PARTNERS IN ENVIRONMENTAL TECHNOLOGY

SERDP Strategic Environmental Research and Development Program

ESTCP

INFORMATION B•U•L•L•E•T•I•N

JANUARY 2000
NUMBER 3

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The poster sessions at the recent Symposium & Workshop provided valuable opportunities for direct interaction with researchers.

For more event highlights, turn to pp. 4–5.

Attendees Rate *Partners in Environmental Technology* Symposium & Workshop As Top Technical Environmental Symposium

With more than 570 participants and a well-developed technical theme promoting sustainable development within the DoD, the recent *Partners in Environmental Technology* Technical Symposium & Workshop sponsored by SERDP and ESTCP proved to be not only the largest but also the most successful to date. The Symposium drew attendees from government, academia, the private sector, and the user community who spent November 30-December 2, 1999, reviewing promising environmental research & development efforts and demonstration & validation projects and learning about future opportunities.

The annual *Partners in Environmental Technology* event reflects the partnership formed by the two host organizations. More significantly, it highlights the many different partnerships that play a pivotal role in the success of Federal technology development: the partnership between DoD research and development programs; the partnership between DoD, DOE, EPA, and other Federal agencies; the partnership between Federal agencies and private industry and academia; and, most importantly, the partnership between technology developers, the numerous end users of technology, and environmental regulators/policy developers.

Leading off the two and a half day program was a Plenary Session featuring high-level Administration and Federal officials as well as other renowned speakers. Those addressing the assembly of participants included Dr. Delores Etter, Deputy Under Secretary of Defense for Science and Technology; Dr. Jonathan Lash, President of World Resources Institute and Former Co-Chair of the President's Council on Sustainable Development; Mr. Michael Leake, Director of Sensors and Electronic Systems for Environmental Health and Safety and Materials Processing – Raytheon Systems Company; Ms. Sherri Goodman, Deputy Under Secretary of Defense for Environmental Security; and Dr. Martha Krebs, Director of the DOE's Office of Science and Chair of the SERDP Council. The opening of the Symposium also marked Dr. Krebs' last day in her post at DOE. It was fitting, therefore, that as her last act as Council Chair, she presented the first annual SERDP "Project of the Year" awards. The projects recognized were representative of the high caliber of technologies showcased at the Symposium.

The first award recipient, Dr. Jeffrey W. Talley of the U.S. Army Corps of Engineers Engineer Research and Development Center–Vicksburg, received recognition for his Cleanup project "*Assessment and Prediction of Biostabilization of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediments*." Since its initiation as a SERDP project in FY 1998, this effort has investigated *biostabilization*—a newly-developed concept whereby accessible pollutants are biodegraded in a soil or sediment matrix, leaving a bound residue that is biologically unavailable and immobile. This research project has sought to identify those factors affecting biostabilization of PAHs on sediments and to develop the technical basis for enhancing natural recovery processes that occur in-situ during biotreatment of sediments contaminated with PAHs. In FY 1999, Dr. Talley and his research team from Carnegie Mellon University, Stanford University, and Naval Research Laboratory used a suite of microscale spectroscopic and spectrometric techniques to investigate biostabilization. This investigation has revealed that for harbor sediments from two sources, PAHs reside primarily on black coal-derived particles. This is the first direct evidence at the microscale of a physically distinct class of particles that sequester most of the PAHs.

See Symposium, page 6

S•U•C•C•E•S•S STORIES

SERDP-funded research and development efforts and ESTCP-funded demonstration and validation activities continue to provide a rapidly increasing number of outstanding technical advances. These developments are highly important and relevant to the Department of Defense (DoD), Department of Energy (DOE), Environmental Protection Agency (EPA), and many other user communities.

SUCCESS STORY

Assessment of In-Situ Oxidation Technology

Soil and groundwater contaminated with chlorinated volatile organic compounds (CVOC) is a widespread problem at Department of Defense sites. Currently, pump-and-treat and excavation are the most common approaches for treating dense non-aqueous phase liquids (DNAPL); however, both have limitations. Because there are many sites with CVOC contamination, there is a great need for cost effective and reliable in-situ technologies. Consequently, vendors and site managers have been proceeding rapidly to test in-situ oxidation (ISO) as a remediation technology for CVOCs in both soil and groundwater. ISO involves injection of strong oxidants into the contaminated subsurface, in some cases with other chemicals that function as catalysts. The oxidants chemically break down CVOCs upon contact to inert materials, such as carbon dioxide, chloride, and water. Most commercial applications have used either hydrogen peroxide or potassium permanganate in the saturated zone and either hydrogen peroxide or ozone for the vadose zone.

Project Approach and Objectives

This ESTCP initiative was designed to survey selected sites where ISO has been used to help provide guidance on the use of the technology. The project was conducted in two phases. The first phase consisted of a site survey to identify where ISO had been used, the scale at which it was deployed, the specific oxidants and vendors used, and its success or failure to meet the project objectives. The second phase consisted of further evaluation of selected Phase I sites and the development of site profiles. The evaluation consisted of a review of the site conditions and characterization data available, the design parameters and rationale, the cost and performance of ISO under real-world conditions, the reasons for success or failure of ISO to meet the project objectives, and any specific technological concerns. At the conclusion of the Phase II evaluation, the site information was summarized to develop some initial guidance on the selection and use of ISO, the lessons learned to date regarding the testing and use of the technology, and the key data gaps. This information was captured in an ISO assessment report that can be found on ESTCP's web site under *Technical Documents*.

Lessons Learned

Various key factors were identified from this study that should be considered at other sites where ISO is proposed to remediate DNAPL. For example, factors that should be considered as part of site characterization include total oxidant demand, contaminant delineation, mass estimate measurements, and vapor monitoring. Design issue factors include better determination of the expected radius of influence, oxidant concentration, methods to enhance mixing, and incorporation of ISO into an overall site management strategy. Finally, future operational considerations should include the implementation of multiple injections, monitoring vapors for VOCs and explosion potential, and monitoring for CVOC rebound.

Pilot-scale testing of the efficacy of in-situ oxidation of CVOCs is currently inconclusive. Further testing is necessary to bridge the fundamental theories of the laboratory with the needs of the remediation team. The most important issues associated with the goal of integrating ISO science with solutions to real-world problems include the fate and behavior of the oxidant in the subsurface environment and the design features of the technology that ensure effective treatment. The ability to verify effective treatment and the determination of treatment mechanisms will continue to affect the success of the ISO technology.

The ISO report attempts to capture the current state-of-the-art for this very promising technology, recognizing it is in a state of rapid development. By review of past projects, the report is intended to provide site managers with a better understanding of the conditions under which ISO should be used, realistic goals for the technology, and limited guidance on the data needs and best practices for its use at specific sites.

For additional information about the ISO assessment report, please view www.estcp.org/technical_documents.htm or contact either Dr. Marvin Unger, ThermoRetec, at (610) 992-9950 or via e-mail at munger@thermoretec.com or Dr. Hans Stroo, ThermoRetec, at (310) 522-9550 or via e-mail at hstroo@thermoretec.com. ◆

SERDP
Strategic Environmental Research and Development Program

SUCCESS STORY

SERDP Co-Sponsors Development of Innovative and Environmentally Friendly Trapped Vortex Combustor for DoD Engines

The military uses gas turbine engines in all of its aircraft, half of its ships, and many other applications including tanks, helicopters, and auxiliary power units. The gas turbine engines are utilized to generate power in ships, tanks, and helicopters and to develop thrust in fighter and transport vehicles. These turbine engines, however, are a major source of emissions such as unburned hydrocarbons, particulate matter under 2.5 microns ($PM_{2.5}$), carbon monoxides, oxides of nitrogen (NOx), and sulfur oxides (SOx) at DoD air bases or ports. These pollutants are hazardous to human health and damage our environment by causing smog, acid rain, global warming, and the depletion of the earth's ozone layer. Although military aircraft are exempt from standards that regulate emissions from commercial aircraft, the DoD has had a long-standing policy to make a good faith effort to comply with all applicable environmental regulations.

Within the gas turbine engines, it is the combustor that is the main source of emissions. To address this, SERDP is co-sponsoring an effort through which the Air Force Research Laboratory is working with General Electric Aircraft Engines (GEAC) to develop an optimized Trapped Vortex Combustor (TVC) technology that can meet future DoD gas turbine engine environmental and performance needs. The TVC also will be used in GEAC's Integrated High Performance Turbine Engine Technology (IHPTET) Phase III prototype gas turbine engine.

The TVC is a revolutionary design change from the 40-year tradition of using swirl cups to stabilize the flame. Conventional combustors use swirling air to create a recirculation zone that transports hot combustion products back to the combustor face to keep the flame lit. Conventional combustors work well, but they are limited in terms of stability, performance, and pollutant emissions. The idea of trapping a vortex in a cavity to maintain a stable flame originated on an Air Force Office of Scientific Research (AFOSR) program with the Propulsion Directorate of the Air Force Research Laboratory. The TVC maintains a high degree of flame stability because the recirculation zone or vortex trapped in the cavity is very stable as shown in the figure at right. The cavity protects the flame zone in the vortex from the high velocity of the main air flow. The TVC serves as a pilot burner and provides a continuous ignition source for the main combustor.

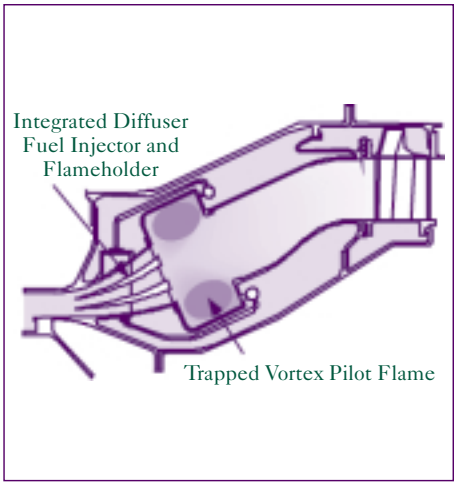
The 12" TVC sector prototype has demonstrated . . .

- **55 percent reduction in aircraft NO_x emissions**
- **50 percent reduction in VOCs based on typical in-service commercial aircraft engines**

These emissions are as good as in the best low-emissions combustor used in commercial aircraft.

Low NO_x emissions from a TVC are primarily the result of improved fuel and air mixing in the cavity and front end of the main combustion zone and the short burning length and low residence time made possible by the stability of the TVC.

Recent results from initial high-pressure tests of a 12" rectangular prototypical TVC sector rig demonstrated significant progress toward reaching the emissions and performance goals. For both emissions and performance, the TVC sector



Cross-sectional view of Trapped Vortex Combustor

functioned as well or better than current production combustors. This comparison is based on the performance of conventional swirl cup stabilized gas turbine engine combustor designs.

Estimates based on the TVC sector data indicate that Navy ships with a TVC could reduce yearly NO_x emissions by 55 percent and VOCs by 50 percent compared to the LM2500 engine. It also demonstrated a 58 percent reduction in lean blow out limit and a 42 percent increase in altitude relight capability. These results are extremely encouraging considering that they were obtained with the first design of a prototypical TVC. Significant emissions and performance improvements are expected with additional research and development. There is also a high probability of transitioning the TVC technology to military as well as commercial gas turbine engines. The Air Force, Navy, and the Department of Energy, with help from the SERDP and ESTCP Program Office, are planning a joint program to continue the development and a full-scale demonstration of the low-emissions, high-performance TVC technology.

For additional information, please contact Dr. Mel Roquemore, Air Force Research Laboratory, Wright Patterson Air Force Base, Dayton, OH, at (937) 255-6813, or via e-mail at melr@ward.appl.wpafb.af.mil. ◆

Partners in Environmental Technology

Technical Symposium & Workshop

November 30–December 2, 1999
Hyatt Regency Crystal City
Arlington, Virginia

Above: The "live" component of this poster presentation helps demonstrate the use of satellite-based biotelemetry for monitoring and tracking threatened and endangered species. *Recipient, Conservation Project of the Year Award.*

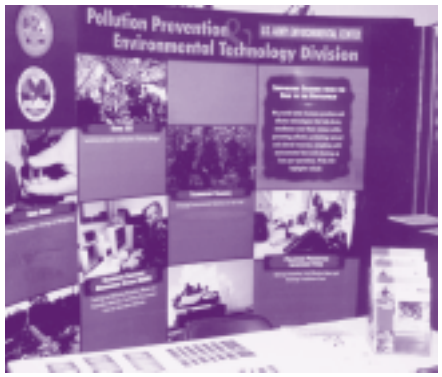
Above: Dr. Bob Holst (left), Program Manager for Compliance and Conservation, and Mr. Chuck Pellerin, Program Manager for Pollution Prevention, greet SERDP Scientific Advisory Board Vice Chair Dr. Jean'ne Shreeve.

Top Left Clockwise: Mr. Peter Krumhansl from GTE-BBN Technologies describes his research efforts; Turbine Propulsion Technologies Session Chair Dr. Mel Roquemore from the Air Force Research Laboratory; Keynote Speakers Dr. Lorne Everett from ARCADIS Geraghty and Miller, Inc., and Ms. Shari Zuskin Barash from EPA.

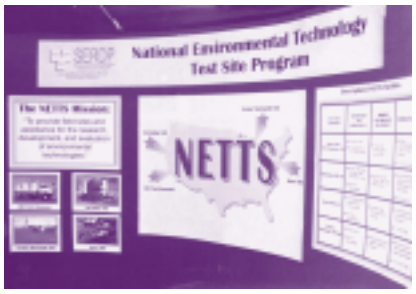
Above: Ms. Cathy Vogel, Program Manager for Cleanup, shares a moment with a colleague.

Left: The two and one-half day event provides numerous opportunities for networking with researchers and Program Office Staff.

Right and Below: Display booths from approximately 25 organizations providing R&D funding for environmental efforts offer valuable networking opportunities.



Left: At the SERDP and ESTCP booth, attendees meet with Staff to discuss ongoing research efforts and Program requirements.



Plenary Speakers

Far Left: Deputy Under Secretary of Defense for Environmental Security Ms. Sherri Goodman discusses sustainable development initiatives within the DoD.

Left: Deputy Under Secretary of Defense for Science and Technology Dr. Delores Etter delivers the Welcoming Address.

Far Left: Dr. Jonathan Lash, representing World Resources Institute and the former President's Council on Sustainable Development, and Mr. Michael Leake, representing Raytheon Systems Company, earn high marks for their briefings.

Left: Dr. Martha Krebs, Director of DOE's Office of Science and Chair of the SERDP Council, presents the SERDP Pollution Prevention Project of the Year Award to Dr. Richard Brenner of the U.S. Department of Agriculture, Center for Medical, Agricultural, and Veterinary Entomology.

Left: Dr. Jeffrey Marqusee (left) and Mr. Bradley Smith (right) congratulate SERDP Compliance of the Year Award recipient Dr. Steven Rice of DOE's Sandi National Laboratory.

Left: Technical sessions lead to stimulating off-line discussions with colleagues.

Left: This year's expanded poster area featured 110 presentations by Federal agencies, private industry, and academia.

Left: Poster sessions enable direct interaction with researchers.

Left: For the "Advanced Biotelemetry for Resource Management" effort, Dr. William Seegar of the U.S. Army Soldier, Biological, and Chemical Command and his research team were recognized with the SERDP Conservation Project of the Year Award.

Right: Dr. Jeffrey Talley, SERDP Cleanup Project of the Year Award recipient, pictured with members of his research team from the USACE ERDC-Vicksburg and Mr. Bradley Smith (far left) and Dr. Jeffrey Marqusee (far right).

Symposium, from page 1

For his work on the "*Kinetics of Supercritical Water Oxidation*" project, Dr. Steven F. Rice from the U.S. DOE Sandia National Laboratory in Livermore, CA, received the Compliance Project of the Year Award. Dr. Rice and his team of researchers from Sandia National Laboratory, Massachusetts Institute of Technology, and Princeton University addressed the problem of DoD-unique hazardous waste streams that result from the production of munitions. Because of the highly toxic nature of these waste streams and their by-products, incineration has not been a viable treatment method. As an alternative to incineration, supercritical water oxidation (SCWO) provides high reaction rates at moderate temperatures without producing harmful nitrogen oxides. SCWO development hinges on successfully engineering reactors to meet long-term equipment reliability goals that are threatened by the formation of deposits (scaling) and corrosion of reactor materials. Successful reactor designs depend on an accurate understanding of the reaction kinetics of typical waste feed materials. Dr. Rice's effort, which was completed in FY 1998, successfully developed a fundamental model of oxidation kinetics in supercritical water. The application of this model has resulted in the efficient design of an autothermal feed system for SCWO waste treatment reactors which permits safe operation with varying waste streams.

The Conservation Project of the Year, was awarded to Dr. William S. Seegar of the U.S. Army Soldier, Biological, and Chemical Command in Aberdeen Proving Ground, MD, for pioneering the development and use of satellite-based biotelemetry technology for monitoring and tracking of wildlife. Military installations are in need of management tools and plans to address threatened and endangered species (TES) based on regional habitat assessments. Through the "*Advanced Biotelemetry for Resource Management*" project, Dr. Seegar and his teammates from the University of Maryland's Center for Conservation Research & Technology, Boise State University, and the U.S. Geological Survey developed a harmonic radar with "cross band transponder system" that will allow continuous monitoring of extremely small birds for up to two years at distances up to 1000 meters. The transponder system includes compact (1-2 grams), radar-activated VHF transmitters along with a mobile radar system. The radar system activates the VHF tags on the target species and provides location estimates via an automated computer system. Previously unattainable natural history information for wildlife species of interest can be obtained through this technology. This information, assimilated through the use of Geographical Information System (GIS), affords maps of animal movements in relation to habitat types, geopolitical boundaries, vegetation cover, and many other geographically-oriented data. Furthermore, this technology provides a means to conduct impact assessments on wildlife because of military training and testing without interruption to military operations.

The Pollution Prevention project of the Year Award was presented to Dr. Richard Brenner of the U.S. Department of Agriculture (USDA), Center for Medical, Agricultural, and Veterinary Entomology for his research effort entitled "*Pesticide Reduction Using Precision Targeting*." Using the traditional approach to pest control, the DoD currently uses approximately one million pounds of pesticide annually in three major settings: for warehousing, for facilities with chronic pest problems, and in deployments with risks from disease vectors. Under SERDP sponsorship, Dr. Brenner and his team of scientists from the USDA, the University of Florida, and the Armed Forces Pest Management Board successfully developed an analytical and predictive tool that uses state-of-the-art, commercially available hand-held computers, global positioning system (GPS) and GIS technologies, and customized software. Through a structured monitoring plan and strategic placement of toxic baits, "hot spots" of pest activity are easily determined. Instead of spraying every baseboard or corner of a building, pesticide application is limited to these "hot spots." Pesticide reductions of between 40 and 90 percent can be achieved through this precision-targeting. This research team has successfully fielded this technology only four years after initiating research and has aided the Army in mitigating disease vector borne diseases caused by various pests both here and in other developing countries.

The outstanding and thought-provoking Plenary Session set the tone for the technical sessions, the heart of the Symposium and Workshop. Approximately 100 speakers provided superb technical presentations developed around 12 high interest topics. Additionally, throughout the event, participants had the opportunity to tour the expanded exhibit area that spotlighted 110 posters summarizing the latest advances in environmental technology and 24 display booths that provided information on closely-related environmental research programs. This forum enabled valuable networking opportunities between the various "partners" in attendance.

As we close the books on this past year's Symposium, we invite you to visit the *Symposium & Workshops* portion of either the SERDP web site at **www.serdp.org** or the ESTCP web site at **www.estcp.org** to learn more about the four Project of the Year Award efforts or to obtain the technical presentation or poster presentation abstracts. We also encourage you to mark your calendars for the next Symposium & Workshop which is scheduled to be held November 28-30, 2000, at the Hyatt Regency Crystal City in Arlington, Virginia. ◆

PROGRAM NOTES

- **THANKS TO ALL OF YOU WHO PARTICIPATED IN OR ATTENDED THE PARTNERS IN ENVIRONMENTAL TECHNOLOGY TECHNICAL SYMPOSIUM AND WORKSHOP IN DECEMBER.** The event was a tremendous success thanks to all of your efforts. *Be sure to mark your calendars for the next Symposium which will be held November 28-30, 2000, at the Hyatt Regency Crystal City in Arlington, Virginia.*
- **BEGIN PLANNING NOW FOR THE COMBINED SERDP AND ESTCP IN-PROGRESS REVIEWS (IPRs)** which are scheduled to be held in the Washington, DC, area during April and May. The tentative schedule calls for the IPRs to be held on the following dates: Pollution Prevention IPR (April 3-7); UXO IPR (April 10-11); Conservation IPR (April 27-28); Cleanup IPR (May 8-12); and Compliance IPR (May 16-17).

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- **THE PROGRESS REPORT FOR THE FIRST QUARTER OF GOVERNMENT FY 2000 IS DUE ON JANUARY 31, 2000.** For assistance, please contact your Program Manager Assistant.
- **THE SERDP EXPLORATORY DEVELOPMENT (SEED) PROPOSALS IN RESPONSE TO THE SEED BROAD AGENCY ANNOUNCEMENT (BAA)** are due to the Program Office by 4:00 p.m. EST on March 7, 2000.
- **THE SERDP SCIENTIFIC ADVISORY BOARD (SAB)** is scheduled to meet March 14-15 in Arlington, Virginia. Contact Amy Kelly at (703) 696-2124 or via e-mail at kellya@acq.osd.mil for additional information.
- **FULL PROPOSALS REQUESTED IN RESPONSE TO THE BAA AND THE FEDERAL CALL FOR PROPOSALS** are due to the Program Office by 4:00 p.m. EST on March 16, 2000.
- **THE PROGRESS REPORT FOR THE SECOND QUARTER OF GOVERNMENT FY 2000 IS DUE APRIL 30, 2000.** For assistance, please contact your Program Manager Assistant.
- **COPIES OF ALL PRODUCTS/ REPORTS PARTIALLY OR WHOLLY SUPPORTED BY SERDP** should be sent to Mike Hathaway at the Program Office in order to keep the SERDP Staff current on SERDP results and to broaden all aspects of technology

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transfer. These topics include copies of papers, reports, abstracts, presentations, patents, etc. For more information, please contact Mike Hathaway at (703) 506-1400 ext. 542 or via e-mail at Mike_Hathaway@labat.com.

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- **THE PREPROPOSALS IN RESPONSE TO THE NON-DoD FEDERAL AND BAA SOLICITATIONS** are due to the Program Office by 4:00 p.m. EST on March 9, 2000.
- **QUARTERLY REPORTS FOR THE SECOND QUARTER OF GOVERNMENT FY 2000 ARE DUE APRIL 5, 2000.** For assistance, contact your Program Manager.
- **THE DoD PHASE I PROPOSALS** are due to the Program Office by 4:00 p.m. EST on April 13, 2000.
- **NEW PUBLICATIONS NOW AVAILABLE ON THE ESTCP HOME PAGE www.estcp.org**

Technology Assessments

Cleanup

Technology Status Review In-Situ Oxidation

Groundwater Circulating Well Technology Assessment

PARTNERS IN ENVIRONMENTAL TECHNOLOGY

INFORMATION BULLETIN

JANUARY 2000 ◆ NUMBER 3

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Information and ideas for future articles are always welcome. Address comments, suggestions, mailing list requests, and address changes to

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FOR SERDP AND ESTCP

JANUARY 2000

January 31
SERDP progress report for the first quarter of Government FY 2000 due

FEBRUARY 2000

February 2
SERDP full proposals requested from qualified proposers responding to the Core Broad Agency Announcement (BAA) Solicitation

MARCH 2000

March 7
The SERDP Exploratory Development (SEED) proposals in response to the SEED BAA due

March 9
The ESTCP preproposals in response to the non-DoD Federal and BAA solicitations due

March 14-15
SERDP Scientific Advisory Board (SAB) meeting, Arlington, Virginia

March 16
SERDP full proposals requested in response to the BAA and the Federal call for proposals due

APRIL 2000

April 3-7
Pollution Prevention In-Progress Review (IPR) meeting

April 5
ESTCP quarterly reports for the second quarter of Government FY 2000 due

April 10-11
UXO In-Progress Review (IPR) meeting

April 13
The ESTCP DoD Phase I proposals due

April 27-28
Conservation In-Progress Review (IPR) meeting

April 30
The SERDP progress report for the second quarter of Government FY 2000 due

MAY 2000

May 8-12
Cleanup In-Progress Review (IPR) meeting

May 16-17
Compliance In-Progress Review (IPR) meeting

RELATED CONFERENCES & EVENTS

March 27-30
NDIA 26th Environmental Symposium and Exhibition
Long Beach Convention Center
Long Beach, CA
For more information, contact Charles Wilkins by phone at (703) 247-2572 or via e-mail at cwilkins@ndia.org.

May 2-4
UXO/Countermine Forum
Anaheim Marriott
Anaheim, CA
For more information, see http://www.denix.osd.mil/TheForum or contact Charlotte Gaylon at 1-888-808-5303 or via e-mail at Forum@tva.gov.

INFORMATION
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