

# Implementation Plan for the Integrated Field-Scale Challenge (IFC) project at the Oak Ridge Field Research Center (ORFRC) Oak Ridge, Tennessee

## 1.0 INTRODUCTION

In January 2007 through a competitive peer review solicitation process, the Department of Energy's (DOE's) Environmental Remediation Sciences Division (ERSD) awarded Oak Ridge National Laboratory's (ORNL) Environmental Sciences Division (ESD) an Integrated Field-Scale Challenge (IFC) project (DOE Solicitation LAB-06-16). The five year project entitled "Multi-scale Investigations on the Rates and Mechanisms of Targeted Immobilization and Natural Attenuation of Metal, Radionuclide and Co-Contaminants in the Subsurface" will be conducted at the Oak Ridge Field Research Center (ORFRC), located on the Oak Ridge Reservation (ORR) in eastern Tennessee just west of the Y-12 National Security Complex. Additional information on the ORFRC is available at the ORFRC website (<http://www.esd.ornl.gov/nabirfrc/>). The purpose of this Implementation Plan is to describe the work processes the project team will follow to safely and efficiently complete the work tasks described in the project proposal. Successful completion of this project will help meet the goals of the Environmental Remediation Sciences Program (ERSP) described in the *draft* ERSP Strategic Plan (2006) ([http://www.sc.doe.gov/ober/ERSD\\_top.html](http://www.sc.doe.gov/ober/ERSD_top.html)).

The primary objective of the IFC project is to advance the understanding and predictive capability of coupled hydrological, geochemical, and microbiological processes that control the *in situ* transport, remediation and natural attenuation of metals, radionuclides (i.e., uranium and technetium), and co-contaminants (i.e., nitrate) at multiple scales ranging from the molecular to the watershed. The research is intended to elucidate the mechanisms and rates of natural removal for important DOE contaminants in plumes that emanate from contaminated source zones, and it will consider as well the effects of source zone remediation measures on the attenuation of those plumes.

The research will focus on determining the key coupled hydrobiogeochemical factors such as pH, electron donor utilization, and redox conditions along contaminant pathways and within specific transition zones that control the fate and transport of uranium, technetium, and co-contaminant nitrate within spatially distributed source zones and groundwater plumes at the ORFRC. Because remedial decisions are made at the watershed scale, investigating and understanding these processes at this scale are necessary for making informed remedial decisions. The specific objectives of this research are to

- quantify recharge pathways and other hydraulic drivers for groundwater flow and dilution of contaminants along flow pathways and determine how they change temporally and spatially during episodic events, seasonally, and long term;
- determine the rates and mechanisms of coupled hydrological, geochemical, and microbiological processes that control the natural attenuation of contaminants in highly diverse subsurface environments and over scales ranging from molecular to watersheds;
- explore novel strategies for enhancing the subsurface stability of immobilized metals and radionuclides;
- understand the long-term impacts of geochemical and hydrologic heterogeneity on the remobilization of immobilized radionuclides;
- improve our ability to predict the long-term effectiveness of remedial activities and natural attenuation processes that control subsurface contaminant behavior across a variety of scales.

Because the results of this research will improve our ability to predict the feasibility of natural attenuation of contaminant plumes and the impact of source zone remediation at multiple scales, the research will provide information to aid decision-making about remediation measures that may be required for effective long-term stewardship at DOE sites.

## 2.0 IMPLEMENTATION OF PLANNING AND MANAGEMENT TASKS

The ORFRC site is well characterized and the site infrastructure has been established (e.g., utilities, field trailers, laboratories, and several well-instrumented field plots). Completing the research tasks described in the IFC Proposal will require considerable planning and coordination among researchers, sponsors, facility operators, regulators and other stake holders. However, because research at the ORFRC has been conducted since April 2000, procedures for conducting field work at the site are well established and will be used with some minor modifications to implement the IFC project. These procedures have been effective for managing large, multi-disciplinary field research projects and have resulted in a high degree of scientific productivity (over 60 publications). A description of how these existing procedures will be modified and used to implement the IFC project at the ORFRC is provided in this section.

### 2.1 Preparation/Modification of Management and Planning Documents

A series of planning documents (available at <http://public.ornl.gov/nabirfrc/frcdoc2.cfm>) that tier from the ERSD Strategic Plan (DOE 2006) have been developed that govern the implementation of projects at the ORFRC. These include the following ORFRC plans:

- Environmental Assessment and FONSI (DOE/EA 1196 2000)
- Management Plan (Watson and Quarles 2004 revised)
- Quality Assurance Plan (Brandt et al., 2004 revised)
- Site Characterization Plan and Addendum (Watson et al., 2001; Watson and Roh 2004)
- Health and Safety Plan (Watson and Quarles, 2007 revised) (tiered from the ORNL HAZWOPER Program Manual 1993)
- Research Safety Summary (2007)
- Communication Strategy (Wolfe et al., 2004 revised)
- Researcher's Guide (2005 revised)
- ORFRC Closure Plan (Bogle and Watson 2006)

Together, these plans form a “road map” for conduct of operations at the ORFRC for both the scientific research to be conducted, as well as the commitments to Environment, Safety and Health. These existing operations documents will be revised as needed during the first 6 months of the IFC project to address IFC project implementation issues. The ORFRC Management Plan (2004) in particular describes the procedures that must be followed to initiate and conduct field work at the ORFRC. The Management Plan also provides a list of the roles and responsibilities of individuals and organizations involved with research activities at the ORFRC.

**Regulatory Compliance:** The regulatory framework for operating the ORFRC and implementing new projects at the site has already been agreed upon with the regulators through a modification of the Bear Creek Hydrogeologic Regime RCRA Post Closure Permit. The steps for implementing a new project (e.g., IFC Project) at the ORFRC are described in the ORFRC Management Plan (2004). Memorandums of Understanding describing how the ORFRC will operate and the roles and responsibilities of each party are already in place between UT-Battelle (ORNL contractor) and Bechtel Jacobs Corporation (BJC) (Environmental Management contractor) and BWXT (Y-12 contractor). A list of site contacts is provided in the ORFRC Management Plan (2004). National Environmental Policy Act (NEPA) issues have already been addressed through an Environmental Assessment (DOE 2000a) that resulted in a finding of no significant impact (DOE 2000b). The existing NEPA categorical exclusions for the ORNL ESD to conduct environmental investigations and research should cover any new unanticipated activities that may be proposed that are not covered by the existing Environmental Assessment.

**Preparation of detailed IFC Task Plans:** In addition to the existing higher level operational plans, detailed IFC project task plans will be prepared describing each work phase that is going to be conducted at the ORFRC. These detailed task plans will be prepared by IFC investigators, responsible for executing individual project tasks. Task plans will be prepared at the beginning of each year for tasks that will be conducted in the coming year and as needed. Task Plans will include detailed descriptions of the work to be completed, schedule, staffing, sampling and analysis procedures, data management procedures (sample numbering etc), quality control issues and special waste handling procedures. Where appropriate the Task Plans will refer to existing sampling and analysis procedures previously described in other plans such as the Site Characterization Plan (2001) and Addendum (2004). The Task Plans will be reviewed by the IFC principal investigator (PI) (Phil Jardine) and ORFRC Manager (David Watson) to assure scientific and operational issues are addressed. Task Plans will be shared with appropriate CO-PIs to ensure coordination among disciplines.

**Health and Safety:** Specific Environment, Safety, Health, and Quality (ESH&Q) requirements for activities conducted at the ORFRC are determined on a project-by-project basis through individual Integrated Safety Management System (ISMS) project reviews conducted in accordance with, and as described in, the ORFRC Management Plan. The reviews include preparation of a Research Safety Summary (RSS) which addresses necessary and appropriate controls, requirements, and training specific to the hazards presented by each project. In addition to the RSS the ORFRC is governed by a Health and Safety Plan that describes safety considerations for conducting field work at the ORFRC.

**Data Management:** The Quality Assurance Plan (2004) will be updated to include data management and quality control procedures that will be implemented for the IFC project. To the extent possible existing ORFRC procedures will be used on the IFC project for sample labeling and tracking, data management and quality assurance. The existing ORFRC database will be used to store new IFC project data and the publicly accessible website and listserv (<http://www.esd.ornl.gov/nabirfrc/>) will be used to distribute information and data to the broader scientific community, United States Department of Energy's Office of Environmental Management (EM), regulators and the public. A password-protected version of the database will be used to load, store and share research data among project researchers. A password-protected, web accessible project worksite (i.e., Sharepoint) will be used to disseminate and store project-related information such as meeting notes, work plans, and schedules. Site characterization data collected on the project will also be periodically transferred to the Oak Ridge Environmental Information System for use by environmental decision makers.

**Collection and Shipping of Samples to Researchers:** Groundwater and sediment samples will be provided to ERSD researchers upon request once they have the appropriate radionuclide licenses in place to accept the samples. Procedures for requesting and shipping samples are provided in the Management Plan (2004) and the Researcher's Guide to Using the ORFRC (<http://public.ornl.gov/nabirfrc/UserGuide.pdf>). Equipment (e.g., glove bag in the field trailer) and procedures are in place to collect samples anaerobically and aseptically and store them at -80 °C as needed. A small percentage of samples will be archived during routine project sampling to fulfill unanticipated sample requests. It is anticipated that some drilling (coring and well installation) will be required to fulfill these requests. However, larger efforts such as installation of field plots or multi-sample watershed wide sampling events will require other arrangements to complete.

**Waste Management and Site Closure Activities:** Waste disposal procedures are described in the Management Plan (2004) and, except for the cost of characterizing the wastes, there is no cost to the project for disposing of ORFRC wastes. Except for the installation of wells, we do not anticipate creating any additional infrastructure that will need decommissioning beyond what is already there. ORFRC wells will be plugged and abandoned unless BWXT Y-12 or BJC agrees to accept them, or the regulators agree upon another strategy. A Closure Plan (2006) for the existing infrastructure at the ORFRC is currently being finalized. When ORFRC research activities cease, all ORFRC supplies, equipment, field trailers, tents, and wells and associated structures will be distributed among ORNL, BJC, and BWXT Y-12 as

appropriate. Supplies and equipment owned by UT-Battelle will be removed from ORFRC sites unless they are transferred to BWXT Y-12 and/or BJC. Supplies and equipment owned by BWXT Y-12 and BJC (if any) will be returned to them in substantially the same condition as when loaned to UT-Battelle, and will be decontaminated in accordance with UT-Battelle's Radiation Protection Program. ORFRC field trailers and tents will be removed, unless they are offered to and accepted by BJC, BWXT Y-12, or some other responsible party. UT-Battelle will be responsible for terminating site services to these field trailers and tents in a safe and compliant manner. Additional information on plans for site closure are provided in the draft FRC Closure Plan (2006).

**Reporting and Review:** The PI and Field Site Manager will participate in quarterly conference calls with the ERSD Program Manager. In addition, written quarterly reports of operational activities will be provided to the ERSD Program Manager. The quarterly progress report will include highlights of major scientific accomplishments for the quarter, a detailed listing and explanation of on-going projects (including sampling projects) as well as any projects anticipated during the next quarter, any other significant actions planned for the next quarter, a summary of Field Site operations expenditures tracked against annual projections, identification of any management issues, schedule status and variances, discussion of interactions with the public, staffing issues, and any general Field Site difficulties and actions taken. An annual summary report would be submitted to ERSD 90 days prior to the anniversary of the initial funding date. The annual summary report would contain a summary of the information provided in the quarterly reports. Coordination among the IFC researchers will be handled through regular conference calls and project meetings.

An outside review committee consisting of local Stakeholders (DOE, regulator, and EM contractor) will be convened as needed to provide review and comments on IFC work plans.

## **2.2 Roles and Responsibilities of Project Team**

Our team consists of geochemists, microbiologists, hydrogeologists, geophysicists, numerical modelers and statisticians with past experience working at the ORFRC (Table 1). The PI will be Dr. Philip Jardine, a geochemist with extensive knowledge of the ORFRC through his roles as a co-PI on a past ORFRC research project and as the ORFRC Science Advisor. Reporting to Dr. Jardine will be the Leads listed in Table 1. Mr. David Watson will continue as the Field Site Manager responsible for coordinating sampling and *in situ* research activities at the ORFRC, ensuring Environmental, Safety, and Health (ES&H) compliance and managing ORFRC staff and infrastructure. He will also coordinate with investigators from other ERSP projects funded to conduct research at the site and fulfill requests for groundwater and sediment samples.

Mr. Kirk Hyder and Mr. Kenneth Lowe are field technicians with primary responsibility for drilling, collecting core and groundwater samples, installing wells, conducting tracer tests, and sample analyses. Mr. Lowe is also an expert in ICP/MS analysis of inorganic compounds, and Mr. Hyder has extensive experience analyzing fixed gas samples using GC techniques. To maintain quality, efficiency, and flexibility in scheduling we anticipate using ORNL staff and drilling rigs (Geoprobe and Hologator) to conduct most of the coring and well installation. Ms. Tonia Mehlhorn and Ms. Xiangping Yin will assist with sample analyses and field sampling. Ms. Sue Carroll will assist with microbial sampling and analysis. Ms. Mary Anna Bogle will be the Health and Safety Officer and will also provide project support. Ms. Susan Holladay will assist with maintaining the website and data management. All of the technical staff assigned to this project are highly trained and competent professionals, each having between 10 and 30 years experience conducting complex field and lab environmental investigations and sample analyses. They have all worked in various capacities on the ORFRC for the past six years and have a detailed understanding of site conditions and requirements.

Table 1 Institutional affiliation, expertise, and role of principal researchers.

<b>Researcher</b>	<b>Institution</b>	<b>Expertise</b>	<b>Role</b>
Dr. Philip Jardine	ORNL	Geochemistry	<b>Principal Investigator</b> – Attenuation studies
Mr. David Watson	ORNL	Hydrogeology	<b>Field Site Manager</b> – Hydraulic studies
Dr. Susan Hubbard	LBNL	Geophysics/Stochastic Hydrology	<b>Lead</b> – Geophysics studies of manipulations
Dr. Craig Criddle	Stanford Univ.	Environmental Engineering	<b>Lead</b> – Biological manipulations
Dr. Joel Kostka	Florida State Univ.	Microbiology	<b>Lead</b> – Microbial studies
Dr. Jack Parker	ORNL	Soil Physics	<b>Lead</b> – Flow and reactive transport modeling
Dr. Gregory Baker	Univ. Tennessee	Geophysics	Plume and recharge geophysics, geology for attenuation studies
Mr. Craig Brandt	ORNL	Statistics/Biochemistry	Data management, statistical analysis, Web site maintenance
Dr. Scott Brooks	ORNL	Biogeochemistry	Organic P manipulations
Dr. Baohua Gu	ORNL	Soil/Environmental Chemistry	pH manipulations and Tc chemistry
Dr. Ken Kemner	ANL	Physics	U speciation, mineral structure analysis by EXAFS, XANES
Dr. Peter Kitanidis	Stanford Univ.	Engineering/Water Resources	Modeling of manipulations and tracer tests
Dr. Anthony Palumbo	ORNL	Microbiology	Microbial field studies and analysis
Dr. Christopher Schadt	ORNL	Microbiology	Microbial field studies and analysis
Dr. Brian Spalding	ORNL	Soil Science	Fixed gas analysis, radioanalytics, isotope analysis
Dr. Amy Wolfe	ORNL	Anthropology	Stakeholder communications
Dr. Weimin Wu	Stanford Univ.	Environmental Engineering	Biological manipulations
Dr. Jizhong Zhou	Univ. Oklahoma	Microbiology	Microarray analysis