



U.S. DEPARTMENT OF
ENERGY

Savannah River Site

**A Presentation to the
SRS Citizens Advisory Board
Facilities Disposition and Site Remediation Committee**

Area Completion Projects Savannah River National Laboratory Technology Collaboration

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Acronyms

\$/lb	Dollars / Pounds	LaBr	Lanthanum Bromide
\$1M	One Million Dollars	LANL	Los Alamos National Laboratory
20L	20 Liters	LBNL	Lawrence Berkeley National Laboratory
ACP	Area Completion Projects	M&O	Maintenance and Operations
Al	Aluminum	MicroCED	Micro-Biological-Based Chlorinated Ethene Destruction
ASCEM	Advanced Simulation Capability for Environmental Management	MNA	Monitored Natural Attenuation
BSWTS	Big Stream Water Treatment System	ORNL	Oak Ridge National Laboratory
CMTS	Central Mercury Treatment System (Y-12)	PCE	Polychlorinated Biphenyls
CPT	Cone Penetrometer Technology	pH	Negative Logarithm of Effective Hydrogen-Ion Concentration
Cu ft	Cubic Feet	PNNL	Pacific Northwest National Laboratory
Cu cy	Cubic Yards	R&D	Research and Development
CVOCs	Chlorinated Volatile Organic Compounds	SFA	Science Focus Area
DOE	Department of Energy	SNL	Sandia National Laboratory
EA	Early Action	SVE	Soil Vapor Extraction
HQ	Headquarters	TCE	Trichloroethylene, Triclene
I-129	Iodine-129	TRU	Transuranic Waste
IDW	Investigative Derived Waste	VOCs	Volatile Organic Compounds
IFRC	Integrated Field Scale Subsurface Research Challenges	SRS-AC	Savannah River Site – Area Completion
ITRC	Interstate Technology and Regulatory Council	SRNL	Savannah River National Laboratory
INL	Idaho National Laboratory		



Purpose

Demonstrate collaboration and communication between Savannah River National Laboratory and Area Completion Projects in successful development and deployment of innovative technologies that address SRS, the DOE Complex, and other environmental restoration needs.



- **Mature Program**
- **Early realization that technology would result in cost effective, schedule efficient, and improved cleanup**
- **ACP and SRNL have been collaborating from Program's onset to address project specific technology needs**





Initial Focus:

- Minimally to non-invasive, real time characterization technologies

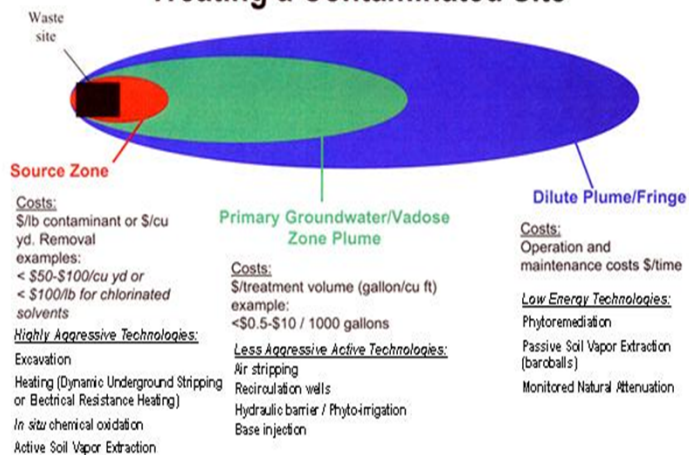
Direct Push Technology



Mobile Lab



Treating a Contaminated Site



Excavation / Removal



- Aggressive source remediations



- Minimally to non-invasive, real time characterization technologies

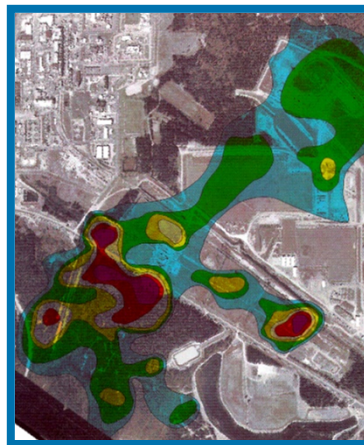
–Simpler mobilization



–Minimize / eliminate
Investigative Derived Waste



–Immediate delineation
of nature and extent



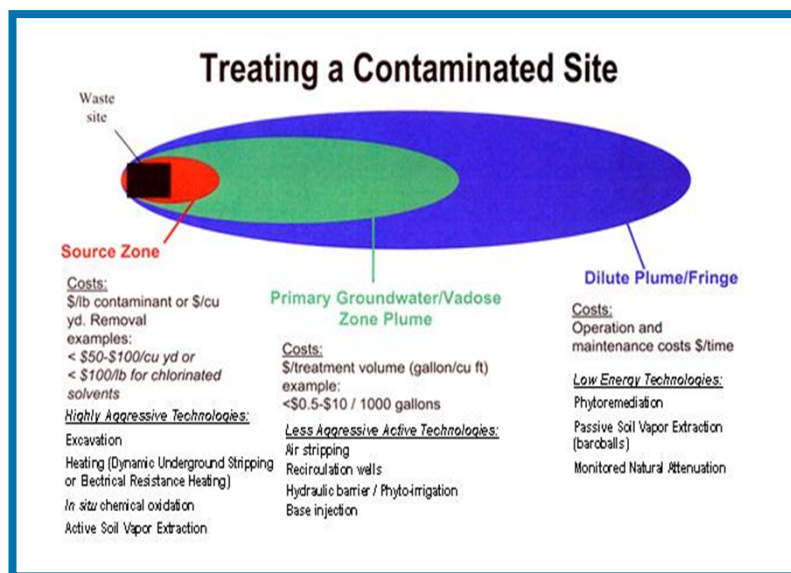


- **Aggressive source remediations**
 - **Eliminates largest impact to risk and transport of contaminants**





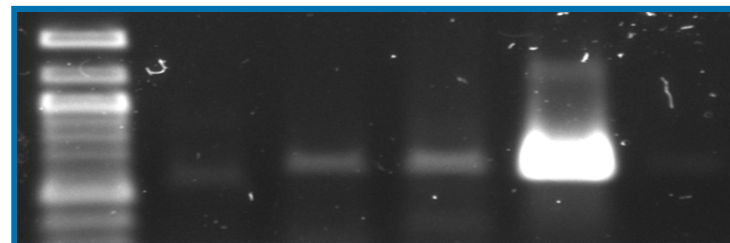
- As Program matured and evolved into Area Completions, remediation technology needs evolved:
 - “Polishing”/ passive remediations (low energy, sustainable)
 - Monitored Natural Attenuation and Enhanced Attenuation approaches
 - In Situ closure of technologies for hardened facilities



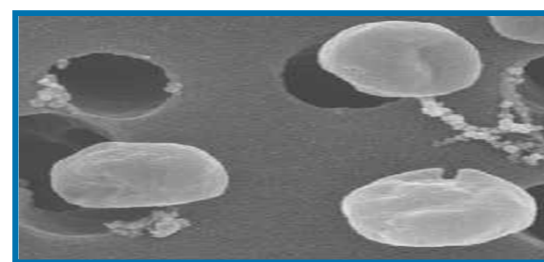


Micro-biological-based Chlorinated Ethene Destruction (MicroCED)

- Indigenous bacteria discovered at SRS
- Capable of complete reductive dechlorination of Chlorinated Volatile Organic Compounds
- The presence of these bacterium at SRS will provide support for future Area Completion Projects Monitored Natural Attenuation and Enhanced Attenuation projects



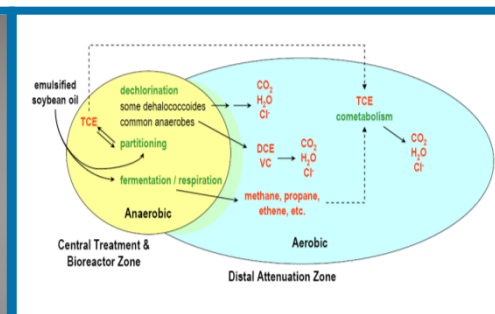
Genetic signature indicating the presence of MicroCED



Microscopic picture of MicroCED



MicroCED growth canister.



MicroCED TCE Concentration Reduction Process



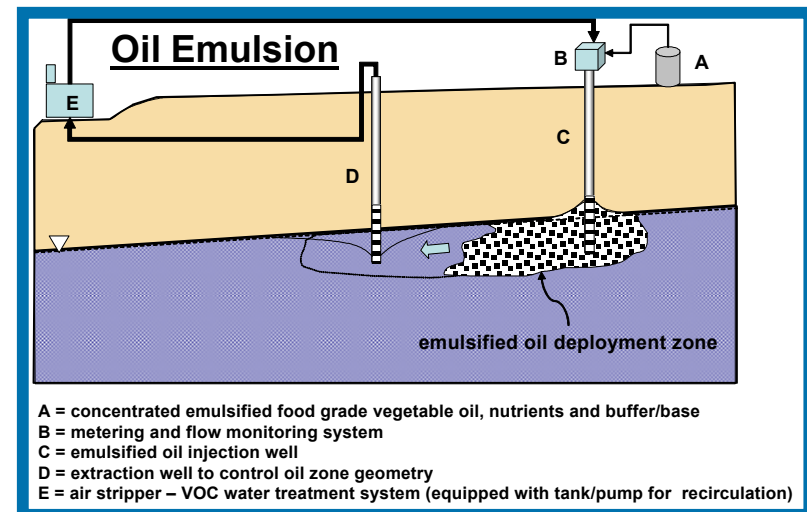
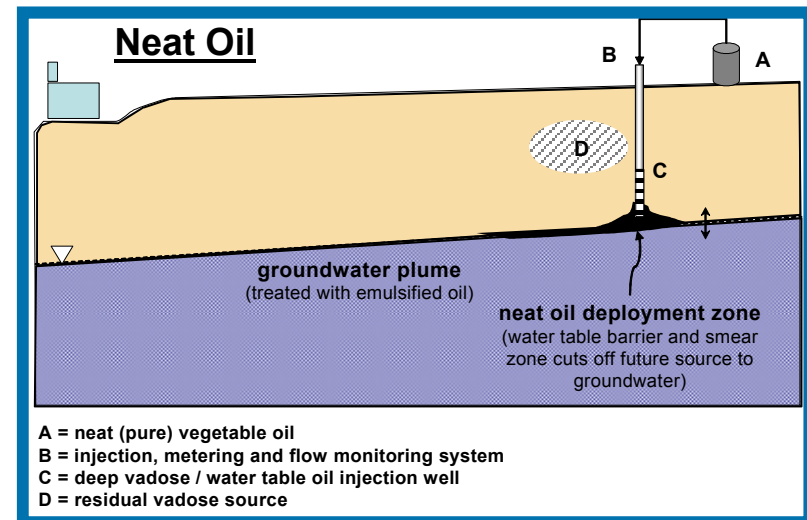
Edible Oils Technology

Background:

- T Area has a small persistent Trichloroethylene / Polychlorinated Biphenyls plume which is managed with Pump and Treat (airstripper)
 - Approximately \$1M/year Maintenance & Operation costs
 - At a point of diminishing returns

New Strategy:

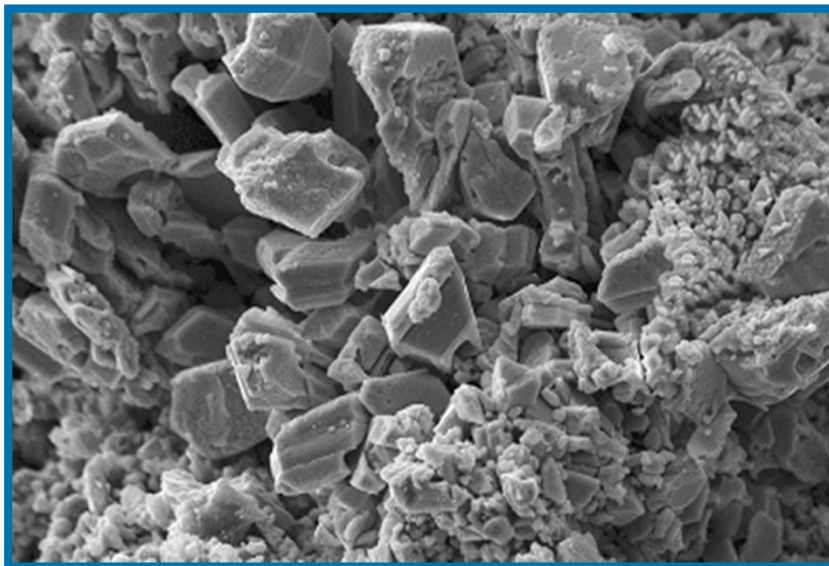
- Use Edible Oil injection techniques to sequester and biologically destroy the Volatile Organic Compounds
 - Inject Neat Edible Oil to sequester Volatile Organic Compounds (vadose zone source)
 - Inject Edible Oil emulsion (food source) to promote microbial activity and reducing conditions in groundwater (reductive dechlorination)
 - Obvious results in less than six months



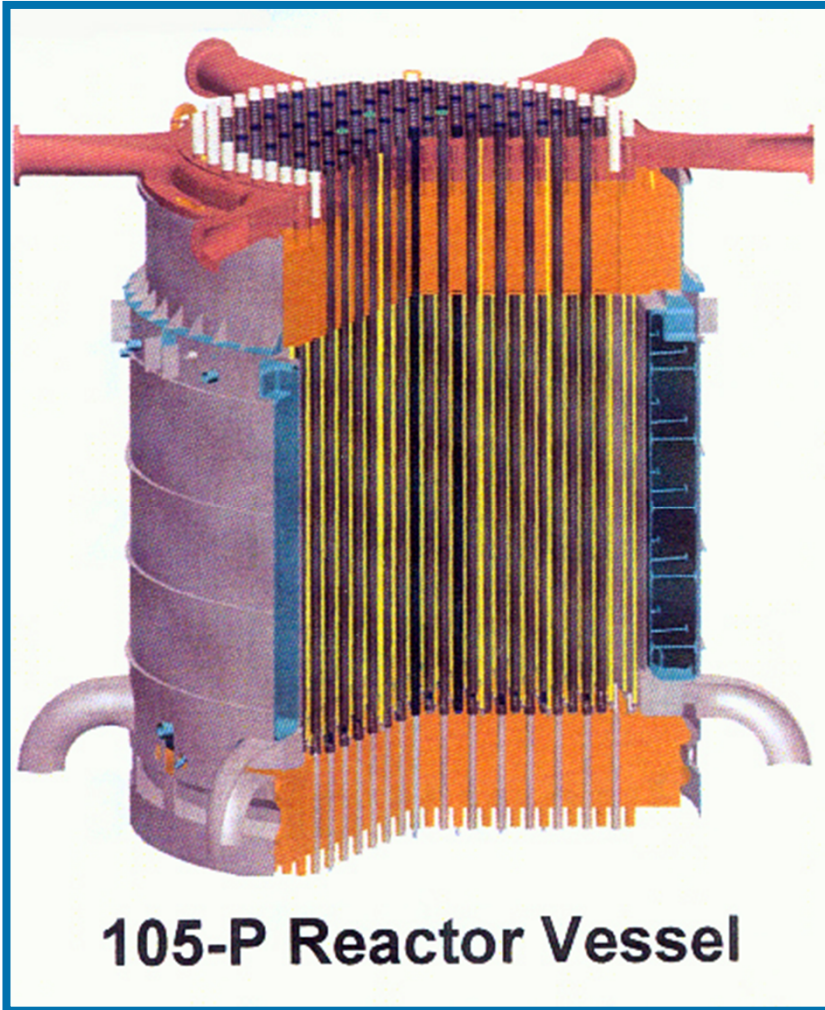


- Initiated first application in the F-Seepage Basin groundwater
- Iodine-129 can be captured with silver chloride to form silver iodide, which has a very low solubility
- Bench scale studies indicate that the materials developed are very effective
- SRNL will patent the invention for use

Electron Photomicrograph



Silver chloride in a soil matrix
after capture of iodine
(crystal structure change)



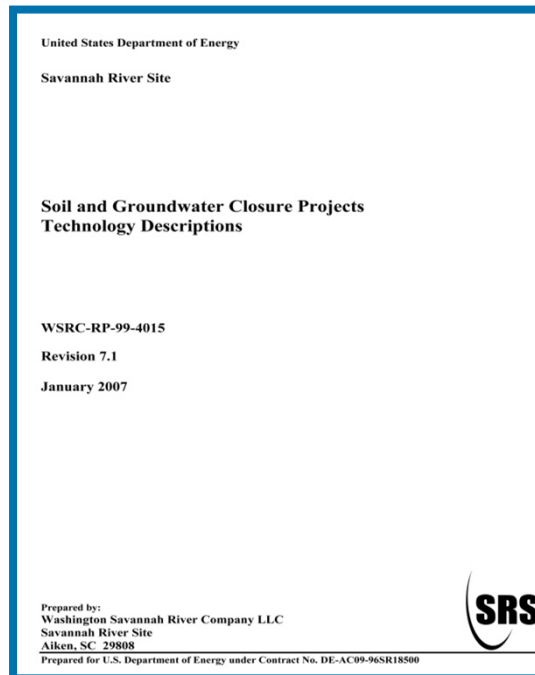
- Reactor Vessel contains internal aluminum (Al) metal components
- Al metal corrodes in caustic solution creating hydrogen
- Portland cement grout:
Negative Logarithm of Effective Hydrogen-Ion Concentration (pH)
12.4 to 13.1
- Neutral pH grout / fill have been evaluated and Calcium Sulfate mixture identified



- Soil and groundwater technology development and deployment at SRS can be found at:

http://irmsrv02.srs.gov/general/programs/soil/gen/sgcp_tech_descriptions.pdf

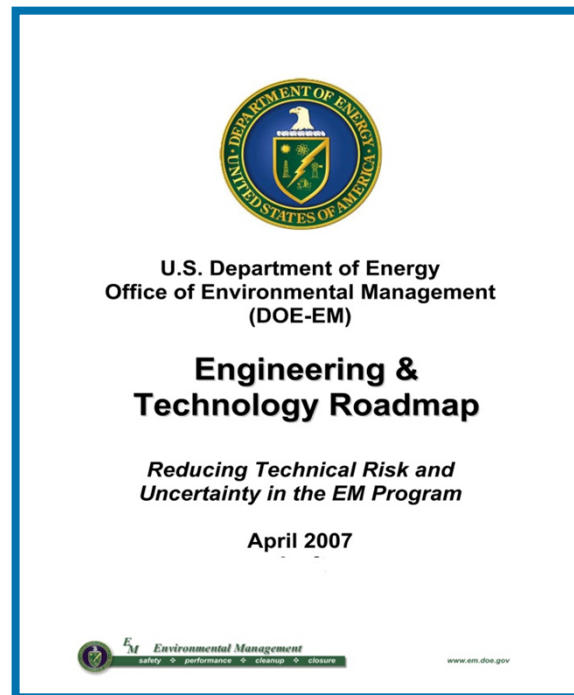
- **WSRC-RP-99-4015**



- **Project and lab contacts identified**



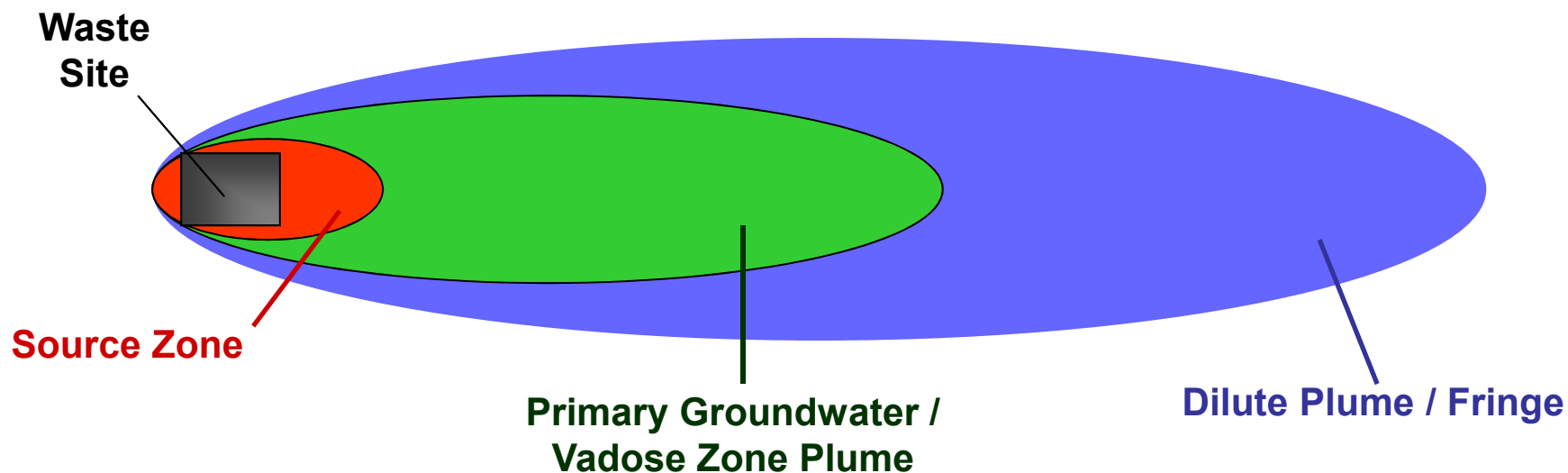
- **Programmatic technology needs:**
 - **SRS-Area Completion Projects, collaborating with HQ and Savannah River National Laboratory, contributed to the 2007 DOE Technology Roadmap**



- **Research and development will benefit the entire DOE Complex and beyond**



- **Soil and groundwater needs identified:**
 - **Monitored Natural Attenuation / Enhanced Attenuation for Volatile Organic Compounds**
 - **Monitored Natural Attenuation / Enhanced Attenuation for Metals and Radionuclides**
 - **Remediation of “Tight” Zones**
 - **Long Term Monitoring**

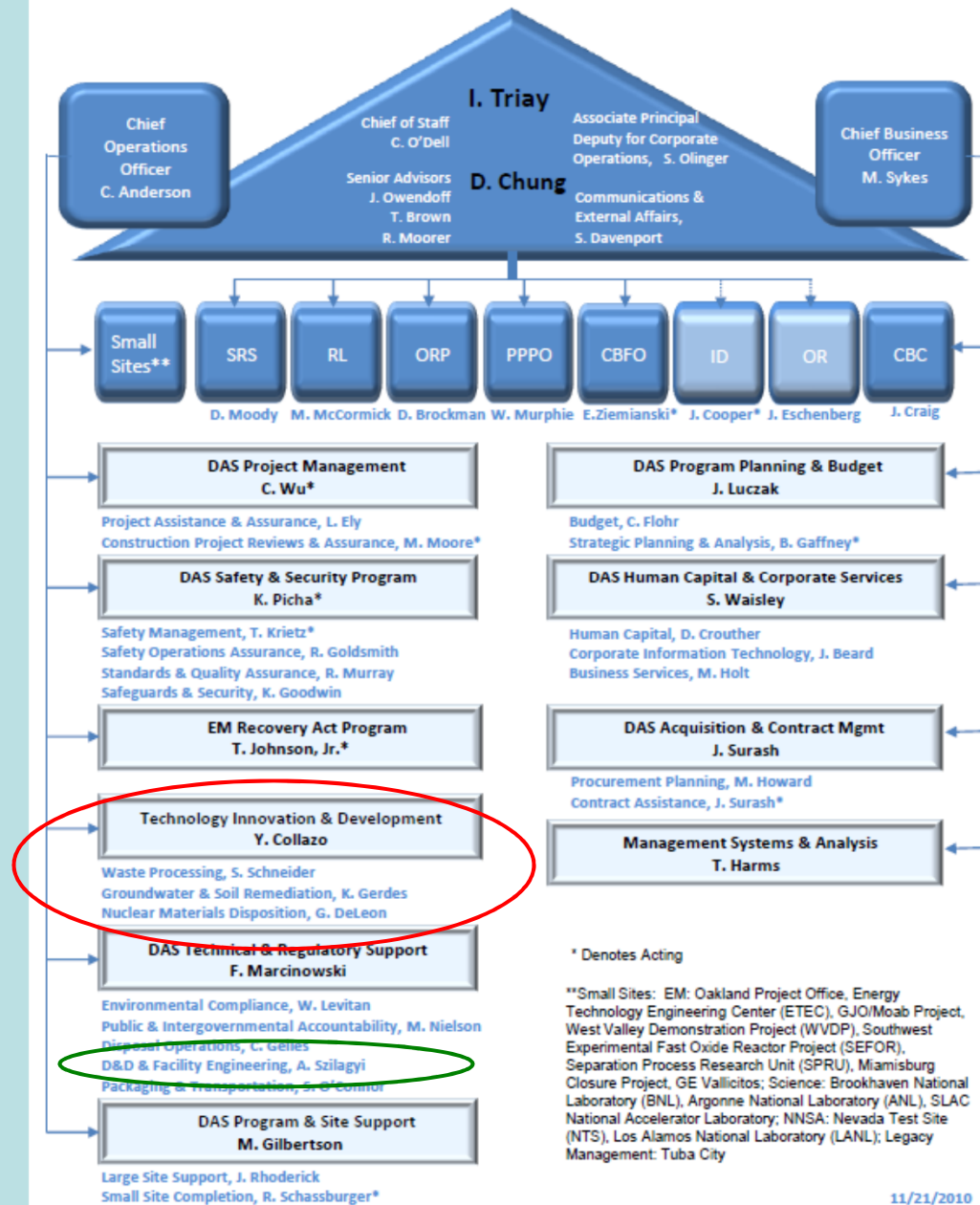


Matching Remediation Technologies to the Real World Is the Applied Science Opportunity and Is Key to Transformational Environmental Management

Bob Aylward

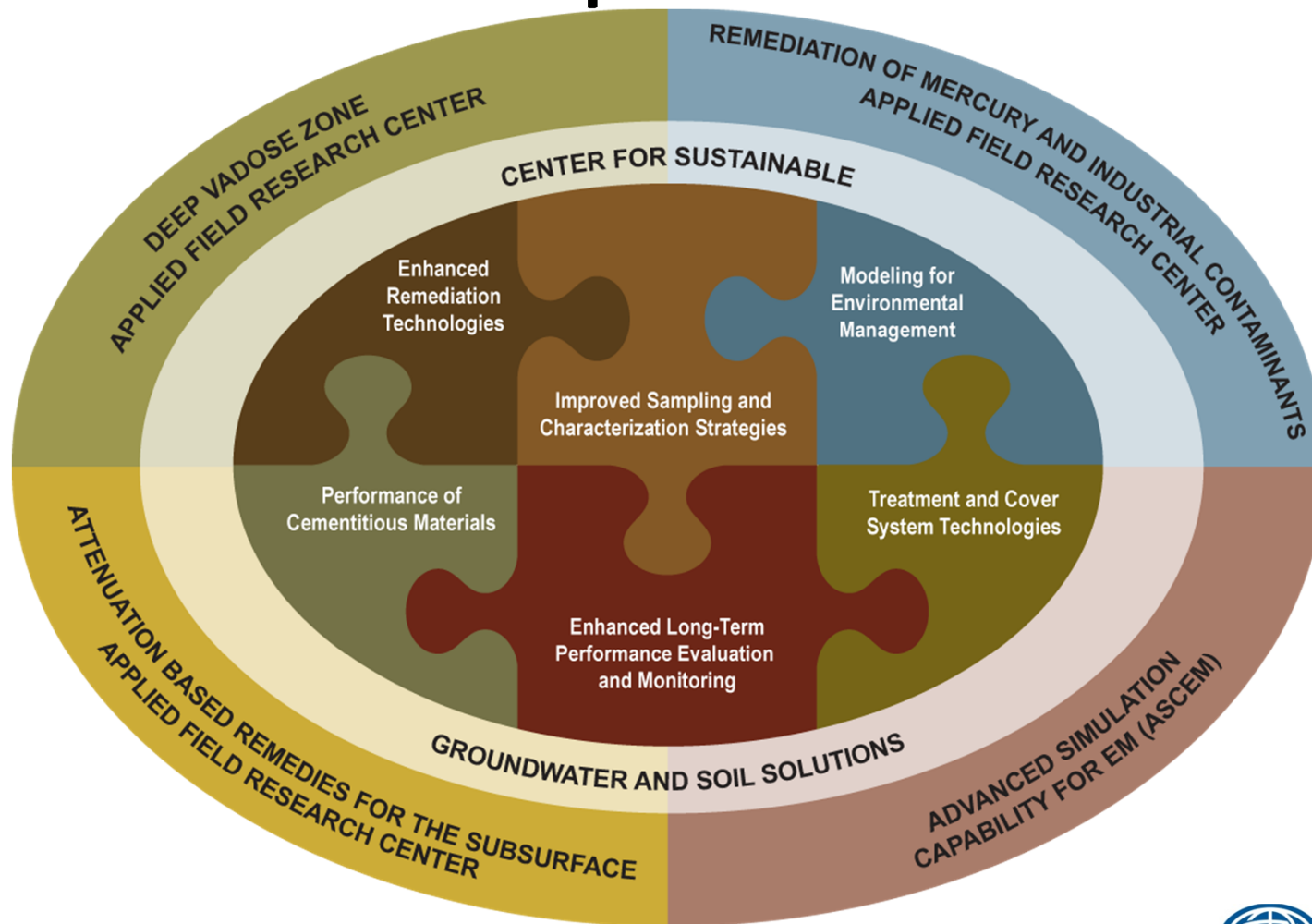
**Environmental Restoration Technologies Section
Savannah River National Laboratory**

The EM Leadership Pyramid





Groundwater and Soil Remediation Research & Development Areas



Attenuation-Based Remedies for the Subsurface Applied Field Research Center

- Identify and understand waste site evolution in the context of sustainable long-term remediation for metals and radionuclides
- Research areas include development of:
 - Enhanced attenuation technologies
 - Tools and approaches to support field characterization and monitoring
 - Tools and approaches to support decision-making
- Collaboration with SRS site, academia, industry, and the national laboratories, as well as Interstate Technology and Regulatory Council
- Advanced Simulation Capability for Environmental Management Phase 1 Demonstration based on SRS F Area and continuing integration efforts

• Integration with Science Focus Areas:

- Partnering with LBNL on Predicting Contaminant Mobility at the Plume Scale challenge
 - F-Area is key field site for challenge
 - Focusing on increasing complexity of contaminant mobility over stewardship timeframes
 - Sorption, Geophysical & Isotopic studies
 - Reactive Transport Modeling



Lab Contributors:

SRNL, LBNL,
PNNL, SNL

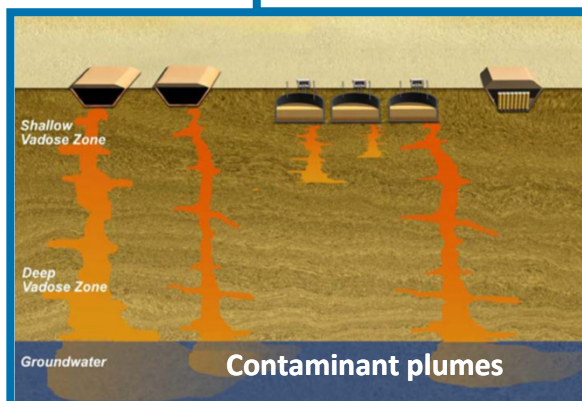


Deep Vadose Zone Applied Field Research Center

Mission: to protect water resources over the long-term by developing effective solutions to solve DOE's most challenging deep vadose zone characterization, remediation, monitoring, and prediction challenges

- **Remedial Design**
 - Research to support deep vadose zone remediation
- **Controlling Processes**
 - Quantify coupled processes for conceptual model development
- **Monitoring**
 - Assessing performance and long-term threats
 - Advanced subsurface monitoring technologies
- **Predictive Modeling and Data Integration**
 - Simulate integrated processes

- **Integration with Integrated Field-Scale Subsurface Research Challenges (IFRCs) and Science Focus Areas (SFAs):**
 - Hanford 300 Area Solving Uranium Migration at the Hanford Site
 - Role of Microenvironments and Transition Zones in Subsurface Reactive Contaminant Transport
 - Predicting Contaminant Mobility at the Plume Site



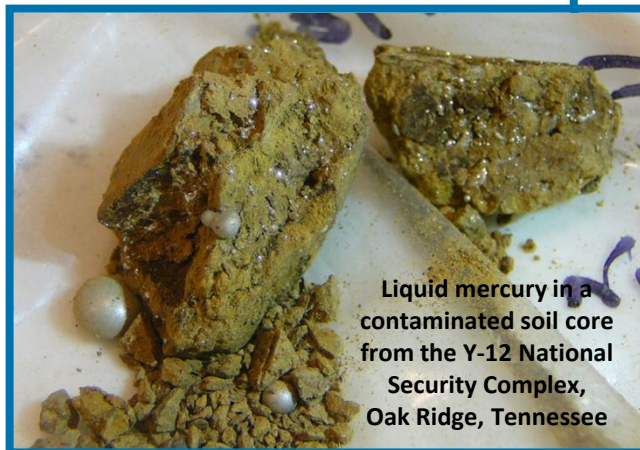
Lab Contributors:
PNNL, INL, LBNL



Remediation of Mercury and Industrial Contaminants Applied Field Research Center

- Develop and demonstrate innovative methods for treating multiple mercury species in soil water, debris
- Begin laboratory- and intermediate-scale comparisons of these methods
- Demonstrate mercury characterization tools developed under the Characterization priority area
- Improve conceptual models of mercury flux and transport at Oak Ridge

- Integration with Integrated Field-Scale Subsurface Research Challenges (IFRCs) and Science Focus Areas (SFAs):
 - Oak Ridge IFRC: *“Multi-scale Investigations on the Rates and Mechanisms of Targeted Immobilization and Natural Attenuation of Metals, Radionuclide and Co-contaminants in the Subsurface”*
 - Oak Ridge National Laboratory SFA: *“Biogeochemical and Molecular Mechanisms Controlling Mercury Transformation in the Environment”*



Liquid mercury in a contaminated soil core from the Y-12 National Security Complex, Oak Ridge, Tennessee

Lab Contributors:

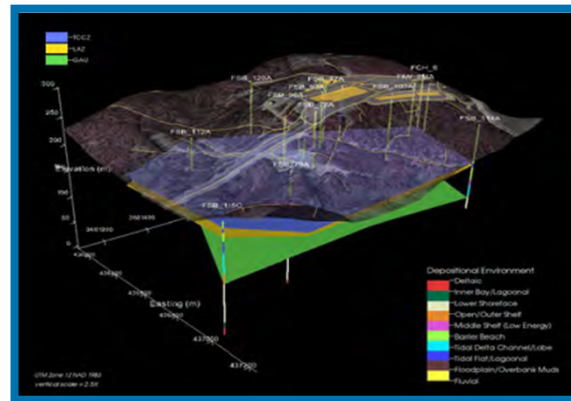
Oak Ridge National Laboratory, Savannah
River National Laboratory

Advanced Simulation Capability for Environmental Management (ASCEM)

- Develop a science-based tool and approach for integrating data and scientific understanding for contaminant fate and transport enabling informed decision making
- Organized into three thrust areas:
 - Multi-Process High Performance Computing
 - Platform and Integrated Toolsets (user interface with associated toolsets)
 - Site Applications
- Integrated with other centers for critical data and decision support
- **FY 10:** Completed ASCEM Phase 1 Demonstration; workshop with Fossil Energy
- **FY 11:** Peer Review, workshop with Nuclear Energy

Integration with Integrated Field-Scale Subsurface Research Challenges and Science Focus Areas:

- Integrated Field-Scale Subsurface Research Challenges sites and Science Focus Areas are providing significant datasets and insights for model testing, validation & verification of model components
- **“Predicting Plume Mobility Challenge”** – LBNL SFA conducted jointly with SRNL at the F-Area – used in ASCEM Phase 1 Demonstration



ASCEM website: <http://ascemdoe.org/>

Lab Contributors:

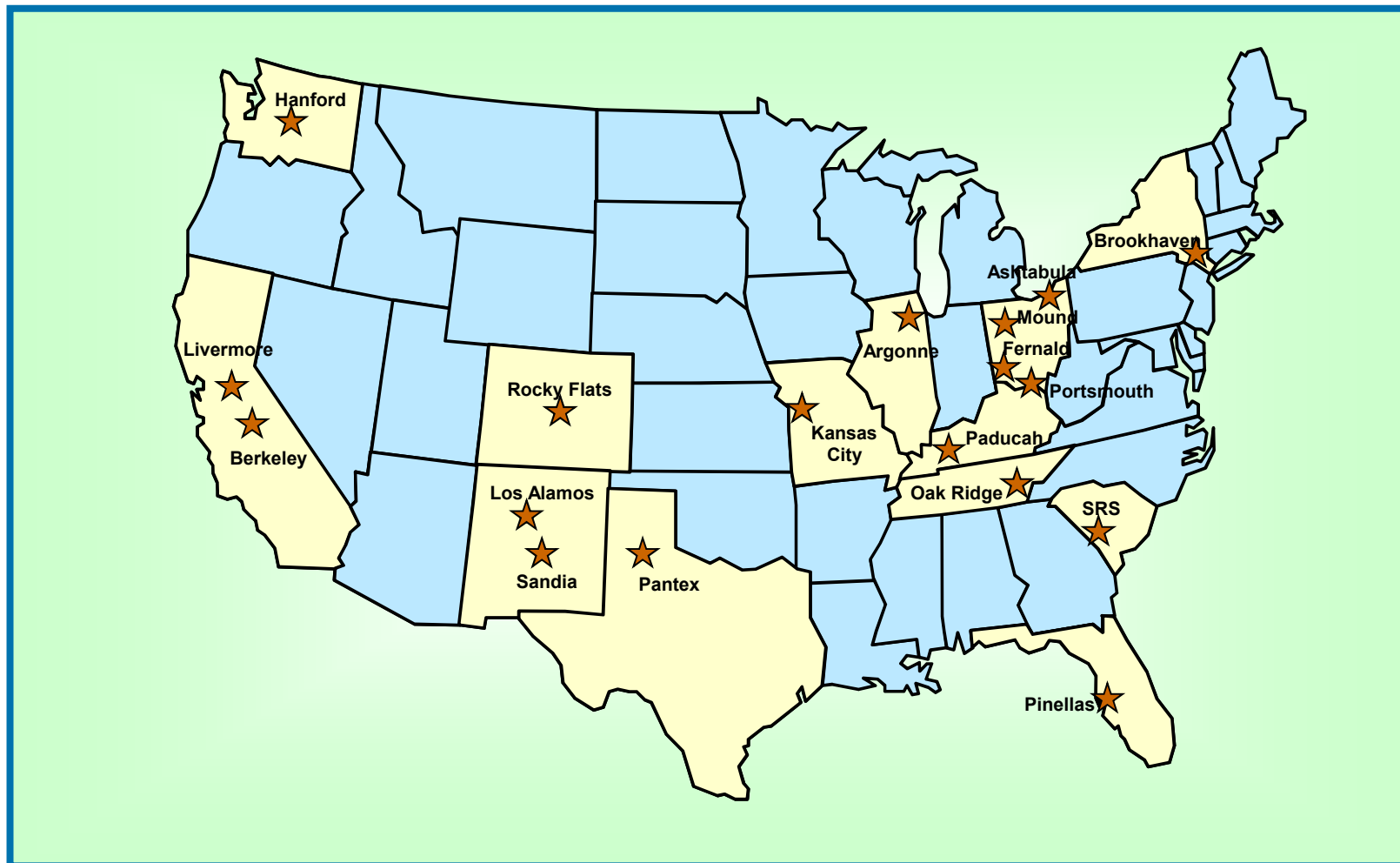
ANL, INL, LANL, LBNL,
LLNL, ORNL, PNNL, SRNL



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ACP / SRNL Technology Collaboration

Environmental Management Center for Sustainable Groundwater and Soil Solutions Technology Import and Export



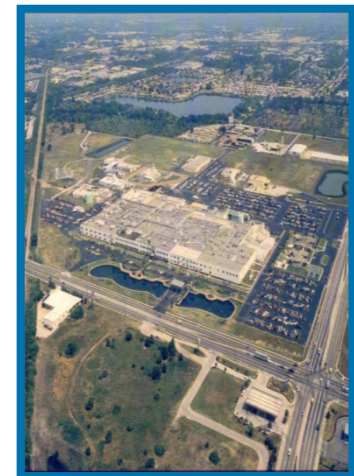


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ACP / SRNL Technology Collaboration

Environmental Management Center for Sustainable Groundwater and Soil Solutions Technology Import and Export

- Developed Conceptual Site Model and technically robust, cost-effective approach for characterization of mercury contaminated soils / sediments
- Independent technical review of Building 100 plume at former Pinellas Site in Largo, Florida; recommended phased subsurface investigation / monitoring on- and off-site
- Independent technical review of the C-400 Interim Remedial Project Phase I electrical resistance heating (ERH) results at the Paducah Gaseous Diffusion Plant





Summary and Conclusions

- **Area Completion Projects and Savannah River National Laboratory have a long history of successful collaboration in the groundwater and soil technology development and deployment area**
- **The DOE Headquarters Technology Innovation & Development Program provides valuable resources that support applied science advancements at SRS and across the DOE Complex**
- **The combined site and headquarters program successes result in technology import and export opportunities for all of Environmental Management (EM)**