SERDP & ESTCP Announce 2013 Projects of the Year

Efforts Help to Enhance DoD Mission Capabilities While Improving Environmental Performance

THE STRATEGIC ENVIRONMENTAL Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP) have selected six Projects of the Year in recognition of outstanding research and technology developments that will benefit the Department of Defense (DoD). These efforts are helping DoD enhance its mission capabilities, improve its environmental performance, and reduce costs. Recipients of this prestigious honor and descriptions of their award-winning projects follow.

Munitions Response

SERDP Project of the Year

Acoustic Response of Underwater Munitions Near a Sediment Interface: Measurement-Model Comparisons and Classification Schemes

Dr. Steven G. Kargl, University of Washington

In an important milestone, scientists have shown that low-frequency sonar can be an effective method for detecting and classifying underwater munitions in a real-world, open water setting. In work funded by SERDP, Dr. Steven Kargl of the University of Washington collaborated with a half dozen research

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teams in conducting a complex, coordinated experiment in the Gulf of Mexico.

In prior laboratory experiments and carefully controlled tests in ponds, low-frequency sonar has shown promise as a method to detect and classify underwater munitions. Determining if this acoustic technique would work in an open water environment with multiple variables is the next step in assessing its viability for routine use.

In the SERDP project, conducted in the summer of 2013, teams set up a series of jigs in the Gulf, placed various objects, including munitions, on the sandy bottom and among the rocks on the sea floor, then used sonar to detect and classify the items. Along the way, the research teams encountered a number of real-world interferences including fish using the jigs as artificial reefs that had to be overcome.

The high-quality data set collected through this project shows that low-frequency sonar can be effective in detecting and classifying underwater munitions in real-world conditions. The development of a sonar-based survey system would provide DoD with an efficient means of collecting accurate information about the location and identity of underwater munitions to support management or cleanup.

ESTCP Project of the Year

Compressor Airfoil Protective Coatings for Turbine Engine Fuel Efficiency

Mr. Gregory Kilchenstein, Office of the Secretary of Defense, Logistics and Materiel Readiness

An innovative new protective coating for jet engine compressor blades, demonstrated in an ESTCP-funded study, could save DoD tens of millions of dollars by extending the life of the engines and improving fuel efficiency, and at the same time reducing carbon emissions.

Jet engines are used in thousands of military aircraft and tanks. A key component of these engines is an axial compressor, made up of several rows of airfoils, which are wing-shaped pieces of metal. During the operation of the aircraft and tank engines, these airfoils constantly spin at rapid speeds, and air and particulates, such as sand, pass through them. Over time, the surfaces of these airfoils wear down and decrease the efficiency of the engine, requiring more fuel to be used to achieve the same performance. The airfoils, which must operate in extremely high temperatures, are made of high-performance metals and are very expensive to replace.

This ESTCP project demonstrates that innovative erosion-corrosion resistant coatings extend the life of jet engines and improve fuel efficiency by as much as five percent, while also reducing carbon emissions. Pictured here is Matt Juarez, one of the project team members from StandardAero Inc.

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In the ESTCP study, Mr. Greg Kilchenstein of the Office of the Secretary of Defense, Logistics and Materiel Readiness, and his multi-Service team demonstrated that applying a thin erosion-corrosion resistant coating can extend the life of the airfoils and improve fuel efficiency. The coating is a multilayer ceramic-metallic matrix applied in a vacuum using a cathodic arc physical vapor deposition process. The study found that the coating can improve fuel efficiency by as much as five percent, which could result in substantial savings in fuel costs, as well as reducing carbon emissions. The study also demonstrated these innovative coatings can extend the life of the airfoils, leading to further cost savings by reducing repairs and extending the life of the aircraft and tank engines.

Resource Conservation and Climate Change

SERDP Project of the Year

Development and Use of Genetic Methods for Assessing Aquatic Environmental Condition and Recruitment Dynamics of Native Stream Fishes on Pacific Islands

Dr. Michael J. Blum, Tulane University

An extensive study of the life history and genetics of at-risk fish species may help ensure the U.S. military can continue to operate its multiple installations throughout Hawaii and other Pacific Islands sustainably for decades to come. Training troops and testing weapon systems at these installations is essential to DoD's mission. At the same time, the Department has an obligation to conduct its activities in ways that do not harm the environment or prevent continued military use. In recent years, DoD has taken a holistic approach, exploring how to improve its land use and natural resource management within ecosystem and watershed contexts that extend beyond the installation boundary.

To that end, a SERDP-funded project led by Dr. Michael Blum of Tulane University tracked the life history and genetic attributes of two at-risk native fish species in the Hawaiian Islands. Over the course of their lifecycle, these fish start out in fresh water, move to the near-shore marine envi-

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ronment, then migrate out to sea and eventually return to fresh water. Because these species spend periods of their lives throughout the linked watershed-marine environment, studying these fish can serve as a surrogate for studying the health of the Islands' complex ecological systems. At all points along the way, the condition of the ecological system must be healthy and connected for the species to survive and thrive.

Using genetic assessment protocols, researchers identified potential watershed impacts from multiple sources, including land use associated with the military, urbanization, and agriculture. However, the presence of non-native fish also had a prominent impact on native fish species' population viability. The study results reinforce the need for DoD natural resource managers to continue taking steps to monitor and protect resources within a watershed context, through management practices such as avoiding excessive sediment and nutrient loadings to streams, as well as working with other land managers to take a holistic approach to protecting the complex ecological systems of Hawaii and other Pacific Islands.

Environmental Restoration

SERDP Project of the Year

Coupled Diffusion and Reaction Processes in Rock Matrices: Impact on Dilute Groundwater Plumes

Dr. Charles E. Schaefer, Jr., CB&I

One of DoD's most challenging environmental restoration issues is determining how to deal with contaminants that have seeped into the fractures in bedrock and are a continuing source of groundwater contamination. A recent SERDP-funded research project found that studying the fundamental features of the bedrock itself may hold a key to addressing this challenge.

Dr. Charles Schaefer of CB&I and his team measured and evaluated the ways in which the mineralogy of the bedrock can affect how chemicals are stored and how long it takes for those contaminants to break down through natural attenuation. For this project, the researchers focused on trichloroethene (TCE), a toxic cleaning solvent used for much of the twentieth

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century by the military and private industry. TCE is one of the most widely dispersed contaminants in the United States, and it is found on nearly all military installations in the country. On those installations that are known to have fractured bedrock, TCE migrates through conductive fractures, and also into the rock itself. For these sites, it is extremely difficult and, in many cases cost-prohibitive, to locate the contaminant source and remove it.

The study found that the mineralogy of the bedrock can have a significant effect on the rate of natural attenuation of TCE. For example, the presence of ferrous iron minerals within the rock, which is common in many types of bedrock, can hasten the rate of TCE dechlorination. While it was long believed that natural attenuation of TCE in bedrock would take hundreds of years, the results of this study suggest that in fact it could occur within our lifetime.

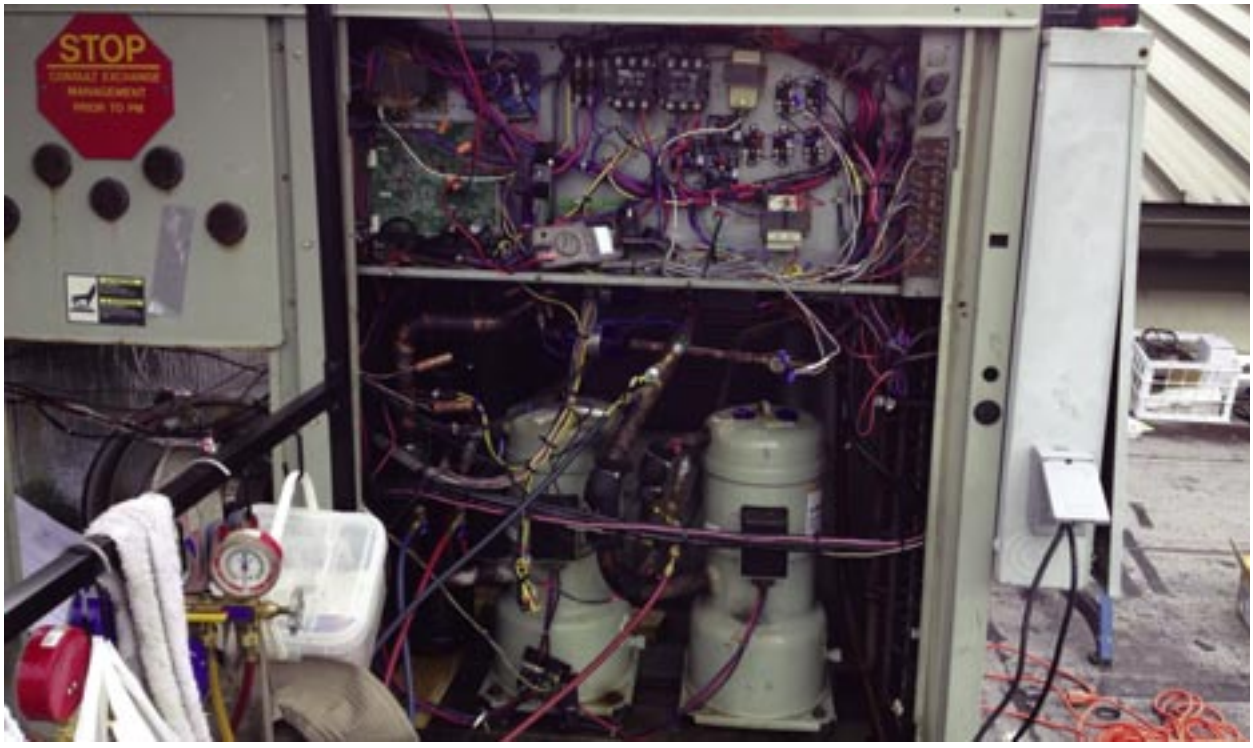
The data from this study can be used to better predict rates of TCE dechlorination at bedrock sites on military installations, providing DoD with an essential tool to guide decisions on how best to treat contaminated sites. At sites where acceptable rates of monitored natural attenuation (MNA) can be demonstrated, more aggressive and expensive treatment can be avoided.

ESTCP Project of the Year

Demonstration and Testing of ClimaStat® for Improved DX Air-Conditioning Efficiency

Dr. Michael West and Dr. Richard Combes, Advantek Consulting

As the manager of 300,000 buildings on hundreds of military installations with an annual facility energy cost of more than $4 billion, DoD is actively seeking ways to reduce its energy costs through its Installation Energy Test Bed initiative. A recent ESTCP-funded study demonstrated a low-cost innovative technology that could provide significant cost savings by improving energy efficiency in roof- or ground-mounted heating and air



Innovative ClimaStat technology improves energy efficiency by 29 percent for an HVAC retrofit at Marine Corps Air Station Beaufort and 17 percent for a new system at Cape Canaveral Air Force Station as part of an ESTCP demonstration.

conditioning systems used for small buildings of less than 100,000 square feet. Tens of thousands of these buildings exist on military installations throughout the United States.

In the ESTCP demonstration, Dr. Michael West and Dr. Richard Combes of Advantek Consulting installed the new ClimaStat technology in heating, ventilation, and air conditioning (HVAC) systems at two installations. ClimaStat is a refrigeration-science technology consisting of small devices with multiple sensors that helps regulate the pressure changes across an HVAC system. ClimaStat can be field-retrofitted into existing HVAC equipment or installed in new equipment. At Marine Corps Air Station Beaufort, South Carolina, the study demonstrated 29 percent efficiency improvements on the retrofit of an existing system. At Cape Canaveral Air Force Station, Patrick Air Force Base, Florida, the study demonstrated 17 percent savings on a brand new system. The payback periods for these two scenarios are four years and three years, respectively.

The ESTCP investment provided the Advantek team with a unique opportunity to take an idea they had demonstrated as a laboratory prototype and install it into a real-world commercial system. The team used more than 90 sensors in the demonstrations, providing a rigorous test of the technology's ability to improve energy efficiency. Both of the military installations that participated in the demonstration have plans to install additional ClimaStat devices. The demonstrations showed that there is great potential to use the technology to condition buildings on other DoD installations, as well as commercial buildings in the private sector.

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Weapons Systems and Platforms

SERDP Project of the Year

Nanostructured Copper Alloys as an Alternative to Copper-Beryllium

Dr. Jonathan L. McCrea and Dr. Brandon Bouwhuis, Integran Technologies Inc.

For decades, certain essential parts in military fixed and rotary wing platforms have been made with copper-beryllium alloys. Beryllium is particularly useful for this purpose because it is both lightweight and strong, a rare combination not found in most other metals. Bushings, small round metal components used in helicopter rotors, for example, must be lightweight, but also strong enough to withstand a demanding operating environment. The problem is beryllium is a toxic material that can be harmful to workers who handle it during assembly and repair. Working with beryllium, which requires donning protective gear and taking extensive precautions, is costly and time-consuming.

A SERDP-funded project developed and validated a nanocrystalline copper electroplating process that produces an environmentally benign copper alloy that matches the desirable properties of copper-beryllium. This pulsed electroplating process, developed by Dr. Jonathan McCrea and Dr. Brandon Bouwhuis at Integran Technologies Inc., goes beyond merely coating a metal object. Rather, components that require little to no machining to achieve final dimensions are created by this pulsed-plating process, which alters the crystalline structure of the metal alloys as they are being formed. The study showed this innovative process also can be used successfully for large metal sheets and high conductivity wires, both of which are used in multiple military applications.

The development of these nanostructured copper alloys, which match the essential beryllium properties of being both lightweight and high-strength, without the toxicity, could result in substantial cost savings for DoD.

SERDP and ESTCP are DoD's environmental research programs, harnessing the latest science and technology to improve DoD's environmental performance, reduce costs, and enhance and sustain mission capabilities. SERDP and ESTCP respond to environmental technology requirements common to all of the military Services, complementing the Services' research programs. The programs promote partnerships and collaboration among academia, industry, the military Services, and other Federal agencies. Both manage investments in five program areas:

SERDP researchers developed an innovative plating process that produces nanostructured copper alloys that match beryllium's essential properties of being lightweight and high-strength, without the toxicity. Pictured here are plated bushings, small round metal components used in helicopter rotors.

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1. Energy and Water
2. Environmental Restoration
3. Munitions Response
4. Resource Conservation and Climate Change
5. Weapons Systems and Platforms

SERDP and ESTCP are independent programs managed from a joint office to coordinate the full spectrum of efforts, from basic and applied research to field demonstration and validation.

SERDP is DoD's environmental science and technology program, planned and executed in partnership with the Department of Energy and the U.S. Environmental Protection Agency, with participation by numerous other Federal and non-Federal organizations. The program focuses on cross-service requirements and pursues solutions to the Department's environmental challenges while enhancing and sustaining military readiness.

ESTCP is DoD's environmental technology demonstration and validation program. Projects conduct formal demonstrations at DoD facilities and sites in operational settings to document and validate improved performance and cost savings. Demonstration results are subject to rigorous technical reviews to ensure that the conclusions are accurate and well supported by data.

For more information, please visit www.serdp-estcp.org. ⚓

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