SOLUTIONS

2013

U.S. Army
Edgewood Chemical Biological Center
Annual Report

U.S.ARMY

U.S. ARMY RDECOM
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

APPROVED FOR PUBLIC RELEASE

Message from the ECBC Director

The rapid advancement of chemical and biological (CB) threats has elevated the urgency of international nonproliferation and demilitarization efforts. As the spectrum of plausible actors, agents, concepts of use and targets continues to evolve, the U.S. Army Edgewood Chemical Biological Center (ECBC) will become an integral part in developing solutions that further the Department of Defense (DoD) mission in protecting the warfighter and the nation.

The 2013 Year in Review, *Solutions*, reflects ECBC's commitment to new capabilities for countering weapons of mass destruction (WMD). Our expertise in chemical, biological, radiological, nuclear and explosives (CBRNE) enables our workforce of more than 1,400 world-class scientists and engineers, to work safely with some of the most dangerous materials known to humankind. This publication illustrates why ECBC is a premier resource in CBRNE defense, integrating lifecycle science, engineering and operations solutions in four key operational areas: **Sense**, **Shape**, **Shield** and **Sustain**. These joint functional concepts represent an integrated network of capabilities that defend against CBRNE agents, delivery systems and adversaries.

The chemical weapons attack in Syria on August 21, which resulted in the death of more than 1,400 civilians, is a strong example of how important the work conducted at ECBC. The global context is changing, and the United States must continue to create solutions to counter traditional WMD threats as well as a vast array of emerging CB threats. Our support to the DoD Chemical and Biological Defense Program has resulted in numerous technology advancements that have bolstered defense capabilities in detection, protection and decontamination. Additionally, our competencies in laboratory analysis, agent storage and handling and elimination have long supported the mission of the Organisation for the Prohibition of Chemical Weapons(OPCW), this year's Nobel Peace Prize winner.

Joseph D. Wienand | ECBC Director

I am proud of ECBC's outstanding personnel, who are dedicated to providing innovative solutions that counter CBRNE threats and protect our military forces and the nation. The quality of their work has not been deterred by the fiscal constraints and resource challenges that have come to define much of 2013. Instead, we have demonstrated resolute endurance and strategic resilience during uncertain times. We have accomplished more national security objectives by partnering with industry, academia and numerous government agencies, capitalizing on a spirit of collaboration that has refined a shared purpose: warfighter solutions. The following pages capture why ECBC is an irrefutable national asset.

Overview

As the nation's principal research and development resource for non-medical chemical biological (CB) defense, U.S. Army Edgewood Chemical Biological Center's (ECBC) supports all phases of the acquisition lifecycle—from basic and applied research through technology development, engineering design, equipment evaluation, product support, sustainment, field operations and demilitarization—to address its customers' unique requirements. ECBC's science and technology expertise has protected the United States from the threat of chemical weapons since 1917. Since that time, the Center has expanded its mission to include biological defense and has emerged today as the nation's premier authority on CB defense. Due to the Center's inventiveness, ECBC's reputation and agency relationships remain strong today.

ECBC has full-time employees located at three different sites in the United States: the Edgewood Area of Aberdeen Proving Ground, Md., Pine Bluff, Ark., and Rock Island, Ill. As a research, development and engineering center under the U.S. Army Research, Development and Engineering Command, ECBC advances the mission of the warfighter and other stakeholders by leveraging its expertise along with specialized equipment and state-of-the-art facilities.

Mission / Integrate lifecycle science, engineering and operations solutions to counter CB threats to U.S. Armed Forces and the nation.

Vision / To be the premier resource for CBRNE, uniting and informing the national defense community.

Strategic Goals / Ensure that ECBC sustains and grows the core competencies required to counter enduring and emerging chemical and biological threats.

Create success for warfighter and CBRNE clients by consistently delivering quality customer service.

Grow and develop the workforce to ensure the continued competencies of the organization to meet evolving CBRNE defense needs.

ON THE COVER

Background Image extends from Front to Back (Excluding Photos)

Sarin, illustrated in the dark grey molecule with the spheres on the cover, is a manmade agent that in its pure form is a clear, odorless, tasteless liquid. It can be vaporized and released into the air or mixed with water to contaminate water and food supplies. Sarin is a nerve agent-type chemical warfare agent that acts on the body by interference with the vital enzyme called cholinesterase. Exposure to a large amount of sarin can lead to death from respiratory failure.

"H" mustard agent, illustrated by the light grey molecule with the open circles featured on the cover, is a manmade chemical agent known as a vesicant or blistering agent. It may have the odor of garlic or onions and can be clear to yellow or brown in its liquid or solid state. Mustard gas was introduced during World War I and can be released into the air as a vapor or into water as an oily textured liquid. Exposure to mustard gas causes damage to the skin, eyes and respiratory tract. Exposure can also cause damage to cellular DNA, especially bone marrow, which can cause aplastic anemia (decreased formation of red blood cells) or pancytopenia (decreased formation of white blood cells and platelets).

The white molecule with images in the circles represents VX, another manmade chemical warfare agent classified as a nerve agent. It is odorless, tasteless and exists as an oily liquid. It is the most potent of all nerve agents and is slow to dissipate, making VX a long-term threat. As with sarin, VX affects the "off switches" of muscles and glands, causing them to be continuously stimulated and stop operating normally, which leads to death.

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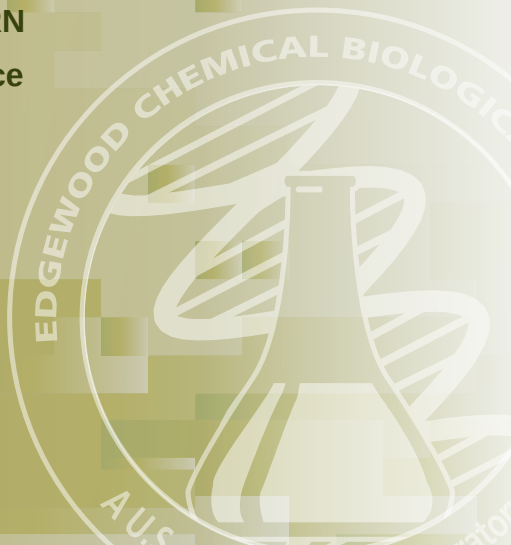
SENSE

The capability to continually provide information about the CBRN situation at a time and place by detecting, identifying and quantifying CBRN hazards in air and water, on land and on personnel, equipment or facilities.



Navigating New Waters CBARR Samples Ocean Floor for HUMMA Project

Five miles off the southern coast of Oahu, Hawaii, a crane lifted a three-person submersible off the deck of a ship then lowered it into the water. The underwater vehicle floated on the surface of the ocean for a few moments as the crew in a chase boat unhooked the submersible as it prepared for its 550-meter journey into the ocean depths. Crisp light blues faded slowly into darker shades of color, and the temperature grew colder in the vast blackness. Even with underwater lights, the researchers inside could only see 20 meters in front of them, through portholes barely as big as their faces.

One of those researchers was Mike Knudsen, the air monitoring manager for the Chemical Biological Application and Risk Reduction (CBARR). The CBARR team supported a multi-phase research effort called the Hawaii Undersea Military Munitions Assessment (HUMMA) to investigate sea-disposed military munitions along the Hawaiian coast.

“A typical dive is between eight and nine hours in a small metal sphere that is seven feet in diameter, and there are three people in there,” Knudsen said. “It was a small, cold space. But an absolute, can’t-pass-up-opportunity. I was excited.”

According to the HUMMA project web-site, both conventional and chemical munitions were discarded south of Pearl Harbor following World War II, including 16,000 M47A2 100-pound, mustard-filled bombs. For two weeks, CBARR supported its second mission for HUMMA and provided chemical analysis for 291 samples collected by the submersible, including 165 sediment samples, five water samples and 36 samples of shrimp tissue.

“Our job on the dive was to provide chemical warfare material sampling expertise and to help locate items on the bottom of the ocean. One of the big pieces of the job was to watch the sonar to make sure the sub didn't run into things or get snagged on other hazards,” said Knudsen, who has made a total of six dives in the submersible.

Old munitions deteriorating on the sea floor littered the muddy sediment like railroad tracks on the sonar map. There are no plants at these depths and few animals, but every once in a while the crew caught a glimpse of a shark or sting-ray.

John Schwarz, CBARR analytical chemistry laboratory manager and project lead, took the equivalent of a mobile analytic platform and stationed it on a boat in order to analyze the collected samples. A glove box was used for sample preparation, and MINICAMS accurately monitored air inside the laboratory space. All equipment in the onboard laboratory, including computer monitors, had to be

tied down due to the ship's movement on the ocean surface. Schwarz said the experience was more unique than anything else he's done for the U.S. Army Edgewood Chemical Biological Center (ECBC) .

"What was unique about this project is that on the ship we were able to execute successfully the same level of quality in our analytical procedures and protocols as we would in our fixed laboratory back at our headquarters at the Aberdeen Proving Ground," Schwarz said. "To me, that's why it was a big achievement. We did it on a ship on the ocean."

While Knudsen and fellow CBARR teammate Jim Swank, the designated explosive ordnance disposal technician of Pine Bluff Arsenal's Field Technology Branch, spent their days in darkness under water, Schwarz spent his nights working in the lab analyzing samples to determine the presence of chemical agents.

According to Schwarz, the munitions themselves are too dangerous to lift from the ocean floor and are unlikely to wash ashore due to the depth of their location, where the water temperature hovers around the 40°F mark. Any possible or potential chemical agent inside the WWII-era weapons would be frozen at that temperature. But there was one thing that was curious about the munitions, Schwarz said: they were home to an increased population of Hawaiian Brisingid sea stars that made the deteriorating munitions a natural habitat. During HUMMA, a few sea stars were collected and sent to Smithsonian scientists to study.

ECBC was first brought onto the project as chemical experts in 2009, two years after the HUMMA project began. The research effort is funded by the U.S. Army and led by the University of Hawaii to investigate the environmental impact of the sea-dumped munitions on the surrounding environment. During that time, prime contractor Environet and the University of Hawaii mapped the ocean floor and used the PISCES manned submersible vehicle to collect samples within 10 feet of a munition.

"The Army considers this research effort extremely important to both helping close data gaps in Department of Defense's (DoD) understanding of the effects of chemical munitions on the ocean environment and helping validate and improving upon procedures developed for investigating sea disposal sites, particularly those in deep water," said Hershell Wolfe, the Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health, in a press release released at the end of Fiscal Year 2013.

Wolfe recognized the CBARR team in a letter of appreciation dated January 10, 2013, citing "a selfless willingness to duty by working nearly around the clock in support of HUMMA's demanding mission goals."

University of Hawaii Principal Investigator Margo Edwards, Ph.D., shared a similar sentiment for ECBC's efforts. In a press release, she stated, "The University of Hawaii's partnership with the U.S. Army and Environet significantly increased Hawaii's and the world's understanding of sea-disposed munitions: how they were disposed in the past and how they have deteriorated right up to the present time. The forthcoming field program will hopefully allow us to expand our understanding of the potential environmental impact of munitions that may contain chemical agent and develop methods for monitoring and modeling future deterioration."

The Army is currently finalizing the research report for the latest mission. The next phase of the project in 2014 will evaluate performance differences between human-occupied submersibles and remotely operated vehicles as well as test new sensors and instruments that will improve the visual mapping and sampling of the munitions.

Volatile Organic Compound Applications Detect Biological Pathogens in Foodstuffs

Scientists at the U.S. Army Edgewood Chemical Biological Center (ECBC) are fine-tuning the powerful sense of smell and integrating it into a technology that can protect food supplies, identify biological agents and equip the warfighter with newfound capabilities.

According to Calvin Chue, Ph.D., an ECBC research biologist, nearly all living creatures or biological materials give off a specific profile of organic compounds, or a unique smell. Those compounds can be detected and identified using a Volatile Organic Compound (VOC) visual indicator that was developed in 2000 by Ken Suslick, Ph.D., at a University of Illinois at Urbana-Champaign laboratory. When biological materials react in the presence of a specific individual compound, the VOC detection application reveals unique patterns that illuminate a certain color after five hours of exposure.

In 2013, ECBC teamed with Specific Technologies of Mountain View, Calif., through a cooperative research and development agreement to utilize the VOC detection application with the military in mind. What was once used to determine whether coffee beans were Starbucks or Folgers can now be used to discern biological agents or test for the spoiling of foodstuffs.

“We’ve been working with them [Science Technologies] as well as the Defence Science Technology Laboratory in Great Britain to validate and verify that the same technology can be applied to biological agents, and we will expand it to foodstuffs and transport issues,” explained Chue.

“We believe it will significantly help troops with their supply and logistics chain. If the warfighter just received a shipment of grapes or meat or dairy from the United States, it may look good but what do you have that tells you that this is going to spoil in a day versus a week? This kind of technology can help.”

The paper-based system is a series of dots that change color over time as the paper is exposed to various odorants. A simple photograph of the colors can be scanned and processed through a software application that identifies what compounds are present.

With the innovative VOC detection applications, Chue and the ECBC team are able to broaden the scope of work for implementation in the military arena at a cost-effective rate. Right now, scientists are developing ways to embed the VOC technology into mason jars in order to better evaluate the foodstuffs inside and determine the preservation rate. Other avenues of implementation could protect the warfighter from biological agents that may have contaminated a container or item.

“There are a number of fields that this will ultimately benefit and could actually have a wide range of applications,” said Chue. “We envision this growing into a mobile platform where it could be inserted into various containers that you could take a picture of in order to determine the state of the VOCs inside.”

It is ECBC’s mission to integrate lifecycle science, engineering and operations solutions to counter chemical biological threats. The VOC detection applications being developed by the center and its partners are a progressive way to advance the safety of U.S. Armed Forces and the nation.

SNIFFER Pilot Program to Launch in Baltimore

The U.S. Army Edgewood Chemical Biological Center (ECBC) is aiming to help cities understand the capabilities of commercial off-the-shelf chemical vapor detectors used by mass-transit systems.

ECBC designed a methodology for testing commercially developed chemical vapor detectors. The pilot program is supported by the U.S. Department of Homeland Security Office of Health Affairs Chemical Defense Program (DHS OHA CDP).

In December 2013, ECBC used the methodology piloted on the Sensor Nodes Inform and Facilitate Fast Emergency Response (SNIFFER) chemical detection system to test detectors selected by the City of Baltimore.

"After the development of the standard test methodology and the success of the SNIFFER pilot, we were requested by the CDP to test chemical detectors for the Maryland Transit Administration in Baltimore," said Nichole Mortin, Detection Engineering Branch team member and co-project manager for SNIFFER.

"Baltimore was selected as a pilot program for this effort, and due to the work we did to develop a sound test methodology, as well as our proximity to Baltimore, CDP requested ECBC to test the detectors selected by the City of Baltimore," she said.

The design of the pilot program was a collaborative effort by multiple ECBC teams, including the Detection Engineering Branch and Protective Factor and Toxic Chambers Branch in the Engineering Directorate, as well as the Chemical, Biological, Nuclear and Radiological Filtration Branch in the Research and Technology Directorate. The selected commercial-off-the-shelf detector is funded through the Fiscal Year 2009 Federal Emergency Management Agency Transportation Security Grant Program.

In 2010, the Transportation Security Administration and CDP co-signed the Chemical Detection Performance Specifications for Mass Transit and Passenger Rail Systems. These specifications allow cities to make an informed decision on the types of chemical vapor detectors to purchase.

The performance specifications list the target chemical agents and toxic chemicals to be identified and quantifed at either the acute exposure guideline levels or the immediately dangerous to life and health levels while operating in an environment with common chemicals (e.g., paints, glues, rail dust) and varying environmental conditions. To determine the efficacy of these detectors ECBC developed and implemented a laboratory test and evaluation plan.

During the test plan development, CDP requested that ECBC use the existing SNIFFER chemical detection system, designed by Sandia National Laboratories, as a test case for piloting the test procedures. Now that the standard test methodology has been developed, the chemical vapor detectors selected will be tested. The results of this testing will then inform the city about how well the detector performed, which will affect how the operations plan is written.

The concept for the test standard was designed so that any qualified laboratory could use this standard test methodology to test chemical detectors and determine if they meet the Transportation Security Grant Program requirements. During this project, the ECBC team's creativity and teamwork not only generated a community standard and great final product, but also secured for them a future project with CDP that will help the local community.

The Rapid Detect-Identity-Decontamination Kit Earns Section 219 Funding

Aircraft decontamination is a complex, challenging process in the aftermath of a biological attack. Returning assets to an active status requires that the decontaminants used are effective yet nondestructive to aircraft interior surfaces, sensitive equipment and electronics.

The Rapid Detect-Identity-Decontaminate Kit is designed for decontamination of suspected areas where spore-forming bacteria may be present inside a military or commercial aircraft. It contains handheld detector assays, personnel protective gear and decontamination materials. The U.S. Army Edgewood Chemical Biological Center (ECBC) utilized various resources to test the effectiveness of the kit. These resources included test beds and biological decontamination methodologies, C-130 cargo aircrafts and barcoded spore technology. Conceptual model design and animation was also used for the kit prototype, which offers a developing solution for the hazard mitigation arena.

“Our goal was to detect a spore contaminant in a suspected area, identify its presence using hand-held assays, decontaminate the areas using a surface decontaminating foam and clear the area of the contaminant after the decontamination process,” said Debbie Menking, project manager. “As a result of the testing, we achieved what we set out to do by demonstrating proof-of-concept for a novel hazard mitigation kit that detects, identifies and decontaminates biological contaminants in aircraft interiors.”

The concept for the Rapid Detect-Identify-Decontaminate Kit was the result of a previous multi-directorate collaboration between Menking and Sofi Ibrahim, Ph.D., a microbiologist who conducted decontamination biological efficacy assessments at ECBC for the Joint Project Manager for Protection. Now, the methodologies and success from that project have grown into another cross-directorate opportunity that explored decontamination efficacy inside aircraft.

“Leveraging momentum from the decon testing in order to take it to the next level was our goal. The Section 219 funding provided the means to drive the development of the proposed kit using tri-directorate assets to explore how effective a Detect-Identify-Decontaminate process could work against biological agent hazards inside an aircraft,” Menking said.

Section 219 funding originated from the National Defense Authorization Act of 2009, which allows military and government research laboratories to tax customers up to three percent of all revenue sources as an indirect fee to help finance the overall cost of a given project. The proposed kit was awarded funds from the Fiscal Year 2013 ECBC 219 funding. The kit was one of nine ECBC projects that effectively met ECBC's objective of maintaining awareness of emerging threats and met the required proposal criteria: innovation, collaboration and potential transition to the warfighter.

"ECBC completed the test execution of the decontamination trials in September, and the C-130 aircrafts are an ECBC capability that nobody else has. Having the ability to walk into an aircraft for testing is unparalleled for most other agencies," said Jerry Pfarr, branch chief of ECBC's Biological Operations Branch.

According to Pfarr, the C-130s enabled ECBC to advance its biological decontamination capability and begin the six-month testing immediately. The biggest challenge, he said, will be delivering the program in a way that will attract interest from the right agencies in order to build the future of aircraft decontamination programs at ECBC.

"Our hope is that we generate enough interest from some of the major funding organizations to create opportunities that will get the C-130s back on the radar and make it known that this capability is here at ECBC, which is located in close proximity to many of these agencies," Pfarr said.

Using the proposed kit, a hazard mitigation team sent inside the aircraft would be able to accurately assess the situation, presumptively identify the agent and determine proper decontamination steps. According to Menking, if somebody opened up an envelope and a powder came out, first responders would go in with the Detect-Identify-Decon Kit using handheld assays for presumptive identification of contamination as the first step in spot-checking around the aircraft.

Decontamination testing occurred on surfaces inside the aircraft as well as on coupons of chemical agent resistant coating (CARC) painted steel. ECBC's barcoded spore technology simulated anthrax and was deposited on the surfaces to illustrate the presence of contamination. The surfaces were then decontaminated with the decontaminant, and according to Menking, demonstrated an effective decontamination process that resulted in either a lower level of simulant or nothing at all.

The developing kit has the potential to impact real-world situations in a variety of environments that may be exposed to suspected contamination. It may also serve as a potential hazard mitigation tool if a spore or powder were to be released on a commercial jet liner. Proof-of-concept for this kind of decontamination method will lead to a conceptual rendering of the kit and may have potential for development of a prototype kit in future studies.

Jeff Warwick, branch chief for ECBC's Conceptual Modeling and Animation branch, led a team to create virtual prototype concepts and supplemental visual communications for the kit during the six-month testing phase.

"Engineers were brought in to team up and advise, based on past experiences with other projects, what are some things to consider in the prototyping process," said Warwick. "For example, the durability and packaging material for those kits could be different depending on whether they will be used on the battlefield or in the homeland."

The kit includes government-off-the-shelf hand-held assays for rapid identification and consists of assembling commercial-off-the-shelf components to decontaminate interior surfaces of the aircraft. ECBC acquired the C-130s from Little Rock Air Force Base in 2011 as part of joint effort between ECBC and the Joint Project Manager for Protection.

Now, 219 funding has afforded ECBC the chance to explore the biological aspect in a new way, with Center-wide capabilities that were not available two years ago. By expanding opportunities for funding across the Center, our scientists and engineers can focus on timely innovative solutions to meet our customers emerging needs

From Bees to Bio Pathogens: How ABOid Identifies the Unknown

Some may remember the bee decrease in 2007, when scientists began noticing a drastic decline of bee colonies with no known cause. What few likely know is that a team of scientists at the U.S. Army Edgewood Chemical Biological Center (ECBC) utilized its own software to detect that a combination of both a virus and a fungi was a likely culprit.

ECBC's scientists continue to enhance and expand this novel software suite of bioinformatics algorithms, which is capable of identifying biological microbes in various backgrounds without any prior knowledge of the sample. Utilizing data from a mass spectrometry-based proteomics system, the team can run any tandem mass spectral data through the software to provide statistical validation of its identity.

The innovative detection algorithm, known as Agents of Biological Origin Identifier (ABOid)and has two patents to date, is capable of providing automated identification of the sample contents from both pure cultures and mixture of microbes present in culture, environmental or biological matrices in far less time than traditional techniques—minutes versus days.

Mass spectrometry-based proteomics is a technique capable of providing the structured sequence information of a given protein. All proteins consist of amino acids arranged in a specific sequence; changing the arrangement generates a new protein. Mass spectrometry-based proteomics looks at all the digested protein fragments and determines the exact sequence arrangement. It then correlates the sequence to its original proteins that are present in a given sample, whether bacterium, virus or toxin.

"We often refer to this as a fishnet approach; with this technique, we collect everything and then sort through it to find what has biological meaning," said Rabih Jabbour, Ph.D., research chemist with the Point Detection Branch.

The mass spectra signatures are then run through ABOid, which sorts out the information on a genomic level and translates it into proteomic output. Results are color-coded to highlight anything that could be considered a pathogen or that is toxic. For sequenced organisms, ABOid is capable of providing strain level identification, which is significant in that one can then reveal important diagnostic information for medical countermeasures.

ABOid utilizes a taxonomic classification approach to classify emerging or unknown—or unsequenced—microbes. If a specific bacteria or microbe is not sequenced, the team can use this approach to determine the closest related microbe. This complements polymerase chain reaction technology and genomic sequencing, providing a critical first step to a genomics team to design an effective primer to sequence the bacteria to a specific target.

Algorithms are hardware independent, so they need only the data file from a mass spectrometer, not the sample itself, which eliminates the cost and logistics of shipping potentially toxic biological material. As cloud technology becomes more advanced, shipping costs will be reduced even further and the applications for ABOid will continue to expand.

Another unique aspect of ABOid is that it can be tailored to meet specific needs. ECBC narrowed the database to 104 viruses specific to the needs of the 20th Support Command, which is currently being trained on ABOid. The full database currently scans for more than 2,800 bacteria, 3,600 viruses, all known toxins and more than 80 fungi and parasites.

"Since ABOid was created, there have been multiple advancements in mass spectrometry technology resulting in increased sensitivity and throughput," said Samir Deshpande, Ph.D., research bioinformatician with the ECBC Point Detection Branch. "We are only bound by the sensitivity of the mass spectrometer: the more sensitive the hardware, the more it can 'see,' which helps provide even better information for ABOid."

To date, ABOid has been has been utilized for multiple applications including detection of viruses, toxins and bacteria in various matrices, from buffers to more complex matrices such as blood. Through basic research funding from the U.S. Army In-House Laboratory Independent Research program, ABOid has been utilized to discriminate between pathogenic and non-pathogenic strains of *E. coli*, as well as evaluating the use of excreted proteins only for identification of bacteria.

TACBIO Generation II Reduces Cost, Size and Power Usage of Previous Generation Detector

Accurately identifying biological threats in order to safeguard U.S. warfighters is a capability the Edgewood Chemical Biological Center (ECBC) has provided the national defense community for years. In Fiscal Year 2013, the Center has developed a next generation tactical biological (TACBIO) detector that reduces costs, saves production time and uses a power source that is more energy efficient than the first generation TACBIO system.

"A network of TACBIOs could work as an early detection system against a biological attack," said Aime Goad, ECBC engineer. "The TACBIO is so light and affordable that units can be sent into the field for troops to place on multiple vehicles in forwarding units," said Richard Kreis, an ECBC senior engineering technician.

The TACBIO Generation II detector, developed in 2013, costs 80 percent less and weighs three times less than its predecessor, which was licensed to General Dynamics Armament and Technical Products in 2009 and to Research International, Inc., in 2010. Since then, ECBC and these partners have collaborated through patent licensing agreements, a cooperative research and development agreement and a partnership intermediary. Such technology transfer mechanisms partnered ECBC expertise and facilities with industry technology to further develop the original TACBIO prototype into a next generation chemical detector that is weatherproof and uses advanced detection algorithms to reduce false alarms.

With funding from the Defense Threat Reduction Agency and the Defense Advanced Research Projects Agency (DARPA), ECBC was able to produce the TACBIO II for just $2,000. New features include deeper UV light sources developed by DAPRA that allow the detector to identify lower concentrations and smaller aerosol particles. This capability is derived from the original TACBIO prototype, which used DARPA's revolutionary Semiconductor Ultraviolet Optical Sources and unique front-end assembly with a novel airflow system to pull air into the detector where a light illuminates, or fluoresces, if an agent is present.

ECBC's state-of-the-art fabrication shop worked closely with the comprehensive TACBIO team to create new working parts for the detector. ECBC was able to dramatically reduce the overall weight of the product by inserting plastic-coated aluminum mirrors to replace the heavy metal ones previously used. The lighter parts were produced on an injection molding machine, which heats pellets and granules of plastic into a molten form before injecting it into a mold. Once it is cooled to proper temperatures, the mold opens and ejects the finished part.

"The process is similar to squeezing Play-Doh through the forming shapes when you were a kid, but much more sophisticated. The molds were made here in our shop and have been used over 700 times," said Kreis.

"What we are able to do here at ECBC is unique. We collaborate closely with our engineering team and fine-tuned these pieces as we want to perfect them. No other Army laboratory has this capability onsite," he said.

First responders and hospitals may someday be able to use the TACBIO to alert emergency personnel to don personnel protective equipment to prevent exposure while treating the patient. The detectors could also be used in facility applications to alert occupants to a potential bio-threat and give them enough time to seek a safe place outside of a dangerous environment.

Army Researchers Develop Better Real Time Remote Sensors

Robert Pazda says his team is accustomed to having to fit 10 pounds of equipment into a five-pound bag. However, his branch's latest project—the Global Strike Near Real Time Battle Data Assessment (NRT-BDA) System—could change all that.

"The Army always wants everything smaller and lighter," said Pazda, the branch chief for Electronic Design and Integration within the Advanced Design and Manufacturing Division of the U.S. Army Edgewood Chemical Biological Center's (ECBC). His team focuses on integrating electronic parts that comprise state-of-the-art devices.

The Global Strike NRT-BDA System sponsored by the Defense Threat Reduction Agency incorporates unattended sensors and a remote warfighter interface to provide timely reporting of conditions during reconnaissance operations.

One sensor includes a chemical agent detector similar in shape and size to a two-pound soda can. The sensors are intended to be air deployed and have been tested from a P-3 Orion aircraft at 1,000 feet. The sensor is equipped with an accelerometer that triggers the release of the cap and small parachute (ballute). Once it lands, spring-loaded legs pop open, allowing it to sit upright.

The detector is also equipped with a global position system (GPS) tracking device. Once the detector has landed and the position remains the same, the device initiates the start sequence of the detector so it can detect chemical agents and other threats, in addition to seismic activity.

This detector, which was a redesign of the Joint Chemical Agent Detector, can feed information to a satellite and then to warfighters manning the interface as far as several thousand miles away.

One of the earlier challenges with the Global Strike NRT-BDA was fitting all three antennas onto a circuit board that was two and a quarter inches in diameter. It needed a GPS antenna for location purposes, an iridium antenna to send information to a satellite and a short-range communications antenna.

In a later design the short-range communication antenna was no longer required. "It's a pre- or post-assessment tool," Pazda said. "You could drop it and know something is there and strike, or you know something's there and avoid the area."

ECBC worked closely with the Johns Hopkins University Applied Physics Lab, Air Force Research Laboratory, Naval Surface Warfare Center Dahlgren Division, Kansas State University and Smith's Detection to design sensors and other components that were incorporated into the device.

There are still challenges to overcome for extended operational time. Currently, the device will last four to six hours, but the goal is to have it monitor its surroundings for several days. Pazda says the biggest challenge his team faces is rapidly changing technology.

"Our world is challenging. We do so much with electronic wizardry, but people don't realize the tens of millions of dollars that were invested in things like cell phones that took decades to perfect what we have today. That's the challenge in this electronic age, to keep up with technology since things happen at a very quick pace," Pazda said.

He noted that the first transistor was invented in 1948, and the first integrated circuit was created in 1951. In 15 years, the world has gone from cell phones to smartphones with internet functionality, cameras and applications that can do just about anything. With the increasing pace of advances in technology, there is a greater push to keep up with the latest generation of technological changes that go along with those advances.

"We have to investigate those products and integrate the newest capabilities to support the warfighter," Pazda said.

SHAPE

The ability to collect, query and assimilate information from sensors (intelligence, medical, etc.) in near real time to inform the force commander so he or she can have an understanding of actual and potential chemical, biological, radiological and nuclear (CBRN) hazards.

JUPITR ATD to Improve Capabilities on Korean Peninsula

The Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) and the U.S. Army Edgewood Chemical Biological Center (ECBC) launched a new advanced technology demonstration (ATD)—the Joint United States Forces Korea (USFK) Portal and Integrated Threat Recognition (JUPITR). The goal of the four-year program is to develop unique biological detection capabilities that will address the demand for stronger biosurveillance capabilities on the Korean Peninsula.

Biosurveillance has been a national priority since 2007, when Homeland Security Presidential Directive-21 formalized the policy that all hazards and threats could take many forms, including naturally occurring disease outbreaks. Two years later, the release of the National Strategy for Countering Biological Threats recognized that pandemic disease knows no borders and that a massive outbreak of a disease was just as much a national security threat as a chemical or radiological incident. The National Strategy for Biosurveillance was established in 2012, and while some organizations have begun moving on the initiative, there are still a number of questions on how to best implement biosurveillance. The JUPITR ATD program allows ECBC and JPEO-CBD to be at the forefront of defining biosurveillance and to demonstrate concepts in a space which allows for an innovative and collaborative approach.

“This is a Department of Defense flagship program for how biosurveillance will manifest itself,” said Peter Emanuel, Ph.D., JUPITR ATD lead and Division Chief of ECBC’s BioSciences Division. “ATDs are a great opportunity to try risky and innovative concepts and really push the envelope on what our technology can do. JUPITR is aggressively pushing technology to the very limit of what we think it can do to demonstrate in the field what biosurveillance can look like.”

JUPITR has four distinct “legs” that are designed to support the overall goal. The first leg of JUPITR is an information portal, similar to a web management tool for health surveillance. Brandon Flores from JPEO-CBD Information Systems demonstrated the current prototype of the portal in ECBC’s Berger Laboratories in January 2013, explaining that, “many people who see it at first say it looks a lot like a personalized iGoogle desktop, except that all the feeds are about disease outbreaks and medical supply shipments.”

The second leg, led by Brady Redmond, Ph.D., of ECBC’s BioSensors Branch, will work with scientists on the Korean Peninsula to build the capabilities of their labs, allowing them to conduct analyses at their own facilities rather than taking valuable time to send samples to stateside laboratories for evaluation.

Jennifer Thermos the Joint Project Manager (JPM) for Contamination Avoidance is leading the third leg, which she refers to as “The Shoot-Off” because it will pit a number of field biological detectors against one another, with the ultimate winner finding a home in the Korean Theater.

The fourth leg explores early warning concepts by building on an ongoing JPM Guardian program called Integrated Base Defense (IBD). IBD has, at its core, a massive multi-functional all-seeing sensor suite designed to rapidly establish a defensive perimeter. In field tests the 15-foot-high box quickly opens, raising telescoping towers and activating a myriad of field sensors, leading one soldier to exclaim, “Time to release the Kraken, boys!” thus coining the nickname “Kraken” for the device.

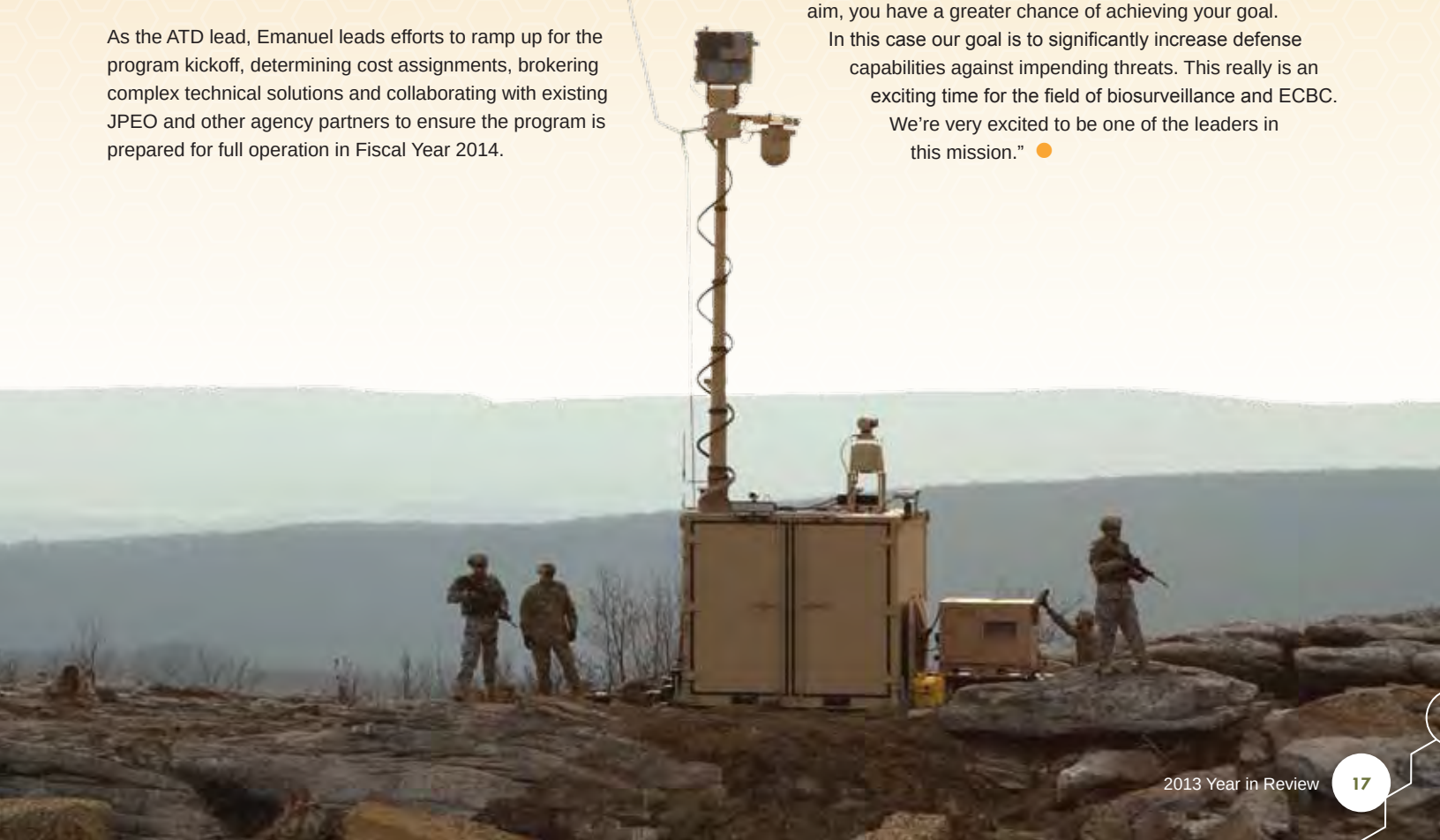
“In JUPITR we will add a chemical/biological capability to the Kraken such that our detectors can fuse with the common operating picture developed by its all-seeing eye in the sky. The devices will learn from Kraken's acoustic, infrared and thermal sensors and be able to direct what and where they look, which amplifies their effectiveness,” said Ken Kammerer, JUPITR ATD's deputy.

As the ATD lead, Emanuel leads efforts to ramp up for the program kickoff, determining cost assignments, brokering complex technical solutions and collaborating with existing JPEO and other agency partners to ensure the program is prepared for full operation in Fiscal Year 2014.

“Our scientists have been working in biosurveillance for so long, this will almost be like a fifth branch under the division,” said Emanuel. “This also provides ECBC the opportunity to have a significant impact in this important field. There are so many opportunities to utilize our talent and our wealth of experience within ECBC.”

This program has been under development for more than two years, born out of an overlapping of lessons learned from previous exercises in Korea, which identified a need for a stronger biosurveillance capability.

“Right now, what we have is akin to a big chess board: the pieces were there; they just aren't working together,” said Emanuel. “When you recognize the strength and the weakness of each piece on the chess board and move them in concert toward a specific aim, you have a greater chance of achieving your goal. In this case our goal is to significantly increase defense capabilities against impending threats. This really is an exciting time for the field of biosurveillance and ECBC. We’re very excited to be one of the leaders in this mission.”



Can Your Phone Do That?

Next Generation Smartphone Technology Capable of Diagnostic Biological Detection

Ask anyone with a smartphone and they will tell you that they can do pretty much anything with it. But the latest applications for smartphones go beyond the conveniences of modern society—they can actually save lives. The U.S. Army Edgewood Chemical Biological Center (ECBC) is developing cellphone-based wide-field fluorescent imaging of microbeads for pathogen detection. In simpler terms, ECBC is developing a technology to collect a sample, analyze the results, geotag the location and send the results to a laboratory for further analysis—all from your smartphone.

Scientists at ECBC worked with a team at the University of California, Los Angeles (UCLA), to adapt its prototype of a plastic, clip-on "microscope" for Android phones, which clips directly over the camera of the smartphone and operates just like a microscope. The user collects a sample, slides it into the device and snaps a picture. An application ("app") "reads" the sample and generates a clear positive or negative detection. The UCLA team is developing the hardware and the software for the device, with ECBC's team providing the diagnostic and detection assays that it will use.

"This takes the place of a standalone microscope and automates the process, which is perfect for soldiers or clinicians who are in a remote area without access to a laboratory," said Patricia Buckley, a research biologist with ECBC and the lead for this project. "Computing in smartphones has grown to be so complex that it can actually replace the computer for these devices."

ECBC has also partnered with Holomic, LLC to develop a second hardware add-on that can take existing assays in the field and integrate them into the smartphone technology, making the results more user-friendly and available for archival within the biosurveillance community. This embodies the same concept of building an electronic database that can be clearly read and interpreted by any individual with access.

These technologies use equipment already in warfighters' hands, significantly reducing the need for additional heavy, expensive equipment and removing the need for a separate computer to run all of the various components.

One of the most significant effects of this technology is that the results from either device can be stored in the phone and later added to a biosurveillance cloud database, allowing for an electronic archive of data that is available to anyone with access to the cloud. This is especially important because of the ability to tag the location from which the sample was taken, allowing for further surveillance and monitoring of that area.

The anticipated end-user for the technology is both military and civilian. "This is ideal for the solider out in the field, in a remote area without a cell tower nearby. He or she can still capture the data and store it until it can be sent back to the command post," said Buckley. "It can also be valuable for clinics or hospitals in underdeveloped areas that may not have sophisticated testing equipment. They are more likely to be able to afford a device like this, which combines the ease and reliability of testing with the ability to communicate the results to a larger facility or organization."

The Defense Threat Reduction Agency and the Chemical Biological Medical Systems Joint Project Management Office fully funded these projects. Next, the team plans to begin working on the next generation peripheral, focusing on integrating sample data with the Army's network.

Advanced Technology Demonstration Branch Continued Rapid Area Sensitive-Site Reconnaissance Evaluation

The Rapid Area Sensitive-Site Reconnaissance (RASR) Advanced Technology Demonstration (ATD) received funding for Fiscal Year 2014. The U.S. Army Edgewood Chemical Biological Center's (ECBC) Advanced Technology Demonstration (ATD) Branch and the Laser Spectroscopy Branch supported this effort sponsored by the Defense Threat Reduction Agency (DTRA). As the Technical Manager (TM), the ECBC ATD Branch provided technical direction during the RASR ATD by managing technical cost and performance. Massachusetts Institute of Technology Lincoln Laboratory (MIT LL) assisted in mitigating technical risk.

The RASR ATD program aims to improve the time to perform initial threat characterization and map the contaminated hot zone area. Detectors that are portable or mounted on an unmanned ground vehicle UGV provide autonomous mapping capability.

"The RASR ATD sensor allows identification of hazards faster and at a standoff distance without having to handle the substance. This, in turn, keeps the warfighter out of harm's way when the hazards are still unknown," said Jack Tilghman, RASR ATD test manager. DTRA awarded contracts to ITT Exelis and FLIR Systems in 2010 to obtain competitive prototypes for the RASR ATD.

The development of the RASR ATD Capabilities Traceability Matrix (CTM) was a collaborative effort led by the Joint Project Manager (JPM) for Nuclear Biological Chemical Contamination Avoidance. With support from the MIT LL, the Operational Manager Lead, Marine Corps Forces Pacific (MARFORPAC) and JPM Guardian, the CTM documented the desired performance parameters for the RASR ATD system and the methods used to verify the performance. The development of the CTM provided the roadmap for the technical and operational demonstrations planning.

Having only one integrated system for the demonstrations was another challenge the RASR ATD team faced. To manage this, the group worked closely with the Army Test and Evaluation Command (ATEC) to define the scope and agree on specific capabilities that could not be tested as part of the technical demonstration at West Desert Test Center, Dugway Proving Ground, Utah, in August 2011 and the Operational Demonstration at the Muscatatuck Urban Training Center in Butler, Ind. in October 2011.

Once all the parameters were set, these demonstrations were successfully completed and the data was used to assess the system in the Joint Military Utility Assessment (JMUA) and the Operational Test Agency Assessment Report (OAR).

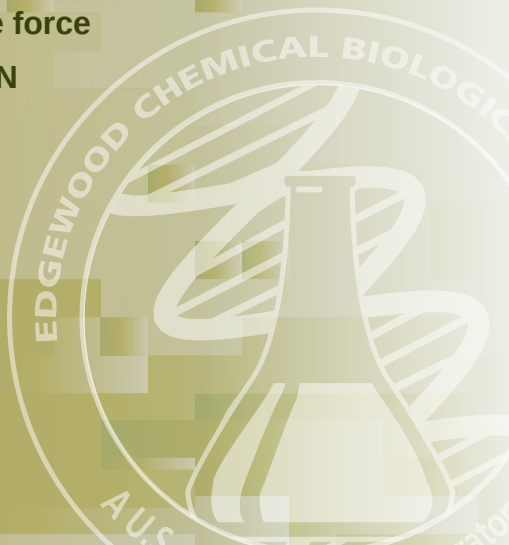
In May 2013, ECBC and FLIR Systems conducted the first RASR ATD Extended User Evaluation (EUE) Training for MARFORPAC at Marine Corps Base in Kaneohe Bay, Hawaii. FLIR Systems provided the Marines with classroom instruction on how to operate the integrated detector system consisting of the Avalon sensor and the iRobot Packbot 510.

To reinforce the technical instruction, ECBC set up operational scenarios during the training to provide the Marines with the opportunity to operate the RASR system in an environment containing unknown hazards. Team members used the training simulants and placed them in various locations in an old building on base. The Marines were then asked to work together and take turns operating the RASR system to enter the building, locate potential targets and use the Avalon to detect the presence of any training simulants in the area.

In 2013, the U.S. Army 20th Support Command identified the 21st Chemical Company at Fort Bragg, NC, as the unit that will receive the second RASR ATD EUE system training.

SHIELD

The capability to shield the force from harm caused by CBRN hazards by preventing or reducing individual and collective exposures.



ECBC Advances DoD Elimination Capability, Produces New FDHS Technology in Record Time

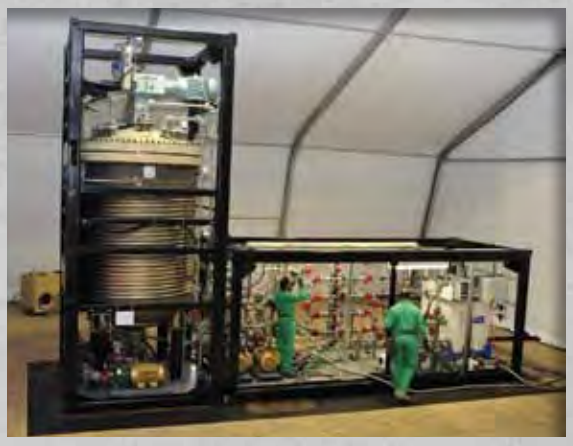
An inside look at how the neutralization system heard around the world was designed, fabricated and manufactured for mission critical performance.

The stakes were high and time was running out. The U.S. Army Edgewood Chemical Biological Center (ECBC) had only six months to produce an operational model of the Field Deployable Hydrolysis System (FDHS), a new transportable elimination technology that could neutralize chemical warfare materiel. In December 2012, the Department of Defense (DoD) had identified a capability gap in chemical agent disposal operations and sought a solution that would meet mission critical needs by the following summer 2013.

Through unprecedented collaborative efforts across multiple government organizations, ECBC led the FDHS effort through full lifecycle development, from design and fabrication to engineering, test and evaluation of the system. As a result, the FDHS can neutralize bulk amounts of known chemical warfare agents and their precursors at a 99.9 percent destruction efficiency rate, converting chemical warfare materiel into compounds not usable as weapons.

The neutralizing capabilities of the FDHS could be applied to several different types of scenarios, potentially revolutionizing the field of warfighter and civilian decontamination.

“The most difficult aspect of designing a system in such a short time period was the need to concurrently perform tasks that would normally be performed sequentially,” said Adam Baker, chemist with ECBC’s Chemical Biological Application and Risk Reduction (CBARR) Business Unit. “Equipment was already being procured while reaction chemistry and skid design were still being finalized. To overcome this challenge, ECBC and the Joint Project Manager for Elimination (JPM E) incorporated proven technology to the greatest extent possible, which helped keep late design changes to a minimum.”



According to Baker, the design team included personnel from ECBC and the JPM E, formerly known as the Chemical Materials Activity, which greatly enhanced the in-house capabilities required to complete such a difficult task. In February 2013, the Defense Threat Reduction Agency (DTRA) provided $1.6 million in initial funding that enabled the integrated design team to capitalize on the interagency partnership’s shared personnel, resources and expertise. ECBC had two primary roles throughout the design process: manage project execution with DTRA and implement the design from the standpoint of the systems operator.

The CBARR Business Unit, comprised of operators, maintenance and safety experts, was utilized from the start of the project to ensure the FDHS product could be safely transported and perform in the expected operational environments. As a result of the 20-week collaborative design phase, the FDHS is a self-sufficient system that includes power generators and a laboratory that is fully capable onsite, needing only consumable materials such as water, reagents and fuel to operate. The system can be set up within 10 days and is equipped with redundant and critical systems that ensure maximum system availability. Should the FDHS be deployed, a crew of 15 trained personnel, including subject matter expertise support from CBARR, would be needed each shift for 24/7 operational capability.

“The process was a rare opportunity for CBARR to work collaboratively with a large number of organizations within and outside of ECBC. One lesson learned from this project is that ECBC can greatly enhance its capabilities by working collaboratively with other organizations with complementary skill sets,” said Baker.

Within ECBC, those skill sets included benchmark chemistry studies from the Chemical Sciences Division within the Research and Technology (R&T) Directorate. R&T scientists analyzed

multiple reagents at varying concentrations and mixing ratios to determine the correct chemistry to achieve a destruction efficiency of 99.9 percent. These studies are the foundation for how the FDHS neutralizes chemical warfare materiel through chemical reactions involving reagents that are mixed and heated to optimize throughput.

To test the neutralization process, Dr. Frederic Berg, Chemical Sciences Division chief, ran reactions to decontaminate different types of agent. Ann Brozena and Patrice Abercrombie-Thomas, researchers within ECBC's Chemical Analysis and Physical Properties Branch of the Chemical Sciences Division, then determined the physical properties of the FDHS reaction products to ensure that the decontaminated chemical warfare agent could be easily pumped out of the machine and disposed of safely. These chemical reactions would be used to break down the warfare agents and ensured that the resulting material produced could not be used as originally intended and was safe for the environment.

"For example, if the reaction produced a sludge-like sample, that consistency would be difficult to pump out of the FDHS. Our measurements confirmed that the reactions produced a pumpable product," said Brozena. "If they can't pump material out after it's destroyed that would throw a wrench into the overall process. Being able to remove the degraded material from the FDHS is as important as the reaction to degrade it."

In addition to the hard science behind the proven neutralization process, ECBC utilized the rapid prototyping capability of the Advanced Design and Manufacturing (ADM) Division within the Center's Engineering Directorate, which played an integral role in the production and manufacturing of the FDHS. During the initial design phase, ADM used their rapid prototyping capabilities to fabricate custom components for the FDHS system, including models of the skid layout and ancillary equipment. Once the design had been finalized by the R&T Directorate, ADM took the specifications to produce a three-dimensional model that was turned into the blueprints for the final product.

Once the blueprints were final, ADM used a combination of commercial off-the-shelf technology and custom-fabricated components to build the seven FDHS systems. In this process, ADM showcased its unique capabilities not only in rapid prototyping and custom fabrication, but also in concurrent design and manufacturing.

On June 27, 2013, ECBC and DTRA signed a technology transfer agreement with the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD). The official transition took place upon completion of an FDHS operational demonstration for DoD stakeholders and signified a transition for advanced development and future integration into the Chemical Biological Defense Program Portfolio. More than 50 ECBC employees accounted for 13,000 hours of work in order to meet the objective to produce an operational model in six months and, as a result, achieved successful transition from science and technology to advanced development.

DECEMBER

12.27.12 Threat Reduction Advisory Committee (TRAC) tasks CMA/ECBC with Capabilities Assessment.

JANUARY

01.28.13 Official decision by Mr. Weber to proceed with FDHS following January 21 IPR.

FEBRUARY

02.04.13 $1.6M in initial funding received from DTRA. Balance of funding received March 21.

MARCH

02.15.13 Direction provided to accelerate schedule and provide full deployable capability. New completion date of July 1.

02.25.13 Start of FDHS support equipment fabrication.

APRIL

04.15.13 Start of FDHS reactor skid fabrication.

MAY

05.10.13 Start of FDHS hydrolysis skid fabrication.

06.10.13 Start of demonstration site setup.

JUNE

06.27.13 Demonstration of FDHS System #1.

JU

U.S. Army Developing Bispectral Obscurants Grenade

Enhanced fill provides new levels of protection to counter emerging high-tech threats

Imagine you are a warfighter in a remote location facing an immediate threat of enemy attack. You have one route of escape, but shifting locations would mean being visible and vulnerable to the enemy. You have a smoke grenade, but it won't protect you if the enemy has advanced technology that allows him to see through the smoke. You have no choice but to take your chances and move out.

A team of the U.S. Army Edgewood Chemical Biological Center (ECBC) researchers is looking to provide enhanced protection for warfighters on the battlefield with the development of a bispectral grenade that blocks the visible and infrared regions of the electromagnetic spectrum. This advanced grenade would be capable of defeating thermal imagers, rifle scopes and devices equipped for night vision or infrared (IR) and other optical sensors, significantly increasing a soldier's survivability when faced with existing and emerging threats.

"Bispectral obscuration has immediate applications in countering thermal imagers, image intensifiers and thermal guided threats, including missile seekers," said Robert Carestia, project engineer with the Smoke and Target Defeat Branch. "This is a new capability for the warfighter that will provide an important level of protection against an enemy equipped with thermal and IR devices and increases a soldier's mobility in theater."

ECBC is developing a new capability for the current M106 grenade, which blocks visual (naked eye) through near infrared portions of the electromagnetic spectrum. In addition to enhancing the fill of the grenade, the team is also focused on improved safety features and ways to reduce cost and weight.

"We have researched various materials for the improved grenade body that help eliminate a 'frag hazard'—fragments that break off during the functioning of the grenade which could cause harm to the soldier or a bystander—utilizing glues, rubber materials, cardboard and plastics," said Carestia. "These have significantly reduced the cost and weight and eliminated central end-cap bolts of the current grenade, which improves the filling process and increases obscurant payload."

Initial testing for the most efficient and best performing bispectral fills has already been completed in the team's unique aerosol chamber, which captured data on duration, mass extinction coefficient, yield factor and transmittance. In August 2013, the team filled the new grenade configuration with various bispectral materials and assessed their effectiveness using the backdrop of a special instrumented vertical grid on a test range at Aberdeen Proving Ground, Md. During the test, they gathered data on contrast reduction, spectral information, mass extinction coefficient and the effective screening area. In total, 108 grenades were tested safely and ahead of schedule.

The next step is to analyze the data and select the top performing bispectral material for further refinement and evaluation. The current Bispectral Obscurant Grenade program is part of the Technology Concept Demonstration for Soldier and Small Unit Protection. A demonstration of the prototype system is planned for late 2014.

SDSU Calls on CBARR for Chemical Testing of Meat Product

FERN links organizations, CBARR expands sampling capability

When a South Dakota beef producer voiced concerns about the safety of his product to a meat inspection staff, the Animal Disease Research and Diagnostic Laboratory (ADRDL) at South Dakota State University (SDSU), called on the Food Emergency Response Network (FERN) for help in early January. Within a few days, the U.S. Army Edgewood Chemical Biological Center (ECBC) answered.

FERN, an integrated system of food-testing laboratories across local, state and federal levels in the United States, facilitated the partnership between SDSU and ECBC's Chemical Biological Application and Risk Reduction (CBARR) Business Unit laboratories. Federal and state funding cuts caused SDSU's biochemistry laboratory to close in 2011, leaving the university without the facility or personnel to support a core chemistry capability for food testing. Furthermore, the absence of a U.S. Department of Agriculture (USDA) laboratory in South Dakota left Laura Ruesch, research associate II at SDSU, with few state resources to reach out to. Instead, she utilized her contacts within FERN to connect to ECBC's Environmental Chemical Monitoring Laboratory.

"It was really great," said Ruesch. "I would have had no way of knowing that ECBC existed if it weren't for the FERN. It was a really great way to connect people who have the resources and similar interest in food testing, but otherwise would not have had contact with one another."

As part of South Dakota's meat inspection program, SDSU needed to conduct additional chemical testing on a meat sample to determine whether or not Ivermectin, an anti-parasitic agent, was present. According to Ruesch, the Ivermectin compound is used in a pesticide that is applied to live cattle to control internal and external parasites such as roundworms, cattle grubs, mites, lice and flies.

"Typically, there is a withdrawal period of 45 days before they can slaughter that animal," Ruesch said. "In that time, whatever product was absorbed into the body of the cow was processed by the liver and kidneys and excreted via feces and urine so levels present in the tissue are reduced to tolerable levels."

The meat sample in question, however, had been processed after only 28 days, before the 45-day time period. Additional testing was conducted by ECBC to ensure the meat sample was not contaminated and the Ivermectin compound was not still present. The anti-parasitic agent is widely used as insecticides in agriculture, gardens and veterinary practices. When exposed to unsafe levels of the chemical, humans may develop mydriasis, depression, coma, tremors, ataxia, stupor, vomiting and drooling.

After two weeks of testing, CBARR found no hazardous levels of Ivermectin in the meat samples.

"A lot of chemistry laboratories that have such a high sample throughput usually don't have the time for some of these more unique cases," Ruesch said. "ECBC really went out of its way to help us out. A lot of places just didn't have the time or the qualified staff available to investigate that method and put it into place."

Nam-Phuong Nguyen, ECBC senior chemist, was excited to take on the task. Based on previously proven USDA methods and the work conducted with raw milk samples, Nguyen developed and verified the appropriate method for detecting the presence of Ivermectin in the ground beef product sample provided by SDSU.

"After we received the samples, I applied my research to develop the analytical methods," Nguyen said. "Using the reference standard provided by Ruesch, I started working on the acquisition methods by first running in scan mode to find and optimize the signal intensity at the peak of interest."

Nguyen had previous experience creating and verifying testing methods, an invaluable resource when conducting this type of work with a quick turnaround time. According to Nguyen, other projects tend to take longer to complete because they typically involve validating another scientist's methods. But because Nguyen had designed the test methods for the FERN project herself, there was only one matrix and one analysis that needed to be done. Method validation serves to ensure that a specific process provides the results researchers anticipate.

"Before working on this project for SDSU, ECBC had done work on a food project for the USDA where we were asked to validate their developing method of detecting three compounds in foods, including orange juice, apple juice, egg yolk, egg white, whole milk, two-percent milk, hot dog and ground beef and deli turkey," Nguyen said. "Although the two projects were seemingly different, the same concepts, with respect to the development and validation of methods, were applied."

Out of nearly 10 laboratories across the country who responded to SDSU's FERN request for chemical testing capabilities, ECBC was the only one awarded the work. CBARR was accepted into FERN as a chemical, biological and radiological testing laboratory in January 2009 and has performed method equivalency testing for biological analysis with food matrices for other FERN partners. The work with SDSU marks the first time ECBC has expanded its FERN efforts to include chemical testing.

The partnership between ECBC and SDSU highlights each organization's commitment to detecting agents of food-borne illness and responding to emergencies involving the contamination of food. The interagency participation within the FERN structure enhances the network's ability to form, develop and operate across the country on complex issues involving the nation's food supply.

Wearable Solutions an Easy Fix for Joint Service Aircrew Mask Program

Protective equipment is an essential part of any warfighters' uniform. During recent conflicts, the protective mask and hood that are a part of the Mission Oriented Protective Posture (MOPP) have presented comfort, thermal, hydration, bodily fluid and claustrophobia issues for flight crews across the services.

In order to address these concerns, the Joint Service Aircrew Mask (JSAM) program was initiated by the Joint Program Executive Office for Chemical Biological Defense (JPEO-CBD) and Joint Project Manager for Protection (JPM P). Within the U.S. Army Edgewood Chemical Biological Center's (ECBC) Protection Engineering Division, Don Kilduff, product manager for the JSAM Apache mask system, and Jon Sampson, PM for the JSAM Rotary Wing mask system, have been working on solutions to mitigate these issues while providing a new design that allows flight-crews to quickly don and doff their masks in-flight without removing their flight helmets. This is accomplished by designing a removable face plate that can easily attach and detach from the hood.

Initially, JSAM was a single program to replace all aviation protective masks. "The basic challenge was that we started a joint mask program for a one-solution-fits-all application, but with more than 130 different platforms, five different helmets and a variety of air-crew equipment, it becomes difficult. Over time, we split the JSAM program into five different systems to meet needs across the DoD aviation community," said Kilduff, who has been a part of the program since its inception in 1999.

When the JPM P created the JSAM variant specifically for the Apache helicopter in 2007, there were some "safe to fly" issues with the mask and hood because the field of view was not better than the legacy system. Kilduff and his team made adjustments to the lens, completed testing in 2009 and then produced and fielded the mask from 2010 through 2012. The team is working on the next iteration of the mask that will interface with the redesigned Apache helicopter helmet and is anticipated to be fielded in 2014.

"Imagine, the soldier is looking at a TV monitor in one eye and flying with the other. The crosshairs for the weapon are on that monitor, but along the side of the screen is also flight symbology providing the solider with vital information. The changes to the mask optimized the soldier's ability to see the sighting system by maximizing the field of view," Kilduff said, explaining the lens readjustment.

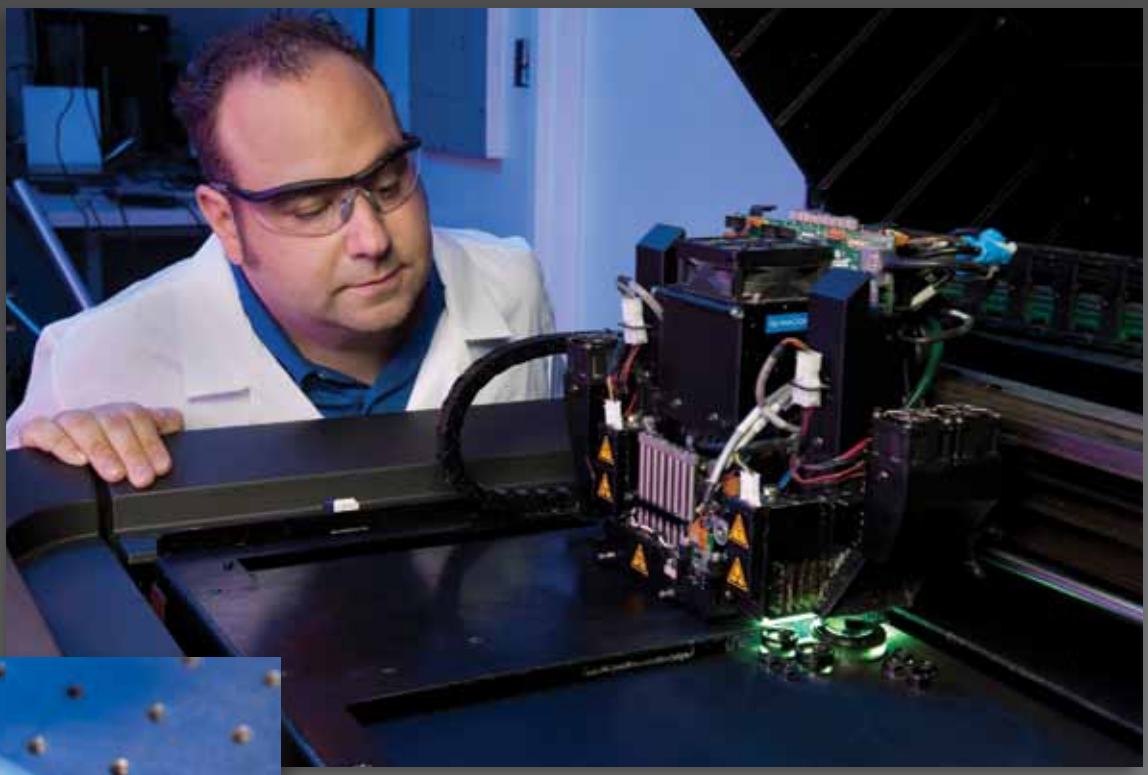
For JSAM Rotary Wing, the challenges stem from the need to produce a mask for all rotary aircraft in all services. The services and aircraft do not always use the same systems, such as flight helmets and body mounted equipment, which presents many integration challenges.

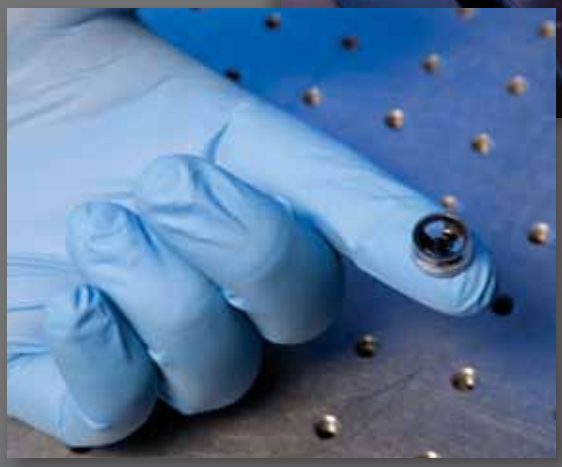
Currently, the Rotary Wing team is in the production qualification test phase and is continuing air-worthiness testing while making slight design modifications, as required. The mask must qualify for each aircraft in each service, an extensive process, given each service's different testing requirements.

The teams in the Protection Engineering Division have used the expertise from across ECBC to provide an improved product within a manageable budget, including environmental chambers, test equipment, the protection factor chamber and the SMARTMAN simulation capabilities during their design and testing phases.

SUSTAIN

The ability to conduct decontamination and medical actions that enable the quick restoration of combat power, maintain and recover essential functions that are free from the effect of CBRN hazards.





ECBC, ARL Collaborate on Octopus-Inspired Suction Cup

Joint project designed to expand size, shape of objects grasped by robots

Robots designed to probe earthquakes, storms or otherwise damaged places may get a better grip of things thanks to the octopus self-sealing suction cup, U.S. Army Edgewood Chemical Biological Center (ECBC) and U.S. Army Research Laboratory (ARL).

A self-sealing suction cup is a collaborative project between the two Army laboratories and the University of Maryland, where Chad Kessens, a robotic manipulation researcher for ARL, is pursuing his doctorate degree in Mechanical Engineering under the advisement of Professor Jaydev Desai. As part of the Ph.D. program, Kessens tested the limits of robotic grasping by developing a new suction technology to expand the range of graspable object shapes and sizes. An expanded grasping capability could improve the way emergency response teams observe areas of devastation by increasing the effectiveness of robotic operations and reducing human risk at dangerous on-site locations.

“Manipulation of unknown objects is a very difficult task for a robot. In traditional applications, the robot would have a model for the object it wants to pick up and would then know how to pick it up. The self-sealing suction cup design could enhance grasping technology, making grasping of unknown objects easier,” Kessens said.

On December 7, 2012, a 7.3-magnitude earthquake was measured by the U.S. Geological Survey off the coast of Japan, shaking buildings in Tokyo and causing a small tsunami to revisit an area that was destroyed by the Fukushima-Daiichi disaster in 2011. In 2012, a 9.0 earthquake killed nearly 20,000 people and led to widespread devastation when the nuclear power plant experienced fuel-rod meltdowns that caused unchecked radiation leakage and contaminated foodstuffs and water in what Reuters called “the world’s worst nuclear crisis in 25 years.”

“When something like the accident in Fukushima happens, it would be very useful if the robots that are sent in could perform some sort of manipulation activity like closing a valve, recovering an object or operating a tool in a contaminated area,” Kessens said. “Even opening a door or a hatch could allow the robot to better observe what’s going on inside the reactor while eliminating the risk of exposing people to radiation.”

Inspired by the octopus, Kessens’ design features a self-sealing component that imitates the sea creature’s ability to individually actuate suction cups based on the object it wants to pick up—from large and small fish to rocks and even a jar of peanut butter. Though suction technology has been applied to the robotics field since the 1960s, it has been limited in its scope and practical only for objects with a specific size and shape. According to Kessens, a traditional suction grasper uses one vacuum pump as a central suction source, which limits the effectiveness of the technology for grasping if some cups on the grasper do not attach to a given object, creating leak points where air enters at the point of engagement.

Instead, Kessens is modifying the technology so a robot could grasp a large range of items by maximizing the strength of the suction. The self-sealing suction cup features a plug that sits nominally in the suction inlet. When the source pump is turned on, the plug of any cup not in contact with an object gets sucked in, sealing itself. This increases the pressure differential and strengthens the suction capability of the cups that are engaged on an object. The design also uses passive reaction forces that cause the cup to activate and open when the lip contacts an object, breaking the seal to initiate suction.

“The joint project, which began in April 2013 between ARL and ECBC, is currently and involved in comprehensive testing of the prototype still needs to be done,” said Kessens. While the ARL scientist provided the concept and design, it was ECBC that generated the prototypes through its expertise in rapid prototype manufacturing. According to Brad Ruprecht, engineering technician and senior model maker in the Advanced Design and Manufacturing Division of ECBC, the biggest challenge was determining how small the cups could be while still making them functional. Part of the process was ECBC’s design capability, including experienced engineering personnel and advanced equipment, to craft a prototype using a multi-material 3D printer.

“What I loved about the project is Chad came to ECBC first and foremost because we had the multi-material machine, and he leveraged that to get a working model right off of the 3D printer,” Ruprecht said. “It has levers and springs and everything else needed to be a working prototype, and it’s worked very well for him. He’s received a lot of good data from it and is definitely moving forward with his design.”

Now on its fourth iteration of the design, the self-sealing suction cup ranges anywhere in size from the palm of a hand to the point of a fingertip. Four fingertip cups can pick up a bottle of wine. The next step is developing a substrate such as a hand or tentacle, where the cups would be located on a robot. Until then, there are plenty of prototypes to be reviewed to finalize the design and conduct testing.

The collaborative effort between ARL and ECBC demonstrates a desire to improve technology, share resources and utilize the expertise of personnel working in laboratories across the U.S. Army Research, Development and Engineering Command.

ECBC Joins Forces with MRICD on Groundbreaking Joint Facility

Proteomics Core Facility opens a new chapter of shared resources and collaboration in proteomics and genomics for ECBC and MRICD

One of the most valuable pieces of advice we are given in life is to share: If people share what they have—be it time, space, resources or talent—chances are they will reap the rewards. That is exactly what the U.S. Army Edgewood Chemical Biological Center (ECBC) and the U.S. Army Medical Research Institute of Chemical Defense (MRICD) are doing with a new facility, the Proteomics Core Facility, which opened in February 2013. This is an unprecedented shared resource designed to support basic and applied research projects that will apply a broad but integrated biological approach to a wide variety of chemical, biological, radiological, nuclear and high-yield explosives (CBRNE) issues.

"Both ECBC and MRICD saw this as a need," said Jennifer Sekowski, Ph.D., diplomat of the Board of Toxicology, molecular toxicologist and ECBC lead for standing up the Proteomics Core Facility. "We already had some individual proteomics and genomics tools at hand, but knew we both needed to expand our toolset. Rather than duplicate the capabilities, why not build our capabilities in one joint facility? Having a combined Genomics and Proteomics Core Facility now allows us to more easily share our resources, provide new training opportunities and expand the amount and type of research we both can do."

The Proteomics Core Facility is in proximity to ECBC's state-of-the-art Genomics Laboratory, which MRICD can utilize. Additionally, MRICD has an exceptional transcriptomics and a microarray core facility, which can be utilized by ECBC scientists. Together, the organizations can support the Defense Threat Reduction Agency (DTRA) Joint Science and Technology Office (JSTO), the National Institutes of Health and other sponsored research in the areas of whole genomic sequencing and finishing, whole transcriptome analysis (RNA-Seq), expression analysis and microRNA. With the newly added equipment, ECBC and MRICD can extend their research utilizing mass spectrometry-based proteomics, high content image analysis of cells and tissues and gel-based imaging.

"This revolutionary joint capability is a wonderful illustration of the cooperation and collaboration across the Aberdeen Proving Ground Edgewood campus," said Joseph Wienand, ECBC's director. "In this time of fiscal awareness, it is a great example of our nation's leading scientists working together to share resources and save funding while working toward the common goal of the protection of our soldiers and our nation."

Colonel Bruce Schoneboom, MRICD commander, is excited to see this unique facility officially launch. “The fact that two organizations came together to build a joint capability is a wonderful testament to the true spirit of collaboration in support of common scientific research, and I hope that this serves as a great example for other installations,” said Schoneboom. “I am very excited to see the great strides the talented MRICD and ECBC staff will take in proteomics and genomics research.”

The initial infrastructure funds to create the Proteomics Core Facility originated from the Office of the Assistant Secretary of Defense for Chemical and Biological Defense and was augmented by both ECBC and MRICD investments. One key goal is the support of the DTRA-JSTO Fiscal Year 2013 Systems Biology programs, which are aimed at toxicological target discovery. The Proteomics Core Facility will be used to support the DTRA-JSTO CB Defense Program and MRICD and ECBC missions to protect the warfighter from the harmful effects of chemical and biological agents.

ECBC scientists will focus their research efforts on the detection and understanding of exposures to toxins and novel chemical and biological threat agents. This knowledge is translated into the development of more capable masks and uniforms for the warfighter as well as more effective decontamination materials.

MRICD scientists will focus their research efforts toward a thorough, foundational knowledge and understanding of the toxicology of chemical agents, toxic industrial chemicals and toxins for the development of therapeutics and prophylactic treatments to protect warfighters and civilians. Through this work researchers will develop and test countermeasures to protect against the acute and long term effects of exposure to such agents.

“We are so excited to see all of our efforts come to fruition with the launch of this facility,” said Sekowski. “We have already initiated several projects and look forward to the development of a broader medical and non-medical understanding of and response to chemical and biological threats.”

This is a sensational example of a very real need: quick and accurate diagnosis of exposure to a toxicant to better triage patients and the identification of the agent so proper treatment can be administered.

Army Additive Manufacturing Brings Concepts to Life with 3D Imaging

Additive manufacturing technology has gained notoriety due to its ability to reproduce everything from gun parts with full functionality, to exact replicas of children's toys. Three-dimensional printing has even made an appearance in recent pop music videos, transporting viewers through a seemingly futuristic odyssey to clone a high-tech version of will.i.am.

However, Rick Moore, chief of the Rapid Technologies and Inspection Branch at the U.S. Army Edgewood Chemical and Biological Center (ECBC) notes, “More than toys or gun parts can be produced with these additive manufacturing technologies."

Additive Manufacturing (also known as rapid prototyping or 3D printing) is the process of making a three-dimensional solid object of virtually any shape from a digital model. Having this capability has increased the speed at which products are brought to market, while also proving to be ideal for testing, which allows for cost-effective design changes during the preproduction cycle of a product.

In 2013, Moore and his team have been utilizing these revolutionary processes and capabilities to produce items in support of the warfighter and the homeland, all within their Rapid Technologies lab on-campus at ECBC.

“3D-printing and 3D laser scanning are capabilities we've had here since the mid-1990s,” said Moore. “These capabilities help us get equipment in the hands of the warfighter quicker, and they also provide access for other engineering and science groups to design products with the ability for many iterations or design changes before fully investing critical funds into the mass-production of that item.”

In the simplest of concepts, as Moore explains it, “It's a process that can take an idea that has been drawn on a napkin and transform it into a 3D product that you can look at, feel and test in a matter of hours or a few short days.”

The Rapid Technologies Branch supported prototyping of the Anthropomorphic Control Arm (ACA), a recent project of the Advanced Design and Manufacturing Division in support of the Defense Threat Reduction Agency Robotics.

"The ACA is an intuitive joystick developed to control a hydraulic actuating arm and claw mounted on a military vehicle. Much like how a human arm has wrist, elbows and the ability to twist or extend, the ACA has joints that mimic these motions to manipulate the vehicle mounted arms in a fashion that requires little to no training between operators," said ECBC engineering technician Brad Ruprecht.

The ACA project has been through multiple design iterations ranging from simple wood or cardboard models that test ergonomics to more involved designs built using polycarbonate or nylon plastic materials that support the integration of electronics and sensors that allow full functionality testing.

Beyond the Additive Manufacturing capabilities of the branch, there is also a highly capable 3D scanning department supported by engineering technician Ryan Gilley.

"3D scanning is great for recreating organic items, such as those fitted to human anatomy—or even exploded fragments—and for items involving prismatic geometry, like hole-patterns or custom brackets," said Gilley.

In cases of evidence collection, exploded fragments provided by the U.S. Army Research Laboratory's Survivability/Lethality Analysis Directorate can be scanned and accurately recreated for various uses, such as lightweight replicates that preserve the integrity or security of the physical sample. In fact, components from an entire vehicle system can be scanned and recreated in a 3D-CAD environment to very accurate detail to assist groups like the Letterkenny Army Depot in the production of mine-resistant ambush protected vehicles.

While the engineers of the Rapid Technologies and Inspection Branch are using their 3D equipment to make life safer for the warfighter, they recognize its presence in popular culture as well.

"Sure, the technology is available for home use, but we feel the higher functionality and capability we have been able to achieve has been a credit to the team I have put together, combined with our accessibility to unique projects provided by ECBC and other Department of Defense organizations," said Moore.

The Rapid Technologies engineers truly care about utilizing this capability to make the world a better place for the warfighter. "We want to be a part of the driving technology behind the evolution of additive manufacturing in the Army and can hopefully shape its future into something meaningful," Hitch reflects.

They are halfway there. Hitch said some manufacturers have already come to them for their opinion on the technologies and materials.

"We like contributing and we want to use our tools to help the Army improve and evolve," Moore said.

ECBC Engineers Modify Decontamination Methods to Save Costs and Increase Accuracy

With team members located in Edgewood, Md., and Rock Island, Ill., the U.S. Army Edgewood Chemical Biological Center (ECBC) operates as one team revolutionizing warfighter chemical and biological decontamination efforts.

In February 2013, the team has recently worked together to support three decontamination projects aimed at improving the effectiveness and supportability of current decontamination methods, saving money for the Army in the long run. These projects are the Mass Casualty Decontamination (MCD) Limited Objective Experiment for the M26, the M100 Shelf Life Study and updates to the M12A1 Super Tropical Bleach (STB) mixing procedures.

MCD Limited Objective Experiment is a project managed by the Joint Experimentation and Analysis Division (JEAD), a part of the Joint Requirements Office, in support of several organizations. The project is an experiment to evaluate several configurations, both commercial off-the-shelf and organic, and assess their relative ability to support MCD mission requirements, such as providing water to shower stations for ambulatory and non-ambulatory decontamination situations.

"Currently, the Army uses commercial systems," said Joe Grodecki, a Rock Island engineer with the Decontamination Engineering Branch. "We are completing water tests to see if they could use an Army system such as the M26 small-scale decontamination apparatus instead."

Grodecki explained that using the M26 could be cheaper for the Army than their current systems because the Army already owns M26 systems. These systems are also easily maintained since the users are already trained on the equipment and logistics support is already in place. Currently the group is in the initial phases of the evaluation.

The Center is supporting the JEAD by managing the Limited Objective Experiment, designing the experiment and leading the execution of the experiment.

The next study the branch has been working on is the M100 Shelf Life Study, which is an experiment to extend the shelf life of the M100 Sorbent Decontamination System. The M100 uses a sorbent powder for immediate decontamination, specifically, the removal of gross liquid

contamination from frequently touched surfaces. Currently, the M100 has a shelf life of 10 years before it must be disposed of and replaced, but the Decon Engineering Branch is working to make that a bit longer.

"We've been working with TACOM to extend the M100 shelf life up to 15 years," Burns said. The team plans to test select M100s every year from 10 to 15 years of life. "If we could continue to increase the shelf life of this product by 50 percent, it can save the Army a lot of money in the long run on replacement and shipping costs."

Yet another way that ECBC is modifying existing decontamination methods is their experimentations with STB, which has been a military decontamination method for decades. STB is a mixture of a several different chemicals and is used in several decontamination applications, to include decontamination of larger areas like vehicles and terrain. When applied using the M12A1 Decontamination Apparatus, STB is mixed into the hopper of the M12 Decontamination apparatus and disseminated using spray attachments.

"We were able to improve procedures within the M12 technical manual to help make the STB mixing process easier on the warfighter," Burns said.

The results of the team's testing is being reflected in the M12 tech manuals, and a special message was also sent to users in the field providing interim guidance to smooth STB mixing operations.

ECBC, through facilities and capabilities, is at the forefront of the development and evaluation of decontamination technologies to neutralize, destroy or mitigate chemical and biological hazards, thus ensuring the safety of the warfighter.

Army Researchers Test Around the World in 26 Chambers

In a given work day the U.S. Army Edgewood Chemical Biological Center (ECBC) Environmental and Field Test Branch (EFTB) engineers Audrey Moberly and Greg Carter can visit the tropics, freeze in the Arctic or survive a sandstorm.

The ECBC engineers spend time walking in and out of the branch's 26 environmental test chambers, assisting groups within and outside of the ECBC to ensure military equipment—masks and detectors—can withstand any natural elements.

"We are here to do the hard testing to ensure that the equipment being sent to our warfighters can last through harsh environmental elements," said Moberly. The testing chambers include temperature/humidity, salt fog, sand/dust, solar radiation, altitude, hot environmental, cold environmental and rain. The temperature chambers range from negative 60°F to 300°F, with humidity levels ranging from two percent to nearly 100 percent.

There are many elemental factors that engineers need to be mindful of when creating and designing a product. It goes beyond just the climate of the area where they will be using the equipment.

Transportation has to be taken into account. For example, will it be driven through a mountain terrain in a box in a hot vehicle for a couple hours, or maybe in a cold space? Our facilities simulate everything from the final destination climate to any natural factors that could pose a problem during transportation.

Vibration testing is controlled in a separate room with computer analog equipment where the engineers can observe the testing environment, and adjust conditions. The group can videotape testing for future documentation. The vibration testing complies with the American Society for Testing of Materials International test standards as well as military, federal and commercial test standards. EFTB can also conduct altitude testing, which is a low pressure test that can be conducted up to 45,000 feet. One version of the altitude test is a rapid decompression to simulate a sudden loss of pressure in an aircraft. EFTB's testing facilities have been used to test the Joint Service Aircrew Mask, Joint Service General Purpose Mask, reconnaissance vehicles for the Joint Program Manager for Nuclear, Biological and Chemical Contamination Avoidance and many others.

As resources change, equipment needs to be sent to warfighters faster and be more durable for whatever comes. Environmental and harsh testing complies with Environmental Engineering Considerations and Laboratory Tests. "We can replicate almost any environment on earth," said Moberly. "Just tell us where you want to go."

ON THE HORIZON

West Point Cadets Work Alongside Chemical and Biological Experts at ECBC

The U.S. Army Edgewood Chemical Biological Center (ECBC) welcomed cadets from the U.S. Military Academy at West Point this during June and July of 2013 to work on chemical and biological defense projects.

The cadets were participating in the Academy's Advanced Individual Academic Development (AIAD) program which provides them with an opportunity to observe and implement concepts from their course work over several weeks during the summer months.

Ten cadets selected to receive their additional training at ECBC and worked on two to three week rotations. In this volunteer program, students forfeit their vacation to receive additional laboratory academic credits toward their education.

By coming to ECBC, the cadets worked with some of the nation's most experienced subject matter experts in the field of chemical and biological defense. While the hands-on experience will be valuable to them, the ECBC mentors who hosted a student also gained a valuable direct connection to the solider, our end user.

"This program is a great opportunity for ECBC to mentor the future generation of Army leaders," Senior Research Scientist Augustus Way Fountain III, Ph.D., said.

The cadets were able gain insight into the difference between a research laboratory versus an academic laboratory and learn about the Army's research, development, test and evaluation enterprise.

Cadet Benjamin Lacey, an incoming sophomore at the Academy, investigated proteomic mass spectrometry in the Point Detection Branch of the Research and Technology Directorate during his rotation at ECBC.

"Ben's enthusiasm and dedication to learning as much as he could during his time here at ECBC was inspiring" Lacey's mentor Mary Wade, Ph.D., chief of the Point Detection Branch, said. "It makes me appreciate my work to help the warfighters and future warfighters, like Ben, even more."

While this was not ECBC's first year hosting cadets with the AIAD program, ECBC is working with West Point to expand opportunities for West Point students and faculty to do research here. A memorandum of understanding is currently being staffed between the two organizations that will provide cadets with more AIAD opportunities, support faculty research in support of chemical and biological defense needs and provide a fellowship opportunity for ECBC researchers to periodically teach at the Academy.

ECBC Works Toward Next Generation Gas Mask

It's hot. Humidity is near 100 percent, and you're in full combat gear. Between your helmet and your mask, your entire head is covered, leaving a sensation of suffocating heat. Sweat pours as you run, climb and crawl through enemy territory. The lifeline that can get you through it? A fan that brings the relief of soothing air across your face, under the tight-fitted mask.

Current technology brings this vital relief to a soldier via a powered air purifying respirator (PAPR), which usually consists of a hose connected to the face mask from a blower unit and battery pack that hangs off the soldier's hip or back. While this brings the necessary airflow to the soldier, a typical PAPR is heavy and cumbersome, adding to the weight of the equipment they already carry.

In 2013, scientists with the U.S. Army Edgewood Chemical Biological Center (ECBC) began designing concepts for the next generation of chemical, biological, radioactive and nuclear (CBRN) respirators, developing a fan embedded within the mask's filtration system that uses less power, is lighter, has less weight and is far less bulky than conventional PAPRs. Yet despite its reduced weight and power, this novel air-management system offers major improvements to the current level of comfort and effectiveness of the mask.

The mini-blower technology works by pulling air in through the filtration system on the side of the mask and sweeping it across the nose cup to allow for even flow across the face. When the user exhales, the air valve closes and diverts all of the clean filtered air into the mask's eye cavity to over-pressurize the face piece, preventing any potential for outside contaminates to enter the mask should there be a break in the seal.

In test bed studies, a modified, commercial version of the M50 joint service general purpose mask has proven to be more comfortable to a soldier, and maintains the same or greater effectiveness when crawling, running, or during rifle exercises and combat maneuvers. These technology demonstrations produced real-time data on mask protection factors, thermal sensation and comfort to the soldier.

The team, members of ECBC's Respiratory Protection Branch, continues to develop multiple technologies, anticipating integration with next generation helmet and communication system designs and user needs. As the team looks ahead, they anticipate a mask that is able to sense when the fan needs to come on and when it should shut off based on physiological monitoring, and the ability of the user to control the scalability (operational mode) of the system: fan off, fan on with airflow just to the eye cavity or fan on with airflow to both the eye cavity and nose cup.

ECBC, Academia Collaborators Develop Human-on-a-Chip

A couple of years ago, two researchers from the U.S. Army Edgewood Chemical Biological Center (ECBC) heard Harvard Professor Donald Ingber, M.D., Ph.D., speak at a conference about his lung-on-a-chip research, and they knew they had to speak to him. The organ or lung in this case, is composed of swatches of human tissue that are placed on “chips” of silicon wafer the size of a computer thumb drive. Ingber’s model was a 3D swatch of lung tissue that actually acted like a human lung by “breathing.” Ingber had created a way for the sides of his model contract and expand like a lung. This was revolutionary because until then the organs-on-a-chip did not do much to simulate the organs they represented.

After the conference was over, the two researchers—Harry Salem, Ph.D., and Russell Dorsey, Ph.D.—approached Ingber to discuss their own organ-on-a-chip research at ECBC and to discuss the possibility of collaborating.

In the fall of 2013, organ-on-a-chip scientists—both from Harvard and several businesses founded and ran by Harvard professors—have visited the Center, and Salem and Dorsey have also traveled to Harvard University’s Cambridge, Mass., campus. After seeing all of the capabilities of Harvard and ECBC, the teams are excited about the thought of collaboration.

As an Army research lab, ECBC researchers have been studying the organs-on-a-chip for several years, exposing organs-on-a-chip to various chemicals, pharmaceuticals and chemical warfare agents. ECBC is the nation's principal research and development resource for non-medical chemical and biological defense and the center’s main focus is supporting the warfighter.

Salem, the Center’s chief scientist for Life Sciences, and his team’s research are assessing the effectiveness and toxicity of chemicals and drugs in relation to humans and their ability to process them. The plan is for Harvard to provide its functioning lung model, allowing Salem’s team to make comparisons between biological and chemical warfare agents tested, their countermeasures, and the static models’ results

“Collaborating with top experts in the field, such as Harvard University, the Wyss Institute and others, the Army is living up to its reputation as a team player and innovator,” ECBC Research and Technology director Joseph Corriveau, Ph.D., said. “While the center’s research directly impacts the defense of our warfighters, the organ-on-a-chip research will have a resounding global impact.”

Founded by Ingber, the Wyss Institute for biologically inspired engineering is part of Harvard University. In 2005, Harvard convened a committee to envision the future of bioengineering, and they created the Wyss Institute. The Institute’s research is used to solve real-world problems. Another major collaborator is the private company Cellbridge. Founded by Harvard professor George Whitesides, Cellbridge performs similar studies to the Wyss institute and develops technology solutions for the stem cell and 3D tissue culture markets. Researchers at the Wyss Institute and Cellbridge frequently collaborate.

Collaboration between ECBC and these organizations could lead to many testing improvements. The organ-on-a-chip research could provide more solutions and narrow their research efforts early in the testing process by quickly yielding accurate results, thereby providing the warfighter with defense solutions in a more timely and manner.

SUCCESSES

ECBC Shapes Diverse STEM Workforce to Sustain National Security

The U.S. Army Edgewood Chemical Biological Center's (ECBC) Community and Educational Outreach Program taps into a diverse talent pool of future science, technology, engineering and math (STEM) professionals who support schools systems in surrounding communities to ensure the Department of Defense (DoD) remains a globally dominant fighting force well into the 21st century. As significant numbers of the DoD workforce become eligible for retirement, it is vital to national security that the Armed Forces sustain readiness and fulfill mission-critical requirements. With that goal in mind, ECBC scientists and engineers inspire, develop and attract the STEM talent essential to deliver innovative solutions for current and future challenges.

Subject matter experts (SMEs) at ECBC are uniquely positioned to entice future workforce generations into careers that help protect warfighters and the nation against potential CBRNE threats. While relaying the rewarding nature of their everyday jobs, they translate their specialized expertise and passion for STEM disciplines into valuable experiences that address the educational needs of teachers and students.

ECBC SMEs reinforce the real-world application of STEM principles to students from kindergarten through 12th grade through career exploration, curriculum development, guest lectures, mentoring, project judging, scientist-in-the classroom activities, STEM learning modules, summer camp support, teacher professional development and hands-on tours of its facilities.

During the 2012-13 school year, the National Defense Education Program sponsored ECBC to plan, design and execute STEM education initiatives that assist teachers in meeting the STEM requirements in the Maryland Common Core State Curriculum and allow students to apply essential skills and knowledge associated with the new standards.

Looking to foster early engineering and technological literacy through inquiry and design-based learning, ECBC has helped teachers at Harford and Cecil County, Maryland public schools implement the Engineering is Elementary curriculum. U.S. Army scientists and engineers at ECBC planned and conducted hands-on STEM lessons to give elementary school students the opportunity to apply the engineering design process and develop solutions to a real-world problem. ECBC has helped reinforce the agricultural, chemical, electrical, environmental and materials engineering units.

As part of the Center's Adopt-a-SME program, ECBC offered professional development in math robotics to Maryland Public School teachers in Cecil County. This allowed them to make math lessons more applicable to the real-world of science and engineering. ECBC scientists and engineers, who had previously contributed their knowledge and skills to the training, were called upon as future educational resources. Participating teachers invited SMEs into classrooms to help implement the training modules

In 2013, for the first time, the Center participated in the Army's Gains in the Education of Mathematics and Science program, which was held at APG's new STEM Education and Outreach Center over the summer. ECBC scientists and engineers offered fifth-, sixth- and seventh-grade students a hands-on STEM activity called 'The Color of Science' that enabled them to explore the difference between acids and bases and the use of a pH indicator. They also applied the engineering design process during the 'Egg Drop Challenge' and 'Gas Mask Challenge' sessions. Additional Army STEM programs that ECBC supported this year included the eCYBERMISSION competition as well as the Junior Science and Humanities Symposium.

More than
8,500 students
were served.

Worked with nearly
900 teachers.

Have a volunteer
base of more than
100 subject matter experts.

Work closely with
60 schools in
2 school districts.

U.S. Army One of Thomson Reuters Top 100 Global Innovators

2013 began with he U.S. Department of the Army being named one of the Thomson Reuters Top 100 Global Innovators for the previous year, recognizing its efforts in innovative approaches to global defense. Also named was the U.S. Department of the Navy, marking the first time government agencies made this elite list. According to the official report released in April 2013, these government entities were recognized for their significant investment in innovation, with efforts strongly focused on national security.

The U.S. Army Edgewood Chemical Biological Center (ECBC) scientists and researchers, who developed 20 patents in 2012, continue to be recognized for groundbreaking research in fields such as decontamination, chemical and biological agent detection and the safe handling of chemical agents.

Thomson Reuters used a set of four criteria to establish the list: Success, patents awarded versus patent applications; Global, the number of inventions that have quadrilateral patents (from the United States, European, Japan and China patent offices); Influence, the numbers of times a patent or invention was cited over the last five years; and Volume, organizations that had 100 or more innovative patents in the last three years.

"Top 20 Inventors for the U.S. Army 2009-2011," featured two of ECBC's own: Jose-Luis Sagripanti, Ph.D., Senior Research Scientist for Biochemistry, and George Wagner, Ph.D., a member of ECBC's Chemical Biological Protection and Decontamination Division. During that time, Sagripanti received seven patents, and Wagner received five. All the U.S. Army had 436 published inventions, of which 327 were awarded with a patent.

According to the Thomson Reuters report, "The Thomson Reuters Top 100 Global Innovator companies are world leaders of innovation and economic growth." The research cites the U.S. Army with having a higher percentage of innovative work than the healthcare, pharmaceutical and media/internet industries, among others.

The expertise of the scientists and researchers within ECBC continue to support the Army's position as a leader in global chemical and biological defense, striving to achieve the most innovative and technologically advanced solutions for the warfighter and the nation.

To read the full report on the Thomson Reuters Top 100 Innovators, please visit **www.top100innovators.com**, and for list of ECBC's patents awarded in 2013, please see page 50-51.

In the News

As of September 2013

WINTER 2012/2013

Winter 2012-2013 / **CST + CBRNE Magazine** / **Tactical Defense Media**
R& D Spotlight – ECBC: A Premier Resource for CBRNE Defense

December 2012 / **I-95 Business Magazine**
Encrypted DNA Technology Protects the Warfighter

February 2013 / **National Defense Magazine**
New Way to Test Airborne Pathogen Sensors Slated for BioWatch Program

February 2013 / **I-95 Business Magazine**
Women Inspiring Innovation through Imagination: ECBC Celebrates Women in STEM

February 2013 / **Scientific American**
3-D Printed Octopus Suckers Help Robots Stick

March 2013 / **Armed With Science – Department of Defense Blog**
Can Your Phone Do This?

March 2013 / **NASA Tech Briefs**
Army Researchers Develop Better Remote Sensors

SPRING/SUMMER 2013

April 2013 / **The Baltimore Sun**
APG Working on Biosurveillance in Response to North Korea Threats

April 2013 / **Popular Science**
Parachuting Canister Detects Chemical Weapons

May 2013 / **National Defense Magazine**
Army to Test Assay Reader Add-On for Smartphones

June 2013 / **U.S. Army Acquisition Support Center (USAASC)**
ECBC Engineers Create Tablet Applications for Cost-Effective Training Options

Summer 2013 / **CST+ CBRNE Magazine** / **Tactical Defense Media**
A Strong Defense is Our Best Offense: ECBC Tests the Next Generation of Protective Equipment

Summer 2013 / **Army Chemical Review**
ECBC Partners with Universities for Advanced Research Initiatives

July 2013 / **CBRNe World**
U.S. Army Continues Efforts to Improve Detection at Fraction of Cost

July 2013 / **U.S. Army Acquisition Support Center (USAASC)**
Army Scientists Research new Technologies for Rapid, Accurate Detection Capabilities

August 2013 / **Food Science & Technology**
The Journal of the Institute of Food Science and Technology

FALL 2013

September 2013 / **Defense News**
DoD Developing Mobile Units to Neutralize Chemical Weapons Materials

September 2013 / **Smithsonian Magazine**
The Pentagon Just Built a Mobile Chemical Weapons Neutralizing Factory

September 2013 / **Army.mil**
Army Chemical Lab Earns Top Grade in Proficiency Test

2013 Accomplishments

FISCAL YEAR AWARDS

Baltimore Federal Executive Board Excellence in Federal Career Awards
In recognition for outstanding supervisor (GS-13 and above)
Gold & Silver / Dr. Peter Emanuel

In recognition for outstanding professional (Non-Supervisory)
Bronze / Peter Annunziato

In recognition for EEO (Diversity and Inclusion Award)
Silver / Barbara Hawk

In recognition for Rookie Employee of the Year
Silver / James Dallas Wright, Jr.

SELECT FISCAL YEAR TECHNICAL REPORTS

Semi-Automated Technique for Detection of Explosive Materials within Fingerprints on Novel Surfaces / February 2013
Classified report.
Steven Christesen, Augustus Way Fountain III, Jason Guicheteau, Phillip Wilcox

Decontamination of Emerging Threat Compounds: Physical Removal from Military-Relevant Materials / August 2013
Conducted an initial assessment of the STERIS modified Vaporous Hydrogen Peroxide Technology for the removal of an emerging chemical threat.
Teri Lalain, Brent Mantooth, Shawn Pusey, Matthew Willis

Particle Size and Concentration Characterization of Two Screening Obscuration Module Prototypes / August 2013
The particle size distribution characteristics of two prototype screening obscuration modules were evaluated in the ambient breeze tunnel facility.
Daniel G. Wise

Assessment of Law Enforcement Chemical, Biological, Radiological, and Nuclear Personal Protective Equipment Audible Signature / September 2013
Investigate the audible signature characteristics of multiple law enforcement CBRN personal protective equipment ensembles when worn with tactical law enforcement equipment.
Daniel J. Barker, Karen M. Coyne

Pilot-Scale Manufacturing of ZZAT for Chemical Filtration Applications / September 2013
Pilot-scale manufacturing of the noncarbon filtration material ZZAT (zinczirconium-argentums-triethylenediamine), which included the preparation of 10 individual 250-pound batches of filtration material.
William Feaver, Michael Knapke, Gregory Peterson, Joseph Rossin

R&T PUBLICATIONS

Photochemistry and Photobiology / February 2013
Inactivation of Pseudomonas aeruginosa by Direct Sunlight

G. Grote H.-J. Marschall B. Niederwöhrmeier Dr. J.-L. Sagripanti

Chemical Communications / March 2013
Removal of Airborne Toxic Chemicals by Porous Organic Polymers Containing Metal-Catecholates

G. Peterson

Journal of the American Chemical Society / April 2013
Striped, Ellipsoidal Particles by Controlled Assembly of Diblock Copolymers

K. Killops

Journal of Chemical & Engineering Data / May 2013
Ambient Temperature Vapor Pressure and Adsorption Capacity for (Perfluorooctyl) Ethylene, 3-(Perfluorobutyl) Propanol, Perfluorohexanoic Acid, Ethyl Perfluorooctanoate, and Perfluoro-3,6-dioxaheptanoic Acid

J. Buchanan T.G. Glover J. Mahle G.W. Peterson B. Schindler

Journal of Forensic Identification / June 2013
Sequential Raman Chemical Imaging and Biometric Analysis of Fingerprint for Rapid Identification of Threat Materials and Individuals

J. Guicheteau

Pathoadaptive Mutations in Salmonella Enterica Isolated after Serial Passage in Mice / July 2013
Identification of mutations in a collection of lineages of Salmonella enterica serovar Typhimurium that emerged in the populations following extensive serial passage of the strains in the mouse peritoneal infection model.

D. Andersson N. Anwar S. Broomall E. Fochler
H. Gibbons M. Karavis S. Koskiniemi A. Liem
P. McGregor L. McNew G. Ouellette M. Rhen
C. Rosenzweig L. Sandegren E. Skowronski

International Test and Evaluation Association Journal / September 2013
X-Ray Fluorescence Spectroscopy for Analysis of Explosive-Related Materials and Unknowns

E. Valdes

The Journal of Visualized Experiments / October 2013
Preparation of Hydrophobic Metal-organic Frameworks via Plasma Enhanced Chemical Vapor Deposition of Perfluoroalkanes for the Removal of Ammonia

J. Decoste G.W. Peterson

TECHNOLOGIES TRANSFERRED TO INDUSTRY

Sample Heater Assembly and Method of Use Thereof / October 5, 2012
Commercialization Partner / TrueTech, Inc..

Micro UV Particle Detector (TACBIO) / December 20, 2012
Commercialization Partner / Lighthouse Worldwide Solutions

Color Changing Polymer for Chemical Biological Threat & Pathogen Detection / April 16, 2013
Commercialization Partner / University of Maryland College Park Joint Ownership Agreement (JOA)

2013 Awarded Patents & Patent Licensing Agreements

2013 Fiscal Year Filings / 24 Invention Disclosures Filed / 20 Patent Applications Filed
17 Provisional Patent Applications Filed / 22 Patents Issued

RESEARCH & TECHNOLOGY DIRECTORATE

#8,278,495 / **System for Decontamination of Chemical Weapons Agents using Solid Sorbent with Liquid Decontamination Solution**

William R. Creasy, H. Dupont Durst, David J. McGarvey, Daniel Waysbort

#8,281,809 / **Aerosol Inlet Flow Modulator**

Lawrence J. Hyttinen, Daniel G. Wise

#8,309,029 / **Virus and Particulate Separation from Solution**

Charles H. Wick

#8,317,931 / **Nanotubular Titania for Decontamination of Chemical Warfare Agents and Toxic Industial Chemicals**

Alfred Kleinhammes, George W. Wagner, Yue Wu

#8,337,776 / **Closed-loop Waste Disposal System for Enhanced Safety**

Terrence G. D'Onofrio, Luis Enrique Faure, George Noya

#8,357,335 / **Colorimetric Assay for the Determination of Hydrolysis Activity from HD and other Halogenated, Oganics**

Joseph J. DeFrank, Steven P. Harvey

#8,367,327 / **Method for Simultaneously Detecting Multiple Biological Threat Agents**

Jose-Luis Sagripanti, Monica C. Zandomeni

#8,412,464 / **Methods for Detection and Identification of Cell Type**

Samir V. Deshpande, Jacek P. Dworzanski, Rabih E. Jabbour, Patrick E. McCubbin, Michael F. Stanford, Charles H. Wick, Alan W. Zulich

#8,454,224 / **Fomite Tumbler and Method of Transferring Biological Material**

Jerold R. Bottiger, Ph.D., Warren L. Gardner, William R. Sayers, Leslie I. Williams

#8,479,727 / **Enhanced Chemical/Biological Respiratory Protection System**

David M. Caretti, Stephen E. Chase, Corey M. Grove

#8,514,392 / **Spectrophotopolarimeter Sensor and Artificial Neural Network Analytics for Distant Chemical and Biological Threat Detection**

Jerold R. Bottiger, Arthur H. Carrieri, Jack Cooper, Kevin C. Hung, David J. Owens, Erik S. Roese

#8,524,482 / **Method and System for Sampling and Separating Submicron-Sized Particles Based on Density and or Size to Detect the Presence of a Particular Agent**

Charles H. Wick

#8,524,155 / **Virus and Particulate Separation from Solution**

Charles H. Wick

#8,530,719 / **Zirconium Hydroxide for Decontaminating Toxic Agents**

Gregory W. Peterson Joseph A. Rossin George W. Wagner

ENGINEERING DIRECTORATE

#8,342,337 / **Water Sampling Device and Method for Use with a Radiation Probe**

James A. Genovese Patrick M. Nolan

#8,347,685 / **Method and Device for Validating or Calibrating a Chemical Detector at a Point of Use**

Note / Funded by JPM NBC; inventors are NIST employees.

Jeffrey R. Anderson Pamela M. Chu

#8,365,804 / **Portable Inflatable Protective Partitioning System**

James A. Genovese Patrick M. Nolan Charles Ruppert Win Van Basten

#8,404,490 / **Detecting Nerve Agents and Determining the Types Thereof**

James A. Genovese Robin L. Matthews Kwok Y. Ong

#8,413,564 / **Portable Vented Suppressive Shield for Protective Tactical Emplacement Over Suspected Explosive Devices Fragments**

Stephen J. Comaty James A. Genovese Edward M. Rychwalski

#8,454,892 / **Chemical Agent Detection System for Fluid Media**

Stephen J. Comaty James A. Genovese Patrick M. Nolan Edward M. Rychwalski

#8,427,814 / **Mobile Power Distribution System**

Jeffery A. Gonce

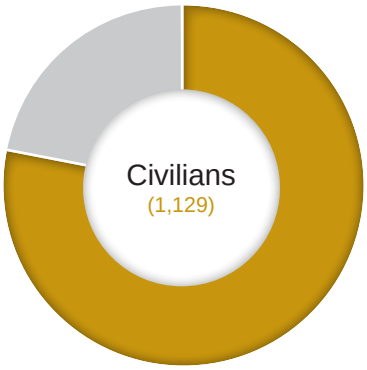
#8,465,606 / **Composition of Matter for an Incendiary Device and Method of Manufacture**

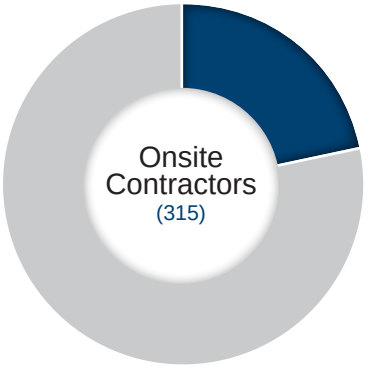
Gene V. Tracy David R. Redding

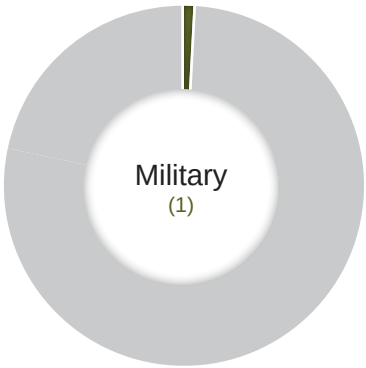
DIR OF PROGRAM INTEGRATION

2013 Workforce Figures

As of September 30, 2013







MANPOWER

Despite the challenges presented by today's fiscal environment, the U.S. Army Edgewood Chemical Biological Center (ECBC) continues to invest in its most valuable asset—its employees—by seeking new ways to support employee development and promote employee recognition. ECBC is familiar with leveraging creative and innovative solutions to support employees. With training dollars being cut, ECBC's Workforce Management Office (WMO) set out to find alternate funding sources for a number of workforce development initiatives. WMO championed efforts toward securing funds by applying for Section 852, Defense Acquisition Workforce Development Funds. This fund allows the Department of Defense (DoD) to recruit, hire, develop, train and retain its acquisition workforce.

One venture supported by these Section 852 funds was the renovation and transformation of an engineering laboratory into a computer lab designated as an acquisition learning center. The computer lab can be used by acquisition employees to complete required training to meet acquisition career field certification or continuous learning requirements to maintain their professional and technical proficiency. The Center's ability to offer a designated space for acquisition training is hugely important because nearly half of the ECBC population is in an Acquisition, Logistics and Technology (AL&T) position. Individuals within AL&T positions spend more than half of their job duty time in the planning, design, development, testing, contracting, production, introduction, logistics support and disposal of systems, equipment, facilities and supplies or services in support of the military mission.

1,445
Total Manpower

46
Average Age

17
Average Years of Service

Realizing the importance that business credits may have on career progression for some opportunities and the value of continuous learning, the WMO also used Section 852 funding to put into place an onsite four-course business credit series provided by Harford Community College. These courses included: Accounting Principles, Purchasing & Material Management, Principles of Marketing and Principles of Management. ECBC prides itself as being an organization that is more than 90-percent customer funded, which is unique within the DoD. Remaining competitive in this type of environment requires not only cutting-edge research and development, but also keen business savvy.

"We view professional development in a holistic way," WMO Supervisory Project Management Specialist Kim Hoffman said. "Traditional classroom training, coupled with experiential learning, can produce profound results. In fact, the Aberdeen Proving Ground (APG) Senior Leadership Cohort has accomplished that union and has provided a tremendous opportunity for folks to better understand our organizational story, create networks among colleagues and hone leadership skills." Participation in the APG Senior Leadership Cohort was the third initiative sponsored with Section 852 funding. The program is modeled after the Office of Personnel Management's Executive Core Qualifications. The cohort was created to build a self-sustaining leadership community among high-potential GS-14/15 and equivalent level managers at APG and to develop leaders as individuals within team and organizational atmospheres across the installation.

The final program supported by Section 852 funding was a four-part "Women in Science" speaker series in honor of Women's History Month. The 2013 theme, "Women Inspiring Innovation Through Imagination: Celebrating Women in Science, Technology, Engineering and Mathematics," allowed women in senior-level positions from the local and APG community, including Jill Smith, director of the U.S. Army Communications-Electronics Research, Development and Engineering Command (CERDEC), an opportunity to share their career accomplishments, lessons learned and wisdom with attendees ranging from junior level to higher.

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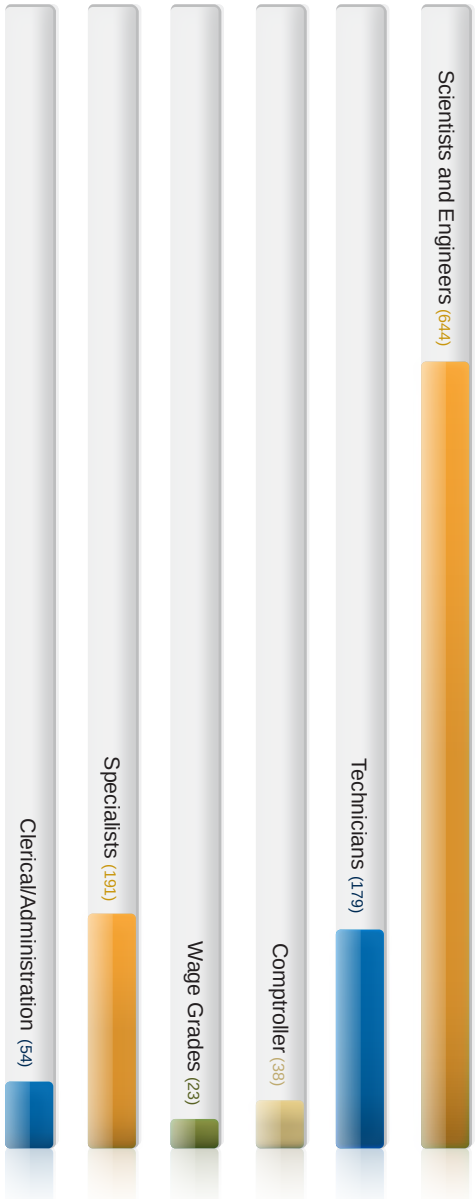
EXPERTISE
of Government Employees

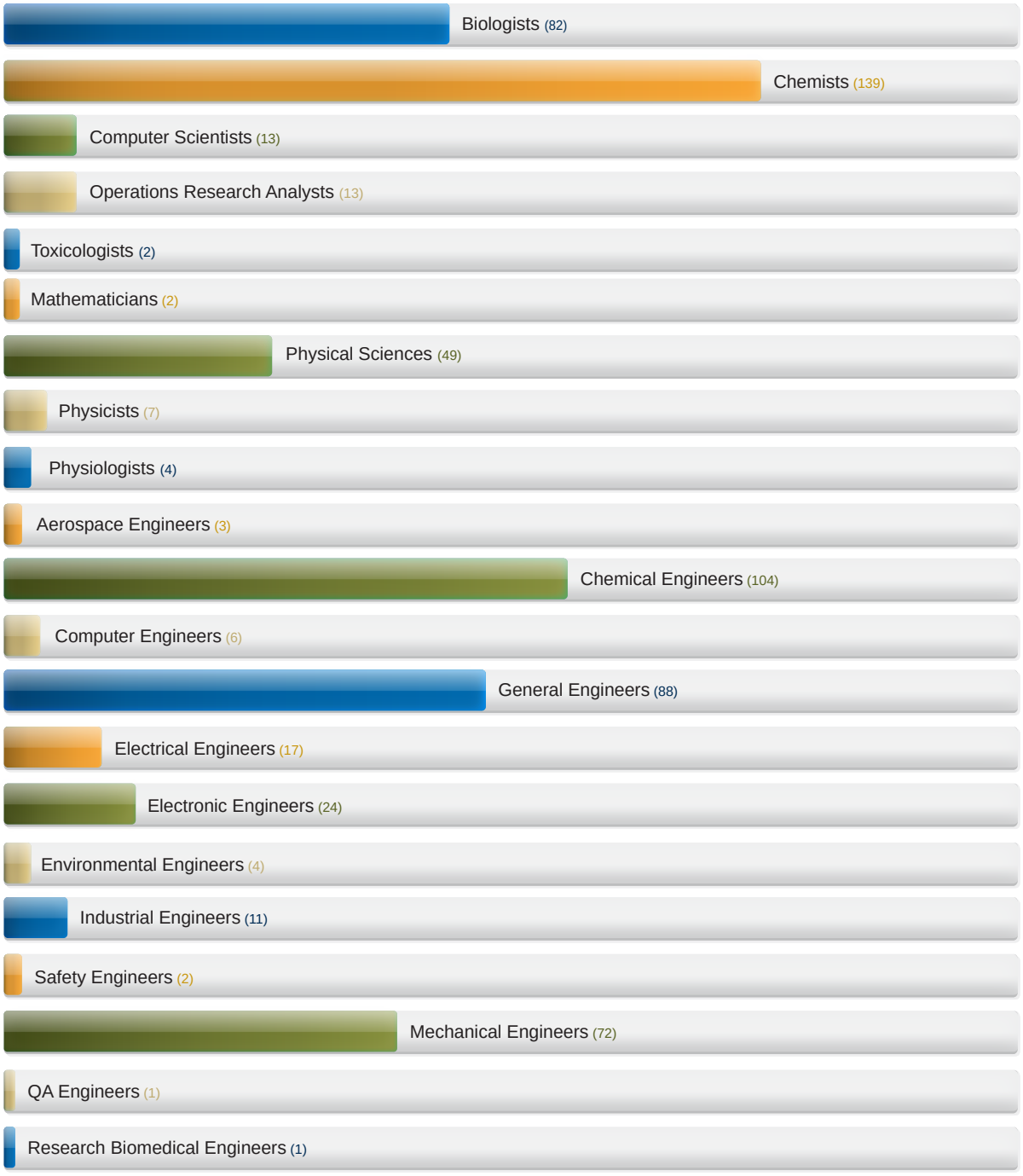


*Numbers are based on 1,129 civilians

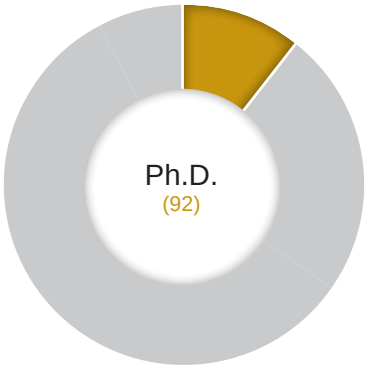
2013 Workforce Figures

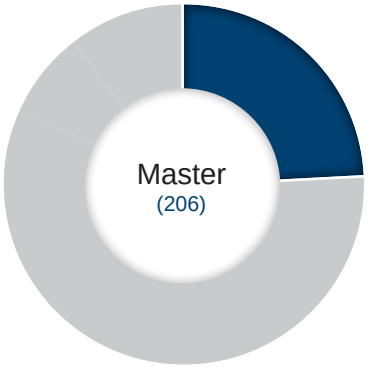
As of September 30, 2013

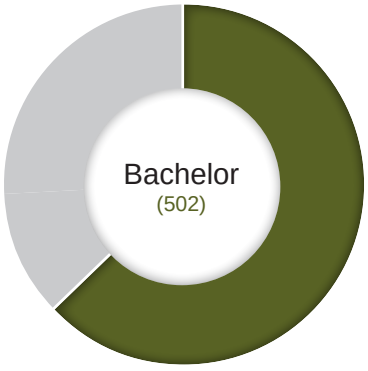
SCIENTISTS AND ENGINEERS*



*Numbers are based on 1,129 civilians







DEGREES
Held by Government Employees

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In addition to pioneering resourceful solutions in support of various training and professional development initiatives, WMO also re-engineered the Center's awards program to be more robust and resilient in light of current budget constraints. As a 2013 management objective, WMO enhanced the employee recognition program through greater marketing and consultations with supervisors by a dedicated awards program manager. WMO strategically implemented an awareness campaign including the development of key informational materials and projected timelines aimed at making the award application process more efficient and less burdensome. Although still early in its conception, honorary awards conferred rose by 50 percent compared to the same time last year.

Barbara Hawk, supervisory management and program analyst, describes not only the importance of increasing awareness of awards programs, but also choosing the right candidates to be honored.

"WMO has been dedicated to honoring employees across the Center for their excellence in technical proficiency, leadership excellence, involvement in minority programs and more," she said. "We ensure a diverse set of candidates are honored by conducting a targeted survey of the workforce to identify potential candidates based on the award criteria."

ECBC is committed to creating an environment where employees feel engaged and can fulfill their career goals while making a difference for the warfighter and nation.

"Ensuring support to employees across the Center—whether it is related to human resources, training or development—is of utmost importance to WMO," said Workforce Management Office Chief Mary Martinez. "We will continue to find creative solutions to bring more opportunities to our scientists, engineers, researchers and all sectors of the workforce."

EDGEWOOD
CHEMICAL BIOLOGICAL CENTER
A U.S. Army RDECOM Laboratory

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