Office of Energy Research
Notice 98-04

Environmental Management Science Program: Research Related to Decontamination and Decommissioning of Facilities

Department of Energy
Office of Energy Research and
Office of Environmental Management

Energy Research Financial Assistance Program Notice 98-04; Environmental Management Science Program: Research Related to Decontamination and Decommissioning of Facilities

AGENCY: U.S. Department of Energy (DOE)

ACTION: Notice inviting grant applications

SUMMARY: The Offices of Energy Research (ER) and Environmental Management (EM), U.S. Department of Energy, hereby announce their interest in receiving grant applications for performance of innovative, fundamental research to support specifically activities for facility decontamination and decommissioning (D&D); which include, but are not limited to, the characterization, monitoring, and certification of contaminated equipment and facilities; contaminant removal, contaminant control of various treatment processes; the treatment, removal, and stabilization of DOE D&D-derived radioactive, hazardous chemical, and mixed wastes.

DATES: Potential applicants are strongly encouraged to submit a brief preapplication. All preapplications, referencing Program Notice 98-04, should be received by DOE by 4:30 P.M. E.S.T., December 16, 1997. A response encouraging or discouraging a formal application generally will be communicated to the applicant within three weeks of receipt. The deadline for receipt of formal applications is 4:30 P.M., E.S.T., March 17, 1998, in order to be accepted for merit review and to permit timely consideration for award in Fiscal Year 1998.

ADDRESSES: All preapplications, referencing Program Notice 98-04, should be sent to Dr. Roland F. Hirsch, ER-73, Mail Stop F-240, Office of Biological and Environmental Research, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290. Preapplications will be accepted if submitted by U. S.

Postal Service, including Express Mail, commercial mail delivery service, or hand delivery, but will not be accepted by fax, electronic mail, or other means.

After receiving notification from DOE concerning successful preapplications, applicants may prepare and submit formal applications. Applications must be sent to: U.S. Department of Energy, Office of Energy Research, Grants and Contracts Division, ER-64, 19901 Germantown Road, Germantown, MD 20874-1290, Attn: Program Notice 98-04. The above address for formal applications must also be used when submitting formal applications by U.S. Postal Service Express Mail, any commercial mail delivery service, or when hand carried by the applicant.

FOR FURTHER INFORMATION CONTACT: Dr. Roland F. Hirsch, ER-73, Mail Stop F-240, Office of Biological and Environmental Research, Office of Energy Research, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290, telephone: (301) 903-5349, fax: (301) 903-0567, E-mail: roland.hirsch@oer.doe.gov, or Mr. Mark Gilbertson, Office of Science and Risk Policy, Office of Science and Technology, Office of Environmental Management, 1000 Independence Avenue, SW, Washington, D.C. 20585, telephone:(202) 586-7150, E-mail: mark.gilbertson@em.doe.gov.

SUPPLEMENTARY INFORMATION: The Office of Environmental Management, in partnership with the Office of Energy Research, sponsors the Environmental Management Science Program (EMSP) to fulfill DOE's continuing commitment to the cleanup of DOE's environmental legacy. The program was initiated in Fiscal Year 1996.

The DOE Environmental Management program currently has ongoing applied research and engineering efforts under its Technology Development Program. These efforts must be supplemented with basic research to address long-term technical issues crucial to the EM mission. Basic research can also provide EM with near-term fundamental data that may be critical to the advancement of technologies that are under development but not yet at full scale nor implemented. Proposed basic research under this notice should contribute to environmental management activities that would decrease risk for the public and workers, provide opportunities for major cost reductions, reduce time required to achieve EM's mission goals, and, in general, should address problems that are considered intractable without new knowledge. This program is designed to inspire "breakthroughs" in areas critical to the EM mission through basic research and will be managed in partnership with ER. ER's well-established procedures, as set forth in the Energy Research Merit Review System, as published in the Federal Register, March 11, 1991, Vol. 56, No. 47, pages 10244-10246, will be used for merit review of applications submitted in response to this notice. This information is also available on the World Wide Web at

http://www.er.doe.gov/production/grants/merit.html. Subsequent to the formal scientific merit review, applications that are judged to be scientifically meritorious will be evaluated by DOE for relevance to the objectives of the Environmental Management Science Program. Additional information can be obtained at ***http://www.em.doe.gov/science***.

Additional Notices for the Environmental Management Science Program may be issued during Fiscal Year 1998 covering other areas within the scope of the EM program.

Purpose

The need to build a stronger scientific basis for the Environmental Management effort has been established in a number of recent studies and reports. The Galvin Commission report ("Alternative Futures for the Department of Energy National Laboratories," February 1995) also provided the following observations and recommendations:

"There is a particular need for long term, basic research in disciplines related to environmental cleanup " … " Adopting a science-based approach that includes supporting development of technologies and expertise " … "could lead to both reduced cleanup costs and smaller environmental impacts at existing sites and to the development of a scientific foundation for advances in environmental technologies."

The Environmental Management Advisory Board Science Committee (Resolution on the Environmental Management Science Program, May 2, 1997) made the following observations:

"EMSP results are likely to be of significant value to EM" ... "Early program benefits, include: improved understanding of EM science needs, linkage with technology needs, and expansion of the cadre of scientific personnel working on EM problems" ... "Science program has the potential to lead to significant improvement in future risk reduction and cost and time savings."

The objectives of the Environmental Management Science Program are to:

- Provide scientific knowledge that will revolutionize technologies and clean-up approaches to significantly reduce future costs, schedules, and risks;
- "Bridge the gap" between broad fundamental research that has wide-ranging applicability such as that performed in DOE's Office of Energy Research and needs-driven applied technology development that is conducted in EM's Office of Science and Technology; and

- Focus the Nation's science infrastructure on critical DOE environmental management problems.

Representative Research Areas

Basic research is solicited in all areas of science with the potential for addressing problems in decontamination and decommissioning of nuclear facilities, an important subject of concern to the Department's Environmental Management Program. The relevant scientific disciplines include, but are not limited to, bioremediation, chemistry (including analytical chemistry and instrumentation, surface chemistry, and separations chemistry), computational sciences (including research and development of digital control algorithms for robotics, communication procedures and software technology for remote control of processing equipment), engineering sciences (including control systems and optimization, diagnostics, transport processes, fracture mechanics, and bioengineering), materials science (including alternate materials processing routes for waste minimization, welding and joining, degradation mechanisms, including corrosion and irradiation damage in radioactive waste forms, and remote sensing and monitoring), and physics (including optical, surface, and fluid physics).

Program Funding

Up to a total of $4,000,000 of Fiscal Year 1998 Federal funds is expected to be available for new Environmental Management Science Program awards resulting from this Notice. Multiple-year funding of grant awards is anticipated, contingent upon the availability of funds. Award sizes are expected to be on the order of $100,000–$300,000 per year for total project costs for a typical three-year grant. Collaborative projects involving several research groups or more than one institution may receive larger awards if merited. The program will be competitive and offered to investigators in universities or other institutions of higher education, other non-profit or for-profit organizations, non-Federal agencies or entities, or unaffiliated individuals. DOE reserves the right to fund in whole or part any or none of the applications received in response to this Notice. A parallel announcement with a similar potential total amount of funds will be issued to DOE Federally Funded Research and Development Centers. All projects will be evaluated using the same criteria, regardless of the submitting institution.

Collaboration and Training

Applicants to the EMSP are strongly encouraged to collaborate with researchers in other institutions, such as universities, industry, non-profit organizations, federal laboratories and Federally Funded Research and Development Centers (FFRDCs),

including the DOE National Laboratories, where appropriate, and to incorporate cost sharing and/or consortia wherever feasible.

Applicants are also encouraged to provide training opportunities, including student involvement, in applications submitted to the program.

Collaborative research applications may be submitted in several ways:

(1) When multiple private sector or academic organizations intend to propose collaborative or joint research projects, the lead organization may submit a single application which includes another organization as a lower-tier participant (subcontract) who will be responsible for a smaller portion of the overall project. If approved for funding, DOE may provide the total project funds to the lead organization who will provide funding to the other participant via a subcontract arrangement. The application should clearly describe the role to be played by each organization, specify the managerial arrangements and explain the advantages of the multi-organizational effort.

(2) Alternatively, multiple private sector or academic organizations who intend to propose collaborative or joint research projects may each prepare a portion of the application, then combine each portion into a single, integrated scientific application. A separate Face Page and Budget Pages must be included for each organization participating in the collaborative project. The joint application must be submitted to DOE as one package. If approved for funding, DOE will award a separate grant to each collaborating organization.

(3) Private sector or academic applicants who wish to form a collaborative project with a DOE FFRDC may not include the DOE FFRDC in their application as a lower-tier participant (subcontract). Rather each collaborator may prepare a portion of the proposal, then combine each portion into a single, integrated scientific proposal. The private sector or academic organization must include a Face Page and Budget Pages for their portion of the project. The FFRDC must include separate Budget Pages for their portion of the project. The joint proposal must be submitted to DOE as one package. If approved for funding, DOE will award a grant to the private sector or academic organization. The FFRDC will be funded, through existing DOE contracts, from funds specifically designated for new FFRDC projects. DOE FFRDCs will not compete for funding already designated for private sector or academic organizations. Other Federal laboratories who wish to form collaborative projects may also follow guidelines outlined in this section.

Preapplications

A brief preapplication may be submitted. The original and five copies must be received by December 16, 1997, to be considered. The preapplication should identify on the cover sheet the institution, PI name, address, telephone, fax and E-mail address for the principal investigator, title of the project, and the field of scientific research (using the list in the Application Categories section). The preapplication should consist of up to three pages of narrative describing the research objectives and the plan for accomplishing them, and should also include a paragraph describing the research background of the principal investigator and key collaborators if any.

Preapplications will be evaluated relative to the scope and research needs of the DOE's Environmental Management Science Program by qualified DOE program managers from both ER and EM. Preapplications are strongly encouraged but not required prior to submission of a full application. Please note that notification of a successful preapplication is not an indication that an award will be made in response to the formal application.

Application Format

Applicants are expected to use the following format in addition to following instructions in the Office of Energy Research Application Guide. Applications must be written in English, with all budgets in U.S. dollars.

- ER Face Page (DOE F 4650.2 (10-91))
- Application classification sheet (a plain sheet of paper with one selection from the list of scientific fields listed in the Application Categories Section)
- Table of Contents
- Project Abstract (no more than one page)
- Budgets for each year and a summary budget page for the entire project period (using DOE F 4620.1)
- Budget Explanation
- Budgets and Budget explanation for each collaborative subproject, if any
- Project Narrative (recommended length is no more than 20 pages; multi-investigator collaborative projects may use more pages if necessary up to a total of 40 pages)

    Goals
    Significance of Project to the EMSP
    Background
    Research Plan

        Preliminary Studies (if applicable)
        Research Design and Methodologies

- Literature Cited
- Collaborative Arrangements (if applicable)
- Biographical Sketches (limit 2 pages per senior investigator)
- Description of Facilities and Resources
- Current and Pending Support for each senior investigator

Application Categories

In order to properly classify each preapplication and application for evaluation and review, the documents must indicate the applicant's preferred scientific research field, selected from the following list.

Field of Scientific Research:

1. Bioremediation
2. Analytical Chemistry and Instrumentation
3. Separations Chemistry
4. Surface Chemistry
5. Computer and Mathematical Sciences
6. Engineering Sciences
7. Materials Science
8. Physics
9. Other

Application Evaluation and Selection

Scientific Merit. The program will support the most scientifically meritorious and relevant work, regardless of the institution. Formal applications will be subjected to scientific merit review (peer review) and will be evaluated against the following evaluation criteria listed in descending order of importance as codified at 10 CFR 605.10(d).

1. Scientific and/or Technical Merit of the Project
2. Appropriateness of the Proposed Method or Approach
3. Competency of Applicant's Personnel and Adequacy of Proposed Resources
4. Reasonableness and Appropriateness of the Proposed Budget.

External peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Non-federal reviewers may be used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

Relevance to Mission. Subsequent to the formal scientific merit review, applications which are judged to be scientifically meritorious will be evaluated by DOE for

relevance to the objectives of the Environmental Management Science Program. These objectives were established in the Conference Report for the Fiscal Year 1996 Energy and Water Development Appropriations Act, and are published in the Congressional Record--House, October 26, 1995, page H10956.

DOE shall also consider, as part of the evaluation, program policy factors such as an appropriate balance among the program areas, including research already in progress. Research funded in the Environmental Management Science Program in Fiscal Year 1996 and Fiscal Year 1997 can be viewed at ***http://www.doe.gov/em52/science-grants.html***.

Application Guide and Forms

Information about the development, submission of applications, eligibility, limitations, evaluation, the selection process, and other policies and procedures may be found in 10 CFR Part 605, and in the Application Guide for the Office of Energy Research Financial Assistance Program. Electronic access to the Guide and required forms is made available via the World Wide Web at ***http://www.er.doe.gov/production/grants/grants.html***.

Major Environmental Management Challenges

This research announcement has been developed for Fiscal Year 1998, along with a development process for a long-term program within Environmental Management, with the objective of providing continuity in scientific knowledge that will revolutionize technologies and clean-up approaches for solving DOE's most complex environmental problems. The following is an overview of the technical challenge facing the Environmental Management Program in the area of Decontamination and Decommissioning which is the focus of this announcement. More detailed descriptions of the specific technical needs and areas of emphasis associated with this problem area can be found in the background section of this Notice.

Deactivation refers to ceasing facility operations and placing the facility in a safe and stable condition to prevent unacceptable exposure of people or the environment to radioactive or other hazardous materials until the facility can be decommissioned. Typically, deactivation involves removal of stored radioactive and other hazardous materials and the draining of systems. Decommissioning is the process of decontaminating or removing contaminated equipment and structures to achieve the desired end state for the facility. Desired end states include complete removal and remediation of the facility, release of the facility for unrestricted use, or release of facility for restricted use. Decontamination is the removal of unwanted radioactive or hazardous contamination by a chemical or mechanical process.

DOE must decontaminate and decommission a large number of aging, surplus facilities. The nature and magnitude of the facility decontamination, decommissioning, and material disposition problems require Environmental Management to address these problems quickly and cost-effectively. In Facility Decontamination and Decommissioning, Environmental Management is attempting to solve the problems of 7,000 contaminated buildings that require deactivation, and 900 contaminated buildings including their contents that require decommissioning. DOE is also responsible for decontaminating the metal and concrete within those buildings and disposing of 180,000 metric tons of scrap metal.

Several themes in the area of Facility Decontamination and Decommissioning were identified from research needs statements. These are summarized below:

- *Characterization*: Improved characterization and monitoring and certification of contaminated equipment and facilities with emphasis on real time characterization in the field.
- *Contaminant removal*: Advances in the removal of contamination from equipment and facilities, particularly metallic structures and equipment, and concrete structures. Other gaps in the knowledge base exist in containment technologies to prevent radioactive emissions and spread of contamination during deactivation and decommissioning; improved knowledge for safe removal of hazardous materials, including asbestos and lead; and remote handling and operations and ideas that could increase worker safety and productivity.
- *Reduction of waste*: Methods for reduction of waste volume produced by decontamination and decommissioning.

The aforementioned areas of emphasis does not preclude, and DOE strongly encourages, any innovative or creative ideas contributing to solving EM D&D challenges mentioned throughout this Notice.

Background

The United States involvement in nuclear weapons development for the last 50 years has resulted in the development of a vast research, production, and testing network known as the nuclear weapons complex. The Department has the challenge of deactivating 7,000 contaminated buildings and decommissioning 900 contaminated buildings that are currently on DOE's list of surplus facilities. It is also responsible for decontaminating the metal and concrete within those buildings and disposing of 180,000 metric tons of scrap metal. As stated earlier, deactivation refers to ceasing facility operations and placing the facility in a safe and stable condition to prevent unacceptable exposure of people or the environment to radioactive or other hazardous materials until the facility can be decommissioned. Typically, deactivation involves

removal of fuel and stored radioactive and other hazardous materials and draining of systems. Decommissioning is the process of decontaminating or removing contaminated equipment and structures to achieve the desired end state for the facility. Desired end states include complete removal and remediation of the facility, release of facility for unrestricted use, or release of facility for restricted use. Decontamination is the removal of unwanted radioactive or hazardous contamination by a chemical or mechanical process.

Decontamination and Decommissioning (D&D) is centered around four main areas of surplus facilities. These are Reactor Facilities, Processing Facilities, Laboratory Facilities, and Infrastructure and Supporting Activities that pertain to all types of surplus facilities.

Reactor facilities include production, test, and research reactors and their associated buildings. These facilities represent a significant portion of DOE's D&D mortgage. The decontamination and decommissioning of these reactors could expose workers to high levels of radiation and hazardous material using currently-available, labor-intensive technologies.

Processing facilities includes plutonium, uranium, tritium, lithium processing facilities, and gaseous diffusion plants. Decommissioning of these facilities could benefit from innovative science in the areas of in-situ characterization and analysis, less costly waste disposal options, automated systems for containment and dismantlement, and material recycling.

Laboratory facilities include hot cells, gloveboxes, and analytical laboratories. Hot cells and gloveboxes have a high-radiation environment with highly-contaminated equipment. Decommissioning of these facilities could benefit from innovative science in the areas of debris removal, wet and dry decontamination methods, waste segregation and volume reduction, and remote and robotic dismantlement techniques.

Infrastructure and Supporting Activities includes innovative science in the areas of worker safety and protection; concrete and metal recycle; pollution prevention; and final waste forms.

This research agenda has been developed for Fiscal Year 1998, along with a development process for a long term program within EM, with the objective of providing continuity in scientific knowledge that will revolutionize technologies and clean-up approaches for solving DOE's most complex environmental problems. The following are descriptions of the Facility Decontamination and Decommissioning challenges which are intended to help align research and researchers in these efforts. Also included in bullet form are the specific science research challenges.

Characterization

Improvement of characterization, monitoring, and certification of contaminated equipment and facilities. Improvements are needed in the area of remote characterization and remote surveying, including improved means to obtain samples remotely from difficult-to-access places such as underground tanks and piping systems and in areas having high radiation fields or other hazardous situations. Rapid automated characterization and certification of levels of surface radioactive contamination on scrap metal is needed; that is, systems which can differentiate between contaminated and non-contaminated equipment and methods to aid in material segregation. Also, advances in engineering sciences associated with development of miniaturized and micro-equipment, robotics, and control theories are needed to support remote inspection needs. A method is needed to trace and plot the exact spatial location of underground piping and unknown buried or embedded objects. Improved remote and non-intrusive methods are needed to verify the existence or absence of contamination in drains, pipes, and associated equipment. Non-destructive characterization mapping methods are needed. Improved radiological characterization and certification of contaminated equipment and facilities are also needed. Improved methods and techniques are needed to detect the presence of asbestos-containing materials in the field in real-time or near real-time. Improved methods and ideas are needed to detect and quantify contaminants that have penetrated below the surface of porous materials such as concrete and transite.

Some examples of specific science research challenges include but are not limited to:

- Research to advance the state-of-the art for radiation-hardened microelectronics, sensors, sample-collection systems, and controls in robotics for remote characterizations in difficult-to-access places and in areas having high radiation fields or other hazardous situations.
- Applications of new principles and innovations to support the development of sensors, detectors, or monitors for rapid automated characterization and certification of levels of radionuclides, asbestos, lead, dioxin, or other toxic substances that may exist on the surface of scrap metal, equipment, and facilities, or be introduced into the atmosphere during cleanup operations.
- Research to expand knowledge of the principles of energy beam-material interactions, including energy coupling, mass removal by vaporization and ablation, particle generation, gas dynamics, solid vapor entrainment, and transport processes, for characterizing and removing contamination from surfaces.

Deactivation. Improved methods and ideas to reduce the cost to survey and maintain facilities awaiting deactivation or decommissioning, including automated, non-

intrusive monitoring of facilities for structural integrity and contaminant migration. Improved methods and ideas should minimize labor and cost to survey and maintain facilities.

Some examples of specific science research challenges include but are not limited to:

- Exploration of computational and artificial intelligence approaches for robotics technology to enhance material packing, disposition, or recycling and thereby help reduce the health risks to workers, as well as the costs and time associated with decontamination and decommissioning.

Contaminant Removal

Improved methods for removing contamination from surfaces, including metals, concrete, and non-porous surfaces. In contaminated facilities, much of the concrete, paint, or similar materials are contaminated only on the surface or to a relatively shallow depth (for concrete, typically less than one inch). Fundamental studies associated with diffusion of species into and out of porous materials are needed to design innovative approaches to cleaning of porous materials. Historically, such materials have been handled by mechanically removing the paint by sanding/blasting or the surface layers of concrete through a scrabbling operation. These processes are slow and costly and directly expose the workers to radiation fields. Dust control is also a problem. In addition to surface contamination, concrete often contains expansion joints or cracks where contamination may have penetrated deeper. Jackhammers are typically used to remove concrete from these cracks or seams in an attempt to remove the contamination. This is a labor intensive operation. It is desired that new or significantly improved ideas be developed to decontaminate these concrete structures and painted areas, and reduce the amount of secondary waste. In addition, improved methods and ideas are needed to remove greater than one-inch depth of concrete surface.

Improved understanding of radionuclide and heavy metal adhesion and adsorption to material surfaces is needed. Fundamental studies associated with structure bonding of materials is advantageous to develop new or improved removal methods. Steel or other metals are often encountered in a variety of shapes and sizes in contaminated nuclear facilities. Since the decontamination of metal often results in the generation of large volumes of secondary waste, the metal is disposed of as radioactive waste rather than expend funds on decontaminating and surveying the metal. New or significantly improved decontamination techniques are needed for stainless steel, copper, nickel, iron, carbon steel structural members, and galvanized siding that could lead to recycling the metal into products for use within DOE, or free releasing the metal to the commercial scrap metal market. The decontamination process should be cost

effective and safe and should not generate large volumes of a secondary waste, which would be difficult or expensive to dispose of. Improved methods and ideas are needed for in-situ decontamination of contaminated pipes.

Some examples of specific science research challenges include but are not limited to:

- Research to develop understanding of the formation and dissolution of surface films, including structure, speciation, composition and energetics.
- Elucidation of the mechanisms of radionuclide and metal adhesion, adsorption, and structural bonding to material surfaces, including work specific to Pu and other actinides.
- Exploration of principles of ultrasonic irradiation and cavitation to evaluate potential for destroying organic contaminants, accelerating reaction rates, enhancing catalysis, and cleaning surfaces.
- Research on the nature and design of ligands that can photo-release radionuclides, metals, and contaminants from surfaces.
- Elucidation of the principles of biological approaches to surface cleaning and diagnostics.

Containment methods/techniques to prevent spread of contamination. Cleanup, decommissioning, dismantling, and construction activities will require containment methods to prevent the spread of contamination offsite or to uncontaminated areas on-site. Containment of the airborne contamination during disassembly and demolition activities is also a problem. Fundamental chemical research is desired for development of fixatives and auto-forming barriers to support development of cost effective containment technology. Fundamental chemical research is needed in the development of cost effective reactant or binding agents. Improved and easily portable containment systems are also needed. Research is needed to improve personal protective equipment to improve the level of worker protection, productivity, and comfort with emphasis on reducing heat stress to workers and ability to safely and comfortably work at heights and in confined or restricted spaces.

Some examples of specific science research challenges include but are not limited to:

- Research to support the development of fixatives, binding agents, and auto-forming barriers for effective containment on surfaces.
- Scientific and engineering research to support development of easily portable systems for containing environmental contaminants.

Remote decontamination and decommissioning handling and operations, including demolition. Improved methods of remote demolition are needed: fast, cost-effective ways of dismantling metal structures, piping, machinery, and concrete structures. The

goal is to reduce the requirement of hands-on dismantlement by D&D workers while reducing the cost of such operations. Basic science is needed to improve the ability of robotic devices to function in harsh environments such as high radiation, high temperature, and/or abrasive environments.

Some examples of specific science research challenges include but are not limited to:

- Work to improve the ability of robotic devices to function in harsh environments such as high radiation, high temperature, and/or abrasive environments.

Improvement of decontamination techniques for process equipment and facilities dismantlement. Research into ways to decontaminate complex process equipment and techniques to recycle materials or reduce waste are needed. Improved methods and ideas are needed to dismantle or cut metallic and other materials in the form of metallic equipment and piping, concrete structures, asbestos-containing materials, and other construction materials.

Some examples of specific science research challenges include but are not limited to:

- Research to remove limitations on achievable power levels in, and ease of control of, remotely operable focused heat sources, such as electron and laser beams.
- Research to establish criteria and methods for the identification and isolation of components which require further treatment.

Reduction of Waste

Reduction of wastes produced by decontamination and decommissioning. Many wastes are generated in the process of decommissioning a contaminated nuclear facility. Typically, large amounts of concrete, metal, and construction materials (e.g., roofing, asphalt, asbestos, lumber, tile, siding, and sometimes electronic equipment) are encountered as waste. Improved methods are needed for volume reduction of decommissioning waste such as metallic equipment, piping, conduit, concrete structures, metallic support structures, and asbestos-containing materials. Recycling or reuse of these materials would result in significant reductions in the volume of waste. Improved techniques or ideas are needed that could dismantle or decontaminate equipment and structures while minimizing the generation of secondary waste.

Some examples of specific science research challenges include but are not limited to:

- Research on fracture mechanisms in various types of materials.

- Elucidation of the principles of the diffusive and advective transport of chemical species in porous or fractured material.
- Engineering research to couple existing surface decontamination methods with diagnostic and control technologies to discriminate between contaminated and non-contaminated areas on heterogeneous surfaces.
- Research to support development of computational and artificial intelligence approaches for robotics technology to enhance material packing, disposition, or recycling and reduce the risks, costs and time associated with decontamination and decommissioning.

Details of the programs of the Office of Environmental Management and the technologies currently under development or in use by Environmental Management Program can be found on the World Wide Web at ***http://www.em.doe.gov*** and at the extensive links contained therein. These programs and technologies should be used to obtain a better understanding of the missions and challenges in environmental management in DOE when considering areas of research to be proposed.

References for Background Information

Note: World Wide Web locations of these documents are provided where possible. For those without access to the World Wide Web, hard copies of these references may be obtained by writing Mark A. Gilbertson at the address listed in the FOR FURTHER INFORMATION CONTACT section.

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http://tikal.inel.gov/tip_int.htm

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http://www.nap.edu/readingroom/books/envmanage/

National Research Council. 1995. Improving the Environment: An Evaluation of DOE's Environmental Management Program. National Academy Press, Washington, D.C.
http://www.nap.edu/readingroom/books/doeemp/

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U.S. Congress, Office of Technology Assessment. Complex Cleanup: The Environmental Legacy of Nuclear Weapons Production, February 1991. U.S. Government Printing Office, Washington, D.C. NTIS Order number: PB91143743. To order, call the NTIS sales desk at (703) 487-4650.
http://www.wws.princeton.edu:80/~ota/disk1/1991/9113_n.html

National Science and Technology Council. 1996. Assessing Fundamental Science, Council on Fundamental Science.
http://www.nsf.gov/sbe/srs/ostp/assess/

The Catalog of Federal Domestic Assistance Number for this program is 81.049, and the solicitation control number is ERFAP 10 CFR Part 605.

John Rodney Clark
Associate Director
for Resource Management
Office of Energy Research

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