

THE NAVY'S ENERGY & ENVIRONMENTAL MAGAZINE

# Currents

spring 2012

NAVY SURGES TOWARD  
*Energy  
Independence*



SUCCESSFUL  
BIOFUEL DEMOS  
FUEL THE  
GREAT GREEN FLEET

Spotlight on Rocky Mountain Institute  
Highlights from the 2011 Naval Energy Forum  
From Wind Farms to Whales, Navy Marks  
Significant Milestones in Environmental Management

**2012  
Navy  
Earth Day  
poster  
inside!**



THE NAVY'S ENERGY & ENVIRONMENTAL MAGAZINE  
**Currents**

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Energy and Environmental Readiness Division

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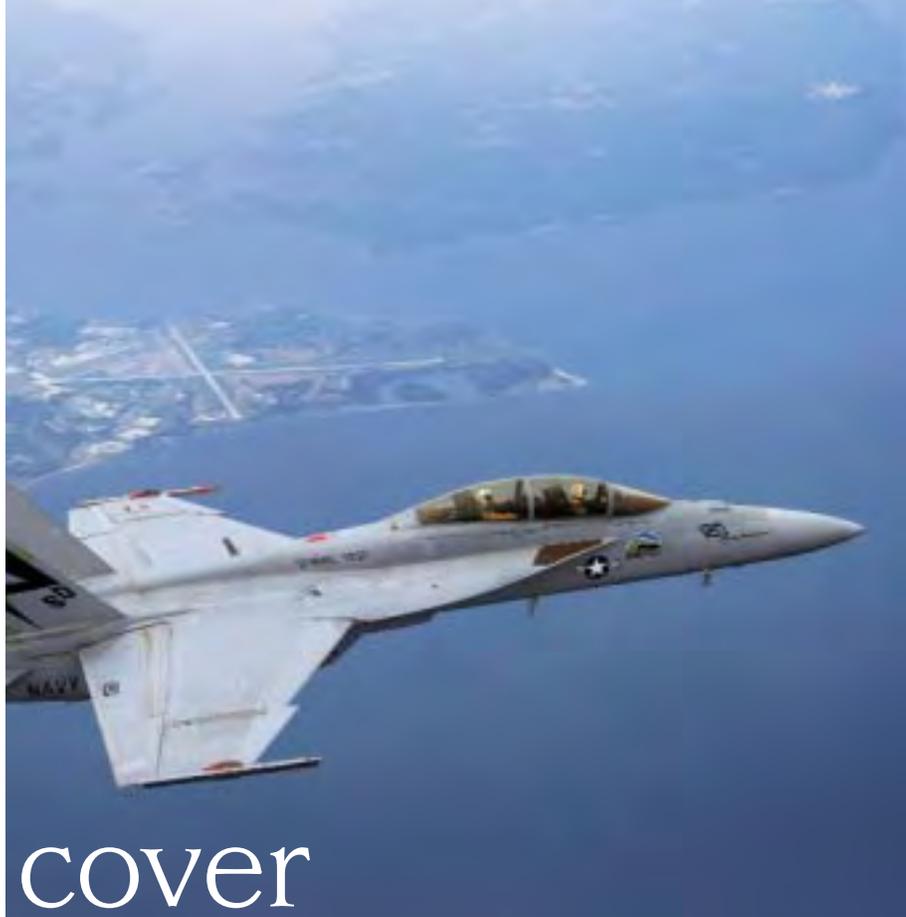
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A series of successful demonstrations of camelina- and algae-based biofuels in several types of aircraft and small boats in 2010 and 2011 is propelling the Navy toward the Great Green Fleet.

*Photo by Liz Goettee*



## Navy Surges Toward Energy Independence

Successful Biofuel Demos Fuel the Great Green Fleet

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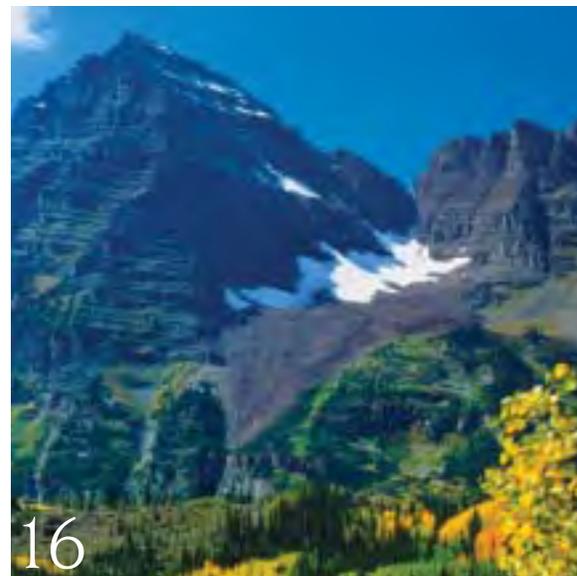
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## Much to Remember & Celebrate This Earth Day

**IN JUST FIVE** months, Congress approved funding for two fully armed naval vessels and a crew of 80, added six ships to the Navy's inventory, selected a Commander of the Fleet, commissioned eighteen naval officers, and stood up two Marine battalions. Moreover, service pay and subsistence tables were established, and standard naval codes of discipline were drafted. It was the 13th of October, 1775, and the Revolutionary War loomed on the horizon.

All of this was accomplished without phones, computers, and central air and heating. What fueled such astonishing productivity? I believe it was our forefathers' fierce ache for national independence. But independence can come in countless forms, including energy independence.

Can you imagine a future where energy shortages do not exist? Where energy prices remain fairly stable? Where people are routinely energy conscious? Where fueling your vehicle does not necessarily require burning a fuel that comes largely from someplace overseas? Where businesses are rewarded for sound ecological practices?

Those of you present at the 2011 Naval Energy Forum heard top energy leaders from industry, government, and the military confirm that *it is possible for us to have an energy-secure future—but only if we act now and take two vital actions: (1) diversify our domestic energy resources and (2) limit the amount of energy we use.*

In 1957, Admiral Hyman Rickover offered a cautionary analogy for the latter point:

Fossil fuels resemble capital in the bank. A prudent and responsible parent will use his capital sparingly in order to pass on to his children as much as possible of his inheritance. A selfish and irresponsible parent will squander it in riotous living and care not one whit how his offspring will fare.

This decade is our window of opportunity to accomplish those two goals and increase our national security, but since action follows thought, the key to our success begins with changing how we think about energy.

It was Albert Einstein who cautioned, "We cannot solve the problems we have created with the same thinking that created them." For those of us fighting for an energy

secure nation, that means we must judiciously and thoughtfully promote a culture change that alters the way we think about energy. Conventional thinking got us where we are today, but it will not take us where we need to go. To learn more about the Navy-wide culture change taking place, read on. Review the in-depth coverage of the 2011 Naval Energy Forum on pages 42–51 in this issue of *Currents*.



Historically, dogged patriotism has played a key role in motivating Americans when indifference was not an alternative. One example is the War of 1812. As early as 1803, there were distressing reports of British ships being manned by thousands of American citizens who were kidnapped and forced into service under extreme duress. In foreign ports, British ships routinely blocked American ships from procuring life-sustaining replenishments. Still, during all that contention, the U.S. attempted peaceful negotiations with Britain. After all, at that time, only twenty years had passed since the British had signed the 1783 Treaty of Paris that recognized the independent nation of the United States of America. In the meantime, many of our nation's merchants faced economic disaster due to a continuing blockade. Our nation's coal trade was crippled (fortunately, in some ways, because it resulted in innovative energy paths). Finally, following the 1811 Battle of Tippecanoe, a surge of renewed patriotism swept through the country. And on 18 June 1812, a war that many on both sides of the Atlantic feared, was ultimately declared. You will be hearing a lot more about the War of 1812 as our nation celebrates the bicentennial anniversary of this struggle.

In today's Navy, patriotic pride continues to motivate vital change. If we are to achieve true energy security, one fact is clear: victory will be determined from the gun deck upward. Our number one weapon in this fight is a gutsy, tenacious, and highly resourceful world-class force: the United States Navy Sailor. Nobody realizes that fact better

than Master Chief Petty Officer of the Navy, Rick West who recently formed a new Senior Enlisted Executive Steering Committee (ESC), led by Force Master Chief Christopher Engles. MCPON West established the ESC to better advise Sailors in the Fleet about the Sailors' role in the new energy culture change.

It is always a pleasure for me to publically recognize those commands that are leading our Navy's energy and environmental efforts. As such, I extend a hearty Bravo Zulu to the winners of the 2011 Navy Community Service Environmental Stewardship Flagship Awards. These awards recognize the best year-round Navy volunteer supported programs or special projects that promote education and good stewardship of environmental resources.

One of the many interesting stories reported from this competition is that of Center for Naval Aviation Technical Training Unit, Whidbey Island's participation in the air station's yearly "dumpster dive" in support of Earth Day. Since 1990, commands from Naval Air Station Whidbey Island that comprise "Team Whidbey" have raised awareness of the benefits of recycling by supporting the base's recycling waste management efforts. One activity involves the unit's commanding officer and others to climb into dumpsters and recover recyclables. This year, nearly seventy-five percent of the items in the dumpsters were able to be recycled.

I would also like to acknowledge the winners of the FY 2011 Chief of Naval Operations Environmental Awards competition. This awards program is highly competitive and recognizes excellence in environmental programs and initiatives that promote natural resources conservation, cultural resources management, environmental quality, sustainability, environmental restoration, and weapon system acquisition. A ceremony honoring the winners and recognizing their achievements will be held 5 June at the United States Navy Memorial in Washington, D.C. (A complete list of this year's winners can be found on pages 62-63 in this issue of *Currents*. Additional information about these award programs can also be found at <http://greenfleet.dodlive.mil/environment/awards>.)

Mark your calendars! Earth Day 2012 will be Sunday, 22 April. Worldwide, Navy and Marine Corps commands and individuals will host and participate in diverse activities to celebrate on the official Earth Day date and throughout April and May. My staff works closely with the Secretariat, Chief of Naval Installations Command, and others to

increase awareness of the Department's Earth Day activities. We also strive to help people understand how much of what we do every day—24/7, around the globe—aligns with the Earth Day founders' vision of a sustainable world and with the principal founder of Earth Day, Gaylord Nelson's following message: "The ultimate test of man's conscience may be his willingness to sacrifice something today for future generations whose words of thanks will not be heard." For information on Earth Day 2012, including resources that may be available to your command, visit <http://greenfleet.dodlive.mil/environment/earth-day/>. We've also included our own Earth Day poster in the center spread of this issue of *Currents*.



And finally, if you have not yet heard, I am no longer serving the Navy as Director of the Chief of Naval Operations Energy and Environmental Readiness Division (N45), though I am happy to say this is not goodbye. I will continue overseeing energy and environmental successes, as well as numerous other responsibilities that fall under the OPNAV N4 organization, as I take over for Vice Admiral Bill Burke as the new Deputy Chief of Naval Operations for Fleet Readiness and Logistics (N4). Vice Admiral Burke will be moving onto become the newly appointed Deputy Chief of Naval Operations for Warfare Systems (N9), and I greatly look forward to working with him on shared issues in his new position.

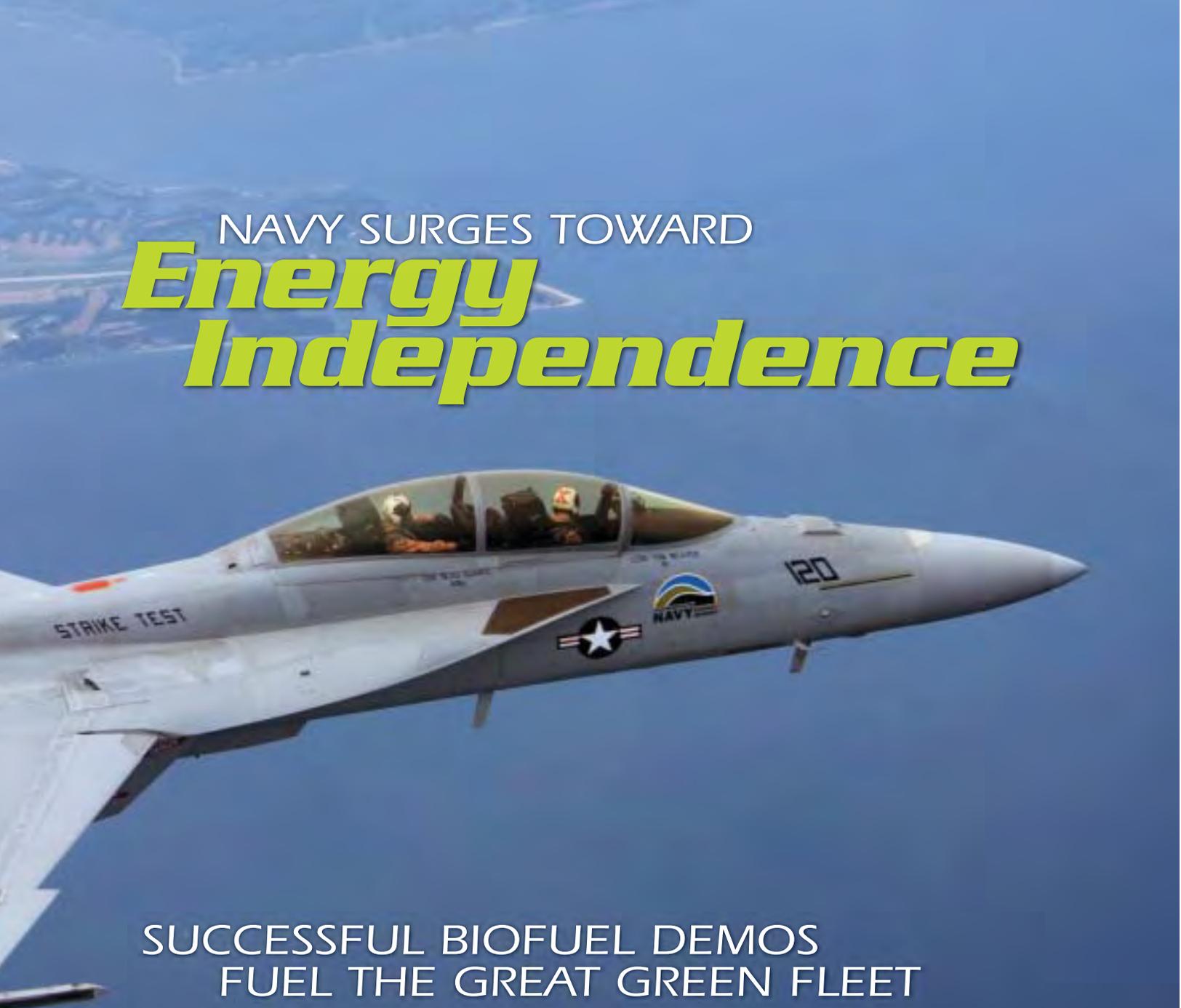
For those of you who are working tirelessly to achieve the Navy's Energy Vision, and those of you working to ensure a sustainable Navy through our environmental stewardship responsibilities, let me leave you with this final thought: What you do matters and your leadership notices and appreciates your efforts! Promoting energy independence and environmental stewardship are noble and critical pursuits for your Navy and nation. Of course, such responsibilities are not anchored in any one person or single office. This is a shared fight and we all must play our part, whether at home protecting our critical infrastructure or overseas defending our national security interests. No matter which role you play, you are a patriot and have given much for our great nation. So, thank you, most sincerely, for your service, your commitment, and your leadership. ⚓

Vice Admiral Philip H. Cullom  
Deputy Chief of Naval Operations for Fleet Readiness and Logistics



An F/A-18F Super Hornet strike fighter, dubbed the “Green Hornet,” conducts a supersonic test flight at Naval Air Station Patuxent River. The aircraft is fueled with a 50/50 Camelina seed-based biofuel blend. This Earth Day 2010 test drew hundreds of onlookers, including Secretary of the Navy Ray Mabus, who has made research, development, and increased use of alternative fuels a priority for the Navy.





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*Energy  
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SUCCESSFUL BIOFUEL DEMOS  
FUEL THE GREAT GREEN FLEET

**A** series of successful demonstrations of camelina- and algae-based biofuels in several types of aircraft and small boats in 2010 and 2011 is propelling the Navy toward the Great Green Fleet.

In 2009, Secretary of the Navy Ray Mabus announced his plan to fuel half the Navy's energy consumption through alternative fuels by 2020. "We're doing this for one reason," Mabus stated, "We're doing it to be better warfighters."

## THE BASICS ABOUT THE *Navy Fuels Team*

The Navy Fuels Team is part of the Naval Fuels and Lubricants Cross Function Team. The team is comprised of technical experts from across the Navy. Officially chartered in 1999, the team includes representation from the aviation, ship, logistics, research and operational communities. The team's mission is to provide a single source of fuels-related technical expertise, guidance and solutions to all levels of the Navy.

***We buy too much fuel from potentially or actually volatile places on earth.***

***—Secretary Ray Mabus***

biofuel specification. Based at the Naval Air Station (NAS) Patuxent River, Maryland, the team had begun testing small amounts of biofuels in 2008. Their work accelerated when the Secretary's goals were announced.

"The Navy Fuels Team has the job of taking the fuels that various manufacturers and refiners are producing and getting them approved," states Rick Kamin, Navy Fuels Team Lead.

Mabus explained how energy security and national security go hand-in-hand. "We buy too much fuel from potentially or actually volatile places on earth. We give them a say on whether our ships sail, whether our aircraft fly, whether those ground vehicles operate because we get our fuel from them."

Another major contributing factor is cost. When Mabus first announced the Navy's energy goals in 2009, the price of a barrel of oil was \$76. Just two years later, the price averages around \$100. For every \$1 increase in the price of a barrel of oil, the U.S. military faces \$31 million in additional fuel costs.

Even more importantly, Mabus reported that for every 50 convoys, one Marine is either killed or wounded.

### ***Developing the First Aviation Biofuel***

When the Secretary announced his alternative energy goals, the Navy Fuels Team was already working on a

"We wrote a procurement specification that specified the performance properties for the bio component of the aviation fuel blend," Kamin continued. The new fuel blend had to meet the following operational requirements:

- It must be a drop-in replacement for the petroleum-based fuel.
- It must meet or exceed the performance requirements of the petroleum-based fuel. (There must be no notable operational differences.)
- The biofuel must be able to be successfully mixed or alternated with petroleum fuel.
- The biofuel must require no modifications or enhancements to the configuration of the aircraft or ship.
- The biofuel must require no modifications or enhancements to the Navy's existing fuel storage or transfer infrastructure.

# ***Navy Biofuels Timeline***

■ **CAMELINA**  
■ **ALGAE**

*F/A-18  
Green Hornet*

**APR 10**



*Rigid Hull  
Inflatable Boat*

**JUL 10**



*Riverine Command  
Boat—Experimental*

**OCT 10**



*MH-60S Seahawk*

**NOV 10**



**2010**



**Navy Fuels Team Lead Rick Kamin and his team wrote the specification for the new biofuel and supervised testing which led to its approval.**

“Although, we were looking for a sustainable plant—and/or algae-derived oil—that was not competitive with food crops, we did not specify that it needed to be a camelina-based fuel,” explained Kamin.

The team sent the procurement specification for JP-5 jet fuel to the Defense Logistics Agency (DLA) Energy (formally known as the Defense Energy Support Center), which has the responsibility of purchasing fuel for the Department of Defense (DoD). An open solicitation was put forth to the energy industry to develop and produce a suitable fuel, and in 2009, a contract for almost 600,000 gallons of biofuel (190,000 gallons for the Navy and



An MH-60S Seahawk helicopter tests a 50/50 Camelina seed-based biofuel blend at NAS Patuxent River. The test demonstrates another step toward the certification of fuels from non-petroleum sources for use in all Navy and Marine Corps aircraft.  
*Sean Seremet*

400,000 gallons for the Air Force) was awarded to Sustainable Oils, Inc.

Sustainable Oils supplied test fuel created from the oil of a mustard seed known as camelina. The team then began an aggressive schedule of laboratory testing, followed by component and engine testing. The camelina-based JP-5 was blended with petroleum-based JP-5 in a 1:1 blend then tested in the laboratory and test stand without a hitch.

In early 2010, an F/A-18 Green Hornet fighter jet became the first aircraft to fly on the biofuel blend. It was this same Green Hornet that took to the skies at NAS Patuxent River for a series of 16 test flights—including a high-profile flight on Earth Day 2010, which marked the first time that an aircraft had flown faster than the speed of sound on biofuel-blend jet fuel.

Mike Rudy, the Green Hornet program’s Environment, Safety and

Occupational Health Coordinator, was pleased with the results of the demonstrations. “We observed no operational difference with the biofuel,” he confirmed. Subsequent tests confirmed that the JP-5 fuel performed to specifications.

Following the success of the F/A-18 test flights, numerous other platforms were tested with the 50/50 blend fuel. In November 2010, a MH-60S Seahawk helicopter—the next generation submarine hunter and multi-mission helicopter—took to the skies above NAS Patuxent River. Test results indicate that the aircraft performed as expected, through its full flight envelope with no degradation of capability.

The MH-60S is designed for anti-surface warfare, combat support, humanitarian disaster relief and search and rescue, aero medical evacuation, special warfare and organic airborne mine countermeasures.



**2011**

## THE BASICS ABOUT **Biofuels**

**N**either the camelina- nor algae-based biofuel being tested by the Navy Fuels Team is derived from a feedstock that competes with food crops—an important factor in the Navy's biofuel selection.

Camelina (*Camelina sativa*) is related to mustard and rape seeds. Its seed can be 40 percent oil and has a similar chemical structure as petroleum. Other benefits of camelina are that it is a valuable rotation crop for wheat and is grown when a field would otherwise lie fallow. Its water and fertilizer input requirements are minimal. (For more on information on converting camelina into a biofuel feedstock for the Navy, read our cover story in the winter 2011 issue of *Currents*.)

The type of algae-based fuel being tested by the Navy is a hydro-processed renewable diesel, better suited than other biodiesels to equipment operating in the marine environment. Various permutations of algae-based fuels are being created and tested worldwide in automobiles, ships and aircraft.

***We observed no operational differences with the biofuel.***

**—Mike Rudy**

In 2011, test flights were fast and furious at NAS Patuxent River and elsewhere. In June, the Seahawk flew again, this time with an algae-based biofuel blend. (See our sidebar, "The Basics About Biofuels.") This flight marked the first time an algae-based fuel was used in any military aircraft. It validated in operation what was confirmed in the laboratory, that different renewable hydroprocessed feed sources producing similar oils could be used interchangeably. This ability to use multiple renewable sources to produce a similar fuel would vastly increase potential supply sources without having the need for each to undergo costly test stand evaluations.

In August 2011, the MV-22 Osprey became the first Marine Corps aircraft and the first tilt rotor vehicle to be flown on a biofuel blend. The Osprey hovered just above the runway for about a minute, then took off for the skies, eventually reaching an altitude of 25,000 feet. The MV-22 is a tilt rotor, multi-mission aircraft that combines the functionality of a helicopter with the long range and high speed of a turboprop aircraft.

Later that same month, a T-45C Goshawk training craft successfully flew with the camelina fuel blend. The T-45C Goshawk is a tandem-seat aircraft used by the Navy and Marine Corps to train pilots on carrier and

An MV-22 Osprey lifts off from NAS Patuxent River during a successful biofuel test flight. The tilt-rotor aircraft flew at altitudes of up to 25,000 feet on a 50/50 blend of camelina-based biofuel and standard petroleum based JP-5 fuel.

*Steven Kays*





A T-45C Goshawk training aircraft conducts a test flight using a biofuel blend of JP-5 jet fuel and plant-based camelina.

*Kelly Schindler*

The Blue Angels flew F/A-18 fighter jets powered with camelina-based biofuel on Labor Day weekend 2011.



tactical mission operations. The test flight was performed by the “Salty Dogs” of Air Test and Evaluation Squadron (VX) 23.

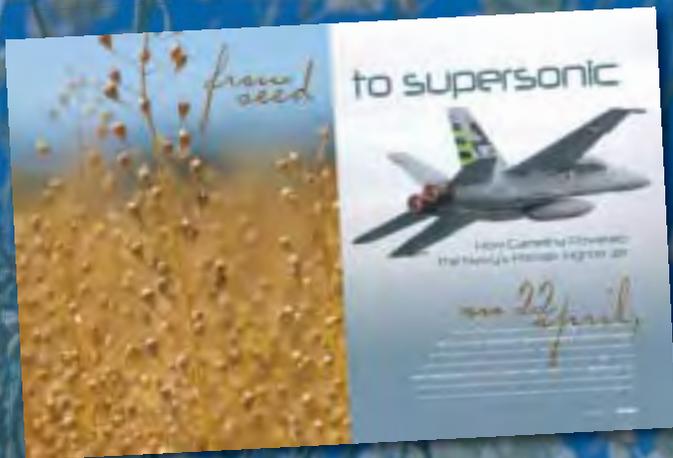
On Labor Day weekend, the biofuel blend faced its ultimate performance test at NAS Patuxent River as the Blue Angels performed at the base’s air show. In the most public

demonstration of biofuel use to date, six F/A-18 jets soared, dipped, and flew in trademark formations—all without a hitch.

Also in September, an EA-6B Prowler became the first aircraft in the electronic warfare category to fly under biofuel power. The Prowler is a long-range craft, capable of jamming and intercepting enemy radar, data and commu-

FOR MORE  
**Information**

**F**or more insights into the road that led to this series of test flights with biofuels, see our article entitled “From Seed to Supersonic: How Camelina Powered the Navy’s Premier Fighter Jet” in the winter 2011 issue of *Currents*.



***There were no observed differences in the ship's performance, even at full power.***

nication signals. Captain John Green, program manager for the EA-6B, emphasized that, “given the EA-6B Prowler’s critical role in joint warfare it was important that we complete this qualification to allow Carrier Air Wings and expeditionary sites the operational flexibility to utilize biofuel.”

Meanwhile, on the west coast, personnel from the Naval Air Warfare Center Weapons Division, in China Lake, California performed a biofuel flight test on an AV-8B Harrier. According to Hal Bennett, project lead for the AV-8B biofuel flight test program, the testing was flawless. The short-takeoff vertical landing aircraft rolled down the runway several hundred feet, took off, then accelerated into a maximum performance climb. Testing included phasing maneuvers, hard cranks, wind up turns, hard turns with nozzle biting and even some inverted flight.

The seventh and final test aircraft took to the skies in September. An MQ-8B Fire Scout successfully flew the first unmanned biofueled flight at Webster Field in St. Inigoes,



An EA-6B Prowler flies over Southern Maryland on a biofuel blend of JP-5 aviation fuel and camelina oil. The Prowler successfully completed its inaugural biofuel flight here continuing the Navy’s surge toward energy independence.

*Kelly Schindler*



An AV-8B Harrier assigned to Air Test and Evaluation Squadron (VX) 31 conducts the first test flight of a mix of 50/50 jet fuel and biofuel. The test was conducted over Naval Air Warfare Center Weapons Division, China Lake.



An MQ-8B Fire Scout UAV successfully completed the first unmanned biofuel flight at Webster Field. The aircraft flew with a combination of JP-5 aviation fuel and plant-based non-food source camellia. Fire Scout is the seventh and final aircraft to demonstrate the versatility of biofuel through its use in all facets of naval aviation.

Kelly Schindler

Maryland. Powered by the camellina blend, the craft was piloted by the Unmanned Aircraft Systems Test Directorate. Rear Admiral Bill Shannon, Program Executive Officer for Unmanned Aviation and Strike Weapons, stated, "I am very pleased we can add MQ-8B to the list of successful bioflights completed at NAS Patuxent River this year, bringing us one step closer to achieving the Navy's energy goals."

The Fire Scout is a Vertical Take-Off and Landing vehicle designed to provide troops with situational awareness, intelligence and surveillance.

### ***Making Waves on the High Seas***

While the Navy Fuels Team was developing and testing their JP-5 blend, they were simultaneously working on an algae-based fuel for use in ship engines. In January, 2011, the team conducted testing on marine gas turbines using a 50/50 mixture of F-76 petroleum and algae-based biofuel.

This fuel received its first "road test" in July 2010, when a Rigid-Hull Inflatable Boat (RHIB) set sail at Fort Monroe, Virginia. The RHIB, a high-performance 7-meter craft, was tested alongside an identical vessel powered by 100 percent petroleum.

There were no observed differences in the ship's performance, even at full power.

In October 2010, in the waters off Naval Station Norfolk, Virginia the Navy reached another milestone on the road toward energy security. Conducting a full power demonstration of an alternative fuel-powered riverine boat, the

## ***Locomotive Joins Fleet*** OF ENVIRONMENTALLY FRIENDLY AIRCRAFT & BOATS

**A**n environmentally friendly locomotive made news when it entered service at the Naval Support Activity (NSA) Crane, Indiana. Used for transporting ordnance, the new "N-ViroMotive" is a 120-ton switcher locomotive that runs on biodiesel fuel, consumes half the fuel of conventional models, and is certified by the U.S. Environmental Protection Agency for low emissions. (For more information about NSA Crane's green locomotive, read our article entitled "Fuel-Saving Green Locomotive Debuts at NSA Crane: Base Accepts Delivery of First Environmentally Friendly Locomotive" in the spring 2011 issue of *Currents*.)



## Which Biofuel Is Best?

It's difficult to say. **Camelina**, though it has many advantages, is currently not being planted in sufficient quantities to fuel the Great Green Fleet. **Algae** offers a much higher yield, and may be a more promising option, but there are currently several competing methods for growing microalgae. One intriguing project, involving algae production in the ocean, is profiled in the spring 2011 issue of *Currents*. Read our article entitled "NASA & the Navy Developing the Fuel of the Future: Joint Effort Investigating Algae Farms in the Ocean."

## The Navy has commissioned the largest ever purchase of biofuel by the U.S. government.

Riverine Command Boat—Experimental (RCB-X) ran on a 50/50 blend of algae biofuel and petroleum, achieving a top speed of 44.5 knots (about 52 miles per hour).

"Running the RCB-X at its maximum power throughout this test of a second generation marine biofuel was a Wright Brothers moment for the Navy," stated then-Rear Admiral Philip Cullom, director of the Energy and Environmental Readiness Division on the Chief of Naval Operations staff, which leads the Navy's Task Force Energy. It was the first time a naval surface vessel from any nation has ever been driven at full power on biofuel, let alone one derived from algae. (Note: As of 7 March 2012, Cullom was promoted to Vice Admiral and took over as Deputy Chief of Naval Operations for Fleet Readiness and Logistics (N4).)

In October 2011, a Yard Patrol (YP) boat became the next platform to successfully operate on the algae-F-76 blend. The YP boat is a



Sailors assigned to Riverine Group 1 conduct maneuvers aboard Riverine Command Boat (Experimental) (RCB-X) at Naval Station Norfolk. The RCB-X is powered by an alternative fuel blend of 50 percent algae-based and 50 percent NATO F-76 fuels.

MC2 Gregory N. Juday



The Paul Foster conducts a successful demonstration of shipboard alternative fuel use while underway on a 50/50 blend of an algae-derived, hydro-processed algal oil and petroleum F-76.

Charlie Houser



Landing Craft Air Cushion (LCAC) 91 is underway on a 50/50 mix of alternative fuel and F-76 diesel.

Jonathan Gibson

biofuel blend, the LCU operated at full load, over a wide range of engine speeds with no discernable problems.

On 16 November 2011, the Navy launched its largest test of algae as a fuel component off the California coast. The USS Paul F. Foster, a retired destroyer turned self-defense test ship, sailed from San Diego to Port Hueneme, California. 20,000 gallons of the algal-blend fuel powered the ship's one propulsion gas turbine and one ship service gas turbine. Experts onboard monitored the ship's temperature gauges and propulsion, its performance at different speeds, and how much fuel it expended during the 17-hour trip. Though performance data are yet to be evaluated, all indications point to the success of the voyage.

In parallel, a joint project was underway between Maersk Line Limited and the U.S. Navy to test biofuels for their long-term suitability for maritime applications. By the fall of 2011, the Navy Fuels Team was monitoring emissions on biofuel-powered engines, and testing to determine the potential effects of biofuels on the engine's fuel system performance and normal wear and tear.

The final biofuel demonstration of 2011 occurred in Panama City, Florida in December when the Navy tested an algal-petroleum fuel on a Landing Craft-Air Cushioned (LCAC) hovercraft. The hovercraft achieved a top speed of 50 knots, making it the fastest speed to date by a U.S. Navy surface

craft using an alternative fuel blend. The LCAC is used to quickly transport equipment, troops and supplies to and from amphibious watercraft.

### Down the Road

In July 2012, a "Green Strike Group" will operate during the Rim of the Pacific (RIMPAC) exercise, which directly supports SECNAV's energy goal "to demonstrate a Green Strike Group in local operations by 2012 and sail it by 2016." The Green Strike Group will consist of a nuclear aircraft carrier, and ships and aircraft powered by biofuels. It is intended to test, evaluate, and demonstrate the cross-platform utility and functionality of biofuels, and essentially serves as the "final exam" for the Navy's alternative fuels certification program. The demonstration will also incorporate a number of prototype energy efficiency initiatives, such as solid state lighting, a shipboard energy dashboard, and Smart Voyage Planning. To learn more about these initiatives, go to [www.greenfleet.dodlive.mil/energy](http://www.greenfleet.dodlive.mil/energy). 

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108-foot training boat used at Naval Academy, Annapolis, Maryland. Once the Waterfront Readiness Department tests biofuels in YPs and confirms that they operate as well as conventional fuel, they will likely turn their attention to refueling more of the YPs with biofuels according to Senior Chief Engineman Ted Hayhurst.

That same month, a conventional Landing Craft Utility (LCU) 1600-class, went through its paces with the new fuel. Designed in the 1970s, the LCU can transport up to 400 combat-equipped troops or 18 tons of equipment over relatively short distances, from a ship or seagoing base to shore. During its maiden voyage using the



## Co-Founder Amory Lovins Shares His Ideas for an Enduring & Resilient Department of Defense



**O**N 27 JANUARY 2012, Amory Lovins, co-founder of Rocky Mountain Institute (RMI), shared his ideas on an enduring and resilient Department of Defense (DoD) with Kenneth Hess from the public affairs staff at the Chief of Naval Operations Energy and Environmental Readiness Division (N45) and Bruce McCaffrey, managing editor of *Currents*.

**CURRENTS:** Thanks for taking the time to speak with us today, Dr. Lovins.

For readers that may be new to the energy efficiency and sustainability realm, can you give us a little snapshot of your background and expertise?

**LOVINS:** I'm a 64-year-old recovering physicist. I was educated at Harvard and Oxford. I dropped out of both. I'm a former Oxford don (equivalent to a faculty member). I've taught at nine universities plus a new appointment as a professor of practice at the Naval Postgraduate School. I have 11 honorary doctorates and many international awards in energy and environment. I've written 31 books and over 450 papers.

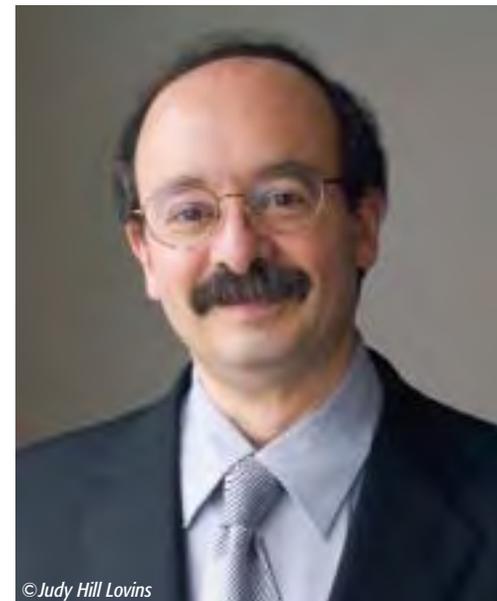
I co-founded RMI in 1982 as a vehicle for my life's work to drive the efficient and restorative use of resources.



Most of my work for four decades has been as a consultant to the private sector and sometimes to governments—spanning over 50 countries—in advanced energy efficiency, energy strategy, and how energy is related to security, economy, environment, and development. I have also had the privilege to work extensively with DoD over the past few decades.

**CURRENTS:** Talk for a moment if you would about Rocky Mountain Institute, its origins and mission, and what led you to create that organization.

**LOVINS:** I co-founded RMI in 1982 as a vehicle for my life's work to drive the efficient and restorative use of resources. The Institute is an independent, entrepreneurial, nonprofit think-and-do tank. We have spun off five



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for-profit and three nonprofit organizations, so we're a bit of an incubator. Our main model is to create important new intellectual capital, mainly with philanthropic support, and then apply, test, break, fix, improve, and spread those ideas through collaborations with powerful partners—usually in the private sector—who are highly motivated to solve a tough problem but feel they need our help to do so. Together we learn rapidly, solve the problem, and create teachable cases and competitive pressure for emulation. That is, we use competition to help early adopters become so conspicuously successful with radical energy resource efficiency that their rivals are forced by competitive pressure to follow suit or lose share. Of course, the mechanisms are different in the military sphere but somewhat analogous.

cost and at far lower operating cost. So it helps with DoD's budgetary pressures as well.

Let me start with the concept of Endurance. In World War II, the Allies' heavy sea forces, it has been said, "floated to victory on a sea of oil," mainly from Texas. Today's forces are about 16 times more oil-intensive, and Texas is now a net importer of oil. DoD can always get the oil it needs—albeit at a high and volatile price that buffets the budget process—but the long-unaccounted cost of delivering that fuel to the battlespace is often enormously higher. It's about 20 to 36 percent of the total cost of the Afghanistan deployment, for example.

[We help] early adopters become so conspicuously successful with radical energy resource efficiency that their rivals are forced by competitive pressure to follow suit or lose share.

The solar power system at Amory Lovins' energy efficient home keeps it running even when the power grid goes down.

© Judy Hill Lovins



**CURRENTS:** Did you want to expand on the military piece of that?

**LOVINS:** Sure. I've worked on many national security issues over the years such as non-proliferation, critical infrastructure vulnerability, and strategic doctrine, but over the past two decades I've focused especially on two new strategic vectors—Endurance and Resilience.

Four big ideas have long driven the revolution in military affairs—speed, stealth, precision and networking. In 2001 and 2008, I was active in shaping two national Defense Science Board (DSB) task force reports that discussed two more big ideas—Endurance and Resilience.

We found that a pervasive waste of energy in the battlespace and the 99 percent dependence of fixed facilities on the highly vulnerable commercial electricity grid are hazarding mission success and incurring huge costs in blood, treasure, and lost combat effectiveness. But Endurance and Resilience can turn these handicaps into revolutionary new capabilities at similar or lower capital

Logistics for fuel have historically used about half of DoD's personnel and a third of the budget. And the cost in blood is even higher. Over a thousand lives have been lost in convoy attacks in the past decade, mainly hauling fuel. But convoys we no longer need cannot be attacked. So saving fuel is a force protector. It's also a force multiplier that frees up fuel guards and logisticians to be trigger-pullers. It's a force enabler that radically increases range and nimbleness, and it's a key to transformational, multi-divisional realignment from tail to tooth that could save many tens of billions of dollars a year.

DoD is introducing two policy tools to make new platforms vastly more efficient, and the prime contractors are already starting to compete in this new environment. The first tool is valuing saved fuel at its fully burdened cost, delivered to the platform in theater in wartime. That's often about ten and sometimes a hundred times the undelivered cost previously assumed. I was recently speaking with one manufacturer of military airframes who gave a

three-figure dollar value per saved gallon against which they're designing their next airplane. That's going to be a very different airplane than when we thought saved fuel was going to be a few dollars a gallon. Also, DoD is adding new energy Key Performance Parameters (KPP) to prime contracts for new platforms. Those innovations will ultimately not only save most of DoD's fuel, but also catalyze leap-ahead efficiency gains in the civilian sector (which uses 50+ times more oil)—just as military science and technology investments in the Internet, Global Positioning Systems, and the jet-engine and microchip industries transformed the civilian economy.

So Endurance combines greatly improved energy efficiency in everything that uses fuel or electricity in the battlespace with autonomous energy supply that makes Endurance a lot cheaper and easier to achieve.

Now let's talk about Resilience. Right now, our land facilities rely 99 percent or so on a commercial grid that is subject to large-scale, cascading blackouts. In the 2008 DSB report entitled *More Fight—Less Fuel*, we recommended that DoD remove its fixed facilities from the commercial power grid and shift to the efficient use of electricity from diverse, dispersed and preferably renewable supplies.

The cost of delivering fuel to the battlespace... is about 20 to 36 percent of the total cost of the Afghanistan deployment.

About 90 percent of bases on the continental United States could do that—often to their economic advantage. This shift makes it possible to reorganize the grid into a series of “islandable” microgrids that normally interchange with the commercial grid but can stand alone at need: they can isolate fractally, then reconnect seamlessly. My own house does this. I don't even know when the grid goes down. The solar power keeps it running with modest storage because I'm using electricity very efficiently.

Denmark is reorganizing its grid in this way, and every year they “stress test” it by pulling the plug on the main

grid to make sure the microgrids can still run their critical loads (which they can). There are about 20 civilian micro-grid experiments worldwide. Perhaps the most spectacular example is in Cuba. They applied this microgrid architecture in 2005 through 2007 to reduce their serious-blackout days per year from 224 to three to zero. And then in 2008, two hurricanes in two weeks shredded their eastern grid, yet Cuba was still able to sustain vital services. This holds important lessons.

So I think without being fond of their politics, we can still learn from Cuba's technical achievement. Efficient use, diverse distributed generators, and islandable microgrids can make bases and their surrounding communities resilient against disruption. DoD has actually launched case studies of this approach in several locations. I hope the Navy, whose [Naval Surface Warfare Center] Dahlgren experts have been critical in this effort, and the Marine Corps will sustain their leadership in shifting all of their facilities rapidly toward resilient electric systems, and there are also good initial efforts in the other Services.



Chief Mass Communication Specialist Kathryn Whittenberger

**CURRENTS:** What incentive do you think those airframe manufacturers have to build a more efficient aircraft? What sort of changeable incentives are they getting from either DoD, the market, or elsewhere for them to want to do that?

**LOVINS:** DoD is telling them that the saved fuel is worth over \$100 a gallon (delivered in midair)—or their own analyses using DoD criteria are telling them that. They're starting to realize that if they don't meet their energy KPPs, there is a real risk of their contracts being

cancelled. So they're very strongly incentivized to design the aircraft for far greater efficiency. As that kind of innovation works through into the civilian sector, it helps get the nation off oil much faster by speeding the transformation of our civilian cars, trucks and planes.

Our own nation, as it comes to need no oil, may feel differently about fighting over oil.

Automobiles use three-fifths of U.S. mobility fuel; two-thirds of their energy use is caused by their weight; and saving one unit of energy at the wheels (by removing weight or drag—turning automotive obesity into fitness)—saves seven units of fuel at the tank. You can take out half to two-thirds of the weight of a car while making it safer using advanced composites that can absorb six to 12 times as much energy per kilogram as steel. And you can also improve aerodynamics, tires, accessories, and integrative design; and then downsize the power train to get the same acceleration from a lighter platform. When you put all that together and take advantage of the radically simpler manufacturing, using

a fifth as much capital, the automobile's efficiency with the same or better performance, and the extra cost of the whole vehicle is approximately zero because simpler



Amory Lovins was asked by Toyota to test drive a pre-release plug-in hybrid electric Prius.

© Judy Hill Lovins

manufacturing and smaller power trains pay for the exotic materials. Such fit autos need three times fewer batteries or fuel cells, making electrification affordable and displacing the rest of the oil. Making all American autos out of carbon-fiber composites instead of heavy steel could, by 2050, displace one-and-a-half Saudi Arabias or half the total output of the Organization of the Petroleum Exporting Countries (OPEC). Those “negabarrels” under Detroit cost just \$18 per barrel, and they’re domestic, secure, carbon-free, and inexhaustible.

## The Basics About Rocky Mountain Institute

**FOUNDED IN DR. LOVINS’** home in Snowmass, Colorado 30 years ago, Rocky Mountain Institute (RMI) today has two offices, employs about 90 people, and has an annual operating budget of nearly \$12 million. RMI’s central approach uses philanthropy-funded innovation to create new solutions to old problems.

Beyond the Navy and Department of Defense work mentioned in this article, some of RMI’s recent work includes:

- A project with the U.S. Department of Energy that first estimated true costs for solar energy systems, and then worked on ways to reduce those costs
- Project Get Ready—an ongoing project that aims to accelerate the adoption of electric vehicles by focusing on city readiness
- A major retrofit of the Empire State Building, resulting in energy savings of \$4.4 million per year.

For more about RMI, visit <http://www.rmi.org>.



Think about the reductions in tensions in places from the Arctic to the Strait of Hormuz to the South China Sea in a world that uses less and ultimately no oil. Our own nation, as it comes to need no oil, may feel differently about fighting over oil. We can even envisage negamissions in the Persian Gulf—Mission Unnecessary. For warfighters, this is very good news.

**CURRENTS:** In your Joint Force Quarterly (Issue 57) article entitled “DoD’s Energy Challenge as Strategic Opportunity” (available at [www.ndu.edu/press/lib/images/jfq-57/lovins.pdf](http://www.ndu.edu/press/lib/images/jfq-57/lovins.pdf)), you also encourage DoD to do a better job of articulating those incentives. You talk about the lack of cohesive strategies and policies and governing structures so that we can properly manage our energy risks.

Making all of our American autos out of carbon-fiber composites instead of heavy steel could, by 2050, displace one-and-a-half Saudi Arabias or half of the oil we import from OPEC.

**LOVINS:** That’s true. There is a lot of work still to do. But Sharon Burke was confirmed as the head of operational energy in the Pentagon, about a year ago, and now that her office is stood up, we’re starting to see good leadership in the Office of the Secretary of Defense (OSD). However, I would say that the Navy and Marine Corps in particular are well ahead of OSD in operationalizing the Endurance strategic vector. There is also excellent work going on in the Army and Air Force. The work that Colonel “Brutus” Charette and the Marine Corps are doing on Experimental Forward Operating Bases (ExFOB) is impressive and in some of their experiments now they’re saving up to 90 percent of forward fuel (fuel delivered for use by the front line warfighter). (Note: The Marine Corps’ ExFOB effort is identifying and evaluating energy efficient capabilities that can reduce risks to Marines and increase their combat effectiveness. Created in 2009, ExFOB brings together stakeholders from across the Marine Corps’ requirements, acquisitions, and technology development communities to quickly evaluate and deploy technologies to reduce the need for “liquid logistics” today and to establish

requirements for tomorrow.) If you look a little closer, the Marine Corps has found in a hot, sandy place that about 95 percent of the electricity from engine-generator sets (gensets) was going to inefficient air conditioning of uninsulated and often unoccupied tents and other structures.

The gensets and their associated wiring were only about ten percent efficient, and we’re getting people blown up in convoys that fuel those gensets. You don’t have to be an engineer to see what’s wrong with this picture. But there is huge leverage in, as an Army Colonel remarked, “defeating Improvised Explosive Devices by not being there.” This story holds true across all platforms and in all Services.



I was on a KC-130 flying between a couple of Midwestern bases a few years ago and happened to notice some heavy pieces of equipment on board that were not necessary for combat capability or airworthiness. I briefed what I’d observed the next morning to a couple of two-star Generals. Within some months, they’d come up with readily removable surplus weight in that aircraft class worth over a billion dollars in present-valued fuel savings. Then they extended to some other heavy classes of aircraft and found several billion more dollars. Nobody had been responsible or rewarded for taking out weight.

In a mid-size civilian airliner, taking a pound out of the plane is worth close to a thousand dollars in present-valued fuel savings. The military economics are a little different but not fundamentally. Throughout the Navy and Marine Corps, we are starting to see the same kind of systematic discipline in operations and design. The biggest, most fundamental advances will be in designing

new platforms. But there is still a lot we can do to run the existing ones better. In our work on USS Princeton (CG 59), for example, we suggested a new way of running their electricity-generating gas turbines that we call virtual trail shafting—analogue to the way propulsion turbines are run when you have a pair on an axial shaft. You fuel one and leave the other spinning without fuel, ready to be fueled and lit off as needed. Virtual trail shafting connects separate gas-turbine generators electrically, using a small motor to keep the unfueled backup unit spinning so the working unit can run at full load for highest efficiency. These kinds of innovations really add up. We've figured out that aboard Princeton—which was in her top quintile for class efficiency—you could save about 40 to 50 percent of the onboard hotel-load electricity. If this were true fleet-wide, you'd end up saving about a sixth of the Navy's non-aviation fuel.

An efficient warfighter is an effective warfighter.

We have a lot of computing power in the fleet now that ought to be considered for more efficient design. In fact, some years ago, we were being visited here at RMI by then-Vice Admiral Denny McGinn—now a senior fellow of our Institute and leading the American Council on Renew-

able Energy. I had just been aboard his command ship—USS Coronado (AGF 11). All over the ship, people were using cutting torches and jackhammers to install new cooling and wiring to accommodate servers that were to provide a network-centric warfare main battle laboratory on board Coronado. So when Denny came to RMI, I showed him a little paperback-book-size Linux™ box that we had just used to replace several Wintel servers. The Linux box poked along at two or three watts and peaked at 15 watts, required no cooling, and could fit into a desk drawer. So it would save a lot of real estate as well as electricity in cooling. Denny got his Executive Officer on the phone and said, “Belay that work on Coronado, we’ve got a better solution.”

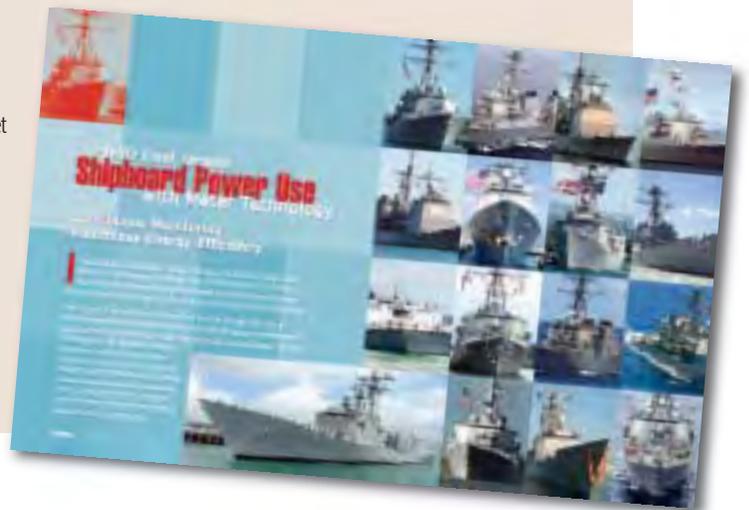


The guided missile cruiser USS Princeton.  
Photographer's Mate 2nd Class Michael J. Pusnik, Jr.

**LOVINS:** Yes. I can give you another example. In 1995, I was asked to deliver a brief the Resource Requirements Review Committee, comprised of Navy admirals and Marine Corps generals, entitled “Negawatts and Hypercars:

## For More Insights

**FOR MORE INSIGHTS** into one of many of the Navy's efforts to achieve energy efficiencies in port and at sea, read our article entitled “Pacific Fleet Targets Shipboard Power Use with Meter Technology: Continuous Monitoring Maximizes Energy Efficiency” in the fall 2011 issue of *Currents*. To browse back issues or subscribe to the magazine, visit the Department of the Navy's Energy, Environment and Climate Change web site—at [greenfleet.dodlive.mil/currents-magazine](http://greenfleet.dodlive.mil/currents-magazine). The RMI team's Princeton study is available at [www.rmi.org/Knowledge-Center/Library/S01-09\\_EnergyEfficiencyUSSPrinceton](http://www.rmi.org/Knowledge-Center/Library/S01-09_EnergyEfficiencyUSSPrinceton).



How the Resource Efficiency Revolution will Transform the Navy.” The meeting was chaired by then-three-star, later four-star Admiral Joe Lopez (who began his service as an enlisted seaman). I did the first ten minutes of the brief on integrated building design, because that’s the most simple and intuitive way to explain how you can achieve big savings more cheaply than small or no savings.

The admiral looks at me and says, “I suppose you know who’s good at the integrated design that you’re describing. Do you think you could get a group of them to sit around a table with our best designers and redesign a building we’ve just designed (so we’ll have something to compare it to)? Then we’ll build it your way and measure it. If it does what you say it will, we have \$6 billion in construction that we’ll do that way next year and \$7 billion the year after, and we’ll want you to indoctrinate our top 350 designers.” I gulped and said “Yes, Sir!”

## The Navy’s test and acquisition programs are greatly accelerating the development of sound and affordable biofuels.

We indoctrinated the designers and the Naval Facilities Engineering Command (NAVFAC) moved out smartly. Some people did some very courageous things within the bureaucracy to make that happen. In the end, it didn’t stick because the people leading it at NAVFAC were so good they got promoted up and out before these concepts had reached full acculturation. So now I think we’ll do it again under the new leadership. After a year, Admiral Lopez called me back, and said, “We have eight buildings built and tested. They do what you said they would. Write me a report card. I want to know what to improve next.”

I tell that story to our civilian clients—chief executives in their own large organizations—in the hopes that they’ll get that good. Some of them are, but not very many. This was the beginning of my naval education in the difference between leadership and management—lessons for which I’m eternally grateful to the Navy.

**CURRENTS:** As a result of all this research and experimentation, do you feel like we’re beginning to break down

barriers to doing things a different way? Or are we still in a transition period?

**LOVINS:** We are definitely still in a transition period. It will take relentless patience and meticulous attention to detail to change some traditional attitudes. I appreciate the Marine and Navy leadership on those cultural changes. For so long, the attitude throughout the military was “we don’t do fuel, we buy fuel.” And it took a while to realize that an efficient warfighter is an effective warfighter. As this new way of thinking starts to permeate the military, we will start to change the training and educational systems, the reward systems, and the details of how we foster and sustain energy knowledge throughout the services. In that context,



I’m delighted that, at the Cebrowski Institute at the Naval Postgraduate School, we’re now designing both an energy certificate course and an energy master’s course—the first in any Service to inculcate the understanding of energy and the associated organizational and cultural change vectors into the next generation of leadership.

**CURRENTS:** What do you think the Navy’s doing right from an energy standpoint?

**LOVINS:** Well, we hear the most about biofuels. The Navy’s test and acquisition programs are greatly accelerating the development of sound and affordable biofuels. It’s all moving many years faster than it would have otherwise. But I think the underlying efficiency advance is even more significant. And the Navy’s work on renewable electricity is also very important. Not just big projects like China Lake geothermal, but a lot of photo-

voltaics and other sources going in at facilities around the world. I think also the institutional changes are very important, with leaders like Vice Admiral Cullom. I'm immensely impressed with the detail and strategic astuteness with which his agenda is being

It's remarkable how naval leadership has driven the civilian transformations from sail to coal to oil to nuclear energy, and now to renewables.

implemented across the Navy and Marine Corps. I was very interested to look at the structure and rewards systems in some of the Navy's energy efficiency programs. When skippers got a share of what they saved in operational energy through smarter practices, the savings flourished. When there was no such incentive—when the ship got no direct benefit from saving energy—the savings dwindled. When the incentives came back, so did the savings. There's an important lesson here about what people pay attention to and how to focus that attention on systematic improvement.

I think military leadership will be very important in driving the civilian efficiency and renewable energy revolutions. This is not only in the obvious ways like technology development, but also social influence and leadership.



Wind turbines at Naval Station Guantanamo Bay, Cuba.  
Chief Mass Communication Specialist Bill Mesta

For example, we now have lots of direct digital controls in civilian life, but most of the people who built them were trained in the Navy. And indeed, if you look back at the much longer history, it's remarkable how naval leadership has driven the civilian transformations from sail to coal to oil to nuclear energy, and now to renewables.

I think that's a wonderful tradition, and I'm thrilled to be able to contribute to that ongoing naval leadership in how we use and provide energy in the civilian economy.

## Reinventing Fire: Bold Business Solutions for the New Energy Era

**DR. LOVINS' NEWEST** (and 31st) book offers workable solutions for four energy-intensive sectors of the economy: transportation, buildings, industry, and electricity.

"Following official projections, the U.S. will have a 2.6 fold bigger economy in 2050 than in 2010," Dr. Lovins states. "We show how to run that economy with no oil, no coal, no nuclear energy—and a third less natural gas. We found that this would cost five trillion dollars less than business as usual in net present value, assuming that all externalities—all hidden costs—are worth zero. *Reinventing Fire* also claims that the

proposed transition would require no new inventions, no act of Congress, and could be led by business for profit.

"We followed advice ascribed to General Eisenhower," Lovins says. "If a problem cannot be solved, enlarge it."

Looking at energy use by sector, in other words, is ignoring the bigger picture. "We integrated all four energy-using sectors: transportation, buildings, industry and electricity, and we found that, indeed, you can more easily solve the electricity and auto problems together than separately. We also integrated four kinds of innovation—not just

technology and policy, but also design and strategy—new competitive strategies, new business models. Those turn out to be even more powerful than the innovations in technology and policy—and those are certainly impressive. And all four together are much more than the sum of their parts, and offer deeply disruptive business opportunities. Entrepreneurs are starting to pick up this approach. With five trillion dollars on the table, there's plenty of incentive," he says.

For more about *Reinventing Fire: Bold Business Solutions for the New Energy Era*, visit <http://www.rmi.org/rfexecutivesummary>.

That being said, there are still some shortcomings in how we calculate the fully burdened cost of fuel. For example, we're counting the costs of fielded personnel for logistics and force protection, but not of the severalfold more personnel who are on rotation stateside, in training, and so on to support that fielded one-third or one-fourth of the total force structure. We should be counting the pyramid of all assets and functions that we'd no longer need if a given gallon need never again be delivered.

We are also at an early stage of extending to saved electricity the same attention that we're giving to saved fuel. So when we hear of expeditionary warfighters hugely burdened by all the batteries they need to carry, the first thing that occurs to me is, "Is their electronic equipment as efficiently designed as, say, an iPhone or a Sony consumer electronics device?" I think the answer is probably "no," because nobody told the designers how much a saved watt-hour is worth.

I am most looking forward to the thorough design reforms entering the contractor community so that they will be competing over radical energy efficiency.

In the long run, the biggest energy-saving potential is in the design of new platforms and new tactical and strategic concepts based on the radically improved capabilities of those platforms. I am most looking forward to the thorough design reforms entering the contractor community so that they will be competing over radical energy efficiency. When that competition becomes really keen, driven by the fully burdened cost of energy and energy KPPs, then the institutional change that Vice Admiral Cullom and others are driving will become permanently ingrained.

**CURRENTS:** What do you think needs to happen for the U.S. and the rest of the world to have the energy we need for the long term?

**LOVINS:** We need to use energy in an economically efficient way, and get it from diverse, distributed, and increasingly renewable sources that don't run out, cannot be cut

off, and are stably priced and everlastingly available. This is a big task. That's why we called our latest book *Reinventing Fire*, because it really is that profound a change in human infrastructure. Fire made us human, fossil fuels made us modern, and now we need a new fire that makes us safe, secure, healthy and durable. We have a big task ahead for the next 40 years. It's not easy; it's only easier than not doing it.

**CURRENTS:** Is there anything else you'd like to say to *Currents* readers?



**LOVINS:** For those of you who are already in this fight, a big Bravo Zulu for who you are and what you do. For those of you who have yet to grasp the energy opportunity, it is a huge and worthy challenge, and vital to the Navy's mission. I look forward to you enlisting in the cause and being properly rewarded in your conscience and career for the results you'll achieve. As a civilian and a novice in military affairs, I'm learning something every day from your cultures. And I thank you for that, and for defending all of us who are constantly inspired by your example. ⚓

# Noise Management at Pax River Range Ensures Test & Evaluation Success

## Response System & Analysis Tools Among Effective Mitigation Measures

**A NUMBER OF** measures employed by the Sustainability Office (SO) at the Naval Air Station (NAS) Patuxent River, MD (Pax River) are effectively managing the noise issues related to base test and evaluation (T&E) operations.

The Naval Air Systems Command (NAVAIR) ranges operate major test ranges and facilities on the East and West Coasts of the United States for Naval aviation test, evaluation, experimentation and training. These large, unencroached tracts of land, sea and air space provide a variety of terrain, including desert, mountain, littoral and open-ocean. NAVAIR schedules and operates these interoperable air, land and sea ranges, range instrumentation and associated facilities; and provides air vehicle and weapons systems modification and instrumentation.

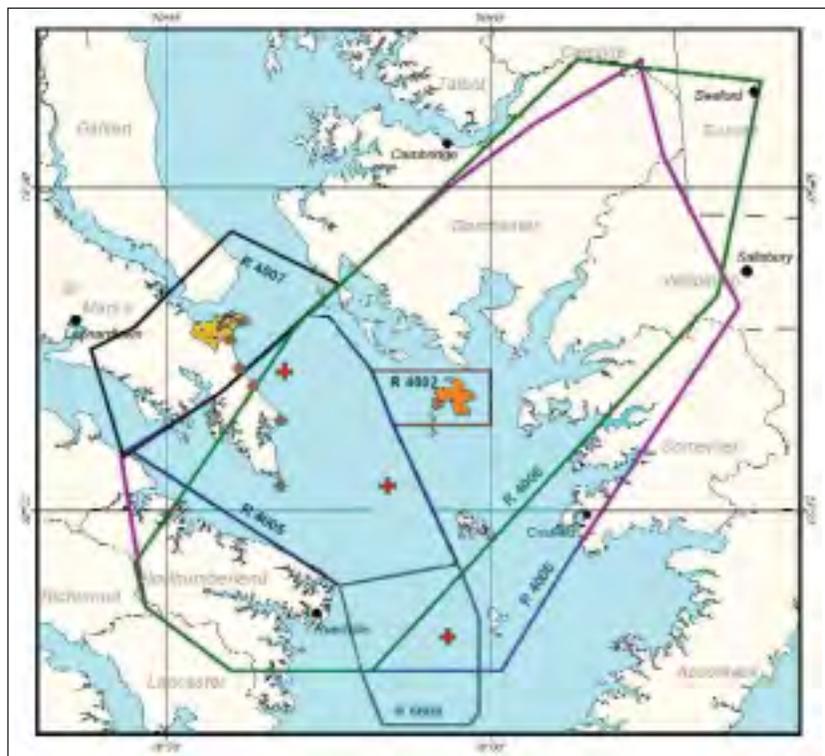
Range SOs—located at Patuxent River, MD, China Lake, CA, and Point Mugu, CA—work to ensure environmental compliance and manage encroachment on test and evaluation operations conducted at these three NAVAIR range sites. The mission of the SO is to “support fleet readiness by ensuring

access to ranges, facilities and resources as well as public support for the Navy’s test, training, evaluation and experimentation mission.”

At the Atlantic Test Ranges (ATR) located at Pax River, the SO mission includes an emphasis on main-

taining a quality noise management program.

The SO at Pax River is responsible for tracking noise disturbances in all of the airspace used by the ATRs. Range airspace includes parts of Maryland, Delaware and Virginia.



The SO at Pax River is responsible for tracking noise disturbances in all of the airspace used by the Atlantic Test Ranges. Range airspace includes parts of Maryland, Delaware and Virginia.



Sonic boom monitors, like this one installed and calibrated at Pax River, are an important part of the base's initiative to limit noise disturbances.

According to Chris Jarboe, SO team lead at ATR, proactive involvement is ongoing in several core areas, including range management planning support, encroachment management, public outreach, comprehensive noise management, operational environmental planning, and information technology support.

“The SO performs a number of different services for the Naval Air Station, one of which is noise management. As the community around Pax River expands, noise management grows in importance. Noise management includes the monitoring, control and abatement of aircraft noise in the community surrounding our ranges,” Jarboe explains.

As part of the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) was developed for Pax River in 1998. During the public review and comment of the EIS, it was discovered that noise was the largest concern for the communities. To address this concern, five specific mitigation measures were proposed to reduce noise impacts and were documented in the Record of Decision (ROD), finalized in 1999. The Navy still adheres to these mitigation measures, which include the following.

1. **Establishing a Noise Disturbance Response System**

The SO developed a centralized process to ensure noise disturbance reports are received, investigated, responded to and recorded in a database. Noise distur-

bances can be received either through the Noise Disturbance Hotline or the web (at [paxnoise@navy.mil](mailto:paxnoise@navy.mil)). Once noise disturbance reports are received, they are immediately investigated by Pax River Air Operations. If the aircraft flying at the time of the complaint are found to be associated with Pax River operations, the aircrew is then notified that a complaint was filed. A follow-up response is provided to the complainant to provide information about the event and any related actions. Through this process, the most community-friendly flight plan is assured while still meeting the objectives of the Navy mission.

2. **Monitoring the Open Air Engine Test Cell (OAETC)**

Due to the location of the OAETC facility, on Pax River directly across from high-density housing, the SO found that engine noise has the potential to reach substantial levels (up to 110 decibels) in these communities. In response to these findings, operations are authorized only when wind direction and velocity avert the noise away from local communities, thereby significantly lowering noise impacts.

3. **Providing Awareness Briefs and Videos**

According to Jarboe, the aircrew awareness brief “informs squadrons and pilots of how their flight operations may affect the local communities and reiterates

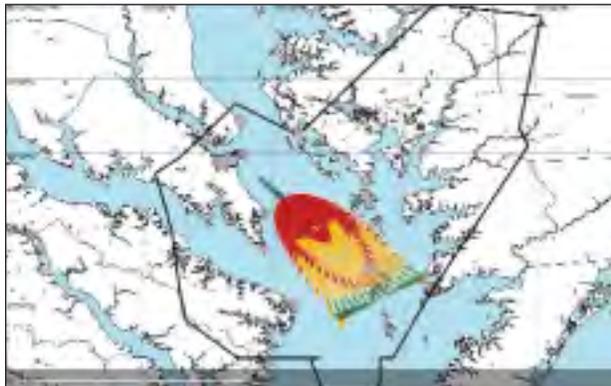
information provided in the Air Operations Manual.” In short, this brief and video remind squadrons to fly safely and to keep the communities under range airspace in mind.

#### 4. Expanding Flight Routes for Unmanned Aircraft Systems (UAS)

UAS engine sounds can closely mimic the noise of high-pitched lawnmower engines, and to mitigate this disturbance, their flight patterns have been altered and expanded. UAS flights were originally concentrated over the Northern Neck of Virginia, but were expanded to include a larger area over the Chesapeake Bay.

#### 5. Installing and Maintaining Sonic Boom Monitors

Nine sonic boom monitors have been installed at various locations around the Chesapeake Bay to provide quantitative data on sound pressure levels of sonic booms. These data can be used to validate the occurrence of sonic booms, allowing the SO to evaluate which communities are affected by supersonic events.



The SBPT is used before every scheduled sonic boom-capable flight operation.

### Pax River Noise Mitigation Measures

1. Establishing a Noise Disturbance Response System
2. Monitoring the Open Air Engine Test Cell
3. Providing Awareness Briefs and Videos
4. Expanding Flight Routes for Unmanned Aircraft Systems
5. Installing and Maintaining Sonic Boom Monitors

A sonic boom monitor, an important part of Pax River’s initiative to limit noise disturbances, has been installed and calibrated on base.

In an effort to continue noise mitigation efforts beyond what is specified in the EIS and ROD, the SO has also developed two noise analysis tools. The Sonic Boom Prediction Tool (SBPT), a pre-flight analysis tool, is used by ATR before every scheduled supersonic weapons-separations flight. The SBPT factors the type of aircraft, altitude, position and speed, along with several real-time environmental conditions to predict how and where the noise generated from a sonic boom will be concentrated.

The Flight Track Analysis Wizard (FTAW), a post-flight analysis tool, recreates the flight paths of aircraft associated with disturbance calls to determine what was happening at the time of the reported incident. The FTAW provides valuable information on both Pax River and non-Pax flights related to noise disturbance complaints, allowing the SO to assess flight patterns and their impacts on the community.

A final measure the SO takes to prevent noise issues from arising is through continuous communication with the community—this occurs in many different forums. Press releases are aired to alert the community to operations outside of business hours or normal operational tempo. Real estate pamphlets inform potential buyers about the types of aircraft and potential associated noise at Pax River. They also provide more information about the Navy’s Air Installation Compatible Use Zones (AICUZ), which provide visual representations of noise contours for Pax River and the nearby Webster Field Annex.

Noise management is an ever-present issue at Pax River and noise issues are expected to grow along with increased operations and surrounding population growth. The SO employs many different strategies and tools to manage noise disturbances and is constantly looking for new, more efficient ways to mitigate noise issues. Thanks to the proactive approach of the noise management program, the SO can maintain NAS Patuxent River’s positive relationship with the surrounding community, while ensuring the continuation of the Navy’s T&E mission. 📍

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# 2012-13 *Currents* Calendar Highlights AWARD-WINNING WAYS

Several of the winners of Secretary of the Navy (SECNAV) Energy and Water awards and Environmental awards take the *Currents* calendar stage for 2012. In fact, with so many winners, we even are expanding the calendar to an 18-month format, keeping you covered through June 2013. Each month also includes a quote that is related to the topic or the installation. Here are a few of the items you can expect to see:

**April 2012:** Marine Corps Air Ground Combat Center Twentynine Palms garners three SECNAV awards—two environmental and one energy.

**July 2012:** Naval Station Great Lakes shows off its sustainability.

**October 2012:** For Energy Awareness month, learn how Naval Support Activity Souda Bay Greece captured an energy award.

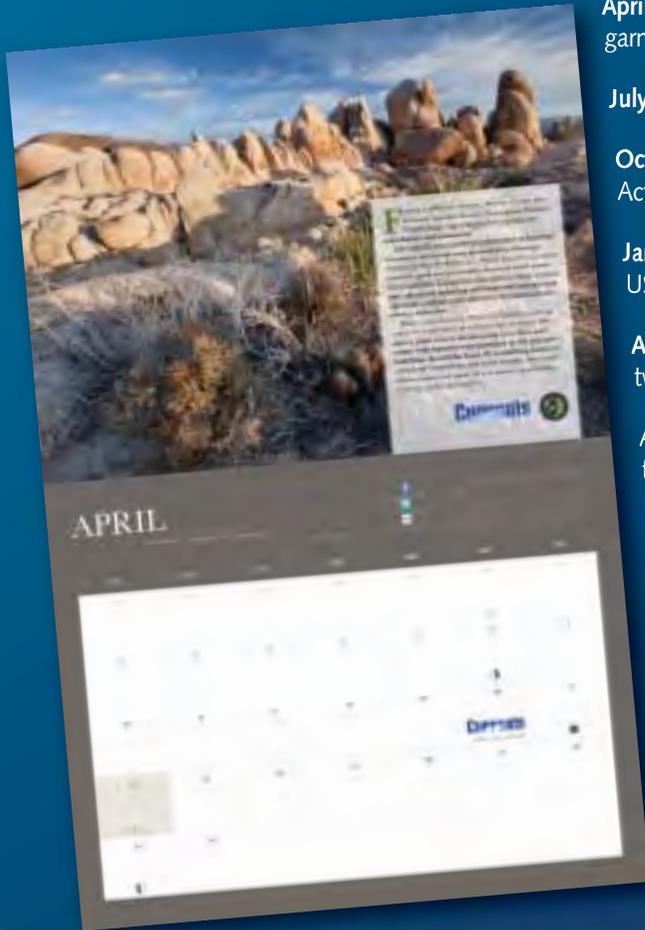
**January 2013:** For the energy award in the large ship category, it is USS BATAAN (LHD 5) taking the prize.

**April 2013:** The submariners at Naval Submarine Base King Bay scoop up two, with an environmental quality award and an energy platinum award.

As the Navy's official energy and environmental magazine, *Currents* has the privilege to share the many ways the Navy's energy and environmental personnel and Sailors work to find and implement the best techniques to achieve their goals. *Currents* provides a forum in which all of you can share your knowledge and successes with your colleagues.

Do you subscribe to *Currents*? If so, you should have received your 2012-13 calendar by now. If not, please contact Lorraine Wass, our distribution manager, at [ljwass@surfbest.net](mailto:ljwass@surfbest.net) or 207-384-5249 to receive your own copy of the calendar, request additional copies and sign up for *Currents*. And don't forget to check us out online at <http://greenfleet.dodlive.mil/currents-magazine>.

Thanks for all of your great work and we look forward to seeing more from you in the pages of *Currents*!



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# From Wind Farms to Whales, Navy Marks Significant Milestones in Environmental Management

## In Celebration of Earth Day, N45 Highlights Environmental Accomplishments of 2011

**FOR THE NAVY**, 2011 marked a series of environmental milestones ranging from the biological to the global scale. As examples, the Navy reviewed hundreds of sites for installation restoration, munitions response, and compatibility issues; conducted marine mammal research; educated thousands of school children and

not impacted. To increase organization-wide alignment on compatibility and readiness and sustainment (CRS) issues, the Navy formed Task Force Compatibility and Readiness Sustainment (TFCRS) in April 2011. The task force is chaired by the Deputy Chief of Naval Operations (CNO) for Fleet Readiness and Logistics (N4) and

our mission,” said Ron Tickle, Branch Head, OPNAV N45 Readiness Sustainment and Compatibility Branch.

In 2011, in coordination with the Office of the Secretary of Defense (OSD) Siting Clearinghouse, TFCRS reviewed 450 energy projects for potential adverse impacts to training and testing. Roughly 430 of these projects were

We’re working closely with government agencies, industry, and local communities to identify ways to move renewable energy projects forward without harming our ability to perform our mission.

—Ron Tickle, Branch Head, Readiness Sustainment and Compatibility Branch, OPNAV N45

others about Navy environmental programs; and tested several aircraft and tactical vehicles on biofuels.

### Compatibility & Readiness Sustainment

As communities around naval installations embrace alternative energy projects and pursue other urban development opportunities, the Navy is working to ensure that local training and other vital military activities are

directed by the CNO Energy and Environmental Readiness Division (OPNAV N45). Through the task force and other workgroups, both internal and external, the Navy is building collaborative approaches and mitigation strategies to address CRS issues.

“We’re working closely with government agencies, industry, and local communities to identify ways to move renewable energy projects forward without harming our ability to perform

determined to have negligible impacts and were cleared for development. Further analysis and/or mitigation measures enabled the Navy to clear all but seven outstanding projects.

Wind turbine projects near Naval Air Station (NAS) Kingsville, TX, NAS Corpus Christi, TX, Navy Weapons Systems Training Facility (NWSTF) Boardman, OR, and the Relocatable-Over-the-Horizon-Radar (ROTHR) facility near Chesapeake, VA are among the

Environmental planning for Navy training, testing and research at sea is an enormously complex challenge, involving large geographic areas, thousands of discrete actions, and covering long periods of time.

It's critical to the Navy mission that we complete these efforts on time, and we will.

—John Quinn, Deputy Director, OPNAV N45



Capt. Mark McLaughlin (left), commanding officer of NAS Kingsville, Texas, and John Quinn, deputy director of OPNAV N45, discuss an area near the base where energy developers are interested in building wind farms. The Navy is working closely with developers and local communities to find solutions that will allow renewable energy projects to move forward without impacting the Navy's mission.

Fifi Kieschnick

areas where alternative energy development has required recent mitigation efforts to protect the Navy's mission.

As part of its interagency involvement, TF CRS engaged with the National Ocean Council in 2011 to develop a Navy Coastal and Marine Spatial Guidebook to assist stakeholders in understanding Navy uses of the maritime environment.

In addition, in September 2011, Vice Admiral William Burke, then-deputy chief of naval operations for fleet readiness and logistics (N4) (now deputy chief of naval operations for warfare systems (N9)), issued interim guidance to assist commands in assessing and coordinating CRS issues. Navy efforts to sustain the capability of vital training and testing areas while supporting local, regional, and national energy and economic goals will continue in 2012.

### Value of Renewable Energy Projects

**THE NAVY RECOGNIZES** the value of renewable energy projects to local communities near naval installations, and supports such projects when they are compatible with vital training and testing activities. To ensure training and testing capacity is maintained, the Navy created Task Force Compatibility and Readiness Sustainment in April 2011. Members of the task force coordinate with the OSD Siting Clearinghouse and work with local entities (e.g., region, installation, community and industry representatives) to find solutions that allow energy projects to proceed without impacting the mission.

### A Holistic Approach to Environmental Planning

Since 2004, the Navy has been assessing potentially significant environmental impacts of military training and testing activities conducted in 14 Operational Areas (OPAREA) throughout the Atlantic and Pacific. This ongoing permitting process has completed long-range, comprehensive environmental impact statements (EIS) for such at-sea military activities as training, testing, and research.

The Navy's environmental planning and permitting is an ongoing, multi-phased process. Exercise and mitigation/monitoring reports must be submitted annually, and permits must be renewed regularly to protect the environment and ensure at-sea training and testing can continue.



The Navy is conducting environmental planning and permitting in the Atlantic and Hawaii-Southern California areas.  
MC3 Scott Pittman

without interruption. (Note: Permits for Navy at-sea training were typically renewed annually through January 2012. Beginning in February 2012, the National Marine Fisheries Service (NMFS) began issuing two to three year permits.) Phase I of the program,

focused on planning for at-sea training on ranges and OPAREAs, began in 2004. As of January 2012, Phase I permitting for all OPAREAs, except Silver Strand Training Complex in California, have been completed. The Navy anticipates Phase I for Silver

Strand Training Complex will be complete later this year.

Phase II, which analyzes broader geographic areas and additional types of training and testing activities, must be completed prior to expiration of Phase I permits, the first of which expires in January 2014. New planning, analyses, and consultations with NMFS will supplement information from Phase I. Phase II will include new effects analysis that incorporate standardized model input parameters such as type of environment, density of animal populations, sound source parameters, and projected locations of marine mammals in the water column to more closely reflect their natural dive profiles.

“Environmental planning for Navy training, testing and research at sea is an enormously complex challenge, involving large geographic areas, thou-

## Navy Training, Testing and Operating Areas

A TOTAL OF 14 Navy training, testing and operating areas are undergoing permitting with NMFS as part of a long-term, phased environmental planning effort. The areas are located throughout the Atlantic and Pacific Oceans.

### Hawaii-Southern California Training & Testing

- Southern California EIS/OEIS
- Silver Strand Training Complex EIS
- Hawaii Islands Range Complex EIS/OEIS

### Northwest Training & Testing

- Naval Undersea Warfare Center Keyport Range Extension EIS/OEIS
- Northwest Training Range Complex EIS/OEIS

### Atlantic Training & Testing

- Atlantic Fleet Active Sonar Training EIS/OEIS
- Virginia Capes Range Complex EIS/OEIS

- Navy Cherry Point Range Complex EIS/OEIS
- Charleston/Jacksonville Range Complex EIS/OEIS
- Undersea Warfare Training Range EIS/OEIS
- Gulf of Mexico EIS/OEIS
- Naval Surface Warfare Center—Coastal Systems Station Panama City Range EIS/OEIS

### Gulf of Alaska Training & Testing

- Gulf of Alaska EIS/OEIS

### Mariana Islands Training & Testing

- Mariana Islands Range Complex EIS/OEIS



Dolphins swim in front of a rigid-hull inflatable boat as Sailors assigned to the guided-missile destroyer USS James E. Williams participate in a visit, board, search and seizure exercise. The Navy funds extensive marine mammal research, with the goal of minimizing the potential for training activities to affect marine mammals.

MC3 Daniel J. Meshel

## The results of the marine mammal research program provide science-based data and technical capabilities that support the Navy's environmental compliance needs during operations at sea.

—Dr. Bob Gisiner, Operational Environmental Readiness and Planning Branch, OPNAV N45

sands of discrete actions, and covering long periods of time. It's critical to the Navy mission that we complete these efforts on time, and we will," said John Quinn, Deputy Director, OPNAV N45.

### Marine Mammal Research Progress

In 2011, the Navy directed nearly \$20 million towards research on marine mammal ecology and population dynamics; criteria and thresholds used to measure effects of Navy-generated sound on marine mammals; and improved technologies for monitoring and mitigating effects of underwater sound from naval activities. "The results of the marine mammal research program provide science-based data and technical capabilities that support the Navy's environmental compliance

needs during operations at sea," said Dr. Bob Gisiner, OPNAV N45 Operational Environmental Readiness and Planning Branch. Two of the dozens of projects are highlighted.

The Naval Undersea Warfare Center Newport has developed a hardware/software system known as Marine Mammal Monitoring on Ranges (M3R) for obtaining marine mammal data using existing instrumented range equipment. M3R marine mammal monitoring systems have been installed at the Atlantic Undersea Test and Evaluation Center (AUTECE) range in the Bahamas, the Southern California Offshore Range (SCORE) in southern California (SOCAL), and the Pacific Missile Range Facility (PMRF) in Hawaii. In 2011, collaboration with the Cascadia Research Collective has enabled the

Navy team to acoustically differentiate between rough-toothed and bottlenose dolphins, based on the structure of the animals' whistles. This monitoring is automated, enabling real-time monitoring of ranges without the addition of specially trained staff.

In a separate effort, Navy-funded researchers Dr. Ted Cranford (San Diego State University) and Dr. Petr Krysl (University of California San Diego) have been developing finite element models of marine mammal hearing anatomy. In 2011, they successfully constructed a model of the biosonar system in beaked whales, including additional modeling tools to simulate the effects of blast trauma. Information from these models will be used to develop more accurate, science-based estimates of the potential effects of naval training activities on marine life.

The ROD Toolkit will save time in completing reviews, help the public and regulators better understand cleanup response actions, and help us achieve new DoD goals for the program.

—Wanda Holmes, Installation Restoration/Oil Programs Lead, Afloat/Ashore Environmental Compliance Branch, OPNAV N45

(See “Rocket Science Unlocking Secrets of Cuvier’s Beaked Whale” in the spring 2010 issue of *Currents*.)

Since 2007, the Navy, NMFS, and partnering research organizations have conducted marine mammal research projects annually in and around the Navy’s SOCAL Range Complex. In 2011, the team conducted a large scale field study (“SOCAL 11”) involving controlled exposure experiments on species of wild, free-ranging marine mammals over several weeks in August and September. During the study, 38 tags were deployed, leading to successful controlled sound exposures with 18 individuals from three species of interest (blue

whale, Risso’s dolphin, and Cuvier’s beaked whale). Data from SOCAL 11 supports improved metrics of environmental risk from naval activities, as well as providing baseline information about marine mammal populations in areas where the Navy regularly trains and operates.

### Setting Sights on Site Closeout

The Navy made steady progress this year toward Department of Defense (DoD) Installation Restoration Program (IRP) and Munitions Response Program (MRP) goals. In fiscal year (FY) 2011, the Navy planned to achieve remedy-in-place (RIP) or response complete (RC) for 71 IRP sites containing hazardous substances or pollutants, but exceeded initial expectations and closed out 78 sites. Since the beginning of the program, the Navy has closed out nearly 3,400 sites. Under the MRP, which responds to unexploded ordnance and military munitions, the Navy reached RIP/RC at 131 sites (36 percent) of 361 sites.

Collaboration in 2011 between the Navy and U.S. Environmental Protection Agency (EPA) resulted in a toolkit designed to improve the quality and transparency of information presented in the publicly available record of decision (ROD) for installation restoration sites. The toolkit provides guidance for conveying information and describing selected remedies, ultimately making the process more cost effective and understandable. According to Wanda Holmes, Installation Restoration/Oil Programs Lead for OPNAV N45’s Afloat/Ashore Environmental Compliance Branch, “The ROD Toolkit will save time in completing reviews, help the public and regulators better understand cleanup response actions, and help us achieve new DoD goals for the program.”

DoD’s new Environmental Restoration (ER) Program goals are to achieve 90 percent RC by the end of FY 2018 and 95 percent RC by the end of FY 2021 for all sites in the program. These goals apply to all sites in the ER Program including IRP, MRP, and compliance cleanup (new sites that came into the program as a result of eliminating the 1986 eligibility cut-off date in December 2008).



The Navy’s MRP oversees investigations and remediation of unexploded ordnance and military munitions, which can pose environmental and human health and safety threats.

MC1 Sean Mulligan



Sailors replant grasses in a local marsh as part of an environmental restoration project. Projects such as these protect the health of local waterways.

*MC2 Roadell Hickman*

### The Navy's Environmental Restoration Program

THE NAVY IS responsible for managing sites with legacy hazardous materials (the Installation Restoration Program) and sites with munitions and explosives constituents (the Munitions Response Program). Together, these programs comprise the Navy's Environmental Restoration Program. The goal of the program is to achieve remedy in place (i.e., implement a technological or engineering solution to control the contamination) or response complete (i.e., meet all cleanup requirements specified in the site's decision document, issued by a state or federal regulatory agency) at all sites, which will protect human health and the environment and in many cases allow the cleaned properties to be used for other purposes.

### Energy & Environment in Acquisition

Meeting Secretary of Navy (SECNAV) Ray Mabus's energy goals and implementing DoD's Operational Energy Strategy are key responsibilities for the Navy. To meet those responsibilities, the Navy has committed to reforming its requirements-setting, acquisition, and

contracting processes to incorporate energy performance criteria into decisions for systems acquisition.

In June 2011, the Assistant Secretary of the Navy (ASN) (Research, Development & Acquisition (RDA)) issued a memorandum that provides guidance for platforms and weapon systems on the use of energy considerations in acquisition planning, analyses, development and competitive source selections. The memorandum requires acquisition plans to include a discussion of energy consumption in the Total Ownership Cost analysis, energy consideration in each step of the gate review process, and the feasibility of energy efficiency upgrades for major modernization of legacy programs. In September 2011, OPNAV N45 established the Navy Operational Energy in Acquisition Team (EN-ACQT) to ensure that energy-related factors are incorporated into decisions at all phases of system development and acquisition. EN-ACQT is modeled after the Navy Acquisition Environmental Readiness Integrated Product Team (ACQ-ER IPT), which was established to ensure environmental considerations are consistently incorporated into system development and acquisition decisions. OPNAV N45 also established a SharePoint site to support operations of each group and provide a working area for members to review, provide comments and participate in discussions regarding acquisition.

As we've done for environmental considerations in the past, the Navy is now developing and integrating energy efficiency considerations into key decision making processes for systems acquisition.

—Andy Del Collo, Branch Head, Financial, Administrative, Strategic Planning, Training, Acquisition and Research and Development Branch, OPNAV N45

“As we've done for environmental considerations in the past, the Navy is now developing and integrating energy efficiency considerations into key decision-making processes for systems acquisition,” said Andy Del Collo, Branch Head, Financial, Administrative, Strategic Planning, Training, Acquisition and Research and Development Branch, OPNAV N45.

EN-ACQT, ACQ-ER IPT, and OPNAV N45 will continue to provide acquisition tools as part of a comprehensive effort to position the Navy as a leader

in energy efficiency and environmental readiness.

### Ozone Depleting Substances Services Steering Committee

The Navy's Ozone Depleting Substances Services Steering Committee (ODS SSC), chaired by OPNAV N45, continued in 2011 to provide input to the United States' position in negotiations aimed at phasing down hydrofluorocarbon (HFC) production. DoD and the ODS SSC support a proposal by the United

States, Canada, and Mexico to regulate HFCs under the Montreal Protocol on Ozone Depleting Substances. However, HFCs are needed for critical military applications such as refrigeration and fire suppression aboard naval vessels, aircraft and other weapon systems. Use of HFCs for these purposes is necessary because no environmentally preferable alternatives exist that meet military requirements.

Working closely with the State Department, the ODS SSC assured that the final U.S. negotiating position



The USS North Carolina (SSN 777), the Navy's fourth Virginia-class submarine, is rolled out from a modular outfitting facility during construction. New acquisition rules require naval vessels and weapon systems to be developed with energy considerations in mind, from initial design through final disposal.

John Whalen



The Navy uses Compressed Natural Gas to fuel some non-tactical vehicles. This helps reduce emissions compared with traditional liquid petroleum fuels.

*MCS Scott Pittman*

included language that would allow a minimum level of HFC production to continue for military mission critical applications. DoD invested over \$3 billion to find and implement alternatives to ozone depleting substances over the past 20 years, with the majority of this investment going toward HFCs. (Note: The \$3 billion estimate was contained in the 1995 DoD Ozone-Depleting Substance Reduction Program Report to Congress.) While HFCs are greenhouse gases, they actually have lower global warming potentials than the ozone depleting substances (ODS) they replaced.

Although the proposed HFC amendment failed to pass at the 2011 Montreal Protocol Meeting in Bali, the ODS SSC will continue to work

with the State Department and EPA as they negotiate with the international community on this issue to address the mounting threat of global climate change.

### Clean Air Act Services Steering Committee

The Clean Air Act Services Steering Committee (CAA SSC), also chaired by OPNAV N45, continued to provide leadership on CAA issues for DoD in 2011. The committee reviewed more than 30 draft and proposed CAA regulations to identify potential impacts to DoD operations. In recent years, the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Industrial, Commercial and Institutional Boilers and Process Heaters for both major and area sources; and the

Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources, Commercial and Industrial Solid Waste Incineration Units, have been among the major regulations the CAA SSC has been tracking.

In 2011, the CAA SSC was involved in an interagency review of a proposed reconsideration of these rules, coordinated by the Office of Management and Budget. CAA SSC recommended allowing intermittent-use boilers (which EPA defines as “limited use units”) on major source permits to be defined by operational hours or heat input. To avoid a compliance deadline taking effect before EPA takes final action on the proposal, CAA SSC also recommended temporarily delaying implementation of the area source rule.

Sharing information about our environmental and energy successes—during special events and online—helps people who care about the Navy understand how serious we are about these issues, and empowers them to inform others.

—Kenneth Hess, Environmental Lead,  
Communication and Outreach Branch, OPNAV N45

The CAA SSC was also actively involved in emission factor development efforts for unique military sources. Emission factors are used to estimate emissions for determining compliance with CAA standards. The committee submitted comments on EPA's draft *Guidance on the Recommended Procedures for Development of Emissions Factors*. Many of the comments addressed issues pertaining to evaluating the quality of data received to support emission factor development. The CAA SSC also developed a standard process for reviewing and commenting on emission factors developed by DoD services and agencies for military-unique equipment in cases where the emission factors are intended for publication in regulatory documents. The process was approved by DASN (Environment) in November 2011 and has since been used to coordinate the review of several test plans and reports.

### Air Shows, Classrooms, & Social Media— Making the Message Heard

Informing the public about the Navy's environmental and energy-related accomplishments remained a high priority

in 2011. Commands hosted exhibits, delivered educational presentations, and participated in activities highlighting the Navy's focus on protecting natural resources, recycling, reducing energy use, and incorporating alternative energy sources ashore and afloat.

Nearly 50 commands participated in Earth Day events in 2011, such as community tree plantings, recycling drives, and beach cleanups. U.S. Fleet Forces Command (USFF) ramped up its environmental outreach program this year, giving environmental talks to approximately 12,000 schoolchildren, and distributing outreach materials such as *Currents* magazines, posters, and coloring books. OPNAV N45 and supporting commands, including the Naval Air Systems Command (NAVAIR), Naval Sea Systems Command, Naval Facilities Engineering Command (NAVFAC) Mid Atlantic, and local installations hosted additional Navy environmental and energy exhibits at air shows, Fleet Weeks, and other events that attracted more than 200,000 people. Navy environment/energy booth personnel handed out over 25,000 outreach materials at these events.



Families learn about the Navy's environmental and energy programs during the NAS Patuxent River Air Show.

Kenneth Hess

“Sharing information about our environmental and energy successes—during special events and online—helps people who care about the Navy understand how serious we are about these issues, and empowers them to inform others,” said Kenneth Hess, Environmental Lead, Communication and Outreach Branch, OPNAV N45.

Among the highest profile outreach opportunities of 2011 was the NAS Patuxent River Air Show, 2-4 September, where all six Blue Angels flew on a 50/50 blend of camelina-based biofuel and conventional jet fuel. Navy outreach personnel and NAVAIR fuel scientists were interviewed by Southern Maryland radio station WSMD, demonstrated hands-on biofuel displays, and provided photo opportunities with naval aircraft—the Green Hornet (F/A-18 Super Hornet), MH-60S Seahawk, and T-45



Installations around the world participate in Earth Day activities and often invite local communities to participate.

MC1 Jay C. Pugh

Goshawk—that have all flown on a biofuel blend. Remarks at the event by Secretary Ray Mabus emphasized that energy efficiency and alternative fuel initiatives clearly have an environmental benefit, but that the Department’s primary purpose in pursuing them is to improve warfighting capability.

### Moving Out on Social Media

The Navy enhanced its online environment/energy presence on social media platforms in 2011, including the Naval Energy Facebook and Twitter pages, the *Currents* magazine Facebook, Twitter, and Flickr pages, and the Navy Energy and Environment YouTube channel.

### Stay Connected Online

**TO LEARN MORE** about the Navy’s environmental accomplishments, visit us at [www.greenfleet.dodlive.mil](http://www.greenfleet.dodlive.mil), or “like” us on Facebook at <http://facebook.com/navycurrents> and <http://facebook.com/naalenergy>. And don’t forget to look for the Navy’s energy and environmental exhibit during Fleet Weeks, air shows, and other events.

Facebook users alone increased nearly 94 percent for both Facebook pages.

So far in 2012, the Navy continues to focus on achieving compliance goals for cleanup and munitions response, obtaining permits for at-sea training and testing, funding marine mammal research, ensuring our continued ability to train and operate ashore while minimizing impacts from local energy projects, and improving the effectiveness of outreach activities. As the Navy team makes solid progress toward SECNAV’s ambitious energy goals and remains responsive to emerging requirements, these environment-oriented programs—and the dedicated professionals who run them—deserve a tip of the hat for all they do to support the Navy’s mission and protect the global ecosystem we all share. 🌱

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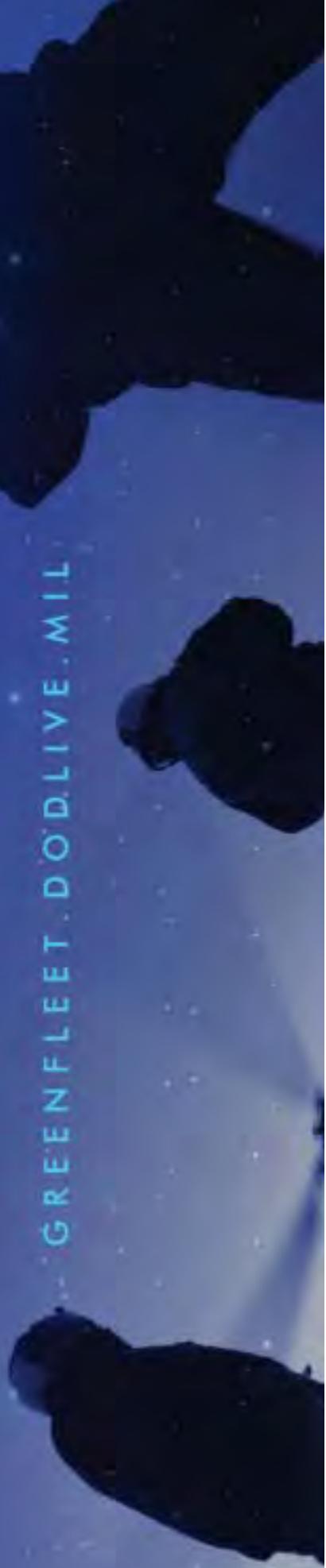
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# Creating Spartan Energy Warriors

## Highlights from the 2011 Naval Energy Forum

**ON 5 MAY** 1961, astronaut Alan Shepard, Jr., became the first American in space. His suborbital flight lasted just 15 minutes, but it led to President John F. Kennedy's challenge to Congress and the nation just twenty days later—"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth."

In 2009, in the wake of small Navy successes in energy efficiency and alternatives, Secretary of the Navy (SECNAV) Ray Mabus announced Navy energy goals that were every bit as ambitious as President Kennedy's challenge. And like the National Aero-

navics and Space Administration of the 1960s, today's Navy has risen to the challenge. At the 2011 Naval Energy Forum, hundreds of senior military, federal agency, Congressional leaders, and other professionals met to discuss challenges, successes, and the way ahead for achieving the Navy's and the nation's energy future.

Then-Rear Admiral Philip H. Cullom, Director, Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45), began the Forum with remarks about imperatives for change. He shared a number of global factors impacting U.S. policy, as well as the Navy's

Energy Program—increasing demand for energy by some of the most populous countries around the world, increasing oil prices and a global struggle to control energy costs, and increasing interruptions to access to reliable energy sources. "Given these new energy realities, there are many changes ahead. The



Secretary of the Navy Ray Mabus.

bottom line remains combat capability and energy security; therefore, we must take a broader look at energy and at what we can and should do," said Cullom. "We must have the vision to think about where we want the Navy to be in 2020 and 2030. Without that long view, we'll continually be making the short steps that are not enough to get us to where we need to go." (Note: As of 7 March 2012, Cullom was promoted to Vice Admiral and took over as Deputy Chief of Naval Operations for Fleet Readiness and Logistics (N4).)

Remarks by the Secretary of the Navy underscored the importance of the Navy's energy program. The Honorable Ray Mabus remarked, "We are a military organization. And we're doing



Vice Admiral Phillip H. Cullom with issues of *Currents* magazine.

this so that we can be a better military, so that we can fight better, so that we can perform the duties and the mission given to us by this country, now and into the future.”

Chief of Naval Operations (CNO) Admiral Jonathan Greenert agreed. “Simply put, we have got to be ready. And readiness and energy are clearly linked,” said Greenert.

During the Forum, speakers and participants discussed the Navy’s commitment to meeting Secretary of the Navy’s and the Chief of Naval Operations’ energy goals. What follows is a synopsis of the various programs and initiatives intended to improve energy efficiency and achieve energy independence.



Chief of Naval Operations Jonathan Greenert and Vice Admiral William Burke.

## SECNAV Energy Goals

AS THE U.S. GOVERNMENT is working to reduce energy consumption and lead the Nation toward energy independence, the Secretary of the Navy (SECNAV) has outlined five energy goals. These goals seek to enhance and better enable our combat capabilities, to provide greater energy security. Outlined below are examples of how the Navy is moving forward to achieving each of the goals.

### 1. Increase Alternative Energy Use Department of the Navy (DON)-wide

By 2020, 50 percent of total DON energy consumption will come from alternative sources.

- Decrease energy consumption through installation of energy efficient technologies and development of policies that encourage energy awareness and conservation.
- Continue aggressive pursuit by Marine Corps of technologies that will help achieve greater energy efficiency while increasing combat effectiveness in the theater.
- Partner with industry, commercial aviation, and other government agencies to develop a demand signal to alternative fuel industry and encourage growth of a domestically produced, cost competitive biofuel industry.

### 2. Increase Alternative Energy Ashore

By 2020, DON will produce at least 50 percent of shore-based energy requirements from alternative sources; 50 percent of DON installations will be net zero.

- Continue installation of energy efficient upgrades to buildings and facilities.
- Encourage military members and families to conserve energy through incentives and other programs to empower them to save and be aware of their own energy consumption.

- Produce or consume one Gigawatt of new, renewable energy to power naval installations across the country using existing authorities such as Power Purchase Agreements, enhanced use leases, and joint ventures.

### 3. Sail the “Great Green Fleet”

By 2012, DON will demonstrate a Green Strike Group in local operations and sail it by 2016.

- Complete biofuel blend testing of all Great Green Fleet components by the end of FY 2012, building upon Navy’s successful test of the F/A-18 E/F Super Hornet, RCBX (small assault craft), MH-60S Seahawk helicopter, MV-22 Osprey, T-45 training aircraft, F/A-18 C/D legacy Hornet, EA-6B Prowler, and MQ-8B Fire Scout unmanned aircraft on alternative fuels.

### 4. Reduce Non-Tactical Petroleum Use

By 2015, DON will reduce petroleum use in the commercial vehicle fleet by 50 percent.

- Increase purchase and use of flex fuel vehicles, hybrid electric vehicles, and neighborhood electric vehicles.
- Expand alternative fuel infrastructure to support these vehicles.

### 5. Energy Efficient Acquisition

- Create a standardized process for determination of lifecycle energy costs, fully-burdened cost of energy and other energy related characteristics of potential platforms, weapons systems, and buildings.
- Encourage contractors to minimize energy footprint and factor energy into the acquisition decision making process.



Vice Admiral David Architzel.

In addition to successfully testing and certifying its aircraft to fly on biofuel blends, Naval Aviation is actively pursuing a full spectrum of technologies to increase aircraft efficiency. (For more insights, read the Fuels Certification Program section in this article and our cover story in this issue of *Currents*.) Efforts are currently underway to increase the engine efficiency of the both the F/A-18 Super Hornet and F-35 Joint Strike Fighter. Also under evaluation are innovative coatings for the airframes' exteriors that reduce friction and drag. Flight simulator enhancements are being introduced across the fleet that will reduce the need for actual flight hours without impacting combat readiness. Even the equipment used to launch aircraft from carriers is being re-designed for energy efficiency. At the 2011 Forum, Vice Admiral Architzel shared the progress on the electromagnetic aircraft launching system,

We need to insist upon using every tool in the toolbox to maximize energy conservation while meeting our mission.

—Vice Admiral David Architzel

### Naval Aviation

Naval Aviation is at the forefront of introducing energy efficiency advancements to its fleet of over 3,700 fixed and rotary wing aircraft. The approach has been systematic and holistic, as every aspect of the program is a target for efficiency gains and every member responsible for energy consciousness. At the 2011 Naval Energy Forum, Vice Admiral David Architzel, Commander of the Naval Air Systems Command (NAVAIR), stated, “Our plan is to fly all Navy aircraft on biofuels. Navy aircraft will be designed and sustained to achieve maximum energy efficiency. And as a leader in innovation, Naval Aviation will continue to be the global force for good.”

In 2011, Naval Aviation strengthened this commitment to operational energy conservation by launching the Aircraft Energy Conservation Program (Air ENCON). Through fleet training and outreach opportunities, Air ENCON will develop and institutionalize energy conservation best practices across the fleet. Energy-optimizing mission planning, increased utilization of synthetic training, and more efficient refueling are just a few of the initiatives demonstrating the aviation community's proactive approach to conservation.

a technology that uses a short burst of compressed energy to propel aircrafts up to launch speeds and is ten times more energy efficient than the steam catapults used today.

“The knowledge is out there, and we need to insist upon using every tool in the toolbox to maximize energy conservation while meeting our mission,” said Architzel.



Admiral John C. Harvey.



Rear Admiral Ann Phillips.

### Maritime Initiatives

“Improving our energy efficiency, and investing in alternative fuels, increases our ability to execute prompt and sustained combat at sea.” These words, offered by Admiral John C. Harvey, Commander, U.S. Fleet Forces, at the 2011 Naval Energy Forum, reinforce the fundamental mindset behind the entire Navy Energy Program—energy is a strategic resource that enhances combat effectiveness. Pursuing and achieving operational energy efficiencies reduces vulnerabilities while increasing capabilities, resulting in a more lethal, more effective, maritime fleet.

While confident that such a future is attainable, Admiral Harvey recognizes that there is no “silver bullet” solution to the Fleet’s vast energy demands in the present. But as he acknowledged, “Small steps can get you big results.” By installing solid state lighting, using Shipboard Energy Dashboards that display energy loads and Smart Voyage Planning decision aids that determine most fuel-efficient transit routes, and back-fitting the fleet with energy efficient hybrid drives,

propeller coatings, and stern flaps, the Fleet has already begun to realize the benefits of its investments and will continue to do so as new and innovative advancements come online. Rear Admiral Ann Phillips, Director, Surface Warfare Division, concurs with the incremental approach, “These ships burn large amounts of fuel every year, so even a small savings will add up to a considerable amount over time.”

### Expeditionary

Innovative energy and water solutions for the individual operatives who are forward deployed at the tip of the spear help to eliminate the logistical tether and allow them to operate with increased speed, flexibility, and lethality. As articulated by Colonel Robert Charette, Director of the U.S. Marine Corps Expeditionary Energy Office, “Aggressively pursuing renewable and energy efficient technology is about making a more combat effective Marine Corps. This means a Marine Corps that is lighter and more self-sufficient than today, can operate in austere locations, and stay longer at less risk.”

Validation of these efforts is already being reported back from the front lines. In recent operations in Afghanistan, India Company 3rd Battalion/5th Division brought with them several experimental

solar energy technologies designed to decrease their energy footprint. These prototypes included SPACES, a flexible panel used for charging small items such as batteries and radios, and GREENS, a larger solar array capable of powering a platoon-sized Combat Operations Center. India Company’s evaluation of, and training with, these samples was so overwhelmingly positive that it prompted large-scale implementation when the battalion actually deployed.

Consistent with the Marine Corps expeditionary energy successes, Secretary Mabus announced at the 2011 Naval Energy Forum plans to deploy a SEAL team utilizing a myriad of advanced energy and water technologies. This endeavor is part of a “Net Zero Energy-Net Zero Water” initiative where the SEALs, once deployed, will be entirely self-sufficient for their mission power and water requirements. The Navy Energy Coordination Office (located within OPNAV N45) is working in conjunction with the Naval Facilities Engineering Command, the Expeditionary Warfare Division (OPNAV N85), and the Naval Special Warfare Command to identify and



Colonel Robert Charette.

procure the equipment that will fulfill this objective, including man-portable water purification systems, solar/DC-powered refrigeration units, and universal small battery charging units.

## Shore

There are more than seventy shore-based installations spread around the globe. Most of these facilities draw upon a fragile and overly burdened commercial electrical grid for the

energy supply for shore installations is an essential piece the Navy's Energy Program. As Vice Admiral William French, who at the time of the Forum served as Commander, Navy Region Southwest (now serving as Commander, Navy Installations Command) stated, "At the end of the day, it's all about energy security. We don't want to have to spend time worrying about our grid or our backup grid, and we need energy security to do that..."

and reduce dependence on the commercial grid.

Eliminating wasted energy reduces consumption on Navy facilities, further reducing vulnerability to man-made or natural catastrophes. The Navy invests funds in purchasing and installing advanced metering systems which can, in real time, monitor energy consumption down to the building level. These data will inform strategic facility management decisions that

To be considered net-zero, the installation must match or exceed the energy it consumes with energy generated on or near the installation from alternative energy sources.

energy they need to support the Fleet. This reliance on an external energy supply presents a significant vulnerability: any interruption—be it from human error, natural disaster, or targeted enemy attack—could cripple critical Navy infrastructure, such as communications, radar, and other defense-related networks. Protecting

The SECNAV, CNO, and other Navy leaders have recognized this potential vulnerability and have made facility energy security a priority. The Secretary of the Navy has set ambitious goals of protecting critical infrastructure via reliable and redundant power systems and by establishing 50 percent of Navy bases as net-zero by 2020. To be considered net-zero, the installation must match or exceed the energy it consumes with energy generated on or near the installation from alternative energy sources. The Navy is also investing in alternative energy production through wind turbines, geothermal systems, and small-scale solar arrays that supplement energy generation

can result in the capture of significant energy savings. Further, new shore construction will be built to mandatory energy efficiency specifications.

## Fuel Certification Program

While the aviation, maritime, expeditionary, and shore communities have their own unique efficiency challenges, they also share in a common energy need—liquid fuel. From aircraft to submarines, amphibious assault vehicles to re-supply jeeps, liquid fuel is a nearly universal requirement in both combat and support operations. Wary of the price fluctuations that stem from a volatile commercial market and finite world supply, SECNAV and CNO have put forth ambitious goals for reducing total consumption while simultaneously increasing the percentage fuel derived from renewable sources.

Significant advancement has been made towards these goals. In the last



Vice Admiral William French.

twenty-four months alone, NAVAIR has completed flight testing of 50/50 biofuel blend for use in all Navy tactical aircraft with universally successful results. Similar progress has been made on the Maritime side; in the last two years, biofuel blends have been successfully demonstrated on an Experimental Riverine Command Boat (RCB-X), a Landing Craft Air Cushion (LCAC), and, in the largest demonstration of biofuels to date, a Self Defense Test Ship (USS Paul F. Foster). Given that the maritime and aviation communities constitute about 93 percent of the Navy's total petroleum consumption, these advancements represent a critical milestone in achieving these targets.

The Navy's vision stretches beyond the short-term horizon and it is committed to perpetually qualifying and fielding even more game-changing energy solutions. Future testing will be conducted on additional promising fuel production technologies and sources with the goal of expanding the field of potential power generators for Naval ships and aircraft.

### **Command, Control, Communication, Computers, Combat Systems & Intelligence**

A strategic analysis of the energy used by command, control, communications, computers, combat systems, and intelligence (C5I) systems across the Navy may reveal potential energy savings in traditionally unexplored areas. Energy efficiency can be optimized in these environments in the same manner that an aircraft or submarine can be, and the savings realized are just as valuable. Rear Admiral Matt Klunder, who at the time of the Forum served as Director of Intelligence, Surveillance, and Reconnaissance Capabilities (OPNAV N2/N6) (and now serves as Chief of Naval Research), discussed how a Navy that optimizes C5I systems might reduce its energy demand, "It means maybe that a building gets a lot smaller, maybe the power required for that building is a lot less, and maybe there's a lot fewer people inside that building."

OPNAV N45 is currently baselining the Navy's C5I energy consumption and conducting an analysis of how it impacts the Navy's total energy consumption. For example, the energy required to power Navy/Marine Corps Intranet end-user devices (desktop computers, monitors, laptops) represents nearly one-and-a-half percent of total Navy energy use ashore. Capturing even incremental efficiency improvements in C5I environments, via unobtrusive measures like shutting off machines in the evenings and weekends, could achieve



Rear Admiral Matthew L. Klunder.

significant reductions, allowing valuable resources to be redirected to other areas of critical need.

Data center consolidation is another undertaking that will lead to C5I energy savings. Led by OPNAV N2/N6, and with the support of numerous other organizations, the Navy will reduce the current duplication of time, effort, and resources by consolidating and optimizing its Information Technology environment across the country. The office of the Deputy Chief of Naval Operations for Information Dominance has called for a plan to reduce Navy storage facilities by 25 percent and increase server utilization by 40 percent or more as part of a government-wide effort first promulgated by the White House in 2011.

### **Acquisition**

In the current fiscal environment, it has become even more important to ensure that the components of our future force are frugal energy users. Because energy costs and fuel prices continue to rise, and budgets are increasingly pressurized, energy efficiency is one factor that stretches acquisition accounts. As a result, a June 2011 memorandum released by Assistant Secretary of the Navy for Research, Development, and Acquisition Mr. Sean Stackley ordered the Navy to "take substantive measures to include energy performance in the acquisition of platforms and weapon systems." This memorandum mandates the calculation of Fully-Burdened Cost of Energy (FBCE) and requires the Navy to use FBCE to evaluate the affordability of alternatives and make tradeoff decisions. Additionally, when considering modernization and upgrades to existing systems, Navy System Commands must factor in energy efficiency.



Vice Admiral Phillip H. Cullom, Rear Admiral William French, and Colonel Robert Charette.



Former Senator John Warner addressing a question from the audience.



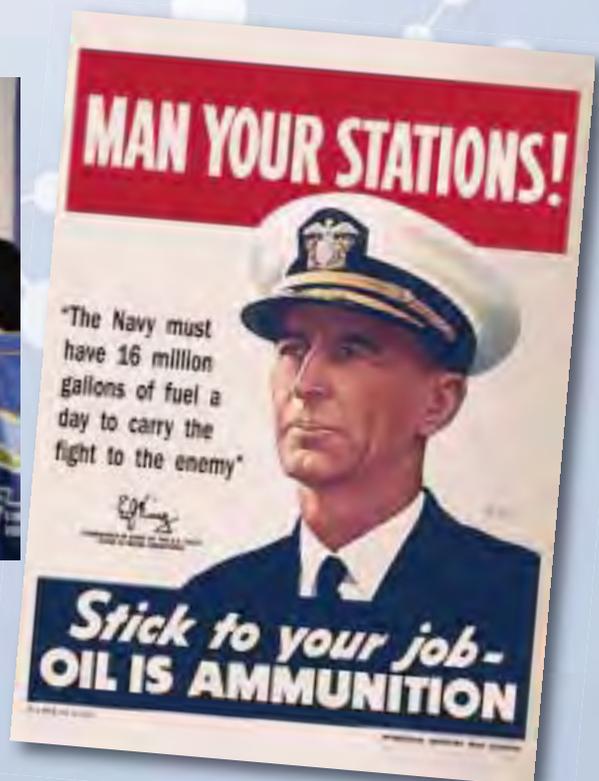
Former Senator John Warner and Vice Admiral David Architzel.



Vice Admiral Phillip H. Cullom, Mr. Tom Hicks (Deputy Assistant Secretary of the Navy (Energy)), Dr. Henry Kelly (Acting Assistant Secretary and Principal Deputy Assistant Secretary for the Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy) and Ms. Sarah Bittleman, Senior Advisor to U.S. Department of Agriculture Secretary Tom Vilsack.



Vice Admiral Phillip H. Cullom, former Senator John Warner, and the World War II "Oil for Ammo" poster.



As the resource sponsor for all readiness and logistics for the Navy, the Chief of Naval Operations for Readiness and Logistics (OPNAV N4) must increasingly consider energy factors as it continues to, in the words of Assistant Deputy Chief of Naval Operations for Readiness and Logistics Ms. Jo Decker, “ensure that our force structure—including ships, aviation, weapons, supply—are funded, maintained, trained, and ready to respond to the Combatant Commanders’ requirements.” This responsibility applies not just to today’s force, but to tomorrow’s force as well. As Ms. Decker pointed out at the 2011 Naval Energy Forum, OPNAV N4 must work with Chief of Naval Operations for Integration of Capabilities and Resources (OPNAV N8), requirement sponsors, and platform sponsors to successfully anticipate and fund future requirements. By building energy efficiency into calculations of platforms’ total ownership costs, OPNAV N4 is helping to institutionalize the Spartan warrior mindset into the Navy acquisitions paradigm.

### Resourcing Energy Capabilities

Speaking at the Forum, Vice Admiral John Terence Blake, Deputy Chief of

Naval Operations for Integration of Capabilities and Resources, described his position as “the Chief Financial Officer for the Navy.” In that capacity, Vice Admiral Blake must negotiate the slim trade space between readiness and fiscal pressures, such as the current ten-year federal discretionary spending cap. Energy costs comprise a significant portion of this limited room for maneuver.

In order to properly resource energy capabilities, Vice Admiral Blake revealed that the Navy must design fuel efficiency in the “front end” of the acquisitions process, rather than trying to have it forced out “at the back end by the commander in the field.” For this reason, OPNAV N8 has championed efficiency initiatives, dedicating \$900 million in this fiscal year and \$3.7 billion across the

Future Years Defense Program, to energy investment in tactical systems at sea and ashore, with the goal of ensuring maximum combat capability with minimum energy expenditure. In the words of Vice Admiral Blake, “The Navy is committed to the energy program and investing in

areas that make sense for the Navy. And at the end of our day, the job of the Navy is to protect the nation, and responsibly invest in those programs and platforms that will defend against our most likely evolving threats. Energy is definitely a part of that equation.”

### Science and Technology

“We invest in technologies, and the development and discovery of technologies,” said Dr. Richard Carlin, Department Head of the Sea Warfare and Weapons Department at the Office of Naval Research (ONR), during the 2011 Naval Energy Forum. In that capacity, the ONR Science and Technology (S&T) Organization helps provide the necessary S&T to reach toward SECNAV’s energy goals. After the announcement of the SECNAV energy goals in 2009, ONR made power and energy one of its focus pillars; as such, the group continues to invest heavily in research and development of programs such as hybrid-electric ships, fuel cell cars, next-generation electronics using silicon carbide, and efficient tactical vehicles. ONR also



Vice Admiral John Terence Blake.



Ms. Jo Decker.

has contributed to the Navy's biofuel program by providing research supporting certification of the fuels and engaging in inter-agency efforts, such as helping the U.S. Department of Agriculture determine how to sustainably grow biomass. In fact, ONR supports a collective Spartan warrior mindset, as Dr. Carlin revealed, "reaching out to all of our partner services, all of our partners in the other agencies around the federal government, and of course with states and universities and everybody that we work with" to help discover and develop the S&T necessary to attain the energy goals. (For more insights about ONR's achievements in the energy arena, check out our spotlight interview of former Rear Admiral Nevin Carr and Dr. Richard Carlin in

the winter 2012 issue of *Currents*.)

### Culture Change

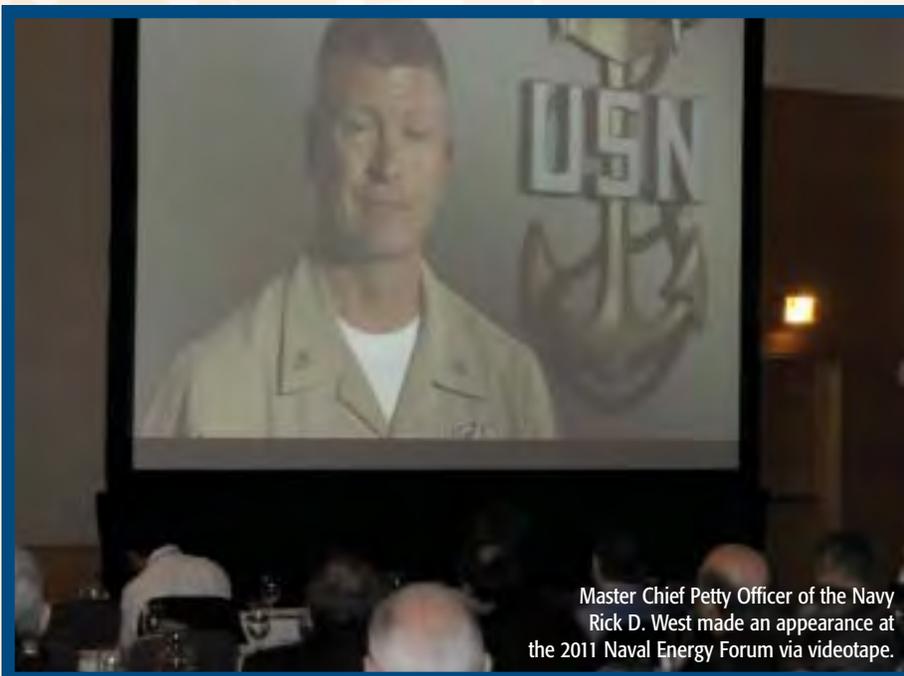
Modifying an organization's goals without changing its culture will accomplish very little. It is for this reason that leaders such as Commander, U.S. Fleet Forces Command, Admiral John C. Harvey and Master Chief Petty Officer of the Navy (MCPON) Rick D. West addressed the importance of changing the culture of the Navy to achieve an 'energy frugal' mindset.



Dr. Richard T. Carlin.

As Admiral Harvey indicated at the 2011 Naval Energy Forum, the young Sailors who form the "great core of our force... grew up green." Thus, the culture change challenge lies in institu-

Modifying an organization's goals without changing its culture will accomplish very little.



Master Chief Petty Officer of the Navy Rick D. West made an appearance at the 2011 Naval Energy Forum via videotape.

tionalizing the "green" nature of our Sailors into daily deckplate practices, in moving this concept up the chain of command, and helping Navy Sailors, officers, civilians, and families at all levels realize the tactical and strategic impacts of energy use and conservation. The end goal of culture change, as Admiral Harvey pointed out, is to make energy conservation and efficiency practices part of the natural, instinctive behavior of all Navy personnel—the resulting 'energy-smart Navy' will have "an overwhelming strategic advantage over potential adversaries."

Before leaving on a trip to the Middle East where MCPON West was scheduled to meet with Sailors stationed there, he videotaped his comments

# We must evolve today if we are to be an agile Spartan Naval Force for the 21st Century.

—Vice Admiral Phillip H. Cullom

that were later replayed at the Forum. Those comments focused on Sailors' individual responsibility in achieving national energy security. "In order for us to remain a global force for good, we all need to think about energy—our energy security, efficiency, and independence," he said. MCPON encouraged Sailors to "think and live energy awareness," and invited Vice Admiral Phillip H. Cullom to discuss energy matters with the Navy's Fleet, Force, and Command Master Chiefs at the MCPON Leadership Mess

## Future Energy Milestones & Events

TO MONITOR FUTURE milestones and events, such as the Green Strike Group demonstration (scheduled for this summer as part of the 2012 Rim of the Pacific Exercise) and the fourth annual Naval Energy Forum (scheduled for 17–18 October 2012 in Washington, D.C.) go to [www.greenfleet.dodlive.mil/energy](http://www.greenfleet.dodlive.mil/energy) or [www.facebook.com/naenergy](http://www.facebook.com/naenergy).

Symposium, which occurred shortly after the Forum.

The Navy is now aggressively pursuing culture change through many efforts. The aviation community is stimulating change by revitalizing its Air ENCON program. The surface community is adding an energy component to the Battle E award to encourage ships to more closely consider how they use energy. In order to educate future energy leaders, the Naval Postgraduate School is initiating two energy-related master's degrees. Additionally, in order to promote a Navy-wide energy culture and provide a forum for Sailors and deckplate leaders to share their best ideas for increasing combat capability along with energy efficiency, MCPON West is standing up a Senior Enlisted Energy Executive Steering Committee to advise the Navy's Task Force Energy.

## Conclusion

"We must evolve today if we are to be an agile Spartan Naval Force for the 21st Century." This forward-leaning directive, articulated first in Vice Admiral Phillip H. Cullom's opening remarks and then echoed by nearly all the 2011 Naval Energy Forum's other distinguished presenters, speaks to both the critically and immediacy of

a new Naval energy direction. Energy is a strategic resource that enhances combat capability. Whether afloat or ashore, from commanding officers to the future Sailors enrolled at the Academy, this mindset must resonate through the Fleet and strengthen its ability to maintain, train, and equip combat-ready Naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. Last year's Forum attendees heard firsthand the advancements that have been made to-date. This fall, the 2012 Naval Energy Forum (scheduled for 17–18 October 2012 in Washington, D.C.) will celebrate the even greater progress made towards securing a safe, sustainable energy future for the Navy and the country she protects. ⚓

Photos by *Mattox Photography*

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# State-of-the-Art Fuel Cleaning System Saves Millions of Dollars at Pearl Harbor

## System Cleans Marine Diesel Fuel by Removing Particulate Contaminants & Trace Quantities of Seawater

**A PROTOTYPE SYSTEM** at Pearl Harbor that cleans marine diesel fuel removed from Navy vessels during maintenance availabilities is saving taxpayers and the U.S. Pacific Fleet millions of dollars in fuel replacement and disposal costs.

Prospects are bright for even larger savings—not just at Pearl Harbor, but Navy-wide—as placement of production models of the prototype fuel cleaning system is considered for additional Fleet locations.

The system is one of many initiatives of the Commander, U.S. Pacific Fleet's (COMPACFLT) Integrated Energy Strategy, under the leadership of Rear Admiral Kate Gregory, commander, Naval Facilities Engineering Command, Pacific, and Rear Admiral Richard D. Berkey, deputy chief of staff for fleet maintenance for the Pacific Fleet.

COMPACFLT funded the innovative prototype system, which was designed and developed by Keith Nesmith, Navy Region Hawaii's port operations program manager.

Before ships undergo maintenance or repair work at Pearl Harbor Naval

Shipyards, the fuel tanks often must be emptied. These tanks typically contain both marine diesel fuel (F-76) and seawater, which serves to compensate for weight lost as fuel is consumed, in order to preserve the ship's trim. While the two liquids don't mix completely, there's usually some seawater in the fuel and some fuel in the seawater. In the past, the

fuel was removed and discarded as waste, and the contaminated compensating water (comp water) was processed through a pierside Bilge and Oily Wastewater Treatment System (BOWTS). Recognizing the potential for significant savings, Nesmith envisioned a system that would clean the marine diesel fuel by removing particulate contaminants



Pearl Harbor's new fuel and comp water cleaning system consists of the fuel cleaner subsystem (at right behind the generator), the comp water cleaner (at left center) and the zinc remover (at far left).

*MC2 David J. Kolmel*

and trace quantities of seawater, enabling the fuel to meet military specifications. The result is the fuel can be used or returned for full credit. Without that processing capability, the Navy lost the use of the fuel, which currently costs more than \$3 a gallon.

“In the past, every time we defueled a ship, we had to pay a contractor to get rid of the fuel,” said Nesmith, “Not only did we lose the value of the fuel, we were paying to have it taken away, which made no sense to me.”

A couple of years ago, Nesmith located a 1969-vintage jet fuel cleaner at Marine Corps Base Hawaii and put it to work cleaning contaminated marine diesel fuel at Pearl Harbor. The unit was slow, unreliable and equipped with expensive filters prone to fouling.

Nesmith, a retired Navy officer, studied the subject of fuel cleaning and fuel specifications, and conceived a series of filters to trap contaminants and remove seawater. He was unable to find any commercially available systems, but did locate an east coast contractor willing to build a system to meet Navy requirements.

COMPACFLT provided \$250,000 from its Integrated Sea-Shore Energy initiative, a wide-ranging effort to reduce consumption of petroleum-derived energy under the Secretary of the Navy’s energy goals.

The new Fuel Oil Water Cleaning System uses a series of industrial filters to capture particulates from the fuel and coalescers to remove seawater. The system can process fuel at a rate of up to 500 gallons per minute.

“The Navy can reuse the fuel, saving millions of dollars in the process,” said Nesmith. The new system cleans fuel much faster and more thoroughly than the old jet fuel system. “It’s one-of-a-kind, state-of-the-art technology that paid for itself with the first 70,000 gallons of fuel it cleaned,” he continued.

Working with COMPACFLT’s energy manager Matthew Cohen, Nesmith had the contractor fabricate a second system to treat comp water removed during the defueling process.



Zinc removal subsystem on YON-328 at Pearl Harbor. In background is the comp water cleaner and at right is the fuel cleaner.

*MC2 David J. Kolmel*



A no-drip hose connection between a fuel barge and USS Chung-Hoon.

*MC2 David J. Kolmel*

The comp water removal system that Cohen and Nesmith devised provides the Navy with an alternative to using the BOWTS, which now costs 42 cents per gallon of water processed. In addition to removing fuel from the comp water, a third set of equipment removes trace quantities of zinc, which gets into the comp water from the sacrificial anodes that protect the steel fuel tanks from corrosion. Operated either as stand-alone units, or as a coordinated system, all three equipment packages are located on a fuel

barge (also known as a “YON” for Yard Craft-Oil-Navy) that can be placed alongside any ship requiring defueling.

“This new system is cost-effective in many ways, not the least of which is the reduction of the load on our BOWTS,” said CWO3 Timothy Greene, Joint Base Pearl Harbor-Hickam port operations officer. “In addition, it is also good for Hawaii’s environment.”

The full system works like this. Contaminants are removed from the fuel as a ship’s fuel tanks are emptied into the

tanks on the YON. There, the fuel and comp water are allowed to settle into separate layers (water is denser than marine diesel fuel). After the fuel and water have settled, the water is pumped out of the bottom of the holding tank, and cleaned of fuel and zinc before being pumped into a wastewater system ashore. The fuel that remains in the YON is run through the fuel cleaning system, which removes contaminants and any residual seawater. After inspection, testing and certification by a fuel laboratory, the fuel is ready for reissue to a ship or

submarine requiring fuel, or return to the local fuel activity for credit.

Captain Dan McNair, COMPACFLT deputy fleet civil engineer, says, “This project demonstrates the Secretary of the Navy’s goal of reducing waste streams conserves resources, increases combat effectiveness, and saves taxpayers millions of dollars,” a reference to Secretary of the Navy Ray Mabus’s energy initiatives.

“Every gallon of fuel reclaimed is one less we have to bring to Hawaii over very long supply routes,” McNair said.

## About Keith Nesmith

PEARL HARBOR’S NEW fuel and comp water cleaning systems are only the latest innovation from the active mind of Keith Nesmith, port operations program manager for Navy Region Hawaii.

Nesmith retired from the Navy in 2006 as a commander, after 14 years of enlisted service and 16 years as an officer. His last job in uniform was port operations officer for Naval Station Pearl Harbor, so he didn’t move far when he retired. Since then, he has saved taxpayers tens of millions of dollars with innovations that include:

- **A multi-function paint/maintenance barge system to replace the scaffold-like contraptions that workers stand on while painting or preparing ship hulls for painting.**

In 2006, Nesmith designed the new paint/maintenance barge to incorporate a 32-foot hydraulic lift, lights, a power generator to operate power tools on the main deck and lift platform, and paint/hazardous material

**2011 demonstration of the new paint maintenance barge that Keith Nesmith designed to replace the old cumbersome one-, two-, three- and four-tier paint floats at Pearl Harbor.**

*Keith Nesmith*



containment system to a barge in order to support the Fleet’s maintenance requirements. The paint/maintenance barge is far safer, more stable and maneuverable and more environmentally friendly than the clumsy old system. The new paint/maintenance barge is also far less expensive to maintain and procure. The new paint/maintenance barge has proved to be more effective and efficient, reducing old paint float inventory by 50 percent, and saving \$1.6 million in annual labor and material costs, \$900,000 in annual preventive maintenance costs, and \$4.8 million in phase replacement costs.

- **Improved oil spill containment system for Pearl Harbor.**

In 2007, Nesmith devised a boom guide system that significantly reduced oil boom maintenance labor costs by 90 percent, and maintenance, cleanup and operating costs while ensuring efficient and effective containment of spills in the harbor. The system allows quick removal and installation of permanent oil boom for maintenance, repair and oil spill containment.

- **Replaced the aging USS Arizona Memorial ferry boats with new boats that run on biodiesel in 2009.**

The boats carry 1.6 million visitors a year. As a member of the integrated product team for the new boats, Nesmith ensured that the boats were designed to operate on clean-fuel technology, meet operational requirements, and provide a safe environment for passengers by designing cleats into the freeboard of the boat and were equipped with bow thrusters to assist the Navy crew in mooring evolutions. He also saw that the boats were numbered after the USS Arizona (39-1 through 39-6),



Lieutenant Commander Will Hagan and Matthew Cohen from the Commander, Pacific Fleet staff inspect comp water cleaner aboard fuel barge (YON-328) as it defuels USS Chung-Hoon (DDG-93).  
*MC2 David J. Kolmel*

and with the help of the Commander, Navy Region Hawaii Public Affairs Office, were named for 7 December 1941, Medal of Honor recipients. “The boats are state-of-the-art, reliable, environmentally friendly and represent the Navy’s honor, courage, pride and commitment,” he says.

- **Designed a port operations computerized management program called Port Operations System Tracking (POST) process for Pearl Harbor.**

The program ensured port evolutions were executed on time and flawlessly every time. The POST system was incorporated in what is now known as Port Operations Management System (POMS), which is used to manage all port requirements in support of the Fleet. For an evolution such as a ship tying up at a pier, connections/disconnections of hotel services, POMS ensures all port support requirements are scheduled, published, executed safely, and on time, every time. “Personnel must answer questions in order to schedule an evolution. This process ensures my personnel and other organizations have all the right equipment and information to successfully manage and execute these tasks in support of the Fleet requirements. Every question has to be answered, down to ‘What size hose does the ship need for fueling?’” Nesmith said. The POMS system allows three people at Pearl Harbor Port Operations to do what would normally take several dozen.

These innovations, he says, “are, first, a result of ensuring my organization and personnel are extremely successful in executing their mission professionally and safely every time. Second, my ideas must



Keith Nesmith, Navy Region Hawaii port operations program manager, and COMPACFLT energy manager Matthew Cohen recall the months they spent perfecting the new fuel and comp water cleaning system.  
*MC2 David J. Kolmel*

provide a one- to two-year return on investment for the taxpayer. Third, they must provide unprecedented efficiencies.”

Stay tuned. He’s already working on another idea to improve port operations and save significant money for taxpayers and the Navy.

“My challenge to the rest of the Navy is, if you have a good idea on how to be more efficient and effective, then share it with your chain of command so that it can be properly staffed and implemented,” he said.



Left and center, samples of comp water from two levels in the holding tank of a ship waste off-loading barge (SWOB). At right, water from the same tank after being run through the comp water cleaner.

MC2 David J. Kolmel

He credits Nesmith and Cohen for the success of the prototype systems.

“They worked tirelessly with the contractor to work the bugs out,” said McNair. “While the technology of fuel

waste. That fuel was run through the cleaning system and returned to military specifications, saving the Navy about \$355,000—a full return on investment after one use.

marine diesel fuel, saving COMPACFLT and the Navy over \$8 million in fuel replacement costs and more than \$3 million in cost avoidance from not having to dispose of the fuel as waste.

“In addition, once the comp water cleaning system is placed into full service, we expect to save up to a million dollars a year in comp water processing costs,” Nesmith added.

The fuel cleaning system is such a success that Nesmith has received approval and funding from Commander, Navy Installations Command (CNIC) to design and acquire a more compact, purpose-built platform for the fuel and comp water cleaning equipment to be mounted on.

## The Navy can reuse the fuel, saving millions of dollars in the process.

—Keith Nesmith

filtration is not new, creating a system able to separate water and zinc contamination from fuel to meet military fuel specifications in large volumes was an untested idea.”

Nesmith says, “Now we’ve moved beyond testing into operations and are saving lots of money, while significantly reducing our amount of waste.”

For example, the cleaning system was recently used to recover 90,000 gallons of F-76 marine diesel that had failed a fuel laboratory test and been declared

In another case, the Defense Logistics Agency (DLA) and Naval Supply Systems Command (NAVSUP) asked Navy Region Hawaii to clean 100,000 gallons of F-76 marine diesel that had been pumped through newly replaced fuel pipelines and was deemed contaminated and unfit for issue. The fuel was cleaned and returned to military specifications, saving hundreds of thousands of dollars.

In its first year, Navy Region Hawaii has cleaned 2 million gallons of F-76

“The platform will make it easier to maneuver around the harbor and between ships,” he said.

Additional fuel cleaning systems are on order, with the next system scheduled for delivery to a Navy facility located on Washington State’s Puget Sound. [↴](#)

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## Naval Safety Center Serves Up Fleet Environmental Training

Online Initiative Blended with Afloat Environmental Protection Coordinator Course

**THE NAVAL SAFETY** and Environmental Training Center (NAVSAFENVTRACEN), a leader in naval environmental protection training and Distance Learning, recently implemented their blended online initiative with the Afloat Environmental Protection Coordinator (AEPC) course.

AEPCs act as the key environmental advisor to commanding officers and are required on all afloat units. They play a critical role, ensuring national and local environmental requirements are met during underway and in port operations. AEPC training is a requirement for qualification as an AEPC and covers a variety of topics, from oil spill contingency planning to environmental compliance evaluation and assessment. Until recently, students were required to attend a two-day resident course in San Diego, CA, Norfolk, VA, or at one of a few Video Tele-Training (VTT) facilities. In either case, students were required to travel to the location where the training was offered, often costing valuable travel dollars, transit time, and mission disruptions.

### Enter the Age of Cloud-based Collaborative Learning Environments (CLE)

Partnering with the Naval Postgraduate School (NPS), NAVSAFENVTRACEN developed a course architecture, integrating the Sakai CLE, hosted at NPS, with Defense Connect Online (DCO). (Note: Sakai is an open source educational software platform distributed under the Educational Community License.) This new training modality provides both asynchronous (student centric) and synchronous (instructor led) components with real life scenarios that immerse the student in the role of the

AEPC onboard ship. Within the course structure, students must respond to a variety of real world events that weave them through the AEPC knowledge base, requiring critical thinking and problem solving. The solo work performed by the student is interspersed with short, strategically-scheduled, live sessions with the instructor, from both a presentation and 'professor office hours' perspective, where students can join a virtual classroom established by the instructor, for live one-on-one or group discussions.

### Choice, Freedom & Savings

The Sakai-based global online course is 16 hours of curriculum, the same as the resident and VTT venues. Students are given five days to complete the course, providing a convenience to work within varying schedules and commitments to complete and submit assignments and engage with the instructor, all without the need to go on Temporary Assigned Duty (TAD). "Our vision is to offer choice to our customer in how and where they train, by using innovative and emerging technologies like Sakai and DCO," said CDR Greg Cook, NAVSAFENVTRACEN Commanding Officer. The Sakai and DCO portal is available 24/7 and can be accessed from practically any computer and location with a broadband internet connection.

Course Manager and Instructor, Michelle Smith says that students are attending the training from multiple locations; ship, office, home and even an internet café. "They appreciate the flexibility, including the ability to access the training using their own equipment," said Smith. The Java enterprise-based Sakai and Flash-enabled DCO do not require an application download, allowing fast ease of access through an internet browser. Since all materials are stored on the cloud, both instructor and students can access the portal from multiple computers and locations based on their individual needs, providing unparalleled choice and access freedom.

Through use of Sakai and DCO, NAVSAFENVTRACEN has built an innovative and collaborative training platform that provides afloat commands with highly trained AEPCs ready to support environmental mission requirements, without the high cost associated with travel and TAD. 

### The Basics About NAVSAFENVTRACEN

**NAVSAFENVTRACEN PROVIDES SAFETY** and environmental training across the Navy and Marine Corps enterprise. In FY11, the command trained 9,200 students at more than 40 worldwide locations using a variety of modalities including resident, video-tele-training and blended Distance Learning.

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## Jackalyne Pfannenstiel Guest Speaker at China Lake Groundbreaking

13.78 Megawatt Photovoltaic Solar System to Be the Largest in the Navy

**ASSISTANT SECRETARY OF** the Navy (Energy, Installations & Environment) Jackalyne Pfannenstiel was the guest speaker at the ceremonial groundbreaking of a 13.78 megawatt photovoltaic solar plant being built on 118 acres onboard the Naval Air Weapons Station (NAWS) China Lake in California. NAWS China Lake Commanding Officer Jeffrey A. Dodson hosted the event, which was held on 18 January 2012 at the construction site under sunny skies.

The plant is the first 20-year power purchase agreement awarded under Federal Legislation 10 USC 2922a—a long-term contracting authority mechanism. SunPower Corporation will construct, operate and maintain the system and sell the power to the Navy, while Metropolitan Life, the financier, will own the system. Under the agreement, NAWS China Lake will purchase \$80 to \$100 million worth of energy, at a negotiated price, from SunPower Corporation during the next 20 years, saving the Navy approximately \$13 million in energy costs with no start-up costs to the government. It is expected to provide 30 percent of China Lake's energy requirements.

When completed in the fall of 2012, the system will be the largest solar system in the Navy and the second largest system in the Department of Defense. The largest is at Nellis Air Force Base, NV.

"China Lake is an energy heartland for the state, for the country and for the Navy," said Pfannenstiel, referring to Coso Geothermal, the geothermal plant on base that produces about 200 megawatts of base-load power.

However, to meet the Department of the Navy's goal of meeting half of its energy consumption with alternative sources by 2012, Pfannenstiel said more renewable power from fertile sites such as China Lake is still needed. In fact, she said, the Navy is going to need to add an additional 800 to 1,200 megawatts of renewable capacity to its arsenal.

Pfannenstiel feels it can be done by employing "the best technologies, on the best sites, with the best partners."

According to Pfannenstiel, the best technologies are those that provide clean, sustainable, renewable power at prices

that are comparable to utility prices. She noted that the cost of producing energy from renewable sources has fallen significantly in recent years and she predicts it will continue to fall as technologies continue to advance. However, she noted, she hasn't seen any forecast that shows utility rates decreasing over the next decade.

Technologies that reduce the need for energy are also important, Pfannenstiel stressed. "The cheapest, cleanest, most secure kilowatt hour is the one we don't need to use. Energy efficiency technologies, as well as renewable technologies, will help us meet our 50 percent reduction goals," Pfannenstiel said.

China Lake is an energy heartland  
for the state, for the country  
and for the Navy.

—Jackalyne Pfannenstiel

Pfannenstiel said the best sites are those that provide abundant supplies of sun, wind, biomass or geothermal steam and are compatible with the military missions. "We must always be cognizant that some technologies at some locations are perfectly compatible with the military use of those sites, and others aren't," she said. "Having said that, however, I want to stress that concerns about mission compatibility can often be resolved with good faith efforts by all parties and, to meet our goals, the Navy must commit to seeking resolution where possible."

The final step in reaching the Navy's intended goal is great partners, noting this project had a series of partners, including SunPower Corporation and the State of California.

"Our success at meeting our alternative energy goals depends on our effectiveness at working with financial, environmental, utility and governmental partners," she stressed.

"The Navy has a long-standing record of identifying energy and water conservation opportunities across our facilities," said Commander, Navy Region Southwest (NRSW) Rear Adm. Dixon Smith. "For many years we have focused on energy efficiency improvements at every one of our shore installations," he continued.

To meet the many energy challenges now and in the future, Smith noted that the Southwest team would continue to focus on three areas:



ASN (E&E) Jackalyne Pfannenstiel (third from left) joins (left to right, first row) NAVFAC Southwest Capt. Clifford Maurer, NAWC China Lake Commanding Officer Capt. Jeffrey Dodson, NRSW Commander Rear Adm. Dixon Smith, Naval Air Warfare Center—Weapons Division (NAWCWD) Commander Mat Winter and SunPower Corporation President Howard Wenger in tossing the first shovel of dirt for the groundbreaking ceremony of the 13.78 megawatt photovoltaic solar power plant being built onboard NAWC China Lake. Watching the event are (left to right, second row) MetLife Private Securities Director Mark Bisci; City of Ridgecrest Councilman Jason Patin; Deputy Assistant Secretary of the Navy (Energy) Thomas Hicks; Kern County Supervisor Jon McQuiston; Deputy Director of the Governor’s Office of Planning and Research, Governor’s Military Advisor Wade Crowfoot; California Energy Commission Chair Dr. Robert Weisenmiller; NAWCWD Executive Director Scott O’Neil and Javier Reyes, field representative for California Assemblywoman Shannon Grove.

1. Instilling a culture of conservation throughout the Navy
2. Pushing toward energy efficiency and increased use of renewable energy sources
3. Ensuring energy security across Navy Region Southwest bases

“We are continuing to transform our culture from one of consumption to one focused on conservation,” the admiral said, noting they are doing this through greater transparency, by sharing data and information with their Sailors, civilians and senior leadership.

“Part of this culture change is to instill a sense of ownership and accountability for energy consumption, from the individual Sailor and families living in quarters, across our military and civilian employees in our work spaces, to our leadership who oversee a wide variety of missions across the Southwest,” Smith said.

He emphasized that as the culture change takes root, they also need to improve energy efficiency, reducing utility demand and cost.

Smith noted that when new buildings are constructed, the team focuses on total lifecycle costs, with the intent to

meet the mission in modern infrastructure that minimizes the Navy’s cost.

While the Southwest team has accomplished much, Smith said, there is still more to do, continually striving to identify significantly more opportunities to reduce energy consumption, improve shore efficiency and continually find smarter ways to accomplish the military’s mission.

“Blazing new trails is never easy and there is an extraordinary new level of effort that went into market research and preparing complicated acquisition documentation, navigating complicated regulation incentives, and doing technical analysis to put this together,” said Naval Facilities Engineering Command (NAVFAC) Southwest Commanding Officer Capt. Clifford Maurer, noting two other photovoltaic systems are already in the system—a one-megawatt photovoltaic system at Marine Corps Air Ground Combat Center Twentynine Palms and another one-megawatt system at Marine Corps Logistics Base Barstow. [↴](#)

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## NESDI Program Releases FY11 Year in Review Report

Eight Case Studies Highlight Successful Transitions of New Technologies into the Fleet

**THE NAVY ENVIRONMENTAL** Sustainability Development to Integration (NESDI) program has released its annual report to highlight the program's accomplishments in Fiscal Year (FY) 2011.



The report, entitled “NESDI FY11 Year in Review Report: Accomplishments of the Navy Environmental Sustainability Development to Integration,” contains a financial review of program expenditures as well as insights into projects that were particularly successful in demonstrating the use of an innovative technology or collecting critical information to enhance the efficiency of environmental management programs across the Navy. The following eight projects are presented as case studies in the FY11 report:

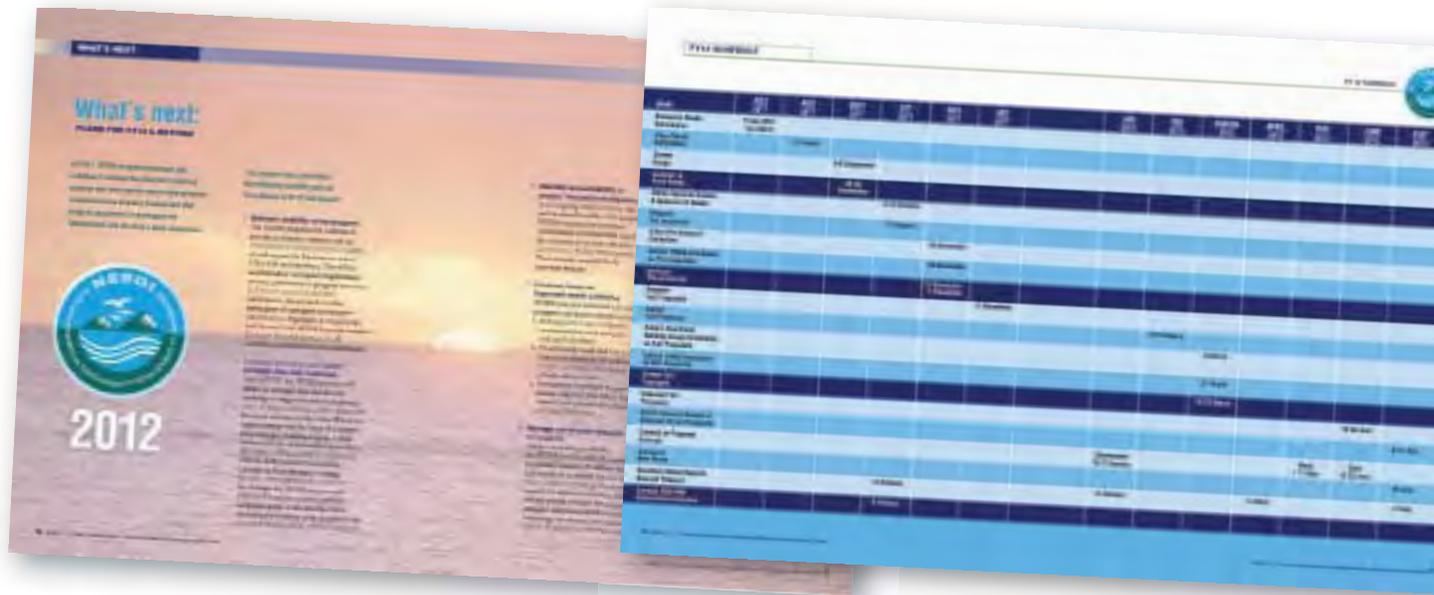
The technologies, studies, and models highlighted in this report support the Fleet through efficient and effective execution of environmental programs.

The NESDI program relies on all Navy personnel to help identify environmental concerns and support the implementation of resultant solutions. There are many ways to participate in the NESDI program, including:

- Submitting and validating environmental needs
- Reviewing technologies already in development
- Supporting transition efforts in your organization or at your installation
- Acting as a Principal Investigator on a NESDI project



PROJECT	DESCRIPTION
Operational Range Clearance—Alternative Green Targets	This project demonstrated and validated an alternative green tank target that lacks the hazardous components in tanks currently used on ranges. The green target is an effective replacement for the diminishing supply of M60 tanks.
Direct-Push and Point-and-Detect, In Situ Sensors for Perchlorate	This project validated the use of direct push and point-and-detect sensor systems for field use to measure perchlorate, either for rapid screening and monitoring purposes or for contaminant source characterization of perchlorate in groundwater or surface waters.
Evaluation of Corn Hybrid Polymer Blast Media for the Removal of Coatings from Delicate Substrates	This project provided an effective, environmentally preferred media to remove coatings from difficult, high-value, Naval Sea Systems Command and Naval Air Systems Command delicate substrates, including fiberglass, aluminum, carbon fiber, graphite, and Kevlar.
Sustainable Naval Facilities	This project identified and evaluated a web based assessment tool that Navy personnel can use to reduce the environmental impact of the Navy's existing facilities through the use of sustainable practices, policies, and technologies.
Dredge Spoil Management Alternatives Initiation Decision Report (IDR)	This project identified the Navy sites requiring dredging, determined the potential beneficial reuse of the dredged material from these sites, and evaluated the viability of using contaminated dredge spoils as a cement kiln feed stock.
Abiotic Treatment of 1,2,3-Trichloropropane (TCP) to Protect Drinking Water Resources	This project demonstrated that zero valent zinc can be used to treat TCP in groundwater.
Waste-to-Clean Energy (WtCE) IDR	This IDR identified WtCE technologies for potential implementation across the Navy. The IDR includes the development of model WtCE case studies to facilitate technology implementation at different Navy regions and/or installations.
Predictive Trajectory Model for Oil Spills for Navy Harbors	This project will improve the accuracy of the existing models to predict oil trajectories in Navy harbors and provide a validated modeling tool for the Navy On-Scene Coordinators with accurate information.



### Communication is Key at NESDI Stormwater In-Progress Review

**IN AN EFFORT** to address the emerging requirements associated with the ongoing challenges of effectively managing stormwater at Navy facilities, the NESDI program convened a meeting of stormwater end users, researchers and policymakers in San Diego on 10-11 January 2012. Communication, communication and more communication was the overriding theme of this two-day In-Progress Review (IPR)—better and more frequent communication among program personnel, Principal Investigators and end users who share in the responsibility to ensure that NESDI projects are efficiently executed and results are successfully transitioned.

Nearly three dozen participants from across the Navy gathered to hear briefings about ongoing projects, provide valuable feedback to Principal Investigators, and brainstorm on a roadmap for future program stormwater investments. In addition to personnel from the program's resource sponsor organization (CNO N45), end users from Naval Base San Diego, Naval Facilities Engineering Command (NAVFAC) Southwest, NAVFAC Northwest, NAVFAC Hawaii, and NAVFAC Mid-Atlantic joined NESDI personnel in person and over the phone to ensure existing projects and future investments are properly focused.

Follow-on tasks include a stormwater investment strategy (roadmap) and other IPRs to be held in other Navy regions to bring more end users into the fold. The NESDI program's other IPRs will be held this year on 8–10 May in Port Hueneme, California and 19–20 June in Arlington, Virginia. For more information, contact Cindy Webber at [cynthia.webber@navy.mil](mailto:cynthia.webber@navy.mil) and 760-939-2060.

- Providing demonstration sites for various NESDI projects
- Staying up-to-date by regularly visiting the program's web site

The NESDI program is the Navy's environmental research and development demonstration and validation program, sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division (CNO N45) and managed by the Naval Facilities Engineering Command. The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes, materials, and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness.

For a hardcopy of the NESDI program's FY11 and other Year in Review reports, please contact Lorraine Wass at 207-384-5249 or [ljwass@surfbest.net](mailto:ljwass@surfbest.net). An electronic (pdf) version of the report can also be downloaded from the program's web site at [www.nesdi.navy.mil](http://www.nesdi.navy.mil). 

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## Fiscal Year 2011 CNO Environmental Award Winners Announced

Annual Awards Recognize Outstanding Environmental Stewardship

**VICE ADMIRAL WILLIAM BURKE**, then-deputy chief of naval operations for fleet readiness and logistics (N4) (now deputy chief of naval operations for warfare systems (N9)), announced the winners in the fiscal year (FY) 2011 Chief of Naval Operations (CNO) Environmental Awards competition on 22 February 2012.

Your dedication to environmental stewardship is commendable and your actions exemplify the Navy's commitment to protecting and preserving the environment.

—Vice Admiral William Burke

The annual awards program recognizes Navy ships, installations, and people for outstanding performance in promoting environmental stewardship. Each year, environmental subject matter experts review nominations from commands around the world and select winners for each of the award categories. For the FY 2011 competition, 30 winners were selected in 10 award categories.

In a Naval message announcing the winners, Burke commended the winners.

“Congratulations to all award winners and nominees,” he said. “Your dedication to environmental stewardship is commendable and your actions exemplify the Navy’s

commitment to protecting and preserving the environment. Well done.”

Listed alphabetically within each category, the FY 2011 CNO Environmental Award winners are:



### Natural Resources Conservation, Small Installation

- Fleet Logistics Center—Puget Sound, Fuel Department, Washington
- Naval Support Activity Panama City, Florida
- Pacific Missile Range Facility Barking Sands, Hawaii

### Natural Resources Conservation, Individual or Team

- Naval Base Guam Public Works Department Environmental Division, Marianas
- Naval Support Activity Panama City Environmental Staff, Florida
- Pacific Missile Range Facility Integrated Natural Resources Management Plan Implementation Team, Hawaii

### Cultural Resources Management, Installation

- Commander, Fleet Activities Yokosuka, Japan
- Joint Base Pearl Harbor-Hickam, Hawaii
- Naval Base Guam, Marianas



Naval Base Guam.  
MC2 Peter Lewis

## Environmental Quality, Non-industrial Installation

- Commander, Fleet Activities Sasebo, Japan
- Commander, Fleet Activities Yokosuka, Japan
- Naval Base San Diego, California

## Environmental Quality, Individual or Team

- Awni M. Almasri of U.S. Naval Support Activity, Bahrain
- Naval Supply Systems Command Fleet Logistics Center Pearl Harbor Environmental Quality Team, Hawaii
- Navy Region Center Singapore Environmental Sustainability Team

## Environmental Quality, Large Ship

- USS Carl Vinson (CVN 70)
- USS Enterprise (CVN 65)
- USS Ronald Reagan (CVN 76)

## Sustainability, Industrial Installation

- Naval Weapons Station Seal Beach, California (including Detachments Fallbrook and Norco)
- U.S. Naval Ship Repair Facility and Japan Regional Maintenance Center, Yokosuka, Japan
- U.S. Navy Fleet Readiness Center East, Cherry Point, North Carolina

## Environmental Restoration, Installation

- Naval Air Weapons Station China Lake, California
- Naval Base Ventura County, Point Mugu-Port Hueneme-San Nicolas, California
- Portsmouth Naval Shipyard, Maine

## Environmental Restoration, Individual or Team

- Mare Island Investigation Area H1 Restoration Team, Naval Facilities Engineering Command Base

The aircraft carrier USS Enterprise (CVN 65).  
MC3 Nick C. Scott



Realignment and Closure Program Management Office, California

- Silver Strand Training Complex Navy Installation Restoration Site 11 Team, Naval Base Coronado, California
- Vieques Naval Installation Project Management Team, Puerto Rico

## Environmental Excellence in Weapon System Acquisition, Large Program, Individual or Team

- F/A-18E/F & EA-18G Program Office, PMA 265—Green Hornet Team, Patuxent River, Maryland
- PMA-290 Environment, Safety, and Occupational Health Team, Patuxent River, Maryland
- USS Virginia (SSN 774) Class Test & Evaluation Environmental Team, Washington Navy Yard, D.C.

All CNO winners advanced to the Secretary of the Navy level of competition. A ceremony honoring the winners and recognizing their achievements will be held 5 June 2012 at the United States Navy Memorial in Washington, D.C. ⚓

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## NAVSUP WSS Releases First-Ever Buy It Green Guide

Resource Designed to Promote Sustainable Purchasing

**EXECUTIVE ORDER 13423**, “Strengthening Federal Environmental, Energy, and Transportation Management,” mandates that sustainability buying is included in all transactions except tactical vehicles and equipment. This executive order along with other legal statutes requires the Department of Defense (DoD) to increase the use of sustainable materials.

The DoD Strategic Sustainability Performance Plan goal is that 95 percent of all applicable DoD procurements will include sustainability requirements. To support meeting that goal, Naval Supply System Weapon Systems Command (NAVSUP WSS) Code 0772, the NAVSUP lead for green procurement, has compiled the *Buy It Green Guide* for purchasers to use to incorporate sustainable products into procurements.

The guide also discusses (and debunks) the top three myths surrounding sustainable products.

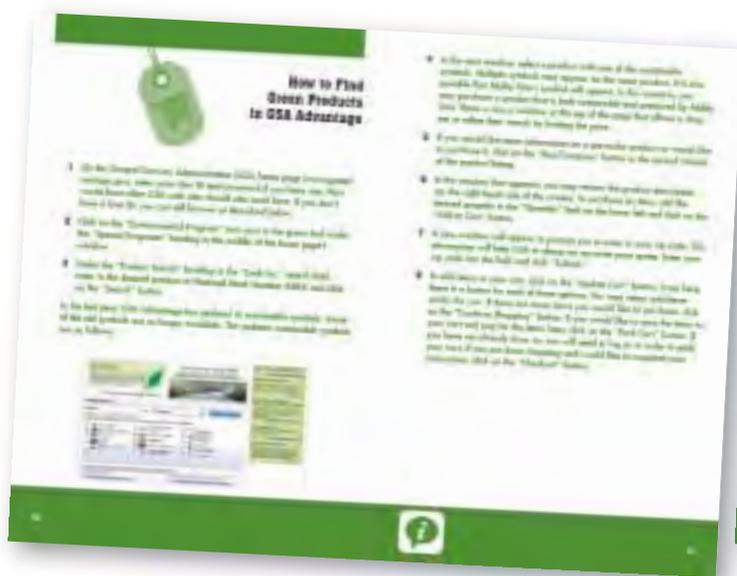
The *Buy It Green Guide* serves as a single comprehensive source for green procurement from procurement through purchasing. The guide includes integrating requirements mandating the use of sustainable materials into contracts and statements of work, an extensive list of environmentally sustainable products within the DoD supply system and step-by-step instructions on locating and ordering green products online via the following websites:

1. GSA Global
2. GSA Advantage
3. DoD EMALL
4. Ability One
5. Federal Prison Industries

To create the guide, a list of the Navy’s highest demand items from the Defense Logistics Agency

(DLA) and the General Services Administration (GSA) was compiled. These products ranged from paper towels to air conditioners. The products classified as sustainable by GSA and/or DLA were listed in the guide. Green substitutes were found for popular products that were not designated as sustainable by GSA or DLA. These substitutes were similar to the original product but possessed environmentally sustainable qualities while still being within the same price range, performed just as well and are readily available.





The *Buy It Green Guide* includes step-by-step information on how to order from several web sites.



Each product listing features icons explaining what makes it green and where the product can be found, along with pricing information.

A pdf of the *Buy It Green Guide* can be found at [https://www.navsup.navy.mil/ccpmd/purchase\\_card/buy\\_green](https://www.navsup.navy.mil/ccpmd/purchase_card/buy_green). The *Buy It Green Guide* will be updated periodically as new products and new information become available. Please do your part and buy sustainably as much as possible.

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## BE PART OF OUR FALL ISSUE

### Submissions Are Due by 20 July

We're already planning our Fall 2012 issue. And you can be a part of it! If you have a story that you want us to consider, you need to submit your final text and images by 20 July 2012.

**The power of your experiences is even greater when you share them with our readers.**

Your chances of being published in *Currents* are dramatically increased if you follow our article template. Simply request this easy-to-use template by sending an email to Bruce McCaffrey, our Managing Editor, at [bruceMcCaffrey@sbcglobal.net](mailto:bruceMcCaffrey@sbcglobal.net). Bruce is available at 773-376-6200 if you have any questions or would like to discuss your story ideas.

We look forward to reading your stories about all the great work you're doing to optimize the Navy's energy use and serve as good stewards of the environment.

## Currents Deadlines

- Fall 2012 Issue: Friday, 20 July 2012
- Winter 2013 Issue: Friday, 19 October 2012
- Spring 2013 Issue: Friday, 18 January 2013
- Summer 2013 Issue: Friday, 19 April 2013

You can also refer to your *Currents* calendar for reminders about these deadlines.

# SERDP & ESTCP Announce 2011 Projects of the Year at Annual Symposium

## Winners Include Modeling Effort to Help Identify Buried Unexploded Ordnance

**FIVE PROJECT-OF-THE-YEAR** Awards were presented at the 2011 Partners in Environmental Technology Technical Symposium and Workshop sponsored by the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP) 29 November–1 December 2011 in Washington, D.C. The symposium was attended by more than 1,200 environmental professionals from the military, government agencies, academia, private industry, and the regulatory community. The awards honor principal investigators who, through their outstanding efforts, have helped the Department of Defense (DoD) achieve its mission while improving its environmental performance. Award recipients include:



### Resource Conservation and Climate Change, SERDP Project of the Year

Forecasting the Effects of Multiple, Interacting Stressors on At-Risk Populations—Dr. Joshua Lawler, University of Washington

DoD land managers face the dual responsibility of meeting the national security mission and stewardship responsibilities. DoD is one of the nation's largest federal land managers and is responsible for managing more species at risk per acre than any other federal agency.



Cassi Hayden

Dr. Joshua Lawler, recipient of the SERDP Resource Conservation and Climate Change Project-of-the-Year Award, demonstrated his modeling tool, which helps land managers sustain training activities and meet stewardship responsibilities by simulating responses of at-risk species to multiple, interacting stressors including invasive species, pollution, habitat loss and fragmentation, disease, and climate change.





SERDP Munitions Response Project-of-the-Year Award recipient Dr. Fridon Shubitidze (right) and team member Dr. Ben Barrowes presented sophisticated models that, when applied to advanced sensor data, significantly improve the ability to distinguish UXO from clutter, reducing munitions response costs and accelerating the cleanup process.

If populations decline, both the military's ability to use training ranges and the nation's biologic treasures are put at risk.

At-risk species often face multiple interacting threats or stressors, such as invasive species, pollution, habitat loss and fragmentation, and disease. In the coming years, climate change will be a significant additional stressor. Land managers have traditionally addressed potential environmental stressors one at a time. But, given the complexity and potential interactions of these stressors, that one-at-a-time method is no longer effective.

To improve management of species facing multiple threats, Dr. Lawler and his colleagues have developed a flexible, spatially explicit population model designed to simulate a wide range of species in complex and changing landscapes. They applied this model to three at-risk populations on three military installations—the red-cockaded woodpecker at Fort Benning, Georgia; the desert tortoise at Fort Irwin, California; and the black-capped vireo at Fort Hood, Texas—to investigate the effects of climate change, land-use change, military training, invasive species, and disease. These case studies provide critical insights into the importance of multiple interacting threats.

This research advances the ability to forecast the effects of multiple, interacting stressors and provides a practical modeling tool for DoD land managers. This tool will enhance the military's ability to manage plant and animal populations while sustaining training and other essential activities today and in the future as we learn to adapt to climate change.



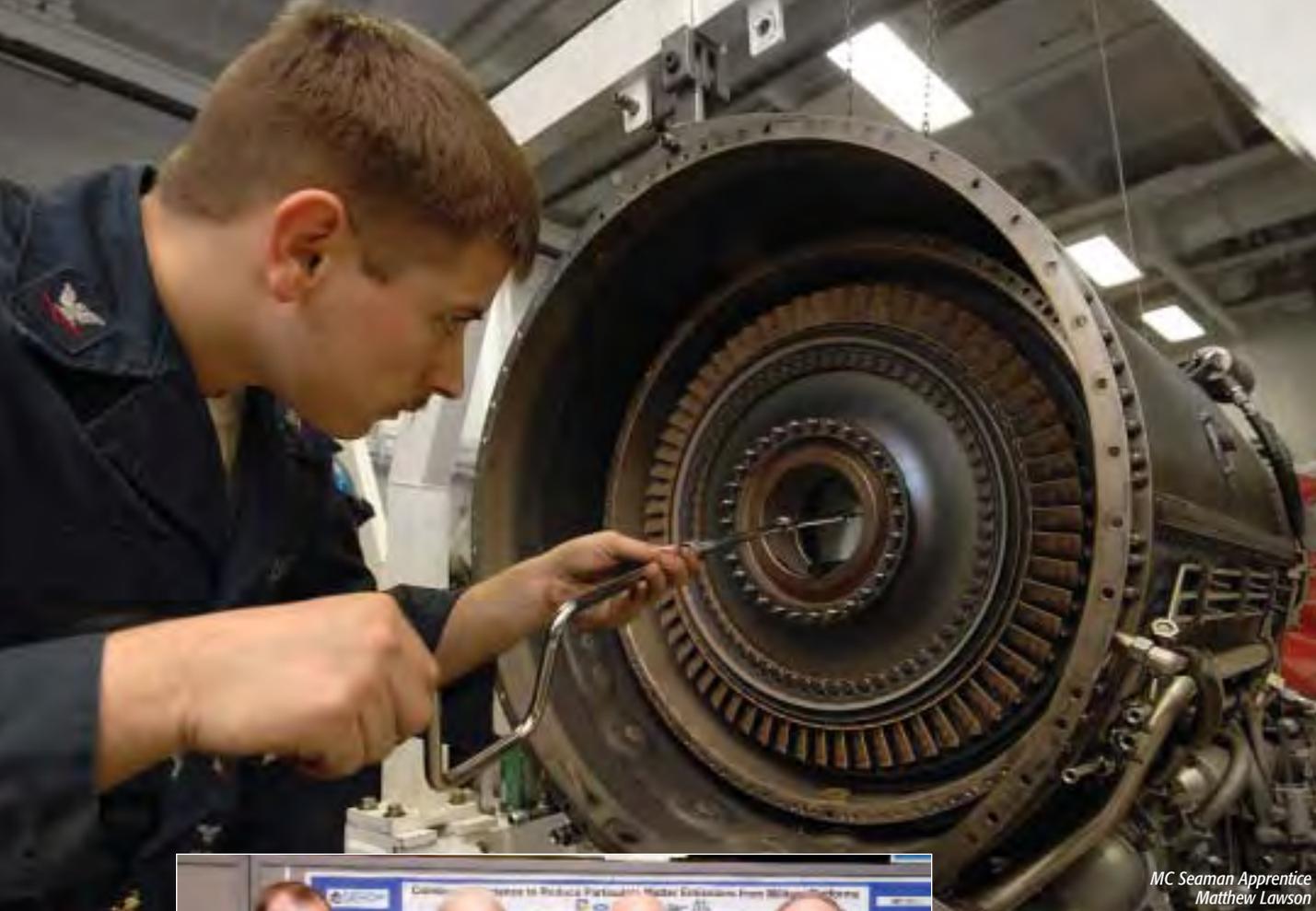
## Munitions Response, SERDP Project of the Year

Advanced Signal Processing for UXO Discrimination—Dr. Fridon Shubitidze, Dartmouth College and Sky Research, Inc.

DoD's liability for munitions response is estimated in the tens of billions of dollars. With resources constrained, munitions response actions on many sites are forecast to be decades out. One of the most promising technology advances for reducing the cost per site and accelerating the pace of cleanup is in the use of classification to distinguish the buried unexploded ordnance (UXO) from the vast quantity of harmless pieces of metal found on any site, allowing resources to be directed to removing only the UXO.

Recently developed advanced electromagnetic induction sensors record detailed responses from buried targets that have powerful classification potential. The traditional models used to analyze sensor data, however, are unable to exploit all the information available from these sensors.

Dr. Shubitidze and his colleagues developed sophisticated, physically complete models that extract more meaningful parameters from advanced sensor data for classification.



MC Seaman Apprentice  
Matthew Lawson



Cassi Hayden

The improved understanding of soot formation achieved by SERDP Weapons Systems and Platforms Project-of-the-Year Award recipient Dr. Mel Roquemore (center right) and his team from academia, industry, and government laboratories will enable manufacturers to design and build high-performance engines that emit less pollution.

Their methods are applicable to all currently available advanced electromagnetic sensors and easily extended to others that may be developed. These models have rapidly transitioned to field demonstration. In fact, Dr. Shubitidze and his team demonstrated near perfect classification at the former Camp Butner in North Carolina.

These new models will lead to significant improvements in the ability to distinguish between UXO and harmless objects, particularly on difficult sites. Using classification, substantial cost savings will be realized and available resources can be used to accelerate risk reduction on munitions response sites.

## Weapons Systems and Platforms, SERDP Project of the Year

Combustion Science to Reduce Particulate Matter Emissions for Military Platforms—Dr. Mel Roquemore, Air Force Research Laboratory

Soot formation in gas turbine engines is a major concern in the design of modern aircraft propulsion systems. Gas turbine engines are a source of particulate matter emissions, a substantial fraction of which consist of soot particles with diameters of less than 2.5 microns, or PM2.5, that are subject to regulation under the National Ambient Air Quality Standards. The long-term solution is to build DoD's engines of the future in a way that reduces their emissions—a daunting challenge given the complexity involved.

Minimization of emissions from gas turbine engines during initial design is currently not possible. Accurate modeling of soot formation is diffi-

cult due to the complex underlying chemical and physical processes. These processes involve a sequence of gas phase reactions, followed by particle inception, particle-particle interactions, condensation, particle growth, and oxidation. The reactions involve literally hundreds of chemical species and take place in extreme environments of pressure, temperature, and turbulence. This environment is challenging for both modeling and measurements.

Dr. Roquemore led a collaborative team from academia, industry, and government laboratories in advancing the fundamental science relevant to the formation of PM<sub>2.5</sub>. The team conducted experiments and simulations to understand the chemistry, fluid dynamics, and thermodynamics of particle formation in high-performance engines. Validated detailed soot and full chemical models can be applied, in conjunction with full three-dimensional combustor design codes, to estimate soot and other emissions for gas turbine combustors.

This research represents a critical achievement in the quest to enable jet engine manufacturers to design and build engines that emit less pollution.

### Environmental Restoration, SERDP Project of the Year

Assessing Vapor Intrusion at Chlorinated Solvent-Impacted Sites—Dr. Paul Johnson, Arizona State University

Military installations and surrounding communities across the nation are affected by groundwater contaminated with chlorinated solvents. In recent years, concerns have grown over the migration of contaminated vapors from these groundwater plumes into people's homes. Vapor intrusion is now often the risk driver for many actions at cleanup sites across DoD.

The risk from vapor intrusion is a complex process that can be influenced by many variables. Accurately predicting exposure is critical to protect human health and make wise use of resources.

Dr. Johnson and colleagues have successfully linked laboratory-scale research and modeling studies with an integrated field-scale assessment in a real home next to Hill Air Force Base to understand and deal with the impacts of real-world issues such as:



SERDP's Environmental Restoration Project of the Year, led by Dr. Paul Johnson (back center), successfully linked laboratory-scale research and modeling studies with an integrated field-scale assessment in a real home next to Hill Air Force Base in developing new methods for accurately and cost-effectively assessing the vapor intrusion pathway.

*Cassi Hayden*

- The high temporal and spatial variability that makes assessments so complex
- The uncertain relationship between groundwater concentrations and indoor air
- The impacts of home construction and variable soil gas concentrations
- The large number of other sources of indoor chemicals

This research has generated the knowledge and methods needed to more accurately and cost-effectively assess the groundwater-to-indoor air pathway. This work will improve DoD's ability to protect the health of families living on base and neighbors in the surrounding communities, while saving resources so that they can be effectively used at chlorinated solvent sites across the nation.

### ESTCP Project of the Year

Passive Sampling to Support Remediation of Contaminated Sediments—Dr. Philip Gschwend, Massachusetts Institute of Technology

DoD manages hundreds of contaminated sediment sites in bays, harbors, lakes, wetlands, and rivers. Historically, regulators and site managers have assessed these sites by measuring how much of a specific chemical such as



ESTCP Project-of-the-Year Award recipient Dr. Philip Gschwend (right) and his team demonstrated and validated a commercially viable, simple passive sampler that measures the fraction of sediment contamination that poses a risk to ecological receptors and human health. This accurate and robust technique can be cost-effectively employed at virtually all DoD contaminated sediment sites to characterize the risk of contaminants entering the food chain.

polychlorinated biphenyls is present in the sediment. However, total concentrations are poorly correlated with the toxic impacts that need to be addressed. What is needed is a way to easily and cost-effectively measure the fraction of those chemicals at a particular field site that can be taken up by an organism and cause harm.

Dr. Gschwend and his colleagues have demonstrated and validated a commercially viable, simple passive sampler that can measure the fraction of the chemical that is of concern. Developed under SERDP, the passive samplers utilize an inert low-density polyethylene medium to accumulate organic compounds from contaminated sediment beds. The polyethylene concentrations can be converted to contaminant concentrations that are available to the organisms in this environment.

This accurate and robust passive sampling technique can be cost-effectively employed at virtually all DoD contaminated sediment sites to characterize the risk of contaminants entering the food chain. It provides significant savings in manpower, number of days in the field, equipment, and shipping costs as compared to traditional sampling methods. For sites already in the remedial action process, the use of these samplers could significantly reduce the costs of long-term moni-

toring. Beyond cost reduction, the passive sampling technique can help guide remediation efforts to target the real risk and thus improve the health of the environment at sediment sites across DoD and the nation.

### Symposium Presentations & On-Demand Videos Available

Additional information about the 2011 Symposium, including plenary and technical session presentations and short course on-demand videos, is available at <http://symposium2011.serdp-estcp.org>.

### Plans Under Way for 2012 Symposium & Workshop

The 2012 Partners in Environmental Technology Technical Symposium & Workshop is scheduled to be held 27-29 November 2012, in Washington, D.C. The Call for Poster Abstracts will be released by the end of May 2012. Visit <http://symposium2012.serdp-estcp.org> for the most up-to-date event information. 

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# Zero-Valent Zinc Shows Promise for Removing TCP from Groundwater

## Studies Show Positive Results Removing Recalcitrant Compound from Pendleton Well

**THE SOLVENT 1,2,3-TRICHLOROPROPANE** (TCP), which is highly toxic to humans, is attracting increasing regulatory attention. As sampling and analytical methods improve, TCP detection in groundwater resources is on the rise. As of 2007, TCP had been detected in more than 200 samples at twenty or more Department of Defense sites.

At Marine Corps Base (MCB) Camp Pendleton, CA, TCP was detected at levels above California's action level, resulting in two groundwater wells being removed from service. MCB Camp Pendleton officials faced significant challenges in trying to address the contamination because TCP is difficult to degrade (i.e., breakdown into its chemical components). Recent studies at MCB Camp Pendleton, sponsored by the Navy Environmental Sustainability Development to Integration (NESDI) program, show promise for removing TCP from groundwater wells.

### Background

TCP is a chlorinated volatile organic compound that has been used in a variety of chemical production processes, in agricultural chemicals, and as a solvent. Over time, point and non-point source releases of TCP have contaminated soil and groundwater in many places.

Because its toxicity to humans appears to be high relative to other chlorinated solvents, even low-level exposures to TCP could pose significant human health risk. Consequently, the Cali-

fornia Department of Public Health (DPH, formerly the Department of Health Services (DHS)) has set a notification level of 0.005 micrograms per liter ( $\mu\text{g/L}$ ) for TCP in drinking water (DHS, 2005), which is much lower than the corresponding level for other chlorinated solvents such as trichloroethene (TCE:  $5 \mu\text{g/L}$ ). California requires monitoring for TCP as an unregulated chemical and has specified an Action Level of  $0.5 \mu\text{g/L}$  for removing a public drinking water well from service. In addition, the California Office of Environmental Health Hazard Assessment (OEHHA) has established a public health goal (PHG) of  $0.0007 \mu\text{g/L}$  in drinking water based on recent re-evaluation of risk exposures. In 2009, the U.S. Environmental Protection Agency, which does not yet regulate TCP in drinking water, added the compound to its Contaminant Candidate List 3 (CCL3).

### State Action Levels (Federal MCL anticipated)

STATE	CONCENTRATION	UNITS
CA	0.005 <sup>a</sup> 0.0007 <sup>b</sup>	$\mu\text{g/L}$
CT	0.05	$\mu\text{g/L}$
TX	0.13	$\mu\text{g/L}$
OR <sup>c</sup>	N/A	N/A

a—CA DPH notification level

b—CA OEHHA Public Health Goal

c—TCP designated an "Unregulated Organic"

## Looking for TCP Treatment Alternatives at MCB Camp Pendleton

At MCB Camp Pendleton, TCP has been detected in three of nine groundwater production wells located within the Santa Margarita River valley, north and west of the portion of the site known as the 22/23 Area. These wells have been taken offline and MCB Camp Pendleton considered multiple options to replace the lost resource, including:

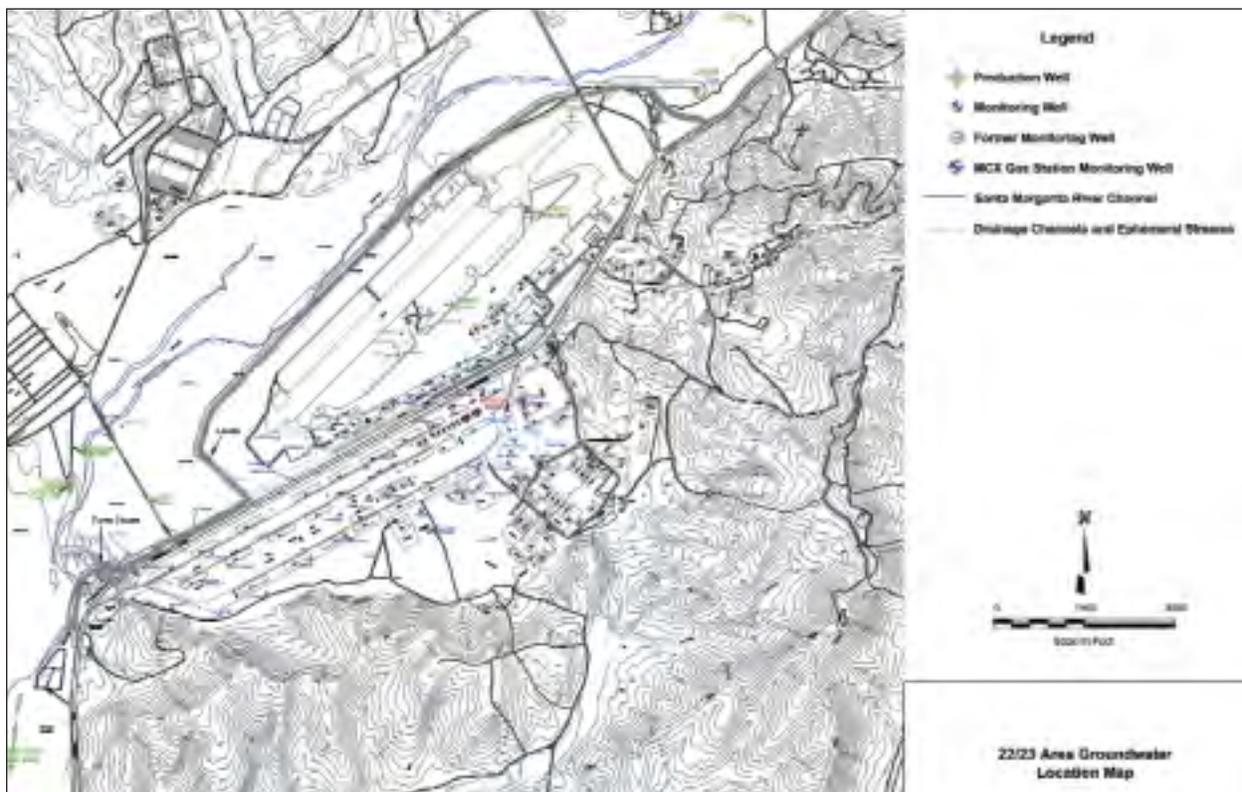
- Installing additional groundwater production wells
- Developing an approach to treat affected groundwater, either in situ or at the wellhead
- Purchasing drinking water from an outside source

Past research offered possibilities for finding a way to treat the affected groundwater. Results of work supported by the Secretary of Defense's Strategic Environmental Research and Development Program (SERDP) and conducted by Dr. Paul Tratnyek and his students at the Oregon Health and Science University (OHSU), showed the potential of using zero-valent metals (ZVM) to degrade organic compounds.

In 2009, personnel from the Naval Facilities Engineering Service Center (NAVFAC ESC), with resources and guidance provided by the NESDI program, began to evaluate two types of zinc and one proprietary form of iron for degrading TCP. The project took a step-wise effort beginning with Tratnyek conducting laboratory (bench scale) experiments then proceeding to a larger, two-phase on-site column test at MCB Camp Pendleton.

Specific objectives of the project included:

- Assess the ability of Zero-valent Zinc (ZVZ) and/or Zero-valent Iron (ZVI) to effectively degrade TCP in MCB Camp Pendleton groundwater
- Evaluate potential secondary water quality effects (e.g., changes in pH or dissolved zinc concentration) that could affect future implementation of a ZVZ or ZVI remedy
- Identify potential factors that may affect performance of ZVZ or ZVI as a remedy for TCP in groundwater
- Conduct a preliminary evaluation of the full-scale applicability of ZVZ or ZVI for treatment of TCP in groundwater at Camp Pendleton



## The Basics About the NESDI Program

**THE NESDI PROGRAM** seeks to provide solutions by demonstrating, validating and integrating innovative technologies, processes, materials, and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness. The program accomplishes this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The NESDI program is the Navy's environmental shoreside 6.4 Research, Development, Test and Evaluation program. The NESDI technology demonstration and validation program is sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities

Engineering Command. The program is the Navy's complement to the Department of Defense's Environmental Security Technology Certification Program which conducts demonstration and validation of technologies important to the tri-Services, U.S. Environmental Protection Agency and Department of Energy.

For more information, visit the NESDI program web site at [www.nesdi.navy.mil](http://www.nesdi.navy.mil) or contact Leslie Karr, the NESDI Program Manager at 805-982-1618, DSN: 551-1618 or [leslie.karr@navy.mil](mailto:leslie.karr@navy.mil).



### Step One—Into the Laboratory

Results from the preceding SERDP research project (ER-1457) showed that although TCP was significantly harder to degrade than other chlorinated solvents, ZVMs showed promise for chemical reduction. ZVZ and one form of ZVI (a proprietary high reactivity, atomized iron powder) were of particular interest. These results provided the starting point for the new project.

Tratnyek's initial laboratory studies at OHSU were conducted to help identify which ZVM materials were most suitable for the MCB Camp Pendleton groundwater conditions. This would also provide information necessary for subsequent on-site testing to evaluate ZVM performance. The lab work included batch studies, using both deionized water and groundwater from MCB Camp Pendleton, to identify the best ZVM candidates, establish degradation rate constants and identify other factors that might affect on-site testing. Batch studies were followed by small-scale column experiments.

Based on the batch experimental results, two ZVZ materials advanced to the next step—zinc dust 64 (Zn64) and zinc powder 1210 (Zn1210).

The small-scale column experiments were conducted to assess the short-term performance of Zn64 and Zn1210 in flow-through systems and to identify an effective mixing ratio of Zn64 with sand for future on-site testing. The experiments were performed in columns packed with materials corresponding to specific batch experiments. The columns were packed with either pure ZVZ or a ZVZ/sand mixture and were operated in an up-flow manner, with the influent entering the bottom of the column and effluent exiting the top. The columns were operated until a steady-state concentration was reached (about 24 to 48 hours), after which an experimental observed rate constant for the column was determined.

Based on the column results, a 25% Zn64/sand mixture appeared to be a favorable choice for on-site testing. However, the Zn64 columns appeared

to produce a larger amount of hydrogen gas relative to the Zn1210 columns. Since it was thought that this hydrogen gas production, along with other factors such as clogging, aging and inhibition by sand could affect the long-term performance of the Zn64/sand mixture, 100% Zn1210 was also retained as a material for on-site testing. Its long-term performance could then be compared to that of Zn64. Finally, the proprietary ZVI, was retained as a material for on-site testing in order to provide a baseline for comparing ZVZ performance to that of a ZVI material.

### Step Two—On-Site for Column Testing

Following baseline testing of groundwater from a MCB Camp Pendleton well, researchers initiated the first of two column-testing phases. Three types of reactive media were used:

1. 25% Zn64 and 75% sand mixture
2. 100% Zn1210
3. 50% ZVI and 50% sand mixture

Data generated from the batch experiments were analyzed to develop estimated TCP degradation rates for the different media. These degradation rates then were used to develop design parameters for column volume based on a target TCP degradation of 95%, an initial TCP concentration of 5 µg/L, and a nominal groundwater flow rate of 5 milliliters per minute (mL/min).

### Phase I

The Phase I column testing configuration is shown in the following figure. The influent reservoir contained groundwater from MCB Camp Pendleton monitoring well 6W-35B, spiked with TCP to a nominal concentration of 5 µg/L. The columns were operated as up-flow systems, with the groundwater influent entering the bottom of the columns.

The three sets of columns were scheduled for a 12-week operation period. Every two weeks, samples were collected from the influent reservoir, the midpoint of each column,

and the effluent of each column. The samples were tested for:

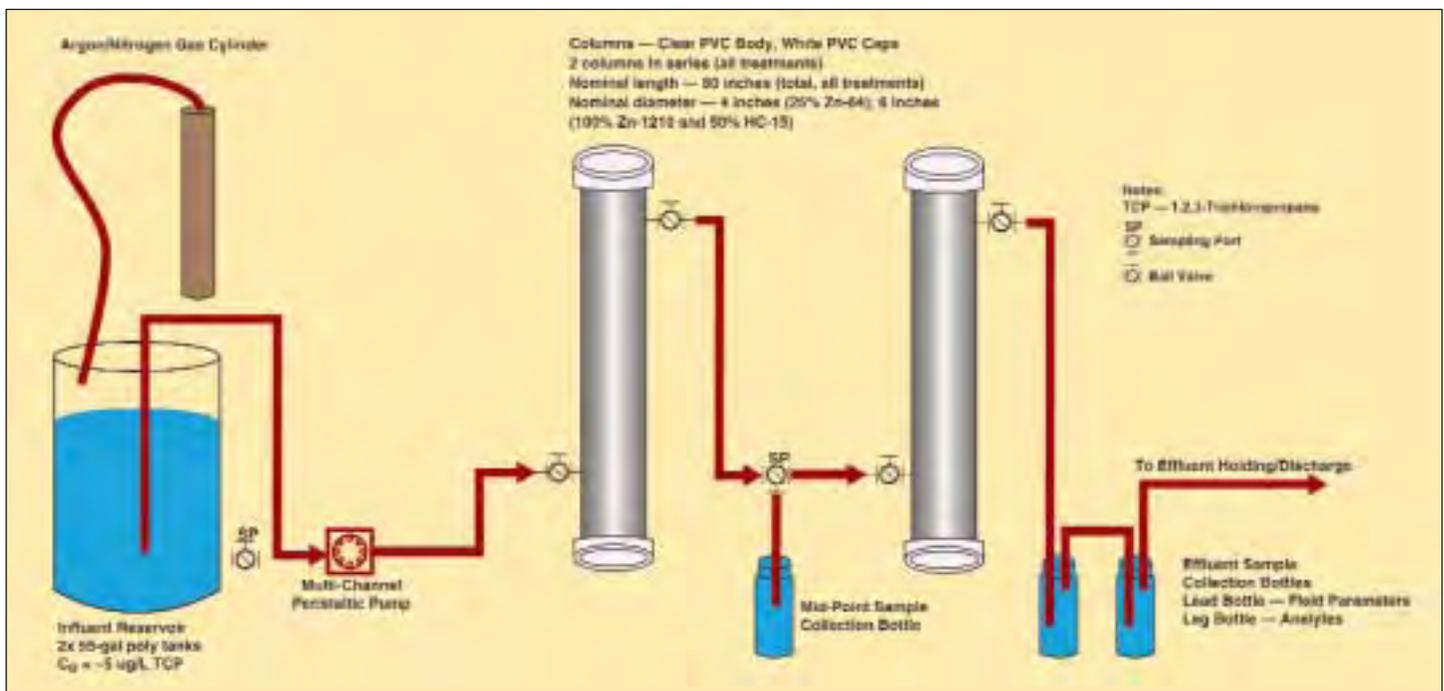
- Field parameters (pH, Oxidation-Reduction Potential, temperature, and Dissolved Oxygen)
- Propane and Propene
- TCP
- Dissolved Zinc
- Cations (Calcium, Iron, Magnesium, Potassium, and Sodium)
- Anions (Chloride, Nitrate, Nitrite, and Sulfate)
- Total Sulfide
- Silica
- Phosphate
- Alkalinity (Total, Bicarbonate, and Carbonate)

Column operations initially proceeded without event, although some problems did arise later in the testing period. First, the zinc columns developed leaks,

which were attributed to increased pressure from hydrogen gas production. The columns were modified to address the issue and re-started. Following restart, upward flow through the second ZVI column could not be maintained (possibly due to cementing of the ZVI material at the column inlet). The ZVI column flows were reconfigured. All three columns again were restarted and operated for three more weeks, until the input tube to the Zn1210 column broke, draining the lead column. After additional issues following restart, the Zn1210 column was discontinued.

Based on the results of the Phase I column operations, it appeared that the selected materials performed relatively well with respect to reducing TCP concentrations in groundwater. (See the following page.) In particular, Zn1210 performed significantly better in reducing TCP than expected from laboratory studies.

During the first four weeks of column operation, TCP removal in both the



Zn64 and Zn1210 columns were similar to or exceeded predicted values. After week four, TCP removal efficiency in the Zn64 column decreased from approximately 95% to 60% and continued to decrease through the remainder of testing. In contrast, the Zn1210 column maintained a TCP removal efficiency of over 95% until it was taken offline. The ZVI column performance did not meet predictions for TCP removal. See the results of Phase I tests in the figure to the right.

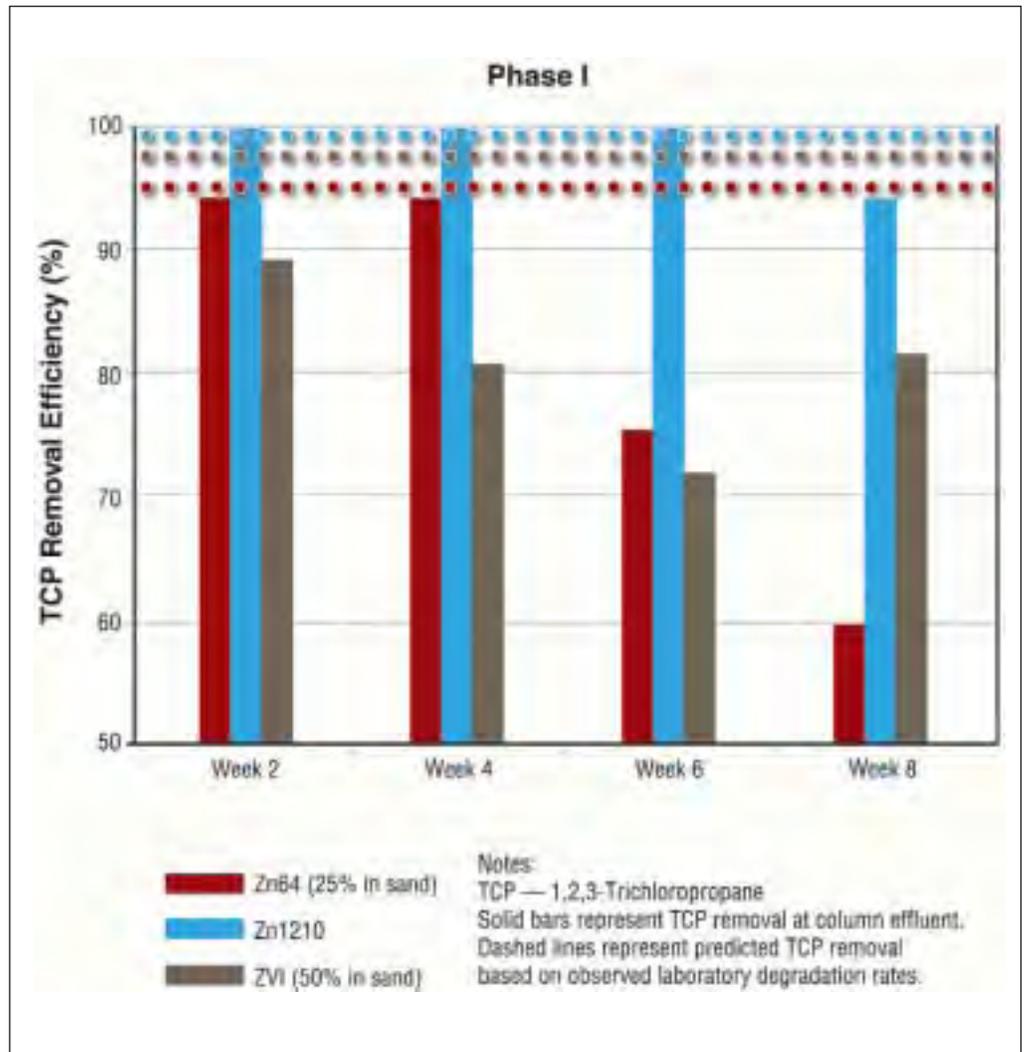
### Phase II

Based on the Phase I results, four types of media were selected for evaluation during the Phase II column testing:

1. 25% Zn64 and 75% sand mixture
2. 33% Zn1210 and 67% sand mixture
3. 67% Zn1210 and 33% sand mixture
4. 100% Zn1210

The first and fourth types of media were selected to confirm the Phase I TCP degradation results. The second and third media types were selected to evaluate the efficacy of TCP degradation by Zn1210 when mixed with sand, as might occur in a permeable reactive barrier (PRB)-style deployment.

The Phase II columns were redesigned to address the operational issues experienced during Phase I. The design also reflected the TCP



degradation rates observed during the Phase I testing and the nominal target groundwater flow rate of 5 mL/min. As in Phase I, columns were operated for twelve weeks, with samples collected every two weeks from the influent reservoir, the midpoint of each column, and the effluent of each column. Phase II columns operated without problem. Phase II results are presented on the following page.

The Phase II Zn1210 columns met or exceeded the predicted TCP removal throughout the 12 weeks of column operations, confirming the Phase I

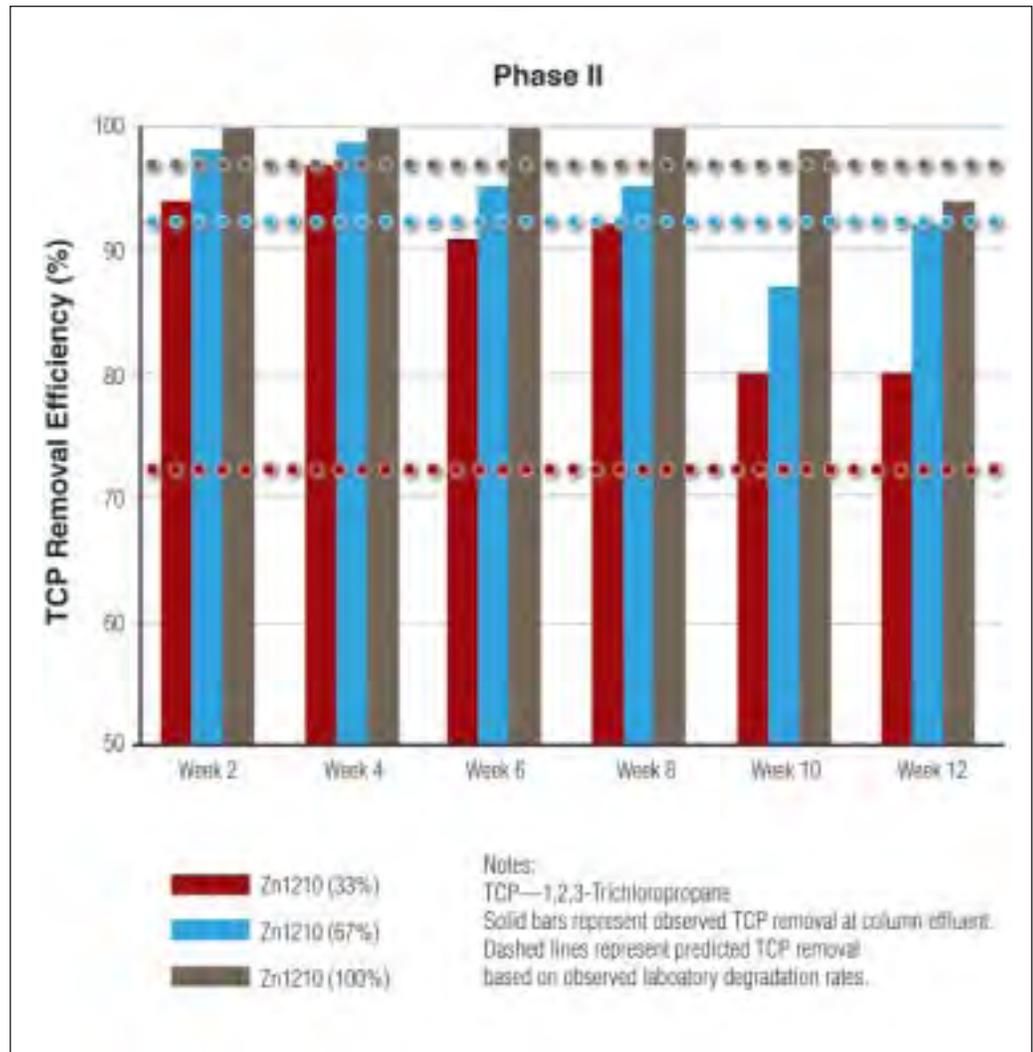
column results. TCP removal efficiency after week 12 ranged from approximately 80% (the 33% Zn1210 and 67% sand column) to 95% (the 100% Zn1210 column). The high reactivity of the Zn1210 when combined with sand suggests that deployment of Zn1210/sand mixtures may be a viable remedial approach. TCP removal efficiency by the Phase II Zn64 column also remained high throughout the 12 weeks of operation, and was 90% at the conclusion of testing.

Other important parameters were sampled during column operation.

Propene, a byproduct of the TCP degradation, was detected in the effluent of each of the Phase II column throughout the 12 weeks of operation. The propene concentrations, however, were less than expected based on the amount of TCP removed. Concentrations of dissolved zinc in the Phase II column effluent were less than 0.5 mg/L.

During weeks 4 and 12 of Phase II operation, samples were collected for evaluating changes in groundwater geochemistry through the columns. Calcium, silica, and alkalinity concentrations decreased significantly between the influent and effluent of all four Phase II columns in week 4. Manganese concentrations also decreased in the columns to a lesser extent. The week 12 sampling of these analytes, observed at the column midpoints and effluent, were generally higher than those observed during week 4. It appears that the mechanisms operating within the columns to remove these compounds from groundwater became less efficient over the course of the 12-week operational phase.

After Phase II testing was completed, the columns were drained and tested for physical and chemical material changes. The zinc particles did not cement together as has been occasionally observed with ZVI. The moderate decreases in reactivity may be due to surface changes on the zinc particles that made them chemically passive.



### Can It Scale?

Based on the results of the preliminary laboratory studies and on-site column testing, ZVZ appears to be a viable technology for degrading 1,2,3-TCP. In particular, ZVZ appears to have the following technical advantages:

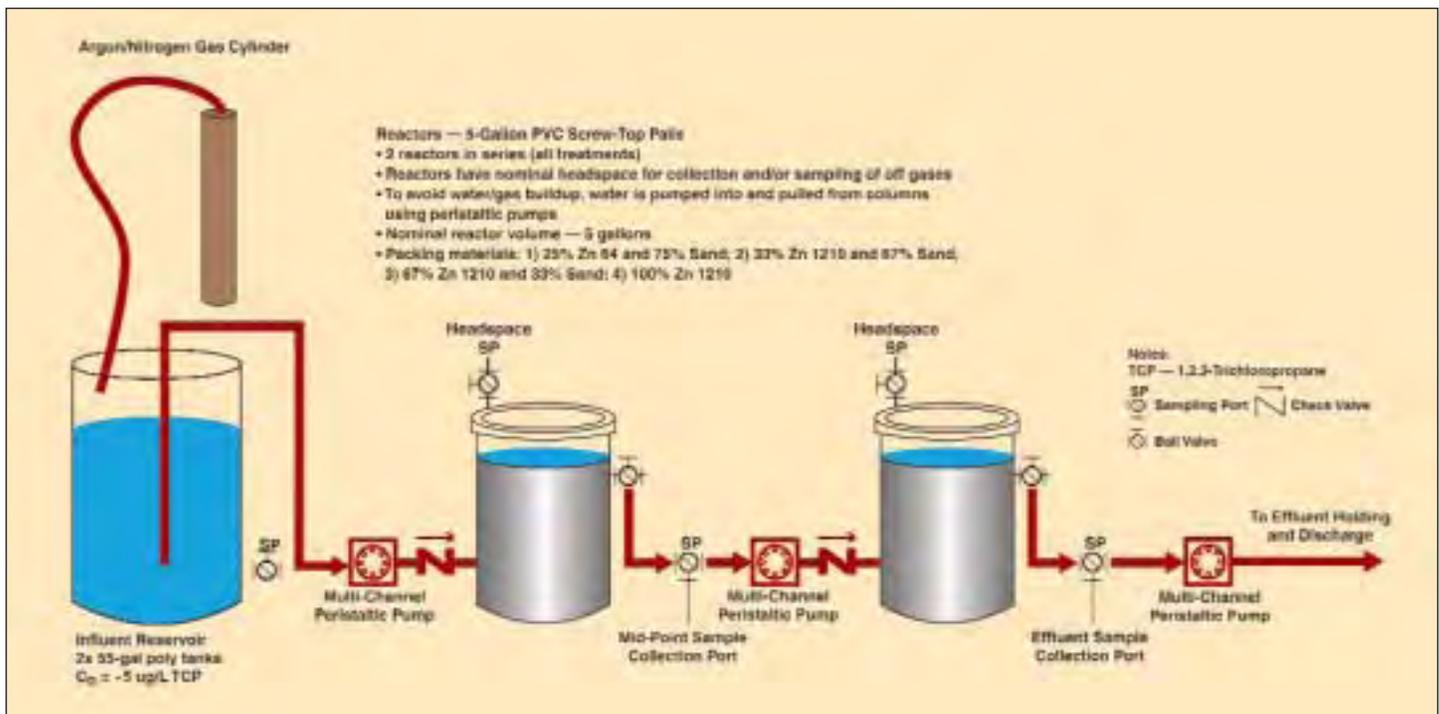
- Relatively high rates of TCP degradation, with predictable degradation behavior when transitioning from laboratory testing to field testing
- Limited changes to TCP degradation rates over time

- No identified secondary water quality effects

The on-site column testing identified Zn1210 as a promising material due to its better than expected TCP degradation performance and ease of handling relative to finer zinc materials such as Zn64.

The primary limitation of ZVZ as a remedial technology for TCP degradation is expected to be cost since ZVZ is significantly more expensive than other ZVMs such as ZVI.

Models were developed to evaluate the costs of applying this technology



## The NESDI-sponsored study demonstrated that it might be possible to remediate this difficult toxic compound.

at scale both in situ (e.g., permeable reactive barrier) and ex situ (wellhead treatment of TCP at an affected water supply well). The results of the scale-up evaluation indicated that:

- Under current market conditions, the technology is not economically feasible for ex situ application due to the large reactor volumes required for treatment and high cost of ZVZ.
- The technology may be economically feasible for in situ application, particularly under the following site conditions:
  - The areal extent of TCP is limited. This would allow the length and height of a PRB application to be minimized,

reducing the volume of material required.

- The groundwater flow velocity is relatively low. This will reduce the volume of zinc required for PRB construction.
- The cost for the in situ application is low relative to wellhead activated carbon treatment (e.g., low groundwater flow velocities and high groundwater extraction rates).

### Conclusion

The NESDI-sponsored study demonstrated that it might be possible to remediate this difficult toxic compound. Based in part on these results, a pilot scale PRB is being considered to treat

affected groundwater at MCB Camp Pendleton. As Theresa Morley from Naval Facilities Engineering Command Southwest noted, “I want to thank the NESDI program for sponsoring this study. We were really scratching our heads trying to figure out how to remediate such a toxic, emergent, recalcitrant compound.” 

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