Quarterly KRCEE-DOE Project Activity Summary Report

KENTUCKY RESEARCH CONSORTIUM FOR ENERGY AND ENVIRONMENT

July 2005 – September 2005

November 2005

KRCEE-DOE Earmark Quarterly Progress Report
July 2005 – September 2005

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KRCEE-DOE Earmark PHASE I PROJECTS
Quarterly Activity Reports

1. UK-KWRRI DOE Earmark Administration & Short-Term Project Quarterly Report

October 15, 2005

Project Title

KRCEE Administration & Short Term Projects

Project Goals

- Respond with research, review, and recommendations to DOE short-term project requests
- Coordinate, supervise, and integrate KRCEE-DOE earmark project activities

Projected Completion Date:

September, 2006

Percentage Completion to Date:

Contractual arrangements with faculty and staff Project Teams to conduct long-term projects related to Phase I DOE earmark activities at PGDP are in process or completed.

Contracts with CDM, Inc., Tricord, Inc., and Argonne National Laboratories (thru Tricord) were being negotiated at the end of the quarter.

100% of the short-term projects requested by DOE through this quarter have been completed. Because short-term projects are not scoped in advance no percentage completion is applicable.

Project Team/Member Roles/Tasks:

Dr. Lindell Ormsbee/ Director, UK-KRCEE. Direct KRCEE-DOE earmark activities.

Steve Hampson/Asst. Director, UK-KRCEE. Program and daily activity lead.

Dr. John A. Volpe/KRCEE Contractor. Provide technical, radioactive material, radiation health, and regulatory expertise for KRCEE-DOE earmark projects.

Jim Kipp/Associate Director, UK-KWRRI. Provide administrative and technical support for KRCEE-DOE earmark activities.

Edwin Ebrahimi/Financial Officer, UK-KRCEE **.** Provide support for KRCEE-DOE earmark financial activities.

Anna Hoover/ Administrative support, UK-KRCEE.

Stephanie Jenkins/ Administrative support, UK-KRCEE.

Project Activity Status:

- No quarterly activity meeting with DOE PPO July - September, 2005.
- Redefined and distributed timelines for Holocene project in July & August 2005.
- Continued reference document and PGDP project document digitization & uploads to ftp site July - September 2005.
- IT contractor provided first set of automated (indexed) PDF documents September 2005.
- Conducted 6th quarterly meeting with KRCEE-DOE Project Teams August 2005.
- Finalized Holocene Displacement Project MOU and site access/Readiness Review Requirements with DOE/Navarro Eng./Bechtel Jacobs July – early September 2005.
- Completed Bechtel Jacobs/DOE Readiness Review for Holocene project September 2005.
- Held meetings/conference calls with KRCEE Holocene Project contractors to finalize MOU, site access/Readiness Review Requirements, and to coordinate/run thru site activities July, August, September 2005.
- Finalized project team contract for Jacobs Engineering for Holocene Project August 2005.
- Conducted final review of KRCEE Holocene MOU, Health and Safety Plan, and Workplan with UK Safety office, UK-SPA, and UK-legal office August 2005.
- Planned and coordinated SW "Real-Time" Remedial Demonstration Project field reconnaissance with Tricord, Inc., Murray State University, UK Agricultural Engineering, SAIC, and PGDP Site Office August 2005.
- Obtained Holocene Project ITR contractor review and approval for implementation of Holocene work plan August 2005.
- Meeting with Dr. Richard Halbrook/SIU and Tim Kreher/WKWMA to finalize plans for Ecological Activities Summary Project August 2005.
- Began contracting process for Ecological Activities Summary Project with Dr. Halbrook/SIU and Dr. Whiteman/Murray State University August – September 2005.
- Completed 6th quarterly report (for April thru June, 2005) for distribution July – September 2005.
- Conference calls with Argonne National Laboratories and Tricord, Inc. relative to project roles, potential technical subcontractors and implementation of SW "Real-Time" Characterization & Remediation Project July 2005.
- Meeting with CDM, Tricord, UK-Ag Engineering relative to implementation of the Real Time Surface Water Demonstration Project August 2005.

- Coordinated meeting with BJ and PGDP site contractors for Data Warehouse Project site participation August, 2005.
- Conference calls with SAIC/Dublin office & UK-KGS for PGDP Data Warehouse Project at UK July, August, & September 2005.
- Began Holocene Displacement Project fieldwork September 2005.
- Daily calls with Holocene Project technical oversight manager, field oversight manager and health & safety manager (September 2005)
- Daily conference call with Holocene Project Team and Field Project Team to discus daily progress and coordinate field/core logging/core transport activities (September 2005)

Projected Task Summary for KRCEE 8th Quarter Project Activities:

- Coordinate KRCEE-DOE earmark-wide Project Team meeting (10 – 11/05)
- Plan meeting with DOE to discuss project needs (10 – 11/05)
- Convene Holocene Project ITR team and Project Team in Lexington to review core assessment methods and project fieldwork progress to date (9/05)
- Complete Holocene Displacement fieldwork at PGDP (10/05)
- Complete Holocene Displacement core logging at Lexington 10/05)
- Provide initial report to DOE, Regulatory Agencies and Stakeholders for Holocene Project activities (10/05)
- Coordinate PGDP Data Warehouse data exchange with Bechtel-Jacobs/DOE Site Office/Navarro Engineering/site contractors (10/05 – 12/05)
- Begin training for PGDP Data Warehouse Project (12/05)
- Finalize SW "Real-time" project contracts, Tricord, Argonne, & CDM (11/05)
- Continue SnT Landfill historical data analysis (10 - 12/05)

2. UK-Paducah Chemical Engineering Uranium Battery Project Quarterly Report

October 15, 2005

Project Title

Development of Depleted Uranium Batteries

Project Goals

- Characterize uranium dioxide's electrochemical properties in various organic solvents/lithium salts commonly used in commercial battery industry. These experiments will be performed in a glove box where the moisture and oxygen concentration will be controlled. These tests will mainly consist of cyclic voltammetry and impedance spectroscopy experiments. This information will be used to construct a battery with uranium dioxide as the cathode.
- Manufacture uranium-lithium compounds to mirror the construction of manganese-lithium compounds commonly used in commercial batteries and characterize their electrochemical behavior in common organic solvent/lithium salts.
- Construct a battery consisting of lithium-uranium dioxide.

Projected Completion Date:

June 2006

Percentage Completion to Date:

85%

Project Team/Member Roles/Tasks:

Dr. Paul Dunbar/Asst. Professor of Chemical and Materials Engineering-UK Paducah, **PI.** Perform electrochemical testing on experimental uranium-lithium cells.

Dr. Rhonda Lee/Assistant Professor of Chemical and Materials Engineering-UK Paducah, **Co-PI**. Perform electrochemical testing on experimental cells and make lithiated uranium compounds.

Dr. Stephen Lipka/Center for Applied Energy Research-UK, materials science consultant for electrochemical cell assemblage and data interpretation.

Walter Tracinski/Applied Power International. Lithium battery expert who will construct prototype batteries.

Dr. Rick Howard/Battery Materials Consultant. Dr. Howard has guided the methods to construct LixUyOz compounds.

Graduate Student Technician to perform daily repetitive experiments.

Project Activity Status:

- The first tasks were to identify and purchase equipment capable of producing electrochemical experiments of high quality using uranium dioxide (UO_2 and U_3O_8) as cathode materials in an electrochemical cell to mirror experiments performed on manganese dioxide compounds. This involved purchasing hardware including a Vac-Atmosphere glovebox, potentiostat, frequency response analyzer, materials needed to produce the correct cathode thicknesses, state-of-the-art electrochemical cells, software to perform and analyze the data, lithium salts/solvents made by battery manufacturers, lithius metal to be used as reference and counter electrodes. These tasks have been completed.

- Build a prototype battery consisting of uranium dioxide as the cathode and lithium as the anode. This was completed last June (2004) and the battery showed a low current output (as expected), but it surprisingly showed the ability to be recharged.

- Since last fall (October 2004) we began to focus on the construction of lithiated uranium compounds. In theory these compounds show the most promise of producing a high current output as well as the ability to be recharged.

- Dr. Richard Howard was hired to determine the best strategy to construct these compounds. Dr. Howard recommended the purchase of a tube furnace whereby reducing conditions could be created to permit the proper chemical reaction to produce the compound Li_2UO_3.

- Electrochemical properties of uranium dioxide are being measured in four different electrochemical cells. Each cell has a different lithium electrolyte in 1 M solutions used in commercial lithium batteries

- A tube furnace has been used to produce a $Li_xU_zO_y$ compound which may have suitable electrochemical properties. This compound was manufactured July 13, 2005. It will be tested for reversibility and for its valence state the week of July 18th. This compound will also be tested July 25th through July 30th in various lithium electrolytes.

- Walter Tracinski of Applied Power DESIGNED, BUILT AND TESTED prototype batter dueing the quarter. BATTERY WAS RECHARGABLE.

Project Summary:

- Project Team will optimize battery design from October thru December 2005.
- Additional funding requested from KRCEE for battery optimization
- Additonal six-months time requested from KRCEE for completion of battery optimization

3. Murray State University Surface Water Modeling & TMDL Quarterly Report

October 10, 2005

Project Title:

Surface Water Characterization and TMDL Development for the Paducah Gaseous Diffusion Plant and Associated Impaired Creeks

Project Goals:

The project has two major goals as follows:

1. Hydrologic characterization of the PGDP area including a water budget analysis of the PGDP facility. Characterization will include the development and calibration of continuous simulation hydrologic models for the Bayou and Little Bayou creek watersheds using the HSPF watershed model or other appropriate tools.

2. Development of Total Maximum Daily Loads (TMDLs) for each creek. Constituents of concern for Bayou Creek are iron, lead, copper, mercury, and Tc-99. Constituents of concern for Little Bayou Creek are iron, lead, copper, and Tc-99.

Project Team/ Member Roles/Tasks:

Mike Kemp, Ph.D./Murray State University, Department of Industrial and Engineering Technology, Principle Investigator (PI) – Overall project administration, budget and schedule control, coordination with UK project management, primary lead on TMDL development emphasizing water quality.

Andy Kellie/Murray State University, Department of Industrial and Engineering Technology, Co-PI – Primary lead on hydrologic model development and calibration, secondary lead on TMDL development emphasizing water quantity.

Jane Benson/Murray State University, Center for Reservoir Research and Department of Geosciences – Technical support on Geographic Information System operations and hydrologic model development and calibration.

John Hart/Murray State University, Department of Industrial and Engineering Technology – Technical support on computer systems hardware and software, network management, and field monitoring instrumentation and equipment acquisition, installation, and operation.

Matt Philips/Murray State University, Environmental Engineering Technology – Student technical support on hydrologic model data entry and water quality data analyses.

Mike Matthews/Murray State University, Environmental Engineering Technology – Student technical support on hydrologic model data entry and water quality data analyses.

Tammy Boyd/Murray State University, Department of Geosciences – student technical support on hydrologic model data input.

Project Activity Status
(% Completion) (Projected Completion Date):

Hydrologic Model Development and Calibration (90%) (11/05)

1. Acquire Existing Plant Outfall and Creek Flow Data (100%)

2. Acquire Model Input Existing Data (100%)

3. Preliminary Model Development (100%)

4. Initial Model Calibration (100%)

5. Install Flow Measurement Equipment If Needed (0%) (Task not needed)

6. Calibrate Model Based on Actual Measurements (80%) (11/05)

TMDL Development (30%) (9/05)

1. Acquire Existing Water Quality Data (100%)

2. Identify Waste Sources (100%)

3. Input Model Mass Loadings to Model (10%) (TBD)

4. Allocate Mass Loadings (0%) (TBD)

5. Final Model Calibration and Long Term Run (0%) (TBD)

6. Final Report (70%) (12/05)

Significant Findings:

1. General. Preparation of a draft final report is underway. The draft report should be completed in October. After review of the draft by UK, the final report is expected to be completed by December. A no cost time extension has been issued changing the project completion date to December 31, 2005.

2. Hydrologic model

Numerous calibration scenarios were run using HSPF. Scenarios varied by year (1996 – 2003) and by sub basin where gauging data was available. A spreadsheet analysis form was developed to compare the observed and predicted flows and calculate the runoff volume differences, percent difference, and correlation coefficient.

Potential sources of differences were investigated, including the following:

- Known problems at the gauging stations (in "dv_cd" field of the USGS NWIS files)
- Comparison of rain events (precipitation) among the Paducah Barkley Regional Airport, Grand Chain, and Bardwell weather stations to determine if an event could have occurred in the Bayou Creek watershed that was not recorded at the Barkley station, or vice-versa. The Grand Chain gage is approximately 15 miles to the west-northwest of PGDP and Bardwell gage is approximately 19 miles to the southwest of PGDP.

No significant conflicts were found.

Other parameters in the HSPF model then were tested as recommended by BASINS "Technical Note 6" and by Dr. Chandra of the University of Kentucky. The parameters and values used in the model include:

LZSN {6, 7, 8} in the PWAT-PARM2 module for Lower Zone Storage Nominal
INFILT {0.01, 0.16, 2.5} in the PWAT-PARM2 module for Infiltration
UZSN in the PWAT-PARM2 module for Upper Zone Storage Nominal

At present, continued tuning of the model is still necessary to achieve consistently good results over the entire data spectrum. Further, disaggregation of model data to an hourly basis is necessary to closely match predicted and gauged storm hydrographs. Simulations of metal concentrations in an Excel format were completed using both observed (gauged) and predicted (modeled) flows.

Maps were created to show the study area, to change the KAR for iron, and to show the DEM , streams, and sub basins for Dr. Chandra and Dr. Lingireddy.

3. TMDL development

A meeting was held with Kentucky DOW personnel to discuss TMDL development. The state is concerned that sufficient data do not exist to support preparation of the TMDLs. Following discussions with UK, the thrust of the final report was revised to include compilation and interpretation of existing data and calibration of the hydrologic model. Specific TMDL development in on hold pending resolution of additional chemical sampling and flow measurement needs for the outfalls and the streams.

4. University of Louisville Groundwater & Burial Ground Project Report

October 10, 2005

Project Title

Evaluation of technology characterization for soils, landfills and groundwater, Part 1 (concentration of S and T landfills)

Project Goals:

- Review & evaluate existing groundwater information/documents/data for the PGDP.
- Identify data gaps and provide recommendations for improvements groundwater monitoring
- Provide updated recommendations relative to applicable groundwater technologies
- Evaluate landfill/burial ground information/documents/data for the PGDP.
- Provide summary of releases, release potential
- Provide BEP/BMP monitoring & remediation recommendations for landfills and burial grounds.

Project Team/Member Roles/Tasks:

Dr. D. J. Hagerty/CEE Department-UL , **Co-PI.** Coordinate activities with KRCEE and project team colleagues, conduct document review, prepare comments, evaluate adequacy of characterization efforts to date.

Dr. James C. Watters/ChE Department-UL, **Co-PI.** Assist with the coordination of activities for the project.

Rebecca Thompson/ChE Department-UL, Research Assistant**.** Conduct document reviews, prepare comments, evaluate adequacy of characterization efforts to date, coordinate activities with KCEE colleagues

Nick Uhl/CEE Department-UL – Research Assistant. Conduct document review, prepare comments, evaluate adequacy of characterization efforts to date, coordinate activities with KCEE colleagues

Project Tasks:

Task (percent completion) (projected completion date)

1. Landfill waste characterization and source evaluation (60%) (9/30/2005)

a) **Project 1A**: Characterize the wastes in the S&T landfill and in other landfills on the PGDP site.
b) **Project 1B:** Evaluate mobility of contaminants in the S&T Landfill and in other PGDP landfills and the likelihood that contaminants from PGDP landfills have entered the groundwater flow system, or the surface water flow system.
c) **Project 1C:** Evaluate the collected data on site conditions and groundwater flow around the PGDP landfills to assess the adequacy of that data in identifying sources of contaminants and portraying concentration zones of those contaminants.

2. Groundwater Management/Remediation (90%) (9/30/2005)

a) **Project 2A:** review and critique the process by which prior decisions were made relevant to groundwater remediation.
b) **Project 2B:** Assess changes in technologies that were evaluated previously, and investigate new remediation technologies and/or new combinations of remediation technologies.

Project Activity Status:

Landfill Waste characterization and source evaluation.

In the last quarter, documents from DOE sources and from state files have been examined in more depth to characterize the wastes deposited in the landfills. The S landfill was used for deposition of "residential" wastes from 1981 through 1990, and the T landfill was used for "inert" wastes from 1985 through 1992. A leachate treatment facility later was added for the leachate generated from the S landfill. The U landfill was opened in 1995 after the S and T landfills were closed, and has been used for deposition of non-hazardous solid wastes including wastes with characteristics similar to wastes generated at residential, commercial, institutional, industrial and municipal facilities.

According to a 1980 report in the files of the Division of Wastes of the Department of Environmental Protection, the S landfill was operated and maintained by the Plant Services Department. Waste materials from throughout the Paducah Gaseous Diffusion Plant facilities were deposited in containers labeled "Sanitary Landfill Only." The intention was to limit materials placed in the S landfill to wastes paper, rags, wood, floor sweepings, garbage, paint and soft drink cans. Flyash and bottom ash from the C-600 steam plant were deposited in the S landfill after the steam plant was put into operation.

Some of the wastes deposited in the S landfill were considered hazardous at the time they were deposited. Those wastes included:

Waste	Tons per Year	Comments
Transite sheeting	5	sheeting was cemented asbestos
Cooling tower fill	2.5	contained vinyl asbestos and organics

Cooling tower wood	0.5	wood was treated with fungicide that contained arsenic and pentachlorophenate

Trenches were excavated in the ash, "trash" was placed in the trenches, and the trenches were backfilled with ash. "A final cover of dirt and clay is placed on the ash to facilitate runoff and avoid erosion and leaching," according to the 1980 report. About 2.7 tons of "rubbish" and 15.9 tons of ash were delivered to the S landfill each day in the early 1980s, according to the report. The rubbish was compacted with a tracked vehicle (a dozer) and covered about once per week. An approximate breakdown of the nonhazardous materials placed in the S landfill included:

Waste	Tons per Year	Cubic feet per Year
Ash	5,800	315,000
Paper	650	44,000
Wood	100	10,000
Metal	100	5,000
Garbage	50	4,000
Miscellaneous	100	8,000

Elsewhere in the files of reports from state inspectors who visited the S landfill during the early 1980s, the approximate breakdown of the materials deposited in the landfill was given as:

Waste	Percent
Cardboard	42 percent
Paper	35 percent
Garbage	13 percent
Small wood pieces	5 percent
Miscellaneous	5 percent

Published information on characteristics of leachate from landfills was reviewed to determine the nature of leachate that could be expected from the S and T landfills. Observed values of total iron concentration in leachate from sanitary landfills have varied from 4,000 micrograms/L to as high as 2,200,000 micrograms per liter, with an average value of about 1,600,000 micrograms per liter. Chemical oxygen demand values have ranged from 11,000 micrograms/L to 84,000,000 micrograms/L. Total organic carbon values have ranged from 1,500,000 micrograms/L to 20,000,000 micrograms/L. Concentrations of lead in leachate have varied from 29,000 micrograms/L to as high as 40,000 micrograms/L. Cadmium concentrations have varied from zero to as high as 564 micrograms/L. Zinc and other heavy metals may appear in significant concentrations in landfill leachate. Sulfate concentrations have been reported to range from 50,000 micrograms per liter to 1,2000,000 micrograms per liter. Chloride concentrations have been reported between 200,000 micrograms per liter and 3,000,000 micrograms per liter.

Samples of leachate have been collected from tanks at the S landfill but only after the landfill had been closed for a number of years. Typical data reported in Quarterly Operating Reports for the S landfill include data from February 1997: pH of the sample was 6.4, and conductivity was 804 micromhos per centimeter. Chemical oxygen demand was 42 mg/L. Metal concentrations of interest were:

Metal	Concentration	Reporting Limit
	Micrograms/L	Micrograms/L
Al	750*	200
Cr	50*	10
Fe	2,660	100
Mg	16,700	5,000
Na	17,900	5,000
Pb	250*	3

*Analyzed but not detected at the analyte quantitation limit.

TCE concentration was less than 20 micrograms/L and Te-99 concentration was zero.

Even with the indicated solubilization of metals in the landfill leachate, the Tc-99 levels are very low, typically below detection limits. The TCE concentrations, where given, were at or below detection limits. With these very low concentrations of contaminants of concern in the leachate from the landfills, it appears unlikely that the landfills could serve as the sources for higher concentrations of the same contaminants in the groundwater in the Regional Gravel Aquifer, below the fine-grained soil layers in the UCRS.

Information on materials found below the landfills also was reviewed. During expansion of the S landfill, D'Appolonia Waste Management Services of Pittsburgh examined the subsurface soils by means of borings. A layer of fill was found blanketing the entire site. Ground surface elevations varied between about elevation 356 feet and elevation 400 feet. Beneath the fill was a clay stratum, which would form the base of each new cell. The base of that clay stratum was located approximately between elevation 343 feet and elevation 346 feet, and the thickness of the clay layer exceeded 14 feet.

Four borings were drilled within the boundaries proposed for the two new cells. Four other borings had been done in areas within the S landfill area but not under the locations of the two new proposed cells. No water was found in any boring, even when the borings penetrated to a sand seam in the middle of the UCRS. Laboratory hydraulic conductivity tests were done on undisturbed samples from each boring. The test results, in terms of hydraulic conductivity, ranged from 9×10^{-7} cm/sec to 5×10^{-6} cm/sec. This partially saturated clay stratum was found continuously in all borings done at the site, including those done in earlier studies outside the areas of the two new cells. The lack of saturation in the clay would reduce the effective hydraulic conductivity of the clay stratum even below the values listed above.

Since 1989, four additional cells have been constructed at the S and T landfills. However, all of those cells have been equipped with compacted clay liners for which the hydraulic conductivity has been given as 2×10^{-8} cm/sec. The rate of leachate migration from the S and T landfills would have been very slow, and much slower than the rate of groundwater movement in the Regional Gravel Aquifer. Given the very low concentrations of TCE and Tc-99 found in the leachate from the S landfill, very small amounts of those contaminants would have migrated out of the landfills during the time when those leachate samples were obtained in the late 1990s and since 2000. If the vertical migration rate of the contaminants from the landfills were very low, and very much lower than the rate of lateral groundwater flow in the RGA, then the contaminant concentrations would have been reduced even more by dilution. Dilution would have occurred even for contaminants migrating out of the old waste disposal area under the S and T landfills (SWMU 145), because of the clay stratum of low hydraulic conductivity located beneath the entire area of the S and T landfills.

Data on concentrations of chemicals in the groundwater samples from monitoring wells around the S and T landfills have been evaluated from the perspective of parameters used to characterize landfill leachate. Concentrations of those parameters provide some indications on the probability that contaminants have leaked out of the landfills, and patterns in concentrations also indicate relative likelihood that contaminants have not leaked out of the landfills.

Total organic carbon values in leachate from sanitary landfills in the United States have ranged from 1,500 mg/L to 20,000 mg/L. Total organic carbon concentrations vary widely in the results of analyses on groundwater samples taken around the S and T landfills. However, a significant pattern or trend is apparent. Consistently, through the entire period of monitoring, TOC levels in the samples from monitoring wells within the landfill perimeter (MW 221, MW 222, MW 223 and MW 224) have been at detection limits (generally 1 mg/L) or less. In the groundwater samples from the other monitoring wells around the landfills, TOC levels were much higher. If leachate were migrating from the S landfill, TOC levels would be very likely to be higher in MW 221, MW 222, MW 223 and MW 224 than in any other monitoring wells.

Chemical Oxygen Demand values for samples taken from the monitoring wells around the S and T landfills typically have been at detection limits with the exception of samples from a limited number of wells. Chemical oxygen demand values have ranged from 11 mg/L to 84,000 mg/L in samples of leachate from landfills in the United States. In samples from MW 393 located northeast of the T landfill, COD values have reached as high as 254 mg/L. In MW 370 located northwest of the landfills but close to the North-South Drainage Ditch, COD values have reached as high as 134 mg/L.

Among anions, chloride concentrations typically were less than 50 mg/L in samples from monitoring wells around the S and T landfills. However, higher values were recorded for samples from some monitoring wells. Chloride concentrations reached as high as 108 mg/L in MW 396, located southeast (and upgradient according to the groundwater flow

model developed for the PGDP site), and were in the range from 58 mg/L to 64 mg/L in MW 394 and MW 395 in the same cluster with MW 396. The highest chloride concentrations were obtained in samples from MW 390, a well screened in the UCRS and located northwest of the landfills and close to the North-South Drainage Ditch; in samples from that well, chloride concentrations ranged from 292 mg/L to 316 mg/L. In samples from MW 17, located northwest of the S landfill between the landfills and the North-South Drainage Ditch, chloride concentrations reached as high as 98 mg/L. Chloride concentrations in the range from 55 mg/L to about 63 mg/L were found in samples from MW 264 and MW 266 located north of the landfills and close to the North-South Drainage Ditch. In contrast, chloride concentrations in samples from wells inside the landfill perimeter averaged below 40 mg/L.

Sulfate concentrations in leachate from sanitary landfills in the United States have been reported in the range from 50 mg/L to 1,2000 mg/L. Sulfate concentrations provide a dramatic picture of variations around the S and T landfills. Within the landfill perimeter, in samples of groundwater from MW 220, MW 221, MW 222, and MW 224, sulfate concentrations typically were less than 15 mg/L with the exception of MW 220 where concentrations reached as high as 42 mg/L. Very low sulfate concentrations were obtained from samples taken from a well cluster southeast of the landfills (MW 394, MW 395 and MW 396) and from samples taken from a well cluster northeast of the landfills (MW 391, MW 392 and MW 393). In samples from those two clusters of wells, sulfate levels did not exceed 17 mg/L. In samples taken from wells north of the landfills but near the North-South Drainage Ditch (MW 179, MW 263, MW 264), sulfate concentrations ranged from over 220 mg/L in MW 179 to about 80 mg/L in the other two monitoring wells. In monitoring well 373, sulfate concentration reached as high as 809 mg/L; that monitoring well was north of the landfills but very close to the North-South Drainage Ditch. With decreasing distance from the landfills, sulfate levels declined in MW 42 (up to 240 mg/L), MW 17 (up to 202 mg/L), MW 18 (up to 160 mg/L) and MW 39 (up to 71 mg/L). In MW 16, south of the landfills, sulfate levels ranged from about 31 mg/L to about 39 mg/L. These sulfate levels indicated a clear pattern of low concentrations within the landfill perimeter and progressively higher concentration with increasing proximity to the North-South Drainage Ditch. Comprehensive data on sulfate concentrations in groundwater samples from around the S and T landfills are contained in Appendix D of this report.

Metals concentrations provide further indications of where contaminants found in the groundwater beneath the S and T landfills have originated. For zinc, concentration values within the S and T landfill area proper, in MW 221, MW 222, MW 223 and MW 224 varied from 0.005 mg/L to 0.05 mg/L, until 1996 when concentration values increased to 0.25-0.29 mg/L. In MW 18, just north of the S landfill, zinc concentrations varied from 0.005 mg/L to 0.006 mg/L. In contrast, zinc concentrations in MW 19 near the North-South Drainage Ditch northwest of the two landfills ranged from 0.36 to 0.91 mg/L. In MW 17, between the two landfills and the North-South Drainage Ditch, zinc concentrations varied from 0.24 mg/L to 2.0 mg/L. In MW 16, southwest of the S and T landfills, zinc concentrations varied from 0.08 mg/L to 1.11 mg/L.

Lead levels were very slightly higher in samples from MW 17, MW 19 and MW 44, but no recognizable pattern or trend could be detected in lead concentrations. In samples taken from the new monitoring wells installed in 2001, lead levels were listed equal to the detection limit of the test. Cadmium levels in samples from the monitoring wells around the S and T landfills consistently have been at or below 0.005 mg/L since 1996, and provide no insights into leachate movements.

As a further indicator of possible contaminant migration from the S and T landfills, gross alpha activity values in samples taken from monitoring wells around the S and T landfills were examined. With the exception of one value, 31.39 pCi/L for MW 223 just west of the S landfill, the values for gross alpha activity for samples near or within the landfill perimeter generally are not different from values for samples from other wells.

The contaminant concentration/activity maps developed as part of this evaluation do not support the conclusion that the S and T landfills were sources of TCE and Tc-99 indicated by analysis of groundwater samples taken from the aquifers below the landfills. Data on TCE concentrations and Tc-99 activities from specific monitoring wells around the S and T landfills, plotted versus time, do not show clear indications of movement of contaminants from sources within the landfill area to the north-northeast along the presumed direction of groundwater flow.

Data on concentrations of chemicals other than TCE and Tc-99 in samples taken from monitoring wells around the landfill area do not support the hypothesis that contaminants have been leached out of the two landfills. Rather, those data indicate that the North-South Drainage Ditch is a much more likely to be the source of contaminants found in the groundwater under the landfills, than the landfills themselves.

Information obtained in the most recent exploration effort around the S and T landfills appears to support judgments made previously on the basis of analysis of contaminant concentrations in the groundwater around the landfills, that the landfills are not sources of TCE or Tc-99.

The evaluation of conditions in the groundwater under the S and T landfills has an element of uncertainty in regard to a definitive conclusion about the likelihood that contaminants have been leached out of the S and T landfills into underlying aquifers. Casings of many of the monitoring wells around the landfills corroded severely. Thus, the data obtained from all of the wells, and especially those that were replaced because of corrosion, must be considered somewhat suspect because of the possibility that contaminants migrated into subsurface areas from source zones near the surface when monitoring wells were installed through or near the North-South Drainage Ditch. However, such an occurrence would tend to increase contaminant levels in wells around the landfills, so the evaluation presented herein is a conservative assessment.

A final report describing the results of the review of documents and evaluation of data from samples of groundwater obtained from monitoring wells around the S and T landfills was completed and submitted.

2. Groundwater Management/Remediation technologies. In the last quarter, the report on the review of remediation technologies was completed and submitted. No significant new work was done, compared to the work that was reported at the last Quarterly Meeting.

Projected Task Summary for next Quarter:

1. Continue assessment of historical data, new data, and conditions at SnT and U Landfills (Task 1A & B)(12/30/2005).
2. Develop cross-sections depicting physical conditions underlying the SnT and U landfills reflecting the relationships of well screens to lithology, each other, and NSDD (Task 1A & B) (12/30/2005).
3. Finish D1 updated technology review relative to technology in ITRD report (Task 2A & B) (9/30/2005).

5. UK/CE Groundwater Modeling Project Quarterly Report

October 5, 2005

Project Title:

Groundwater Modeling

Project Goals:

- Evaluate the adequacy of existing groundwater models at the site
- Recommend necessary improvements to the models
- Conduct Sensitivity analyses for CAB/PGDP GW modeling team Water Budget Items
- Evaluate the potential use of natural attenuation for addressing off-site dissolved phase groundwater contaminants
- Use the models to evaluate the efficiency of proposed groundwater remediation plans

Projected Completion Date:

September, 2005 for existing tasks, additional time and tasks are expected as part of Phase I activities.

Percentage Completion to Date:

90% on Phase I tasks identified at start of Project. Percentage completion for additional tasks that were identified are listed with project tasks below.

Project Team/Member Roles/Tasks:

Srinivasa Lingireddy, Ph.D./Associate Professor of Civil Engineering-UK, PI. Coordinate the team activities, recruit and direct graduate students and post-doctoral scholars to help with the modeling efforts, prepare quarterly reports.

Steve Hampson/Assistant Director, UK-KRCEE – Project Manager

Dr. Lindell Ormsbee/ Director, UK-KRCEE**.** Technical Advisor

Dr. Joe Hagerty/Professor of Civil Engineering, UL. Provide technical consultations and expert opinion on modeling activities

Dr. Chandramouli Viswanathan/Visiting Faculty, UK Civil Engineering. Provide technical modeling experience to PGDP groundwater and Murray State University

TMDL Project HSPF models.

Jim Kipp/Associate Director, UK-KWRRI, Provide technical and administrative support

Project Activity Status

Task (per cent completion)(expected date of completion):

1. Finalize reviews, evaluations, and recommendations from previous and ongoing UK groundwater modeling activities for the PGDP site. **(95%)(12/2005)**

2. Provide modeling assessment for a range of groundwater remedial approaches including natural attenuation, hydraulic containment, pump & treat, and source/dissolved phase removal/treatment. **(50%) (12/2005)**

3. Provide modeling assessment for the efficiency and expected performance of proposed groundwater remediation plans. **(30%) (12/2005)**

4. Conduct "Water Budget" sensitivity analyses with DOE contractors Navarro, Bechtel Jacobs, and SAIC **(100%) (12/2005)**

    (a) Sensitivity analysis on hydraulic conductivity in layer 3 (RGA aquifer) (100%)(6/03)
    (b) Sensitivity analysis on Big Bayou and Little Bayou creek stages their influence on contaminant distribution and system potentiometric surface (100%)(6/03)
    (c) Evaluation of water inputs to model and water outputs from as percentage of total model water inputs/outputs including storage, constant head, recharge, river leakage, head dependent boundary (100%)(6/03)

5. Develop MS EXCEL macro for conversion of Rockware geologic software lithologic/stratigraphic input of PGDP data to format suitable for input with C-Tech EVS 3-D software **(100%)(6/05)**

6. Develop MS EXCEL macro for PGDP data evaluation relative to #analyses, # detects, # analyses exceeding health/regulatory/background thresholds. **(90%) (7/2005)**

7. Completed evaluation of initial of baseline model provided to UK by DOE contractors **(100%)(6/05)**

Projected Tasks Summary for UK-CE KRCEE next Quarter:

- Add Risk Targets columns to MS EXCEL data macro that will be applied as qualitative and quantitative evaluation of data from gw, sw, soil, sediment sampling locations (10/05 - 12/05)
- Obtain additional GW Modeling (PGDP) Team sensitivity analyses necessary for this phase of Project (10/05 - 12/05)
- Finalize modeling of natural attenuation simulations and include multiple simulation reflecting variations on pumping on and off site wells in conjunction with plant shutdown effects (10/05 - 12/05)
- Model changes in infiltration due to removal of building and road (10/05 – 2/06)
- Obtain and verify groundwater withdrawals from TVA & vicinity (10/05)
- Evaluate boundary condition effects on current vicinity & SWMU scale models (10/05 – 4/06)
- Complete simulations and documentation of groundwater conditions when plant activities cease under a number of possible remedial scenarios with consideration of multiple parameter sensitivity analyses (10/05 - 11/05)
- Evaluate and identify for future reference the predicted changes in observation well levels with Olmstead Dam pool increase (10/05 – 11/05)
- Complete evaluation of transport model calibration (10/05 – 12/05)
- Evaluate DOE contractor Kd Sensitivity Analysis document (circa June 2002) (10/05 – 12/05)

Significant Findings to date:

1. Existing groundwater flow model calibrated well to two significant field water level measuring events
2. Reduction of Hydraulic Conductivity (K) at the end of the first stress period indicates that the reduction of K increases the head values at observation wells.
3. Reduction in K with resulting increase in head levels at observation wells leads to deviation of model results from the calibrated model.
4. Conclude that assignments of K in zones as presently understood and applied is representative of physical system.
5. Existing groundwater flow model accounts for Ohio River stage change from Olmstead Dam with 306’ msl pool in Stress Period 2.
6. Transport model calibration not well understood or widely distributed
7. Existing sensitivity analyses conducted for transfer of model to new contractors not intensely reviewed or widely distributed
8. Stage changes in LBC have greater influence on head distribution and plume configuration than stage changes in BBC
9. Stage of LBC influences contaminant distribution in NE Plume & NW Plume

6. UK Chemical Engineering Nickel Project Quarterly Report

May 25, 2005

Project Title:

Background research & chemical engineering evaluation of technologies for the removal of 99Tc from volumetrically contaminated metals.

Projected Completion Date:

June 30, 2004.

Percentage Completion to Date:

100%

Project Goals:

- Provide standard preparation of market available Ni for distribution to laboratories conducting analyses
- Investigate the chemical/physical characteristics ^{99}Tc
- Evaluate market uses of Nickel
- Identify market uses where slightly volumetrically contaminated Ni might be utilized
- Conduct a thorough research & review effort to identify documented removal methods for ^{99}Tc from volumetrically contaminated material
- Provide recommendations for bench scale study to evaluate removal of ^{99}Tc if processes other than commercially available CVD or electrochemical refining are promising

Project Team/Member Roles/Tasks:

Dr. Eric Grulke/UK-Chemical & Materials Engineering, PI. Lead project efforts.

Louie El Asami/UK-Chemical & Materials Engineering, Graduate Research Assistant. Conduct daily research & investigative efforts.

Dr. Lindell Ormsbee/ Director, UK-KRCEE. Technical Advisor.

Dr. John A. Volpe/KRCEE Contractor. Provide technical and regulatory expertise for radioactive material issues.

Steve Hampson/KRCEE. General project support.

Project Activity Status:

Task (% completion)(Completion Date/Projected Completion Date)

- Provide standard preparation of market available Ni for distribution to laboratories conducting analyses.(100%) (11/03)
- Meetings with project team to discuss chemistry, removal, and release issues (100%) (10/03, 11/03, 2/04, 6/04, 8/04, 9/04, 10/04)
- Conduct research into documented removal technologies (100%) (6/04)
- Identify promising technologies for removal (100%) (6/04)
- **FINAL PROJECT REPORT DISTRIBUTED JANUARY 2005.**

Task Summary:

Distributed final report (1/05)

Significant Findings:

Chemical properties of ^{99}Tc and it's properties associated with other materials are poorly distributed and not readily available if documented.

Russian research and obscure DOE-complex research have indicated that some simple chemical-physical processes that are less complex than CVD are likely to be successful for the removal of ^{99}Tc from volumetrically contaminated metal.

Bench-scale testing to verify ^{99}Tc properties and removal from metal matrices are being developed and preliminary testing should be conducted beginning in early CY 2005.

BASED ON THE FINDINGS FROM THIS PROJECT TEAMS COMPLETION OF WORK, A RESEARCH AND DEVELOPMENT PROJECT FOR THE DEVELOPMENT OF 99Tc/Ni DISTILLATION-SEPARATION PROCESS WAS INITIATED IN AUGUST 2005 AS PART OF KRCEE PHASE II ACTIVITIES.

7. UK – KGS & Geological Sciences Seismic Monitoring and Seismic Hazard Assessment Quarterly Report.

October 25, 2005

Project Title:

Enhancing Earthquake Monitoring and Assessing Seismic Hazard for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

*In budget information, earthquake monitoring and assessing seismic hazards are distinguished as separate projects. However, the co-PI's are the same individuals and the funding for these seismic-related projects was split between the co-PI's respective institutions - the UK-Kentucky Geological Survey and the UK-Department of Geological Sciences.

Projected Completion Date:

September 2005

Percentage Completion to Date:

85%

Project Goals:

- To better monitor and locate earthquakes in the Jackson Purchase/Paducah area
- To provide an independent and peer reviewed probabilistic ground motion hazard assessment for the Paducah Gaseous Diffusion Plant (PGDP).

Project Team/Member Roles/Tasks:

Dr. Zhenming Wang/Seismologist and Section Head/Geological Hazards, UK-Kentucky Geological Survey, **Co-PI**

Dr. Edward W. Woolery/Assistant Professor, UK-Department of Geological Sciences University of Kentucky, **Co-PI**.

Dr. John Kiefer/UK-KGS. Project Team member.

Jim Kipp/UK-KWRRI. Project Team member.

Dr. Lindell Ormsbee/Director, UK-KRCEE. Project Team member.

Steve Hampson/UK-KRCEE. General project management.

Project Activity Status:

1. **Seismic Monitoring**

Task 1. Installation of seismic stations in Jackson Purchase to enhance the existing seismic system network allows for monitoring of area micro-seismicity and the collection of seismic data directly related to and needed for ongoing and future DOE-PGDP activities. Data collected at this and other stations will provide information that will assist in the development of a database to characterize the amplification effect of near-surface soils on strong ground motion in the New Madrid Seismic Zone.

Task (Percent Complete)(Projected completion)

- Identify new seismic station locations in the area (100%)(04/04)
- Contract driller for PGDP seismic station installation in WKWMA (100%) (3/04)
- Install WKWMA boreholes (100%) (4/04-8/04)
- Order PGDP seismic instruments (100%) (1/04)
- Completed installation seismic station at Paducah Airport (100%)(8/04)
- Completed installation seismic station in Lovelaceville (100%) (8/04)
- Implemented new Health and Safety and Notification procedures for PGDP work (100%)(1/05-3/05)
- Installed fence and electric for WKWMA seismic installation (100%)(1/05-3/05)
- Prepare seismic instruments for the station at WKWMA (100%) (1/05-3/05)
- Conducted in-situ velocity testing (100%)(3/05)
- Completed installation of seismic station monitoring instruments at WKWMA (100%) (4/05)
- Continue data collection from WKWMA seismic monitoring station (TBD)(TBD)

2. Seismic Hazard Assessment

Task (Percent Complete)(Projected completion)

Task 1: Thorough literature review – There are many new developments and data in seismic hazard assessment methodology, geology, and seismology locally, regionally, and nationally. The focus will be on the new geological and geophysical investigations in the area. The literature review will ensure the use of the best data (i.e., source zonation and attenuation) and methodology for PGDP seismic related activities (95%)(10/31/05).

Task 2: Seismic source Characterization: Based on the information derived from Task 1, the seismic sources and attenuation relationship in and around PGDP will be defined (90%)(11/30/05).

Task 3: Probabilistic seismic hazard analysis (PSHA): PSHA will be performed based on the data from Task 2 (90%)(Draft due 11/30/05).

Task 4: Deterministic seismic hazard analysis (DSHA): DSHA will be performed based on the data from Task 2 (90%)(11/30/05).

Task 5: Develop Preliminary report (90%)(11/30/05).

Task 6: Panel review: A 5-member review panel consisting of national and international experts will be formed to review the preliminary report (25%)(12/31/05).

8. UK-Geological Sciences PGDP Stratigraphic Model Project Quarterly Report

October 5, 2005

Project Title:

Development of Conceptual Stratigraphic Model for the PGDP.

Projected Completion Date:

June 30, 2006

Percentage Completion to Date:
65%

Project Goals:

- To develop a detailed, conceptual model of the stratigraphic framework at the PGDP

Project Team/Member Roles/Tasks:

Dr. Alan Fryar/UK-Department of Geological Sciences, **PI**. Conduct background research, oversee collection of existing and field data, integrate data into compatible electronic model, prepare project reports, and coordinate budget.

Dr. Steve Greb/UK-Kentucky Geological Survey, **Co-PI.** Consult with PI to plan/interpret experimental plan. Assist with field work.

Josh Sexton/UK-Graduate Student. Perform daily tasks, organization of data, execution of field work relative to project goals.

Project Activity Status:

This project officially started July 1, 2005.

- Participate in PGDP GW Modeling Team quarterly meeting (NA)(3/04 & 7/04)
- Identify and recruit graduate student (100%)(4/04)
- Identify existing information (95%)(09/05)
- Develop database of lithologic logs (95%)(9/05).
- Map exposures along Little Bayou and Bayou creeks and their tributaries (85%)(12/05).
- Correlate sedimentary facies in areal and cross-sectional views using Arcview, Surfer, and RockWorks 2002 (60%)(01/06)

Significant Findings:

Over the past quarter, many project advancements have been made. Previously conducted field surveys along Bayou and Little Bayou Creeks have now been enhanced by a published paleoliquifaction study (SAIC, 2004) in the same area. A better understanding of the Upper Continental sediments and their depositional environment has also been developed from collaboration with an ongoing KRCEE project. Holocene project sediment-core samples have indicated the lateral tracing of up to five (5) possible sediment facies. This, along with very little if any Holocene

Josh Sexton offered support during the final half of the quarter to William Lettis and Associates, the seismic investigation contractor for the project. This opportunity allowed for notes to be made on features (texture, color, bedding, etc.) viewed in core samples that will provide a comparison for what is seen in outcrop.

Optically stimulated luminescence (OSL) dating of core samples as part of the Holocene project will also augment sampling that will be conducted along the creeks by the project team. OSL sampling locations along both creeks have now been selected and a sampling plan has been developed according to standard methods (Foreman, 2005; Mahan, 2005; USGS, 2005). Samples should be collected during the following quarter and will be analyzed by mid-spring. These data are likely to support the stratigraphic units picked by the project team and aid in the interpretation of depositional history.

Borings were also added to the digital database during the past quarter. The most important of these borings were the USGS Heath GQ borings, which will provide needed lithologic information for the southern portion of the study area.

Conceptual Model Development:

Lithologic database information in conjunction with surficial data at this time is believed to be sufficient and a stratigraphic framework is now being created. Additional lithologic data, however, will be entered as needed. Stratigraphic contacts are currently being identified to construct the stratigraphic framework and preliminary lithologic cross-sections have been evaluated. During the next quarter a *rough* draft of site-wide stratigraphic cross-sections are anticipated to be created, along with an isopach map from ground surface to the base of the Lower Continental Deposits (Mounds Gravels) and an isolith map of the gravel dominated facies of the RGA.

Goals for the Next Quarter:

- Examine the portion of Bayou Creek that has yet to be mapped
- Collect OSL samples and prepare samples for analysis
- Make a final decision on a laboratory to process OSL samples
- Create isopach and isolith maps for the study area
- Begin creation of preliminary stratigraphic cross-sections

References:

Foreman, S., 2005, Personal Communication, Department of Earth and Environmental Sciences, The University of Illinois at Chicago

Mahan, S.A., 2005, Personal Communication, USGS Luminescence Dating Laboratory, United States Gological Survey

USGS, 2005, Information for Prospective Thermoluminescence (TL) and Optically Stimulated Luminescence (OSL); Section IV: How to Collect Samples for TL and OSL Dating, http://crustal.usgs.gov/laboratories/luminescence_dating/section4.html

SAIC, 2004, *Seismic Investigation Report for Siting of a Potential On-Site CERCLA Waste Disposal Facility at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* Report. DOE/OR/07-2038D2, SAIC Engineering Inc, Oak Ridge, TN

9. UK Agricultural Engineering Sediment/Contaminant Release Control Project

(Project Activities continue on hold pending completion of contractual arrangements)

October 12, 2005

Project Title:

Development and Design of Cost-effective, Real-Time Implementable Sediment and Contaminant Release Controls

Projected Completion Date:

June 30, 2006.

Percentage Completion to Date:

45%

Project Goals:

- Provide soil/surface water/sediment transport model that will accurately predict soil/sediment and associated contaminant trends.
- Evaluate, design, assess and provide recommendations for surface water/sediment/contaminant control remedial options that will be cost effective and will be able to be implemented in real time.

Project Team/Member Roles/Tasks:

Dr. Richard Warner/UK-Agricultural Engineering, Surface Mining Institute, LLC, **PI**. Lead project efforts.

Dr. Lindell Ormsbee/ Director, UK-KRCEE**.** Technical Advisor.

Dr. John A. Volpe/KRCEE-contractor. Provide technical and regulatory expertise for radioactive material issues.

Dr. Mike Kemp/Murray State University. Technical Advisor

Steve Hampson/UK, KRCEE. General project support.

Project Activity Status:

Task (% Completion) (Projected Project Completion Date)

- Obtain and review site maps for relevant environmental and engineering features (100%) (9/05)
- Obtain and review rainfall records for PDGP site and vicinity (90%) (3/06)
- Obtain and review soil, storm water, and sediment data for outfalls (30%) (3/06)
- Complete review and identification of applicable, readily-implementable, cost-effective storm water/sediment/contaminant control technologies (60%) (12/05)
- Identified alternative controls including weep berms, flocculation, and sand filters.
- Evaluated the potential performance of each of the above controls (60%)(08/05)
- Conducted preliminary hydrologic modeling of the 20 mm and the 2 yr 24 hr design storm (60%)(08/05)
- Prediction of hydrologic response (rainfall-runoff) for current conditions (20%) (3/06)
- Develop conceptual designs of alternative control systems (65%) (3/06)
- Provide report and design recommendations for outfalls (0%) (6/06)

Project Task Summary:

Task (% Completion) (Date Completed)

- Conducted on-site field reconnaissance for KPDES Outfalls 008, 011, 015 (100%)(08/05)
- Participated in Real Time" Remediation Demonstration Project meeting in Paducah with Tricord, Inc., CDM, KRCEE, Navarro Engineering (100%)(08/05)
- Provided KRCEE with surface water flow controls for duration of "Real Time" Remediation Demonstration Project (100%)(09/05)

Significant Findings:

- Need detailed description and dimensions of current surface water and sediment control facilities observed in plan and in the field.
- The apparent lack of a digital terrain model or a contour map with 2-ft contours will require an approximate delineation of watershed and subwatershed boundaries.
- There is concern that there will not be sufficient space to locate a passive control system. Field reconnaissance is being scheduled to assess space limitations.

- Tradeoffs between surface water treatment and sub-surface water contamination are a design consideration.

ACTIVE KRCEE-DOE Earmark PHASE II PROJECTS
Quarterly Activity Reports

10. UK Geological Sciences & KGS Field Determination of S & P Wave Velocities

October 5, 2005

Project Title:

Field Determination of S & P Wave Velocities for Ground Motion Model Input at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky Field Determination of S & P Wave Velocities for Ground Motion Model Input at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Project Goals:

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- To obtain site-specific S- and P-wave velocity field measurements at the PGDP.
- To obtain field measurements of site specific soil damping properties at the PGDP.
- To provide measured P- and S-wave velocity models at each of the PGDP seismic monitoring sites.
- To provide accurate seismic models that reflect measured site specific S- and P-wave velocities and measured soil damping properties for the PGDP.
- Preliminary report and summary report summarizing the site specific P- and S-wave velocity models
- Preliminary report and summary report summarizing the measured damping properties of PGDP soils.
- Inclusion of site specific P- and S-wave velocity models and soil damping

Projected Completion Date*:

November 2005

*Field activities relative to this project were completed in March and April 2005. BASED ON QUALITY OF INITIAL FIELD DATA ACQUISITION, ADDITIONAL FIELD MEASUREMENTS WILL BE NECESSARY. ADDITIONAL FIELD MEASUREMENTS WILL BE OBTAINED IN OCTOBER AND NOVEMBER 2005.

Percentage Completion to Date:

75%

Project Team/Member Roles/Tasks:

Dr. Zhenming Wang/Seismologist and Section Head/Geological Hazards
UK-Kentucky Geological Survey, **Co-PI.**

Dr. Edward W. Woolery/Assistant Professor, UK-Department of Geological Sciences, **Co-PI**.

Dr. John Kiefer/UK- KGS. Project Team member.

Jim Kipp/UK-KWRRI. Project Team member.

Dr. Lindell Ormsbee/ Director, UK-KRCEE**.** Project Team member.

Steve Hampson/UK-KRCEE. General project management.

Project Activity Status:

Task (% Completion) (Projected Project Completion Date)

- Procure equipment (100%) (8/04)
- Conduct field measurements I (100%) (04/05)
- Data Reduction and assessment I (100%) (4/05)
- Conduct field measurements II (0%) (10/05 – 11/05)
- Data Reduction and assessment II (0%) (10/05 – 11/05)
- Preliminary report and summary report summarizing the site specific P- and S-wave velocity models (0%) (11/05)
- Preliminary report and summary report summarizing the measured damping properties of PGDP soils. (0%) (11/05)

11. UK-KRCEE Adaptive Sampling and Analysis Real-Time Remediation Project ("Real-Time Remediation" or "NDA" Project)

October 5, 2005

Project Title:

Field Demonstration Project for the Application of real-time survey and analytical methods (Non Destructive Analyses) for Cost Effective, Real-time Remediation of Surface Water, Sediment, and Soil at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Projected Completion Date:

October 2005 – July 2006.

Percentage Completion to Date:

25%

Project Goals:

1. To demonstrate the effectiveness of real-time survey and analytical methods to:

   - Identify sediment and soil requiring remediation in a section of Outfall 011 at the PGDP
   - Verify achievement of cleanup goals following remediation of a section of Outfall 011 at the PGDP
   - Provide WAC characterization that is both time and cost-effective relative to presently deployed methods at the PGDP

2. Provide a general cost & time comparison for the deployment of real-time survey and analytical methods and remediation completion versus historical methods previously and presently utilized for site characterization and for conducting remedial actions at the PGDP

3. Present concept and proposed plans to CAB, regulatory decision makers, and DOE/contractors

4. Present results and recommendations for future utilization of process for soil and sediment remediation at the PGDP

5. Involve the developers of EPA TRIAD and Argonne National Laboratory ASAP Programs

Project Team/Member Roles/Tasks:

Steve Hampson/Assistant Director, UK-KRCEE. Review of documents, methods, and contractors chosen for implementation of real-time characterization and cleanup demonstration.

Dr. John A Volpe/Technical Consultant, KRCEE. Conduct evaluation of methods for real-time site characterization and cleanup.

Dr. Lindell Ormsbee/ Director, UK-KRCEE. Technical Advisor.

Dr. D. Joseph Hagerty/ Professor, UL- College of Engineering. Technical Advisor.

Dr. Mike Kemp/Professor, Murray State University. Technical Advisor

Dr. Richard Warner/UK-Agricultural Engineering. Technical Support.

Mr. David Williams/PGDP-RPM, Region IV EPA. Advisor.

Mr. John Richards/Region IV EPA. Mr. Richards will bring subject matter experience on related projects in Region IV and experience related to his role in the development of the multi-agency MARSSIM guidance.

Mr. Tony Hatton/EPPC, Assistant Director Division of Waste Management. Mr. Hatton will provide remedial and regulatory expertise as a member of the project team.

Project Activity Status:

1. KRCEE will develop a demonstration project utilizing real-time sampling, real-time analysis, and real-time cleanup of a section Outfall 011. A final status survey will employ statistical sampling of the remediated area to demonstrate utility of real-time methods and to confirm the attainment of cleanup goals.

2. KRCEE will develop sampling and analysis plans and quality assurance project plans to ensure the production of the quality data to support Data Quality Objectives.

3. KRCEE will utilize approaches developed by USEPA, DOE and DOE national laboratories to demonstrate the effectiveness of real-time assessment and cleanup of outfalls, ditches, and soils at the Paducah Gaseous Diffusion (PGDP).

4. The project will demonstrate utilization of appropriate radiation survey instruments, *in situ* gamma spectroscopy for radionuclides, head space measurement/in-field electron capture gas chromatography for volatile organics, and XRF technology for metals.

Task Summary:

Task (% Completion) (Projected Project Completion Date)

1. Internet and document search and reviews to evaluate the availability and applicability of adaptive sampling and analysis approach characterization, remediation, cleanup verification, and waste characterization methods applicable to soil and sediment remedial needs at the PGDP (100%)(01/05)
2. Internet search to find companies that have the capability to implement real-time survey mapping, and analysis procedures. A number of companies have the capability of conducting a radiation walkover survey utilizing coupled radiological survey and data positioning. Real-time methods utilized by various companies employ a GPS systems coupled to a survey meter that permits measurement, recording, and mapping of impact areas. In comparison to other technologies real-time survey and mapping technologies allow for greater areal coverage and complete site characterization versus traditional multiple phases of random location sampling and laboratory analyses.(75%)(07/05)
3. Requested a quotes from Canberra for in-situ gamma spectroscopy (50%)(07/05).
4. Review of DRAFT DOE G 441.1-XX, "CONTROL AND RELEASE OF PROPERTY WITH RESIDUAL RADIOACTIVE MATERIAL for use with DOE 5400.5, *Radiation Protection of the Public and the Environment, April 2002* and applicable portioins of MARLAP multi-agency guidance document (100%)(10/04).
5. Reviewed EPA Triad methodology and decision making documents and Argonne National Laboratory Adaptive Sampling and Analysis Program (ASAP) documents (100%)(10/04).
6. Reviewed Triad and ASAP remedial projects conducted at other sites and documented on the internet (75%)(09/04 – 07/05).
7. Contacted Argonne National Laboratories and began project discussions and contracting process (50%)(11/04 – 08/05).
8. Met with EPPC and EPA to provide information, discuss, gain acceptance and Project Team participation for concept and project (100%) (11/04 – 02/05)
9. Developed SW "Real-Time" Project Team Flowchart (100%)(02/05).
10. Presented SW "Real-Time" Project to PGDP CAB (100%)(03/05).
11. Developed project specific templates for HASP, WP, Waste Mgmt Plan, QAPP (60%)(01/06).
12. Development of a final confirmation sampling approach utilizing Visual Sampling Program (50%)(01/06).
13. Conducted kickoff conference call with project team participants from KRCEE, UK-Ag Engineering, Tricord, Inc., Navarro Engineering, CDM, USEPA, and KDWM (100%)(08/05)

12. UK Chemical Engineering Nickel Distillation Project Quarterly Report

October 5, 2005

Project Title:

Engineering Research and Development for Cost-effective Distillation Technology to Accomplish the Separation of 99Tc/Ni and Decontamination of PGDP Nickel Ingots.

Projected Completion Date:

December, 2006.

Percentage Completion to Date:

45%

Project Goals:

- Design and Construct Knudsen Cell Mass Spectrometer to generate physical and chemical property data for Rhenium- Nickel prior to generating data for ^{99}Tc-Nickel system
- Investigate and document the chemical/physical characteristics of ^{99}Tc
- Investigate and document the chemical/physical characteristics Nickel
- Apply research findings to develop bench-scale distillation unit for the separation of 99Tc from nickel ingots
- Conduct bench scale experiments
- Apply research and bench scale experiment findings to the design of full-scale process

Project Team/Member Roles/Tasks:

Dr. Eric Grulke/UK-Chemical & Materials Engineering, **PI**. Lead project efforts.

Louie El Asami/UK-Chemical & Materials Engineering, Graduate Research Assistant. Conduct daily research & investigative efforts.

Dr. Tony Zhai/UK-Chemical & Materials Engineering, Metallurgy Technical Advisor

Dr. Lindell Ormsbee/ Director, UK-KRCEE. Technical Advisor.

Mr. Bert Lynn/UK-Chemical & Materials Engineering, Mass Spectrometer Expert. Will advise project team on MS design, procurement of materials, and will construct the specialized MS equipment.

Dr. John A. Volpe/KRCEE-contractor. Provide technical and regulatory expertise for radioactive material issues.

Steve Hampson/UK-KRCEE. General project support.

Project Activity Status:

(% Completion) (Projected Task Completion Date)

- Conduct research to construct specialized mass spectrometer.(100%) (11/03)
- Meetings with MS specialist to identify design parameters and suppliers (100%)(7/04 – 12/04)
- Submit equipment cost estimates (100%) (8/04)
- Complete equipment procurement from suppliers (100%) (7/05)
- Visited NASA research facility in Ohio to observe Knudsen cell mass spectrometer installation (100%)(12/04)
- Assembly of Knudsen Cell Mass Spectrometer or KCMS (90%)(10/05)
- Calibration of KCMS (0%)(12/05)
- Begin analytical tests (0%)(1/06 - 12/06)

Significant Findings:

TBD

13. UK–KRCEE, UK Geological Sciences & KGS Holocene Issues Project Team

October 4, 2005

Project Title:

Field Study and Peer Review for Determination of Holocene Displacement at the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Projected Completion Date(s):

- Fieldwork - September, 2005
- C-14 and TLS Sampling – November thru January, 2005.
- Preliminary Reporting to Stakeholders – November, 2005
- Draft Project Report – January, 2006
- Final Project Report for DOE – February, 2006
- Report for Publication – January to June, 2006

Percentage Completion to Date:

80%

Project Goals:

- To determine whether Holocene displacement has occurred along target zones associated with faults identified at the C-746-U landfill
- To provide an independent and peer reviewed report summarizing the results of the field investigation

Project Team/Member Roles/Tasks:

Dr. Zhenming Wang/ Seismologist and Section Head/Geological Hazards, UK-Kentucky Geological Survey, **Co-PI**

Dr. Edward W. Woolery,/Assistant Professor, UK-Department of Geological Sciences, **Co-PI**.

Dr. Martitia Tuttle/Tuttle and Associates. (formerly Univ. of Maryland). Project Team member-Independent Technical Review.

Dr. Roy Van Arsdale/University of Memphis. Project Team Member-Independent Technical Review.

Mr. John Nelson/ Illinois Geological Survey. Project Team.

Mr. John Nelson/ Illinois Geological Survey. Project Team.

Dr. William Lettis, John Baldwin, Keith Kelsen/Lettis & Assoc., Walnut Grove, Ca. Project Team Members, Field Oversight Contractors

Dr. Dave Amick/SAIC-Augusta. Project Team.

Mr. Marshall Davenport/Jacobs Engineering, Oak Ridge. Project Team

Steve Hampson/UK, KRCEE. General project management.

Project Activity Status:

Task (% Completion) (Projected Project Completion Date)

Task 1. Recruit project and Independent Technical Review (ITR) teams comprised of experienced national and international experts (100%)(03/05)

Complete ITR Contracts (100%) (7/05)

Task 2. Hire experienced/qualified contractor to obtain DPT cores

Complete Project Team Contracts (100%) (8/05)
Finalized Miller Drilling Contract (100%)(07/05)

Task 3. Hire experienced field management team to oversee all aspects of fieldwork

Completed William Lettis and Associates contract for workplan development, background research, and field oversight (100%) (11/04)

WLA Project Team background research completed (100%) (8/05)

Completed contracting process with SAIC-Paducah to provide field oversight manager to coordinate activities on-site (100%)(05/05)

Completed field preparation and Health and Safety management with Tricord, Inc. (100%)(08/05)

Task 4. Complete review and submission of Readiness Review items

Readiness Review Requirements information package for UK-KRCEE was substantially completed by Bechtel Jacobs (100%)(2/05)

KRCEE/UK MOU review and project specific revisions (100%)(2/05 – 7/05)

Submitted Readiness Review as complete package (100%)(09/05)

Completed Holocene Project readiness review at PGDP (100%)(09/05)

Task 5. Complete project scoping.

Write workplan, Health and Safety plan and submittals (100%)(09/05)
Compile and distribute background information to technical contractors (100%)(07/05)
Plan and conduct field recon (100%)(04/05)

Task 6. Conducted field activities (100%)(9/05)
Complete core assessment (90%)(11/05)
Complete cross-sections (50%)(1/06)

Task 7. Convene project team to write preliminary project report (Expected 10/05 - 1/06)

Task 8. Submit and revise project report based on ITR review (Expected 1/06 – 3/06)

Task 9. Preliminary reporting for stakeholders (Expected 11/05 - 12/05)

Task 10.Final report for distribution and journal publication (Expected 1/06 - 03/06)

Significant Findings:

TBD

14. PGDP Data Warehouse Development

October 12, 2005

Project Title:

PGDP Data Warehouse Development

Projected Completion Date:

January, 2006

Percentage Completion to Date:

80%

Project Goals:

Develop a secure internet accessible website to provide managers and scientists access to the PGDP geospatial, geotechnical, environmental and related data to support environmental projects such as site characterization, groundwater modeling, regulatory compliance, remedial design, and risk assessment. The Data Warehouse Project will implement and complet activites related to the following categories:

1. Website Modification and Development
2. Geospatial Data Warehouse Development
3. Training

Project Team/Member Roles/Tasks:

Steve Hampson/UK, KRCEE. General project management.

Steve Cordiviola/UK-Kentucky Geological Survey (KGS). Daily Technical Management

Dave Korns/SAIC-Dublin, Ohio. SAIC Technical Lead

Dr. John A Volpe/Technical Consultant, KRCEE. General project support.

Project Activity Status:

Task(% Completion) (Projected Completion Date)

Task 1. Develop Scope of Work (100%)(04/05)

Task 2. Hire experienced DOE contractor to apply previous project expertise to development of Data Warehouse

Complete SAIC Contract (100%) (4/05)

Task 3. Hire experienced UK staff to participate in daily project activities

Complete full-time 4-month contract for KGS IT manager (100%)(04/05)
Complete part-time 3 month contract for KGS IT manager (100%)(09/05)

Task 4. Website Modification and Development

1. Assembly of PGDP-specific website (100%)(9/05)
2. Interface/meetings with Bechtel Jacobs project and IT personnel to identify site project participants, data/information not presently in OREIS, and short/long-term data use needs for site activities (85%)(08/05)
3. Beta-testing for PGDP Data Warehouse with PGDP personnel (0%)(01/06)

Task 5. Geospatial Data Warehouse Development

1. Obtain, input, and format OREIS database (100%)(07/05)
2. Obtain, input, and format geospatial information from existing data, internal sources, and external sources (80%)(08/05)

Task 6. Training

1. Obtain software and application-specific training for KGS-IT manager (100%)(07/05)
2. Provide training to Project Team for prototype database (20%)(09/05 – 10/05)
3. Provide user training (0%)(12/05)

Significant Findings

1. Completed import of OREIS database.
2. Met with site project personnel relative to their needs for system.
3. Compiled GIS features and layers and integrated into system
4. Setup temporary server and made available to KGS and KRCEE personnel for initial evaluation
5. Continued compilation of geoscience data
6. As of 10/1/2005, a prototype web-based PGDP Data Warehouse is being evaluated by KRCEE, Project Team members, and DOE/Navarro Engineering.