



National Defense Center for  
Energy and Environment



## 2012 Annual Report



Since 1991, the National Defense Center for Energy and Environment (NDCEE) has served as a national leadership organization to address high-priority environmental, safety, occupational health, and energy challenges for the Department of Defense (DoD), other government organizations, and the industrial community.

The NDCEE's mission is to support DoD sustainability and readiness through:

- Research, development, and test efforts to identify available alternatives
- Demonstration, validation, and transition of technologies to defense installations, industrial activities, and private industry
- Training that supports the fielding of new, validated technologies

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## A MESSAGE FROM THE EXECUTIVE AGENT



*“The NDCEE continues to be a valued partner in executing the DoD’s strategy to enhance sustainability and security, maintain readiness, and achieve mission objectives. The challenges our Services and defense agencies face are ever changing and we must remain a step ahead as a Nation and a Force to safeguard our resources and our warfighters. As we continue to strive for safer, more sustainable installations and operations, the NDCEE serves as a force multiplier by identifying, validating, and transitioning mission-driven solutions that optimize performance, minimize our footprint, reduce lifecycle costs, and improve the quality of our workplaces. Understanding the interdependencies between environmental, energy, and health and safety aspects, as well as security, cost, and operational implications, is part of the NDCEE’s comprehensive approach. Fostering collaboration between government stakeholders, academia, and the public and private sectors for more than two decades, the NDCEE is able to apply innovative, yet practical solutions to address legacy and emerging challenges across the DoD and other federal agencies. I encourage you to consider how the NDCEE can support your mission.”*

**– Hershell “Hew” E. Wolfe, Deputy Assistant Secretary of the Army (Environment, Safety, and Occupational Health), and Department of Defense Executive Agent for the National Defense Center for Energy and Environment**



**DoD Executive Agent  
Office of the Assistant Secretary of the Army  
for Installations, Energy and Environment**



# YEAR IN REVIEW 2012

## FOCUSED SOLUTIONS TO REDUCE LIFECYCLE COSTS AND IMPACTS

In Fiscal Year 2012 (FY12), the NDCEE continued to investigate sustainable solutions to optimize maintenance and repair operations, increase the DoD's awareness and use of green products, and enhance the sustainability of ammunition production. In support of aviation maintenance operations, the NDCEE developed and transitioned a gasket kit to eliminate nose bay corrosion issues experienced on the MH-60R SEAHAWK® helicopter, saving the Navy \$1.8M annually. Similarly, recommended facility and process upgrades provided to the Marine Corps will significantly reduce the time and cost to refurbish tactical ground equipment and extend the service life of clothing and equipment used in training operations. In ongoing support of the Defense Logistics Agency's sustainable product initiatives, the NDCEE developed a hydraulic fluid purification specification that will accelerate the adoption of this technology and significantly reduce the amount of hydraulic fluid currently being disposed. In addition, the NDCEE identified and validated several drop-in replacement materials that will reduce personnel lead exposure in Air Force plating operations. Reducing risk in ammunition production and disposal processes, the NDCEE supported the Army in validating an alternative munitions primer sealant and evaluating the reuse of components from stockpiled munitions planned for demilitarization. Through these and other initiatives, the NDCEE is reducing lifecycle impacts and total ownership costs while improving industrial base capability.

## INNOVATIVE APPROACHES TO SAFETY AND SUSTAINABILITY

The NDCEE supports several DoD initiatives that comprehensively address environmental, energy, and safety challenges and require not only materiel solutions, but also policy and cultural change. For example, the NDCEE provides strategic support to the Army's Net Zero Installation Initiative, which integrates policy and technical solutions spanning energy, water, and waste. In FY12, the NDCEE developed and applied a methodology to conduct comprehensive waste assessments at net zero pilot sites, identifying opportunities to further exploit existing waste diversion programs and target waste at the source. The NDCEE also conducted energy and water security assessments to ensure mission considerations are fully incorporated into net zero strategies. In support of energy and safety culture change initiatives, the NDCEE developed online energy awareness training for the Air Force and, through the DoD Voluntary Protection Programs (VPP) Center of Excellence, delivered safety webinars, workshops, and training courses, and assisted 16 DoD sites in submitting applications for VPP Star status. Applying a system of systems approach to contingency base operations to optimize water, waste, and energy considerations, the NDCEE conducted field-worthy demonstrations on a variety of technologies spanning mobile wastewater treatment, waste-to-energy, mobile incineration, and in-vessel composting. In support of these comprehensive approaches, the NDCEE integrates and transitions solutions spanning doctrine, organization, training, materiel, leadership, personnel, and facilities.

## INFORMING DECISIONS TO OPTIMIZE READINESS AND MITIGATE RISK

DoD leaders require relevant, accurate information and effective analysis to inform technical and business decisions and address root cause issues. In FY12, the NDCEE provided critical information, data infrastructure, web-based tools, and analysis to identify and mitigate workplace injuries and industrial hygiene issues – ensuring that DoD personnel are provided with the safest possible working and training conditions. The NDCEE also provided strategic communications and decision support to the Army's Energy Initiatives Task Force to reduce risk and optimize investments in large-scale renewable energy projects. Similar support was provided to formulate recommendations for DoD-wide implementation of an enterprise energy information management solution. Finally, to help define management options for munitions and explosives of concern, the NDCEE continued efforts to characterize and mitigate environmental hazards resulting from decades old sea-disposed munitions and evaluated the effect of residual magnetism on range clearance operations. In developing and validating tools and techniques to optimize data collection, integration, and analysis, the NDCEE provides valuable information management and decision support that enables the DoD to make informed decisions affecting sustainability, security, operational readiness, and organizational risk.

*"Today, threats and constraints to the supply of energy, water, and other resources needed across the DoD are growing in scope and complexity both at home and abroad. We must proactively address and mitigate these threats to ensure the DoD of tomorrow has the same access to resources as the DoD of today. Addressing these issues is mission essential, operationally necessary, and financially prudent. This is especially true as budgetary reductions further underscore the need to re-evaluate how we do business and implement technical and business best practices to reduce lifecycle costs. The NDCEE fulfills a critical role in helping DoD secure uninterrupted access to energy, enhance civilian and warfighter safety, and achieve sustainability. I am proud of the significant contributions made by the NDCEE to enable DoD decision makers to prioritize actions and investments based on clear returns - measured in terms of future savings, reduced liability, and added mission capability."*



**– Honorable Katherine Hammack,  
Assistant Secretary of the Army  
for Installations, Energy and Environment**

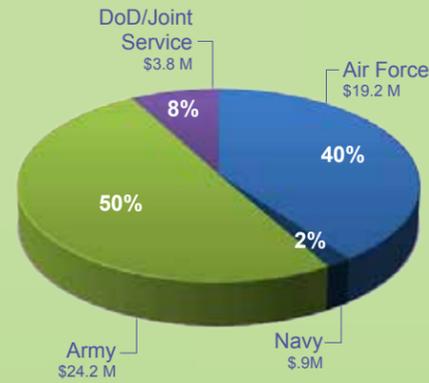
In FY12, the NDCEE continued the critical mission it began over 20 years ago: identifying, demonstrating, evaluating, and fielding technologies in support of DoD readiness, sustainability, and the warfighter.

**38** task orders completed in FY12

**22** task orders awarded, in addition to several cost modifications received, increasing dollars on contract by **\$48.1M**

**51.4%** of subcontracted dollars to date awarded to small businesses

more than **150** client and stakeholder organizations served



The NDCEE is working across the Army, Navy/Marines, Air Force, and DoD. This chart shows the percentage of FY12 contract awards supporting each client.

## Operational Statistics

NDCEE outreach activities directly support technology transition by disseminating information on technologies to audiences within the DoD and across other federal agencies. Extending the base of knowledge is an important part of the NDCEE's mission.

### deliverables

Averaging almost 100 client deliverables per month, the NDCEE maintained an average on-time delivery greater than 99%. To ensure that pertinent technical information from NDCEE projects is widely shared, **458** deliverables were uploaded to the Defense Technical Information Center (DTIC).

### publications

Capability Summary • 2011 Annual Report • FY11 Technologies Publication • Spring/Summer and Fall/Winter Newsletter • Task Descriptions • Technology Fact Sheets • Three articles featuring NDCEE accomplishments submitted to military and technical journals

### conferences

exhibited and presented at **12** conferences

subject matter experts contributed **17** technical presentations and posters

**88** participants from government and industry attended the NDCEE Program Review held on August 28, 2012 at Joint Base Myer-Henderson Hall

[www.ndcee.ctc.com](http://www.ndcee.ctc.com)

**12,000** visits to the site per month, on average

## MarCom Gold Award Winner



NDCEE Exhibit Booth • 2011 Annual Report • Capability Summary • Bannerstand Display

The NDCEE performs value-added activities to advance the technology readiness level (TRL) of potential solutions in all phases of the transition process – Assessment, Systems Integration and Testing, Demonstration/Validation, and Transition.

Assessment (TRL 1-8)	Systems Integration and Testing (TRL 3-5)	Demonstration/Validation (TRL 6-8)
<p>Literature searches, data mining, surveys, and other methods are employed in this phase to ensure problem context, drivers, and end-user needs are well understood; obtain available technical, economic, and lifecycle data on current and alternative technologies; and focus technology transition efforts.</p>  <p>On-site Water Packaging</p>	<p>This phase includes those activities involved in the evolution of scientific concepts and research towards tangible and integrated technical solutions, including: preliminary design, system or process development and fabrication, prototyping, computer modeling, and bench-scale or laboratory testing.</p>  <p>Ground Vehicle Energy Absorbing Seat</p>	<p>This phase includes activities associated with testing and evaluating potential technology alternatives against user requirements. Whether at the prototype- or full-scale, demonstration/validation can encompass a variety of evaluation objectives including feasibility, optimization, and/or operational acceptance testing.</p>  <p>T-11 Parachute</p>

## FY12 Technology Transitions

### Transition (TRL 8-9)

The final phase may include implementation, start-up, training, and/or other support efforts necessary to field validated technologies for installation and weapon system end users.



#### Capability Risk Profile Tool

Risk response strategies were developed and provided to the Air Force for their HC-130, HH-60, and Guardian Angel assets.



#### Composting

Transitioned to Joint Base Myer-Henderson Hall, this in-vessel system converts organic waste into nutrient rich fertilizer.



#### Corrosion Prevention and Control

Capabilities and throughput rates increased as a result of process improvements implemented at the Marine Corps Base Hawaii Corrosion Repair Facility.



#### Energy Awareness Training

Strategic, operational, and general energy awareness training modules were developed and made available on-line to all Air Force members.



#### GIS for Facilities Management

A comprehensive GIS with more than 20 facilities management data layers was implemented at Tobyhanna Army Depot.



#### Laser Induced Breakdown Spectroscopy

Transitioned to Corpus Christi Army Depot, LIBS is used to conduct solder composition analysis on electronic components.



#### Photovoltaic Arrays

Following results of a successful six-month demonstration/validation, a 42 kW roof-mounted array was transitioned to Camp Katuu, Palau.



#### Sports Injury Surveillance System

The secure, web-based SISS was deployed at the Air Force Academy, providing them with improved injury and illness reporting capabilities.

# FOCUSED SOLUTIONS TO REDUCE LIFECYCLE COSTS AND IMPACTS

**\$1.8M**

expected cost savings for retrofitted MH-60R fleet

**80%**

potential labor reduction with cosmoline removal process

**97%**

nitrate removal efficiency

As weapon systems are developed, tested, fielded, and maintained, lifecycle costs and impacts must be reduced. Leveraging experience and knowledge gained over more than two decades, the NDCEE continues to focus on identifying and evaluating alternative materials, processes, and technologies to mitigate corrosion and its impacts. NDCEE green procurement and sustainable acquisition activities have also optimized DoD weapon system design and maintenance, as well as ammunition production operations. Overall, NDCEE solutions have reduced total ownership costs and environmental impacts, decreased employee exposure to hazardous materials, and improved performance and mission capability.

## OPTIMIZING CORROSION PREVENTION AND CONTROL

One persistent challenge that requires consistent attention and innovation is corrosion prevention. Corrosion of weapon systems and support equipment has a significant impact on readiness, reliability, maintenance, and the cost of ownership. The Government Accountability Office estimates that one third of the \$10-20 billion that the DoD spends annually on corrosion can be avoided by applying commercially available corrosion prevention and control techniques. The NDCEE is working to support corrosion control efforts across the equipment lifecycle — from design and materials selection through operation and maintenance.

One example is a gasket kit retrofit developed with Naval Air Systems Command (NAVAIR) to reduce the susceptibility to saltwater corrosion of the MH-60R SEAHAWK® helicopter nose bay. Addressing nose bay corrosion damage requires approximately 350-400 labor hours and 9-10 weeks of down time per helicopter per year. Working with a gasket vendor, Aviation Devices and Electronic Components (Av-DEC), the NDCEE developed a gasket kit for the nose bay avionics shelves. Upon compression, the aluminum mesh in the gasket makes solid contact with the electronic component and its mating surface and a polyurethane gel fills all voids, totally bonding the component to the aircraft. This provides a high degree of environmental protection, while still allowing electrical conductivity and easy removal.



An Av-DEC gasket installed on bare metal provides a conductive water resistant seal.



Superhydrophobic materials are being investigated to determine if their rapid water runoff properties can reduce corrosion as well as provide water-proofing, anti-icing, anti-fouling, and drag reduction benefits.



An oven heating process for cosmoline removal was validated for parts with simple geometries such as pinions and gears, resulting in increased shop throughput and reduced hazardous material usage and waste.



A tension fabric structure installed at the Marine Corps Base Hawaii CRF for staging vehicles during curing has the potential to increase paint booth throughput by 40%.



NDCEE storage and process improvement recommendations will reduce equipment deterioration effects and replacement/refit costs for MWTC.



NDCEE validates green products against military specifications prior to procurement and introduction into the supply chain.



Alternative materials were demonstrated at OC-ALC and OO-ALC to replace lead containing conductive tapes used in chromium and nickel electroplating and nickel strike operations.

This MH-60R fleet retrofit is expected to save the Navy an estimated \$1.8 million annually in reduced maintenance time and materials. Further savings are possible as it is anticipated that the gasket can be used on the fleet's sister helicopter, the MH-60S. In addition, this solution is anticipated to have joint services application for corrosion control on Army, Air Force, and Coast Guard helicopter platforms. This effort and related NDCEE and NAVAIR initiatives to streamline aircraft maintainability will improve fleet readiness and reduce total ownership costs.

The NDCEE is also assisting the military with the identification and evaluation of new materials and coatings for corrosion prevention applications. One example is superhydrophobic (extremely water repellent) coatings; these materials are being investigated to determine if their rapid water runoff properties can reduce corrosion as well as provide other benefits. In FY12, the NDCEE completed a survey to identify superhydrophobic coatings that are commercially available or in development, as well as formulation changes or additives that could impart superhydrophobic properties in existing coatings. One dozen potential coatings were identified along with 43 potential coating additives. This emerging market has the potential to provide the military with advanced coatings that reduce corrosion, extend equipment service life, and decrease maintenance requirements and costs.

In addition to developing design and material improvements to mitigate corrosion, the NDCEE also optimized an existing Army corrosion prevention process to increase throughput and reduce hazardous material usage and waste. The removal of cosmoline – a petroleum-based product that is commonly used to protect metallic parts from corrosion while in storage – is done via a labor

intensive hand scraping/solvent process or by a waste oil-generating Heat Transfer Oil (HTO) process. The NDCEE coordinated with the transmission and engine cleaning shops at Corpus Christi Army Depot (CCAD) to validate an alternative oven heating process for cosmoline removal. In FY12, findings from an NDCEE technology demonstration were used to develop a new process standard for technology implementation. The oven removal process was approved for parts with simple geometries and results in increased throughput, reduced solvent usage and disposal, and elimination of the cleaning oil. It is anticipated that CCAD could realize a 55% to 80% reduction in labor hours when compared to hand scraping or HTO vat heating.

The NDCEE is supporting the U.S. Marine Corps Corrosion Prevention and Control Program in their mission to extend tactical ground and ground support equipment life and reduce associated maintenance requirements and costs. In recent years, the NDCEE has evaluated and implemented paint and blast booth modifications in Corrosion Repair Facilities (CRFs). In FY12, the NDCEE supplemented these modifications with the installation of

**“The new Av-DEC gasket design and implementation package provided through the NDCEE by CTC to address the MH-60R nose bay corrosion issue (shelf and black boxes) will decrease costs and improve aircraft availability for the Fleet and the Integrated Maintenance Program.”**

**– David Bullock, NAVAIR In Service Support Center, MCAS Cherry Point**

a tension fabric structure at the Marine Corps Base Hawaii CRF to provide weather protection for painted vehicles during cure. This simple solution increases the throughput of paint operations by providing a staging area that allows assets to be removed from the paint booth after fifteen minutes instead of four hours as previously required. In addition, this significantly improves the coating quality by allowing each vehicle to fully cure over an extended time period in a protected area prior to exposure to the elements.

The NDCEE also supported the Marine Corps in optimizing storage facilities and procedures to extend the service life of clothing and equipment used in training and operations. The Program Manager for Infantry Combat Equipment maintains and operates facilities at Marine Corps Base Quantico (MCBQ) and Mountain Warfare Training Center (MWTC) to distribute, refurbish, maintain, and store clothing and equipment. As these items are returned from training and/or mission operations they are inspected, refurbished, and placed in storage where, without proper environmental protection, they can deteriorate. To address this issue, the NDCEE conducted a thorough engineering analysis to develop a cost-effective solution to improve the indoor environmental conditions in several buildings and analyzed preparation, storage, and distribution processes. Recommended building upgrades and process improvements will be implemented in FY13.

### **ENABLING GREEN PROCUREMENT AND SUSTAINABLE ACQUISITION**

Many government requirements direct military agencies to give procurement preference to biobased products and low or non-toxic chemicals and materials. Green procurement

and sustainable acquisition efforts identify, evaluate, and promote the use of new materials, chemicals, systems, and processes to reduce or eliminate environmental, safety, and health impacts of weapon systems – from design to disposal. The NDCEE continues to be actively involved in assisting the military with these efforts.

Greening of weapon systems requires that their environmental impacts are accurately documented and assessed by both system developers and the installations where the systems are fielded. The Environmental Quality Testing Operating Procedure (EQTOP) was developed by the Army Environmental Command to ensure this type of information is accurately and consistently collected. The NDCEE conducted a demonstration and validation of EQTOP by reviewing data generated from two case studies and cross walking the EQTOP with other existing methods. The NDCEE verified the procedure and resulting data are valid, and determined the cost of collecting this information so that Program Managers can include this in their system acquisition programs.

Before green products and alternative processes can be implemented in weapon system designs or maintenance operations, they must be validated to ensure they meet DoD performance specifications and operating requirements. The NDCEE is providing support to the Defense Logistics Agency (DLA) Aviation Hazardous Minimization and Green Products Branch in evaluating a variety of sustainable products, including alternatives to reduce lead (Pb) use in plating operations. Many DoD maintenance facilities currently use a Pb-based, cadmium-containing conductive tape, called a plating robber, for chromium and nickel electroplating operations.



To mitigate environmental issues and supply chain risks, the NDCEE evaluated alternative primer sealants for small caliber ammunition production at LCAAP.

The NDCEE conducted a technology assessment of commercially available alternatives that possess similar chemical, physical, and electrical properties as the currently used plating robber and identified five potential alternative materials. Bench-scale testing narrowed the list to two candidates – an aluminum foil tape and a high-flex nickel-copper tape. The NDCEE worked with Oklahoma City Air Logistics Complex (OC-ALC) and Ogden Air Logistics Complex (OO-ALC) to conduct on-site demonstrations of the two candidate tapes for both chromium and nickel electroplating and nickel strike operations. At this time, OC-ALC is considering implementing the aluminum foil tape as it is most similar to the currently used plating robber and the most cost effective of the alternatives. This change would result in increased protection of worker health and potential reduction of monitoring and health care costs – without increasing procurement costs.

NDCEE support to DLA also resulted in the development of a draft performance specification for Hydraulic Fluid Purification (HFP). Currently, the 36 thousand tons of hazardous waste returned to the U.S. from Iraq and Afghanistan includes significant amounts of hydraulic fluid; it is anticipated that implementing HFP will reduce the hydraulic fluid waste stream by 50% to 80%. In developing the performance specification, the NDCEE collaborated with service ground support equipment engineering offices (NAVAIR Lakehurst, Redstone Arsenal, and Warner Robins ALC) and the Joint Panel on Aviation Support Equipment. An HFP system performance standard provides guidance to ensure that contaminant levels are reduced while preserving the fluids' performance characteristics based on known standards and criteria. The standardization of HFP systems will benefit the military by enabling increased product availability and lowering procurement and waste disposal costs.

Leveraging more than a decade of Air Force technology development and demonstration, the NDCEE is supporting the validation and transition of laser coatings removal systems as an alternative to conventional aircraft depainting using chemicals and/or abrasive media blasting. In addition to reducing water usage, air emissions, and waste generation, laser technology can selectively remove coatings – for example, removing the topcoat, but leaving the chromate containing primer – further optimizing aircraft maintenance. In FY12, the NDCEE initiated the final design and development of fully automated laser coatings removal systems for F-16 and C-130 aircraft, to be validated in a production environment and ultimately transitioned to OO-ALC. In addition, the NDCEE procured small handheld laser units that will be used for touch-up work on small areas, both on and off-aircraft. Ongoing evaluations of laser-stripped substrates are being carried out to verify optimal laser settings for depaint activities with minimal impact on substrate condition. Implementation of laser coatings removal is anticipated to eliminate worker exposure to hazardous chemicals, significantly reduce labor and overall maintenance costs, and reduce hazardous waste generation by more than one ton per aircraft.

### INCREASING THE SUSTAINABILITY OF THE AMMUNITION INDUSTRIAL BASE

Because operating Army Ammunition Plants (AAPs) is resource intensive, the Army is applying a sustainability perspective to preserve plant production capabilities while reducing their environmental and energy footprint and operating cost. In FY12, the NDCEE provided support to enhance ammunition industrial base sustainability by evaluating opportunities to optimize facility use, incorporate new and innovative technologies, and reduce environmental impacts and energy consumption.

This included support for the Lake City Army Ammunition Plant (LCAAP) on modernizing production of green small caliber ammunition in partnership with the Project Manager – Maneuver Ammunition Systems, and the Armament Research, Development and Engineering Center. Under their green ammunition program, the traditional lead bullet was replaced with a non-lead alternative, the M855A1 (5.56mm); however, the conventional circular crimp assembly process step used during M855A1 manufacture did not provide sufficient retention force for the primer when the bullet was fired. In conjunction with industry partners and the Army, the NDCEE developed and evaluated a modified circular crimp process that offers the potential to



Wastewater samples were taken from an outfall at RFAAP's acid area for a batch-process demonstration of CCIX that resulted in 97% nitrate removal.

optimize the priming process and overcome production challenges. This success will eliminate up to 2,000 tons of lead from small caliber ammunition manufacturing each year.

The NDCEE has also been supporting LCAAP in minimizing environmental impacts while reducing future production risks. LCAAP uses purple lacquer as a munitions primer sealant, which contains several Hazardous Air Pollutants and 70% Volatile Organic Compounds. The use of this material leaves LCAAP vulnerable to future usage restrictions due to its hazardous nature. Testing of three promising alternatives indicated that cost and performance results were satisfactory. Anticipated benefits of these alternative materials include reduced production time, increased ease of use, potential quality improvements, reduced employee exposure to hazardous material, and the elimination of potential future supply chain restrictions for the purple lacquer.

The NDCEE has been assisting Radford Army Ammunition Plant (RFAAP) to achieve more sustainable operations by evaluating the nitrate sources and concentrations currently released to the New River. Although RFAAP is within its permit requirements and no detrimental water quality effects to the river have been identified, the Army is pursuing ways to reduce nitrate discharges. Since nitrate is a stable and highly soluble ion that does not precipitate or adsorb easily, it is difficult to remove from water using conventional filtration or activated carbon adsorption. The NDCEE demonstrated a counter current ion exchange (CCIX) process at RFAAP that uses a specially developed resin in multiple columns to remove nitrate ions from

wastewater. Once the resin columns are saturated, a solution of ammonium hydroxide is used to strip the nitrates, producing ammonium nitrate, which can be used on-site as a fertilizer for landscaping. This initial proof-of-concept demonstration validated the technology was able to achieve nitrate removal efficiencies of up to 97%.

And finally, the NDCEE is supporting end of lifecycle impacts by assisting the Program Executive Office Ammunition and Joint Munitions Command in evaluating the reuse potential of certain components in the stockpiled munitions to be demilitarized (demil). The NDCEE determined that D846 propellant and Composition B explosive were the two most promising reuse candidates, with a potential annual savings of \$4 million. The Project Manager Demilitarization has since decided to pursue these two opportunities for implementation.



Reuse of munitions components D846 propellant and Composition B explosive will enable the reduction of the demil stockpile as well as offset demil execution costs.

# INNOVATIVE APPROACHES TO SAFETY AND SUSTAINABILITY



**1,000+**

airmen and civilians take voluntary energy awareness training

**50%**

increase in solid waste diversion potential through increased utilization of existing programs

**\$54M**

cost avoidance over past decade at VPP Star Sites

Proactively addressing safety, environmental, and energy issues is often more effective and efficient than waiting for regulations, violations, or some other crisis to motivate action. Being proactive can save money, reduce risks, and most importantly, ensure the mission can be met today and in the future. This involves engaging with a broader community of stakeholders, applying a system of systems perspective, adopting innovative approaches to technology deployment, and recognizing the mutually reinforcing relationship between mission, community, and environment. Examples of innovative approaches that span energy, environmental, safety, and occupational health issues can be found in the Army's Net Zero Initiative, the Air Forces' Energy Awareness Training, DoD's Voluntary Protection Programs, and the contingency base community of practice. The NDCEE provided vital support to each of these in FY12.

## PROVIDING A FRAMEWORK TO ACHIEVE NET ZERO

The Army's Net Zero (NZ) Installation Initiative established aggressive, long-range goals for designated installations to produce as much energy as they consume, return water to their watershed in same quantity and quality as removed, and eliminate waste sent to landfills. The NZ approach comprehensively addresses and exploits the interrelationships between water, energy, and waste – looking at both demand and supply side issues as well as mission and security implications. The NDCEE continued to support the Army's NZ initiative in FY12 with an emphasis on NZ waste as well as a focus on energy and water security considerations.

The NDCEE developed a comprehensive assessment protocol for all waste streams in all installation activities and completed demonstrations of the protocol at six pilot installations. This was accomplished by characterizing waste and documenting material flow based on Activity Groups, enabling waste diversion and recycling programs to more effectively target waste at its source. A "Divertability Scale" was applied to indicate the extent to which existing waste streams are easy to divert (leveraging a program already in place), possible to divert (programs can easily be developed), or challenging (new technology or infrastructure needed). This analysis led to the





The NDCEE developed and deployed web-based energy awareness training for the Air Force to enable all service personnel to more fully consider energy impacts in their daily routines.

identification of additional waste minimization and diversion prospects – increasing the total potential diversion of waste while providing insights into many new opportunities to collaborate with organizations across the installation.

The NDCEE research provided Fort Hood with many immediate opportunities to increase their recycling rate. Examples include: focusing glass recycling on major generators such as Morale, Welfare, and Recreation facilities; focusing plastic beverage container recycling in personnel housing; bolstering yard waste composting in family housing areas; and, focusing expanded polystyrene recycling on major generators, such as the hospital. The information collected by the NDCEE also enabled a renewed focus on efficient solid waste management and collection, specifically on the efficiency of collection pick-ups and utilizing the collection contractor to support waste minimization and diversion efforts.

Based on waste characterization results from several pilot installations, the NDCEE determined that waste diversion at large installations could be increased by 50% through increased use of existing diversion programs. In addition, the NDCEE estimated that many installations' solid waste streams contain 25% to 50% biodegradable organic material for which many readily available technologies (e.g., composting) can be applied. The NDCEE also identified multiple small-scale waste processing technologies targeting the most challenging waste streams, such as Styrofoam™/ expanded polystyrene and consumer contaminated waste – materials that must be addressed to achieve zero waste to landfill goals.

In addition to the NDCEE's significant NZ waste efforts, the NDCEE also supported various NZ energy and water initiatives. Energy and water security are increasingly areas of focus within the DoD; recent policy

documents define and prioritize these concepts. There is a gap, however, in integrating security concerns with NZ. The NDCEE helped to address this gap by developing and testing energy and water security assessment protocols at two pilot sites. A non-classified water security assessment at Joint Base Lewis McChord helped reveal actions that could address both NZ and water security concerns simultaneously. This was accomplished by expanding the traditional perspective of water security beyond short-term vulnerability planning to longer-term resource protection. A non-classified energy security assessment at Fort Hunter Liggett helped to identify missing pieces of critical infrastructure required to integrate proposed renewable energy strategies with critical mission demands. Applying a security lens to NZ ensures mission needs are fully accounted for and NZ efforts do not negatively impact security and vice versa.

### FOSTERING CULTURE CHANGE

Organizational culture change is a critical part of achieving energy, environmental, and safety goals. Changes in underlying perceptions and issue awareness are critical to successful adoption of best practices and innovative technologies. The NDCEE facilitated culture change efforts in FY12 through the development and deployment of energy awareness training and continued operation of the DoD Voluntary Protection Programs Center of Excellence (VPP CX).

The Air Force recognizes the critical importance of changing culture to achieving its energy vision. As stated in the 2010 Energy Plan: "As the culture changes and the Air Force increases its energy awareness, new ideas and methodologies for operating more efficiently will emerge as airmen consider energy in their day-to-day duties." In support of Air Force energy culture change initiatives, the NDCEE worked with more than 40 Air Force and energy subject matter experts to develop an on-line energy awareness training module. This training,

**"The end result [Air Force Energy Awareness Training] was a professional product that is being used by the Air Force and getting praise from users and leaders alike....that not only improves energy security, but also plays a part towards the Air Force and our Nation becoming less dependent on foreign oil."**

**– Lt Col Woodard, US Air Force**

which addresses acquisition, aviation, governance, green procurement, ground vehicles, and infrastructure, enables the Air Force to build the foundation for a culture that will continuously reduce energy demand and use new energy sources effectively. Reaching all levels of the organization, the curriculum makes energy meaningful to the airmen, whatever their daily responsibilities. More than 1,000 airmen and civilians have taken the course to date, which is available online through the Air Force Civil Engineer Center's Energy Directorate.

Awareness and culture change are also key to the success of DoD safety initiatives, as showcased by the success of DoD sites participating in the Occupational Safety and Health Administration's (OSHA's) Voluntary Protection Programs (VPP). Overall, DoD VPP Star Sites reported more than a 70% reduction in incident rates and more than \$54 million in cost avoidance over the past decade – not including the costs saved through workers' compensation.

In large part, this success was achieved through the support of the DoD VPP CX. The VPP CX provides a combination of onsite technical support and remote/ electronic support to increase awareness, track progress, and share lessons learned and successes across the DoD – applying an innovative and systematic approach to continuously improve workplace health and safety at military installations. VPP CX accomplishments in FY12 include assisting 16 DoD sites in submitting their applications for OSHA VPP Star status. The VPP CX also set several new DoD installations on their path to achieve VPP Star recognition, completing 25 New Site (Stage 1) Baseline Assessments in FY12.



The DoD VPP CX's many outreach and training tools continue to expand awareness of workplace safety risks and enable culture change to effectively reduce these risks.

Through the VPP CX, the NDCEE delivered webinars, Train the Trainer Assessor courses, and Train the Trainer Implementation and Sustainment courses. The NDCEE presented 24 workshops at conferences to address VPP challenges that are specific to the DoD and provided mentors to DoD sites to assist them with their training needs. In addition, the electronic VPP tool, which aids in tracking and assisting VPP implementation progress, currently has more than 4,000 registered DoD users. The assessments, tools, and training provided by the NDCEE provide the foundation for the organizational culture change needed to effectively reduce workplace injuries in the DoD.

### APPLYING A SYSTEM OF SYSTEMS PERSPECTIVE TO CONTINGENCY BASES

Contingency bases are highly dependent on outside resources and generate large amounts of waste. Reducing the logistical and environmental burden of contingency bases requires a holistic, system-based perspective that involves all aspects of doctrine, organization, training, materiel, leadership, personnel, and facilities. The NDCEE performed activities in FY12 to reduce the contingency base footprint for the Navy and the Army through a System of Systems framework that enables integrated water, waste, and energy solutions.

The U.S. Naval Expeditionary Base Camp Lemonnier, Djibouti, Africa, has reduced its energy, water, and waste footprint through multiple efficiency and conservation efforts as the camp transitions from temporary to enduring. The NDCEE worked with the Naval Facilities Engineering Service Center to research and develop additional efforts the camp may undertake to achieve further reductions. For instance, the NDCEE developed a water bottle lifecycle model to document baseline conditions as the camp relies heavily on bottled water for drinking purposes, creating a logistic and solid waste burden. The NDCEE also researched the feasibility of on-site water packaging technologies, but determined this approach would negatively impact the local groundwater aquifer and would not reduce the plastic waste volume generated from water bottles.

A Microgrid Planning Tool was also demonstrated at Camp Lemonnier. The tool uses information gathered from site surveys to model the baseline grid configuration and propose features to optimize the grid architecture, change power sources, and integrate renewable energy. Four options were identified for the camp involving



A small-scale WTE system powers lights using wood chips and refuse-derived fuel, representative of solid waste generated in theater.



The Renewable Energy Suite integrates biomass, PV, and batteries to provide mobile power at remote sites. Mounting the PV arrays directly on the system's shipping containers helps to enhance mobility for in-theater applications.



Small-scale incinerators with secondary burn chambers were evaluated for their potential to reduce environmental and human health risks from the burning of contingency base solid waste.



In-vessel composting systems, such as this unit transitioned to JBM-HH, enable rapid conversion of food and other organic waste to compost in a more compact footprint as compared to traditional methods, such as windrows and aerated static piles.



An inclined auger mixes and aerates organic waste to achieve conversion to compost within three weeks, indexing the material to the back of the container for easy removal and use.



The NDCEE demonstrated a mobile, containerized wastewater treatment system at Fort Leonard Wood, assessing performance, energy use, and ease of mobilization and demobilization.

changes to prime power distribution lines and architecture, increased use of renewable energy sources, and installation of a microgrid control system. Implementation of the proposed modifications and operational changes could achieve a potential fuel reduction equal to \$1 million annually. The NDCEE also researched solid waste management technologies to remove wet organic waste from the incinerators and improve burn efficiency, further reducing the fuel burden of the camp by 250 gallons per day.

In coordination with U.S. Army Central (USARCENT), the interrelationship of waste and energy was further exploited in a demonstration of small-scale, mobile Waste-to-Energy (WTE) technologies to generate electrical power and process mixed waste streams typical to a contingency base. One of the WTE technologies tested was a 20 kW biomass gasification system. While the system was designed for shredded biomass, the NDCEE tested its ability to handle a variety of waste streams. The results indicated that the system could generate power from other sources of waste, but that extensive waste pre-processing (drying, shredding, pelletizing, etc.) and equipment maintenance are required.

Leveraging a unique biomass source – coconut shells – the NDCEE designed, constructed, and demonstrated an expeditionary Renewable Energy Suite in coordination with the Headquarters U.S. Southern Command and the Cooperative Security Location (CSL) Comalapa, El Salvador. This system was designed to fit in a 20 foot ISO container and operate independent of the local power infrastructure. It integrates a biomass gasifier (designed and developed by the State University of New York),

generator set, photovoltaic panels (PVs), and lithium iron magnesium phosphate batteries. Preliminary testing of the system indicates it is capable of providing 80 kWh of electricity per day, meeting energy requirements of the CSL host site facility.

In addition to WTE solutions, the NDCEE conducted demonstrations of other solid waste management technologies, including two small-scale incinerators and in-vessel composting. In coordination with ARCENT, Product Manager, Force Sustainment Systems (PM FSS), and Army Public Health Command, the NDCEE collected the necessary operational, environmental emissions, and health and safety data to determine if incinerators are a safe and viable option for handling waste at forward contingency bases. The demonstration was conducted using municipal solid waste collected and sorted to resemble the characteristics of waste typical to contingency bases. Results are being used by PM FSS to downselect an incinerator and develop the Material Fielding Plan for this technology.

**“Integrating disparate but interdependent support functions (solid waste, wastewater, and energy management) is essential to understanding a base camp as a system of systems and reducing the logistical burden contingency bases place on the warfighter. Activities conducted by the NDCEE are pioneering steps toward this goal.”**

**– John Horstmann, U.S. Army Central**

Given the high percentage of organic material in fixed installation and contingency base waste streams, the NDCEE demonstrated an in-vessel composting technology at Joint-Base Myer-Henderson Hall (JBM-HH). As part of their sustainability efforts, JBM-HH proposed to compost manure and food waste to reduce the amount of landfilled solid waste. The overlap between desired in-vessel technologies for rapid composting at JBM-HH and contingency bases provided a unique opportunity for demonstration and validation. Two different mixes were tested; one mix that included horse manure generated by the Old Guard’s Caisson Platoon and another that represented the feedstock generated by contingency bases. The demonstration validated that the selected composting system, Green Mountain Technology’s Earth Flow™, was capable of reducing the volume of waste by 30% in a two- to three-week time frame, producing compost mature enough to be used for erosion control purposes. Based on the results of the demonstration, food waste segregation, handling, and transportation issues are the largest hurdles to overcome before this type of waste management is feasible in theater. JBM-HH procured the unit for continued use in composting stable bedding and horse manure at the installation, anticipating, with full implementation, an operating cost reduction of more than \$50,000 per year.

In addition to managing municipal solid waste, contingency bases must also manage wastewater for reuse and/or disposal. Multiple wastewater treatment package plants are available for rapid mobilization and treatment of wastewater. However, these systems often have high energy and maintenance requirements which limit

their applicability to contingency bases. The NDCEE demonstrated the AX-Mobile by Orenco Systems, Inc. – a lightweight, containerized, wastewater treatment system that uses textile sheets in a packed bed media filter to treat 5,000 gallons per day – in coordination with ARCENT and the Army Engineer School at Fort Leonard Wood, Missouri. The demonstration results confirmed the ability of the technology to treat wastewater to desired standards using a military-supplied 5kW Tactical Quiet Generator. As with the other demonstrations, the mobilization and operation requirements and system performance were assessed, and modifications needed to ruggedize the technology for use in theater were provided to the Army.

As the DoD applies materiel solutions (such as those demonstrated by the NDCEE) to reduce the environmental and logistics footprint of contingency bases, the impact of these technology transfers will need to be documented in order to determine if the desired positive outcomes have been achieved. The NDCEE conducted a policy, doctrine, and requirements analysis focused on the issue of metrics and the flow of information in regards to energy use, water use, nonhazardous solid waste generation, and wastewater generation at contingency bases. Based on a review of Army Regulations, Field Manuals, and guidance documents, limited reporting requirements or reporting responsibilities were found, and those that do exist are primarily for tracking petroleum use. Several potential Courses of Action were provided to help address the need for metrics. Improved collection of data from contingency bases will be needed to support integrated efforts to reduce the environmental and logistics footprint and enhance operational efficiency.

# INFORMING DECISIONS TO OPTIMIZE READINESS AND MITIGATE RISK



1,584

Army industrial shops benefited from IH assessments

14

non-metallic materials tested for compatibility with reduced sulfur fuels

180

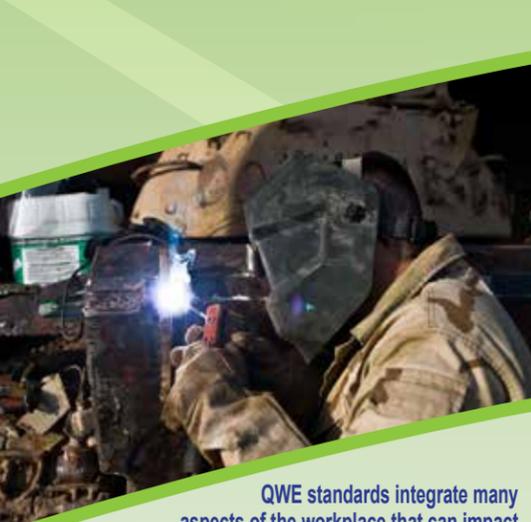
large-scale renewable energy opportunities evaluated through the EITF

Accurate, relevant, and readily available data are necessary to make effective decisions, reduce risk, and optimize operations. Developing and optimizing protocols, tools, and systems for collecting, integrating, analyzing, and presenting environmental, safety, occupational health, and energy (ESOHE) data is a core capability of the NDCEE. In FY12, the NDCEE provided critical information, data infrastructure, and analysis to identify and mitigate workplace injuries and industrial hygiene issues, enable the safe transition to reformulated fuels, develop and prioritize renewable energy projects, and formulate management strategies for munitions and explosives of concern (MEC).

## IMPROVING WORKING CONDITIONS AND MISSION SAFETY

Workplace health and safety is a priority for the DoD, but identifying critical issues, focusing risk mitigation strategies, and tracking the effectiveness of safety programs and health initiatives are all dependent upon the consistency, validity, and availability of data collected from the workplace, training events, and exercises. In FY12, the NDCEE provided business process analyses, technical subject matter expertise, focused data collection, risk assessments, and information system development, demonstration, and deployment in support of several DoD initiatives that provide a critical foundation for improving workplace and warfighter safety and health.

A strong industrial base relies on a strong and healthy workforce. To provide soldiers and civilians the safest and healthiest workplace possible, the Project Director - Joint Services developed a common set of Quality of Work Environment (QWE) standards to be applied across the Army's industrial facilities. These standards are intended to integrate safety, industrial hygiene, occupational health, ergonomics, and fire safety into an overall perspective of the workplace. These considerations were previously addressed in multiple departments, with disparate reporting systems. To streamline the QWE assessment process, the NDCEE developed and tested a QWE Mobile Web Application that integrates QWE criteria into a single data management system. On-site inspectors now have a standardized methodology for observing and recording data. The QWE tool allows data to be recorded and stored for later download to the database or entered immediately, thereby increasing the speed and efficiency of the transfer of field data. The NDCEE demonstrated and validated the tool during benchmark assessments at 18 Army sites, including training QWE team members to use the



QWE standards integrate many aspects of the workplace that can impact personnel health and safety, holistically reducing risk and improving the industrial base work environment.



The NDCEE is enabling improved collection and reporting of IH data to allow the Army to systematically identify and mitigate occupational health risks across industrial worksites.



A web-based SISS is now being used by the USAFA to reduce sports-related injury rates amongst its cadets, improving training and readiness.



Business process rules established for the FR2 data warehouse ensure conformed data are available to inform mitigation actions to reduce DoD injuries.



Risk identification and analysis completed by the NDCEE helped to focus attention on latent and systemic issues for the Air Force's CSAR assets.



The tensile strength of elastomeric materials was measured before and after immersion to ensure compatibility of common fuel system components with reduced sulfur fuels.

tool. Information management is key to the successful implementation of the QWE initiative – enabling the Army to overcome business process stovepipes, enforce standard metrics, and improve data searching and reporting capability.

Providing actionable data for mitigating occupational health risks was also the goal of the NDCEE's characterization of worksites at 25 Army installations in the U.S., Korea, Japan, and Germany. The DoD uses the Defense Occupational and Environmental Health Readiness System (DOEHRS) - Industrial Hygiene (IH) to manage its IH data. Each installation's DOEHRS-IH record is standardized to provide a current, reliable, accurate, and sustainable reporting capability to support decisions concerning the health of soldiers, family members, and the civilian workforce. NDCEE-developed data collection templates and procedures are used to standardize the survey workflow and data collection and to support a rigorous quality review before data becomes part of the DOEHRS-IH dataset. The NDCEE IH team identified occupational noise and chemical exposures, assessed workplace illumination and ventilation, and identified ergonomic hazards. In addition, the team documented administrative and personal protective equipment controls and assessed engineering control performance. Of the shops visited in FY12, 26% had no prior DOEHRS-

IH record, leaving workers at risk of industrial hazard exposures not visible to the Army and DoD enterprise. Existing shops were updated with fresh information on the workforce, process changes, and changes to workplace hazards and controls. The DOEHRS-IH data collected provides a foundation for long-term decision-making regarding the implementation and resourcing of occupational health programs across the DoD.

Operational readiness depends on a fighting force that is trained and ready for duty. While sports are vital for fitness and morale, injuries suffered on the playing field can affect training and readiness. In FY12, the NDCEE provided functionality updates and security support to the Sports Injury Surveillance System (SISS), which was transitioned to the U.S. Air Force Academy (USAFA). To ensure data consistency, the NDCEE developed a detailed user guide with instructions and outlined roles for the System and Health Insurance Portability and Accountability Act Administrators, Medical Providers, Technicians, Receptionists, Athletic Trainers, Safety Managers, and Cadet Safety Office personnel. The SISS provides the USAFA with a secure, web-based software application that allows instantaneous access to aggregate injury and illness information for stakeholder groups across the entire organization, allowing them to identify risk factors, monitor intervention results, and reduce injuries and training costs.

**"The support provided through the NDCEE by CTC for USAPHC has directly increased the operational capabilities of our DOEHRS-IH MIS and consequently the Army's ability to make accurate and effective decisions regarding potential occupational health exposures at its installations worldwide. Additionally, the development and implementation of new procedures for standardizing the acquisition of industrial hygiene data has demonstrated better methodologies for improving how the Army collects and maintains its occupational exposure information. This provides a way ahead towards an effective and efficient common operating model for the Army Industrial Hygiene Program."**

– Bryan Lynch, US Army Public Health Command

Similar to the SISS, the Defense Safety Oversight Council uses the Force Risk Reduction (FR2) data warehouse to collect, organize, and analyze injury data across the Services and identify trends, understand root causes, and identify mitigation actions. The NDCEE collected available data from across the Services and used the data to develop use cases and requirements, which led to implementation of detailed business rules to integrate the data sets into the FR2 warehouse. For the validated data sets, the team then built and automated high level and detailed reports to disseminate the information to leadership and end-users DoD-wide. The ultimate goal of the data fusion was to ensure accessible, accurate, and conformed data are available to inform decision-making.

For inherently dangerous missions, such as Combat Search and Rescue (CSAR), reduction of injury risk requires vigilant and constant attention. Personnel Recovery Capability Risk Profiles (PRCRPs) are decision-support tools used by the DoD to identify, examine, and mitigate risks for specific capabilities, such as CSAR. In FY12, the NDCEE developed a PRCRP for several Air Force CSAR assets, including both personnel and equipment. Using the principles of the Reason Accident Causation Model, 12 risk identification methods were applied to the data, including a comprehensive literature review, stakeholder analysis, interviews, environmental scan, risk dimension analysis, data analysis, and task analysis. The risks were ranked from highest to lowest and multiple treatments identified to address each risk. The PRCRP identified latent and systemic issues that may contribute to strategic, command, and operational risk and have not yet received attention. It will be used to develop, resource, and implement capability-wide change initiatives to reduce the risk profile of the CSAR and assure that the

capability is available when needed either for combat search and rescue or to support humanitarian response.

The NDCEE's decision support efforts reinforce the DoD's ongoing emphasis on reducing risks in the workplace and in operations. The result is not only a safer military today, but reduced health care costs from occupational injury and illness in the future.

### ENABLING THE TRANSITION TO ALTERNATIVE FUELS AND RENEWABLE ENERGY

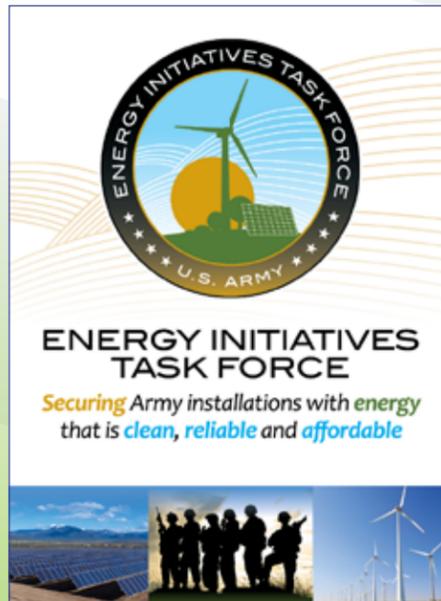
The DoD is aggressively reducing energy use and increasing the use of alternative energy sources throughout its facilities and operations. Informed decision-making is critical to reduce potential risks, optimize investments, and accelerate goal achievement. In FY12, the NDCEE examined the impact of alternative fuels on weapon system components, provided recommendations to support DoD enterprise energy information management, and developed and applied innovative decision-support tools to analyze complex data in support of renewable energy initiatives.

The NDCEE conducted testing and provided critical technical data to the Navy as they work toward transitioning to reduced sulfur fuels for tactical vehicles. Elastomeric seals used in fuel systems absorb aromatics in the fuel and swell, creating a tight, leak-free seal. Ultra-low sulfur fuels with lower levels of aromatic compounds may reduce seal swell and eventually cause components to crack. To ensure that fuel-wetted materials used are compatible with the new fuels, the NDCEE researched and documented historical trends and the impact of reducing sulfur content in petroleum fuels. The NDCEE also performed a series of material compatibility tests on 14 common seal and component materials including o-ring and sheet materials, in addition

to, hose and component materials. Overall, the o-ring and sheet materials had acceptable performance with only two materials from this group of elastomers failing to meet the acceptance criteria. Hose and component testing also had acceptable performance with only two components from this group failing to meet acceptance criteria. Given that the failure of even a single fuel pump seal can immobilize an entire military asset, this research is critical to mitigate potential negative impacts to readiness.

As the Army strives to meet energy security and sustainability goals, investment in renewable energy and energy efficient technologies will help ensure the Army can meet mission requirements today and into the future. Deploying renewable energy projects on Army land requires careful evaluation of performance benefits and operational challenges as well as investment options and lifecycle costs. The NDCEE supported the Army's Energy Initiatives Task Force (EITF), established in September 2011, in their efforts to leverage private sector investments in large-scale energy projects and provide the support installations need to overcome financial, technical, and regulatory obstacles to renewable energy. In FY12, the NDCEE provided critical communications and technical support to the EITF to enhance the efficiency and effectiveness of decision making in this complex area, thereby enabling feasible projects to be identified quickly.

The NDCEE's technical support to the EITF resulted in an optimized renewable energy project portfolio for EITF consideration. This involved not only gathering data from multiple sources, but meaningfully integrating the data to support EITF decisions. The NDCEE partnered with the National Renewable Energy Laboratory to assemble geographic information on Army-owned sites with renewable energy potential. Additional criteria included grid premium estimates, historical price volatility, current demand, strategic interest, electricity reliability, and the estimated cost (or savings) realized by the Army upon project implementation. The NDCEE developed a portfolio optimization tool to evaluate the projects that successfully made it through the initial screening process based on desired objectives of the decision-



The EITF is based on a collaborative business approach – opening doors so renewable energy companies can connect with interested installations. The EITF represents the interests of Army installations to potential investors and technology providers, and as such required a marketing and branding campaign. The NDCEE-developed EITF branding campaign won a 2012 MarCom Platinum Award, the organization's top honor.

maker. The NDCEE also provided critical data collection and analysis for project planning, design, integration, cost evaluation, and operational support for the proposed projects.

The NDCEE's support enabled the Army to successfully identify, evaluate, and select potential projects for implementation under its new Task Force within months of its establishment, with Request for Proposals (RFPs) effectively released to interested parties for renewable energy projects expected to generate 43 megawatts of energy collectively at Fort Detrick and Fort Drum. It also complemented efforts of the US Army Corps of Engineers-Huntsville, who developed and released a \$7 billion Multi-Award Task Order Contract RFP for the procurement of clean energy projects. Optimized project development, combined with consistent outreach to connect Army stakeholders with interested investors and technology providers, is effectively speeding the development and implementation of large-scale renewable projects within the Army and supporting their goal to deploy one gigawatt of renewable energy by 2025. These efforts help to inform Army decision making and optimize operational readiness by reducing reliance on fossil fuels.

In addition to informing decisions on specific projects, the NDCEE also provided strategic support to enterprise initiatives. Data management is a common challenge for large, complex organizations such as the DoD, especially when the information of interest – energy consumption – is not reported consistently across the Services. The Deputy Under Secretary of Defense for Installations and Environment, Business Enterprise Information Directorate developed the DoD Enterprise Energy Information Management Solution (EEIM) to more effectively manage and monitor energy programs. The EEIM provides a series of desired capabilities, standard processes, and data elements. In FY12, the NDCEE investigated existing energy reporting requirements and compared these to the desired end state of EEIM – formulating recommendations for the DoD to assist in the implementation an enterprise solution.



New techniques and technologies for assessment of sea disposal sites are essential to the DoD's efforts to locate, characterize, and manage risks from chemical munitions in a manner that protects and preserves our water resources and sensitive habitats.

## ADDRESSING LEGACY MUNITIONS CHALLENGES

The DoD continues to address environmental and safety challenges associated with legacy munitions management practices. These practices were once internationally accepted methods, but have since been discontinued due to the implementation of modern munitions disposal requirements and increased understanding of potential environmental and safety impacts. In FY12, the NDCEE continued efforts to improve data acquisition and assessment tools and techniques to address ongoing challenges related to MEC.

Following World Wars I and II, large quantities of munitions were disposed in U.S. coastal waters, potentially contaminating ocean ecosystems with metals, explosives, and other hazardous compounds. In support of DoD efforts to mitigate these impacts, the NDCEE refined techniques for assessing sea disposal sites and provided useful data for informing management actions. For example, the NDCEE assisted the development and demonstration of an innovative process to significantly increase the efficiency of analyzing underwater imagery and sonar data. Underwater munitions disposal areas are cluttered with rocks, coral, and other naturally occurring materials and cultural debris that mimic the sonar signal expected from munitions, making discrimination of the materials complex and labor intensive. The NDCEE collaborated with academia and industry to develop an algorithm and user interface that permits the user to adjust a number of variables to filter the data and identify targets/patterns of interest in the analysis automatically - significantly improving the

efficiency in the video review process. The algorithm successfully detected single pixel reflectors and discriminated between the military munitions trails and background noise.

The NDCEE team then used these advanced data processing techniques to maximize the resolution and resolvability of sonar data from a survey conducted off the coast of Hawaii, where previous investigations by the Department of Business, Economic Development and Tourism had identified suspect M47 100-pound mustard bombs. The results of the survey include an expanded geographic information system database and interpretative imagery of the region, as well as recommendations for continued improvements to the remote sensing methodology. The data management procedures developed will assist the DoD in characterizing other military munitions sea-disposal sites.



The SeaCat Hybrid is an example of an Autonomous Underwater Vehicle/Remotely Operated Vehicle that may be used to approach areas of interest and verify underwater munitions.



Polychaete worms are species with a close association to marine sediments, making them extremely suitable in the evaluation of the effects of arsenic on benthic organisms.

In addition to improving site assessment techniques, the NDCEE also investigated potential environmental impacts caused by MEC. The NDCEE assessed biota, sea water, and sediment composition changes following a technology demonstration of the Army's Remotely Operated Underwater Munitions Recovery System, which recovered munitions at depths of up to 120 feet. The results were compared with data from investigations prior to munitions removal. The initial results indicate that leaving the munitions in place may be safer and more environmentally-friendly than recovery. These results will assist the DoD in determining the best management options for sea-disposed munitions.

The NDCEE conducted a focused study on one specific contaminant of concern – arsenic – present in more than one third of chemical agents disposed in the ocean. The NDCEE partnered with the University of Hawaii to study the fate of arsenic released in marine environments by spiking marine sediments and sea water with known concentrations of arsenic, exposing marine organisms to the spiked materials, and measuring the uptake and excretion of arsenic over time. Laboratory analyses of the samples will identify absorption and retention of several arsenic phases in sea water and allow for the prediction of biological uptake of arsenic from the aquatic habitat. This information will help qualify potential environmental impacts from arsenic in marine sediments and enable

**“The findings from the UXO residual magnetism study have the potential to reduce the cost of military munitions detection and discrimination actions at munition sites. Work at the NDCEE will help the DoD understand if the recovery of surface ferrous materials associated with UXO when using strong electromagnets causes residual magnetism that could impact the Army’s ability to detect and discriminate anomalies in the future using magnetometry or electromagnetic surveys.”**

– JC King, Director Chemical Munitions and Chemical Matters, ODASA(ESOH)

the DoD to determine effective strategies for addressing potential threats to sea life.

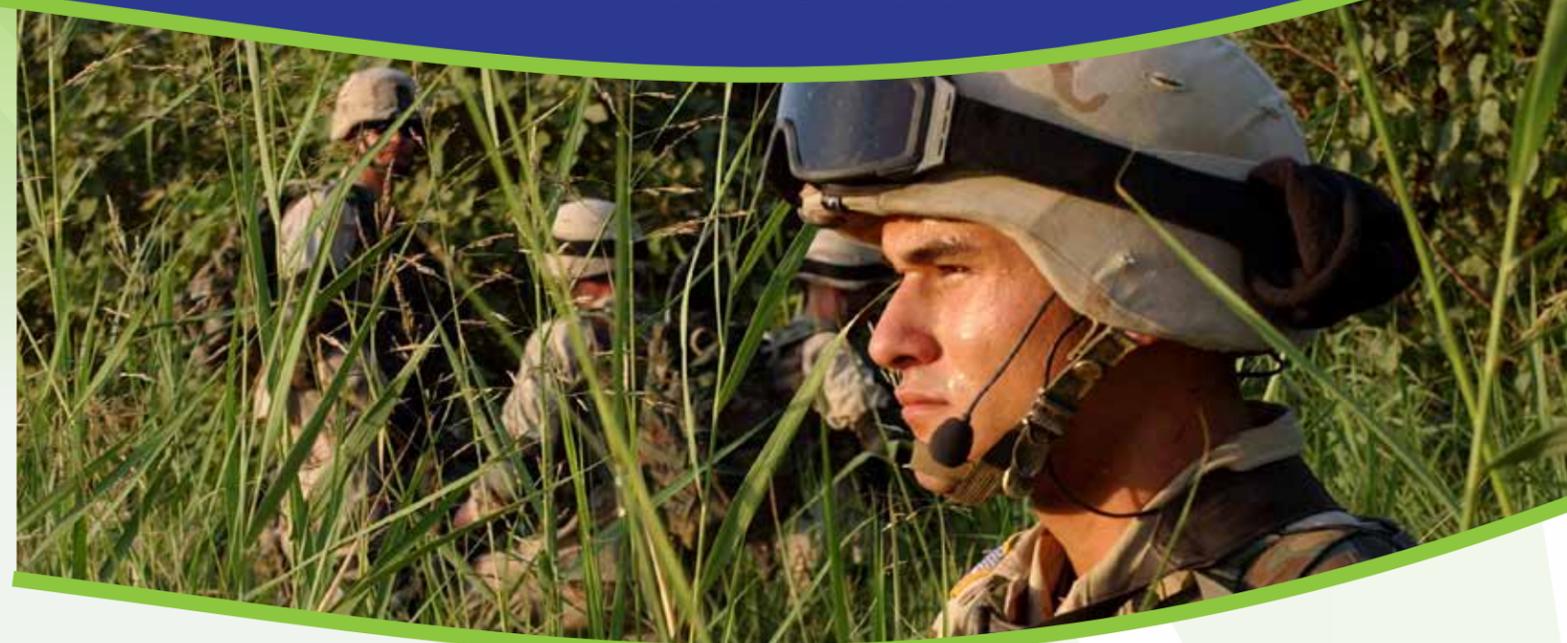
Unexploded Ordnance (UXO) is present at many munitions response sites resulting in ongoing environmental and safety concerns. Unlike discarded military munitions, UXO are military munitions that: have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, or projected; and remain unexploded by malfunction, design, or other causes. The NDCEE has conducted multiple efforts to improve the effectiveness and safety of range clearance operations and in FY12, this included a study on the impacts of using magnets to recover surface and near-surface ordnance. Electromagnetic induction and magnetometer surveys are effective methods for UXO detection and discrimination. However, munitions recovery using magnets can magnetize the soil, and this residual magnetism could negatively affect future range surveys in the same region.

To assess the magnetic susceptibility of soils containing varying compositions of minerals and organic materials, the NDCEE collected soil samples and assessed them for elemental composition, specifically iron. Results from the study sites were compared to existing soil composition data from Fort Bragg and Tyndall Air Force Base. The NDCEE also took hysteresis readings at a study site before and after magnetic exposure. Hysteresis collection locations and strength confirmed an increase in residual measured magnetism following soil magnetic exposure. Thus the impacts of using magnets for munitions recovery must be taken into account during subsequent range clearance activities at the same site if magnetic recovery is the technology of choice.

In FY12, the NDCEE not only conducted research and testing to obtain critical information, but also developed and validated tools to optimize the collection, analysis, integration, and presentation of relevant data in support of DoD environmental, energy, and safety programs. This information management and decision support continues to enable the DoD to make informed technical and business decisions, reduce risk, and optimize readiness.



The Magnetic Unexploded Ordnance Recovery System was used to simulate magnetic recovery of munitions during an NDCEE assessment of potential impacts of residual magnetism on range clearance operations.



Throughout FY13 and beyond, the NDCEE will continue to provide focused sustainability solutions across the DoD's acquisition lifecycle. For example, to provide the DoD with the capability to better analyze and assess the lifecycle implications of its early acquisition decisions, the NDCEE will demonstrate a lifecycle assessment model that addresses five key sustainability attributes: energy, chemicals and materials, water use, land, and hazard mitigation. Building on continued success in identifying and validating biobased and other green products to ensure they meet DoD specifications and operational requirements, in FY13 DLA will establish a virtual DoD Sustainable Products Center (SPC). In addition to developing the DoD SPC website that serves as a central repository for green products and services, the NDCEE will proactively reach out to various installations in an effort to increase the awareness of green products and identify the needs and opportunities within each of the Services. In addition to validating green products, the NDCEE will continue the demonstration and transition of automated laser coatings removal systems for repainting fighter and cargo size aircraft at OO-ALC. For the Army, corrosion under paint test standards will be developed to assist in evaluating the performance of available nondestructive testing technologies to detect hidden corrosion on painted aluminum substrates.

To provide the data and analysis necessary to allow leaders to make informed decisions, the NDCEE will complete an ongoing evaluation and statistical comparison of injury rates between the traditional T-10 and the new T-11 parachute designs. Efforts to standardize and increase the value of IH data will

also continue as we develop and demonstrate improved data collection capabilities for DOEHRs-IH. In addition, the NDCEE will transfer the Alertness Management for Military Operations technology to a web based system, providing Commanders the ability to make decisions on operational readiness in real time. Building on prior design efforts, the NDCEE will integrate and test a Vehicle Event Data Recorder to collect valuable data that can be used to minimize the potential for occupant casualties during a vehicle crash, rollover, or blast event.

In FY13, the NDCEE will continue initiatives to protect and conserve a critical natural resource – water – as well as efforts to enhance energy security. Implementing an evaluation methodology developed in support of Army facilities complying with total maximum daily load requirements in the Chesapeake Bay Watershed, the NDCEE will apply this assessment approach to Air Force, Navy, and Marine Corps facilities, as well as the Pentagon and Arlington National Cemetery. Finally, in the continued pursuit of NZ installations, the NDCEE will develop and demonstrate a Water Balance Model, as well as approaches to comprehensively assess water and energy security. In addition, the NDCEE will leverage the NZ approach developed for fixed installations and apply it to a pilot contingency base.

As we look ahead, the NDCEE is excited about the possibilities of another year of innovation at work that will allow us to continue to support the DoD mission, meet sustainability goals, and protect our warfighters at home and abroad.



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