

**Federal Remediation Technologies Roundtable Meeting, Arlington, VA, May 17, 2006**

**FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE MEETING  
Arlington, Virginia  
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**ACTION ITEMS**

- ▶ Marti Otto will provide contact information between Brian Bone and Jeff Heimerman to facilitate technology transfer.
- ▶ Marti Otto will provide contact information to help Dietmar Müller and Anje Sinke to locate the ITRC Remedial Process Optimization Team's draft performance-based management document.

**WELCOME/OPENING REMARKS**

Walt Kovalick (U.S. EPA/OSRTI) welcomed the attendees and opened the 32nd meeting of the Federal Remediation Technologies Roundtable (FRTR) with a brief overview of the agenda. Participants introduced themselves. (A list of participants is attached to this copy for EPA's files only; it will not appear on the FRTR web site.) He reminded participants that their input on topics for upcoming meetings is needed and encouraged agency representatives to fill out the ballot forms distributed and turn them in at the end of the meeting.

**USGS PUBLICATIONS UPDATE**

David Morganwalp (U.S. Geological Survey) announced the recent publication of Circular 1292: *Volatile Organic Compounds in the Nation's Ground Water and Drinking-Water Supply Wells* ([water.usgs.gov/nawqa/vocs/national\\_assessment/](http://water.usgs.gov/nawqa/vocs/national_assessment/)). This assessment of 55 volatile organic compounds (VOCs) in aquifers and drinking-water supply wells is based on VOC analyses of about 3,500 water samples from various types of wells, representing almost 100 different aquifer studies. The supply-well analysis samples were collected at the well head, before any treatment or blending, from about 2,400 domestic wells and 1,100 public wells. The investigators found that many of the nation's aquifers are vulnerable to low-level VOC contamination. This finding suggests a need to include VOCs in ground-water monitoring programs to track the trend of the low-level contamination identified in this assessment, as well as indicating the importance of continuing to control sources of VOCs. VOC contamination in aquifers may be more prevalent than previously reported in monitoring programs, at least in part because the older analytical methods had higher reporting levels.

Some VOCs were detected more frequently than others. Though a total of 42 VOCs were detected in aquifer samples, only 15 occurred in about 1 percent or more of the samples. Chloroform was the most frequently detected compound. Its source is attributed, in part, to the recycling of chlorinated waters to aquifers. The solvent tetrachloroethylene (PCE) and the gasoline oxygenate methyl tert butyl ether (MTBE) were the second and third most frequently detected compounds, respectively. Overall, the 15 most frequently detected compounds comprise a large fraction of the low-level VOC contamination and provide a logical focus for future monitoring of aquifers. Though VOCs were detected frequently in samples from domestic and public wells, only a small percentage of samples had VOC concentrations of potential human-health concern.

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The relatively frequent detection of MTBE in aquifers was not an anticipated outcome of the assessment because of MTBE's short and recent use (a decade or less). The MTBE findings demonstrate how quickly some anthropogenic chemicals, especially those that are mobile and persistent like MTBE, can reach aquifers that are susceptible to land-surface or atmospheric contamination.

### UPDATE ON SELECTED FRTR PROJECTS

#### *Technology Innovation: Additional Updates*

Walt Kovalick provided updates of ongoing FRTR project. Forty new cost and performance case studies and technology assessment reports have been added to the database on the FRTR web site for 2006: 10 remediation technologies case studies, 12 site characterization and monitoring technologies case studies, three remediation technology assessments, and 15 long-term monitoring and optimization studies. The additions bring the total number of resources to 716.

Cross-organizational discussions are ongoing in the Triad Community of Practice (CoP), with participation by EPA, DOE, DoD, states, and the private sector in monthly conference calls. The CoP members share Triad developments, experience, and case studies. There are four active subgroups for Leadership, Marketing, Science and Technology, and Training. The Training group is developing a Triad curriculum and an inventory of interagency course offerings. EPA provides classroom training in EPA Regional offices for the Regions and states, as well as providing the infrastructure for Internet seminars sponsored by EPA and by the Interstate Technology Regulatory Council (ITRC). The Air Force has presented three of five deliveries of a 3-day course that relates records of decision to systematic planning and discusses connections to risk assessment in the Triad approach. The U.S. Army Corps of Engineers is planning four deliveries of a 1.5-day class that focuses on systematic planning. EPA, the Navy, and the Federal Facilities Forum are collaborating on development and delivery of additional training on the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP). An international workshop, "The Importance of Data Quality in Contaminated Land Work," was held in April 2006 by Contaminated Land: Applications in Real Environments (CL:AIRE), and the Field Analytical Suppliers Association (FASA) plans to hold a seminar on advancing field analytics in Europe—"Using Field Analytics to Improve Data Quality and the Cost-Effectiveness of Contaminated Land Work"—on May 18. In collaboration with U.S. Triad training efforts, the Navy's Southwest Division is developing a Navy version of Triad training that will contain key implementation concepts.

Kovalick discussed new information resources on persistent organic pollutants, commonly referred to as POPs, that have been developed by EPA's Office of Superfund Remediation and Technology Innovation. A report, *Non-Combustion Technologies for Remediation of Persistent Organic Pollutants in Stockpiles and Soil*, EPA 542-R-05-006, has been added to the CLU-IN library ([www.cluin.org/download/remed/542r05006/final\\_pops\\_report\\_web.pdf](http://www.cluin.org/download/remed/542r05006/final_pops_report_web.pdf)). The report provides descriptions of 13 non-combustion technologies and evaluates the technologies based on POPs treated, media treated, pretreatment requirements, performance, and cost. Technology performance is illustrated in case studies. Newer technologies applicable to POPs remediation include sonic technology, phytoremediation, and bioremediation (Daramend®, Xenorem™, and

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anaerobic bioremediation using blood meal). The report also identifies several technologies once considered useful to POPs treatment that are currently not being marketed (generally due to cost), such as gas-phase chemical reduction (GPCR™), Solvated Electron Technology, and AEA Silver II™. EPA has also developed a POPs section for CLU-IN's Contaminant Focus area ([www.cluin.org/POPs](http://www.cluin.org/POPs)). It includes a list of international websites for additional information on POPs.

Kovalick went on to introduce the technical session for this meeting. The first four presenters spoke via telephone from Europe.

### **INDUSTRY AND INTERNATIONAL ENVIRONMENTAL TECHNOLOGY DEVELOPMENT INITIATIVES**

#### ***UK Technology Initiatives – Role of the Regulator***

Brian Bone (Environment Agency for England and Wales) discussed the responsibilities and goals of the Environment Agency. The Environment Agency is the leading public body for protecting and improving the environment in the United Kingdom (UK). Its main tasks are to implement government policy, regulate businesses, and react where there is a flood or pollution incident. A science strategy was published in 2004 that sets out how the agency will use science to solve key environmental problems over the next 10 years.

The agency also published a framework in 2004 for applying a risk management approach when dealing with land affected by contamination. This framework should help industry and regulators adjust from an engineering-based to a knowledge-based approach to remediation and lead to wider use of both measurement and remediation technologies. Its publication was timely due to recent changes in waste management legislation that have led to an increase in the cost of disposing contaminated soil to a landfill. But the uptake of new technologies can be slow due to stakeholders' lack of confidence and the risk of investing in technologies that lack a "track record."

Bone noted the importance of a guidance document entitled *Model Procedures for the Management of Land Contamination*, CLR 11. It was published in 2004 and can be accessed at [www.environment-agency.gov.uk/commondata/105385/model\\_procedures\\_881483.pdf](http://www.environment-agency.gov.uk/commondata/105385/model_procedures_881483.pdf). This guidance was developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK. Local authorities are the leads for these activities, and they may apply to the Environment Agency and other appropriate agencies for advice on the project.

The European Union (EU) Landfill Directive has brought about dramatic changes in the potential for disposing contaminated soils: disposal capacity in the UK has decreased from 300 landfills able to take contaminated soil to merely a few dozen. Acceptance criteria are stringent. The effect of the Landfill Directive has encouraged use of on-site technologies and highlighted the need for additional robust, reliable, and cost-effective treatment technologies. Pre-treatment technologies can also help to reduce the volume of soil to be remediated or disposed.

The Environment Agency is working with others to develop and transfer knowledge needed to address land contamination issues and to promote effective technology uptake. The agency is closely networked with other key organizations, some of which are identified in the presentation. Links with knowledge transfer initiatives can only improve a wider understanding of regulatory drivers and barriers, strengthen stakeholders' confidence in new technologies, and ultimately lead to their effective use in managing land contamination. Key to this in the UK is the Integrated Pollution Management Network, the subject of the next presentation.

***The Integrated Pollution Management Network***

Simon Jackman (IPM-Net) provided an overview of the purpose and activities of the IPM-Net. IPM-Net assists businesses involved in the management of environmental pollution by supporting innovation and technology development, providing knowledge, and developing skilled personnel. The network operates at the national level to enhance business competitiveness and is funded by the UK's Department for Trade and Industry (DTI) and the Department for Food, Environment, and Rural Affairs (Defra). IPM-Net has developed from FIRSTFARADAY ([www.firstfaraday.com](http://www.firstfaraday.com)), a national center of excellence for the management of contaminated land, and is led by the University of Oxford in partnership with leading academic and networking organizations from across the UK.

Knowledge Transfer Networks (KTNs) stimulate innovation in the UK's key technology sectors by promoting collaboration, best practices, and knowledge sharing between industry and academia. By encouraging partnerships and teamwork, KTNS aim to position the UK as the innovation engine for Europe.

IPM-Net is developing a Web portal (still under construction) and a range of newsletters, bulletins, and other publications to serve the pollution management community and to encourage and disseminate skills transfer. The publications are complemented by conferences, workshops, and training courses for industry. The organization facilitates a portfolio of multidisciplinary research and development (R&D) projects between industrial and academic partners, industrial CASE (Co-operative Awards in Sciences of the Environment) studentships, and Knowledge Transfer Partnerships, and is working at a European and international level to develop strategic partnerships for technology development. Projects are selected using a ranking system developed as part of the prioritization strategy. When working with the UK government, projects are prioritized on a quality or cost/benefit basis; they are not technology-specific, instead they are focused on technology areas, like decision support tools.

IPM-Net has inherited from FIRSTFARADAY an industrial membership of over 300 companies, which it supports through the provision of advice and solutions, including technology brokering, facilitation of access to business support mechanisms, and development of networks to address specific technologies or challenges. Approximately 70 percent of the members are consultants or intermediaries. The roster also includes technology providers, who find that membership can help their technologies achieve commercial use.

***NICOLE: Evolving Perspectives in Contaminated Site Management in Europe***

Anje Sinke (Network for Industrially Contaminated Land in Europe, NICOLE) said that NICOLE will celebrate its 10th anniversary in 2006. As a leading forum on contaminated land management, NICOLE promotes co-operation between industry, academia, and service providers on the development of sustainable technologies. NICOLE strives to:

- Provide a European forum for the dissemination and exchange of good practices, practical and scientific knowledge and ideas to manage contaminated land in a sustainable way.
- Stimulate coordinated, interdisciplinary projects on collaborative research and knowledge transfer to address identified needs.
- Develop new relationships and strengthen existing relationships with other networks.

NICOLE currently has 127 members. Membership fees are used to support and further develop the aims of the network, including technical exchanges, network conferences, special-interest meetings, brokerage of research and research contacts, and information dissemination via a website ([www.nicole.org](http://www.nicole.org)), newsletter, and journal publications. NICOLE contains an Industry SubGroup (ISG) with 25 members, a Service Providers SubGroup (SPG) with 35 members, 67 individual members from the academic sector/research community, and numerous members from other organizations, including research planners, non-profit organizations, other networks, and funding organizations.

As an example of work done through NICOLE, Sinke discussed a demonstration and review of the applicability of monitored natural attenuation (MNA) at eight field sites. Over a four-year period, eight industrial partners made investigations as part of this demonstration project. The site summary reports were reviewed by twelve independent reviewers. In general, MNA was viewed as applicable and effective at many sites. The proposed methodology was considered very useful, though differences of opinion from reviewers of different nationalities were marked. More information on this project is available at [www.nicole.org/projects/projects.asp](http://www.nicole.org/projects/projects.asp).

***EURODEMO: Management & Remediation of Contaminated Soils & Groundwater – Towards Innovation and Sustainability***

Dietmar Müller (Austrian Federal Environment Agency) described the establishment of EURODEMO in 2005 as a new platform with the ambition to boost technology demonstration in the field of soil and groundwater remediation. EURODEMO is an initiative funded by the European Commission, Directorate-General for Research, and includes a large European consortium covering the whole spectrum of relevant stakeholders. The top priorities are to make the demonstration of promising soil and groundwater technologies easier to implement, to harmonize performance evaluation of demonstrated technologies, and to generate an overview of existing funding opportunities and already demonstrated technologies. EURODEMO aims to make sure that investors obtain a better overview of the innovation potential in Europe and plans to pave the way for transnational co-operation and joint funding of technology demonstration. The organization intends to be the principal European coordination activity for soil and groundwater remediation technology demonstrations, by (1) preparing a detailed database of remediation projects demonstrating (innovative/promising) remediation technologies, (2) creating a database of funding resources available for demonstration projects, (3) working to

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reduce the barriers that hamper the use of promising remediation technologies, and (4) promoting agreement on quality criteria for the reporting of remediation demonstration projects.

The European Commission has recognized a need for strengthening environmental technologies innovation to increase the competitiveness of European technologies in a global market and to achieve sustainable development in Europe. In the area of soil and groundwater remediation, innovative technologies are available and have proven applicability and performance on demonstration scales, but market response has been disappointing. Consequently, initiatives have been launched to promote and study the application of these technologies. EURODEMO was funded under the 6th European Framework Programme for Research as one strategic initiative for supporting the goal of providing a central European hub for remediation demonstration projects. A core job of the consortium is to enhance and consolidate existing information regarding European remediation demonstration projects in one central place:

[www.eurodemo.info](http://www.eurodemo.info). The project results are also intended to support the development of a European environmental technologies verification (ETV) process. An ETV program is needed to overcome barriers and reluctance to accept new technologies.

Beth Moore (DOE) remarked that DOE has been discussing the use of financial incentive contracts to encourage contractors to change from a system with mediocre performance, like standard pump and treat, to an innovative technology that may produce better results. Along those same lines, the ITRC Remedial Process Optimization Team is working on a guidance document on performance-based management in which incentive fees are offered to stimulate use of new technologies. Müller and Sinke expressed interest in this incentive-based stimulation of technology use and in the guidance document.

### ***ETAP: The EU Environmental Technologies Action Plan***

Lars-Olof Hollner (Delegation of the European Commission) discussed the EU's development of an Environmental Technologies Action Plan, or ETAP. The ETAP defines an environmental technology as any technology that provides a clear environmental advantage. Some of the more obvious examples include solar and wind power, or water purification technologies. There are many other examples, including some that are widely used but little known, such as energy-efficient devices, intelligent catalytic converters, or thermally efficient window frames. Some environmental technologies are born from substituting one technology with a biologically friendly alternative. For example, white biotechnology uses bacteria, yeasts, and enzymes for new kinds of products that can be used as alternatives to chemical detergents, water resource management, soil remediation, or biomass processing. In addition, bio-plastics and bio-diesel are rapidly emerging as alternatives to petroleum-based products. Even information and communication technology can encourage eco-innovation by reducing population mobility through tele-working, dematerializing products through digital equivalents, and decreasing the consumption of energy on a societal level.

Environmental technologies have the potential to reduce pressures on natural resources and boost EU competitiveness, but barriers hinder their development and acceptance in the marketplace. Regulations, economic considerations, and lack of consumer awareness can all present barriers to the use of new environmental technologies. Technology-prescriptive legislation or standards and lack of protection for intellectual property in developing countries form regulatory barriers to

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market expansion. Economically, prices often do not reflect true costs, and technology developers may find it difficult to access funding because of start-up costs and low return on investment. Lack of information and awareness on the part of both business and consumer is another limiting factor, as well as lack of training in some sectors. EU action is needed with additional action at national and local levels to remove these barriers.

For example, the Lisbon strategy for growth and jobs couples economic growth, job creation, and a better environment. ETAP's aim is to encourage innovation along those lines to improve the situation for business, jobs, and the environment all over Europe. One example of ETAP activity is Green Public Procurement (GPP). An estimated 16 percent of the European Gross Domestic Product (GDP) is accounted for through public procurement. If ETAP can help to make sure that procured materials are environmentally friendly, that could make a big difference. Europe-wide studies indicate that although public purchasers often have green intentions, these do not always lead to green outcomes. ETAP is working on GPP with member states not only as part of ETAP but also as an initiative in its own right.

ETAP has the following development priorities to encourage eco-innovation and environmental technologies: promoting research and development in environmental technologies, promoting verification and labeling of new technologies, improving opportunities for investments and risk capital, encouraging better market instruments such as national taxation and reforms of state aid, and promoting the 'greening' of public procurement and better awareness and training. Launched in 2004, ETAP is taking action in all these areas, involving the European Commission, member states, industry, and NGOs working together. The European Parliament has supported these efforts and committed itself to action. ETAP technology platforms will bring together researchers, industry, financial institutions, and decision-makers to build a long-term vision of research needs and future market development. A testing centers network will allow independent validation of performance, which will increase the confidence of technology users. The centers will also develop common protocols to technology testing and performance assessment.

For more information on ETAP, visit [www.europa.eu.int/comm/environment/etap](http://www.europa.eu.int/comm/environment/etap). For more information on environmentally green technologies and their encouragement, visit the European Environment Agency portal at [technologies.ewindows.eu.org/](http://technologies.ewindows.eu.org/).

### ***Sustainable Development Technology Canada™: Partnering for Real Results***

Keith Watson (Sustainable Development Technology Canada™) said that SDTC is a non-profit foundation that finances and supports the development and demonstration of clean technologies that provide solutions to issues of climate change, clean air, water quality, and soil, and that deliver economic, environmental, and health benefits to Canadians. Its mission is to "act as the primary catalyst in building a sustainable development technology infrastructure in Canada." SDTC draws from an investment fund of \$550 million.

SDTC was established by the Government of Canada in 2001 to act as the primary catalyst in building a sustainable development technology infrastructure in Canada. The Foundation reports to Parliament through the Minister of Natural Resources Canada. Rather than simply funding groundbreaking technologies, SDTC works closely with a growing network of stakeholders and partners to build the capacity of Canadian clean-technology entrepreneurs, helping them form



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strategic relationships, formalize their business plans, and build a critical mass of sustainable development capability in Canada.

There are many links in the innovation chain between research and commercialization. Two of the most critical—but traditionally under-supported—are development and demonstration. These are the critical stages at which technologies exit the laboratory and prove themselves in full-scale, real-world test situations. SDTC bridges the gap in the innovation chain by fast-tracking groundbreaking clean technologies through development and demonstration, in preparation for commercialization. It fosters and encourages innovation and collaboration among private, academic, and public-sector partners, and strives to ensure the dispersion of clean technologies in relevant market sectors throughout Canada.

One of SDTC's chief aims is to de-risk clean technologies in a way that will ultimately attract downstream private-sector investment and open up opportunities for commercial success. This effort follows a stringent due-diligence process when selecting technologies to support and actively strengthens project consortia by requiring every project to involve representatives from the entire supply chain: researchers, product developers, manufacturers, distributors, retailers and end customers. In all, 80 percent of SDTC consortia are industry-led. SDTC Funding has two phases for applicants (submission of statement of interest and proposal by invitation) and four decision gates (SDTC review, review by technical and business experts, evaluation by Investment Committee and Project Review Committee, and Board approval). To date, there have been 8 rounds of technical, market, business, and environment applications, with 1084 applications. The \$2.3 billion spent in funding requests has yielded \$9.2 billion in total project value. There are no restrictions on project size: the smallest project has been funded at \$150 thousand and the largest has been \$8 million. The project average is roughly \$2.8 million.

Funding for soil and water technology projects was approved in 2004, the solicitation was announced in 2005, and the first group of applicants is just now being shepherded through the process. Most of the proposals were focused on water treatment, rather than soil. The broader the potential for application of a technology, the more likely it is to be funded. For example, Gradek Energy Inc. has developed a process for separating bitumen from oil sands, low-grade oil sands ore, and tailings ponds. Current oil sands processes leave vast, environmentally hostile tailings streams and ponds containing an estimated billion barrels of unrecovered bitumen. The Gradek recovery process is based on re-usable plastic beads to which hydrocarbons adsorb. The process also extracts the significant concentrations of titanium, aluminum, and zirconium oxides embedded in oil sands. This technology will find application by both the oil industry and the environmental remediation sector.

Canada's 2002 Environmental Industry Survey showed that the Canadian Environmental Industry earned \$15.8 billion in 2002, which was an increase of 27% from 2000 to 2002. In the 2005 budget, the government of Canada opted to invest \$5 billion over the next five years to preserve the natural environment and to address climate change.

Sustainability involves making social and economic decisions with three considerations in mind: environmentally, ensuring that resources are not consumed faster than they can be replenished; economically, supporting prosperity and growth; and socially, respecting the values, culture and

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human needs of communities. All of the projects funded by SDTC support these goals. Visit the SDTC website at [www.sdtc.ca](http://www.sdtc.ca).

### ***Electric Power Research Institute: MGP Site Management Program***

Andy Coleman (Electric Power Research Institute) explained that the Institute (EPRI) was founded in 1973 following a Congressional inquiry into a power outage that occurred in New York City. EPRI is a non-profit electricity collaborative research organization dedicated to technology development, integration, demonstration, and application. EPRI has over 700 North American members alone and more than 130 international participants. In addition to power generation and markets, its extensive research program includes environment and energy analysis with attention to air quality, global climate change, land and groundwater, water and ecosystems, and occupational health and safety. EPRI owns the results of its research (400 patents and 1000+ current products), but the generalized research results can be obtained by the public.

On over 1,600 ongoing projects, R&D is generally performed by subcontractors. One collaboratively funded project area is examining site management issues for manufactured gas plants (MGPs). The EPRI MGP program focuses on using R&D to assist in reducing long-term costs to utility industry and involves studies in the following areas: development of in situ technologies that reduce or eliminate the need for soil excavation and removal, forensics and fingerprinting, MGP residuals, non-aqueous phase liquids (NAPLs), off-site emissions/odor issues, methods and techniques for remediating sediments, and human and ecological risks. In MGP site characterization, EPRI is credited for validating some down-hole screening tools, such as the Tar-Specific Green Optical Screening Tool (TarGOST®), which is owned by Dakota Technologies Inc. of Fargo, ND. EPRI has seen this rapid, inexpensive, and reliable tool used at 36 MGP sites to pinpoint areas where remediation is needed. The technology supports source identification using forensic techniques to identify and measure degradation products of hydrocarbon-type contaminants and can also provide evidence of the effectiveness of natural and engineered remediation.

EPRI members are power generators, and membership costs vary. Project funding comes from the membership dues or fees. To prioritize funding for R&D projects, EPRI members express their research needs and then all vote on which needs seem to be greatest or most generally applicable. Project results are developed into reports. The research areas and products generated are available through the EPRI website ([www.epri.org](http://www.epri.org)).

### ***Investment Strategy in SERDP and ESTCP***

Andrea Leeson (SERDP/ESTCP) explained the different investments in technology development made by the U.S. Department of Defense's Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP). SERDP ([www.serdp.org](http://www.serdp.org)) pursues basic and applied research, most frequently at the laboratory scale, while ESTCP ([www.estcp.org](http://www.estcp.org)) is committed to the field demonstration and validation of innovative environmental technologies. Both programs work cooperatively, and their efforts are driven by both the need to sustain DoD ranges and range operations and the need to reduce current and future environmental liabilities. The environmental restoration research focus areas include chlorinated solvents (dissolved phase and dense non-aqueous phase liquid, or DNAPL,

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source zones), munitions constituents (perchlorate, energetics, heavy metals), sediments, risk assessment, site characterization and monitoring, and performance assessment and optimization.

DNAPL source zone technologies remediation efforts are currently focused on an in situ chemical oxidation initiative and a thermal treatment initiative. The oxidation initiative is examining the mode of action of oxidants on free-phase and residual DNAPLs, the stability and reactivity of oxidants in an aquifer matrix with varying soil conditions, and the impact of varying soil parameters on oxidant fate and overall destruction efficiency. In 2005, the thermal treatment initiative began studying mechanisms of removal and destruction of free-phase and residual DNAPLs, the impact of varying subsurface conditions on overall removal and destruction efficiency during thermal treatment, and the limitations associated with thermal treatment.

The SERDP/ESTCP DNAPL Workshop was held March 7-8, 2006 in Baltimore. Sixty attendees gathered for the two-day meeting. The ultimate goal was to define a path forward to reduce DNAPL cleanup uncertainty. The workshop highlighted the need for future research to provide useful guidance on (1) how and when source zone remediation should be attempted, (2) identifying reasonable objectives for DNAPL source zone remediation at specific sites, and (3) measuring progress toward achieving those objectives.

The SERDP/ESTCP MBT Workshop will be held August 9-10, 2006, in Charlottesville Virginia. The objectives are to (1) examine the current state of the science and technology of molecular biological tools (MBTs) that are applicable to the cleanup of hazardous wastes, (2) assess the current operational usage of such tools and identify technical and other barriers to their use, (3) identify promising areas of R&D that have the potential to lead to improved cost-effective tools to support remedial design and decisions, (4) and identify the most promising areas that are ready for and could benefit from rigorous field-scale demonstrations. A summary report on this meeting will be posted on the SERDP and ESTCP websites.

SERDP/ESTCP energetics remediation research is concerned with perchlorate issues, particularly with those of treatment. SERDP initiated perchlorate bioremediation R&D in 1998. Fundamental and applied studies showed the potential and method for cost-effective treatment. Dozens of perchlorate in situ bioremediation field demonstrations are ongoing across DoD facilities. R&D of ex situ bioreactor treatment for perchlorate in drinking water was initiated by an industry consortium (AwwaRF) in 1998 and completed in 2004, but currently, only ion exchange is used for drinking water treatment. FY2005 initiatives include a Congressionally-mandated ESTCP program to demonstrate and evaluate new approaches and a SERDP program to develop next-generation treatment.

The initial focus of heavy metals research was on small arms lead cleanup that produced several ESTCP demonstrations of lead removal from soil. Heavy metals bioavailability is also an issue of concern that was investigated under a FY00 SERDP statement of need (SON) and in a follow-on FY03 SON. The FY04 SERDP SON to investigate remediation of heavy metals in groundwater led to the selection of three projects.

Leeson identified SERDP FY06 SON areas:

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- Improved understanding of the distribution and impacts of subsurface remedial amendments in groundwater
- Development and placement of amendments for in situ remediation of contaminated sediments
- Assessment and measurement of processes impacting fate and transport of contaminants in sediments
- Containment/treatment of energetic and propellant material releases on testing and training ranges.

She also described SON areas for FY07:

- Ecosystem risk and recovery assessment for contaminated sediments
- Improved understanding of remediation performance in fractured geological settings
- Identification of biomarkers to assess groundwater contaminant degradation potential of a microbial population
- Investigation of cis-DCE and vinyl chloride degradation mechanisms and environmental relevance
- Improved sampling techniques for Efficient Use of Molecular Biological Tools to Assess Groundwater Remediation

Future research will continue efforts on existing chlorinated solvents work by emphasizing DNAPL source zone treatment and evaluating the true cost and performance of the treatments, improving performance assessment tools, and improving measurements of source mass and mass flux. The sustainable ranges study of munitions constituents will focus on the degradation of energetics in the environment, ecotoxicity, rapid detection/screening, in situ remediation, sequestration/containment, and decontamination of range scrap. Sediments research will continue to receive funding, with added emphasis on in situ technologies, and emerging contaminants, which are also an area of interest.

### ***Current and Future Directions of the Environmental Technologies R&D Program at SSC-SD***

Pamela Boss (Navy, SPAWAR) provided an overview of sensors developed under the sponsorship of Space and Naval Warfare Systems Center San Diego (SSC-SD). In earlier efforts, sensors were developed for use in site characterization and environmental monitoring, and to assess environmental quality and health. Modeling was conducted to determine suitable placement of sensors to optimize their performance. Current research efforts are focused on fleet and regional environmental support, contaminated sediment management, environmental security compliance conservation and cleanup, and sensor development.

The REEFEX EcoRisk Assessment is examining the conversion of inactive Navy vessels into reefs if preliminary data can be verified that suggest the artificial reefs would pose no threat to human health or the environment. SSC-SD is conducting an ecological risk assessments to support an application for a risk-based disposal permit to create artificial reefs with decommissioned vessels. The SINKEX project is a risk assessment of the potential release of PCBs, metals, or PAHs from solid materials on sunken navy ships in the deep ocean. Release behaviors of PCBs in solid materials have been investigated under laboratory-simulated shallow and deep ocean leaching conditions to determine whether they can adversely affect the adjacent marine environment. Data from this effort were used to support risk assessments for the sinking

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of an aircraft carrier, the ex-ORISKANY, off the coast of Florida early in May 2006. This is the first vessel in the Navy's artificial reef inventory.

Sediment transport tools to evaluate physical stability and natural recovery are important to Navy operations. These tools support the characterization of the fate and transport of contaminated sediments using a reliable set of measurement technologies and analysis techniques, which allow an evaluation of sediment physical stability and natural recovery potential. The project to develop containment and monitoring strategies for contaminated sediment management seeks a suite of integrated remedy, validation, and monitoring packages.

An Environmental Security Research, Development, Test, & Evaluation (RDT&E) project will demonstrate new technologies (trident probe and ultraseep system) for the assessment of coastal landfills and hazardous waste sites with groundwater discharge to the surface. Another project will demonstrate and validate an integrated, harbor-scale, fate-and-effects model for copper in DoD harbors to achieve more scientifically based, cost-effective compliance. The model will account for transport, flushing, sediment exchange, complexation, and bioavailability. In sensor development, work is going forward on a perchlorate sensor based on Raman (SERS) and BiQuat technologies, a MEMS-based optical sensor, and an electronic "tongue" based on non-specific calcogenide.

A dual-camera GeoVis probe is being developed for Pacific Northwest National Laboratory for use in characterizing soil porosity. The GeoVIS probe is used with SCAPS to obtain detailed information about subsurface soil characteristics on very small spatial scales. The GeoVIS device illuminates the surrounding soil through a sapphire window on the side of the probe. Video signals from the camera are returned to the surface, where they can be viewed in real time on a video monitor and documented on a video recorder. Both cameras look out the same window. In the current configuration, the cameras will have different magnifications to cover the range of soil types. Greater magnification is better to view finer soils, less magnification is needed for sandy soils.

SSD-SD also has developed several bioassay techniques. QwikLite and QwikSed were developed as rapid and inexpensive bioluminescent field screening tools to detect the presence of toxic metals and organics in sediments and pore-water samples. Commercialization of the QwikLite 2000 is being pursued.

Future research will include continued fleet support, particularly in the area of total maximum daily loads (TMDLs) from shore facilities. Promising areas in sensor research will involve deploying sensors on unmanned vehicles, such as robots, submersibles, and buoys, as well as development of MEMS-based sensors. Capture matrices are also of interest for the extraction/concentration of a target analyte from a complex sample matrix. Development will address ease of separation and automation of system operation.

### ***Review of EPA-ORD Remediation Technology Programs***

Steve Lingle (EPA/ORD) reviewed several Office of Research and Development (ORD) programs that focus on remediation. EPA's Superfund Innovative Technology Evaluation (SITE) Program ([www.epa.gov/ord/site](http://www.epa.gov/ord/site)) has provided relevant innovative technology performance data

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to regions and other decision makers, including cost data for evaluation of remediation and monitoring options. At Loring AFB in Maine, for example, a SITE demonstration of steam-enhanced in situ remediation of DNAPL in fractured rock provided performance and cost data that supported the use of the technology by the Army Corps of Engineers at a site in Rhode Island. Two additional implementations of the technology are planned for Maine.

The Small Business Innovation Research (SBIR) Program funds small businesses (fewer than 500 employees) to develop and commercialize technologies that federal agencies need. The details of SBIR implementation varies across the federal agencies. EPA budgeted \$6 million for the program in 2006. At EPA, an SBIR Phase I grant is competitively awarded to achieve proof of concept for a technology. Each grant typically awards \$70,000 over six months. Technology commercialization is the focus in SBIR Phase II, which awards \$225,000 to \$345,000 (with options) over a two-year period. Lingle provided several examples of SBIR grand projects: nanocrystalline zero-valent iron for in situ remediation, magnetite ( $\text{Fe}^3\text{O}_4$ ) nanoparticles for groundwater remediation, fence-line fugitive emissions ambient monitor, field screening detector for metals in soil, and chromium (VI) sensor. The full history of EPA's SBIR award program is available on the website ([www.epa.gov/ncer/sbir](http://www.epa.gov/ncer/sbir)).

The Nanotechnology Research Program ([epa.gov/ncer/nano](http://epa.gov/ncer/nano)) falls under EPA's extramural STAR Grants Program. This research addresses the interactions of nanomaterials with the environment and any possible risks that may be posed by nanotechnology. Between 2002 and 2004, eight STAR nanotechnology research grants were awarded for remediation of soil and groundwater and six grants for sensors. Examples of nanotechnology research projects include nanoscale bimetallic particles for in-situ remediation, Fe(0)-based nanoparticles for in situ degradation of DNAPL chlorinated organic solvents, and synthesis and application of a new class of stabilized nanoscale iron particles for rapid destruction of chlorinated hydrocarbons in soil and groundwater.

Research themes in groundwater and ecosystems restoration in EPA's Robert S. Kerr Environmental Research Center in Ada, OK ([www.epa.gov/ada/](http://www.epa.gov/ada/)) focus on groundwater, oil spills, site characterization and soil research, mining sites, and the Technical Support Centers. The center works to answer specific questions, such as How can DNAPL source zones be effectively remediated? or Are there effective in situ bioremediation methods for DNAPL plumes? DNAPL researchers in ORD are working to develop technical guidance for assessing different technologies for DNAPL source areas, as well as a basis for using mass flux as a performance metric. ORD, the Army, and EPA Region 10 are in the process of applying a mass-flux approach for site-wide performance assessment at Fort Lewis.

### ***National Homeland Security Research Center Technology Testing & Evaluation Program Overview***

Jonathan Herrmann (EPA/ORD) said that, following the terrorist attacks of September 2001, EPA developed a Strategic Plan for Homeland Security. The Strategic Plan is committed to enhancing national security and protecting the citizens of the United States. It is the basis for the creation of the National Homeland Security Research Center (NHSRC), which began operation in Cincinnati, Ohio, in September 2002. Originally designed with a three-year lifespan, NHSRC was faced with addressing scientific and technical issues that required longer than three years to

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resolve. Reviews of NHSRC programs by the National Academies, as well as commentaries by other federal organizations, recommended that NHSRC continue as an organization within EPA to address national security research needs.

NHSRC ([www.epa.gov/nhsrc/](http://www.epa.gov/nhsrc/)) became a permanent organization within EPA's Office of Research and Development in December 2004. The Center has a staff of about 50 full-time employees, half of them headquartered in Cincinnati. EPA's homeland security research and development program is designed to focus attention on the most probable, highest-impact events, while maintaining flexibility to adapt to unknown situations that might arise. These threat scenarios and the information gathered from stakeholders make up the basis of NHSRC's research and development program. As additional information is developed or provided from others, NHSRC revises its priorities accordingly.

NHSRC's Technology Testing and Evaluation Program (TTEP) provides technical information on the performance of commercially available technologies that may have application to homeland security in support of Homeland Security Presidential Directives HSPD-7, HSPD-9, and HSPD-10. The TTEP tests and evaluates homeland security related technologies and produce a technology evaluation report for each. The reports contain detailed performance information that can be used by emergency and remedial response personnel, water utility operators, and building and facility managers for selecting technologies for purchase and for deployment in protecting against or recovering from a chemical, biological, or radiological terrorist attack.

NHSRC collaborates with USGS, the Coast Guard, the Federal Bureau of Investigation, Centers for Disease Control, DoD, Department of Homeland Security, Federal Emergency Management Agency, National Institute of Standards and Technology, DOE, professional associations, as well as utilities within the water industry, universities, non-profit organizations, and several offices within EPA. Of particular current interest is the development of in-line sensors for real-time monitoring of water supply systems. Traditional water quality monitoring equipment does not answer the present real-time need, and there are also issues with reliability, maintenance, and cost. Multiple benefits should accrue from dual use, which is the argument the collaborators are presenting to vendors in their efforts to promote the development of new monitoring devices.

### ***Interstate Technology and Regulatory Council (ITRC)***

Tim Titus explained how ITRC works with industry and stakeholders to achieve state regulatory acceptance of environmental technologies. ITRC consists of 43 states, the District of Columbia, multiple federal partners, industry participants, and other stakeholders. It fosters cooperation among these stakeholders in breaking down barriers and reducing compliance costs, making it easier to use new technologies and helping states to maximize resources. ITRC accomplishes its mission in two ways: it develops guidance documents and training courses to meet the needs of both regulators and environmental consultants, and it works with state representatives to ensure that ITRC products and services have maximum impact among state environmental agencies and technology users. ITRC originated in 1995 from a previous initiative by the Western Governors' Association. In January 1999, it affiliated with the Environmental Research Institute of the States, a nonprofit educational subsidiary of the Environmental Council of the States (ECOS).

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ITRC receives regional support from the Western Governors' Association and Southern States Energy Board and financial support from EPA, DOE, and DoD.

At the present time, ITRC has 15 technical working teams. The teams develop guidance documents and training courses to meet the information needs of regulatory staff, technology vendors, and environmental consultants. Team formation is based on available funding, and technical topics are selected in one of two ways: a topic is proposed by ITRC members, or a topic consistent with the ITRC Strategic Plan is proposed and funded by an outside source. State regulators lead ITRC technical teams, which rely on broad-based participation from federal agencies, industry, academia, and other stakeholders in producing collaborative products. Currently, 45 of the 50 states are ITRC members. The reports produced by the technical teams are available on the ITRC website ([www.itrcweb.org](http://www.itrcweb.org)).

The technical teams develop both classroom and Internet-based training. These courses create a unique forum for the exchange of technical and regulatory information because they are based on ITRC guidance documents, which reflect the consensus opinion of ITRC members from state and federal environmental agencies, the private sector, and citizen stakeholders. The Internet training sessions, which are free, were originally developed to train state regulators. The courses last two to two and one-half hours and cover technical and regulatory information specific to environmental technologies and innovative approaches. Question-and-answer periods allow participants and instructors to interact. At the end of the presentation, participants are guided to links for related documents and other online resources. Registration for the courses opens four to six weeks prior to each course offering. The courses are hosted on EPA's CLU-IN website. As of the end of April 2006, approximately 26,000 people had attended the ITRC Internet seminars. Past seminars are archived on the CLU-IN website ([www.clu-in.org](http://www.clu-in.org)). ITRC continues to provide classroom training, but these offerings are scheduled less frequently than the Internet courses because they are much more expensive to hold and require at least six months to set up.

Though ITRC's focus has been on remediation of hazardous waste sites since its inception, its members are beginning to consider expanding into other areas of environmental contamination problem-solving, such as stormwater management, metal-mining wastes, emerging contaminants, and pollution resulting from agricultural practices. According to Titus, ITRC believes it is important to look ahead and ask, "What is the issue that will bite me next?"

### **MEETING WRAP-UP**

The next FRTR meeting will be held December 6 or 13, 2006 at One Potomac Yard, 2777 South Crystal Drive, in Crystal City, a new building where all of the Crystal City based EPA offices will be consolidated.

The meeting was adjourned.



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Arlington, Virginia  
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