Office of Science
Notice 01-12

Natural and Accelerated Bioremediation Research (NABIR) Program

Department of Energy
Office of Science

Office of Science Financial Assistance Program Notice 01-12: Natural and Accelerated Bioremediation Research (NABIR) 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 (SC), 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 that address the scientific aims of individual NABIR Science Elements including Biogeochemistry, Biotransformation, Community Dynamics, as well as Assessment projects that relate to those elements. Applications for research in other elements will not be considered at this time. Applications for research on Bioremediation and its Societal Implications and Concerns (BASIC) have been solicited under a separate announcement (Notice 00-21).

DATES: Researchers are strongly encouraged (but not required) to submit a preapplication for programmatic review. The deadline for preapplications is January 8, 2001. 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, 2001, to be accepted for merit review and to permit timely consideration for award late in Fiscal Year 2001 or in early Fiscal Year 2002. 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 preapplication, referencing Program Notice 01-12, it should be sent by e-mail to: anna.palmisano@science.doe.gov.

Formal applications referencing Program Notice 01-12 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 01-12. 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 01-12 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. In particular, the program focuses on research that will lead to immobilization of radionuclides and/or metals in place, or that will reduce re-mobilization. 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 has established a Field Research Center (FRC) at the Y-12 site near Oak Ridge National Laboratory (ORNL). The FRC is a focal point of NABIR field research and can provide investigators with DOE-relevant samples contaminated with uranium and other radionuclides or metals. Additional information about NABIR and the 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 for radionuclides and metals in subsurface environments (both vadose and saturated zones, below the root zone) at the DOE sites. Contaminants of particular interest are

the radionuclides uranium, technetium, and plutonium and the metals chromium and mercury. While the focus of the NABIR Program is on field-scale research, the research program will support laboratory, theoretical, modeling, and other non-field research projects, if they fill gaps that would be necessary to improve understanding required for field-scale applications. Problems characterized by large areas with low-concentration of contaminants are emphasized over problems of localized, high concentrations. NABIR research will focus on research leading to immobilization rather than mobilization scenarios for bioremediation of metals and radionuclides. Although the program is directed at specific goals, it supports research that is more fundamental in nature than demonstration projects.

NABIR will not support research leading to ex situ treatments, nor will research on phytoremediation be supported. 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 radionuclides and metals. The NABIR Program will not support research to evaluate the risk of contaminants to humans or to the environment.

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. Applications involving microbial amendments will be solicited in a separate announcement. 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).

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 managers.

Current Request for Applications

Research projects that address the scientific aims of individual NABIR elements, including Biogeochemistry, Biotransformation, Community Dynamics, as well as Assessment projects supporting those three elements are being solicited. Applications for research on other elements will not be addressed at this time. Applications for research on Bioremediation and its Societal Implications and Concerns (BASIC) have

been solicited under a separate announcement (Notice 00-21). Applicants for research projects within individual program elements should state which science element is most closely aligned with the proposed research. Applicants are encouraged to propose interdisciplinary research that transcends more than one research element. However, a primary element should be specified for the purpose of merit review.

Biogeochemical Dynamics

The goal of this area is to understand the fundamental biogeochemical reactions that would lead to long-term immobilization of metal and radionuclide contaminants in the subsurface. The focus is on reactions that govern the concentration, chemical speciation, and distribution of metals (Cr, Hg) and radionuclides (U, Tc, Pu) between the aqueous and solid phases.

Contaminated subsurface environments are complex. Biogeochemical reactions in subsurface environments are influenced by a wide variety of factors, including the availability of electron donors and acceptors, the nature of the microbial community, the chemical species or form of contaminant, the hydrology, and the nature of the environmental matrix. Often several competing redox reactions make the prediction of the substrates, products, and kinetics difficult. The biogeochemical reactions are further complicated by the sorption of contaminants and reaction products to mineral surfaces, and the presence of natural organic matter and co- contaminants. The research challenge is to identify and prioritize the key biogeochemical reactions that are needed to predict the rate and extent of reactions to immobilize radionuclides and metals for long term stability. New and creative scientific approaches are sought that address the following fundamental research questions:

- With the goal of increasing immobilization of radionuclides and metals, 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? How do factors such as co- contaminants, sorption processes, and the structure and composition of minerals that serve as terminal electron acceptors, influence these reactions?
- With the goal of decreasing the possible re-mobilization of immobilized radionuclides and metals, how can the above questions be addressed? Under what conditions would the contaminants remobilize, and what alterations to the environment would increase the long-term stability of metals and radionuclides in the subsurface?
- What influence do hydrological processes such as reactive transport, advective/dispersive transport and colloidal transport have on the biological availability, transformation, and movement of radionuclides and metals?

Biotransformation

DOE subsurface sites encompass a range of redox environments where contaminants such as uranium are present. One challenge is to understand the impact of these environments on microbial physiological processes involved in the transformation of radionuclides and metals to an immobilized form. 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. A second challenge is to accelerate the rates of these physiological processes in situ, in complex subsurface environments. Biotransformation of metals and radionuclides in the subsurface 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. 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 primary metabolic pathways for biotransformation of radionuclides and/or metals by subsurface microorganisms at DOE sites, such as the FRC?
- Can these biotransformations be harnessed or accelerated to immobilize radionuclides and/or metals in the subsurface?
- What environmental controls affect microbial physiological processes involved in radionuclide and metal biotransformations leading to immobilization in vadose and saturated zones? What factors inhibit these transformations in situ?

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. One challenge is to determine if sufficient genotypic and/or phenotypic potential exists to support natural and/or accelerated (biostimulated) bioremediation. 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. A second challenge is to optimize the community structure and activity for immobilization of radionuclides and metals, and to determine the long term stability of bioremediative communities. 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 (or other environmental factors) on microbial community activity and diversity, particularly of populations that transform radionuclides and metals?
- What is the role of consortial interactions on biotransformations of metals and radionuclides in contaminated subsurface environments? Such interactions might include competition for electron donors and acceptors, or other consortial interactions that affect the transformation of metals and radionuclides.
- What is the potential importance of gene transfer in natural microbial communities at subsurface sites contaminated with radionuclides or metals?

Assessment

The Assessment Element is a cross-cutting element with a goal to develop innovative methods to assess processes and endpoints in support of the NABIR Science Elements. In this call, assessment projects that support the Science Elements of Biogeochemistry, Biotransformation, and Community Dynamics/Microbial Ecology are being sought. Methods may range from molecular to field scale, but they should improve the understanding of in situ bioremediation processes in subsurface environments contaminated with radionuclides and metals. Priority will be given to research applications that could lead to fieldable, cost-effective, real time assessment techniques and/or instrumentation. NABIR will not fund projects that examine endpoints relating to human health risks. Research should address the development of innovative and effective methods for assessing or quantifying:

- Biogeochemical processes, biotransformation processes and rates, and microbial community structure and function relative to bioremediation of metals and radionuclides.
- Bioremediation end points, in particular, the concentration, speciation and stability of radionuclide and metal contaminants.

Program Funding

It is anticipated that approximately $2 million will be available for multiple awards to be made in late FY 2001 and early FY 2002 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 four scientific research element projects are expected to range from $100,000 to $400,000 total costs. 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.

Merit Review

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.

Submission Information

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. Renewal applications must include a list of publications resulting from prior NABIR funding. 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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for Resource Management

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