Office of Science
Notice 00-05

Natural and Accelerated Bioremediation Research Program

Department of Energy
Office of Science

Office of Science Financial Assistance Program Notice 00-05: Natural and Accelerated Bioremediation Research Program

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

ACTION: Notice inviting grant applications.

SUMMARY: The Office of Biological and Environmental Research (OBER) of the Office of Science, U.S. Department of Energy (DOE), hereby announces its interest in receiving applications for research grants in the Natural and Accelerated Bioremediation Research (NABIR) Program. Applications should describe research projects in one of the following categories:

1. Research projects that address the scientific aims of individual NABIR elements including Biogeochemistry, Biotransformation, Community Dynamics, Biomolecular Science and Engineering, and Assessment.

2. Research projects to be performed at a Field Research Center addressing field scale biostimulation of microbiological processes that immobilize metals and/or radionuclides. Interdisciplinary teams should include, at a minimum, experts in the fields of microbiology, geochemistry, and hydrology.

DOE has proposed to establish a Field Research Center (FRC) at one of two national laboratories, either the Y-12 site near Oak Ridge National Laboratory (ORNL) or the Hanford site at Pacific Northwest National Laboratory (PNNL). DOE is now preparing an Environmental Assessment pursuant to the National Environmental Policy Act (NEPA) to determine whether to prepare an environmental impact statement or a finding of no significant impact for the establishment of an FRC at one of these alternative sites. As part of its assessment, the Department will also evaluate a “no-action” alternative under which it would preserve the status quo and establish no FRC. The Department has identified ORNL as its preferred alternative in the draft Environmental Assessment.

Any awards made to perform research at the FRC will be contingent upon the outcome of this NEPA review, and no awards will be made until the appropriate NEPA review is completed. All research applications that are bounded by the assumptions, impacts, and analysis of the Environmental Assessment will be presumed to be covered by the Assessment. All research applications that appear to exceed the assumptions, impacts, or analysis of the Assessment will be reviewed to determine what, if any additional NEPA review is required.

Applications for research in the Bacterial Transport (Acceleration) or System Integration Elements will not be considered at this time. Applications for research on Bioremediation and its Societal Implications and Concerns (BASIC) will be solicited under a separate announcement.

DATES: Researchers are strongly encouraged (but not required) to submit a preapplication for programmatic review. Early submission of preapplications is encouraged, to allow time for review for programmatic relevance. A brief preapplication should consist of one or two pages of narrative describing the research objectives and methods.

The deadline for receipt of formal applications is 4:30 p.m., E.S.T., February 28, 2000, to be accepted for merit review and to permit timely consideration for award late in Fiscal Year 2000 or in early Fiscal Year 2001. An original and seven copies of the application must be submitted; however, applicants are requested not to submit multiple applications using more than one delivery or mail service.

ADDRESSES: If submitting a preliminary application, referencing Program Notice 00-05, it should be sent by e-mail to anna.palmisano@science.doe.gov.

Formal applications referencing Program Notice 00-05 on the cover page must be forwarded to: U.S. Department of Energy, Office of Science, Grants and Contracts Division, SC-64, 19901 Germantown Road, Germantown, MD 20874-1290, ATTN: Program Notice 00-05. This address must also be used when submitting applications by U.S. Postal Service Express Mail or any other commercial overnight delivery service, or when hand-carried by the applicant.

FOR FURTHER INFORMATION CONTACT: Dr. Anna Palmisano, Environmental Sciences Division, SC-74, Office of Biological and Environmental Research, Office of Science, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290, telephone: (301) 903-9963, e-mail: anna.palmisano@science.doe.gov, fax: (301) 903-8519. The full text of Program

Notice 00-05 is available via the Internet using the following web site address: http://www.sc.doe.gov/production/grants/grants.html.

SUPPLEMENTARY INFORMATION: The mission of the NABIR Program is to provide the fundamental science to serve as the basis for development of cost-effective bioremediation of radionuclides and metals in the subsurface at DOE sites. NABIR research encompasses both intrinsic bioremediation by naturally occurring microbial communities, as well as accelerated bioremediation through the use of nutrient amendments (inorganic, organic or enzymatic) or microbial amendments. The program consists of seven interrelated scientific research elements (Biogeochemical Dynamics, Biotransformation, Community Dynamics and Microbial Ecology, Biomolecular Science and Engineering, Biotransformation and Biodegradation, Bacterial Transport, and Systems Integration/Data Management). The program also includes an element addressing ethical, legal and social issues of bioremediation called Bioremediation and its Societal Implications and Concerns (BASIC). The NABIR program desires to integrate a field research capability with its existing research program. DOE has proposed to establish a Field Research Center (FRC) at one of two national laboratories, either the Y-12 site near Oak Ridge National Laboratory (ORNL) or the Hanford site at Pacific Northwest National Laboratory (PNNL). DOE is now preparing an Environmental Assessment pursuant to the National Environmental Policy Act (NEPA) to determine whether to prepare an environmental impact statement or a finding of no significant impact for the establishment of an FRC at one of these alternative sites. As part of its assessment, the Department will also evaluate a "no-action" alternative under which it would preserve the status quo and establish no FRC. The Department has identified ORNL as its preferred alternative in the draft Environmental Assessment. Any awards made for research to be performed at the FRC will be contingent upon the outcome of this NEPA review, and no awards will be made until the appropriate NEPA review is completed. All research applications that are bounded by the assumptions, impacts, and analysis of the Environmental Assessment will be presumed to be covered by the Assessment. All research applications that appear to exceed the assumptions, impacts, or analysis of the Assessment will be reviewed to determine what, if any, additional NEPA review is required. Additional information about NABIR and the proposed Field Research Center can be accessed from the NABIR Homepage: http://www.lbl.gov/NABIR/.

Program Focus

The NABIR Program supports hypothesis-driven research that will help determine the potential for, and advance the field of, bioremediation as a cleanup option at the DOE sites. The focus of the NABIR Program is on field-scale research addressing metal and radionuclide contamination in subsurface environments at DOE sites. However,

the research program will support laboratory, theoretical, modeling, and other non-field research projects, if they fill gaps that would be necessary to complete understanding for field-scale applications. Although the program is directed at specific goals, it supports research that is more fundamental in nature than demonstration projects. The NABIR program emphasizes the bioremediation of metals and radionuclides in the subsurface below the root zone, including both vadose and saturated zones. Typically, the bioremediation of metals and radionuclides involves, but is not limited to, mobilization and immobilization scenarios. Investigators without access to laboratories licensed to work with radionuclides may propose research with non-radioactive surrogates of radionuclides, or collaborate with investigators working in a licensed laboratory. Research on bioremediation of organic contaminants, such as solvents and complexing agents will not be considered, except to the extent that they influence the primary goal of understanding the remediation of metals and radionuclides. The NABIR Program will not support research to evaluate the risk to humans or to the environment. Applicants are encouraged to review the NABIR Primer, available at http://www.lbl.gov/NABIR/primer/primer.html, for information on contaminants of DOE interest.

NABIR is a research program designed to serve as a foundation for developing microbial in situ bioremediation techniques. Although ancillary benefits of the research to other cleanup needs such as the use of bioreactors to process waste streams are anticipated, NABIR will not support research leading to ex situ treatments. NABIR research may, however, lead to the application of in situ bioremediation in conjunction with other cleanup methods, for example, using bioremediation to mobilize radionuclides so that pump-and-treat techniques could be more effective. Problems characterized by large areas with low-concentration of contaminants are emphasized over problems of localized, high concentrations. Research on phytoremediation will not be supported by NABIR.

Research plans that involve the potential release of nutrients, enzymes, and/or chemicals to the field (both at contaminated and non-contaminated control sites) should discuss the involvement of the public or stakeholders in their research, beginning with experimental design through completion of the project. All applicants should discuss other relevant societal issues, where appropriate, which may include intellectual property protection, and communication with and outreach to affected communities (including members of affected minority communities where appropriate) to explain the proposed research.

A centrally-maintained database is being developed to provide appropriate data, such as site characterization and kinetics data, needed by a broad segment of investigators. Applications shall include a short discussion of the Quality Assurance and Quality Control (QA/QC) measures that will be applied in data gathering and analysis

activities. Successful grantees will be expected to coordinate their QA/QC measures with NABIR program personnel.

Current Request for Applications

Two kinds of projects are solicited in this request for applications:

1. Research projects that address the scientific aims of individual NABIR elements including Biogeochemistry, Biotransformation, Community Dynamics, Biomolecular Science and Engineering, and Assessment.

2. Research projects to be performed at a Field Research Center addressing field scale biostimulation of microbiological processes that immobilize metals and/or radionuclides. Research would be conducted at the proposed NABIR Field Research Center near Oak Ridge National Laboratory, Oak Ridge, TN or the Hanford site at Pacific Northwest National Laboratory (PNNL). Interdisciplinary teams should include, at a minimum, experts in the fields of microbiology, geochemistry, and hydrology.

Applications for research on Bacterial Transport and Systems Integration will not be addressed at this time. Applications for research on Bioremediation and its Societal Implications and Concerns (BASIC) will be solicited under a separate announcement.

Research Projects Addressing Individual Elements

Applicants for research projects within individual program elements should state which science element is most closely aligned with the proposed research. Although applicants may propose research that transcends more than one research element, a primary element should be specified for the purpose of merit review

Biogeochemical Dynamics: Successful bioremediation of metals and radionuclides at DOE sites is closely linked to understanding the complex and dynamic interplay of hydrological, geochemical, and biological processes within geological media. Understanding the natural biogeochemical processes that control the mobility and form of radionuclides is one of the most challenging problems affecting the future viability of bioremediation at DOE sites, particularly within the thick vadose zones and saturated zones below the root zone where much of the contamination resides.

DOE cleanup problems are at the field scale; the immediate priority in biogeochemical dynamics is to understand the underlying mechanisms and processes governing metal and radionuclide behavior to the field. Focus will be on understanding how natural biogeochemical processes control the mobility and

stability of contaminants in waste mixtures, including the biogeochemical processes that modify the form and behavior of contaminants in mixtures. New and creative scientific approaches are sought that address the following fundamental research questions:

- What are the principal biogeochemical reactions that govern the concentration, chemical speciation, and distribution of metals and radionuclides between the aqueous and solid phases?
- What are the thermodynamic and kinetic controls on these reactions?
- What are the major factors controlling the rate and extent of oxidation and reduction of multivalent radionuclides and naturally-occurring metals in various mineral phases? How can these factors be manipulated to enhance or limit the mobility of contaminants?
- What are the biogeochemical and transport processes that control biological availability, transformation, and movement of radionuclides and metals?

Biotransformation: Biotransformation of metals and radionuclides in subsurface environments is poorly understood, and predictive models based on laboratory studies have not always accurately simulated the observed fate of metals and radionuclides in the field. Knowledge of the metabolic pathways for transformation of these contaminants by naturally occurring microbial communities in vadose zones, saturated zones and the waste plume is needed. It is important to understand the kinetics of desirable metal and radionuclide biotransformations and the physicochemical factors affecting those kinetics. Research is needed to address questions such as:

- What are the metal- and radionuclide-transforming capabilities of indigenous microorganisms in deep vadose or saturated zones representative of DOE sites?
- What are the metabolic pathways for microbial transformation of metals and radionuclides, and can these biological processes be harnessed to sequester metals and/or radionuclides in the subsurface?
- What factors control the kinetics of desirable metal and radionuclide biotransformations in vadose and saturated zones?
- How important are microbial consortial interactions in the biotransformation of metals and radionuclides?
- How is the biotransformation of metals and radionuclides affected by chelators?

Community Dynamics and Microbial Ecology: Fundamental research in Community Dynamics and Microbial Ecology at both the molecular and the microbial level is needed to understand the natural intrinsic processes of bioremediation at contaminated sites. Knowledge of microbial community structure and function may ultimately provide the ability to control or stimulate subsurface communities capable

of transformation of radionuclides and metals. The influence of environmental factors on subsurface communities is important to determining the potential for metal and radionuclide biotransformation. Research should be directed toward the characterization of microbial communities at contaminated sites, and toward understanding microbial community dynamics in the presence of metals and radionuclides. Research is needed to address questions such as:

- Is there sufficient biological activity and diversity in subsurface environments to support natural and/or accelerated bioremediation of metals and radionuclides?
- What are the effects of metals and radionuclides on microbial community activity and diversity, including both metabolic and genetic activity and diversity?
- Do different microbial species interact within communities in subsurface environments contaminated with metals and radionuclides? Such interactions might include competition for substrate, or consortial interactions for transformation of metals and radionuclides.

Biomolecular Science and Engineering: The overall goal of research in the Biomolecular Science and Engineering element is to use molecular and structural biology to enhance understanding of bioremediation of metals and radionuclides, and to genetically modify macro-molecules and microorganisms to improve their bioremedial activities. Using information and data gained from other program elements, the molecules, enzymes, and enzymatic pathways that are most effective for bioremediation of metals and radionuclides will be identified. DOE objectives and priorities for research in Biomolecular Science and Engineering are to: (i) identify, clone, and sequence novel genes and promoters important to the bioremediation of metals and radionuclides; (ii) construct or enhance bioremedial enzymatic pathways; and (iii) transfer key genes for bioremediation to microbes that can survive and compete effectively in a contaminated subsurface environment. Field release of genetically engineered microorganisms at the proposed FRC, however, will not be allowed. Research in these areas is encouraged that includes:

- How can we identify and characterize important genes, gene clusters, promoter elements, proteins, and protein pathways involved in the detoxification of metals and radionuclides or that affect the ability of organisms to live and survive under conditions in which metals and radionuclides are present in significant amounts?
- How can we identify and characterize genes, gene clusters, and promoter elements from different organisms that can work together to effect bioremediation?

- How can we identify and characterize the transfer or acquisition of genes, gene clusters, and promoter elements from one organism to another that can influence processes involved in bioremediation?
- What novel and innovative technologies for the identification and characterization of genes, gene clusters, promoters, and pathways involved in bioremediation can be explored and, on a field scale, used?

Assessment: The two primary objectives of research in the Assessment program element are to study innovative and effective methods for assessing or quantifying (i) bioremediation rate and activity, including microbial community structure and dynamics, biotransformation processes and rates, and electron flow; and (ii) bioremediation end points, including not only the concentration and speciation of the contaminants and byproducts but also the stability and bioavailability of residual end-products. NABIR will not, however, fund projects that examine human health risks of end points. Priority will be given to research applications that could lead to fieldable, cost- effective, real time assessment techniques and/or instrumentation. Assessment research addressing bacterial transport will not be covered in this solicitation. Research is sought to answer questions such as:

- Can quantitative techniques be adapted or developed for measurement of microbial community structure, activity, and effectiveness during bioremediation?
- What are the geophysical, geochemical, and hydrologic properties critical to bioremediation effectiveness and how can they be quantitatively determined?
- Can bioremediation endpoints that accurately measure bioavailability be quantitatively established?

Field Scale Bioremediation Experiment

Although bioremediation of metals and radionuclides has been studied in the laboratory, and bioremediation technologies have been demonstrated in the field, there are few examples of carefully controlled, hypothesis-driven, in situ bioremediation research at the field-scale. The availability of contaminated sites for NABIR research at the proposed Field Research Center would create an opportunity for such field scale experiments. The focus of the first set of field experiments at the proposed FRC would be on immobilization of metals or radionuclides in situ by microbiological processes.

Applicants should propose a testable hypothesis for field research, and they should describe a detailed technical approach that should include 1) establishing an experimental and control plot within the proposed contaminated field site, and 2) manipulating the experimental plot by amendments of nutrients or other chemicals

that might stimulate microbial communities to immobilize contaminants such as uranium. A statistically robust sampling regimen to determine the efficacy of the manipulation should also be described. Moreover, the applicant must explain the technical feasibility of performing the proposed field research.

The applicants should propose research to be performed as an interdisciplinary team including, at a minimum, expertise in microbiology, geochemistry and hydrology. The Principal Investigator for the team must have prior experience in relevant field research. Multi-institutional partnerships are strongly encouraged; for example, applicants may draw expertise from National Laboratories, academia, and other institutions engaged in basic research. The applicants should also describe how they would communicate their proposed experimental design and their results to stakeholders, regulators, and community groups. Although compliance with NEPA is the responsibility of DOE, grantees proposing to conduct field research are expected to provide information necessary for the DOE to complete the NEPA review and documentation. For further information on the proposed FRC, access the NABIR Homepage or contact Mr. Paul Bayer (paul.bayer@science.doe.gov).

It is anticipated that approximately $5 million will be available for multiple awards to be made in late FY 2000 and early FY 2001 in the categories described above, contingent on availability of appropriated funds. Applications may request project support up to three years, with out-year support contingent on availability of funds, progress of the research and programmatic needs. Annual budgets for projects in the five scientific research element projects are expected to range from $100,000 to $400,000 total costs. Annual budgets for interdisciplinary field research projects at the proposed FRC are expected to range from $300,000 - $1,000,000 for total costs. Costs for drilling at the proposed FRC should not be included in the applicant's budget. DOE may encourage collaboration among prospective investigators to promote joint applications or joint research projects by using information obtained through the preliminary applications or through other forms of communication.

Applications will be subjected to formal merit review (peer review) and will be evaluated against the following evaluation criteria which are listed in descending order of importance 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.

Also, as part of the evaluation, program policy factors become a selection priority. Note, external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Non-federal reviewers will often be

used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

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 Science Financial Assistance Program. Electronic access to SC's Financial Assistance Application Guide is possible via the World Wide Web at: http://www.sc.doe.gov/production/grants/grants.html. DOE is under no obligation to pay for any costs associated with the preparation or submission of applications if an award is not made. In addition, for this notice, the research description must be 20 pages or less, exclusive of attachments, and must contain an abstract or summary of the proposed research (to include the hypotheses being tested, the proposed experimental design, and the names of all investigators and their affiliations). Attachments should include short curriculum vitae, QA/QC plan, a listing of all current and pending federal support and letters of intent when collaborations are part of the proposed research. Curriculum vitae should be submitted in a form similar to that of NIH or NSF (two to three pages), see for example: http://www.nsf.gov:80/bfa/cpo/gpg/fkit.htm#forms-9.

The Office of Science as part of its grant regulations requires at 10 CFR 605.11(b) that a recipient receiving a grant and performing research involving recombinant DNA molecules and/or organisms and viruses containing recombinant DNA molecules shall comply with the National Institutes of Health (NIH) "Guidelines for Research Involving Recombinant DNA Molecules," which is available via the world wide web at: http://www.niehs.nih.gov/odhsb/biosafe/nih/rdna-apr98.pdf, (59 FR 34496, July 5, 1994,) or such later revision of those guidelines as may be published in the Federal Register.

Grantees must also comply with other federal and state laws and regulations as appropriate, for example, the Toxic Substances Control Act (TSCA) as it applies to genetically modified organisms. Although compliance with NEPA is the responsibility of DOE, grantees proposing to conduct field research are expected to provide information necessary for the DOE to complete the NEPA review and documentation.

Additional information on the NABIR Program is available at the following web site: http://www.lbl.gov/NABIR/. For researchers who do not have access to the world wide web, please contact Karen Carlson; Environmental Sciences Division, SC-74; U.S. Department of Energy; 19901 Germantown Road; Germantown, MD 20874-1290; phone: (301) 903-3338; fax: (301) 903-8519; E-mail:

karen.carlson@science.doe.gov; for hard copies of background material mentioned in this solicitation.

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

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Associate Director of Science
for Resource Management

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