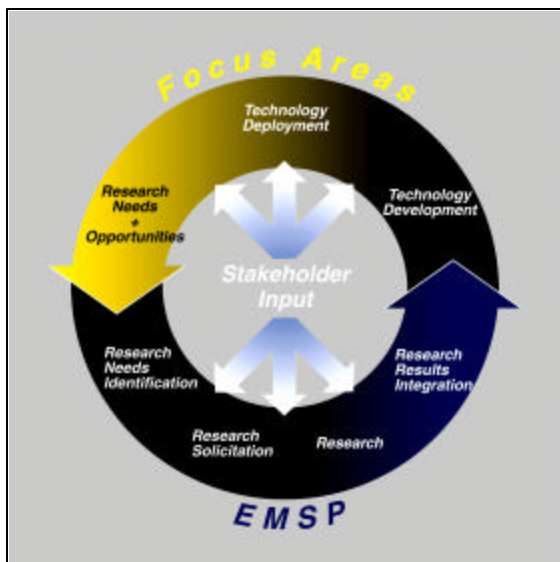


Figure 3. Stakeholder input is integrated throughout the R&D cycle.

- Site Technology Coordination Groups. These are site-specific organizations responsible for developing and managing site research and technology needs.
- Focus Areas. They link EMSP projects to the Department's ongoing waste management and cleanup programs.
- EM Crosscut Programs, such as the Characterization, Monitoring, and Sensor Technology and the Efficient Separations programs
- The Long-Term Stewardship Program.
- Potential users of research at DOE Sites.
- Congress has at times, specified areas of research for the EMSP to pursue.

3.4.2 Use of Long-Term Research Agendas

Long-term research agendas support identification of future basic research needs in the key EM problem areas. A committee of experts reviews a specific EM problem area and recommends a long-term basic research program to address the problem and develop agendas. The committees are made up of scientific advisors from outside the DOE-EM system who assess waste issues and provide recommendations from a more global, long-term perspective than might be achieved from more process or milestone focused site personnel. These independent peer recommendations are integrated with EM site-specific needs to support development of basic research portfolios that are both EM focused and far sighted enough for basic research to have an impact on risks, cost, and schedule.

The National Research Council of the National Academy of Sciences issued the first report titled *Research Needs in Subsurface Science* in the spring of 2000. Two additional efforts are currently underway. Committees are conducting reviews and assessments in the areas of high-level waste and site deactivation and decommissioning. Another agenda for long-term stewardship is planned as well.

3.4.3 Use of Advisory Groups

The Office of Basic and Applied Research will continue to use programmatic advisory groups to assess the direction and success of its programs. These groups have an independent peer perspective that brings insight and recommendations from inside and outside the DOE Complex. The following groups have been used in an advisory role by the Office of Basic and Applied Research in the past:

- The National Research Council advises the EMSP on issues. A committee was recently empanelled to assist the Office of Basic and Applied Research with developing the long-range science plans referenced above.
- The Environmental Management Advisory Board reviews and advises on the overall EMSP program.

- The Environmental Management Advisory Board Science Committee looks at the quality of research and the processes used to select the research, and offers recommendations.
- The Strategic Laboratory Council evaluates EMSP planning and execution in order to identify and recommend issues that require resolution to assure program relevance and successful utilization of research results.

3.4.4 Science and Technology Roadmaps

Science and technology roadmaps include identifying and planning future science and technology necessary to address key EM problem areas. Science and technology roadmaps are a formal process for defining a program strategy to focus on a particular problem area. Roadmaps focus on the vadose zone, high-level waste, and long-term environmental stewardship. These offer a basis for integrated EM programs to address each specific problem area. In general, roadmaps define the mission, goals, and requirements, and are a forum for reaching consensus, identifying and tying together program elements, and establishing a defensible basis for programs and research agendas. Current efforts underway at the INEEL include development of science and technology roadmaps that address the vadose zone and long-term environmental stewardship of DOE sites. The Pacific Northwest National Laboratory is developing a roadmap for remediating tank wastes.

“The primary goal of the vadose zone roadmap is to identify the science and technology research that will be needed over the next 25 years to better predict the fate and transport of contaminants in the vadose zone across the DOE Complex”

—Draft *DOE Complex-wide Vadose Zone Science and Technology Roadmap*

3.5 Integration of Research

Research integration is the term used to refer to activities designed to bring researchers and potential users of research together.

3.5.1 Use of Workshops, Conferences, and Technical Review Meetings

Workshops. Workshops are used to (a) transfer knowledge from the researcher to the end-user, (b) give researchers better understanding of the cleanup problems, (c) promote informational interchange among the researchers, and (d) increase public awareness of the EMSP. Workshops facilitate and promote the exchange of information among EMSP researchers, site problem holders, focus area/crosscutting representatives, and other interested end-users.

The EMSP holds a periodic national workshop that, in combination with other venues such as topical site problem-specific workshops, e.g., Richland vadose zone principal investigators meeting, and conferences, provides a comprehensive forum for information exchange. This national event includes participation by the EMSP researchers and numerous stakeholders from across the EM program.

Topical workshops establish and maintain lines of communication between EMSP researchers and potential end-users at a detailed level, which enhances the quality of the research for cleaning up legacy waste and other uses.

Professional Society Meetings. EMSP will sponsor symposia at appropriate established professional meetings. These symposia will focus on integration and communication among scientists and contribute to common research and development areas. EMSP will reach a broader audience of diverse scientific talent by collaborating with scientific professional organizations and offering greater diversity in information and interactions. The American Nuclear Society and the American Chemical Society are examples of two professional organizations that collaborate with the EMSP as a meeting sponsor.

Conferences. Attendance at conferences allows the EMSP to promote its funded research at selected meetings and stimulate interest in the EMSP.

Focus Area Reviews. The objective of integrating the EMSP into focus area reviews is to give researchers doing research pertinent to a particular focus area a better understanding of end-user needs and site problems. Dialogue between end-users and researchers promotes better understanding of how research results can apply to a particular area and develops a foundation with potential end-users to *pull* mature research toward technical development and deployment.

3.5.2 Integration with Laboratory-Directed Research and Development

Laboratory-directed research and development (LDRD) is research developed at DOE national laboratories. The Office of Basic and Applied Research works closely with the National Laboratories to ensure that collaborations with LDRD-funded research are identified and leveraged. The National Laboratories use discretionary funds to develop research supporting each individual laboratory's institutional plan. EM LDRD research targets many of the same problem areas as the Office of Basic and Applied Research and focus area-funded research. Research at the national laboratories will be coordinated with outside research when appropriate to work toward common goals. This coordination will be mainly through the ESRA program and EMSP research integration effort.

3.5.3 Leveraging the EM Lead-Laboratory Programs

The EM lead laboratory is developing and enhancing core capabilities in the areas of subsurface science and waste management science. The lead laboratory will work with researchers to integrate relevant research into the national laboratory system. This recognizes that some EM researchers do not desire to transition fundamental research into application. The lead laboratory will provide promising concepts and technologies for a path forward. Since the ESRA program is primarily aligned with EM needs identified by the Site Technology Coordination Groups and has the need to build and maintain core capabilities, projects will be selected based on relevance and consistency with the ESRA program. To facilitate this transfer, the laboratory will provide collaborative opportunities for postgraduate students, postdoctoral positions, and summer fellowships.

3.5.4 Integration with Potential Research Users Outside EM

There are several programs outside EM and DOE that have many of the same research needs. The Office of Basic and Applied Research has identified and targeted these as potential users for EM-funded research. Regular communication and close cooperation between these research programs offers a broad national base to address EM issues. Integration with other environmental research supports collaborative, non-duplicative research.

Examples of relevant research programs conducted by DOE and other agencies include the following:

- The Office of Civilian Radioactive Waste Management (OCRWM), responsible for managing the safe storage and ultimate disposal of the nation's commercial spent nuclear fuel
- Natural and Accelerated Bioremediation Research Program (NABIR), sponsored by DOE-SC to increase understanding and use of contaminant bioremediation processes
- Nuclear Energy Research Initiative (NERI), sponsored by DOE's Office of Nuclear Energy to help overcome technical and scientific obstacles to future nuclear energy use
- Small Business Innovative Research (SBIR), managed by DOE-SC, whose topics include those outside EM to increase private sector commercialization of federally funded technologies

- The Strategic Environmental Research and Development Program (SERDP), the Department of Defense's (DOD's) corporate environmental R&D program, which is planned and executed in full partnership with DOE and the Environmental Protection Agency
- DOE Office of Science Low Dose Radiation Research Program, which supports research to determine whether low-dose and low-dose-rate radiation presents a health risk to human health and the environment.

3.5.5 Integration with the Focus Area Lead Laboratories

Each focus area has designated a lead laboratory to coordinate science and technology research and development, as identified below. The Office of Basic and Applied Research works with lead laboratory personnel to identify areas of collaboration for research, information exchange, and project direction.

<u>National Laboratory</u>	<u>Focus Area</u>
Pacific Northwest National Laboratory	Tanks Focus Area
Idaho National Engineering and Environmental Laboratory	TRU/Mixed Waste Focus Area
Los Alamos National Laboratory	Nuclear Materials Focus Area
Savannah River Technology Center	Subsurface Contamination Focus Area
National Energy Technology Laboratory	Deactivation and Decommission Focus Area

3.6 Budget Tables

Table 2. EM Basic Research Funding.

EMSP Basic Research Funding Levels by Fiscal Year* (dollars in thousands)					
	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
FY 1998 Awards D&D, HLW	6,700				
FY 1999 Subcon/Low Dose	10,677	5,500			
FY 2000 Renewals from 1996 and 1997 Awards	7,200	12,500	6,000		
FY 2001 D&D, HLW	9,898	9,400	12,000	5,000	
FY 2002 New Awards, e.g., Subcon/Vadose Zone, Long-Term Stewardship		10,000	10,750	13,000	5,000
FY 2003 New Awards, e.g., Nuclear Materials, TRU/Mixed Waste, Long-Term Stewardship			18,000	18,750	20,750
FY 2004 New Awards, e.g., D&D/HLW				10,000	11,000
FY 2005 New Awards, e.g., Subcon/Vadose Zone, Long-Term Stewardship					10,000
Small-Business Innovative Research**	925	1,000	1,250	1,250	1,250
Integration and Management	1,519	1,600	2,000	2,000	2,000
TOTALS	36,919	40,000	50,000	50,000	50,000

*Does not reflect LDRD funding

**EMSP SBIR funding only. EM selects two research topics and funds are transferred to the Office of Science for technology development awards. See Table 3 for the technology development SBIR funding.

Table 3. EM Applied Research Funding.

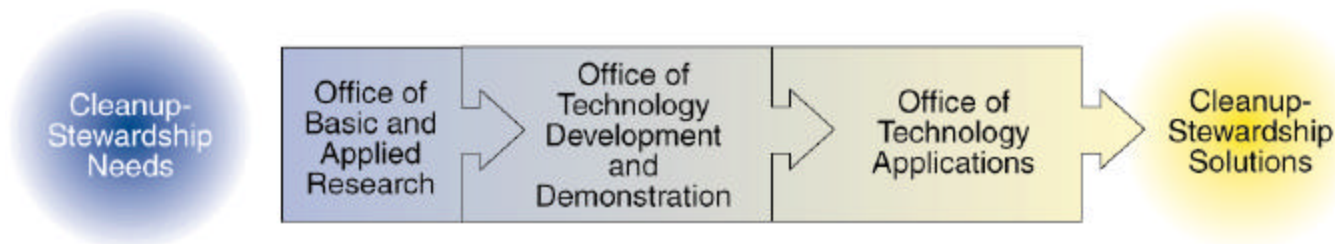
Applied Research* (dollars in thousands)	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
INEEL Environmental Systems Research and Analysis Program	21,000	21,000	21,000	21,000	21,000
ID Long-Term Stewardship Program	4,000	4,000	4,000	4,000	4,000
EM Lead Laboratory Initiatives	0	0	1,000	3,000	5,000
Focus Areas' Applied Research	5,000	20,000	20,000	20,000	20,000
EM Small Business Innovative Research**	3,723	1,500	1,500	1,500	1,500
TOTALS	33,723	46,500	47,500	49,500	51,500

* Does not include any applied research that is being conducted by the focus areas through the Industry and University Programs being managed by the National Energy Technology Laboratory.

** EM selects two research topics and funds are transferred to the Office of Science for technology development awards. See Table 2 for separate EMSP SBIR funding.

4 TECHNICAL PROGRAM

EM research and development programmatic activities are assigned to the Offices of Basic and Applied Research, Technology Development and Demonstration, and Technology Applications. These offices have joint responsibility to coordinate research, development, and deployment investments for EM. The Figure 4 presents the technology maturity cycle and EM's historical investments in science and technology. EM emphasizes completion of each phase of science and technology maturation and transitioning research activities through to the focus areas for use or further development. There are occasions where the steps in the process are bypassed and basic or applied research projects move directly to application. EM uses a focus area-centered approach that vests the authority and responsibility to plan and execute research and development programs with the focus areas. The Office of Basic and Applied research supports the focus areas by developing and managing a research portfolio that meets each focus area's science needs.

**Figure 4.** Team approach for managing technology development and maturation.

4.1 Basic Research Technical Program

The EMSP is a partnership between the DOE Office of Environmental Management (DOE-EM) and the DOE Office of Science (DOE-SC) and makes up the majority of EM's basic research investments. Researchers from DOE laboratories, governmental and private laboratories, universities, research institutions, and industries from around the world conduct the targeted research.

The Department's Idaho Operations Office (ID) administers, manages, and coordinates the award of research grants and supports research integration/research transfer and communications. The Office of Scientific and Technical Information (OSTI) manages communications products such as the Web page, Environmental Science Network, and the Enviro-Sciences e-Print Service. The Savannah River Operations Office and the Richland Operations Office have made significant contributions to the program's management.

The EMSP has seven functional elements: Project Management, Research Needs and Opportunities, Research Solicitation, Project Research, Portfolio Management and Analysis, Research Integration, and Communications. Briefly, the major elements are as follows:

- *Project Management* – supports development of strategic policy for EMSP and plans and administers the key EMSP processes so as to have a defensible basis for program activities
- *Research Needs and Opportunities* – identifies and prioritizes research needs and opportunities of DOE sites, EM focus areas and crosscutting programs, and other existing sources of information for input to EMSP solicitations, research integration, and other processes
- *Research Solicitation* – ensures that procedures are followed for contracting and distributing award funds, supports the development of policy for EMSP project continuation, and performs procurement services for EMSP projects (see Figure 5)
- *Project Research* – performs the actual research, either by universities, national laboratories, or private entities
- *Portfolio Management and Analysis* – collects and maintains information on the EMSP portfolio of research projects in order to provide pertinent information to other organizations and to perform analysis as needed to meet program requirements
- *Research Integration* – ensures that the results of EMSP research will be transferred, communicated, and incorporated into the ongoing technology development programs of the focus areas, crosscutting programs, and cleanup activities of DOE sites
- *Communications* – ensures that research results and information about the program is communicated to the appropriate party, such as focus areas, potential end-users, and stakeholders.

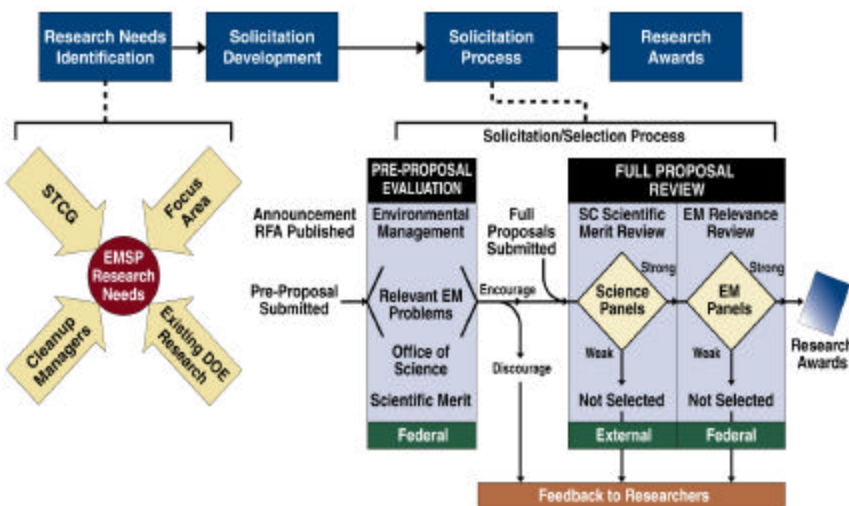


Figure 5. The research solicitation process.

4.2 Applied Research Technical Program

The FY 1995 Research, Development, and Deployment portfolio for the Office of Science and Technology was weighted more heavily in the advanced and engineering development areas, and demonstration and deployment areas with lower investment in applied research and exploratory development. The focus was on technology demonstration and deployment. Historically, most of the funding went toward the technology development and deployment end of the technology maturation cycle. One response to provide more balance across the research and development spectrum was to initiate the Environmental Management Science Program. This still left a gap or valley in resources applied to exploratory development and applied research, key areas of technology development.

Two program areas move research further along the technology maturity path. The National Energy Technology Laboratory manages applied research, development, and demonstration projects that directly support the focus areas in obtaining the participation of private industry and universities to solve EM's environmental problems. As the EM national laboratory, the INEEL is also responsible for transitioning basic research into the DOE national laboratory system.

Many of the basic science projects have achieved results that have proven to be of value to the EM cleanup mission, when applied to specific site problems or used in deployable technologies. The research has generated sufficient technical data and may have identified specific, potential field applications to warrant movement into the applied R&D arena (Gate 2 and beyond). Each of the focus areas has followed these basic research efforts and has made determinations of the applicability of the studies to resolve DOE-EM problem sets and transition EMSP projects into the applied research and development arena.

4.2.1 National Energy Technology Laboratory--Applied Research Calls

FY 2001 and FY 2002 budget planning by each of the focus areas began to identify applied research activities based on longer-term site needs and technology gap analyses. The Strategic Laboratory Council's *Adequacy Analysis of the Environmental Quality Research and Development Portfolio*, the National Research Council's subsurface science research needs assessments and future assessments for deactivation and decommissioning, and high-level waste, and Richland's vadose zone research all identify longer-term research needs. Additional independent technology assessments are being conducted on alternative technologies to incineration for mixed transuranic and alpha low level waste.

NETL is working with the focus areas and DOE sites to establish accurate statements of needs and requirements for applied research studies. Applied research and development solicitations address the requirements identified by the focus areas, based on their evolving long-term research agenda. It is anticipated that these requirements will take into consideration the broad applied research and development needs identified through technology gap analyses, independent studies, and problems to be resolved within 3 to 5 years and beyond. Information is available at <http://netl.doe.gov>.

4.2.2 INEEL Activities as the EM National Laboratory

Congress designated the INEEL as the Center of Excellence for Environmental Stewardship for the Department of Energy in 1999. Under this designation, the INEEL was to serve as a neutral forum to develop scientific solutions for long-term stewardship. The INEEL is also the National Laboratory for DOE-EM. It works within the DOE-EM system of laboratories to coordinate research on and develop appropriate and systematic approaches to long-term stewardship and subsurface science, and the specific tools and mechanism necessary to implement approaches for EM cleanup.

In 1998, the INEEL initiated the Validation and Verification Program, which is now referred to as the ESRA program. The program comprises three distinct activities: (1) environmental systems research,

(2) EM integration, and (3) complex-wide science and technology integration. The Environmental Systems Research activity is looking forward in EM's mission and laying the groundwork for technical foundations to solve EM's future problems. The program focuses on subsurface and waste management science. Under subsurface science, the areas are fluid flow, biogeochemistry, and characterization/monitoring. Under waste management sciences, the areas are spent nuclear fuel biocorrosion studies and transuranic waste characterizations.

The second program element in the ESRA program is EM Integration. EM Integration activities have been successful in developing roadmaps that detail EM complex-wide waste management processes for waste disposition. The EM integration activity has supported management of nuclear materials, stabilization actions and low-level waste facility review.

Complex-wide science and technology integration is technical support to DOE Headquarters in Washington D.C.

Promising concepts need to demonstrate they can function under field conditions. The INEEL coordinates focused problem-driven research across the EM national laboratories using realistic conditions to reduce the technological risk of promising novel concepts and to demonstrate practical feasibility. This focused research results in promising concepts being developed into prospective technologies for solution of critical EM problems.

4.2.3 Industry Programs

Industry Programs foster private sector companies to develop, demonstrate, and deploy cost-effective technologies to solve problems at DOE sites. The program assists private sector companies, including small businesses, universities, and not-for-profit institutions and industry to penetrate the DOE market with their technology solutions and services. The Industry Programs philosophy seeks technology development by the private sector to apply and market technologies to both DOE and non-DOE concerns. To affect these results, Industry Programs primarily implements competitively procured Government contracts and financial assistance agreements in partnership with the focus areas.

The scope of Industry Programs includes management of projects from applied research through the demonstration stage of technology development. This process of technology development requires continued partnership between NETL, the R&D contractor, focus area technical personnel, and DOE site personnel. Historically, many of Industry Programs' projects initiated at the applied research and exploratory development stages of technology development. The procurement vehicles most applicable to contracting with the private sector to conduct applied research for OST are the Broad Agency Announcement and the Program Research and Development Announcement. Since 1992, NETL has issued seven such competitive procurements, resulting in over 120 research and development projects and 50 technology deployments. Information on Industry Programs may be accessed through the NETL website at <http://www.netl.gov>.

4.2.4 University Programs

The mission of the University Programs is to achieve a balanced program for technology development using the intellectual expertise available from universities. Cooperative agreements with universities and academic institutions for value-added intellectual and analytical assistance do this. The focus is on technical assistance and applied research and development to assist private sector companies deliver technologies to meet EM requirements.

The University Programs work with selected universities and academic institutions through Financial Assistance Cooperative Agreements or Grants. University Programs provide value-added intellectual and analytical assistance. Information on the University Programs may be accessed through the NETL web site at <http://www.netl.doe.gov>.

4.2.5 Small Business Innovative Research Program

Each year the Department of Energy issues a collective call for proposals for the Small Business Innovative Research Program. The awards are divided into Phase I and Phase II awards: feasibility studies and development activity. Seventeen Phase I and five Phase II awards were granted. The National Energy Technology Laboratory monitors the results of the research on an on-going basis and invites appropriate projects to participate in workshops designed to inform users of technology availability. The SBIR web site is at <http://sbir.er.doe.gov/sbir>.

The SBIR program at the Department of Energy satisfies the following objectives:

- Obtain high quality scientific and technological research that enables the Department to fulfill its scientific mission.
- Provide high quality, on-time service to the performers of this research, namely the U.S. high-technology small business community.

4.2.6 Strategic Environmental Research and Development Program

Each year the Office of Science and Technology supports or announces interest in receiving applications for environmental research sponsored outside EM. An example of these programs is the Strategic Environmental Research and Development Program (SERDP). SERDP is a joint program between the Departments of Energy and Defense and the Environmental Protection Agency. The web site for SERDP is <http://www.serdp.com>.

SERDP projects focus on Department of Defense (DoD) and Department of Energy (DOE) needs in four areas.

- Cleanup
- Compliance
- Pollution Prevention
- Conservation

4.2.7 Natural and Accelerated Bioremediation Research and Low Dose Radiation Programs

The Office of Science and Technology's Office of Biological and Environmental Research coordinates the Natural and Accelerated Bioremediation Research (NABIR) and Low Dose Radiation Programs. NABIR provides the scientific understanding needed to use natural processes and to develop methods to accelerate these processes for the bioremediation of contaminated soils, sediments, and groundwater at DOE facilities. More information on NABIR is at <http://www.lbl.gov/NABIR/>. The Low Dose Radiation Research Program supports research to determine whether low-dose and low-dose-rate radiation presents a health risk to people. This information is an important determinant in decisions made to protect people from adverse health risks from exposure to radiation. More information is available at <http://www.er.doe.gov/production/ober/lowdose.html>.

4.3 FY 2001 Proposed Activities

4.3.1 Basic Research Activities

Activities that will be occurring over the next year include the following:

1. Identification and development of research needs and opportunities by working with Site Technology Coordination Groups and focus areas, and support of focus areas during development of research technical responses for the paths to closure IPABS-IS data call
2. Development of FY 2002 solicitations for high-level waste and deactivation and decommissioning, and the selection of research by strategic planning for further portfolio development based on identified research needs

3. Management, monitoring, and analysis of the research portfolio through
 - Grant administration activities
 - Refinement of the Multiyear Program Plan and communications plan
 - Support for internal and external program reviews
4. Transition of mature research toward use or further technical development by
 - Topical workshops to be determined with the focus areas
 - Project advocacy for transfer of appropriate mature research to focus areas, crosscutting programs, industry, or other research sources
 - Participation in focus area mid-year reviews, site needs collection visits, and technical response meetings
5. Refinement of the Monitoring Research Needs for the Long-Term Stewardship Roadmap
6. Preliminary planning for the Third EMSP National Workshop
7. Completion of long-term research agendas for high-level waste and deactivation and decommissioning, and preliminary planning of long-term research agendas for TRU/Mixed Waste, Nuclear Materials, or Long-Term Stewardship
8. Enhancement of program visibility and communication of research results (see Section 4.4)
9. Continuation of ongoing LDRD research and a solicitation for additional research with a focus on subsurface sciences to capitalize on and augmenting the work within the ESRA program.

4.3.2 Applied Research Activities

Applied research over the next year includes the following:

1. National Energy Technology Laboratory calls for proposals for each focus area for applied research. These calls will appear in the *Commerce Business Daily* and will be available at <http://www.netl.doe.gov/business/solicit/index.html>.
2. Continued expansion of ESRA program capability product line research activities in topics relevant to subsurface transport, including fluid flow, biogeochemical reactions, and characterization and monitoring.
3. Restructure of ESRA program waste management science activities, reflecting changing EM fundamental science priorities, progress on successful research topics, and response to specific congressional direction. This will include nondestructive examination and nondestructive assay.
4. Planning for enhanced ESRA program studies in separations, in situ calcine characterization, and super critical fluid treatment.
5. Initial planning to enhance ESRA program and EMSP integration to incorporate and transition EMSP basic research through collaboration with EMSP principal investigators.
6. Finalizing the INEEL vadose zone roadmap framework.
7. Initiating the Long-Term Stewardship product line. The draft complex wide science and technology roadmap will be completed as well.
8. Issuance of findings from the Blue Ribbon Panel on Alternatives to Incineration as a basis to support research agenda development.

9. SBIR solicitation issued November 20, 2000 covering the areas of Monitoring of DOE Sites, Facilities, and Personnel and Technologies for Transuranic and Mixed Waste Management. Awards expected near the end of FY 2001.

4.4 Communications

Communications will support efforts to transfer research to others and will be considered in every aspect of the operation and management of this program. Use of communication tools enhances the Office of Basic and Applied Research's ability to both develop and transfer quality research. Current communication tools include:

1. Peer-reviewed scientific literature – Journal articles and papers developed by Office of Basic and Applied Research scientists/researchers.
2. Environmental Management Science Program (EMSP) Web Page – Searchable database of EMSP funded projects: <http://emsp.em.doe.gov>.
3. Focus Area Liaison Support – These are activities to promote good will and research cooperation between focus areas and the Office of Basic and Applied Research at all levels (management through staff).
4. Publications/Press – Press releases and articles prepared promoting promising research results and highlighting specific research projects. This enhances awareness of the types of programs and research that the Office of Basic and Applied Research sponsors.
5. Contributions/Inserts to Initiatives – Articles and/or inserts prepared for publication in Initiatives and subsequent distribution via existing channels to Office of Science and Technology audiences.
6. EMSP Annual Report – An annual status report prepared similar to the focus area annual reports, but aimed more at reporting on progress made and planned activities for the next year.
7. Exhibit Support – Exhibits prepared and staffed for selected meetings and conferences to promote the Office of Basic and Applied Research to other EM Programs and the greater scientific community.
8. Communications Plan – A comprehensive communications plan prepared and updated that offers guidance for developing all aspects of EMSP communications.
9. Research Accomplishments Report – A biannual report that captures EMSP research accomplishments, including publications, peer-reviewed papers, the number of graduate students involved, collaborations, and transfer of research results for use or further development.
10. Research Project Data Management – The management and archival of data produced by individual research projects performed by the Office of Scientific and Technical Information (OSTI). These data include project final reports, peer-reviewed papers, and recommendations for future research. OSTI functions as both a repository and library for this information.
11. e-Print Server - The Enviro-Science e-Print Service is a joint project of DOE's Environmental Management Science Program (EMSP), the U.S. EPA Office of Research and Development, and DoD's Strategic Environmental Research and Development Program (SERDP) and Environmental

**“If you don’t
do *communication*
RIGHT,
nothing else
you do matters.”**

Gerald Boyd
Deputy Assistant Secretary
Office of Science and Technology
at the Communication Working Group Meeting
August 2000

Security Technology Certification Program (ESTCP). It uses EPA's Environmental Information Management System to collect, store, and access published and unpublished manuscripts, conference papers, presentations, and posters. This system does not include formal technical reports, which are available through DOE's *InformationBridge*.

**APPENDIX A: BASIC AND APPLIED RESEARCH KEY
PERSONNEL/ORGANIZATION**

EM Science Program – Headquarters

Provides policy and programmatic support of the EM Science Program, including leading Request for Applications of research needs, ensuring research has application to DOE cleanup problems, and ensuring results are communicated to cleanup personnel.

Mark Gilbertson - Director

US Department of Energy
Office of Basic & Applied Research, Room 3E066
1000 Independence Ave., SW
Washington, DC 20585
Ph: 202/586-7150
Fx: 202/586-1492
Email: mark.gilbertson@em.doe.gov

Justine Alchowiak

US Department of Energy
Office of Basic & Applied Research, Room 3E066
1000 Independence Ave., SW
Washington, DC 20585
Ph: 202/586-4629
Fx: 202/586-1492
Email: justine.alchowiak@em.doe.gov

Arnold Gritzke

US Department of Energy
Office of Basic and Applied Research, Room 3E066
1000 Independence Ave., SW
Washington, DC 20585
Ph: 202/586-3957
Fx: 202/586-1492
Email: arnold.gritzke@em.doe.gov

Ker-Chi Chang

US Department of Energy
Office of Basic & Applied Research
19901 Germantown Rd
Germantown, MD 20874
Ph: 301/903-1383
Fx: 301/903-9770
Email: ker-chi.chang@em.doe.gov

Beth Moore

US Department of Energy
Office of Basic and Applied Research, Room 3E066
1000 Independence Ave., SW
Washington, DC 20585
Ph: 202/586-6334
Fx: 202/586-1492
Email: beth.moore@em.doe.gov

Chester Miller

US Department of Energy
Office of Basic and Applied Research, Room 3E066
1000 Independence Ave., SW
Washington, DC 20585
Ph: 202/586-3952
Fx: 202/586-1492
Email: chester.miller@em.doe.gov

Dan Lillian

US Department of Energy
Office of Basic & Applied Research
19901 Germantown Rd
Germantown, MD 20874
Ph: 301/903-7944
Fx: 301/903-1530
Email: Daniel.Lillian@em.doe.gov

Stephen Lien

US Department of Energy
Office of Basic & Applied Research
1000 Independence Ave., SW
Washington, DC 20585
Ph: 202/586-0438
Fx: 202/586-1492
Email: stephen.lien@em.doe.gov

Office of Science

Manages the Request for Applications of research applications, the scientific review process, and technical management of the research program.

Roland Hirsch

Medical Sciences Division
Office of Biological & Environmental Research
U.S. Department of Energy, SC-73
19901 Germantown Road
Germantown, MD 20874-1290
Ph: 301/903-9009
Fx: 301/903-0567
Email: roland.hirsch@science.doe.gov

Larry James

Medical Sciences Division
Office of Biological & Environmental Research
U.S. Department of Energy, SC-73
19901 Germantown Road
Germantown, MD 20874-1290
Ph: 301/903-7481
Fx: 301/903-0567
Email: larry.james@science.doe.gov

David Thomassen

Life Sciences Division
Office of Biological & Environmental Research
U.S. Department of Energy, SC-72
19901 Germantown Road
Germantown, MD 20874-1290
Ph: 301/903-9817
Fx: 301/903-8521
Email: david.thomassen@science.doe.gov

William Millman

Chemical Sciences Division
Office of Basic Energy Sciences
U.S. Department of Energy, SC-14
19901 Germantown Road
Germantown, MD 20874-1290
Ph: 301/903-5805
Fx: 301/903-4110
Email: william.millman@eor.doe.gov

Richard Gordon

Chemical Sciences Division
Office of Basic Energy Sciences
U.S. Department of Energy, SC-14
19901 Germantown Road
Germantown, MD 20874-1290
Ph: 301/903-8014
Fx: 301/903-4110
Email: richard.gordon@eor.doe.gov

Nicholas Woodward

Engineering and Geosciences Division
Office of Basic Energy Sciences
U.S. Department of Energy, SC-15
19901 Germantown Road
Germantown, MD 20874-1290
Ph: 301/903-4061
Fx: 301/903-0271
Email: nick.woodward@science.doe.gov

Office of Scientific and Technical Information

David Henderson

Department of Energy
Office of Scientific and Technical Information
175 Oak Ridge Turnpike
Oak Ridge, TN 37830
Ph: 423/576-4665
Fx: 423/576-5870
Email: david.henderson@ccmail.osti.gov

EM Science Program - INEEL EM Science Program - INEEL

Provides assistance to the EM Science Program in conducting needs analysis, financial management and procurement, and serves as interface with focus areas, Crosscutting Programs, and other DOE field offices.

Yevgeny Macheret - Lead

Department of Energy
Idaho Operations Office
850 Energy Drive
MS 1225
Idaho Falls, ID 83402
Ph: 208/526-2708
Fx: 208/526-5964
Email: machery@id.doe.gov

Jose Elizondo

Department of Energy
Idaho Operations Office
850 Energy Dr.
MS 1225
Idaho Falls, ID 83402
Ph: 208/526-0965
Fx: 208/526-7246
Email: elizojl@id.doe.gov

Sue Whited

Department of Energy
Idaho Operations Office
850 Energy Dr.
MS 1225
Idaho Falls, ID 83402
Ph: 208/526-5546
Fx: 208/526-5964
Email: whitedbs@id.doe.gov

Walter J. Mings

Department of Energy
Idaho Operations Office
850 Energy Dr.
MS 1225
Idaho Falls, ID 83402
Ph: 208/526-6668
Fx: 208/526-7246
Email: mingswj@inel.gov

Savannah River EMSP Contact

Patrick R. Jackson
Department of Energy
Savannah River Operations Office
Road 1
Aiken, SC 29801
Ph: (803) 725-1425
Email: patrick.jackson@srs.gov

Richland Operations Office Contact

James Hanson
DOE Richland Operations
Room: 1628 Building: EESB
Richland WA 99352
Mail Stop: K8-50
Phone: 509-372-4503
E-mail: james_p_hanson@rl.doe.gov

Focus Area Contacts:

Subsurface Contamination Focus Area

Terry Dyches
Department of Energy
Savannah River Operations Office
Road 1
Aiken, SC 29801
Ph: (803) 725-4231
Email: terrell.dyches@srs.gov

Tanks Focus Area

Ted Pietrock
Richland Operations Office
PO Box 550, MS: K8-50
Richland, WA 99352
Ph (509) 372-4546
Email: theodore_p_pietrock@rl.doe.gov

Deactivation and Decommissioning Focus Area

Harold Shoemaker
DOE- National Energy Technology Laboratory
Room: D06 Building: MGN
Morgantown WV
Ph: (304) 285-4715
E-mail: hshoem@netl.doe.gov

Transuranic/Mixed/Low Level Waste Focus Area

Bill Owca
Department of Energy
Idaho Operations Office
850 Energy Drive
Idaho Falls, ID 83402
Ph: (208) 526-1983
Email: owcawa@id.doe.gov

Nuclear Materials Focus Areas

Ken Osborne
Department of Energy
Idaho Operations Office
850 Energy Drive
Idaho Falls, ID 83402
Ph: (208) 526-0805
E-mail: osbornk@id.doe.gov

University and Industry Programs

Robert C Bedick
DOE-National Energy Technology Laboratory
Room: E02 Building: MGN
Morgantown WV
Ph: 304-285-4505
E-mail: RBEDIC@NETL.DOE.GOV

EM Lead Laboratory Points of Contact:

Long-Term Stewardship Science and Technology

Bryan Bowser
Department of Energy
Idaho Operations Office
850 Energy Drive
Idaho Falls, ID 83402
Ph: (208) 526-1910
E-mail: bowserbj@id.doe.gov

Environmental Systems and Research Analysis Program

David L Miller
INEEL
POB 1625-2208
Idaho Falls, ID 83402-2208
Ph: (208) 526-9052
Email: bsh@inel.gov

EM Small Business Innovative Research Program

Justine Alchowiak
US Department of Energy
Office of Basic & Applied Research
1000 Independence Ave., SW
Office of Basic and Applied Research, Room 3E066
Washington, DC 20024
Ph: 202/586-4629
Fx: 202/586-1492
Email: justine.alchowiak@em.doe.gov

Low Dose Radiation Programs

David Thomassen
US Department of Energy
Office of Science
Life Sciences Division
Room: J-111
19901 Germantown Road
Germantown, MD 20874-1290
Ph:301-903-9817
Fx: 301-903-8521
Email: david.thomassen@science.doe.gov

Strategic Environmental Research and Development Programs

Merrill Heit
US Department of Energy
Environmental Measurements Laboratory
201 Varick Street
5th Floor
New York, NY 10014-4811 Ph: 212-620-3623
Fx: 212-620-3600
Email: MERRILL.HEIT@science.doe.gov

NABIR

Anna Palmisano
Environmental Sciences Division, ER-74
Office of Biological & Environmental Research
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874-1290
Email:anna.palmisano@science.doe.gov

**APPENDIX B: MAJOR MILESTONES AND FY 2001 RESEARCH
INTEGRATION ACTIVITIES**

Major Milestone Title	Fiscal Year	Planned Date
EMSP Call for Proposals	2001	12/00
EMSP Research Awards	2001	9/01
EMSP National Workshop	2002	11/01
EMSP Call for Proposals	2002	12/01
EMSP Research Awards	2002	9/02
EMSP Call for Proposals	2003	12/02
EMSP Research Awards	2003	9/03
EMSP National Workshop	2003	4/03
EMSP Call for Proposals	2004	12/03
EMSP Research Awards	2004	9/04

Conference and Location	Beginning	Ending
TIE FY 2001 Conference - Augusta	Tue 11/14/00	Thu 11/16/00
ANS – Washington DC	Sun 11/12/00	Thu 11/16/00
Material Research Society - Boston	Mon 11/27/00	Thu 11/30/00
SERDP - Arlington, VA	Tue 11/28/00	Thu 11/30/00
TMFA Mid-Year – Salt Lake City	Tue 02/06/01	Wed 02/07/01
Waste Management 01 - Tucson	Sun 2/25/01	Thu 3/1/01
NMFA Mid-Year - Tucson	Thu 3/1/01	Fri 3/2/01
Pittcon - New Orleans	Sun 3/4/01	Sun 3/4/01
TFA Mid-Year Salt Lake City	Mon 3/12/01	Fri 3/16/01
SCFA Mid-Year Atlanta	Tue 3/20/01	Thu 3/22/01
D&D Mid-Year - Miami	Tue 04/17/01	Thu 04/19/01
ACS Spring 2001 - San Diego	Sun 4/1/01	Thu 4/5/01
ANS 2001 Intl. HLW Mgmt Conference - Las Vegas	Sun 4/29/01	Thu 5/3/01
2001 International Containment & Rem.Conference –St. Petersburg	Sun 6/10/01	Wed 6/13/01
CMST/EMSP Sensor Symposium	End of 6/01	End of 6/01
ACS Fall 2001 - Chicago	Sun 8/26/01	Thu 8/30/01
ANS Expo - Reno, NV	Mon 11/12/01	Wed 11/14/01

ADDENDUM: FY 2001 ANNUAL PERFORMANCE PLAN

1. Significant Projects

EMSP is soliciting applications for research grants in the problem areas of High Level Waste and Deactivation and Decommissioning in FY 2001. The focus of these solicitations are those science research needs identified in the Long Term Research Agendas developed for EMSP by the National Academies of Science National Research Council. DOE has also issued a Small Business Innovation Research (SBIR) Solicitation Announcement Schedule seeking grant applications for technologies for transuranic and mixed waste management and monitoring of DOE sites, facilities, and personnel. In addition, a Program Research and Development Announcement (PRDA) has been issued by the National Energy Technology Laboratory (NETL) for proposals to conduct applied research, development and demonstration of innovative and improved technologies to address selected technology needs of the Office of Science and Technology. This call is targeted at private industry and universities; however, collaborations are encouraged.

The National Academy of Sciences/National Research Council (NAS/NRC) provides periodic external peer review and policy recommendations. In FY 2001, the NRC provided two interim reports related to the long-term research needs in the areas of High-level Waste and Deactivation and Decommissioning. The final reports are expected in spring 2001. The NRC will also undertake a similar study for Transuranic and Mixed Waste in FY 2001.

2. Major Technical Milestones

§ The FY 2001 EMSP solicitation announcement schedule follows.

Draft RFAs Complete	November 27, 2000
Solicitations in Federal Register	January 16, 2001
Announcements and Solicitations Distributed	January 2001
Applications Received	
-HLW	March 8, 2001
-D&D	March 20, 2001
Merit Review (HLW, D&D)	May 7-10, 2001
Merit Reviews Completed	May 10, 2001
Relevance Reviews (HLW, D&D)	June 5-7, 2001
Relevance Reviews Completed	June 8, 2001
Selection Complete	June 22, 2001
Make Awards	September 30, 2001

§ The FY 2001 Small Business Innovation Research (SBIR) solicitation announcement schedule follows.

Announcement	November 30, 2000
SBIR Call Proposals Due	February 20, 2001
Make Awards	September 30, 2001

§ The FY 2001 Program Research and Development Announcement (PRDA) for Environmental Management Applied Research and Development solicitation announcement schedule follows:

Announcement	February 20, 2001
PRDA Proposals Due	April 10, 2001
Make Awards	September 30, 2001

§ The R&D Program Plan revision schedule follows.

Draft Informational Aspects Input Due from Focus Areas	February 28, 2001
Final Draft	April 30, 2001

§ Support roadmapping efforts at INEEL that address the vadose zone and long-term environmental stewardship of DOE sites.

§ Support roadmapping efforts at PNNL that address remediating tank wastes.

§ The following schedule has been established for the EM Integrated Planning, Accountability & Budgeting System (IPABS) needs generation process.

Determine site needs	December 4, 2000
Issue technical response guidance	January 24, 2001
Input technical responses into IPABS	February 2001

§ A National Academy of Sciences analysis of the EQ portfolio is planned. The schedule for this activity has not yet been determined.

3. Significant Publications

Annual Report for FY 2000

Multiyear Program Plan FY 2001 – FY 2005

EMSP Accomplishments Report Mid-year FY 2001

EMSP Accomplishments Report Year-end FY 2001

Interim Summary of FY 1996/97 Final Research Reports

Final Summary of FY 1996/97 Final Research Reports

Long-Term Research Needs for High-Level Waste at DOE Sites: Interim Report from NRC

Long-Term Research Needs for High-Level Waste at DOE Sites: Final Report from NRC

Long-Term Research Needs for Deactivation and Decommissioning at DOE Sites: Interim Report from NRC

Long-Term Research Needs for Deactivation and Decommissioning at DOE Sites: Final Report from NRC

Long-Term Research Needs for Transuranic and Mixed Waste at Doe Sites: Interim Report from NRC

4. Indicators of Basic and Applied Science Performance - The successful accomplishment of EMSP goals will be realized by making measured progress in the each of the following activities while maintaining a balance across them.

- \$ Implementing a research agenda that is identified by gap analysis and interaction with and validated by the Focus Areas to focus on the most serious DOE-EM problems for which no adequate solution has been found
- \$ Supporting the application of research results to DOE-EM problems, using a measure such as the number of projects whose results are successfully transferred to the FAs
- \$ Expanding scientific resources focused on EM problem areas using a measure of long-term community commitment to EMSP, such as the number of projects that are renewed after an initial three years
- \$ Publishing EMSP research results in both scientific journals and the media, such as in a number of peer reviewed papers or presentations
- \$ Increasing the number of collaborations between EMSP and Focus Areas, industries, universities, and other government agencies through shared prioritization of needs
- \$ Expanding the cadre of environmental research personnel through increasing the number of funded graduate students each year
- \$ Publishing an Annual Report describing EMSP's progress during the year
- \$ Transferring research project knowledge to FA site managers, other government agencies, industry, and universities for further development
- \$ Coordinating with other federal agencies that have similar research objectives, including but not limited to the SERDP (DoD), ESTCP (DoD), and EPA-ORD (e-print Services)
- \$ Making research results available to all end users through the use of the Internet

These performance metrics will be measured against and recorded in the EMSP Accomplishments Report.

5. Program Supported Conferences, Workshops, or Stakeholder Activities

The following conferences, workshops and Focus Area Mid-Year Reviews will be attended by Environmental Management Science Program personnel.

Workshops and similar forums sponsored by the Office of Basic and Applied Science Programs are useful communication tools because they bring researchers and technology users together. This allows the researchers to learn about and discuss actual technology needs with the end-users. At the same time, site representatives and other end-users have an opportunity to hear about science developments directly from those conducting the R&D work.

It is important to consider that workshops can be costly to the program due to travel and lodging expenses. However, one annual meeting in a central or low cost location, such as in Chicago or Idaho Falls respectively, can prove valuable and cost effective. Such meetings could serve as a unifying force, using a specific theme to highlight pressing problems within EM. Workshops typically feature presentations of the research being conducted by program grantees, with industry and end-user

participation and critiques. The Idaho EMSP staff is the primary party responsible for organizing and facilitating these events.

To the extent possible, program participants attend professional forums to keep the scientific community and/or the public informed with respect to the results and future needs for research initiatives. These events generally feature a variety of subject areas and disciplines, and thus are excellent vehicles for technology transfer among different fields. Direct contacts established at large, interdisciplinary events often produce the synergy of ideas that lead to innovative remediation systems. EMSP displays its exhibit at these events.

EM periodically sponsors meetings focused on EM programs and problems, such as the Waste Management Conference, Decision-Makers Forum, and Technology Information Exchange (TIE) Workshop. Science Program participants attending these events form ties between technology developers and end-user "problem holders," which help to enhance the relevance and value of research projects to the EM clean-up program.

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|---|--------------------------------|---------------------------|
| 1. FY 2001 EMSP Vadose Zone PI Workshop¹ | Nov. 28-30, 2000 | Richland, WA |
| 2. TMWFA Mid-Year Review¹ | Feb. 6-8, 2001 | Salt Lake City, UT |
| 3. Waste Management 2001² | Feb. 25 - March 1, 2001 | Tucson, AZ |
| 4. NMFA Mid-Year Review¹ | March 1-2, 2001 | Tucson, AZ |
| 5. PittCon 2001² | March 4-9, 2001 | New Orleans, LA |
| 6. TFA Mid-Year¹ | March 12-16, 2001 | Salt Lake City, UT |
| 7. SCFA Mid-Year Review¹ | March 20-22, 2001 | Atlanta, GA |
| 8. ACS - Spring Meeting² | April 1-6, 2001 | San Diego, CA |
| 9. D&D Mid-Year Review¹ | April 17-19, 2001 | Miami, FL |
| 10. Weapons Complex Monitor Annual R&D Technology Colloquium² & IRB | April 23-27, 2001 | Salt Lake City, UT |
| 11. ANS 2001 Intl. HLW Mgmt Conference² | April 29 - May 3, 2001 | Las Vegas NV |
| 12. EMSP National Workshop¹ | Spring/Summer 2001 | to be determined |

- | | | |
|---|-------------------------|---------------------------|
| 13. 2001 International Containment & Remediation Technology Conference² | June 10-13, 2001 | St. Petersburg, FL |
| 14. Sensor symposium co-sponsored by EMSP and CMST¹ | June 13-14, 2001 | Atlanta, GA |
| 15. ACS National Meeting² | Aug. 26-30, 2001 | Chicago, IL |
| 16. FY 2001 EMSP Deactivation & Decommissioning PI Workshop¹ | Fall 2001 | to be determined |
| 17. FY 2001 EMSP High-Level Waste PI Workshop¹ | Fall 2001 | to be determined |

¹EMSP personnel attend these meetings to provide the Focus Area personnel an opportunity to exchange program status information, promote the use of knowledge emerging from EMSP Research and to communicate with EMSP Principal Investigators who often are invited to report on specific research projects.

²EMSP displays an exhibit at these conferences to promote its funded research and stimulate interest in the EMSP.