

Environmental Management Science Program

ANNUAL REPORT

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Science Advancing Solutions



U.S. Department of Energy
Office of Environmental Management
Office of Science and Technology

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U.S. Department of Energy

Office of Environmental Management

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We are pleased to provide this third Annual Report for the Environmental Management Science Program. The Program has been successful in establishing new research project awards and communicating the emergence of promising new results for the Department's cleanup program. This year, EMSP sponsored a national workshop where EMSP researchers met one-on-one with environmental technology developers and cleanup project managers. These interactions have brought new ideas and expertise into the Environmental Management Program and have helped to bring the EMSP's scientific results to bear on DOE's cleanup problems. This year EMSP competitively renewed some of the most promising of the projects that were initially funded in FY 1996 and FY 1997. These and other FY 2000 accomplishments are captured in this report, along with additional information on the background, current projects, and future EMSP direction.

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Introduction

The Environmental Management Science Program (EMSP) is a collaborative partnership between the DOE Office of Environmental Management (DOE-EM), Office of Science (DOE-SC), and the Idaho Operations Office (DOE-ID) to sponsor basic environmental and waste management related research. Results are expected to lead to reduction of the costs, schedule, and risks associated with cleaning up the nation's nuclear complex. The EMSP research portfolio addresses the most challenging technical problems of the EM program related to high-level waste, spent nuclear fuel, mixed waste, nuclear materials, subsurface contamination, deactivation and decommissioning, and health, ecology, and risk.

The EMSP was established in response to a mandate from Congress in the Fiscal Year 1996 Energy and Water Development Appropriations Act. Congress directed the Department to "provide sufficient attention and resources to longer-term basic science research which needs to be done to ultimately reduce cleanup costs, ...develop a program that takes advantage of laboratory and university expertise, and ...seek new and innovative cleanup methods to replace current conventional approaches which are often costly and ineffective." This mandate followed similar recommendations from the Galvin Commission to the Secretary of Energy Advisory Board. The EMSP also responds to needs identified by National Academy of Sciences experts, regulators, citizen advisory groups, and other stakeholders.

The mission of the EMSP is to develop and fund a targeted, long-term research program that will result in transformational or breakthrough approaches for solving the Department's environmental problems. The purpose is to provide the basic science knowledge that will lead to reduced remediation cost, schedule, technical uncertainty, or risk. A second priority of the Program is to help alleviate otherwise intractable problems. EMSP research is focused on the Department's cleanup problems and has explicit links to problem holders, including technical staff, managers, and stakeholder advisory groups at the sites. The goal is to support research that will:

- Lead to significantly lower cleanup costs and reduced risks to workers, the public, and the environment over the long term.
- Bridge the gap between broad fundamental research that has wide-ranging applicability, such as that performed in the Office of Science, and needs-driven applied technology development conducted by the EM Office of Science and Technology (OST) Focus Areas.
- Serve as a stimulus for focusing the nation's science infrastructure on critical national environmental management problems.

"... the EMSP should be viewed as an investment that may, in the long term, lead to more effective cleanup. The EMSP alone will not solve all of EM's cleanup problems - but given the sheer magnitude of the cleanup mission and its estimated cost, coupled with the technological challenges, the committee views the investment in EMSP as both prudent and timely."

- National Research Council-Building an Effective Environmental Management Science Program, 1997

Research projects are solicited and awarded according to program needs of the DOE sites and the degree to which those needs can be influenced by scientific findings. Awardees conduct the research and interface with OST Focus Area representatives at multiple points during the projects. Research is integrated into technology development activities of the Focus Areas and site end-users through a number of facilitated interactions, such as topical and site-specific workshops, national workshops, and other EM program meetings. In FY 1999, the first of the EMSP funded projects reached the end of their primary three-year funding period. In FY 2000, the projects funded in FY 1997, reached the end of their primary funding period.

EMSP Organization

Integrating EMSP results with environmental technology development and end-user objectives is accomplished in cooperation and partnership with the Environmental Management's Office of Science and Technology's Office of Basic and Applied Research, DOE-SC, and the DOE-Idaho. The Office of Basic and Applied Research is the lead organization for planning and budgeting. It also provides policy and programmatic guidance, assists in soliciting research needs, ensures research is applicable to DOE cleanup problems, and communicates research results. DOE-SC provides input into Program policy development, manages the solicitation of research applications, oversees the scientific review process, and manages the scientific aspects of the Program. DOE-ID is the lead Field Office for Program execution, which includes: assisting the Office of Basic and Applied Research in analyzing science needs, providing procurement services, integrating research results, and managing project funding. DOE-ID also serves as the interface between the EM Focus Areas, Crosscutting Programs, and other DOE Field Offices.

The EMSP has a number of technical advisory groups providing valuable input on both technical and programmatic matters. In the technical area, EM's Site Technology Coordinating Groups (STCGs) identify technology needs associated with all field sites and cleanup projects. The Focus Areas work with EMSP and the STCGs to evaluate the needs and set basic research directions. The EM Integration team identifies ways to improve efficiencies and cost savings throughout EM and identifies additional science priorities associated with critical waste streams.

Several programmatic advisory groups assist the EMSP with strategic and policy recommendations. The EM Federal Review Board and the EM Advisory Board (EMAB) advise and evaluate overall Program execution. The EMAB Science Committee reviews the processes used to select projects, provides recommendations on Program direction, and advises on EM science policy. DOE's Strategic Laboratory Council also advises the EMSP on planning and execution processes in

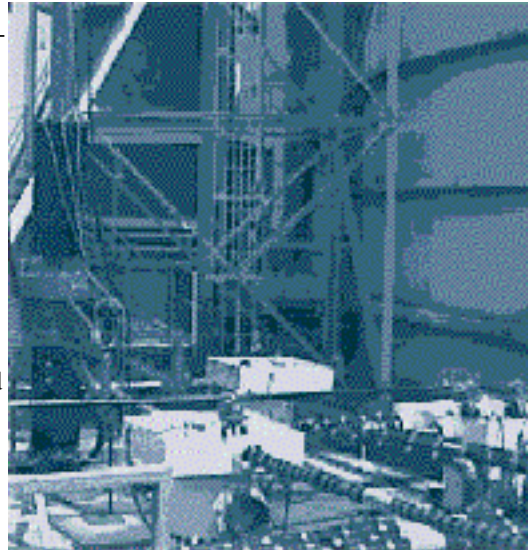
order to ensure programmatic relevance and successful utilization of research results. The National Academy of Sciences/National Research Council (NAS/NRC) provides periodic external peer review and policy recommendations. In FY 2000, the NAS/NRC completed an evaluation of the *Research Needs in Subsurface Science*. Additionally, in FY 2000, the National Academy of Science was commissioned to provide recommendations for long-term science needs in the areas of High-Level Waste (HLW) and Deactivation and Decommissioning (D&D).

EM Problem Areas and Science Needs

DOE field sites have identified key science and technology needs that must be addressed in order to meet cleanup goals set forth in the *Accelerating Cleanup: Paths to Closure* document. Over 460 individual needs have been specified, including 73 associated with basic science research. The Focus Areas assist the EMSP in evaluating these needs and setting research priorities in seven major problem areas, which are described below. Focus Areas also serve as the primary means through which EMSP project results are integrated into EM's technology development and deployment efforts.

High-Level Waste

Within the DOE Complex, 239 underground storage tanks that were used to process and store radioactive and chemical mixed waste, generated from weapons production and manufacturing, still need to be remediated. Collectively, these tanks hold over 100 million gallons of HLW and low-level radioactive waste (LLW) in the form of liquid, sludge, and saltcake, as well as supernate and vapor. Most of the waste is alkaline and contains a diversity of constituents, including nitrate and nitrite salts (approximately half the total volume), hydrated metal oxides, phosphate precipitates, and ferrocyanides. Radionuclides consist primarily of the transuranic (TRU) elements and fission products, specifically strontium-90, cesium-137, and their decay products yttrium-90 and barium-137. Only a small portion of the original tank inventory has been treated and/or disposed of in final form, owing to the significant scientific and technical challenges that must be solved.



Basic research is needed in virtually all aspects of tank characterization and safety, retrieval of tank waste and tank closure, pretreatment and separation processes for tank waste, and waste immobilization and disposal. In 2000, the EMSP requested that the National Academy of Sciences/National Research Council conduct a study of the long-term research needs in the area of HLW. The needs identified in their interim report are given in the box below.

- Long-term issues related to tank closure and characterization of surrounding areas.
- High-efficiency, high-throughput separation methods that would reduce high-level waste program costs over the next few decades.
- Robust, high-loading, immobilization methods and materials that could provide enhancements or alternatives to current immobilization strategies.
- Innovative methods to achieve real-time, and, when practical, in-situ characterization data for HLW and process streams that would be useful for all phases of the waste management program.

Transuranic and Mixed Waste

The term "mixed waste" refers to waste containing both radioactive and hazardous materials. An inventory of over 1,400 different mixed waste streams at 38 DOE sites, amounting to over 160,000 cubic meters, currently awaits treatment and disposal. This inventory will increase with newly-generated mixed waste from DOE's ongoing cleanup activities. However, existing treatment and disposal capacities currently are too limited to achieve significant reduction in the overall inventory.

In FY 2000, DOE realigned the technology development focus area responsible for mixed waste so that it now places increased emphasis on the problems associated with transuranic wastes with particular attention to the technical areas associated with the Waste Isolation Pilot Project near Carlsbad, New Mexico. Because of recent regulatory changes there is particular need for technologies that could replace mixed waste thermal treatment. Research at a fundamental scientific level could lead to innovative processes or technologies, or provide data to permit the advancement of technologies currently under development.



Examples of specific Transuranic and Mixed Waste research and technology needs are:

- Characterization Technologies - Non-destructive evaluation techniques to detect hazardous compounds in containers and facilitate routing of incoming waste streams, and better effluent monitoring to optimize treatment operations and ensure environmental compliance.
- Waste Treatment and Handling - Better information to support high-temperature treatment equipment design and permitting, including hazardous waste thermodynamics, transport, and generation mechanisms; methods for direct removal of radioactive compounds; real-time monitors for heavy metals, dioxins, and volatile organic compounds; and non-thermal treatment processes.
- Toxic Metals Removal - Large-scale techniques for monitoring and removal of mercury and other toxic metals from wastes.
- Radioactive Component Removal - Innovative methods for removing radioactive components, especially small quantities, from solid waste forms, including reprocessing sludges, metals and concrete from D&D, and calcined wastes.
- Hydrogen Generation Control - Methods for controlling hydrogen generation in shipping containers.

Subsurface Contamination



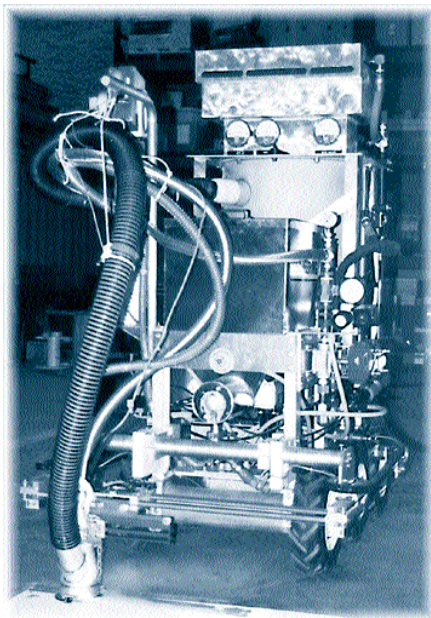
Environmental problems associated with hazardous and radioactive contaminants in soil and groundwater exist at nearly every DOE site. This consists of approximately 40 million cubic meters of contaminated soil and 1.7 trillion liters of contaminated groundwater. In addition, DOE is responsible for remediating numerous landfills, trenches and spill areas with over 3 million cubic meters of leaking waste that are potential sources of further subsurface contamination. Currently available technologies are inadequate or unacceptable due to their high costs, excessive cleanup time, or generation of secondary waste.

Basic scientific research is needed in:

- Subsurface measurements, characterization and transport validation of contaminants in fractured rock and the unsaturated (vadose) zone
- Hydrologic and geochemical processes that affect contaminant migration and immobilization
- Groundwater characterization and contaminant simulation models
- Surface water toxicological cumulative effects
- Contaminant inventory estimates and validation techniques.

"...subsurface contamination is an enormously difficult cleanup problem that represents a potentially large future mortgage for the nation. This mortgage could, however, 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." (National Research Council, Committee on Subsurface Contamination at DOE Sites, 2000)

Deactivation and Decommissioning



DOE is attempting to solve the problem of deactivating over 4,000 buildings and facilities that have completed their mission. Over 3,300 of these buildings and facilities were used in the nuclear weapons production program. In addition, there are another 10,000 buildings and facilities not yet under the auspices of environmental management. Metal and concrete within those buildings must be decontaminated and nearly 200,000 tons of scrap metal must be disposed of. In FY 1998, EMSP targeted research in the D&D problem area in one of the two calls for proposals. Long-term research needs for D&D problems, identified in an interim report from the NAS/NRC this year, are shown in the box below.

- Characterization
 - Means to locate and quantify difficult-to-measure contaminants, preferably real-time, minimally invasive, and field useable.
 - Biotechnological sensors to detect contaminants of interest.
- Decontamination
 - Research into the interactions among contaminants and the construction material.
 - Biotechnological means to remove or remediate contaminants from surfaces or from porous materials.
- Remote Systems
 - Intelligent remote systems that are adaptable to a variety of tasks including actuators, universal operational software to provide criteria-based decisionmaking, and virtual presence of the worker in hazardous environments.

Spent Nuclear Fuel

DOE is custodian for several thousand tons of spent nuclear reactor fuels, which resulted primarily from weapons fabrication, but also include fuel from research and naval reactors. Long-term containment performance of the fuel under realistic storage and disposal conditions remains an issue and affects the ability to license disposal methods.



Specific research needs in this area are:

- Fuel Package Performance - Better understanding of mechanisms that adversely affect fuel packages, including radiolytic effects on surrounding media; corrosion, degradation, and radionuclide release rates; matrix dissolution characteristics; and microbial effects
- Safety Issues - Understanding of pyrophoricity and combustion parameters, gas generation during processing, moisture content measurement and effects, long-term dry storage degradation and kinetics, fissile and radioisotopic content, and segregation behavior of elements
- Additional Characterization - Better and less expensive fission and/or gamma ray nondestructive assay or evaluation for specific fuels, on-line measurement of fissile content and nuclear poisons during stabilization, and more detailed understanding of thermodynamic and kinetic properties of miscellaneous fuel types to facilitate their inclusion in general purpose treatment processes.

Nuclear Materials

DOE is also custodian for large quantities of fissile material which were left in the manufacturing and processing facilities after weapons production was halted. These materials include plutonium solutions, plutonium metals and oxides, plutonium residues and compounds, highly enriched uranium, and other actinides. Research is needed to design processes for safe conversion of various types of fissile materials to optimal forms for safe interim storage, long-term storage, and ultimate disposition.

Improvements are needed in:

- Thermodynamic redox potentials and heterogeneous electron transfer kinetics of selected actinides and complexes
- Actinide chemical thermodynamics and kinetics
- Behavior of mixed oxidation states of plutonium-containing materials
- Plutonium diffusion and corrosion behavior
- Actinide interactions with organometallics, surfaces, and organic residues
- Characterization of plutonium compound solubility
- Performance of x-ray tomography, digital radiography, acoustic resonance spectroscopy, and actinide self-fluorescence.

Ecology/Health/Risk

There is scientific uncertainty regarding a safe level of risk to human health and the environment for the end state of the Department's cleanup effort. Accurate risk analysis requires thorough knowledge of contaminant characteristics, basic ecological processes and principles, rates at which contaminants move through ecosystems, and other health and ecological effects. Research is needed to define transport dynamics of toxic chemicals and radionuclides and potential effects of long-term exposure to combinations of low levels of radionuclides and other contaminants. Research is also required to improve the understanding of threatened and damaged ecosystems and to develop processes to restore viability and quality to these systems. In FY 1999, the EMSP solicited research proposals addressing the effects of exposure to low-dose radiation.



Specific needs in this area were targeted in this year's Low-Dose Radiation Effects research solicitation, including:

- Better understanding of the differences and similarities between low-dose ionizing radiation and endogenous (normal) oxidative damage to deoxyribose nucleic acid (DNA), including improvements to current measurement techniques
- Better characterization and understanding of real (not extrapolated) differences and similarities in biological changes after low-dose exposures
- Scientifically-defensible tools and methods to model recent molecular-level data on low-dose radiation, induced damage, including new algorithms and approaches to accurately reflect potential risk thresholds
- Investigation of genetic factors that affect individual susceptibility to low-dose radiation.

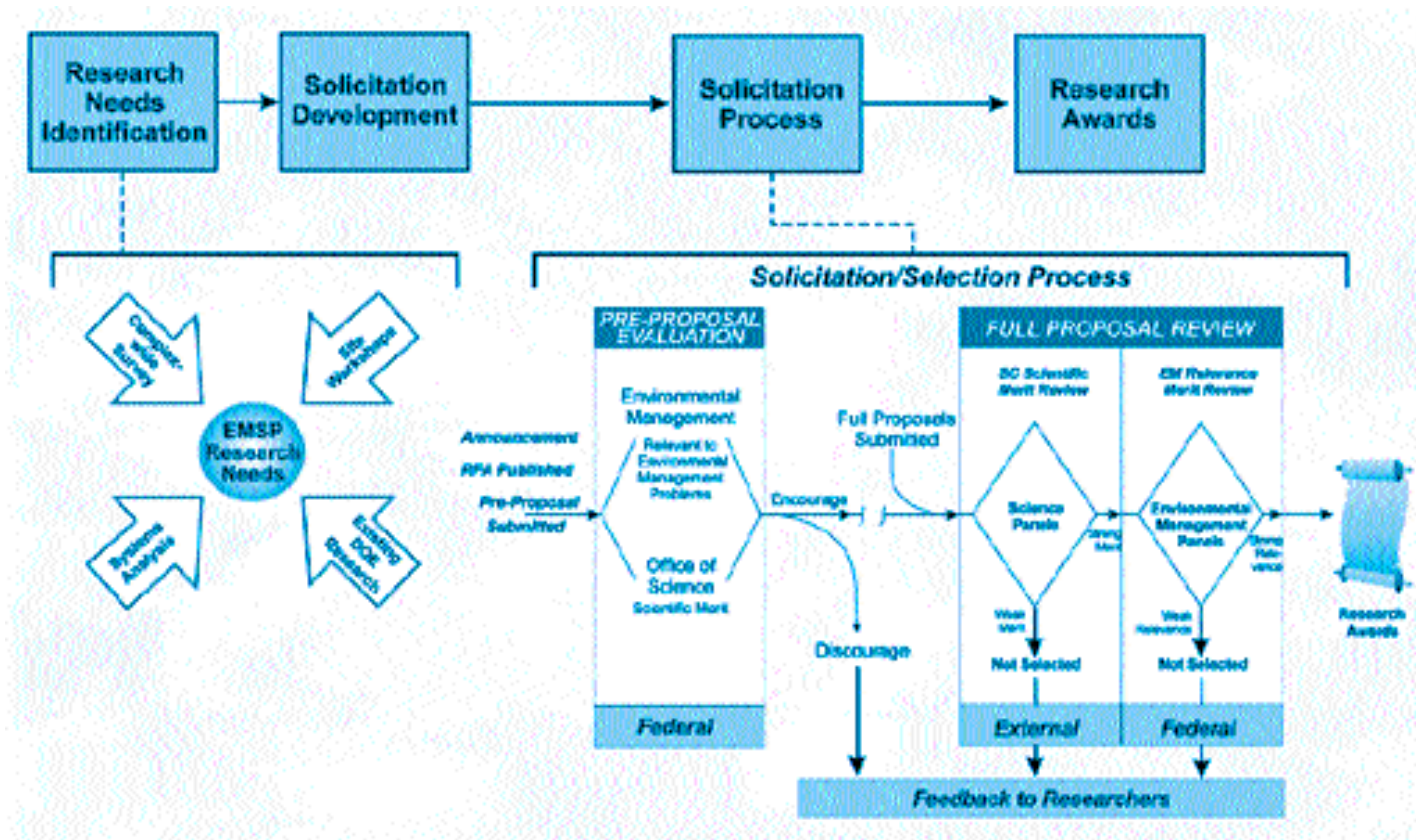
EMSP Project Selection Process

In order to address these basic science needs, the EMSP has developed an innovative process for seeking the broadest possible involvement of government and non-government organizations and researchers. The EMSP process for the submission of proposals and applications for research is illustrated in the schematic. Requests for Applications (RFA) are published in the Federal Register, in addition to direct announcements to universities and laboratories to ensure wide participation by the scientific community. Awards are competitively determined based on applications that best demonstrate both scientific merit and the potential to lead to new and improved solutions to EM's cleanup problems.

EMSP's process for selecting research awards includes optional pre-proposals and mandatory full proposals or grant applications. If the research call is sufficiently broad, the pre-proposals are used to focus proposed research toward more DOE specific topics. Alternatively, when the research topics are well defined, only full proposals are requested. This two-phase process saves both time and effort for researchers, and enhances the quality of full proposals, but does not preclude researchers from submitting full proposals even if discouraged from doing so as a result of the pre-proposal review.

EMSP RFAs clearly communicate research needs and focus researchers on DOE's most intractable cleanup problems or problems needing better solutions. A number of information sources have been used to identify these research needs including site-specific workshops, a complex-wide research needs survey, EM Technology Focus Areas, and the Project Baseline Summary information developed for the *Paths to Closure* document.

Pre-proposals and full proposals are peer reviewed by panels of scientists and engineers from the scientific community to evaluate both scientific merit and relevance to identified EM problems and needs. A two-phase formal review process is used to ensure awards are made to the most meritorious and relevant applications. The initial phase involves evaluations by external peer reviewers who are experts in specific scientific disciplines. The second phase involves review of the scientifically meritorious proposals for relevance to DOE-EM's cleanup needs by DOE Program and Focus Area Managers who are most familiar with EM problems and may be potential users of the research results. Funding is recommended only for those applications that are successful in both reviews.



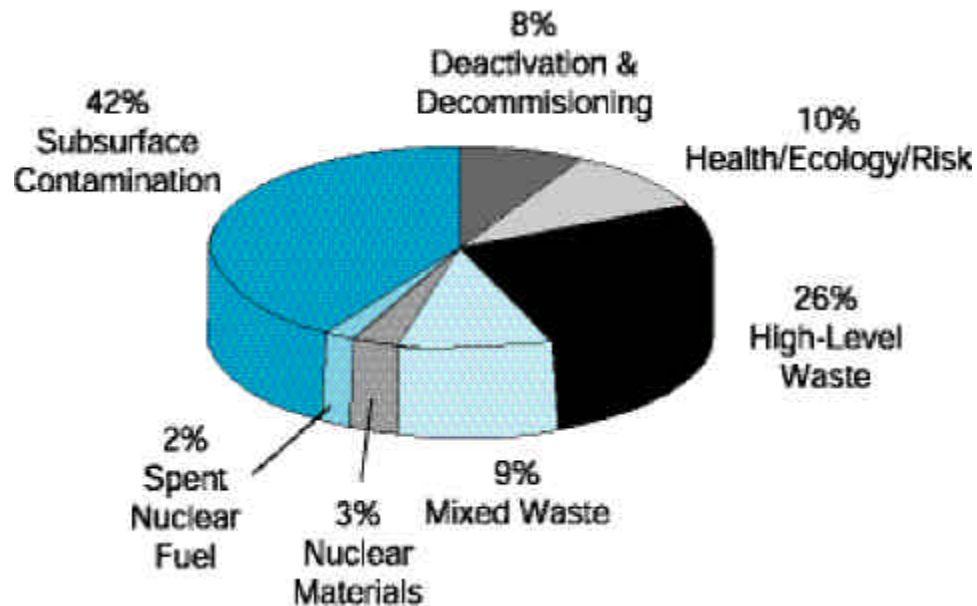
The selection process for the renewal of FY 1996 and FY 1997 projects, conducted this year, used the same overall review process except there was no preproposal phase. This phase was eliminated because the candidates were limited to research projects that were already in the EMSP portfolio and, as such, had already been through a prior screening.

Addressing DOE's environmental management problems and research needs requires the expertise from a variety of scientific disciplines such as chemistry, geology, physics, and biology. From these broad disciplines, 14 science categories have been used in the EMSP's project merit review and selection process. They reflect traditional areas of expertise within the scientific community and facilitate identification of well-qualified technical reviewers. Each science category may represent several sub-categories. For example, engineering science includes such diverse fields as bioengineering, diagnostics, robotics, and design/process modeling. Taken together, the sub-categories reflect the essential scientific underpinning necessary for long-term solutions to EM problems.

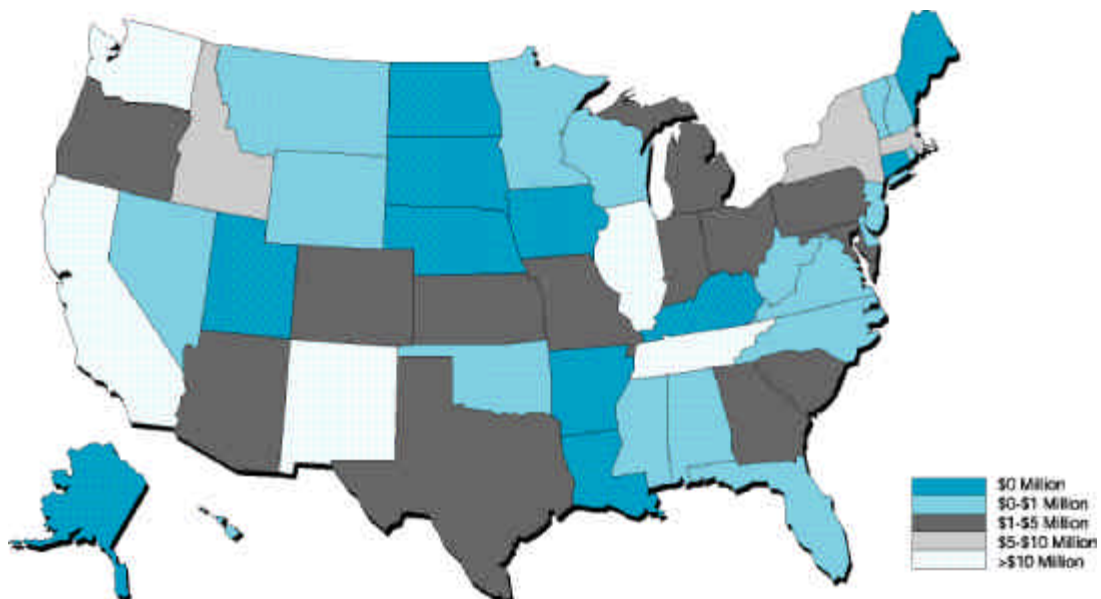
While EMSP research awards address many cleanup needs, they are not generally intended for application at specific sites. In fact, a given research project is likely to address several site-specific problems, or in some cases it may be relevant to more than one EM problem area. The table of EMSP projects provided at the end of this document identifies only the primary EM problem addressed by each research project.

Current Research Portfolio

Since its inception in FY 1996, EMSP has invested over \$254 million in support of 316 research projects. This investment has led to research at 97 universities, 13 national laboratories, and 20 other governmental and private laboratories. Research is being conducted in 40 states and the District of Columbia, two Canadian provinces, Australia, Russia, the United Kingdom, Ireland, Austria, Switzerland, and the Czech Republic. The distribution of the projects by problem area and by location is shown below.



EMSP Funding by Problem Area



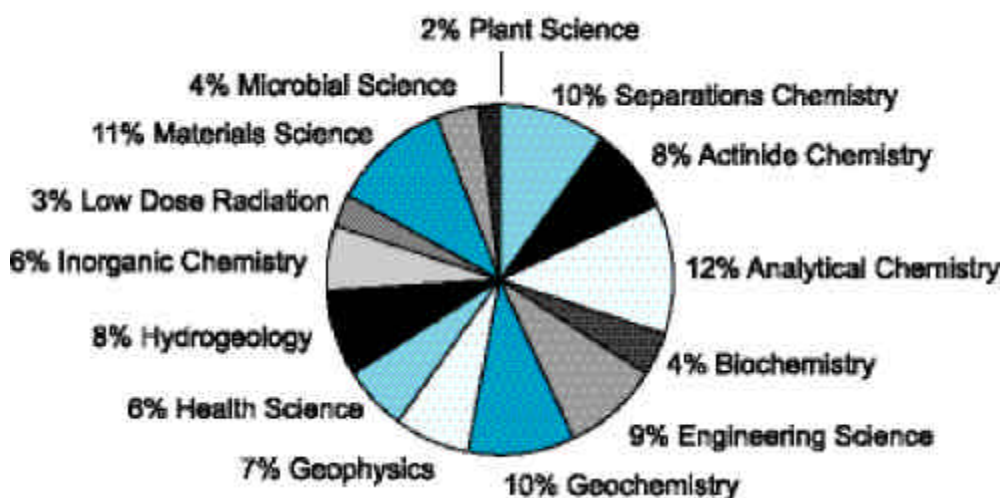
Geographic Distribution of EMSP Projects

During the first year of the program, FY 1996, a single broad RFA was issued, which resulted in 136 project awards. These projects encompassed all of the Department's problem areas. The primary funding period for these projects ended in FY 1999.

In FY 1997 another broad call resulted in the funding of 66 projects. Again, the projects were a cross-section of the Department's problem areas. These projects reached the end of their primary three-year funding period in FY 2000.

In FY 1998, 33 awards were made to respond to needs in the areas of high-level waste and deactivation and decommissioning. Continuing to draw on expertise available from abroad, particularly in high-level waste, the FY 1998 awards also included projects in the Czech Republic and Russia.

Two EMSP solicitations for research were conducted in FY 1999. The first addressed subsurface contaminants and the vadose zone. This solicitation resulted in the selection of 31 projects with a combined funding of over \$25 million. The second solicitation addressed low-dose radiation effects. It resulted in eight project awards with a total funding of \$7.7 million.



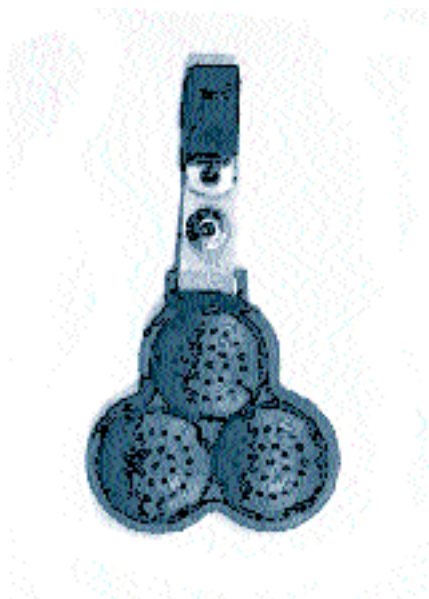
Cumulative EMSP Project Funding by Science Category

In FY 2000, the EMSP conducted a solicitation for the renewal of promising projects initially funded in FY 1996 and FY 1997. The goal of this solicitation was to provide the opportunity to further develop the results of the initial research. This solicitation resulted in the awarding of \$29.6 million for the continuation of research on 42 projects.

EMSP Successes

DOE's technology development effort utilizes a stage-gate model for tracking the movement of projects from basic research through development into full utilization. In this model, the next step for basic research is applied research. Basic research can, however, in many cases provide insight which can be applied to other projects that are at much later stages of development or can, in some cases, provide processes or technology that are ready for immediate use.

An important aspect in the formation of the EMSP was to develop a cadre of scientists focused on the nation's environmental problems. Projects supported by the EMSP have included nearly 550 undergraduate, graduate and post-doctoral researchers and to date has supported 42 theses and dissertations. The research program has led to over 1500 other publications and presentations that serve to stimulate the scientific community.



EMSP projects typically have a three-year term; the first 136 of these projects reached the end of their primary funding in FY 1999 with an additional 66 reaching an end of their primary funding in FY 2000. The research results from these projects have been instrumental in developing new tools for environmental cleanup and in improving the understanding of scientific principles that underlie conventional cleanup methods. While most of these projects will require additional applied research and development to realize their full potential, such as those that were renewed this year, some projects have already had useful impact and others need little additional work to be incorporated into cleanup activities. The following are examples of some early EMSP results that could provide significant benefits to EM's cleanup effort.

Deployment

The results of research directed to developing state-of-the-art personal and environmental exposure assessment for inhaled radionuclides has yielded two new instruments that have been deployed at Fernald for about one year. Together these instruments permit the air concentrations of the gas, the air-borne particulates, and their particle size distribution to be measured on a continuous basis. The new instruments can have wide application at other DOE sites. The first instrument is a radon, thoron passive alpha track detector that can be worn (see photo at the left) or used as an area detector to obtain research quality measurements for modeling or for personal exposure assessment. The second instrument is a particle size analyzer. Although the inhaled particle size is the major determinant of bronchial dose, Fernald, as the first site to deploy this equipment, is the only site attempting to do particle size distribution measurements. Prior to the development of this instrument, the labor intensive effort needed and the cost, precluded these measurements.

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. This material is also expected to have broad application in waste tank remediation throughout the DOE complex.

Transition to Focus Areas

Focus Areas and Crosscutting Programs have transitioned four basic research projects, started under the EMSP, into their applied research efforts. These projects include the demonstration of "Laboratory-on-a-Chip" (project 64982) by the Deactivation and Decommissioning Focus Area, demonstration of miniature spectrometer (project 60231) for groundwater monitoring by the Subsurface Contaminants Focus Area, and two separate demonstrations of Crown Ethers for Cesium Separation (project 55087) at the Savannah River Site and Oak Ridge National Laboratory. This latter separation process has also been commercialized.

Commercialization

Results of nine other projects sponsored by the EMSP have also been commercialized. The process for growing Graphite Nanofibers developed by Northwestern University (project 54571) has been licensed by two companies. The ability to manipulate the physical structure of the graphite fibers offers a wide range of potential applications including microfiltration. Other commercialized separations or filtration projects include Synthesis of New Water-Soluble Metal Binding Polymers (project 54724), and Novel Ceramic-Polymer Composite Membranes for the Separation of Liquid Waste (project 54926). The use of plants to separate mercury from the environment (project 54837) is another novel separation technique that has been commercialized as the result of research sponsored by EMSP. This project involved the engineering of transgenic plants. The results of the research have been so successful that a new company was formed to capitalize on them. Another area where EMSP-sponsored projects have met with commercial success is characterization and monitoring. Three separate projects (projects 54639, 54751, and 60231) have been commercialized as novel methods that improve on existing sensor or analytical technology. Two projects that investigated methods for removing contaminants from surfaces, such as would need to be done in Deactivation and Decommissioning (projects 54914 and 60283) have also been commercialized. The early acceptance of EMSP sponsored research results in the commercial marketplace demonstrates the high relevance of the research included in the EMSP portfolio.

Field Testing

Twelve field testing projects have resulted or are planned based on the promise shown by 10 EMSP sponsored projects. Most of these can be categorized as process improvement or new remedial methods (60143, 55416, 55388, 55332, 55264, 55036, 54914), while the remainder are in the area of characterization and monitoring (60162, 60158, 60115). These field tests provide the opportunity to test the applicability and efficacy of these processes, methods and technologies in actual use situations, although, in some situations the tests are performed on surrogates for the actual site materials.

Additional information on the projects described here can be found in the table of projects at the end of this report or on the EMSP website.

Planning Studies

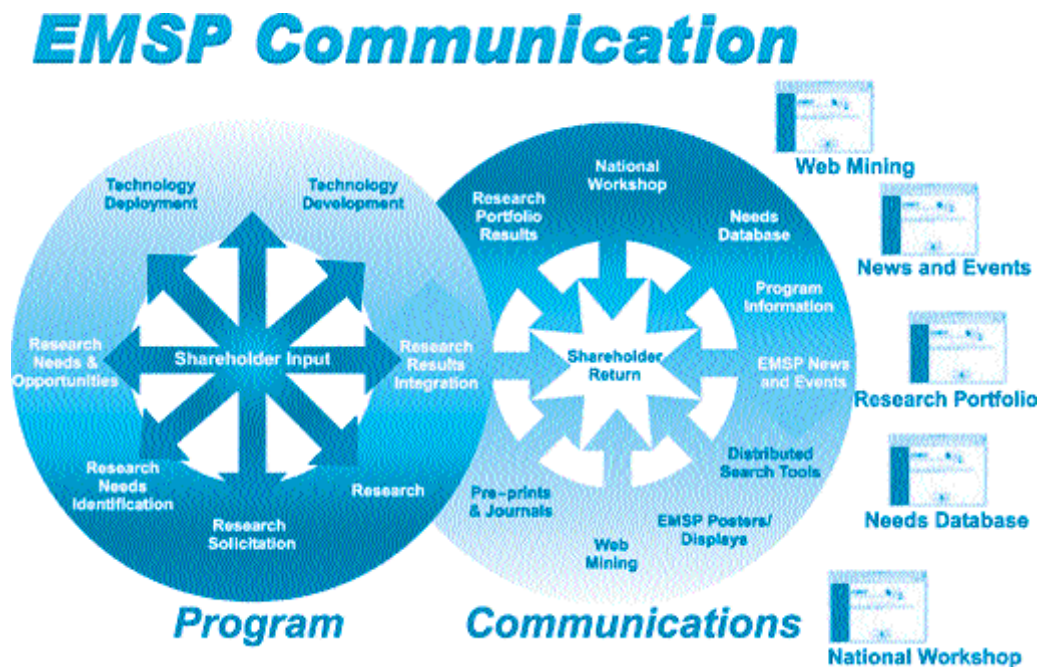
In FY 2000, the NAS/NRC released their final report on *Research Needs in Subsurface Sciences*. The interim report for this study was utilized in formulation of the FY 1999 research solicitation for Subsurface Contaminants and the Vadose Zone. Also in FY 2000, the NAS/NRC initiated studies of the research needs in the areas of Deactivation and Decommissioning and High-Level Waste. These studies are expected to provide insight that will be used in the formulation of the FY 2001 research solicitations.

National Workshop

In April of 2000, the EMSP National Workshop was held in Atlanta, Georgia. This conference brought together over 550 researchers, environmental managers, stakeholders, and regulators. Presentations by the environmental managers, regulators, and stakeholders were included to help the researchers in the formulation of future research direction and the researcher's presentations were to demonstrate to the problemholders, stakeholders and regulators the potential new solutions that are being developed to aid in future cleanup efforts. These interactions were geared to assuring that the EMSP targets the right areas of research, the researchers understand the DOE problem set, and that the problemholders, stakeholders and regulators are aware of the latest developments of the research community. The interactions of the researchers with the user and stakeholder community are an integral part of the EMSP's efforts to move the basic research it sponsors on through the development cycle. The EMSP also sponsored a field trip to the Savannah River Site for the researchers, in order to make them more aware of the types of problems faced by the sites.

Communicating Results

EMSP places high priority on assisting principal investigators in communicating with other researchers, technology developers, and EM cleanup project end-users. A number of documents are available which describe the Program or specific projects. Most recently, a series of *Project Summary Fact Sheets* have been developed to highlight EMSP efforts directed at specific problems. These fact sheets can be found on the EMSP website listed at the end of this report. In addition to these traditional tools, EMSP uses the Internet and a variety of electronic media to disseminate and track information produced by EMSP researchers throughout the technical community. DOE's Office of Scientific and Technical Information and the DOE-Idaho work together to implement these state-of-the-art tools.



Direct interaction between researchers and end-users still provides the most effective means of integrating new talent and ideas into the EM mission. National and site-specific workshops, as well as conferences, allow researchers to meet EM project managers and visit sites with specific science needs.

Because of the success of the April, 2000 EMSP's National Workshop held in Atlanta, GA, another workshop is already in the planning phases.

Additionally, in order to increase awareness of the program among potential end-users and researchers, EMSP's management and staff made presentations or displayed posters at a number of meetings, symposia, and conferences. A few of the events in which EMSP has participated include:

- Waste Management 2000
- The Strategic Environmental Research and Development Program Colloquium
- Technical Information Exchange
- Albuquerque Needs Workshop
- Weapons Complex Monitor's Applied Research Development and Deployment Cleanup Technology Colloquium
- Focus Area Mid-Year Reviews

- Technology Transfer Sessions of the Historically Black Colleges and Universities and Other Minority Institutions Annual Symposium
- Interstate Technology Regulatory Cooperation Workgroup Leadership Team Meeting.

Looking to the Future

The projects initiated in FY 1996 reached the end of their primary funding in FY 1999. The 66 EMSP funded research projects initiated in FY 1997 reached the end of their initial three years of funding in FY 2000. A limited number of these projects have been continued, at no additional cost, beyond their initial funding period. Additionally, because the EMSP is a targeted, long-term research program, funding for 42 of these FY 1996 and FY 1997 projects was renewed for FY 2000. The ultimate goal will be to transfer the scientific and engineering knowledge from these projects to EM stakeholders, including EM/OST Focus Areas and the site problem holders. To assure that future research solicitations are targeted at the right aspects of the Department's problem set, EMSP plans to again enlist the assistance of the National Academy of Sciences to investigate the research needs in the area of TRU and mixed waste and possibly in nuclear materials and spent nuclear fuel. National Academy investigations, conducted in FY 2000, into the research needs in HLW and D&D, are expected to provide the foundation for new research solicitations in these areas in FY 2001. The interim findings of these studies are presented in the discussions of these problem areas in this report. In FY 2001, it is anticipated that the NAS/NRC will be requested to undertake similar studies into the research needs in transuranic and mixed waste that will, in turn, be an integral part of the basis for research solicitations in FY 2002.



"I am challenging the site managers, project managers, industry, regulators, and others involved in our cleanup activities to engage with the scientific community to utilize this valuable resource."

Dr. Carolyn Huntoon - From her keynote address to the EMSP National Workshop

EMSP Project Table

The EMSP Project Table includes all research funded to date, according to scientific category, year of award, EM problem area, and primary research institution. Project titles are abbreviated; however, proposal numbers are consistent with abstracts found in other EMSP publications and web site descriptions. The funding level for the projects has been rounded to the nearest thousand. The award year is shown in bold for the Fiscal Years 1996 and 1997 projects that have been completed, or are expected to be completed, in FY 2000. Projects with a no-cost extension that have not reached their extended end date are denoted by the award year being shown in italics. New FY 2000 projects that resulted from the renewal of existing projects are shown as new entries with the new project number followed by the original project number with an asterisk.

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|---|-----------------|---|--|--------------|-----------------|
| Actinide(Heavy Element) Chemistry | | | | | |
| 1996 | 54595 | f-Element Ion Chelation in Highly Basic Media | University of New Mexico | HLW | 500 |
| 1996 | 54621 | Chemical Speciation of Strontium, Americium, and Curium in High-Level Waste | Pacific Northwest National Laboratory | HLW | 1,051 |
| 1996 | 54679 | Architectural Design Criteria for F-Block Metal Ion Sequestering Agents | Pacific Northwest National Laboratory | TMW | 1,800 |
| 1996 | 54683 | Speciation and Structural Characterization of Actinide-Organic Complexes in Surface and Groundwaters | Woods Hole Oceanographic Institute | SC | 823 |
| 1996 | 54893 | Research to Determine Redox Properties and Their Effects on Speciation and Mobility of Pu | Florida State University | SC | 875 |
| 1997 | 59977 | Templated Ion Exchange Resins Synthesis and Characterization for Selective Actinide Ions Complexation | Johns Hopkins University Applied Physics Lab | HLW | 302 |
| 1997 | 60370 | Rational Design of Metal Ion Sequestering Agents | Lawrence Berkeley National Laboratory | TMW | 405 |
| 1997 | 59967 | Aqueous Electrochemical Mechanisms in Actinide Residue Processing | Los Alamos National Laboratory | NM | 750 |
| 1997 | 60319 | Thermodynamics of Actinide Metals Volatilization in the High-Temperature Treatment of Radioactive Wastes | Lawrence Livermore National Laboratory | NM | 900 |
| 1997 | 59996 | Plutonium Speciation, Solubilization, and Migration in Soils | Los Alamos National Laboratory | SC | 750 |
| 1998 | 65318 | Actinide-Aluminate Speciation in Alkaline Radioactive Waste | Los Alamos National Laboratory | HLW | 1,334 |
| 1998 | 65352 | The Effect of Temperature and Electrolyte Concentrations on Actinide Speciation in HLW | Washington State University | HLW | 865 |
| 1998 | 65370 | Actinide-Specific Interfacial Chemistry of Monolayer Coated Mesoporous Ceramics | Pacific Northwest National Laboratory | HLW | 1,200 |
| 1998 | 65398 | Characterization of Actinides in Simulated Alkaline Tank Waste Sludges and Leach Solutions | Argonne National Laboratory | HLW | 930 |
| 1999 | 70035 | DNAPL Surface Chemistry: Its Impact on DNAPL Distribution in the Vadose Zone and Its Manipulation to Enhance Remediation | Clarkson University | SC | 805 |
| 1999 | 70050 | Novel Optical Detection Schemes for In-Situ Mapping of Volatile Organochlorides in the Vadose Zone | University of South Carolina | SC | 825 |
| 1999 | 70126 | Collaboration: Interfacial Soil Chemistry of Radionuclides in the Unsaturated Zone | Pennsylvania State University | SC | 747 |
| 1999 | 70132 | Speciation, Mobility and Fate of Actinides in Groundwater at the Hanford Site | Woods Hole Oceanographic Institution | SC | 1,000 |
| 1999 | 70176 | Transuranic Interfacial Reaction Studies on Manganese Oxide Hydroxide Mineral Surfaces | Lawrence Berkeley National Laboratory | SC | 750 |
| 2000 | 73749 54621* | Chemical Speciation of Strontium, Americium, and Curium in High-Level Waste: Predictive Modeling of Phase Partitioning During Tank Processing | Pacific Northwest National Laboratory | HLW | 990 |
| 2000 | 73759 54679* | Computational Design of Metal Ion Sequestering Agents | Pacific Northwest National laboratory | TMW | 700 |
| 2000 | 73819 59996* | Plutonium Speciation, Solubilization, and Migration in Soils | Los Alamos National Laboratory | SC | 859 |
| Analytical Chemistry and Instrumentation | | | | | |
| 1996 | 54674 | Design and Development of a New Hybrid Spectroelectrochemical Sensor | University of Cincinnati | HLW | 850 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|-------------|---------------------|--|---|---------------------|------------------------|
| 1996 | 55318 | Improved Analytical Characterization of Solid Waste Forms by Development of Laser Ablation Technology | Lawrence Berkeley National Laboratory | HLW | 1,229 |
| 1996 | 54751 | High Fluence Neutron Source for Nondestructive Characterization of Nuclear Waste | Los Alamos National Laboratory | TMW | 745 |
| 1996 | 54864 | Supramolecular Chemistry of Selective Anion Recognition for Anions of Environmental Relevance | University of Kansas | TMW | 775 |
| 1996 | 55146 | Adsorption/Membrane Filtration as a Contaminant Concentration and Separation | University of Washington | TMW | 610 |
| 1996 | 55171 | Advanced In-Situ Techniques for Chemistry Monitoring and Corrosion Mitigation in SCWO Environments | Pennsylvania State University | TMW | 696 |
| 1996 | 55247 | Ion and Molecule Sensors Using Molecular Recognition in Luminescent, Conductive Polymers | Argonne National Laboratory | TMW | 1,500 |
| 1996 | 54639 | In-Situ Microsensor Development for Measurements of Cr and Ur in Groundwater | New Mexico State University | SC | 690 |
| 1996 | 54698 | Rapid Mass Spectrometric DNA Diagnostics for Assessing Microbial Activity | Lawrence Berkeley National Laboratory | SC | 675 |
| 1996 | 54800 | Construction of Bending Magnet Beamline at the APS for Environmental Studies | University of Washington | SC | 810 |
| 1996 | 55108 | Monitoring Genetic & Metabolic Potential for In-Situ Bioremediation | Oak Ridge National Laboratory | SC | 1,080 |
| 1996 | 55205 | Study of Laser-Induced Breakdown Spectroscopy Using Fiber Optics for Remote Measurements of Trace Metals | University of South Carolina | SC | 630 |
| 1996 | 55328 | Novel Analytical Techniques Based on an Enhanced Electron Attachment Process | University of Tennessee at Knoxville | SC | 540 |
| 1997 | 60163 | Investigation of Techniques to Improve Continuous Air Monitors Under Conditions of High Dust Loading | New Mexico Institute of Mining & Technology | H/E/R | 310 |
| 1997 | 60218 | Novel Mass Spectrometry Mutation Screening for Contaminant Impact Analysis | Oak Ridge National Laboratory | H/E/R | 600 |
| 1997 | 60474 | Ultrahigh Sensitivity Heavy Noble Gas Detectors for Long-term Monitoring and Monitoring Air | Georgia Institute of Technology | H/E/R | 609 |
| 1997 | 59978 | Thermospray Mass Spectrometry Ionization Processes | Oak Ridge National Laboratory | HLW | 590 |
| 1997 | 60075 | Particle Generation by Laser Ablation in Support of HLW Chemical Analysis | Washington State University | HLW | 544 |
| 1997 | 60217 | Optically-Based Array Sensors for Selective In-Situ Analysis of Tank Waste | Oak Ridge National Laboratory | HLW | 600 |
| 1997 | 60219 | Development of Advanced Electrochemical Emission Spectroscopy for Monitoring Corrosion | Pennsylvania State University | HLW | 350 |
| 1997 | 60424 | High Temperature Condensed Phase Mass Spectrometric Analysis | Idaho National Engineering and Environmental Laboratory | HLW | 680 |
| 1997 | 59981 | Broad Spectrum Characterization of Hazardous Waste by Membrane Introduction Mass Spectrometry | Los Alamos National Laboratory | TMW | 655 |
| 1997 | 60070 | Development of Cavity Ringdown Spectroscopy as a Sensitive Continuous Emission Monitor for Metals | Mississippi State University | TMW | 538 |
| 1997 | 60231 | Novel Miniature Spectrometer for Remote Chemical Detection | National Institute of Standards & Technology | TMW | 549 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|------------------------|-----------------|---|---|--------------|-----------------|
| 1997 | 60247 | Miniature Nuclear Magnetic Resonance Spectrometer for In-Situ and In-Process Analysis and Monitoring | University of Illinois at Chicago | NM | 482 |
| 1997 | 60197 | Microsensors for In-Situ Chemical, Physical, and Radiological Characterization of MW | Oak Ridge National Laboratory | SC | 615 |
| 1997 | 60141 | Gamma Ray Imaging for Environmental Remediation | Naval Research Laboratory | SNF | 780 |
| 1998 | 64982 | Metal Ion Analysis Using Near-Infrared Dyes | Naval Research | D&D | 471 |
| 1998 | 65001 | Development of Novel, Simple Multianalyte Sensors for Remote Environmental Analysis | University of Pittsburgh | D&D | 650 |
| 1998 | 65004 | Real-Time Identification and Characterization of Asbestos and Concrete Materials with Radioactive Contamination | Rensselaer Polytechnic Institute | D&D | 600 |
| 1998 | 65340 | Detection and Characterization of Chemicals Present in Tank Waste | Oak Ridge National Laboratory | HLW | 1,005 |
| 1998 | 65421 | Correlation of Chemisorption and Electronic Effects for Metal/Oxide Interfaces | National Institute of Standards & Technology-Maryland | HLW | 1,070 |
| 1998 | 65425 | Mass Spectrometric Fingerprinting of Tank Waste Using Tunable, Ultrafast Infrared Lasers | Vanderbilt University | HLW | 760 |
| 1998 | 65435 | Millimeter-Wave Measurements of High Level and Low Activity Glass Melts | Massachusetts Institute of Technology | HLW | 1,429 |
| 1999 | 70010 | Spectroelectrochemical Sensor for Technetium Applicable to the Vadose Zone | University of Cincinnati | SC | 1,050 |
| 1999 | 70179 | Radionuclide Sensors for Water Monitoring | Pacific Northwest National Laboratory | SC | 825 |
| 2000 | 73807 60218* | Rapid Nucleic Acid Analysis for Contaminant Evaluation | Oak Ridge National Laboratory | H/E/R | 690 |
| 2000 | 73844 60231* | Miniature Chemical Sensor Combining Molecular Recognition Evanescent-Wave Cavity Ring-Down Spectroscopy | National Institute of Standards and Technology | TMW | 950 |
| 2000 | 73839 60141* | Gamma Ray Imaging for Environmental Remediation (GRIER) | Naval Research Laboratory | SNF | 850 |
| 2000 | 73808 60197* | Microsensors for In-Situ Chemical, Physical, & Radiological Characterization of Mixed Waste | Oak Ridge National Laboratory | SC | 630 |
| Biogeochemistry | | | | | |
| 1996 | 54790 | Microbial Mineral Transformations at the Fe(II)/Fe(III) Redox Boundary | University of Toronto | SC | 502 |
| 1996 | 55071 | Reduction and Immobilization of Radionuclides and Toxic Metal Ions Using Combined Zero Valent Iron and Anaerobic Bacteria | Tennessee Technological University | SC | 356 |
| 1996 | 55164 | Advanced Experimental Analysis of Controls on Microbial Fe(III) Oxide Reduction | University of Alabama | SC | 427 |
| 1996 | 55267 | Containment of Toxic Metals and Radionuclides in Porous and Fractured Media | Oak Ridge National Laboratory | SC | 1,235 |
| 1996 | 55388 | Stable Isotopic Investigations of In-Situ Bioremediation of Chlorinated Organic Solvents | Argonne National Laboratory | SC | 825 |
| 1997 | 60015 | Long-term Risk from Actinides in the Environment: Modes of Mobility | Los Alamos National Laboratory | H/E/R | 900 |
| 1998 | 64907 | "Green" Biopolymers for Improved Decontamination of Metals from Surfaces | Oak Ridge National Laboratory | D&D | 900 |
| 1998 | 64931 | Microbially Promoted Solubilization of Steel Corrosion Products and Fate of Actinides | Pacific Northwest National Laboratory | D&D | 1,406 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|----------------------------|-----------------|---|--|--------------|-----------------|
| 1999 | 70063 | Biodegradation of Chlorinated solvents: Reactions Near DNAPL and Enzyme Function | Stanford University | SC | 750 |
| 1999 | 70165 | Integrated Field, Laboratory, and modeling Studies to Determine the Effects of Linked Microbial and Physical Spatial Heterogeneity of Engineered Vadose Zone Bioremediation | Pacific Northwest National laboratory | SC | 1,050 |
| 2000 | 72784 55267* | Microbially Mediated Immobilization of Contaminants through In-Situ Biostimulation: Scale Up of EMSP Project 55267 | Oak Ridge National Laboratory | SC | 1205 |
| 2000 | 73914 55164* | Reductive Immobilization of U(VI) in Fe(III) Oxide- Reducing Subsurface Sediments | University of Alabama | SC | 720 |
| Engineering Science | | | | | |
| 1996 | 55052 | Advanced Sensing and Control Techniques to Facilitate Semi-Autonomous Decommissioning | Clemson University | D&D | 871 |
| 1996 | 54656 | Mixing Processes in HLW Tanks | University of California at Berkeley | HLW | 417 |
| 1996 | 54890 | On-Line Slurry Viscosity and Concentration Measurement as a Real-Time Waste Stream Characterization Tool | University of California at Davis | HLW | 691 |
| 1996 | 55179 | Acoustic Probe for Solid-Gas-Liquid Suspensions | Syracuse University | HLW | 751 |
| 1996 | 55294 | Superconducting Open-Gradient Magnetic Separation for Pretreatment of Waste Vitrification Feeds | Argonne National Laboratory | HLW | 1,500 |
| 1996 | 54973 | Novel Energy-Efficient Plasma Chemical Process for Volatile Toxic Compounds Destruction | Oak Ridge National Laboratory | TMW | 980 |
| 1996 | 55211 | Cavitation Hydrothermal Oxidation: A New Remediation Process | University of Illinois at Urbana-Champaign | TMW | 478 |
| 1996 | 54857 | Surface Nuclear Magnetic Resonance Imaging of Subsurface Water Content Distribution | New Mexico Institute of Mining & Technology | SC | 638 |
| 1996 | 55013 | Biofiltration of Volatile Pollutants | Oak Ridge National Laboratory | SC | 950 |
| 1996 | 55374 | Use of Sonication for In-Well Softening of Semivolatile Organic Compounds | Argonne National Laboratory | SC | 1,470 |
| 1997 | 60040 | Development of Monitoring and Diagnostic Methods for Robots Used in Remediation of Waste Sites | Foster Miller Technologies | D&D | 403 |
| 1997 | 60143 | Foaming in Radioactive Waste Treatment and Immobilization Processes | Illinois Institute of Technology | HLW | 360 |
| 1997 | 60451 | Mechanics of Bubbles in Sludges and Slurries | Pacific Northwest National Laboratory | HLW | 1,132 |
| 1997 | 60155 | Measurements and Models for Hazardous Chemical and MWs | National Institute of Standards & Technology-Boulder | TMW | 500 |
| 1997 | 60326 | Isolation of Metals from Liquid Wastes: Reactive Scavenging in Turbulent Thermal Reactors | University of Arizona | TMW | 1,075 |
| 1997 | 60077 | Development of Nuclear Analysis Capabilities for DOE Waste Management Activities | Oak Ridge National Laboratory | NM | 600 |
| 1997 | 60144 | Flow Visualization of Forced and Natural Convection in Internal Cavities | University of Idaho | SNF | 1,077 |
| 1998 | 64947 | Contaminant-Organic Complexes; Structure and Energetics in Surface Decontamination Processes | Pacific Northwest National Laboratory | D&D | 1,242 |
| 1998 | 64979 | PCB D&D of Sites: Extraction, Electrokinetics, and Hydrothermal Oxidation | South Carolina University Research an Education | D&D | 980 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|---------------------|-----------------|---|---|--------------|-----------------|
| 1998 | 65015 | Three-Dimensional Positron-Sensitive Germanium Detectors | Lawrence Berkeley National Laboratory | D&D | 750 |
| 1998 | 65328 | Electrically Driven Technologies for Radioactive Aerosol Abatement | Oak Ridge National Laboratory | HLW | 830 |
| 1998 | 65371 | Numerical Modeling of Mixing of Chemically Reacting, Non-Newtonian Slurry for Tank Waste Retrieval | University of Minnesota | HLW | 658 |
| 1999 | 70045 | Investigation of Pore-Scale Processes which Affect Soil Vapor Extraction | University of Illinois at Urbana - Champaign | SC | 600 |
| 1999 | 70088 | Interfacial Reduction-Oxidation Mechanisms Governing Fate and Transport of Contaminants in the Vadose Zone | New Mexico Institute of Mining and Technology | SC | 840 |
| 2000 | 73827 54890* | Non-Invasive Diagnostics for Measuring Physical Properties and Processes in High-Level Waste | University of California - Davis | HLW | 655 |
| 2000 | 73896 55179* | Acoustic Monitor for Liquid-Solid Slurries Measurement at Low Weight Fractions | Syracuse University | HLW | 500 |
| 2000 | 73793 55013* | Biofiltration of Volatile Pollutants: Solubility Effects | Oak Ridge National Laboratory | SC | 840 |
| Geochemistry | | | | | |
| 1996 | 55042 | Quantifying Silica Reactivity in Subsurface Environments | Georgia Institute of Technology | HLW | 359 |
| 1996 | 54548 | Efficacy of Oxidative Coupling for Promoting In-Situ Immobilization in Contaminated Soil and Sediment Systems | University of Michigan | SC | 557 |
| 1996 | 54585 | Permanganate Treatment of DNAPLs in Reactive Barriers and Source Zone Flooding Schemes | Ohio State University | SC | 351 |
| 1996 | 54635 | Molecular-Level Process Governing the Interaction of Contaminants with Iron and Manganese Oxides | Pacific Northwest National Laboratory | SC | 1,450 |
| 1996 | 54741 | Characterization of Contaminant Transport Using Naturally-Occurring U-Series Disequilibria | Los Alamos National Laboratory | SC | 900 |
| 1996 | 54823 | Modeling of Cation Binding in Hydrated 2:1 Clay Minerals | New Mexico State University | SC | 359 |
| 1996 | 54860 | Sorption of Heavy Metals and Radionuclides on Mineral Surfaces in Presence of Organic Co-Contaminants | Stanford University | SC | 784 |
| 1996 | 55014 | Kinetics and Mechanisms of Metal Retention/Release in Geochemical Processes in Soil | Alabama A&M University | SC | 362 |
| 1996 | 55148 | Hydrologic and Geochemical Controls on Radionuclides as Determined by Accelerator Mass Spectrometry | Lawrence Livermore National Laboratory | SC | 1,563 |
| 1996 | 55249 | Determination of Contaminant Metal Mobility as a Function of Temperature, Time, and Solution Chemistry | Lawrence Livermore National Laboratory | SC | 1,130 |
| 1996 | 55284 | Aquifer Transport of Th, U, Ra, and Rn in Solution and on Colloids | California Institute of Technology | SC | 500 |
| 1996 | 55351 | Isotopic Diagnostics Evaluation for Subsurface Characterization and Monitoring | Lawrence Berkeley National Laboratory | SC | 763 |
| 1996 | 55396 | Sorption of Colloids, Organics, and Metals onto Gas-Water Interfaces | Lawrence Berkeley National Laboratory | SC | 1,387 |
| 1997 | 60403 | Phase Chemistry of Tank Sludge Residual Components | Sandia National Laboratories-Albuquerque | HLW | 1,157 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|-------------------|-----------------|---|---|--------------|-----------------|
| 1997 | 60355 | Mineral Surface Processes Responsible for the Decreased Retardation of ¹³⁷ Cs from HLW Tank Discharges | Pacific Northwest National Laboratory | SC | 1,250 |
| 1997 | 59849 | Radionuclide Immobilization in the Phases Formed by Corrosion of SNF | University of Michigan | SNF | 481 |
| 1997 | 59960 | Direct Investigations of Radionuclides Immobilization in SNF Alteration Phases | University of Notre Dame | SNF | 782 |
| 1999 | 70070 | Reactivity of Primary Soil Minerals and Secondary Precipitates Beneath Leaking Hanford Tanks | University of Colorado | SC | 720 |
| 1999 | 70081 | Immobilization of Radionuclides in the Hanford Vadose Zone by Incorporation in Solid Phases | Ohio State University | SC | 1,139 |
| 1999 | 70121 | The Influence of Calcium Carbonate Grain Coatings On Contaminant Reactivity in Vadose Zone | Pacific Northwest National Laboratory | SC | 1,300 |
| 1999 | 70146 | Spectroscopic and Microscopic Characterization of Contaminant Uptake and Retention by Carbonates in Soils and Vadose Zone Sediments | State University of New York at Stony Brook | SC | 767 |
| 1999 | 70163 | The Aqueous Thermodynamics and Complexation Reactions of Anionic Silica Species to High Concentration: Effects on Neutralization of Leaked Tank Wastes and Migration of Radionuclides | Pacific Northwest National Laboratory | SC | 974 |
| 1999 | 70177 | Technetium Attenuation on the Vadose Zone: Role of Mineral Interactions | Pacific Northwest National laboratory | SC | 945 |
| 1999 | 70206 | Calcite Precipitation and Trace Metal Partitioning in Groundwater and the Vadose Zone: Remediation of Sr-90 and Other Divalent Metals and Radionuclides in Arid Western Environments | Idaho National Engineering and Environmental Laboratory | SC | 908 |
| 2000 | 73859 55042* | Quantify Silica Reactivity in Subsurface Environments: An Integrated Study of Quartz and Amorphous Silica to Establish a Baseline for Glass Durability | Virginia Polytechnic Institute and State University | HLW | 500 |
| 2000 | 73745 54585* | Permanganate Treatment of DNAPLs in Reactive Barriers and Source Zone Flooding Schemes | Ohio State University | SC | 380 |
| 2000 | 73758 60355* | Fixation Mechanisms and Desorption Rates of Sorbed Cesium in HLW Contaminated Subsurface Sediments: Implications of Future Behavior and In-Ground Stability | Pacific Northwest National Laboratory | SC | 830 |
| 2000 | 73773 55351* | Isotopic Tracers for Waste Fluid Tracking and Fluid-Soil Interactions: Hanford, Washington | Lawrence Berkeley National Laboratory | SC | 720 |
| 2000 | 73775 55396* | Colloid Genesis/Transport and Flow Pathway Alterations Resulting From Interactions of Highly Reactive Waste Solutions and Sediments in the Vadose Zone | Lawrence Berkeley National Laboratory | SC | 600 |
| 2000 | 73751 59849* | Corrosion of Spent Nuclear Fuel: The Long Term Assessment | The University of Michigan | SNF | 445 |
| 2000 | 73691 59960* | Direct Investigations of the Immobilization of Radionuclides in the Alteration Products of Spent Nuclear Fuel | University of Notre Dame | SNF | 1,026 |
| Geophysics | | | | | |
| 1996 | 55141 | Imaging and Characterizing Underground Storage Tank Waste Materials Using Seismic Normal Modes | Massachusetts Institute of Technology | HLW | 576 |
| 1996 | 54655 | Hydrogeological-Geophysical Methods for Subsurface Site Characterization | University of California at Berkeley | SC | 921 |
| 1996 | 54699 | Dielectric and NMR Measurements to Determine the Pore-Scale Location of Organic Contaminants | University of British Columbia | SC | 486 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|-----------------------|-----------------|--|--|--------------|-----------------|
| 1996 | 55011 | Surface and Borehole Electromagnetic Imaging of Conducting Contaminant Plumes | Lawrence Livermore National Laboratory | SC | 1,088 |
| 1996 | 55218 | Seismic Surface-Wave Tomography of Waste Sites | Georgia Institute of Technology | SC | 358 |
| 1996 | 55300 | 3-D Spectral IP Imaging: Non-Invasive Characterization of Contaminant Plumes | Massachusetts Institute of Technology | SC | 710 |
| 1996 | 55332 | Hybrid Hydrologic-Geophysical Inverse Technique for the Vadose Zone Leachates Assessment and Monitoring | Sandia National Laboratories-Albuquerque | SC | 2,024 |
| 1996 | 55411 | Joint Inversion of Geophysical Data for Site Characterization and Restoration Monitoring | Lawrence Livermore National Laboratory | SC | 1,272 |
| 1997 | 60115 | Advanced High Resolution Seismic Imaging | Rice University | SC | 550 |
| 1997 | 60162 | Very Early Time Electromagnetic (VETEM) Prototype Instrument Enhancements & Characterization | U.S. Geological Survey | SC | 820 |
| 1997 | 60199 | Seismic-Reflection and Ground Penetrating Radar for Environmental Site Characterization | University of Kansas | SC | 630 |
| 1997 | 60328 | High Frequency Electromagnetic Impedance Measurements for Characterization, Monitoring and Verification Efforts | Lawrence Berkeley National Laboratory | SC | 816 |
| 1999 | 70012 | Complex Electrical Resistivity for Monitoring DNAPL Contamination | New England Research, Inc. | SC | 510 |
| 1999 | 70052 | Material Property Estimation for Direct Detection of DNAPL Using Integrated Ground-Penetrating Radar Velocity, Imaging, and Attribute Analysis | University of Wyoming | SC | 648 |
| 1999 | 70108 | Effects of Fluid Distribution on Measured Geophysical Properties for Partially Saturated, Shallow Subsurface Conditions | Lawrence Livermore National Laboratory | SC | 750 |
| 1999 | 70115 | The Use of Radar Methods to Determine Moisture Content in the Vadose Zone | University of British Columbia | SC | 372 |
| 1999 | 70220 | High Frequency Electromagnetic Impedance Imaging for Vadose Zone and Groundwater Characterization | Sandia National Laboratories-Albuquerque | SC | 656 |
| 1999 | 70267 | A Hydrologic-Geophysical Method for Characterizing Flow and Transport Processes within the Vadose Zone | University of Wisconsin- Madison | SC | 1,005 |
| 2000 | 73731 60199* | Automated Shallow Seismic Imaging | University of Kansas | SC | 792 |
| 2000 | 73776 60328* | High Frequency Electromagnetic Impedance Measurements for Characterization, Monitoring and Verification Efforts | Lawrence Berkeley National Laboratory | SC | 870 |
| 2000 | 73830 55218* | Seismic Surface Wave Tomography of Waste Sites | Georgia Institute of Technology | SC | 97 |
| 2000 | 73836 55300* | Induced Polarization with Electromagnetic Coupling: 3D Spectral Imaging Theory and Field Tests | Massachusetts Institute of Technology | SC | 712 |
| 2000 | 73962 60115* | Advanced High Resolution Seismic Imaging, Material Properties Estimation and Full Wavefield Inversion for the Shallow Subsurface | Rice University | SC | 216 |
| Health Science | | | | | |
| 1996 | 54546 | Engineered Antibodies for Monitoring of Polynuclear Aromatic Hydrocarbons | University of California at Berkeley | H/E/R | 891 |
| 1996 | 54684 | Mechanism Involved in Trichloroethylene-Induced Liver Cancer | Pacific Northwest National Laboratory | H/E/R | 1,800 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|---------------------|-----------------|--|--|--------------|-----------------|
| 1996 | 54856 | Structural Biology of the Sequestration & Transport of Heavy Metal Toxins | University of Pennsylvania | H/E/R | 980 |
| 1996 | 54931 | A Novel Biomarker for Beryllium Sensitization in Humans | University of Vermont | H/E/R | 649 |
| 1996 | 54940 | Improved Risk Estimates for Carbon Tetrachloride | Lovelace Biomedical & Environmental Research Institute | H/E/R | 1,000 |
| 1996 | 55032 | Environmental Analysis of Endocrine Disrupting Effects from Hydrocarbon Contaminants in the Ecosystem | Tulane University | H/E/R | 620 |
| 1996 | 55100 | Human Genetic Marker for Resistance to Radiations and Chemicals | Columbia University | H/E/R | 751 |
| 1996 | 55356 | An In-Vivo Model to Evaluate the Health Impact of MW Chemicals | University of California at San Francisco | H/E/R | 970 |
| 1996 | 55410 | Determining Significant Endpoints for Ecological Risk Analysis | Savannah River Ecology Laboratory | H/E/R | 898 |
| 1996 | 54584 | Comparison of Elemental Waste Laden Soils Bioavailability Using In-Vivo and In-Vitro Analytical Methodology | University of Medicine & Dentistry of NJ | SC | 506 |
| 1996 | 55033 | Characterization of Chemically Modified Hyperthermophilic Enzymes | Oak Ridge National Laboratory | SC | 1,393 |
| 1996 | 55185 | Strategies for Designing Inexpensive but Selective Bioadsorbents for Environmental Pollutants | University of Texas at Austin | SC | 749 |
| 1996 | 55343 | Enzyme Engineering for Biodegradation of Chlorinated Organic Pollutants | Lawrence Berkeley National Laboratory | SC | 550 |
| 1997 | 59828 | Bioavailability of Organic Solvents in Soils: Biologically Based Models for Human Risk Assessments | University of California at San Francisco | H/E/R | 1,105 |
| 1997 | 59882 | Measurements of Radon, Thoron, Isotopic Uranium and Thorium to Determine Exposure & Risk | New York University School of Medicine | H/E/R | 630 |
| 1997 | 59918 | Improved Radiation Dosimetry/Risk Estimates | Lovelace Biomedical & Environmental Research Institute | H/E/R | 863 |
| 1997 | 60037 | Estimation of Potential Population Level Effects of Contaminants on Wildlife | Oak Ridge National Laboratory | H/E/R | 619 |
| 2000 | 74050 59882* | Measurement of Radon, Thoron, Isotopic Uranium and Thorium to Determine Occupational and Environmental Exposure | New York University School of Medicine | H/E/R | 400 |
| 2000 | 73942 59918* | Improved Radiation Dosimetry Risk Estimates to Facilitate Environmental Management of Plutonium Contaminated Soils | Lovelace Biomedical & Environmental Research Institute | H/E/R | 1,000 |
| Hydrogeology | | | | | |
| 1996 | 54576 | Inclusion of Interfacial Area Between Phases in the Physical and Mathematical Subsurface Multiphase Flow Description | University of Notre Dame | SC | 845 |
| 1996 | 54680 | Migration and Entrapment of DNAPLs in Heterogeneous Porous Media | University of Michigan | SC | 582 |
| 1996 | 54793 | Establishing a Quantitative Functional Relationship Between Capillary Pressure, Saturation and Interfacial Area | Cornell University | SC | 962 |
| 1996 | 54888 | Manipulating Subsurface Colloids to Enhance Cleanups of DOE Waste Sites | Massachusetts Institute of Technology | SC | 451 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|----------------------------|-----------------|--|---|--------------|-----------------|
| 1996 | 54908 | Partitioning Tracers for In-Situ Detection and Quantification of DNAPLs in Groundwater Systems | University of Arizona | SC | 777 |
| 1996 | 54950 | Characterization of Contaminant Transport in Heterogeneous Vadose Regimes | Lawrence Livermore National Laboratory | SC | 1,200 |
| 1996 | 55036 | Colloid Transport and Retention in Fractured Deposits | Oak Ridge National Laboratory | SC | 1,100 |
| 1996 | 55083 | Behavior of Dense, Immiscible Solvents in Fractured Clay-Rich Soils | University of Tennessee at Knoxville | SC | 600 |
| 1996 | 55109 | New Permeameters for In-Situ Characterization of Unsaturated Heterogeneous Permeability | New Mexico Institute of Mining & Technology | SC | 612 |
| 1996 | 55196 | In Situ, Field Scale Evaluation of Surfactant Enhanced DNAPL Recovery | Oregon State University | SC | 617 |
| 1996 | 55216 | In-Situ Characterization of DNAPLs Using Partitioning Tracers | University of Texas at Austin | SC | 600 |
| 1996 | 55359 | Chaotic-Dynamical Conceptual Model to Describe Fluid Flow and Contaminant Transport in a Fractured Vadose Zone | Lawrence Berkeley National Laboratory | SC | 1,440 |
| 1996 | 55395 | Physics of DNAPL Migration and Remediation in the Presence of Heterogeneities | Sandia National Laboratories-Albuquerque | SC | 1,245 |
| 1997 | 60069 | Least-Cost Ground water Remediation Design Using Uncertain Hydrogeological Information | University of Vermont | SC | 377 |
| 1997 | 60158 | Development of Radon-222 as a Natural Tracer for Monitoring NAPL Contamination Remediation | Oregon State University | SC | 404 |
| 1998 | 65410 | Study of Rapid Migration of Radionuclides Leaked from HLW Tanks | Pacific Northwest National Laboratory | HLW | 905 |
| 1999 | 70069 | Fast flow in Unsaturated Coarse Sediments | Lawrence Berkeley National Laboratory | SC | 450 |
| 1999 | 70135 | Colloid-Facilitated Transport of Radionuclides Through the Vadose Zone | Washington State University | SC | 700 |
| 1999 | 70149 | Dynamics of Vadose Zone Transport: A Field and Modeling Study Using the Vadose Zone Observatory | Lawrence Livermore National Laboratory | SC | 600 |
| 1999 | 70187 | Quantifying Vadose Zone Flow and Transport Uncertainties Using a Hierarchical Approach | Pacific Northwest National Laboratory | SC | 600 |
| 1999 | 70193 | Influence of Clastic Dikes on Vertical Migration of Contaminants on the Vadose Zone at Hanford | Pacific Northwest National Laboratory | SC | 850 |
| 1999 | 70219 | Fate and Transport of Radionuclides Beneath the Hanford Tank-Farms: Unraveling Coupled Geochemical and Hydrologic Processes in the Vadose Zone | Oak Ridge National Laboratory | SC | 1,210 |
| 2000 | 73732 54680* | Migration and Entrapment of DNAPLs in Heterogeneous Systems: Impact of Waste and Porous Media Composition | The University of Michigan | SC | 675 |
| 2000 | 73812 55395* | Physics of DNAPL Migration and Remediation in the Presence of Heterogeneities | Sandia National Laboratory | SC | 900 |
| Inorganic Chemistry | | | | | |
| 1996 | 54724 | Synthesis of New Water-Soluble Metal-Binding Polymers | Los Alamos National Laboratory | D&D | 1,120 |
| 1996 | 54628 | Colloidal Agglomerates in Tank Sludge: Impact on Waste Processing | Pacific Northwest National Laboratory | HLW | 1,788 |
| 1996 | 54646 | Interfacial Radiolysis Effects in Tank Waste Speciation | Pacific Northwest National Laboratory | HLW | 871 |
| 1996 | 54765 | Enhanced HLW Sludge Processing: Hydrothermal Oxidation of Cr, Te, and Complexants by Nitrate | Los Alamos National Laboratory | HLW | 1,020 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|---------------------------|-----------------|---|---|--------------|-----------------|
| 1996 | 54807 | Studies Related to Chemical Mechanisms of HLW Gas Formation | Georgia Institute of Technology | HLW | 320 |
| 1996 | 55137 | Novel Electrode Materials for Electrochemically-Based Remediation of MWs | California Institute of Technology | HLW | 650 |
| 1996 | 55229 | The NO _x System in Nuclear Waste | University of Notre Dame | HLW | 1,201 |
| 1996 | 54506 | Acid-Base a Behavior in Hydrothermal Processing of Wastes | University of Texas at Austin | TMW | 380 |
| 1996 | 54828 | HLW Processing: Spectroscopic Characterization of Redox Reactions in Supercritical Water | Furman University | TMW | 112 |
| 1996 | 54897 | The Sonophysics and Sonochemistry of Liquid Waste Quantification and Remediation | University of Washington | TMW | 770 |
| 1996 | 55115 | The Adsorption and Reaction of Halogenated Volatile Organic Compounds on Metal Oxides | Texas A&M University | TMW | 390 |
| 1996 | 55276 | Fundamental Chemistry and Thermodynamics of Hydrothermal Oxidation Processes | Oak Ridge National Laboratory | TMW | 1,220 |
| 1996 | 54834 | Investigation of Homogeneous and Heterogeneous Sonochemistry for Hazardous Waste Destruction | Purdue University | SC | 290 |
| 1996 | 55061 | Contaminants Removal from Ground and Waste Waters via Reduction by Zero-Valent Metals | University of California at Riverside | SC | 380 |
| 1996 | 55119 | Phase Equilibria Modification by Electric Fields | Oak Ridge National Laboratory | SC | 1,202 |
| 1997 | 60296 | Research Program to Investigate the Fundamental Chemistry of Technetium | Lawrence Berkeley National Laboratory | HLW | 900 |
| 1997 | 59934 | Hazardous Gas Production by Alpha Particles in Solid Organic Transuranic Waste Matrices | University of Notre Dame | TMW | 400 |
| 1998 | 65411 | Precipitation and Deposition of Aluminum-Containing Phases in Tank Wastes | Pacific Northwest National Laboratory | HLW | 1,120 |
| 2000 | 73778 60296* | Research Program to Investigate the Fundamental Chemistry of Technetium | Lawrence Berkeley National Laboratory | HLW | 600 |
| 2000 | 73832 55229* | The NO _x System in Homogeneous and Heterogeneous Nuclear Waste | University of Notre Dame | HLW | 780 |
| Low Dose Radiation | | | | | |
| 1999 | 69848 | Adaptive Response Against Spontaneous Neoplastic Transformation In-Vitro Induced by Ionizing Radiation | University of California at Irvine | H/E/R | 565 |
| 1999 | 69904 | Low-Dose Risk, Decisions, and Risk Communication | Decision Science Research Institute | H/E/R | 1,230 |
| 1999 | 69906 | Markers of the Low-Dose Radiation Response | Medical College of Georgia | H/E/R | 930 |
| 1999 | 69938 | Biological Effects of LLIR and Normal Oxidative Damage: The Same or Different? | Los Alamos National Laboratory | H/E/R | 1,125 |
| 1999 | 69939 | Sensitivity to Radiation-Induced Cancer in Hemochromatosis | Pacific Northwest National Laboratory | H/E/R | 414 |
| 1999 | 69941 | Linking Molecular Event to Cellular Responses at Low-Dose Exposures | Pacific Northwest National Laboratory | H/E/R | 1,216 |
| 1999 | 69980 | Low-Dose Studies with Focused X-rays in Cell and Tissue Models: Mechanisms of Bystander and Genomic Instability Responses | Gray Laboratory Cancer Research Trust | H/E/R | 1,169 |
| 1999 | 69981 | Mechanisms of Enhanced Cell Killing at Low Doses: Implications for Radiation Risk | Gray Laboratory Cancer Research Trust | H/E/R | 1,065 |
| Materials Science | | | | | |
| 1996 | 54914 | Atmospheric-Pressure Plasma Cleaning of Contaminated Surfaces | University of California at Los Angeles | D&D | 1,212 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|-------------|---------------------|---|--|---------------------|------------------------|
| 1996 | 55380 | In-Situ Spectro-Electrochemical Studies of Radionuclide Contaminated Surface Films on Metals | Argonne National Laboratory | D&D | 1,005 |
| 1996 | 54672 | Radiation Effects in Nuclear Waste Materials | Pacific Northwest National Laboratory | HLW | 2,880 |
| 1996 | 54691 | Radiation Effects on Materials in the Near-Field of Nuclear Waste Repository | University of Michigan | HLW | 408 |
| 1996 | 54773 | Microstructural Properties of HLW Concentrates and Gels with Raman and Infrared Spectroscopies | Los Alamos National Laboratory | HLW | 465 |
| 1996 | 54982 | Analysis of Surface Leaching Processes in Vitrified HLWs Using In-Situ Raman Imaging and Atomistic Modeling | University of Florida | HLW | 559 |
| 1996 | 55188 | Chemical Decomposition of High-Level Nuclear Waste Storage/Disposal Glasses Under Irradiation | Naval Research Laboratory | HLW | 489 |
| 1996 | 55367 | Investigation of Microscopic Radiation Damage in Waste Forms Using ODNMR and AEM Techniques | Argonne National Laboratory | HLW | 698 |
| 1996 | 55110 | Alternative Host Matrix for the Vitrification of Specialized Nuclear Waste Forms | University of Missouri at Rolla | TMW | 625 |
| 1996 | 55387 | Photo-oxidation of Organic Waste Using Semiconductor Nanoclusters | Sandia National Laboratories-Albuquerque | TMW | 1,251 |
| 1996 | 55094 | Chemical and Ceramic Methods Toward Safe Storage of Actinides Using Monazite | Rockwell International Corporation | NM | 1,287 |
| 1996 | 55382 | Determination of Transmutation Effects in Crystalline Waste Forms | Argonne National Laboratory | NM | 913 |
| 1997 | 59925 | Modeling of Diffusion of Pu in Other Metals and of Gaseous Species in Plutonium-Based Systems | West Virginia University | D&D | 435 |
| 1997 | 60363 | Optimization of Thermochemical, Kinetic, and Electrochemical Factors Governing Radionuclides Partitioning during Melt Decontamination | Sandia National Laboratories-Albuquerque | D&D | 1,200 |
| <i>1997</i> | 59827 | Influence of Radiation and Multivalent Cation Additions on Phase Separation and Glass Crystallization | University of Arizona | HLW | 723 |
| 1997 | 60020 | Stability of HLW Forms | Oak Ridge National Laboratory | HLW | 762 |
| 1997 | 60345 | New Silicotitanate Waste Forms: Development and Characterization | Pacific Northwest National Laboratory | HLW | 1,200 |
| 1997 | 60362 | Ion-Exchange Processes and Mechanisms in Glasses | Pacific Northwest National Laboratory | HLW | 901 |
| 1997 | 60401 | Mechanism of Pitting Corrosion Prevention By Nitrite in Carbon Steel Exposed to Dilute Salt Solutions | Savannah River Technology Center | HLW | 650 |
| 1997 | 60118 | Fundamental Thermodynamics of Actinide-Bearing Mineral Waste Forms | Los Alamos National Laboratory | NM | 1,150 |
| <i>1997</i> | 60387 | Distribution & Solubility of Radionuclides & Neutron Absorbers in Waste Forms | Pacific Northwest National Laboratory | NM | 1,800 |
| 1998 | 64896 | Decontamination of Radionuclides from Concrete During and After Thermal Treatment | Oak Ridge National Laboratory | D&D | 816 |
| 1998 | 64946 | Mechanisms of Radionuclide-Hydroxycarboxylic Acid Interactions for Decontaminant of Metallic Surfaces | Brookhaven National Laboratory | D&D | 1,150 |
| 1998 | 65366 | Physical, Chemical and Structural Evolution of Zeolite-Containing Waste Forms | Pennsylvania State University | HLW | 510 |
| 1998 | 65408 | Mechanisms and Kinetics of Organic Aging in High-Level Nuclear Wastes | Pacific Northwest National Laboratory | HLW | 900 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|--------------------------|-----------------|--|---|--------------|-----------------|
| 1998 | 65422 | Modeling of Spinel Settling in Waste Glass Melter | Pacific Northwest National Laboratory | HLW | 875 |
| 2000 | 73835 54914* | Atmospheric-Pressure Plasma Cleaning of Contaminated Surfaces | University of California - Los Angeles | D&D | 1,100 |
| 2000 | 73748 60345* | New Metal Niobate and Silicotitanate Ion Exchangers: Development and Characterization | Pacific Northwest National Laboratory | HLW | 900 |
| 2000 | 73750 54672* | Radiation Effects in Nuclear Waste Materials | Pacific Northwest National Laboratory | HLW | 940 |
| 2000 | 73762 54691* | Radiation Effects on Sorption and Mobilization of Radionuclides during Transport through the Geosphere | University of Michigan | HLW | 600 |
| 2000 | 73976 55110* | Iron Phosphate Glasses: An Alternative for Vitrifying Certain Nuclear Wastes | University of Missouri- Rolla | HLW | 520 |
| Microbial Science | | | | | |
| 1996 | 54666 | Mechanisms, Chemistry, and Kinetics of Anaerobic Biodegradation of cDCE and Vinyl Chloride | Stanford University | SC | 686 |
| 1996 | 54681 | Dynamics of Coupled Contaminant and Microbial Transport in Heterogeneous Porous Media | Pacific Northwest National Laboratory | SC | 2,036 |
| 1996 | 55031 | Genetic Analysis of Stress Responses in Soil Bacteria for Mixed Contaminants Enhanced Bioremediation | Pacific Northwest National Laboratory | SC | 1,022 |
| 1996 | 55105 | Complete Detoxification of Short Chain Chlorinated Aliphatics | Michigan State University | SC | 196 |
| 1996 | 55152 | Molecular Profiling of Microbial Communities from Contaminated Sources | University of Maryland at Baltimore | SC | 607 |
| 1996 | 55264 | High Resolution Definition of Subsurface Heterogeneity for Understanding Natural Field Systems Biodynamics | Lawrence Berkeley National Laboratory | SC | 1,525 |
| 1996 | 55416 | Control of Biologically Active Degradation Zones by Vertical Heterogeneity | Idaho National Engineering and Environmental Laboratory | SC | 2,000 |
| 1997 | 60150 | Genetic Engineering of a Radiation-Resistant Bacterium for Mixed Wastes Biodegradation | University of Washington | TMW | 422 |
| 1997 | 59786 | Design and Construction of <i>Deinococcus radiodurans</i> for Biodegradation of Organic Toxins | Uniformed Services University of the Health Sciences | SC | 800 |
| 2000 | 73833 60150* | Genetic Engineering of a Radiation Resistant Bacterium for Biodegradation of Mixed Wastes | University of Washington | TMW | 480 |
| Plant Science | | | | | |
| 1996 | 54837 | Phytoremediation of Ionic and Methyl Mercury Pollution | University of Georgia | SC | 825 |
| 1996 | 54889 | Using Trees to Remediate Groundwaters Contaminated with Chlorinated Hydrocarbons | University of Washington | SC | 651 |
| 1996 | 54898 | Molecular Dissection of the Cellular Mechanisms Involved in Nickel Hyperaccumulation in Plants | Northern Arizona University | SC | 496 |
| 1996 | 55041 | Molecular Characterization of a Novel Heavy Metal Uptake Transporter from Higher Plants | University of California at San Diego | SC | 483 |
| 1996 | 55097 | Heavy Metal Pumps in Plants | Scripps Research Institute | SC | 325 |
| 1996 | 55118 | Plant Rhizosphere Effects on Metal Mobilization and Transport | University of California at Davis | SC | 455 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|------------------------------|-----------------|--|---|--------------|-----------------|
| 1996 | 55278 | Molecular Genetics of Metal Detoxification: Prospects for Phytoremediation | U.S. Department of Agriculture | SC | 578 |
| 1997 | 60271 | Characterization of a New Family of Metal Transport Proteins | Dartmouth College | SC | 600 |
| 1999 | 70054 | Phytoremediation of Ionic and Methyl Mercury Pollution | University of Georgia | SC | 750 |
| 2000 | 73843 55118* | Mechanisms of Heavy Metal Sequestration in Soils: Plant-Microbe Interactions and Organic Matter Aging | California Department of Land, Air, and Water Resources | SC | 450 |
| 2000 | 73858 54889* | Chlorinated Hydrocarbon Degradation in Plants: Mechanisms and Enhancement of Phytoremediation of Groundwater Contamination | University of Washington | SC | 700 |
| Separations Chemistry | | | | | |
| 1996 | 55103 | Utilization of Kinetic Isotope Effects for the Concentration of Tritium | Oak Ridge National Laboratory | TMW | 1,354 |
| 1996 | 54716 | Polyoxometalates for Radioactive Waste Treatment | Georgetown University | HLW | 333 |
| 1996 | 54735 | Development of Inorganic Ion Exchangers for Nuclear Waste Remediation | Texas A&M University | HLW | 600 |
| 1996 | 54996 | Ionizing Radiation Induced Catalysis on Metal Oxide Particles | Pacific Northwest National Laboratory | HLW | 1,110 |
| 1996 | 55087 | Design and Synthesis of the Next Generation of Crown Ethers for Waste Separations | Oak Ridge National Laboratory | HLW | 1,920 |
| 1996 | 54571 | Removal of Heavy Metals and Organic Contaminants from Aqueous Streams by Novel Filtration Methods | Northeastern University | TMW | 330 |
| 1996 | 54770 | New Anion-Exchange Resins for Improved Separations of NM | Los Alamos National Laboratory | TMW | 1,212 |
| 1996 | 54791 | Managing Tight-binding Receptors for New Separations Technologies | University of Kansas | TMW | 350 |
| 1996 | 54847 | Photocatalytic and Chemical Oxidation of Organic Compounds in Supercritical Carbon Dioxide | National Renewable Energy Laboratory | TMW | 660 |
| 1996 | 54942 | Spectroscopy, Modeling and Computation of Metal Chelate Solubility in Supercritical CO ₂ | University of Notre Dame | TMW | 300 |
| 1996 | 55012 | Extraction and Recovery of Mercury and Lead from Aqueous Waste Streams | Colorado State University | TMW | 333 |
| 1996 | 55223 | De Novo Design of Ligands for Metal Separation | Washington University | TMW | 380 |
| 1996 | 54122 | Broad Spectrum Catalytic System for Removal of Toxic Organics from Water By Deep Oxidation | Pennsylvania State University | SC | 327 |
| 1996 | 54661 | Electrochemical Processes for In-Situ Treatment of Contaminated Soils | University of Delaware | SC | 317 |
| 1996 | 54926 | Novel Ceramic-Polymer Composite Membranes for the Separation of Hazardous Liquid Waste | University of California at Los Angeles | SC | 360 |
| 1997 | 60041 | Removal of Radioactive Cations and Anions Using Ligand-Modified Colloid-Enhanced Ultrafiltration | University of Oklahoma | D&D | 539 |
| 1997 | 60283 | Waste Volume Reduction Using Surface Laser Ablation Characterization and Decontamination | Argonne National Laboratory | D&D | 790 |
| 1997 | 59982 | Reactivity of Peroxynitrite: Implications for Hanford Waste Management and Remediation | Brookhaven National Laboratory | HLW | 700 |
| 1997 | 59990 | Fundamental Chemistry, Characterization, and Separation of Technetium in Hanford Waste | Los Alamos National Laboratory | HLW | 730 |
| 1997 | 59993 | Dynamic Effects of Tank Waste Aging on Radionuclide-Complexant Interactions | Los Alamos National Laboratory | HLW | 559 |

| Year | Proposal No. | Title | Primary Research Institution | Problem Area | Funding (\$000) |
|------|-----------------|--|---------------------------------------|--------------|-----------------|
| 1997 | 60017 | Removal of Technetium, Carbon Tetrachloride, and Metals from DOE Properties | Pennsylvania State University | HLW | 390 |
| 1997 | 60050 | Chemical Speciation of Inorganic Compounds under Hydrothermal Conditions | University of Washington | HLW | 850 |
| 1997 | 60123 | Potential-Modulated Intercalation of Alkali Cations into Metal Hexacyanoferrate Coated Electrodes | University of Washington | HLW | 300 |
| 1997 | 60313 | Radiation Effects on Transport and Bubble Formation in Silicate Glasses | Argonne National Laboratory | HLW | 750 |
| 1997 | 60096 | Rational Synthesis of Imprinted Organofunctional Sol-Gel Materials for Toxic Metal Separation | University of Tennessee at Knoxville | TMW | 450 |
| 1997 | 60392 | Radiolytic and Thermal Process Relevant to Dry Storage of SNFs | Pacific Northwest National Laboratory | SNF | 891 |
| 1998 | 64865 | Micelle Formation and Surface Interactions in Supercritical CO ₂ Fundamental Studies for Actinides Extraction | Los Alamos National Laboratory | D&D | 960 |
| 1998 | 64912 | Interfacial, Transport, and Chemical Properties of Aqueous Surfactant Cleaners | Oak Ridge National Laboratory | D&D | 570 |
| 1998 | 64965 | Supercritical Carbon Dioxide-Soluble Ligands for Extracting Actinide Metal Ions from Porous Solids | Argonne National Laboratory | D&D | 926 |
| 1998 | 65339 | Ion Recognition Approach to Volume Reduction of Alkaline Tank Waste | Oak Ridge National Laboratory | HLW | 900 |
| 1998 | 65351 | Solution Effects on Cesium Complexation with Calixarene Crown Ethers | University of Idaho | HLW | 296 |
| 1998 | 65368 | Speciation, Dissolution, and Redox Reactions of Chromium Relevant to HLW Pretreatment and Separation | Lawrence Berkeley National Laboratory | HLW | 899 |
| 1998 | 65378 | Complexants for Actinide Element Coordination and Immobilization | Argonne National Laboratory | HLW | 830 |
| 1998 | 65409 | Electroactive Materials for Anion Separation-Technetium from Nitrate | Pacific Northwest National Laboratory | HLW | 1,567 |
| 2000 | 73824 59982* | Reactivity of Peroxynitrite: Implications for Hanford Waste Management and Remediation Reactivity of Peroxynitrite: Implications for Hanford Waste Management and Remediation | Brookhaven National Laboratory | TMW | 735 |
| 2000 | 73850 54791* | Managing Tight Binding Receptors For New Separations Technologies | University of Kansas | HLW | 225 |
| 2000 | 74019 54864* | The Supramolecular Chemistry of Anion Recognition for Anions of Environmental Relevance | University of Kansas | HLW | 750 |
| 2000 | 73803 55087* | Next Generation Extractants for Cesium Separation from High-Level Waste: From Fundamental Concepts to Site Implementation | Oak Ridge National Laboratory | HLW | 660 |

Acronyms and Abbreviations

| | |
|---------|---|
| D&D | Deactivation and Decommissioning |
| DNA | Deoxyribose Nucleic Acid |
| DNAPL | Dense Non-Aqueous Phase Liquid |
| DOE-SC | Department of Energy Office of Science |
| DOE-ID | Department of Energy Idaho Operations Office |
| EMAB | Environmental Management Advisory Board |
| EMSP | Environmental Management Science Program |
| EM | Office of Environmental Management |
| H/E/R | Health, Ecology, and Risk |
| HLW | High-Level Waste |
| LLW | Low-Level Waste |
| NAS/NRC | National Academy of Sciences/National Research Council |
| NM | Nuclear Materials |
| OST | Office of Science and Technology |
| RFA | Request for Applications |
| SC | Subsurface Contamination |
| SCWO | Supercritical Water Oxidation |
| SNF | Spent Nuclear Fuel |
| STCG | Site Technology Coordinating Group |
| TRU | Transuranic |
| TMW | Transuranic and Mixed Waste |

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