Office of Energy Research
Notice 98-14

Natural and Accelerated Bioremediation Research Program (NABIR)

Department of Energy
Office of Energy Research

Energy Research Financial Assistance Program Notice 98-14; Natural and Accelerated Bioremediation Research Program (NABIR)

Agency: U.S. Department of Energy

Action: Notice inviting research grant applications.

SUMMARY: The Office of Biological and Environmental Research (OBER) of the Office of Energy Research (ER), 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. Grant applications are being solicited for five of the eight NABIR Program research elements: (1) Assessment; (2) Biotransformation and Biodegradation; (3) Community Dynamics and Microbial Ecology; (4) System Engineering, Integration, Prediction, and Optimization; and Bioremediation and its Social Implications and Concerns (BASIC).

DATES: Applicants should submit a Notice of Intent to Apply, containing a title, a list of investigators, and a five-line summary of proposed research by April 15, 1998.

The deadline for receipt of formal applications is 4:30 p.m., E.D.T., May 13, 1998, to be accepted for merit review and to permit timely consideration for award in fiscal year 1998.

ADDRESSES: Notices of Intent to Apply, referencing Program Notice 98-14, should be sent by E-mail to john.houghton@oer.doe.gov.

Formal applications, referencing Program Notice 98-14, 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 98-14. 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. John Houghton, Environmental Sciences Division, ER-74, Office of Biological and Environmental Research, Office of Energy Research, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290, telephone (301) 903-8288, E-mail john.houghton@oer.doe.gov, fax (301) 903-8519. The full text of Program Notice 98-14 is available via the Internet using the following web site address: ***http://www.er.doe.gov/production/grants/grants.html***.

SUPPLEMENTARY INFORMATION: The mission of the NABIR Program is to provide the scientific understanding needed to use natural in situ processes and to develop new methods to accelerate those processes for bioremediation at DOE facilities. The NABIR program is initially emphasizing the bioremediation of metals and radionuclides in the subsurface below the root zone, including both thick vadose and saturated zones. The program is implemented through seven interrelated scientific research elements (Acceleration, Assessment, Biogeochemical Dynamics, Biomolecular Science and Engineering, Biotransformation and Biodegradation, Community Dynamics and Microbial Ecology, and System Engineering, Integration, Prediction, and Optimization); and a social and legal element called Bioremediation and its Social Implications and Concerns (BASIC). A document entitled Natural and Accelerated Bioremediation Research Program Plan (DOE/ER-0659T) containing an initial planning description of the NABIR Program and each of the science elements is available via the Internet using the following web site address: ***http://www.er.doe.gov/production/ober/nabir/cover.html***. The NABIR Program Plan is also available from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831 (DOE and DOE grantees only) and the U.S. Department of Commerce, Technology Administration, National Technical Information Service, Springfield, VA 22161, (703) 487-4650 (public source). Additional information about NABIR, such as references to infrastructure that could be available to the research community, can be accessed from the NABIR Homepage: ***http://www.lbl.gov/NABIR/***. Abstracts of currently funded projects are available via the Internet using the following web site address: ***http://www.lbl.gov/NABIR/awardees.html***.

Each scientific research element is directed by a program manager from OBER, who is responsible for providing support and overall direction for the element, including determining the relevance of the proposed research to the goals and objectives of the program element to the NABIR and other DOE programs. The NABIR program also has Science Team Leaders, selected through an earlier peer review process, who provide scientific leadership and coordination to the community of NABIR investigators. Information on the current Science Team Leaders and DOE program

staff is available via the Internet using the following web site address: ***http://www.lbl.gov/NABIR/research_5.html***.

Program Focus

The NABIR Program supports long-term, hypothesis-driven research directed at specific topics that will provide the understanding necessary to develop effective new bioremediation technologies for DOE site cleanup. This research will help determine the future viability of bioremediation technologies at the DOE sites. The NABIR Program will not support research to evaluate the risk to humans. Although the program is directed at specific goals, it supports research that is more fundamental in nature than demonstration projects.

The initial emphasis of the NABIR Program is on field-scale research and metal and radionuclide contamination, specifically on the metals and radionuclides associated with past weapons production activities. However, the research program will support laboratory, theoretical, modeling, and other non-field research projects, if they fill important gaps that would be necessary to complete understanding for field-scale studies. The study of real problems might iterate between, for example, the laboratory and the field. Investigators without access to laboratories licensed to work with radionuclides may propose research with non-radioactive surrogates of radionuclides, or collaborate with a licensed laboratory. Typically, the bioremediation of metals and radionuclides involves, but is not limited to, mobilization and immobilization scenarios. Consideration of organic contaminants, such as solvents and complexing agents that would be important substrates, facilitators, inhibitors, or sources of carbon or electron donors or acceptors, can be included in the proposed research to the extent that they influence the primary goal of understanding the remediation of metals and radionuclides. Applicants are encouraged to review Chemical Contaminants on DOE Lands, DOE/ER-0547T, available at the OBER Homepage: ***http://www.er.doe.gov/production/ober/EPR/contam.pdf***, for a compilation of wastes and waste mixtures at the DOE sites.

NABIR is a research program designed to serve as a foundation for microbial in situ bioremediation techniques. Although "spillover" benefits of the research to other cleanup needs such as the use of bioreactors to process waste streams are anticipated, NABIR emphasizes investigations into bioremediation of subsurface waste sites and their by-products released to the environment. This emphasis includes research that will assist 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 contamination are emphasized over problems of localized,

high concentration contamination. Research on phytoremediation will not be supported during this funding period.

In research plans that involve the potential release of chemicals, enzymes, and/or microorganisms to the field (both at contaminated and non-contaminated control sites), applicants must discuss how they will involve 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.

NABIR Infrastructure

The NABIR program anticipates selecting at least one Field Research Center (FRC) located at a DOE site. The FRC will serve as a central facility for researchers to use at their option. However, FRCs will not be identified for at least a year from the date of this solicitation and until National Environmental Policy Act (NEPA) review of the NABIR Program is complete. Applicants may use any available contaminated or uncontaminated field site that is presently available to them, including but not limited to DOE sites. However, investigators are encouraged to consult the listing of current FRC-related field research sites and facilities available to NABIR investigators on the NABIR Homepage, at ***http://www.lbl.gov/NABIR/research_6.html***. Investigators should describe how their research will interface with or transfer to field-scale research at the site they are using, to FRC-related sites, or to the FRC site that will be available in the future. A centrally maintained database will be developed to provide limited information, such as site characterization and kinetics data, that will be needed by a broad segment of investigators. When appropriate, applications must 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 applicants will be expected to coordinate their QA/QC protocols with NABIR program personnel. A draft of guidelines to be used by Natural and Accelerated Bioremediation Research (NABIR) program investigators in managing their information and data can be found on the NABIR Homepage: ***http://www.lbl.gov/NABIR/data-guide.html***.

Scientific Research Elements

The following sections describe each of the NABIR scientific research elements that are emphasized in this solicitation. Applicants may propose research that transcends more than one research element; it is also anticipated that many applications could be placed in more than one element. However, each application should identify the one

science element most closely aligned with the proposed research, to facilitate scientific review.

Assessment: Current methods for measuring and predicting the effectiveness of bioremediation are inadequate and, in most cases, poorly developed. Demonstrating the effectiveness of bioremediation will require documentation for direct measures, such as alteration of contaminant mobility, or indirect measures, such as accumulation of undesirable by-products. The Assessment program seeks the development of innovative and effective methods to assess:

- bioremediation rate and activity, including microbial community structure and dynamics, biotransformation processes and rates, and electron flow; and
- bioremediation endpoints, including not only the concentrations of contaminants and byproducts but also the stability, bioavailability, and toxicity of residual end-products. NABIR will not, however, fund projects that examine human health risks of endpoints.

This element will focus on developing techniques for assessing the bioremedial activities of individual microbial strains and functional groups within a community and on validating existing and emerging laboratory and field techniques. Priority will be given to research applications that could result in techniques and/or instrumentation that: (i) operate in real time; (ii) operate in field-scale heterogeneous environments; (iii) are cost-effective; and (iv) determine endpoints that more closely approximate limited or non-bioavailability. Research is sought to answer questions such as:

- Can quantitative techniques be adapted or developed for measurement of microbial community structure, movement, activity, and effectiveness during bioremediation?
- How can geophysical, geochemical, and hydrologic properties critical to bioremediation effectiveness be determined?
- What new methods might be developed to interpret complex data sets, including temporal and spatial variability in support of bioremediation management?
- Can bioremediation endpoints that accurately measure bioavailability be quantitatively established?

An important priority is the development of "core scale" and field scale technologies to measure viable biomass, community composition, and nutritional status and "core scale" interrogation technologies. These technologies would address such items as biogeochemical processes that control mineral and contaminant distribution, metabolic activity (especially low-level), biotransformation rates, and hydraulic and

hydrogeochemical variables that control microbial distribution. Priority will be given to new and advanced techniques that are likely to be available for use at the NABIR Field Research Center in two to three years (***http://www.lbl.gov/NABIR/research_6.html***).

Biotransformation and Biodegradation: The goal of all bioremediation efforts is to reduce the potential toxicity of chemical contaminants in the field by using living organisms or their products to mineralize, degrade, transform, mobilize, or immobilize contaminants. There is already a significant base of knowledge about many pathways for organic chemical degradation, and several important contaminant degradation mechanisms are presently under detailed investigation. However, the understanding of biotransformation and biodegradation pathways and mechanisms in the field is incomplete. Although the degradation of many organic compounds and the biotransformation of some inorganic compounds in laboratory cultures have been well described, it is often unclear how this information relates to bioremediation processes under field conditions. The biotransformation of metals and radionuclides in thick, variably saturated, vadose zones is poorly understood. Successful laboratory studies have not allowed for predictions about the fate of complex chemical mixtures that include metals and radionuclides in the field. It would be useful to understand: (i) the metabolic pathways taken by mixtures of chemicals in the presence of complex microbial communities in vadose zones and their interfaces with saturated zones and the waste plume; (ii) the kinetics of desirable metal and radionuclide biotransformations and the physicochemical factors affecting the kinetics of those transformations; and (iii) the relationships between microbial cell microenvironments and aqueous geochemistry related to the sequestration, release, precipitation, solubility, organic complexation, or chemical modification (e.g., oxidation/reduction) of metals and radionuclides. Priority will be given to applications for research: (i) using multiple contaminants; (ii) using microbial consortia; and (iii) on microbial processes that permanently sequester or chemically alter metallic or radioactive constituents of mixed wastes. Research is needed to address questions such as:

- How can laboratory studies, especially those involving interdisciplinary approaches or mixed culture approaches, be used to accurately represent field situations and allow for predictions of chemical fate?
- How important are microbial species interactions in the biotransformation of metals and radionuclides?
- How do organic and inorganic co-contaminants, i.e., mixed wastes, affect the rates of microbial biotransformation of metals and radionuclides?
- What factors control the fates and kinetics of microbial metal and radionuclide biotransformations in vadose and saturated zones?

- What are the critical characteristics of sites where natural biotransformation and biodegradation of mixed metal and radionuclide wastes are occurring that promote these processes?
- Can microbiological processes be harnessed to permanently sequester metals and/or radionuclides in the subsurface?
- What are the metal- and radionuclide-transforming capabilities, including metabolic pathways, of indigenous microorganisms in deep vadose or saturated zones representative of DOE sites?

Community Dynamics and Microbial Ecology: Fundamental research in Community Dynamics and Microbial Ecology at both the molecular and the organismal level is needed to understand better the natural intrinsic processes of bioremediation in mixed contaminant sites. A more complete understanding of energetics at the community level may ultimately provide the ability to control or stimulate communities capable of transformation and to channel carbon flow (including natural- and polluting-organic compounds) through these communities or populations. It is essential to understand the roles and interactions of diverse microbial communities in order to understand how and to what extent the structure of the biological community influences the course of bioremediation and to what extent the environmental factors influence community dynamics in sites containing metals and radionuclides. This need is especially critical to successful bioremediation of diffuse metals and radionuclides in thick vadose and deep saturated zones. Research should be directed toward: (i) identifying and characterizing microbial communities at contaminated sites; (ii) understanding the dynamics of in situ microbial communities in the presence of metals and radionuclides; (iii) bacterial survival, including toxic effects from metals and radionuclides; and (iv) measuring key microbial metabolic and transformation processes including reduction, oxidation, mobilization/immobilization, and bacterial survival, including bacterial predation. A specific interest is the understanding of bacterial activity in biofilms that can alter contaminants during intrinsic bioremediation and in situ biostimulation. Research utilizing column and in situ environments is encouraged particularly with non-destructive techniques and real or near-time monitoring.

Particular attention should be given to:

- the distribution, composition and metabolic activity of biofilms particularly at the field scale;
- the ecology and dynamics of microbial communities as a function of local environmental conditions;
- quantifying the spatial distribution of in situ microbial communities, particularly at the field scale;

- environmental factors that affect the presence, abundance, and diversity of in situ, subsurface microbial communities, and
- fluxes of nutrients and electron donors in the saturated/vadose zones across stratigraphic boundaries where differences in microbial activity occur.

System Engineering, Integration, Prediction, and Optimization: This research element primarily supports modeling activities. One goal of the NABIR program is to produce a model or series of models that will help stimulate bioremediation in the field, predict whether bioremediation will be successful and, if so, how to optimize the approach. Models that take advantage of advanced computational tools can be useful for many reasons, including providing a better understanding of the underlying processes, serving as a way to focus attention on the intersection or coupling between processes and subject areas, and identifying priority or rate-limiting processes. One of the distinguishing features of the NABIR program is its emphasis on integrating among the disciplines and research projects. Models can serve as effective tools to improve integration.

This announcement solicits applications that would, at the end of one year of research, define the structure and the content of an integrative model for the NABIR program. However, the investigators would not necessarily construct the model. Instead, they would identify possible data, tools, resources, or information needed for the development of an integrative model. The investigators might, for example, hold workshops or prepare reviews of existing models, including their advantages and limitations. They might identify criteria for a successful integrative model, suggesting parameters for input and output.

Models eventually developed by and for the NABIR program will focus on the in situ bioremediation of metals and radionuclides. An integrative model will include functions such as water flow and transport, chemical and microbiological reactions, as well as peripheral capabilities, such as statistics, geographic information systems, visualization, and uncertainty analysis. The model must be flexible enough to capture and test process models developed in NABIR research projects. Models will be used, in part, to help set future research priorities of the NABIR program by highlighting missing research topics.

The application should describe the manner in which the investigators will interact with the rest of the NABIR research community and the breadth of capability of the investigators proposing the research. It is anticipated that a future solicitation will be offered for the development of an integrative model following the selection of a Field Research Center and on the results of this solicitation. Awards will be made for up to one year. Anticipated levels of funding are $250,000 or less, contingent on the availability of appropriated funds.

Bioremediation and its Societal Implications and Concerns (BASIC): The introduction of non-native or genetically engineered microorganisms or the manipulation of the environment to change its microbial composition or chemical characteristics may raise concerns among those who live or work nearby. Even the reintroduction of native microorganisms into their natural environment can raise people's concerns. Great care is required to involve the affected communities and stakeholders in any plans to use novel agents and/or processes to remediate a contaminated site. Although it may be many years before work in the NABIR Program supports any or all of these activities, it is wise to begin consideration of some of the issues involved now. The Bioremediation and its Societal Implications and Concerns (BASIC) component of the NABIR program is directed at these societal implications of bioremediation.

DOE seeks applications that address effective ways to: (i) articulate the risks and benefits of in situ bioremediation to stakeholders; and (ii) involve affected communities in bioremediation research and decision making. This can include studies or conferences that will identify and clarify the most urgent issues. It is essential that studies, explorations, and discussions of the societal implications of bioremediation research be firmly grounded in the actual NABIR science. As a result, DOE solicits applications for the preparation and dissemination of educational materials, in any appropriate medium, that will enhance understanding of the scientific as well as the societal aspects of bioremediation among the general public or specified groups. Educational efforts that target specific groups should include a detailed description of the relationship between NABIR and that group or community in addition to assessment measures for determining the effectiveness of the educational effort. DOE also encourages applications for the support of conferences focusing on the legal and societal implications of NABIR.

Applicants should demonstrate their knowledge of any relevant literature and should include detailed plans for the gathering and analysis of factual information and its societal implications. Where appropriate, applicants may make use of relevant activities or field sites where bioremediation experiments are planned or underway. All research applications should address the issue of efficient dissemination of results to the widest appropriate audience. Examples of BASIC issues might include:

- effective education of stakeholders and others regarding the underlying NABIR science;
- clarification of public perception of bioremediation issues;
- past experiences and lessons learned from bioremediation using exogenous or engineered organisms;
- bioremediation strategies and technologies involving microbes - the experiences of the commercial sector; and

- intellectual property issues of microbes intended for use in field level bioremediation.

Additional information on the NABIR Program, including those elements which are not a part of this solicitation, 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 Ms. Carlson; Environmental Sciences Division, ER-74; U.S. Department of Energy; 19901 Germantown Road; Germantown, MD 20874-1290; phone (301) 903-3338; fax (301) 903-8519; karen.carlson@oer.doe.gov; for hard copies of background material mentioned in this solicitation.

Program Funding

It is anticipated that up to $3 million will be available for multiple awards to be made in FY 1998 in the categories described above, contingent on the availability of appropriated funds. Applications may request project support up to three years, with out-year support contingent on the availability of funds, progress of the research, and programmatic needs. Annual budgets for research projects in the first four scientific research elements are expected to range from $200,000 to $500,000 total costs. Annual budgets for most of the BASIC projects are not expected to exceed $100,000. Researchers are encouraged to team with investigators in other disciplines where appropriate. DOE may encourage collaboration among prospective investigators, to promote joint applications or joint research projects, by using information obtained through other forms of communication.

Collaboration

Applicants are encouraged to collaborate with researchers in other institutions, such as universities, industry, non-profit organizations, federal laboratories and FFRDCs, including the DOE National Laboratories, where appropriate, and to incorporate cost sharing and/or consortia wherever feasible.

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 (subaward) 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 organizations 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 (subaward). 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 its portion of the project. The FFRDC must include separate Budget Pages for its 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.

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.

The evaluation will include program policy factors such as the relevance of the proposed research to the terms of the announcement and an agency's programmatic needs. Note, 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.

To provide a consistent format for the submission, review and solicitation of grant applications submitted under this notice, the preparation and submission of grant applications must follow the guidelines given in the Application Guide for the Office of Energy Research Financial Assistance Program 10 CFR Part 605.

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***. On the ER grant face page, form DOE F 4650.2, in block 15, also provide the PI's phone number, fax number and E-mail address. 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 include 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.

Although the required original and seven copies of the application must be submitted, researchers are asked to submit an electronic version of the abstract of the proposed research in ASCII format along with a valid e-mail address to Ms. Karen Carlson by e-mail at karen.carlson@oer.doe.gov. Curriculum vitae should be submitted in a form similar to that of the National Institutes of Health (NIH) or the National Science Foundation (NSF) (two to three pages), for example see: ***http://www.nsf.gov:80/bfa/cpo/gpg/fkit.htm#forms-9***.

The Office of Energy Research, 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 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/nih97-1.html***, (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.

RELATED FUNDING OPPORTUNITIES: Investigators may wish to obtain information about the following related funding opportunities:

Department of Energy, Office of Environmental Management: The Environmental Management Science Program (EMSP). Contact: Mr. Mark Gilbertson, Director, Office of Science and Risk Policy, Office of Science and Technology, EM-52, U.S. Department of Energy, 1000 Independence Avenue, S.W., Washington, DC 20585, e-mail mark.gilbertson@em.doe.gov. phone (202) 586-7150. The EMSP home page is available at web site: ***http://www.em.doe.gov/science/***.

DOE/EPA/NSF/ONR Joint Program on Bioremediation, Dr. Robert E. Menzer, U.S. Environmental Protection Agency, National Center for Environmental Research and Quality Assurance, 401 M Street, SW, Washington, DC 20460, menzer.robert@epamail.epa.gov, phone (202) 260-5779.

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
Office of Energy Research

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