REGIONAL TECHNOLOGY COMPILATION FOR DRA / GEORGE GRAY SUMMIT

REGION 1

X-RAY FLUORESCENCE INSTRUMENTS FOR METAL DETECTION IN SOIL AND DUST WIPES

Best Practice: Conducting SBIR and ETV verification on technologies that have a direct application to our regulatory mission as an environmental protection agency.

Best Practice: SBIR funding and ETV verification

Title: X-ray Fluorescence Instruments for Metals Detection in Soil and Dust Wipes

Background: The presence of toxic trace metals in the environment is a significant concern in site monitoring and clean-up assessments. Conventional laboratory analytical methods for determining trace metals are time consuming and costly, and may require multiple analytical methods to determine the target metals in a sample. For example, EPA SW-846 calls for digestion of samples from a variety of matrices (for example, soil, sediment, and dust) by acid digestion (Method 3050A) or microwave-assisted acid digestion (Method 3051) or by Method 3052 for difficult matrices. Analysis of the sample digest is then conducted by inductively coupled plasma (ICP), with either atomic emission spectroscopy (Method 6010) or mass spectrometry (Method 6020) as the final detection method. To allow field personnel to quickly assess the extent of metals contamination at a site, a simple, rapid, cost effective field screening method that is applicable to a wide variety of target metals is critical.

Science: In 1992-6, EPA's SBIR Program gave NITON Phase I, II, & III funding to develop an onsite assessment technology for lead paint. NITON created a portable X-ray fluorescence (XRF) analyzer. In 95-97, they received DOE SBIR funding to create an XRF analyzer for screening trace metals in the field. These two SBIR technologies and more advanced versions were then verified by ETV in 1996-2000. Notable advantages to using XRFs include: field portability (small, battery-operated), high sample throughput (on the order of 30 to 60 samples per day), no chemical waste, and non-destructive analysis, such that confirmation analysis can be performed by laboratory methods on the identical sample that was analyzed in the field.

Outcomes:

(1) Region 1 has used XRF to detect lead paint, lead paint dust, and metals in soil.

(2) Currently, the Region's enforcement inspectors and state childhood lead prevention inspectors use XRF during their inspections of urban housing in New England. The ease of lead paint detection has dramatically improved with the development of XRF, which has enabled the inspectors to document the presence of lead during the inspection and therefore seek immediate abatement to protect the health of children.

(3) XRF was also used in the Lead Safe Yard Project, which took 2,745 soil samples from 100 backyards; the technology enabled the EPA team to respond immediately in setting up low income remedial measures to help mitigate the dermal in ingestion exposure from lead flakes.

(4) For hazardous waste sites in New England, the Region has mainly tested soil for lead and cadmium, but also nickel, zinc, chromium, arsenic, and antimony. The Region's mobile laboratory will take between 200-300 samples over 2-3 days, and with field analysis, they can fine tune the sampling, determine the "hot spots", and check levels of concentration to determine proper disposal of the soil. XRF has enabled them to be more efficient because they can act on the information in the field whereas if they sent every sample to a laboratory it could take between weeks and months to receive the results. In 2004, the Region 1 laboratory has conducted more than 50% of their work on site or 5,000 field analyses using XRF or gas chromatography.

REGION 2

Title: Evaluation of Remedial Technologies in Region 2

Background
The use of innovative remedial technologies has been increasing in Region 2, often involving new approaches with which the Region 2 staff has little experience. For such technologies, ORD expertise is often needed to evaluate, select and/or implement innovative remedial technologies. Assistance from the Technical Support Centers at the National Risk Management Research Laboratory (NRMRL) is available to provide such assistance. Other options for NRMRL technical assistance have included the Superfund Innovative Technology Evaluation (SITE) Program. Several examples of Region 2 projects utilizing ORD technical assistance are listed below.

Science
Innovative technologies which Region 2 has evaluated, selected and/or implemented in recent years include chemical oxidation (e.g., at the Fulton Avenue Superfund site), chemical reduction (e.g., at the Puchack Wellfield Superfund site) and bioremediation (e.g., at the Ciba-Geigy Superfund site). Region 2 is also evaluating innovative remedial technologies which have the potential of producing marketable byproducts, such as sediment washing and the "cement-lock" thermal treatment process. These two processes have been evaluated for New York/New Jersey Harbor sediments and for contaminated sediments from the Passaic River Operable Unit of the Diamond Alkali Superfund site.

Outcomes
NRMRL technical assistance was requested and received for the above projects. At the Fulton Avenue Superfund site, NRMRL assistance contributed to the Region 2 proposal of a remedy which includes in situ chemical oxidation. (Region 2 plans to issue the Record of Decision in FY' 07.) At the Puchack Wellfield Superfund site, NRMRL's review and comment on the treatability study contributed to the selection of the in situ chemical reduction remedy which is currently being designed. At the Ciba-Geigy Superfund site, NRMRL technical assistance contributed to the currently operating remedy, which includes bioremediation (both in situ and ex situ). For the Passaic River Operable Unit of the Diamond Alkali Superfund site, the SITE Program has completed all field work, sampling and analysis for the two technology demonstrations. Final SITE Program reports are currently undergoing review.

What made the technology transfer successful and issues of concern

The SITE Program, which has been of great assistance to Region 2, is currently being phased out, eliminating a valuable resource. The National Exposure Research Laboratory has decided to close the Technical Support Center at its Environmental Sciences Division in Las Vegas. There are reports about plans to eliminate the Ground Water Technical Support Center at the NRMRL's Groundwater and Ecosystems Restoration Division in Ada, OK as part of a reorganization of that Division. (Technical support to the Regions from that Division may still be possible following the planned reorganization.) The impacts of these planned changes on technical support to the Regions aren't clear at this time.

REGION 3

ORD NRMRL and Region III Collaborate to Evaluate Immunoassay Test Kits for the Detection of EDCs

EPA Regions 3 and 5, ORD (NRMRL), USGS, and Abraxis, LLC, have joined in a collaborative effort on a Regional Methods project, utilizing the Environmental Technology Verification program, to evaluate immunoassay test kits for the quantitative determination of endocrine disrupting compounds (EDCs). Currently, high performance liquid chromatography (HPLC), gas chromatography-mass spectrometry (GC-MS), or liquid chromatography-mass spectrometry (LC-MS) are the primary methods used to detect EDCs; however, immunoassay techniques, particularly enzyme-linked immunosorbent assay (ELISA), are becoming increasingly popular due to their sensitivity, ease of use, short analysis time, and cost-effectiveness. Issues persist, however, regarding reproducibility and accuracy when complex environmental samples are analyzed. The primary objective of this research, therefore, will be to evaluate whether commercially available ELISA kits are able to accurately and reliably analyze common environmental samples for selected EDCs. The round robin laboratory evaluation will be done in four phases, each focusing on a different type of water sample (clean water, surface water, WWTP effluent, and WWTP influent) spiked with EDCs. Samples will be analyzed by both ELISA and GC-MS and results compared. If validated, the ELISA technique could provide a relatively easy method for use by Regions, ORD, and state and local programs as a screening tool, much faster and more cost effective than traditional GC-MS, HPLC, or LC-MS methods.

ORD Critique of Homeland Security Method for Anthrax Detection

Region 3 was approached by one of our universities that received a congressional line item to develop a portable anthrax detection system. The university researchers wanted to come to the Region to brief the OSCs/RPMs on the technology. The method involved some novel molecular and nanotechnology techniques that no one in the Region had any experience utilizing. Several ORD scientists were willing to participate in a teleconference with the researchers and give a reality check on the technology and provide some valuable information to the researchers on validation and getting a method utilized by the Agency. They provided an informal, objective review, taking some of the pressure off the region due to political interest in the project. These type of reviews are very important for the region in trying to understand and determine the value of the numerous technologies brought to them.

Guide on Microbial Source Tracking

Trying to determine the sources of microbial contamination in surface waters has been a very controversial issue and important in the TMDL, recreational waters, and other programs. Numerous analytical techniques have been developed, ranging from the fairly basic approach using variations in antimicrobial resistance to the much more sophisticated molecular methods, e.g., ribotyping. The researchers all seem to claim their method is the best, but repeated multi-laboratory studies have demonstrated that they all have deficiencies and there is no "gold standard". Despite the limitations of the methods, states and counties are selecting a method and utilizing the technique for regulatory actions.

ORD has been performing extensive research in this area but recognized that there will be no one perfect method available in the near future. To address this issue, ORD collaborated with 7 regions to develop a Guide on Microbial Source Tracking to highlight the pros and cons of the different methods. Although this effort didn't resolve the problem of which method to select, it did provide a level playing field, so no matter which method was selected, the practitioners would have a basic understanding of the limitations that could be explained if a regulatory action was challenged. ORD should consider more of these types of efforts when no one technology is broadely accepted, but since the Regions and their clients must move forward in their environmental protection initiatives, they have a firm scientific basis for selecting a technology.

REGION 4

Region 4

Technology Best Practice: Dioxin-Furan Fingerprinting: Lower Roanoke River Site, North Carolina

Background: The southeastern United States is heavily concentrated with facilities related to the wood, pulp, and paper industries. Many times these facilities are located within close proximity. The Weyhauser Paper Plant and the Georgia Pacific Hardwood Saw Mill are large facilities located along the lower Roanoke River in North Carolina. The two facilities and the river were being investigated and remediated as part of the National Priority List. Wastes from the facilities included dioxins and furans, along with numerous heavy metals, pesticides and other contaminants. In addition, there are Publicly Owned Treatment Works (POTW) discharges along the river.

Science: To fully characterize the Site and assess responsibility, scientists needed to distinguish the dioxins and furans from the various industrial sources and the POTWs. ORD’s National Exposure Research Laboratory, the Superfund Technical Liaison, and the Region 4 Project Manager undertook “fingerprinting” of the dioxins and furans in the Lower Roanoke River to determine liability and cleanup issues. The fingerprinting was accomplished using sampling and analysis of river, POTW, and onsite soil, water, sludge, and sediment samples performed as part of the site investigation; literature data on typical dioxin/furan congeners found in urban POTW discharges; and an evaluation of the individual dioxin/furan source fingerprints maintained by NERL and its contractors.

Outcome: Using the fingerprints derived from point sources at the site and POTWs, and from literature about POTW discharges, the ORD scientists determined that the dioxins and furans found in the POTW discharges were contributing to the contamination of the river and could be distinguished from those dioxins and furans characteristic of each industrial facility. By using the FALCON statistical analysis, the relative contribution of each source was calculated, the pathways were understood, and liability was correctly attributed to the POTWs.

What made this technology transfer successful: The close cooperation between the ORD scientist, the Superfund Technical Liaison, and the Region 4 Project Manager.

REGION 5

Title: **USE OF COPPER MINE TAILINGS ON LAKE SUPERIOR COASTLINE AS RAW MATERIAL IN THE MANUFACTURE OF ROOFING SHINGLES.**

Problem Statement: Improving the Great Lakes by developing a beneficial use in the cleanup of contaminated copper mine tailings that have accumulated on the Lake Superior Coastline. Specifically, the goal of the study is to convert the environmentally problematic copper mining waste "stamp sand" into beneficial algae resistant roof granule material.

Background: The Keweenaw area of Upper Michigan has been used as a dumping ground for the tailings emanating from copper mining over many years. The Lestech Corporation found that the tailings (now called stamp sands) were a basaltic base with enough copper to be algae resistant. Lestech applied for a feasibility grant ($70,000) under the Small Business Innovation Research (SBIR) program of ORD to study the chemical and physical characteristics and develop a process for converting the waste sands into roof granules.

Positive Outcomes: This preliminary research showed that expensive copper-coated algae resistant roof granules can be substituted with the stamp sand copper mining waste from Upper Michigan. It was found that about 80% of the stamp sand could be converted to roof granule use by proper selection based upon sieve classification.

This research provided the feasibility of the beneficial use of waste tailings for roof granules. This is the first step in commercial development of the material.

Regional and ORD Staff Involved: Region 5: David Macarus, OSEC/ ORD: Jim Gallup, SBIR program.

What Made the Project Successful: The good analysis of the potential use of waste tailings as roof granule raw material coupled with ORD's SBIR program, which is aimed at testing the feasibility of new technology.

REGION 6

1. Best Practice: <u>Cooperation in a RARE project</u>. Providing support in determining the usefulness and applicability of new technology.

Title: EVALUATION OF REMOTE SENSING INFRARED CAMERA.

Background: EPA Region 6 and the Louisiana Department of Environmental Quality evaluated air quality in one of the Louisiana cities, and discovered that the air quality was worse than what would be predicted by consideration of known releases from permitted facilities. A new commercial camera using infrared technology was proposed as a possible way to get an estimate of emissions from tank cars and barges on the Mississippi River in the area. A scientist from NERL/ESD teamed with a Region 6 scientist to test the camera in a RARE project.

Science: The Hawk motion picture camera uses infrared to show fugitive emissions from openings in tank cars, barges, and other sources. The project involved a fly-over of the river area and railroads to see if the camera would pick up emissions from the air. Video recordings were made both with the Hawk camera and a regular video camera.

Outcomes: The Hawk camera showed clear and dramatic evidence of leaks. LDEQ took this information and showed it to the company officials whose barges and cars were leaking, and they readily agreed to have these leaks fixed (which was in their best interest, since it was their product that was being lost).

ORD and R6 Points of Contact: David J. Williams, NERL; Michael Miller, Reg. 6.

What made the technology transfer successful: **Close cooperation between ORD and R6**.

2. Best Practice: <u>Cooperation on new Asbestos Method.</u>

Title: ALTERNATIVE ASBESTOS CONTROL METHOD

Background: The Asbestos NESHAP requires an extensive procedure for removing asbestos when buildings are demolished. Because the procedure is so costly, many communities are forced to leave derelict buildings standing for lack of funding to demolish them. A new, less costly but still environmentally protective method was needed.

Science: NRMRL engineers in Roger Wilmoth's group worked with Region 6 engineers on demonstrating a new method (the Alternative Asbestos Control Method, or AACM) which is similar to the NESHAP method for building destruction under "imminent danger" conditions, but using foam instead of water. The method was tested at Ft. Chaffee, AR, but demolishing two virtually identical side-by-side buildings, one using the NESHAP method and the other using the AACM.

Outcomes: The AACM performed well, being as environmentally protective, but being faster and cheaper. This result is very promising, but further research is needed to prove it under a variety of conditions. The ultimate result could be millions of dollars of savings for cities and much faster action in removing old buildings so that other uses can be made of the land.

ORD and R6 Points of contact: Roger Wilmoth, Bob Olexsey, NRMRL; Adele Cardenas, Region 6

What made the technology transfer successful: **Close cooperation between ORD and R6.**

REGION 7

Title: Asbestos Remediation
Region: Region 7
Problem Statement: Needed technical assistance with asbestos remediation at the St. Louis Airport
Background: Highly controversial asbestos removal project
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision: Excellent technical advice that aided towards a successful removal
Regional and ORD staff involved: Lynn Slugantz (R7), Brenda Groskinsky (R7) Glenn Shaul (ORD), Roger Wilmoth (ORD)
What made the Technology Transfer Successful! : Timely, consistent and effective support throughout the entire project.

Title: Environmental Efficiencies w/ Biofuels Refining Industry
Region: Region 7
Problem Statement: Rapidly growing biofuels industry in need of environmental solutions
Background: Incentive driven industry of bio-based fuels is growing rapidly in the Midwest and in need of environmentally friendly technology innovations.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision: Use of the Small Business Innovation Research Program provided a means for Region 7 to investigate new technologies and funding opportunities that would not otherwise be available.
Regional and ORD staff involved: Brenda Groskinsky (R7), James Gallup (ORD)
What made the Technology Transfer Successful! SBIR Program very supportive of Region 7 technology needs. More than 7 technologies under development for bio-based fuel category.

Title: Lead Mining Waste Remediation
Region: Region 7
Problem Statement: Region 7 needs innovative means for effective large scale remediation solutions.
Background: There are over 1000 lead mine tailing piles in Missouri and Kansas that are in need of remediation.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision: Use of the Small Business Innovation Research Program provided a

means for Region 7 to investigate new technologies and funding opportunities that would not otherwise be available.
Regional and ORD staff involved: Brenda Groskinsky (R7), James Gallup (ORD)
What made the Technology Transfer Successful! Building relationships w/ local small business in the newly developed remediation opportunities.

Title: Small Business Innovation Research

Problem Statement

Region 7 has the need for technologies to be developed that are meeting the needs of critical Regional environmental issues

Background
SBIR has a mandated % of research funding every year for innovative technology development by small businesses

Outcomes
- Region 7 participated in FY06 solicitation
- More than 7 proposals related to R7 technology needs were awarded
- Relationships developed between small businesses and Region 7
- Region 7 formed a relationship w/ the SBIR program and is now working at a higher level on the FY08 solicitation for desperately needed environmentally beneficial biofuels technologies

EPA Contacts

ORD contact: Jim Gallup and April Richards
Regional Contact: Brenda Groskinsky, Regional Science Liaison

Region 8

Technology Best Practice: Sulfate Reducing Bacteria Bioreactors for Remediation of Acid Mine Drainage in Region 8

Background: Remediation of mine waste sites across the country requires good site characterization, careful planning, and sometimes millions of dollars for effective clean-up and perpetual treatment of acid mine drainage (AMD) using conventional lime or soda ash plants. One of the most significant environmental and water quality problems in Region 8 is AMD from both historic abandoned and operating hard rock and metal mines. There is a great need for innovative and effective semi-passive treatment technologies that can help reduce costs and reliance on perpetual treatment. The National Risk Management Research Laboratory's (NRMRL) Mine Waste Technology

Program is investigating and testing many innovative remediation technologies, and has annual funding opportunities for innovative technology research projects. NRMRL's Engineering Technical Support Center (ETSC) has also been providing support to the regions on a wide range of mine waste innovative remediation technology projects throughout the U.S.

Science: One of the most prominent semi-passive technologies for AMD is the use of sulfate-reducing bacteria bioreactors (SRBs). These reactors use anaerobic bacteria to reduce sulfate in AMD to hydrogen sulfide. The sulfide then reacts with dissolved metals in the AMD to form insoluble metal sulfides which precipitate and settle out of solution. Some form or organic compost substrate, such as cow manure and straw, is used as the carbon source for the bacteria. The ETSC has been a leader in developing this technology, and has implemented successful demonstrations in several regions. The ETSC is also studying the microbiological aspects of these bioreactors, working with researchers at the Colorado School of Mines and Colorado State University to understand issues regarding what makes them fail, what are the rate limiting reactions inside the cells, and how can we make them smaller and more efficient. Region 8 has been working with the ETSC and ORD researchers to evaluate current and future best practices for design and operation of these innovative technologies, the use of SRBs at the Upper Tenmile Creek Mining Area and Basin Mining Area Superfund Sites in Montana. ETSC has been testing compost SRBs as part of a combination geochemical bioreactor with pre- and post-treatment wetlands at the Upper Tenmile Creek Superfund Site. A geochemical bioreactor essentially includes limestone rocks in channel discharging to a winding or "serpentine" SRB (four separate cells) to provide adequate contact time for geochemical and biological reactions to occur for metals precipitation throughout the system.

Outcome: In 1999, the site Remedial Program Manager (RPM) contacted the ETSC requesting assistance for the consideration of passive treatment. After a meeting and site visits by ETSC staff and contracted experts, two areas of the site were selected for testing. Both areas are above 7,800 feet in elevation, have no electric power and are difficult to access between November and June. At the first area, Peerless Jenny King Mine, ETSC staff, assisted by their contractor, Golder Associates, and the site contractor constructed wetlands and a bioreactor in September, 2002. .The unique design handles flows up to approximately 50 gallons per minute of AMD water with a pH greater than 5 and zinc concentrations greater than 2,000 ug/L. The system is increasing pH to greater than 7 and reducing metals concentrations by more than 90% to meet EPA and State of Montana water quality standards. The system is virtually totally passive, requiring no power and almost no maintenance.

The second area in the adjacent Basin Mining Area Superfund Site is the Luttrell Repository, which was the old mine pit. This million cubic yard joint repository was designed to accept mine wastes from both government and private landowners in the region. A leachate collection system was constructed so that when the repository is filled and capped, the leachate will be sent to the geochemical bioreactor for treatment

and then discharged. ETSC has been testing the SRB and collecting data for 2 years, and will continue into the future. The results have been exceptional, with the discharge from the reactor meeting all Montana water quality standards except for zinc and sulfate (zinc inflow concentrations up to 40,000 ug/L). Because the system was only recently constructed and became operational, greater improvement in effluent water quality is expected over time. There is also strong collaboration with the U.S. Forest Service and Bureau of Land Management, the primary land owners in the watersheds.

What made this technology transfer successful: Building an effective and long lasting collaborative relationship between the ORD scientists working for NRMRL's Engineering Technical Support Center, EPA Region 8 Remedial Project Manager, Region 8 Superfund and Technology Liaison, and regional academic institutions. The results of this technology are exceptional and this contributes to making this technology a tremendous success.

Region 9

ORD's Technical Support Centers:
A Valuable ORD "Best Practice" Resource for the Regions

ORD's efforts to provide useful products and tools to the Regions have increased in recent years. The ORD Superfund Technical Support Centers (TSCs) and the Superfund and Technology Liaison (STL) Program have been held up as one of these valuable resources for the regional Superfund and RCRA staff. In fact, the TSC format has been cited in the "45 Day Study" as a successful model for other regional programs. The value of the TSCs has been highlighted in many other forums, including those cited below.

- Annual progress reviews of waste research conducted by ORD, OSWER and the Regions
- Board of Scientific Counselors (BOSC) meeting (Dec. 2005)
- ORD's Science-To-Outcome efforts (early 2006)
- ORD (OSP) visits to all 10 regions (early 2007)

The Superfund TSCs are a "best practice" example of the Regions and ORD working together to solve environmental problems. This program allows the regions to tap into the expertise of ORD researchers through technical support, and also allows the researchers to have an insight into present and emerging environmental problems facing the regions. It's beneficial both ways.

Each region's experience is slightly different, but we in Region 9 agree that the TSCs, accessed both through our onsite ORD STL and with staff contacting the TSCs directly, has been beneficial in assisting our staff make better informed cleanup decisions. The program is in itself a best practice. There are many examples of valuable support to Region 9, and here are a few:

- Pemaco Site – evaluation of potential vapor intrusion into homes
- Asbestos – assistance with investigation design for naturally occurring asbestos sites
- Leviathan Mine – assistance with treatment technology evaluation
- Casmalia Landfill – assistance with geophysical site characterization and monitoring

There are generally 3 TSCs used by staff (Cincinnati, Las Vegas, and Ada), although other contacts with ORD scientists have also been helpful. It has now become apparent that this commitment to the TSC program is diminishing.

The Las Vegas TSC was officially disbanded yesterday (on October 1st) and its oversight function handed over to ORD's OSP and the STL program. There will be some Las Vegas scientist assistance, but most of the technical support will be handled by extramural resources (Lockheed and an IAG through DOE). Three of the STLs will now cover the functions of this center and funding beyond FY08 is uncertain. In addition, there has been recent discussion about a proposal to disband the TSC at the Ada Lab. Details on this proposal are less clear, but these changes represent obvious decreases in ORD support that have been valued by the regions since 1987.

If ORD truly wishes to continue to provide useful resources to the Regions, returning to past TSC commitments should be considered. Regions need to retain this "best practice" support to assist in making scientifically based and cost effective decisions.