APPENDIX C

NABIR PROGRAM MANAGEMENT PLAN

NABIR Program Management Plan

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1.0 INTRODUCTION

The Natural and Accelerated Bioremediation Research (NABIR) Program Management Plan describes the Office of Environmental and Biological Research's (OBER) methods for managing the overall research funding under the NABIR Program, the management of a proposed Field Research Center (FRC), and the management of potential risks to the human environment.

The NABIR Program is a ten-year fundamental research program designed to better understand the biotic and abiotic processes in the subsurface, to control and accelerate the biotic processes, and to provide dedicated field sites for field-based research. The program is directed at the specific goal of supporting fundamental research to understand bioremediation processes on complex mixtures of heavy metals and radionuclides in the subsurface. The NABIR Program supports the funding of laboratory-based research as well as computer modeling and other types of research. Field research would focus on the subsurface environment below the zone of root influence, and would be expected to include investigations of both the saturated (e.g., groundwater) and unsaturated (e.g., vadose) zones.

The NABIR Program will only be funding basic fundamental research on promising new methods and technologies that might have the potential to be used by another part of DOE or some other agency for a full cleanup at a future time. The NABIR Program will not fund a DOE Environmental Management cleanup project involving the use of bioremediation. Research involving organic contaminants is only considered to the extent that it influences the primary goal of understanding the fundamental biogeochemical factors that affect bioremediation of heavy metals and radionuclides. Research to evaluate the risk to humans or to the environment, and research on phytoremediation are outside the scope of the NABIR Program. Finally, the NABIR Program will not fund any research that would involve the use of microbes that are human pathogens and field releases of any GEMS.

1.1 Management Structure

1.1.1 Facilitating Coordination/Communication of Research Opportunities and Results

The NABIR Program is managed by a team of Program Managers from OBER. The management team's areas of responsibility include: overall management of research funded under the NABIR Program, the management of a proposed FRC, and the management of potential risks to the human environment. Specifically, two OBER Program Managers coordinate the NABIR Program (Co-coordinators); several OBER Program Managers provide leadership for a number of technical areas of focus (elements) within the NABIR Program (Program Element Managers); and one OBER Program Manager would oversee the NABIR FRC (Field Activities Manager). The NABIR Program Co-coordinators and the Program Element Managers are responsible for developing and soliciting new research for the NABIR Program through the publication of research announcements in the *Federal Register*.

A critical role for the management of the NABIR Program is to facilitate the coordination and communication of research opportunities and results of NABIR-funded research. This

coordination and communication is fostered through an annual meeting at which NABIR investigators are encouraged to present the results of their research. In addition, the NABIR Program periodically sponsors small workshops on specific topics of interest to NABIR investigators. Publication of peer-reviewed research in open scientific literature is strongly encouraged, as is participation in open scientific meetings.

In addition to OBER Program Managers, OBER uses national experts in bioremediation from several DOE National Laboratories. Their efforts are consolidated under the NABIR Program Office. The role of the NABIR Program Office is to assist OBER Program Managers with the development of technical documents and communication tools to facilitate communication among NABIR researchers and other interested parties. For example, in addition to providing assistance with the annual meeting, the NABIR Program Office currently provides information concerning ongoing bioremediation research on the World Wide Web, (http://www.lbl.gov/NABIR), and distributes a quarterly NABIR Program newsletter. Recently the NABIR Program Office developed a primer on bioremediation for use by NABIR researchers and other interested parties.

Individuals external to DOE are also asked to provide advice to OBER concerning the NABIR Program and to assist with communication and coordination of NABIR Program research. A NABIR subcommittee of the Biological and Environmental Research Advisory Committee (established by the Federal Advisory Committee Act) has been established to: a) advise OBER Program Managers on future research directions in bioremediation, b) ensure coordination with other, complementary Federal programs, and c) identify opportunities for leveraging scientific and infrastructure investments.

The management structure developed for the NABIR Program facilitates the coordinated, interdisciplinary research approach, first in the laboratory and then in the field. Table 1 contains a description of the roles and responsibilities of the team members associated with the NABIR Program.

TABLE 1. NABIR Program Management - Roles and Responsibilities

NABIR MANAGEMENT TEAM	ROLE AND RESPONSIBILITY
DOE OBER	
OBER Program Coordinators	Manage and coordinate activities among the seven program elements and all of the field activities.
OBER Program Element Managers	Responsible for general management and oversight (including Environment, Safety and Health issues) of at least one program element.
OBER Field Activities Manager	Works with the OBER Program Element Managers to coordinate field activities associated with the research conducted under each of the NABIR program elements. Oversees activities at the proposed FRCs and at other small-scale research sites.
Non-OBER	
NABIR Program Office Staff (Lawrence Berkeley National Laboratory)	Supports the OBER Program Coordinators by providing communication services and other management and technical assistance.
FRC On-site Manager	Manages the proposed contaminated and background field areas, including obtaining applicable permits from the host state, preparing and implementing site safety plans, scheduling FRC field activities and operations, supervising FRC staff and support personnel, and interacting with NABIR investigators and local stakeholders.
Field Research Advisory Panel (FRAP)	Evaluates and recommends work plans for field research activities at the proposed FRC. Consists of the NABIR Field Activities Manager, FRC Manager(s), host site regulatory experts, appropriate DOE Operations Office staff, at least 3 non-conflicted peer reviewers external to the NABIR Program Office staff and to the Lawrence Berkeley National Laboratory.
NABIR Subcommittee of the Biological and Environmental Research Advisory Committee	Provides management advice to the Program Coordinators. Ensures coordination with other, complementary federal programs and identifies opportunities for leveraging scientific and infrastructure investments.

The NABIR Program is committed to ensuring that best management practices (BMPs) and regulations are implemented in the course of FRC funded research. A Field Research Advisory Panel (FRAP) would be developed to review research work plans (more on work plans in Section 2.2.) for all FRC- related research activities. The FRAP would be established by the NABIR Program Office and would primarily consist of the FRC Managers, host site regulatory experts, appropriate DOE Operations Office staff, and at least three non-conflicted peer reviewers external to the NABIR Program Office staff and the Lawrence Berkeley National Laboratory. Any activity

that would have even a small potential risk on on-going studies, regulatory limitations, and FRC resources would have to be evaluated by the FRAP.

1.1.2 Existing Science-Based Program Elements

The NABIR Program is an integrated effort containing seven interrelated science-based technical program elements. A societal/legal/educational program element also investigates the societal issues and concerns associated with bioremediation. These program elements, described below, would be conducted in the lab and at the proposed FRC.

Biotransformation and Biodegradation—Research focused on understanding the mechanisms of how microorganisms actually transform, degrade, and immobilize complex contaminant mixtures into detoxified materials.

Community Dynamics and Microbial Ecology—Research focused on the natural ecological processes and interactions of biotic and abiotic components of microbial subsurface ecosystems in order to understand their natural influence on the degradation, persistence, and toxicity of mixed contaminants.

Biomolecular Science and Engineering—Research in molecular and structural biology focused on improving the efficiency of bioremediation activities by genetically modifying molecules and organisms to detoxify contaminants of concern to DOE. This research would be conducted strictly in a controlled laboratory setting. There would be no field-based research with genetically modified molecules or organisms at FRCs.[1]

Biogeochemical Dynamics—Research focused on understanding the relationships among several environmental factors that interact or interfere with the survival, growth, and activity of microbial communities and their ability to bioremediate contaminants. The environmental factors are related to the dynamic relationships among geochemical, geological, hydrological, and microbial processes.

Bacterial Transport—Research focused on bioaugmentation of bioremediation by the addition of microorganisms. Microbial degradation activity might be enhanced by altering the flow and transport of microorganisms. This element would develop effective methods for accelerating and optimizing bioremediation rates.

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[1] Scientists have been investigating the use of genetically engineered microorganisms (GEMs) for bioremediation. Genetic engineering is the manipulation of genes to enhance the metabolic capabilities of an organism (LBNL NABIR Primer, January 1999). While the NABIR Program is funding laboratory-based genetic engineering research, at this time, the release of a GEM, according to the EPA definition (TSCA Final Rule, 1997), in the field is not considered to be a part of the NABIR Program. NABIR Program management has determined that the fundamental laboratory research that is prerequisite to the introduction of GEMs for radionuclides and heavy metals in the field has not progressed scientifically to the point where the NABIR Program use of such GEMs in the field within the immediate future can be reasonably assumed, planned or approved. NABIR Program management will re-evaluate at a later time the status of GEMS research to determine whether the program will ever support GEMs research in the field. The final decision on whether to include GEMs field research as part of the future NABIR Program would be evaluated in a separate NEPA process, when appropriate.

Assessment—Research focused on developing methods to measure, monitor, and characterize the success of bioremediation processes and the rates at which they work.

System Engineering, Integration, Prediction, and Optimization—Research focused on integrating the results of all of the program elements and on synthesizing the information so that the effectiveness of bioremediation can be predicted and optimized.

The first five of the science elements study the biology of microorganisms, their ecology and physical environment, their effects on various contaminants, and various mechanisms to enhance or accelerate their bioremediative processes. The sixth science element provides the means to assess and quantify these processes. The last scientific element is designed to integrate the research results so that predictive models can be developed.

The NABIR program is based on an interdisciplinary research approach to the study of bioremediation. Each science program element supports researchers from a broad spectrum of disciplines besides microbiology: such as biology, ecology, hydrology, geology, chemistry, statistics, etc. Some of these researchers conduct independent research studying individual problems within a science element. Other projects involve collaborative efforts on specific problems and would involve researchers from various science program elements to draw on a variety of different perspectives, disciplines, and experiences.

Research involving organic contaminants would only be considered to the extent that it influences the primary goal of understanding the fundamental biogeochemical factors that influence bioremediation of heavy metals and radionuclides. Research to evaluate the risk to humans or to the environment, and research on phytoremediation are outside the scope of the NABIR Program. The NABIR Program will not fund a full cleanup project involving the use of bioremediation. The NABIR Program will not fund any research that would involve the use of microbes that are human pathogens, and it will not conduct any field releases of opportunistic human pathogens.

1.2 Coordinating the Direction, Review and Funding of Research

Historically, OBER has funded a variety of bioremediation-related research through a series of separate programs and projects, including the former Subsurface Science Program. Since late 1996, this funding process has been directed through the NABIR Program. For example, nearly $10 million was made available in the FY 1997 solicitation and awarded. An additional $3 million was awarded in FY 1998 for laboratory-scale research. This funding provides support for research under the NABIR program's seven scientific research elements, and the social-legal Bioremediation and its Societal Implications and Concerns (BASIC) initiative. Depending on the funding available, these awards support research programs of multiple-year duration (typically up to three years).

OBER will continue to periodically solicit applications for funding to conduct coordinated bioremediation research under the NABIR Program. New research activities under the NABIR Program would be conducted at laboratories in universities, industrial facilities, and DOE national laboratories, and in the field. Research project funding awarded to universities, private industry, and individuals is in the form of grants; funding awarded to DOE's national laboratories is provided through the DOE laboratory financial plan process.

As with previous subsurface and bioremediation research funded by OBER, the NABIR Program uses both programmatic peer reviews and proposal peer reviews to aid in the selection and direction of research. Programmatic peer reviews are used to evaluate the overall effectiveness of the program and how well it is achieving its goals. Proposal peer reviews consist of annual scientific peer reviews used to evaluate and select proposed research projects.

Following current DOE practice, each individual research project undertaken as a result of the NABIR Program funding awards undergoes an ES&H review by the appropriate DOE Operations Office. These reviews also ensure full compliance with the requirements of NEPA, and are completed prior to the release of the funding and initiation of the research.

1.2.1 Integrating Laboratory and Field Research Approaches

Much of the bioremediation research funded under the NABIR Program would likely proceed from the laboratory to the field. For example, a researcher might obtain sediment or groundwater samples from a field site. Sediment samples could be in the form of a core sample (a column of sediments taken out of the ground) or in the form of sediments cut out of an exposed outcrop. NABIR-funded researchers could then begin conducting laboratory-scale research on the samples. The results of this research might then be applied to an intermediate-scale of research or pilot field studies.

Intermediate-scale research might include the use of intermediate-scale flow cells or even lysimeters. While intermediate-scale flow cells are large containers for holding subsurface sediments, they are confined to a laboratory. In contrast, lysimeters are structures that resemble large canisters that are embedded in the ground and are closed at the bottom. Lysimeters can be filled with bulk sediments from field sites to study physical-chemical heterogeneities of the sediments, movement of contaminates, and growth of microbial populations. While these two approaches are cheaper than actual field experiments and they can be more easily controlled, intermediate-scale research does not replace research in an open, natural field environment.

The next step in research might be to move to field-scale studies in the open, natural environment. Research at FRC field sites would involve conducting activities in the subsurface within marked plots of land. These types of studies could include well-to-well flow and bacterial and/or contaminant transport studies.

1.3 Providing Field-based Research Activities

Field-based research allows NABIR to apply a coordinated approach to its overall goal of understanding the fundamental biogeochemical processes that determine the success of any bioremediation technology. Two types of field-related research approaches and activities are being undertaken by the NABIR Program, and one is proposed. The two activities that are currently being undertaken are: 1) laboratory/field transition resources, and 2) research on Short-Term Experimental Field Sites (STEFS). The one activity that is proposed and evaluated in this EA is to establish and conduct field research at the FRCs on DOE lands.

1.3.1 Laboratory/Field Transition Resources

Laboratory/field transition resources are tools that are available to NABIR researchers to promote a smooth transition from laboratory research to field research. Laboratory/field transition resources should be considered as intermediate resources that could be used by NABIR researchers to address two major impediments to conducting scientific research in the field: the issue of natural heterogeneity, and the problem of "scaling" research results from the laboratories' micro-scale level to the field-scale. Laboratory/field transition resources currently available to NABIR researchers include facilities such as intermediate-scale instrumented flow cells and lysimeters, and subsurface collections such as:

- the Pacific Northwest National Laboratory (PNNL) Sediment Collection Repository;
- the NABIR "Reference" sample (standardized set of reference sediments including natural and amended sediments and a standard set of humic materials); and
- the Subsurface Microbiology Culture Collection (a reference collection of aerobic and anaerobic bacterial cultures).

Located at laboratories DOE's Pacific Northwest National Laboratory in Richland, Washington, the intermediate-scale flow cells are existing structures that were used during the former Subsurface Science Program (SSP). These resources have been incorporated into the NABIR Program. The intermediate-scale flow cells are containers that are a few meters long and serve as tools for examining blocks of sediments and subsurface materials that are larger than laboratory-scale core samples. Flow cells can be used for investigating subsurface features such as natural physical heterogeneity under controlled conditions, and they provide "controlled environments" that simulate the natural subsurface environment in a laboratory setting without field releases. Flow cells are likely to be used before or during field-based research.

Approximately 20 lysimeters are available through DOE's Oak Ridge National Laboratory in Oak Ridge, Tennessee. They range in size from 8 feet by 10 feet deep to 3 feet by 6 feet deep. The lysimeters are 1/8 inch galvanized steel and have a solid bottom and a cover to form a closed system. They are buried in the ground and filled with soil.

NABIR also has repository responsibility for the microbial culture collection and for several subsurface sample collections, all from the former SSP. This culture collection and the sediment materials form the nucleus of a reference collection of materials and microbial cultures available for use by NABIR researchers. Additional reference materials and microbial cultures would be collected from the proposed FRC and incorporated into the existing repositories.

1.3.2 Short Term Experimental Field Sites (STEFS)

Short term Experimental Field Sites (STEFS) are field sites for special studies that may be on or off DOE lands. These field sites have characteristics that are analogous to the range of hydrogeologic conditions (e.g., rainfall, groundwater, soil types) on DOE sites that are potential FRCs; however, there is only limited manipulation of the subsurface environment. Scientific insights that are gained at these sites would be transferred to the proposed FRC. STEFS are

currently located on non-DOE sites and they have no onsite staff, permanent trailers or laboratories.

An example of a STEFS is in Oyster, Virginia. For several years, NABIR investigators have been conducting fundamental research into the mechanisms by which microorganisms are transported in the subsurface environment of unconsolidated sediments (sand) on non-DOE land. Scientific knowledge gained from this research in a simple system of unconsolidated sediments is useful to the broad community of NABIR researchers. Appendix F contains NEPA documentation for the Oyster Site.

While any one STEFS may not be available for the duration of the NABIR Program, the use of STEFS provides the NABIR Program with:

- a low-cost (relative to an FRC) diversity of field sites and source of samples;
- sources of subsurface samples for NABIR researchers;
- sites to meet the specific, short-term needs of a small team of researchers;
- sites for conducting mechanistic research experiments that support any or all NABIR elements;
- opportunities for *in situ* field research that is expected to transition into research at an FRC; and
- an opportunity for conducting additional or parallel research to test the applicability and transferability of research results from the hydrogeologic regime represented at an FRC, to other analog sites that could represent conditions at other DOE sites.

Similar to the activities that might be conducted at an FRC, activities proposed for a STEFS include: drilling of sampling wells, collection of cores and groundwater samples, geophysical analyses, monitoring of subsurface conditions, and conducting tracer and bacterial transport studies. Because STEFS are selected and used to meet the short-term needs of a small group of NABIR researchers, the environmental impacts of their selection and use are analyzed as Tier II NEPA actions (see Section 2.0 for additional information on Tier II NEPA actions).

1.3.3 Proposed FRCs

Proposed FRCs would be field sites on DOE lands. These sites would serve as the primary "outdoor laboratory" for small-scale *in situ* bioremediation research activities. They would be a primary source for groundwater and sediment samples for NABIR investigators and would also be test sites for manipulation of the subsurface environment. The FRC would consist of one background area and one contaminated area. The environmental analysis portion of this EA focuses on the siting of the FRC, the potential research activities proposed at an FRC, and the selection of up to three sites for the location of the proposed FRC. Detailed information concerning FRCs is provided in Section 3.0 of this EA.

As designed, an acceptable FRC would include a contaminated area and a background area, laboratory/analytical facilities, and office space/trailers. The areas would be of sufficient size to

accommodate multi-investigator studies over the 10-year lifespan of the NABIR Program. To the maximum extent possible, the program would use existing office, laboratory, and field facilities, including access and infrastructure support to reduce costs and environmental impacts, to make efficient use of existing DOE facilities and infrastructure, and to reduce the need for new construction.

OBER proposes to establish one FRC at a DOE site for a long-term (10-year) field research program. The FRC would be the preferred location on DOE lands for much of the field research sponsored by the NABIR Program, and would thereby provide a focus for integrating the field-based program into NABIR. The FRC and supporting infrastructure would be used to facilitate long-term, interdisciplinary research, and would be available as a user site for investigator-initiated research by scientists funded through this and other programs.

The FRC would provide NABIR researchers with areas containing a spectrum of waste types and subsurface environmental media (vadose zone and zone of saturation) that are representative of both background and contaminated conditions across the DOE complex. The FRC would offer both a source for standardized subsurface samples for NABIR researchers, and locations for *in situ* research. Field scale research at the FRC would offer the researcher the opportunity to:

- move laboratory-based research to the field, and
- observe and manipulate bioremediation processes involving heavy metals and radionuclides in a field setting.

The FRC would be staffed by a full-time FRC manager and several full and part-time technical and administrative staff. FRC staff would help facilitate the researchers' access to field locations at the DOE site, and ensure coordination of research activities and compliance with applicable DOE ES&H requirements. OBER would provide funding for infrastructure, staff, additional characterization and field campaigns, but also would anticipate “in-kind” support from the host DOE site. In kind support could include matching funding, staffing or facilities from the host DOE site.

During the first year of FRC operation, work done at the proposed sites would primarily focus on planning and field site development and characterization. By the second year, some *in situ* research might also be conducted. Because intrinsic bioremediation of radionuclides and heavy metals is a slow process, any activities focused on intrinsic bioremediation would be expected to be performed throughout the life of each FRC. *In situ* research on microbial transport, microbial heterogeneity, complexation of contaminants and microorganisms, transformation of contaminants by microorganisms, oxidation/reduction processes, contaminant availability, microbial survival, and nutrient manipulation are some examples of the type of more complex research that would be expected.

2.0 ASSESSING AND MANAGING ENVIRONMENTAL, SAFETY AND HEALTH RISKS

A critical aspect of the current and future implementation of the NABIR Program is compliance with applicable ES&H regulations, particularly for research to be conducted in the field. Following current DOE practice, the appropriate DOE Operations Office ensures compliance with all regulatory and permitting requirements before research funding is released and/or field activities commence for all research activities conducted under the NABIR Program. In addition to satisfying DOE's ES&H requirements, the Operation Office would comply with the requirements of other applicable federal, state, and local laws for each research project. For activities at the proposed FRC, the FRC Manager would provide the coordination necessary to ensure DOE ES&H requirements were met, all site policies and procedures were followed, and site training and security requirements were met. For field projects at other research sites (e.g., STEFS), staff at the appropriate DOE Operations/Site Office coordinate ES&H compliance prior to the distribution of funding.

For research that would involve intrusion into the soils and/or groundwater at DOE FRC sites, there could be potential risks to the safety of the public and workers as well as potential risks to the surrounding natural environment. However, risks can be managed and reduced through the use of BMPs and by following applicable federal, state and local regulations as well as internal DOE requirements.

2.1 NEPA Compliance

One tool that can be used to evaluate the potential impacts posed by field research activities is the NEPA process. A NEPA document examines proposed activities and evaluates their potential impact on the human environment. The following paragraphs highlight how the use of the NEPA process within the NABIR Program would be used to assess risk, as well as what some of the potential areas of impact would be for conducting research under the NABIR Program. Although the NEPA process addresses, in detail, how risks to the human environment would be dealt with, there are management practices that NABIR Program management would implement to reduce the risks to acceptable levels. These also are discussed below.

The strategy for NEPA compliance associated with selection and operation of the proposed FRCs is two-tiered. The first tier includes the preparation of this EA to evaluate the potential environmental impacts of siting and operating the proposed FRC. The second tier of the NABIR NEPA compliance process would be the evaluation of the appropriate level of NEPA documentation that would be prepared for the proposed specific field research. The Tier II NEPA evaluation would consider whether the proposed field research at an FRC is bound by the EA for Selection and Operation of the Proposed Field Research Centers for the NABIR Program. If it were determined that the proposed activities were a major federal action that could significantly impact the environment, an EIS would be prepared. For the FRC, the DOE Operations Office for the proposed FRC would have responsibility for NEPA compliance for that FRC.

2.2 FRC Planning, Documentation and Training

Another set of tools to manage ES&H risks is the documentation and review of all NABIR-funded research projects prior to the initiation of activities. Upon selection of an FRC, and prior to the initiation of any field site characterization or field site research activities, the NABIR Program would expect the FRC manager to develop a set of high-level planning documents to govern the operation of the FRC. These plans would provide the "road map" for the conduct of operations at the FRCs, both in terms of the scientific research to be conducted and the commitments to ES&H. The plans to be developed would include:

- an overall Management Plan for the FRC,
- a Characterization Plan for characterizing both the background and contaminated areas, and
- a Site Closure Outline.

Each of these three plans would have a separate Health and Safety Plan that not only addresses ES&H risks, but includes measures for mitigating those risks.

The NABIR Program is committed to ensuring ES&H specific to the research campaign at the STEFS and at the proposed FRC. The next level of documentation that would be required would be for research campaign-specific documentation that would include a Research Campaign Plan/Approach for any *in situ* research to be conducted at either the background area and/or contaminated areas. Details on the Research Campaign Plans are in Section 3.3 of this Appendix.

In addition to these plans, the NABIR Program would require the development an ES&H training program specific to the STEFS activities and to the FRC activities and field sites. Both the plans and the training programs would be reviewed for overall adequacy in addressing environmental and health and safety concerns and would be approved by the OBER Field Activities Manager, the FRAP and the management at the appropriate DOE Operations/Site Office. The scope of these plans and training programs is described below.

2.2.1 FRC Management Plan

The overall FRC Management Plan would be developed to govern the scientific approach to research at the proposed FRC, as well as to provide the planned approach to ensuring ES&H compliance. The FRC Management Plan would provide a list of the roles and responsibilities of all individuals and organizations involved with research activities at the proposed FRC. The overall FRC Management Plan would contain several ES&H sub-plans, as appendixes, including:

- a Health and Safety Plan (HASP) tiered from the DOE host site HASP,
- a Waste Control Plan for FRC operations,
- an Environmental Compliance Plan,
- a Contingency Plan for potential offsite migration of contaminants, and

- a Site Closure Outline.

The sub-plans would require a review by the OBER Field Activities Manager and approval by the DOE Operations/Site Office where the FRC would be located.

The FRC HASP would provide:

- detailed information as to the types of activities that would take place,
- a listing of FRC staff names along with other named individuals allowed to undertake field activities,
- a description of the location of the proposed activities, and
- information concerning various areas of health and safety. For areas of concern (i.e., confined space; chemical hazards; heat stress; trips, slips and falls; radiological and hazardous materials handling and exposure), the researchers would identify the specific hazards and what mitigating actions or responses would be taken in the event of an accident.

Similar to the Tier II NEPA Process, HASPs would be developed for each individual research project prior to initiation of the work. These HASPs would be developed by a Site Safety Officer and would be approved by the Operations/Site Office at the FRC location.

The Waste Control Plan would identify:

- types and amounts of waste that might be generated as a result of the research conducted, and
- disposal methods and locations that would be used.

An Environmental Compliance Plan would include:

- detailed information concerning the applicable rules, regulations and environmental permits required to conduct the proposed research;
- the approach the proposed FRC and appropriate DOE Operation/Site Office would take to conduct NEPA reviews (e.g., Tier II NEPA); and
- a statement of issues important to federal, state and local regulators and how the FRC manager would address the issues.

The Site Closure Plan would describe:

- the proposed method of closing the proposed research site after the research has been completed. At the start-up of the proposed FRC, many of the details concerning site closure would be unknown. The Site Closure Outline would assist the FRC Manager, appropriate DOE Operations/Site Office, and the NABIR Program management in planning for future site closure needs.

2.2.2 Characterization Activities Plan

Characterization activities are designed to obtain a baseline set of field site conditions. For example, parameters such as ground water and sediment geochemistry, depth to groundwater, and sedimentology would be determined for both the background area and contaminated area.

The Characterization Activities Plan would be developed by the research scientist for each characterization activity that takes place at an FRC. This plan would include:

- a HASP for the specific characterization activity and
- a Waste Control plan.

2.2.3 Research Campaign Plan/Approach

A research campaign would be any *in situ* research at an FRC or a STEFS that would be conducted by one or more investigators. Research campaigns are designed to obtain a greater understanding of the abiotic and biotic interactions in the subsurface (*in situ*). For example, *in situ* research activities might include the injection of tracer elements and nutrient solutions into the groundwater to track groundwater movement.

Each research campaign would have a plan/approach outlining the steps to comply with environmental requirements. The Research Campaign Plan/Approach would include:

- a HASP specific to the research campaign activities (tiered from the FRC HASP, but of sufficient detail to be useful in a field operation),
- a Waste Control Plan for research campaign activities.

2.2.4 ES&H Training

All individuals working full-time as FRC employees or staff would be trained in the required ES&H areas pertinent to their responsibilities. Similarly, all NABIR investigators who would use the proposed FRC for field research would be required to receive ES&H training appropriate to their research activities.

The FRC Manager would be required to have 40-hour Occupational Safety and Health (OSHA) hazardous substance training (Title 29, *Code of Federal Regulations*, Part 1910.120e), and field site-specific radiation safety training (10 *CFR* 835). In addition, the FRC Manager would be required to have hazardous substance supervisor training and field certification (29 *CFR* 1910.120e[4]). Technical staff, who are not working at the contaminated area full-time, would need 24-hour hazardous substance training; however, any staff or NABIR investigator who would be on the contaminated area full-time would be required to have the 40-hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training. In addition to the 24-hour training, technical staff doing field work would be required to have training specific to field operations at the proposed field sites. All individuals funded through the NABIR Program,

conducting research activities at DOE sites, would be required to have the General Employee Radiation Training and the general host DOE site training.

In addition to overall ES&H training, OBER might provide FRC staff with technical training in the areas of sample collection, processing and shipping. The training team would consist of a group of NABIR investigators experienced with obtaining, processing, and shipping research-quality samples. The need for FRC staff to be extremely knowledgeable in this area would be critical to the operation of the proposed FRC.

2.3 Operations/Site Office Management

The third way to manage ES&H risks is for the appropriate DOE Operations/Site Office to maintain a constant awareness and oversight of the FRC operations. The proposed FRC would operate within the ES&H requirements for the host DOE site, and the appropriate DOE Operations/Site Office would be responsible for ensuring that the proposed FRC operates within those boundaries. The appropriate DOE Operations/Site Office would exercise an awareness and oversight of the proposed FRC activities and operations. The appropriate DOE Operations/Site Office would therefore review and approve all ES&H-related documents including, but not limited to, all of the FRC Health and Safety Plans, all FRC Waste Control Plans, and all FRC Contingency Plans associated with mitigating the potential for offsite migration of contaminants. In addition, the appropriate DOE Operations/Site Office would also review the overall FRC Management Plan, the Characterization Plan, the Research Campaign Plan/Approach, and the Site Closure Plan prior to approval by the NABIR Field Activities Manager.