

HANFORD IFC QUARTERLY REPORT ~ JANUARY 2008

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I. Overview and Highlights

This is the second Quarterly Report for the Hanford IFC project. The project has been operational since March 2007 when funding from ERSD was received. At this point all subcontracts have been finalized and are in place, and the team is fully functional. Funds are being distributed incrementally to project participants as received through the continuing resolution. The Hanford IFC website has passed internal PNNL review and it is open to project participants and all interested parties.

As will be discussed in more detail in Section IV, the major highlight for this quarter is the finalization of the IFC field site design and monitoring array, its review by the Washington State Department of Ecology, and its submission to Flour Hanford for installation in the February 2008 – April 2008 timeframe.

II. Significant Changes

There have been no significant changes to the project since the last quarterly report in October 2007.

Since the last quarterly report, the EM-20 Polyphosphate Demonstration Project has reported its first integrated interpretation of its large injection test (performed in summer of 2007) for uranium immobilization through autunite and apatite precipitation. The experiment demonstrated an initial rapid reduction in U concentrations in the treatment zone below regulatory limits as a result of dilution and possibly U precipitation. However, groundwater uranium concentrations rebounded relatively rapidly with time, leading to questions about the effectiveness of the remedy. The concentration rebound was expected based on our “mass transfer hypothesis”, and ERSD-supported research on uranium-contaminated sediments from the site. The results of this test have implications to the future conduct of experiments at the IFC site. Decisions on the manner in which we partner with EM-20 will be made over the course of FY 08 in collaboration with ERSD management. This should be a discussion topic for the ERSD Investigators Meeting in April.

III. Management & Operations

All subcontracts with project participants are in place. Each of the participating institutions is now hiring post-docs and graduate students to perform the necessary research. Some of these participants are accessing data from the web-site, while others have or will travel to PNNL to become more familiar with the 300 A site, and the nature of sediment samples that will soon be available. A project conference call will occur on January 14, 2008 to brief all project participants on the field site and monitoring system

design, discuss the characterization plan, and solicit requests from project participants on samples desired from well installation.

A team meeting is being scheduled for April 29-30, 2008 in Richland, WA. This meeting was moved from January because of requests from project participants. The objectives of the meeting will be to: i.) review and finalize the first four phase 1 injection experiments, and preliminary plans for phase 2, ii.) test the data base system and its various attributes, and iii.) initiate data and other necessary information exchanges to begin hydrologic and reactive transport modeling (for Task 7 Modeling and Interpretational Program).

IV. Quarterly Highlights

For the purposes of this quarterly report and subsequent reporting activities we establish the following as reportable project tasks: 1. Project Management, 2. Site Design and Installation, 3. Web Site and Data Management, 4. Field Site Characterization, 5. Vadose Zone Experiments, 6. Saturated Zone Experiments, 7. Modeling and Interpretation, and 8. ERSD Outreach.

Task 1. Project Management

Final versions of the QA/QC, Site Management, and Health and Safety Plans have been completed and are posted on the Hanford IFC Website.

Detailed budgeting has been completed for site-setup and development of the field injection system, and for the first two FY08 tracer experiments and associated solute analyses. The field injection system is quite involved as it will pump large volumes of waters of different composition from different contaminated regions of the plume, run them through a field trailer for selected analyses and for tracer spiking, and then meter their re-injection into the IFC well field and monitoring array. Our initial volume estimates for the saturated zone injection experiments is approximately 60,000 gallon (252,000 L). This estimate is based on an assumed saturated zone thickness at our injection point and measured groundwater velocities at the nearby EM-20 site. Consequently, there are sophisticated infrastructure and equipment requirements that we are now addressing and resolving.

Task 2. Site Design and Installation

Significant progress has been made on this essential task. First, we have worked through necessary NEPA documentation, and have received a categorical exclusion for the development of our IFC experimental field site. The original signed documents from DOE-Richland Operations for this exclusion are in permanent project files. This was reported in the last quarterly report. Since October, a detailed drilling specifications package has been developed (see attached report), that identifies the location of our experimental site; number of boreholes, depths, and samples to be collected during placement; well completion details; and a well-field closure strategy for when the IFC project is complete. The drilling specifications package was submitted to the Washington State Department of Ecology for required review in mid-December, with return comments received on Jan. 8, 2008. Ecology's comments will require a change in design

to our vadose zone injection wells, and to the final well design for our deep characterization well in the Ringold Formation to be used jointly for IFC and SFA research. These changes are now being made to the Drilling Specifications Plan.

Aspects of the Drilling Specifications Plan were discussed with the FREC in our November 2007 conference call, and a significant comment was recorded (from Richelle Allen-King) regarding our well completion plan and extent of multi-level monitoring. We have continued dialog with her on this subject. We recognize and share her concern, and throughout our design phase we have tried to maximize multi-level monitoring points within the constraints provided by the hydrology of the IFC site and our budget. We are aware of the multi-level monitoring products mentioned by Richelle, and they are good ones. Unfortunately previous experience has shown that they are not easily workable in our system, and will not provide samples of the necessary volume and frequency to trace our injection cloud. We do, however, appreciate these types of suggestions by the FREC and encourage such helpful dialog.

Required applications for formal permitting of our vadose zone and saturated zone injection wells have been submitted and are well on in the process. Initial feedback has been positive, and permits are expected within the month. Completed permits are required before the injection wells can be installed in the field.

Task 3. Website and Data Management

The Hanford IFC Website (<http://ifchanford.pnl.gov/>) is now operational as of early December, 2007. The Website contains comprehensive background information about the 300 A uranium plume; information on project participants; background and project scientific publications; project documents of different sorts including required and optional project and experiment plans, designs, etc.; inventories of samples available to project participants and ERSD investigators; schedules, objectives, and descriptions of planned field experiments; a password protected link to the project data base at INL; and other information. Significant additions in the form of pictures, well logs, geologic descriptions, and results from soil physical and chemical characterizations will be made to the website as well-drilling and installation of the experimental site begins in February.

The data management task has also been initiated at INL and has accelerated with the opening of the website. The prototype data sets of geologic, hydrophysical, geochemical, and other measurement types on 300 A materials (collected by ERSD and EM-40 investigators) that were described in the previous (October 2007) Quarterly Report have been significantly expanded to include additional hydrologic, geologic, and soil physical data; site and well location maps; and results of geophysical measurements performed in the South Process Pond where our site is to be located. Versteeg at INL has been extremely effective in: i.) setting up the data base to accept, manipulate, and display site geophysical measurements and hydrologic data, and ii.) in working “buried administrative channels” at PNNL in order to gain formal clearance (as necessary for web-site posting) for historical hydrologic and monitoring data for the 300 A site that projects participants have requested for geostatistical and hydrologic modeling. The pass-word protected link from the Hanford-IFC web-site to the INL data base is not yet

operational, but will be soon. The performance of the data base will be reviewed by the project team for utility and flexibility at our April team meeting.

Task 4. Field Site Characterization

Plans are under development for characterization of field site core materials obtained during the well drilling campaign. A draft Characterization Plan is currently in internal review. The characterization measurements will include: i.) geologic, hydrophysical, and geochemical properties, ii.) uranium distribution in the vadose zone and saturated zone, and iii.) microbiology. Microbiologic characterization is to be performed on aseptically collected sediments from a single deep borehole (on the northeast side of the triangular monitoring array, red) that will be double the depth of the others, and that will sample both the Hanford and Ringold formations to the top of basalt (see Figure A-6). The total number of samples and their location and method of collection are summarized in Table A-1 of the attached Drilling Specifications report.

The IFC collaborated with EM-40 in the placement of a new monitoring well in the southeast corner of our proposed well-field (Figure A-1, green, well 399-2-5). This well has provided necessary insights on the stratigraphy, facies distribution, and saturated zone thickness at our site (Figure A-2). We have been testing several different types of uranium extractions on sediments from this borehole to perfect a total contaminant U extraction for all core samples. In doing so we have found the contaminant U concentrations in well 399-2-5 sediments are well within the range needed for successful vadose zone and saturated zone U adsorption/desorption/mass transfer experiments. All contaminant U in the sediments sampled to date has been in the adsorbed state. A weak acid extraction has been selected as the primary characterization measurement for total, sorbed contaminant uranium in IFC site sediments.

Geophysical field measurements continued on the acquisition of resistivity data to map sedimentary facies in the South Process Pond area where the IFC experimental site is located. New resistivity transects have been measured through and adjacent to the location of the IFC experimental site, providing the first vertical control on sediment facies variation and heterogeneity at this important location. A resistivity transect was set up parallel to the river to collect time-lapse data over the Christmas break, and to provide insight into the dynamics of river-aquifer interaction near the IFC injection site. Such information is critical to allow quantitative linkage between river stage changes and groundwater flow directions.

Significant progress has also been made in the design of the time-lapse geophysical monitoring system for the field injection experiments. The planned injection experiments will use a combination of real-time geophysical measurements, down-hole ion-selective electrode measurements, in-trailer flow-cell measurements, and direct chemical analyses to monitor tracer movement. In order to finalize our geophysical monitoring strategy, a comparison of three different ERT acquisition systems is planned for mid January in collaboration with Rutgers University, the USGS and INL. IFC scientists are now working with the Hanford Patrol, Fire Marshall, and the DOE site steward to gain

approval to bring seismic sources on site as necessary for the performance of a high resolution seismic survey of the IFC well array and surrounding area in the spring.

Task 5. Vadose Zone Experimental Program

A sequence of proposed vadose zone experiments (Phase I) is currently under planning in terms of objective/hypothesis, injection volume, tracer identity and concentration, uranium concentration, density of analytical measurements, and schedule. These plans are contingent upon the conditions found in the vadose zone during well installation with respect to facies distributions, uranium concentrations, and other variables. Our characterization strategy will emphasize the early measurement of these key parameters to allow finalization of plans for initial vadose zone experiments.

Task 6. Saturated Zone Experimental Program

A sequence of proposed saturated zone experiments (Phase I) is currently under planning in terms of objective/hypothesis, injection volume, tracer identity and concentration, uranium concentration, density of analytical measurements, and schedule. We have also recently decided to use water temperature as an additional subsurface tracer in select experiments to aid in the mapping of subsurface heterogeneities and flow-path contributions to well-water composition, and to provide additional data sets for geostatistical model calibration. In consequence, additional thermistors are being added to our down-hole monitoring arrays to increase spatial resolution of temperature differences in saturated zone waters. The injection experiment infrastructure is being evaluated for its ability to alter and control injection water temperature, and may be modified accordingly to allow such manipulations. Two chemical tracer experiments are planned for the summer and early fall months. The experimental design and sequence for Phase I experiments will be reviewed and debated by all project participants in April, 2008.

Task 7. Modeling and Interpretational Program

External participants have initiated the modeling program in collaboration with PNNL team-members. Two activities are underway. In the first, a deterministic geohydrologic model of our experimental site and associated environs is being developed based on historical river stage – groundwater elevation data, new and continuous hydrologic measurements being made in EM-monitoring wells surrounding the IFC site, hydrogeologic data and parameters from the nearby EM-20 site, recent geophysical measurements, and subsurface stratigraphy as displayed by well 399-3-5. This IFC site model is being imbedded in a larger 300 A plume model to allow calculations of seasonal head gradients, groundwater levels, and flow directions within the IFC site as influenced by river stage. The second activity is developing geostatistical correlations between known 300 A sediment properties and hydrologic parameters as a first step in the establishment of a 3-D geostatistical model for the IFC experimental site. Both of these activities will be continuously updated with new results from the IFC drilling campaign and sediment characterization program after it commences in February.

Task 8. ERSD Outreach

No reportable progress.

V. Non-IFC Project Activities

We have been contacted by several ERSD investigators inquiring about the availability of IFC site materials. We have asked these individuals to wait until our drilling campaign begins in February, as sediment samples from different Hanford and Ringold Formation facies will be obtained during that activity. As shown in Table A-1 of the attachment, there will be both bulk and core samples collected during the IFC drilling campaign that will range significantly in U concentration from background to contaminated levels. These will be available for distribution within the constraints identified in our QA/QC Plan. In the interim, we have prepared an inventory of all available 300 A materials collected by past ERSD, EM-20, and EM-40 studies at the site for posting on the web. We have not yet received any requests for these historic materials from ERSD investigators, although some have been widely distributed to other scientific collaborators of the P.I. (based on their requests).

VI. Funding Issues

Project spending is on tract with projection and there are no funding issues. All carryover funds (\$1,281 K) have been committed to the drilling campaign and equipment for the monitoring wells. An additional \$845 K has been received in FY 08 funding, and of this \$412 K has been spent. Given other commitments for injection equipment and additional field supplies, the project is 19% spent with an elapsed time of 25.1%. This spend rate is consistent with our plans for significant characterization measurements on well field sediments, well testing, and two tracer experiments in the second half of FY 08.

VII. Upcoming Plans/Issues

The following bulleted items summarize plans for the remainder of FY 08.

January 08 – June 08

- Complete characterization plan for experimental field site (January).
- Develop draft multi-year experiment plan and schedule with costing (end-February).
- Begin site installation and well drilling (February).
- Begin geochemical, hydrophysical, and microbiologic characterization of sediments retrieved from boreholes. Distribute samples to team members (February-April).
- Full IFC investigator meeting (April)
- Complete well field and monitoring installation (April).
- Finalize design for first two injection experiments (April-May)
- Perform well testing (pump tests, groundwater flowmeter measurements, May)
- Initiate detailed surface and cross-hole geophysical measurements of experimental domain (May).
- Post multi-year experimental plan with objectives and experimental details on the IFC Website (May).

- Have multiple team-members premodel injection experiments with different codes (May-June).

July 08 – September 08

- Continue testing of the well field and associated continuous monitoring system. Integrate all continuous monitoring equipment with Web-based data management system (June-July).
- Continue detailed geophysical measurements of the field experimental site (June-August).
- Continue and complete first-tier hydrophysical and geochemical characterization measurements on all experimental site core samples, post all results to data base (June-August).
- Continue microbiologic studies of aseptic borehole sediments in collaboration with PNNL SFA.
- Begin assembly of characterization measurements on borehole sediments and detailed geophysical measurements into an integrated geostatistical model of the experimental domain, and an improved hydrologic model for experiment simulation (June-August).
- Perform high-river flow, non-reactive tracer experiment in saturated zone (July).
- Perform low-river flow, non-reactive tracer experiment through a vadose zone, capillary fringe, saturated zone flowpath (September).

VIII. Peer Reviewed Publications, Abstracts, and Presentations

There have been no new presentations or publications resulting from IFC research since the last quarterly report in October, 2007. The IFC team is going to develop a publication plan once the well field installation is well underway.