

ARMY



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TECHNOLOGY

A publication of science and technology news from the
U.S. Army Research, Development and Engineering Command

Focus:
**SOLDIER
PROTECTION**

+PLUS

INTERVIEW WITH
**BRIG. GEN. PAUL A.
OSTROWSKI**
PEO SOLDIER

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FEATURES

- 3** **PROTECTING THE SOLDIER**
Brig. Gen. Paul A. Ostrowski, PEO Soldier, answers questions about a wide range of projects that will further increase Soldier protection.
- 5** **PIECE OF MIND**
Army, university researchers partner to study mild traumatic brain injuries. By T'Jae Gibson, ARL Public Affairs
- 7** **THE VIRTUAL DIMENSION**
To simulate blast effects on Soldiers, engineers redesign virtual models and manikins to more closely reflect operational realities. By Dan Desmond, TARDEC Public Affairs
- 9** **TECHNOLOGICAL OVERMATCH**
At AMRDEC, about 10,000 people deliver collaborative and innovative technical capabilities for responsive and cost-effective research, product development and life-cycle systems engineering solutions to protect Soldiers. The work provides Soldiers with capabilities designed to exceed those of America's enemies and enhance survival. By AMRDEC Public Affairs
- 11** **TESTED TACTICAL PROTECTION FOR SOLDIERS**
Army lab is laser focused on testing and ultimately fielding individual Soldier protection equipment. By Alexandra Foran, NSRDEC
- 15** **PROTECTING THE SOLDIER, PRESERVING THE NATION**
For 96 years ECBC has advanced the development of individual and collective protection equipment. By ECBC Communications
- 18** **NEW BOOTS**
When talking tactics, the talk always centers around boots on the ground. Here is the art and science of new footwear. By Bob Reinhart, USAG-Natick Public Affairs
- 19** **CONFORMAL BATTERY**
Less weight and more power is what every Soldier dreams of. By Dan Lafontaine, RDECOM Public Affairs
- 21** **ARMY SEEKS NEXT GENERATION OF PROTECTION**
Never satisfied with past successes, SPIE works to keep the American Soldier the best equipped in the world. By Doug Graham, Public Affairs, Project Manager Soldier Protection & Individual Equipment. By Debra Dawson, PEO Soldier Public Affairs
- 23** **SOFTWARE MODEL TESTS LETHALITY**
Software model tests lethality and maximizes smart weapon performance model. By T'Jae Gibson, ARL



The flame-resistant Army Combat Shirt is worn under the Interceptor Body Armor instead of the Army Combat Uniform or the Army Aircrew Combat Uniform jacket and standard-issue T-shirt, reducing bulk for Soldiers operating in extreme climates. Read more about how PEO Soldier seeks the next generation of Soldier protection gear on [Page 21](#).

On the cover: NSRDEC equipment designer Rich Landry displays the new individual first aid kit. Read more on [Page 11](#) (U.S. Army photo by David Kamm)

DEPARTMENTS

- 1** **ACRONYM GUIDE**
- 2** **DIRECTOR'S CORNER**
- 25** **NEWSBRIEFS**

ACRONYM GUIDE

RDECOM	Research, Development and Engineering Command
AMC	U.S. Army Materiel Command
AMCOM-LCMC	Life Cycle Management Command
AMRDEC	Aviation and Missile Research, Development and Engineering Center
ARL	Army Research Laboratory
ARDEC	U.S. Armament Research, Development and Engineering Center
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics and Technology
CERDEC	Communications-Electronics Research, Development and Engineering Center
ECBC	Edgewood Chemical Biological Center
NSRDEC	Natick Soldier Research, Development and Engineering Center
PEO Soldier	Program Executive Office Soldier
PM SPIE	Project Manager Soldier Protection and Individual Equipment
TARDEC	Tank Automotive Research, Development and Engineering Center
USAG Natick	U.S. Army Garrison Natick

Welcome to the premier issue of *Army Technology Magazine*. In this edition, we focus on Soldier protection. Our Soldiers are our most valuable asset. The articles in this issue will explore what the Army is doing, how it's working, and what Soldiers are saying.

We'll also look at what the Army has in mind for the Soldier of the future.

Most people have already read stories about our successes in this area without making the connection to our direct impact to protecting Soldiers.

It's easy to find stories about Soldiers coming home from our most recent conflicts who would have died in previous wars.

Behind the scenes of those stories are the untold tales of successful Soldier protection technologies developed by the U.S. Army Research, Development and Engineering Command.

America's smartest people are coming up with technology and engineering solutions for America's Soldiers.

I consider it an honor to work with these people and see the exciting research that's making our warfighters stronger, smarter and safer.

At RDECOM, we have six research, development and engineering centers—called RDECs—and the Army Research Laboratory working on technology and engineering solutions.

At Natick, Mass., our research center works closely with the U.S. Army Program Executive Office Soldier on uniforms and individual protective equipment.

In Detroit, our tank and automotive center works with PEO Ground Combat Systems and the TACOM Life Cycle Management Command to ensure Army ground vehicles are safe.

At Huntsville, Ala., our aviation and missile research center works with PEO Aviation and the AMCOM-LCMC doing the same thing for all Army aircraft.

Our chemical and biological center at Aberdeen Proving Ground, Md., works with the Joint Program Executive Office for Chemical and Biological Defense to develop protective equipment and sensors to mitigate chem-bio threats.

ARL at Adelphi, Md., is looking toward the future and considering advanced solutions in many fields to keep Soldiers safe.

We also have a center in Afghanistan with civilian engineers forward deployed, to respond to problems our Soldiers are having with their kit, that require immediate response.

This all adds up to an integrated approach that considers every scenario where a Soldier is in danger, and it doesn't end there. We partner with domestic and international officials, industry and academia to innovate Soldier Protection solutions.

It's working.

Our Soldiers are being saved by advanced materials in body armor. The designs of our new ground vehicles protect against improvised explosive devices. As we consider every potential danger, we develop innovative technologies and engineering solutions.

As we launch *Army Technology Magazine*, you should know that in the future we will showcase topics like cyber defense, robotics, power and energy and communications, just to name a few.

There are many exciting stories to tell about what our researchers and engineers are doing for America's warfighters.



Dale A. Ormond
Director, RDECOM

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Protecting the Soldier

INTERVIEW WITH BRIG. GEN. PAUL A. OSTROWSKI, U.S. ARMY PEO SOLDIER

Q: How would you describe the Army's commitment to Soldier protection?

Ostrowski: At PEO Soldier, we provide Soldiers with equipment that protects them in a variety of ways from a wide variety of threats. We protect Soldiers from a threat by making them more aware, lethal and survivable. We develop and field a variety of capabilities. They range from reliable and accurate small arms, to ballistic and environmental protection, to night vision optics, to situational awareness tools, and finally, to precision targeting devices. We design these capabilities to achieve battlefield overmatch when it comes to Soldier protection. They enable Soldiers to identify the threat, engage at a place and time of our choosing, and survive the fight.

We always seek innovative technologies to develop and acquire new and better equipment to protect our Soldiers.

Q: How does PEO Soldier partner with Army researchers, industry and academia to develop solutions that will protect Soldiers?

Ostrowski: PEO Soldier works very closely with the Research, Development and Engineering Command. We also work with the Defense Applied Research Projects Agency and academia on a regular and routine basis to further the development of capabilities that address operational gaps identified by our Centers of Excellence. These centers—including the Maneuver Center of Excellence, the Fires Center of Excellence, and the Maneuver Support Center of Excellence—draw from many data sources to identify the full range of doctrine, organization, training, leadership, materiel, personnel and facilities solutions to these given operational gaps. If the Army seeks a materiel solution, it is our mission to work closely with our inherent science and technology communities—as well as our industry partners—to develop, acquire, field and sustain capabilities to our Soldiers.

Brig. Gen. Paul Ostrowski, PEO Soldier, gives at briefing at Picatinny Arsenal, N.J., Sept. 20, 2012. (U.S. Army photo by Erin Usawicz)



Q: How confident are you in the progress that has been made in the last decade? What are your success stories?

Ostrowski: Over the course of the last 12 years, the Army ensured Soldiers have what they need to complete their missions successfully. As a result, we have been able to achieve remarkable advances in situational awareness, night vision and weapon optics, force protection systems, precision engagement tools, and remarkably lethal weaponry. All of this is unparalleled with respect to any other fighting force in history.

The Enhanced Night Vision Goggle is an incredible story. We expertly fused Image Intensifying capabilities with Thermal capabilities. This enables Soldiers to identify and accurately target known threats in all environments. While the Army has fielded Image Intensifying capabilities for quite some time, the ability to fuse Thermal with Image Intensifying means Soldiers can identify threats in zero light, dense vegetation or full-obscured environments. This is unlike anything Soldiers have ever been able to do in the past.

Our force protection capabilities are equally unparalleled. From head-to-torso protection, Soldiers have survived hundreds of engagements that in the past would have resulted in severe injury or death. In response to the growing threat of improvised explosive devices, we were able to leverage the great work of our United Kingdom allies and RDECOM and provide the new Pelvic protection System. It has already saved lives. It protects Soldiers pelvic area by reducing blast penetrations of dirt and fine debris, and from fragmenting munitions and larger debris.

The hard armor inserts in the body armor protect the Soldier against the threats we designed them to stop.

The Common Remotely Operated Weapon Station saves Soldiers' lives by allowing them to operate weapon systems from inside the protective armor of an armored vehicle.

The new XM2010 Enhanced Sniper Rifle allows Soldiers to engage the enemy with greater accuracy and from longer distances than before.

From the helmet to the sole of a Soldier's boots, the equipment developed by PEO Soldier is superior to what the Army



The AN/PSQ-20 Enhanced Night Vision Goggle provides increased capability by incorporating image intensification and long-wave infrared sensors into a single, helmet-mounted passive device. The ENVG combines the visual detail in low light conditions that is provided by image intensification with the thermal sensor's ability to see through fog, dust, and foliage that obscure vision. This thermal capability makes the ENVG, unlike earlier night vision devices, useful during the day as well as at night. The ENVG allows Soldiers to rapidly detect and engage targets because it permits use of existing rifle-mounted aiming lights. (U.S. Army photo)

fielded a decade ago. This ensures Soldiers are the best in the world and the U.S. Army is without peer.

Q: In these times of fiscal uncertainty, what priority goes to the Army's investments in Soldier protection?

Ostrowski: The Army puts the Soldier first no matter what the fiscal climate happens to be.

Q: What is your vision for the future?

Ostrowski: We are working hard to decrease the Soldier load and reduce power consumption while also increasing capabilities. Over the last 12 years, we have provided remarkable targeting, force protection and situational awareness tools to Soldiers. However, it has come at a huge cost in Soldier load. We are committed to working both evolutionary and revolutionary approaches to address Soldier load and reduce the weight of all Soldier capabilities in innovative ways.

Q: Many Soldiers are alive today thanks to the work you and your folks accomplish by

fielding gear designed to protect Soldiers. What do you have to say about that?

Ostrowski: It is a team effort. We remain absolutely committed to, and dependent on, both our organic research and development facilities and our Industry Partners. Together we push the limits of technology to provide dominate force protection to Soldiers.

Earlier this month, we returned a side armor insert to retired Sergeant 1st Class Bryan Wagner. He is now an assistant dean of students with the Wounded Warrior Project. Several Explosively Formed Penetrators hit his up-armored Humvee in 2007. He suffered serious wounds and eventually lost a leg. The EFPs vastly overmatched his side plate. However, it still managed to stop a penetrator that would have been fatal. We conducted forensics research to see how the plate stopped the penetrator and what we can learn from it for future protective equipment. Bryan was nearly speechless when PEO Soldier Command Sgt. Maj. Emmett Maunakea returned that damaged side plate to him. Soldiers like Bryan are why we work so hard on Soldier protection. We want to bring all the Bryans back home. ■

Piece of Mind

Army, university researchers partner to study mild traumatic brain injuries

BY T'JAE GIBSON, ARL PUBLIC AFFAIRS

Even though research has significantly advanced individual Soldier protection in recent years, the U.S. military is working hard to fully protect Soldiers' most delicate organ—the brain—from detonation shock waves that cause structural brain abnormalities believed to result in mild traumatic brain injury.

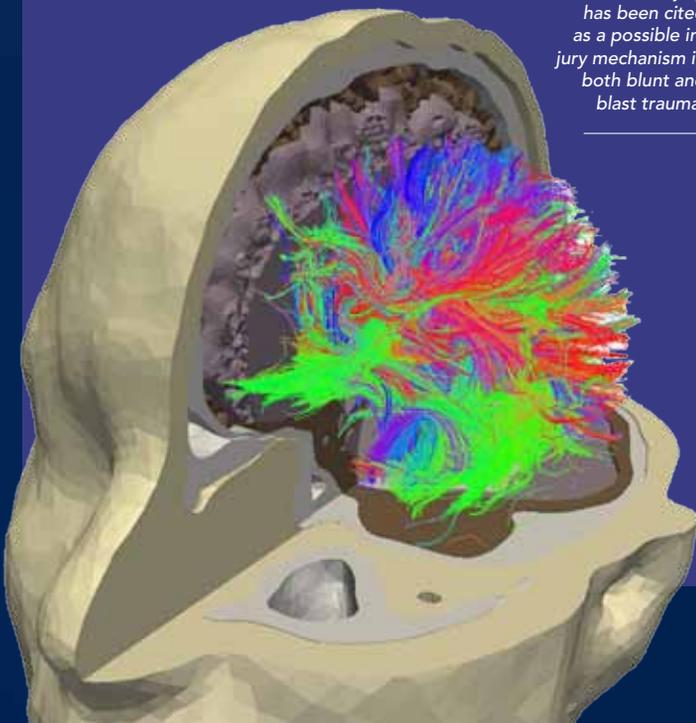
Researchers at the U.S. Army Research Laboratory and several top American universities are advancing studies in blast events to understand exactly how mild traumatic brain injury occurs. This information could then lead to helmets designed to fight this threat.

The Department of Defense recently reported that more 273,000 servicemembers have been diagnosed with traumatic brain injury since 2000. More than 6,000 of those cases were reported in the first quarter of 2013, and the Army accounts for the largest number of cases.

Mild traumatic brain injury is difficult to detect noninvasively, said Amy Dagro, an Army biomedical engineer at Aberdeen Proving Ground, Md. She said it's the type of ailment that patients and doctors don't know exists until it's too late.

To tackle this problem, Army and university researchers are taking an interdisciplinary approach that involves close studies of slices of rodent brains, and combines blast physics, neuroscience and computational modeling to find answers.

Diffuse Axonal Injury has been cited as a possible injury mechanism in both blunt and blast trauma.



NEURONAL NETWORKS: UNDERSTANDING THE BRAIN

The brain is the centerpiece of the human body's nervous system. It's very soft—kind of like tofu—and in adult humans, it weighs on average of 3 pounds. It's also composed of an estimated 80 billion to 120 billion neurons, or nerve cells. These nerve cells have three parts: the dendrites, cell body and the axon. Dendrites are structures on the nerve body that act like cables in that they conduct signals to the cells, which are then emitted by the neuron through the axon.

In the white matter of the brain, neurons align to form "axonal bundles." This fiber tractography can be obtained from patients with Diffusion Tensor Imaging, a type of MRI technique that tracks the diffusion of water molecules in the brain and allows the visualization of the fibers.

While DTI gets the medical community closer to being able to detect mild TBI, so far, the medical community at large hasn't been able to adopt a structured, repeatable standard to do this. Modern medicine has only gotten far enough to consistently detect mild TBI post mortem.

ARL research, however, is attempting to fill that gap.

Dagro's research is focusing on axonal injuries, the rapid stretch of axons in the white matter that causes neuropathologic changes to the brain tissue resulting, at worse, in unconsciousness and persistent vegetative state after head trauma. This injury also has appeared in some cases of mTBI.

"We calculate the strain that's happening in the direction of these fiber bundles," she said, using a 3-D fiber-informed Finite Element model of the human head she and colleague Justin McKee developed to provide physics-based predictions of tissue and axonal damage. "Modeling the axonal injury that occurs in the brain provides a means to relate an insult, or injury from a ballistic event, football tackle or blast wave for example, to a cellular injury mechanism."

Novel algorithms they created read "every single one of the fibers from the DTI data," and assign the elements in the ARL-developed model. "Since everyone's brain is wired differently, everyone has a different structural network and different fiber tractography, so it is important to take this into consideration when trying to predict injury," she said.

High-performing computers within ARL's Supercomputing Research Center enable advanced capabilities to run simulations to capture computationally the way the brain moves inside the skull under blast events

since it is able to perform massively parallel finite element simulations with millions of elements.

"We're using finite element modeling to try and computationally capture traumatic brain injury," Dagro said. "We're trying to link these macro scale blast events to damage on the micro scale.

"ARL's research has entered uncharted territory in that we're attempting to computationally capture the diffuse axonal injury that's happening within the brain. This calculation has not been done before."

She said ARL's computational models link how strain, stress, pressure—all mechanical input parameters—relate to cellular death, for example, "and with that, we're able to inform a network model of the brain and see how the structural model of the brain is getting changed. And in the end, this will actually lead to more knowledge in structure function coupling in the brain.

"So as you increase the cellular death that's going to actually affect the structural network of the brain, which will ultimately lead to a disruption in the communication in the different regions of the brain," she said.

"There's still question as to whether or not this diffuse axonal injury can happen just because of a blast wave. We believe that it is happening at a later stage in the blast wave when the head undergoes some kind of rotation."

STUDYING THE BRAIN, ONE SLICE AT A TIME

Research partners at the University of Nebraska are examining the effects of blast waves on a human head with and without a helmet through multi-scale experiments and simulations looking at combat helmets, the skull and the brain. They're also studying the impact of shock waves on animal brains, one slice at a time.

"We have used a lot of animal models, especially rodents like mice and rats, and also pigs to expose them to similar conditions to see what neurological damage they have. We have found that under minimal conditions—two mach pressures for example, which is like 4 or 5 pounds of C4 at 8-meter distance—you do find that there are some effects that have shown neurological deficits in those animals," said Dr. Namas Chandra, immediate past director, Trauma Mechanics Research Initiative, and Elmer-Koch Professor of Engineering at the University of Nebraska-Lincoln. In July, he was named professor of biomedical engineering at the New Jersey Institute of Technology.

UNL is regenerating precise field IED conditions from inside their Blast Simulation Laboratory, which relies on a university-engineered shock tube that focus on the simulation and measurement of blast waves.

"Right now, if somebody says they have a better helmet, there is no direct way to test that it is really doing what it is supposed to do. Our facility can uniquely be able to test and show if the claim is correct or not. So any changes we're interested in making on the helmet design can be verified, validated and then applied onto the field," Chandra said.



Dr. Namas Chandra



Dr. David Meaney

By understanding what causes brain injuries, are helping to mitigate or eliminate the problem.

"The current helmet was designed against penetrating bullets," Chandra said. "In order to redesign the helmet, we really need to know what causes the injuries so it easily becomes the predictive capability that will be driving the research."

Research partners at the University of Pennsylvania expect their studies into the neurobiology and neuronal communication changes following blast events will shed new light on the mechanics behind mild TBI.

"Most of our work in this partnership involves recreating the blast waves but in a cell culture dish rather than in an outside environment," said Dr. David Meaney, Solomon R. Pollack professor and chairman of bioengineering at the University of Pennsylvania.

One of the standard ways in neuroscience to study circuitry, in isolation instead of a living animal, is to take a suspension of cells and plate them onto a surface.

"The surface is set up in such a way so that the cells can connect; the neurons can connect and form these in-tact networks," Meaney said. "For us, that's really our common platform to probe how a single mechanical force or repeated application to the same force can affect a circuit that we're now imaging."

At the University of Pennsylvania, researchers have the ability to image the activities of these neural circuits that are living neural circuits in a culture dish on a microscope using advanced imaging techniques to actually identify the electrical activity of each of the neurons seen throughout the network.

"Because we can do that, we can literally reconstruct the connections the neurons make among themselves in a dish of neurons," Meaney said. "By doing that, we can then probe if a mechanical force is applied to the circuitry, which part of the circuit starts to disconnect or change."

Duke University experts are leveraging blast physics expertise to other team members on proper loading conditions and set up shock tubes at each of the university sites. Columbia University is conducting blast experiments on brain slices and examines cellular death thresholds.

Dr. Barclay Morrison, a Columbia University researcher, developed empirical functions that relate mechanical input to cellular death. With these empirical functions, researchers can use the mechanical response found in the finite element simulation to predict the damage occurring at the cellular level.

His recent work looks at how incident pressure and the duration of the wave relate to cellular death. In the future, these thresholds will be enhanced to allow for an estimate of how changes in structure lead to changes in function.

Together, with ARL, researchers are aiming to answer the big question: "What part of the blast wave is causing the primary mechanism of TBI?"

"Our goal is to primarily help our Soldiers in the field. As you know things have changed. We are facing a lot of asymmetric warfare with explosions caused by improvised explosive devices and the intensity and type of variation is continuing to increase and the Soldiers are subjected to these traumatic injuries. Our overall goal is to help them mitigate and probably solve the problem if possible," Chandra said. ■

Dr. David Meaney is the Solomon R. Pollack professor and chair bioengineering at the University of Pennsylvania.

Dr. Namas Chandra is the immediate past director, Trauma Mechanics Research Initiative, and Elmer-Koch Professor of Engineering at the University of Nebraska-Lincoln. In July, he was named professor of biomedical engineering at the New Jersey Institute of Technology.

The Virtual Dimension



Fully equipped Soldier models are close to real thing

BY DAN DESMOND, TARDEC PUBLIC AFFAIRS

Soldiers embarking on a mission in a ground vehicle often carry a vest full of gear and secure themselves in the seat with a safety harness. But modeling and simulation engineers have been unable to conduct computer-aided studies showing Soldiers wearing all their personal protective equipment. Similarly, engineers conducting laboratory blast tests did not have manikins wearing the full supply of Soldier gear either.

To remedy these shortfalls, TARDEC engineers have been working with other Army research agencies, plus academic and industry partners, to redesign the

virtual models and manikins that engineers use in survivability studies. The ability to accurately represent the fully geared and encumbered (buckled in) Soldier is expected to result in better predictability for Soldier safety and lower risk of severe injury in vehicles involved in underbody blasts.

In modeling and simulating labs, Army designers who needed a virtual adult male have been relying on a generic software manikin named Jack for about 18 years. Jack isn't even shown wearing civilian clothes. But the newly developed virtual Soldier model—created by

measuring real men and women at Army installations—increase what designers call biofidelity with more realistic shapes, postures and positioning while seated. The upgrade has already dramatically changed Occupant Centric Protection design studies at TARDEC.

Jack could not reflect the way a fully equipped Soldier's posture changes when seated in a military ground vehicle or the variability caused by different sizes of female and male Soldiers. TARDEC has been working with its government, academic and industry partners in the Automotive Research Center based at

the University of Michigan to develop a new virtual Soldier featuring true-to-life dimensions combined with the effects of being “encumbered”—that is, secured in safety equipment in a combat or tactical ground vehicle.

The updated virtual Soldier model is based on measurements from more than 300 enlisted men and women at Army installations to account for physical changes in circumference and constraints with full equipment on. The updated model allows engineers to improve Soldier safety and survivability, its lead researcher explained.

“The path forward to increased safety is modeling and simulation,” said Dr. Matthew Reed, a research professor at the University of Michigan Transportation Research Institute. “It all starts with being able to simulate a human in all variations. We can now study the space claim that results from a Soldier’s body with all their equipment over them. Those factors weren’t available before. For the first time, we’ll be able to quantify accurately the additional effects produced by the width of the protective equipment and all their gear, wearing two different ensembles representing a rifleman and a SAW [Squad Automatic Weapon] gunner. This information is already being used at TARDEC for advanced vehicle layout.”

The Warrior Injury Assessment Manikin will get a similar makeover. Researchers used body landmarks and surface-scan data from 126 Soldiers heighten the accuracy and physical dynamics in blast testing with dummies. Experimenting with manikins reflecting accurate three-dimensional body shapes and joint locations expands designers’ ability to improve vehicle design and enhance survivability. Teams are testing a first-generation model and will follow up with more tests and a new version in 2014.

This next-generation test manikin also incorporates medical research that provides truer measurements to predict skeletal occupant injury during underbody blast events. These leaps forward in safety evaluation play a critical role in the broader effort to re-establish the way military developers design vehicles.

A TARDEC Ground System Survivability team is creating new Occupant Centric Design standards to build a vehicle layout beginning with the Soldier in the driver’s seat and configure systems and protection



A U.S. Soldier with the 2nd Stryker Brigade Combat Team buckles into the driver's seat of a Mine-Resistant, Ambush-Protected vehicle simulator. Wearing gear and a seat belt changes a Soldier's posture in a vehicle. Researchers are redesigning virtual Soldiers for military modeling and simulation studies to accurately reflect those details. (U.S. Army photo by Sgt. Christopher McCullough)

around him. GSS is engaged in a Technically Enabled Capability Demonstration that will help predict driver and crewmember positions and visualize the way Soldiers conduct missions in vehicles. Engineers will also help factor in the “eyellipse” — the principles that optimize driver sight lines from his vantage point inside the vehicle.

GEARED TOWARD ACCURACY

Reed presented the study’s results at the last two ARC program reviews, which took place in May and June in Ann Arbor, Mich. The research team measured 309 Soldiers (including 52 female Soldiers) using a combination of computerized tools and manual input to locate landmarks on shoulders, spines, knees and other bones.

“In the long run, we want to use these data to revamp vehicle design specifications in the Army standards. This is 35 years behind what civilians are doing in passenger car, light truck and commercial vehicle studies,” Reed said. “We actually want to jump ahead of what’s being done in civilian vehicles and use three-dimensional models to define new design standards.”

TARDEC engineers have been using Jack in vehicle designs since the mid-1990s. The team processing data in the studies stressed that survivability in conflict areas is the No. 1 motivation, but comfort and safety will also improve when the software tools accurately represent the Soldier’s space claim.

“Now our designers will know how much space we’ll need to allow for the encumbered Soldier,” said Stacy Budzik, TARDEC engineer. “Nobody had the ability to cover a [computerized] model with gear and now we can do it with a wide range of body types too.”

In a blast situation, particularly an explosion under the vehicle, the force produces a pressure wave, and Soldiers in the path of that energy are put at risk of head, back, lumbar and pelvic injuries.

“We think using these data to appropriately design vehicles and position models will help improve vehicle seat designs and will protect a much larger percentage of Soldiers,” Reed said.

Results will likely be integrated in commercially available tools and are already being used in TARDEC’s internal design and assessment software. ■

TECHNOLOGICAL OVERMATCH

**AMRDEC delivers
Soldier protection**
BY AMRDEC PUBLIC AFFAIRS

At AMRDEC, about 10,000 people deliver collaborative and innovative technical capabilities for responsive and cost-effective research, product development and life-cycle systems engineering solutions to protect Soldiers.

The work provides Soldiers with capabilities designed to exceed those of America's enemies and enhance survival.

MITIGATING THE AFFECTS OF DEGRADED VISUAL ENVIRONMENT

Flying a helicopter through rain, fog or cloudy conditions is challenging and dangerous, so a team of U.S. Army engineers have taken on the challenge to research ways to make flying in degraded visual environments easier and safer for rotorcraft pilots.

In July 2012, the Army initiated AMRDEC's Rotorcraft Degraded Visual Environment Mitigation Program to execute a synchronized, collaborative effort to assess and address the problem of degraded visual environment.

Degraded visual environment, or DVE, is defined as reduced visibility of potentially varying degree, wherein situational awareness and aircraft control cannot be maintained as comprehensively as in normal visual meteorological conditions and can potentially be lost.

According to Todd Dellert, an experimental test pilot and lead of the Rotorcraft DVE Mitigation Program, over the past 10 years DVE contributed to 87 rotorcraft accidents, 108 fatalities and more than \$880 million in material losses. Many of these accidents were due to operations in "brownout" conditions, where helicopter-induced dust clouds result from downwash of the rotor system.

But DVE is more than just brownout. Other factors are smoke, rain, smog, sand and dust, clouds, darkness, fog, snow and flat light.

Dellert said the team's mantra is "Own the Weather," which means the pursuit of material solutions to not only allow safe and efficient rotorcraft operation, but also to expand the capability of commanders

to deploy their rotorcraft aviation assets when the weather is well below visual meteorological conditions minimums.

Army officials view potential DVE mitigation system solutions as comprised of three pillars: improved flight controls, sensors and cueing.

Improving existing flight controls systems and/or laws and handling characteristics will assist the pilot in managing workload when vision or situational awareness is challenged or obscured. Sensor technologies will allow "see-through" capability when DVE conditions are encountered. And symbology, aural or tactile cueing will provide information to the pilot reference aircraft state and potentially guidance for executing a mission task such as landing and take-off.

The Rotorcraft DVE Mitigation Program includes the AMRDEC Aviation Applied Technology Directorate, AMRDEC Aeroflightdynamics Directorate, AMRDEC System Simulation and Development Directorate, and CERDEC's Night Vision and Electronics Sensors Directorate.

Through analysis, simulation, ground and flight test, Dellert said stakeholders on the team are exploring the trade-space involved to assist PEO Aviation in making informed decisions on future material upgrades and potential programs of record. The capstone of the program will be demonstration flights at Yuma Proving Ground in fiscal 2016.

"The AMRDEC Degraded Visual Environment Mitigation Program is oriented toward examining the combinations of technologies required that will give Army rotorcraft pilots the advantage on the battlefield," Dellert said. "In total, this integrated three pronged approach to a Degraded Visual Environment system solution is aimed at increasing aircrew safety and survivability while also helping to provide them every conceivable tactical and operational advantage."

THE SOLDIER PROTECTION LAB

For a day, AMRDEC and Redstone Test Center created a forward operating base spanning Redstone Arsenal's Test Areas 3 and 6.

An MV-22B Osprey with Marine Medium Tiltrotor Squadron 365 lands in brown out conditions during routine missions July. Osprey and other helicopter pilots face these types of landings every day as they support ANSF and NATO forces across the Helmand and Nimroz Provinces in southern Afghanistan. It takes all of the pilots and crew chiefs to successfully land in these conditions as they have to determine how close the ground is and ensure there are no obstacles through the billowing dust. [U.S. Marine Corps photo by Gunnery Sergeant Steven Williams]



The two organizations worked side-by-side to enable a live fire capability demonstration on behalf of Colonel Brett Barraclough, the Integrated Base Defense Trail Boss and the Joint Project Manager Guardian, to demonstrate the value of integrating various force protection and response capabilities into a common operating picture.

During the demonstration, a complex attack on the FOB was conducted using live, virtual and simulated methods to replicate enemy direct fire from multiple locations and a vehicle borne improvised explosive device at the FOB's entry control point.

"The IBD live fire Exercise demonstrated the effectiveness of integrating an interoperable family of systems—including access control, persistent surveillance, remote weapons, unmanned vehicles, and unattended ground sensors—utilizing a Serviced Oriented Architecture, to enable a FOB Battle Captain to defeat a compound, complex insurgent attack," said James Head, lead systems engineer at AMRDEC's Soldier Protection Lab.

In all, over 15 systems participated in the demonstration.

To enable an integrated common operating picture in the base defense operations center, streaming video and data were provided by the Combat Outpost Surveillance Force Protection System, nicknamed "Kraken;" the Raven, small unmanned aircraft system; unmanned ground vehicles; base expeditionary targeting and surveillance system-combined, or BETSS-C, rapid aerostat initial deployment tower, Cerberus mobile tactical surveillance system, and force protection suite.

Supporting the FOB's defense was the AMRDEC-developed containerized weapon system with which role players engaged ground targets.

Attendees included senior representatives from four program executive offices, 12 project management offices, the Force Basing Trail Boss, Office of Naval Research, U.S. Border Patrol, Army Test and Evaluation Command and supporting industry partners.

Barraclough addressed the AMRDEC-RTC team at the end of the day, and said "You have exceeded all my expectations today."

AMRDEC's Soldier Protection Lab supports force protection acquisition lifecycle through research, development, and engineering; integration, verification and validation; training, installation, and maintenance; and technical evaluation studies.

"Our goal at the SPL is to provide the soldier with rapid, dependable engineering solutions that support their mission and allow them to be proactive instead of reactive," said Jim Head, senior engineer and manager, SPL, System Simulation Development Directorate.

In December 2008, U.S. forces in Afghanistan posted on a remote forward operating base approximately 10 kilometers from the Pakistan border identified two suspicious vehicles through their partially installed base expeditionary targeting and surveillance systems-combined. At this time, the PM-FPS installation team had just begun their work, and only two long-range thermal imagers from the Force Protection Suite had been installed. These cameras, along with the RAID tower, were the only surveillance capabilities available to the FOB Commander at the time.

The FOB commander suspected the two vehicles were transferring weapons, hidden amongst the common goods they were passing



An MH-60 Blackhawk helicopter lands at a remote landing zone in Shah Joy district, Zabul province, Afghanistan. Helicopters provide coalition special operations forces an efficient and reliable means of transporting personnel and cargo in rural areas of Afghanistan. [U.S. Navy photo by Mass Communication Specialist 2nd Class Jon Rasmussen]

between the trucks. The two vehicles completed their transfer and then departed in opposite directions. The base defense operators were able to track the vehicles simultaneously with the two LRTIs and ascertain hostile intent without having to deploy their quick reactionary forces.

Mission accomplished—Soldiers protected.

"The work your team has done here at the Soldier Protection Lab has saved lives," said Lieutenant Colonel Chris Lackovic PM-Force Protection Systems.

EXTENDED AREA PROTECTION AND SURVIVABILITY INTEGRATED DEMONSTRATION

The Office of the Deputy Assistant Secretary of the Army for Research and Technology initiated a technology development program for a next-generation counter-rockets, artillery and mortar system that could provide greater lethality across an expanded area of coverage, as well as reduce the footprint and logistics burden including cost, size and transportation requirements.

AMRDEC is leading this program, the extended area protection and survivability integrated demonstration, in which concepts are being developed and demonstrated in near-tactical configurations. AMRDEC is developing missile intercept technologies, and the Armament Research, Development and Engineering Center is developing a gun-based solution. The program will improve the acquisition, track, discrimination, engagement, and defeat of RAM threats through missile-based and gun-based technology development and ultimately be transitioned for use by the Indirect Fires Protection Capability Increment 2-Intercept.

CONCLUSION

"The Army has global responsibilities that require large technological advantages to prevail decisively in combat—'technological overmatch,' if you will. Just as airmen and sailors seek supremacy in the air and on the seas, Soldiers must dominate their enemies on land. Modernizing, especially as end strength is reduced, is the key to ensuring that the Army's dominance continues," said Army Chief of Staff Gen. Raymond T. Odierno. ■

TESTED

Tactical Protection for Soldiers

BY ALEXANDRA FORAN, NSRDEC PUBLIC AFFAIRS

When the average person thinks about Soldier protection, body armor is one of the first things that come to mind. Yet, most people cannot imagine the challenges that come with making better, lighter, stronger body armor or the fact that there are several more pieces of equipment that have to be researched, tested and approved before they reach Soldiers' hands. The scientists and engineers at the U.S. Army NSRDEC know these challenges all too well as they face them every day in their labs when testing and ultimately fielding individual Soldier protection equipment.

U.S. Rep. Niki Tsongas, of Massachusetts, said in a public address this year that, "[Natick is] the only installation of its kind in our system in our nation, which treats the Soldier as a system. The indispensable role that Natick plays in supporting our service personnel is on display in Afghanistan, as it was in Iraq. It's so instrumental in preparing Soldiers for almost any environment they encounter."

Sgt. 1st Class Adam Adams is thoroughly familiar with the environments that Soldiers encounter after four combat mission deployments to both Afghanistan and Iraq. On his most recent deployment to Afghanistan, he was part of a RDECOM Science and Technology Acquisitions Corps Advisor team he gained an invaluable perspective from Soldiers before returning to NSRDEC this May as the senior combat liaison noncommissioned



Don Lee of the Natick Soldier Research, Development and Engineering Center's Headgear Thrust Area, is looking at football helmet technology that could one day help protect Soldiers in the field. (U.S. Army photo by David Kamm)

officer for the Operational Forces Interface Group, which conducts Soldier evaluations on equipment.

Adams' first-hand experience as an infantryman, serving as a senior technology advisor interviewing Soldiers at forward operating bases and contingency operating bases looking for gaps in capabilities or problems with certain pieces of equipment, will serve as a guide and testament to the work done at Natick.

BLAST/BALLISTIC PROTECTION

"I've seen Soldiers shot in the body armor and never break stride. They didn't know that they were even shot until after a gunfight," said Adams, who was shot with a round to the chest in 2003 and survived thanks to his body armor. "My gunner took three rounds atop of his truck, and if it hadn't been for the body armor that was developed here, he would certainly be dead."

Carolyn Westmark is the division chief of the Personal Protective Technology Division and her team's number one challenge is to provide ballistic protection that is equivalent to or better than current systems, but at a reduced weight. Additionally important is designing more comfortable body armor.

"Another major challenge is developing a better understanding of what happens to the Soldier and his or her protective equipment during a blast event," Westmark said.

During these efforts teams often develop cross-disciplinary partnerships with other teams at NSRDEC such as the Anthropometry Team, Biomechanics Team and Modeling and Simulation Team.

A notable recent achievement is the development of an alternate body armor vest design for smaller Soldiers, especially female Soldiers. Additionally the team improved the ability to model the movements of the human body, allowing the design

of more comfortable and better fitting armor, and creating better models to estimate the degree of protection afforded by alternative armor designs.

A few recently developed test methods, which NSRDEC works on with its Army and DoD partners, include a new method of evaluating blast interaction with the Soldier's torso-borne personal protective equipment and methods of assessing the flexibility and durability of fragment protective armor.

"I can honestly say there is no greater reward for your work than having a Soldier whose life was saved by a technology or product you worked on come up and shake your hand and thank you. It's why we do what we do...it's as simple as that," Westmark said.

Developments have been made at stages for higher strength ballistic fibers, improved transparent materials for combat eye protection, prototype mandible attachments for protection of a Soldier's face and jaw, initial concepts for ballistic protective knee and elbow pads, and reduced weight concepts.

"When you look at the plate and you see how it worked and how it prevented worse injury, you just have a lot of respect for what the guys were doing here," Adams said. "All the times you complain about it being heavy and uncomfortable, when you see it actualized like that, on your buddies and on yourself, it puts it in a good context and really focuses the mind as to what the good people at Natick are doing to develop stuff to protect you. Body armor is pretty near and dear to the heart as an infantryman."

MEDICAL PROTECTION/AID

"Over the course of me being there for six months we were

Joining with academia

Natick, UMass Lowell work together for Soldiers

BY BOB REINERT, USAG-NATICK PUBLIC AFFAIRS

In early 2013, scientists and engineers from Natick Soldier Research, Development and Engineering Center joined faculty and student researchers from the University of Massachusetts Lowell in a new research and development initiative at the UMass Lowell campus.

Known as "HEROES"—Harnessing Emerging Research Opportunities to Empower Soldiers—the effort will feature collaborative research projects aimed at Soldier survivability, sustainability, mobility, combat effectiveness, and quality of life in the field. More protective outerwear, body armor and equipment are expected to be among the areas of focus.

"We will bring together some of the best minds from both organizations to brainstorm new solutions to challenges that our men and

women in uniform face," said UMass Lowell Chancellor Marty Meehan. "We're going to be able to, in this collaboration, help our troops and clearly save lives."

NSRDEC and UMass Lowell will share facilities in the venture. In Lowell, NSRDEC scientists and researchers will occupy 5,000 square feet of workspace at Olney Hall that includes laboratories, offices, conference rooms and a "think tank" area. Meanwhile, such unique Natick facilities as the Doriot Climatic Chambers will be made available to UMass Lowell faculty and student researchers.

"We see it as a two-way street," said Jack Obusek, Ph.D., Natick Soldier Systems Center senior manager and NSRDEC director. "The research is wonderful. We're going to create new technology, we're

going to transition it, but we're really, at Natick, about those sons and daughters and protecting them.

This is the first project under a new agreement between the University of Massachusetts System and NSRDEC to facilitate research and development initiatives.

"You can do so much more together than you can all by yourself," said UMass President Robert Caret. "The outcome is really economic vitality and quality of life, both for our military personnel and for the man and woman in the street in the Commonwealth of Massachusetts."

HEROES is of particular interest to Lieutenant Governor Tim Murray, head of the Commonwealth of Massachusetts Military Asset and Security Strategy Task

Force, who has visited Natick several times.

"You understand instantaneously how the work that they are doing can protect and save lives," Murray said. "And these people take this work very seriously, because they understand."

U.S. Representative Niki Tsongas, of Massachusetts, called the effort a "commonsense collaboration between two strong entities, and I really look forward to what comes of it. [Natick is] the only installation of its kind in our system in our nation, which treats the Soldier as a system. The indispensable role that Natick plays in supporting our service personnel is on display in Afghanistan, as it was in Iraq. It's so instrumental in preparing Soldiers for almost any environment they encounter."

able to address the systemic need for Soldiers needing more class 8 (medical equipment) as well as addressing the individual medic's need for reduction of load and enhanced ability to modularize equipment and that was a huge win for the medic community," Adams said.

Some major gaps were able to quickly be filled by NSRDEC, specifically with the oversight of Rich Landry, individual equipment designer with the Load Carriage Prototype Lab and John Kirk, senior engineer for load carriage Product Manager Soldier Clothing and Individual Equipment.

Examples during Adams' science and technology

advisory deployment were the new Individual First Aid Kit and the Improved Modular Medical System (IMMS) for combat medics. Both of these pieces of equipment increase the amount of Soldier protection on the battlefield, with the IFAK supplying each Soldier with double the amount of vital medical aid while easing access to supplies and the IMMS giving the combat medics a more compact system with which to carry critical aid equipment and more options on how they can configure their load module.

"Those [IMMS] bags are so well-received. You live and die by your medic, 'doc' is a big deal,"

Adams said. "We make sure doc's got what he needs and squared away. It's a very close relationship you have with your infantry combat medic and 'doc' is a big deal."

"As a senior infantryman I was elated to see that Natick was able to do something for the combat medic," Adams said. "That was a huge win for Natick, they should be very proud of what they did."

VISION PROTECTION

"Eye protection has come a long way; the Army realized that that is the show-stopper. If you lose your vision doing anything,

nothing's going to happen," Adams said. "There was a huge push for eye protection, gloves and things like that. Some of the smaller stuff that we take for granted."

The primary function of protective eyewear for the Soldier is ballistic fragmentation protection, but the ability to see and engage targets is also critical. One of the biggest challenges is maintaining ballistic protection while adding additional features such as improved abrasion resistance and antifogging technology to the lens.

"Over the past several years we have been developing a new generation of optical

components based on innovative developments in molecular and nanoscale materials that are capable of controlling light in new ways," said Brian Kimball, research physicist for the Nanomaterials Science Team. "The technology is being developed for use in the NSRDEC Soldier Vision Protection and Enhancement Program, with a primary goal of providing the Soldier with a transparent, single-lens vision system that will eliminate the need for the current, multi-lens kit."

Eyewear has to withstand whatever environments and hazards Soldiers face, as well as eye protection from lasers, ultraviolet light and bright sunlight. During day and night, proper light transmission and color recognition must also be maintained.



ENVIRONMENTAL PROTECTION

"If [equipment] doesn't feel good, it's not going to be worn as much," Adams said about gear for Soldiers.

Steve Fossey, a materials research engineer, looks to apply fiber and textile technologies to solve problems related to protection as part of the Nanomaterials Science Team of the Fiber and Materials Physics Division of WarSTAR.

"We look to apply multi-component fiber spinning to problems of Soldier protection," Fossey said. "Recently we have been working on fibers for a new kind of thermal insulation, one that will adapt to changes in the environment."

The concept is simple, the materials will provide insulation when it is cold and less when it is warm, yet designing and spinning a strong enough fiber is a complex task. After much work, Fossey and his team were able to apply for a patent on the way

to optimize fiber bending. While the fiber design and spinning was done at Natick, an industrial partner will be turning those fibers into a fleece.

"We have made both fleeces and battings (like those used in parkas or sleeping bags) that extend the useful temperature range of clothing items," Fossey said, with the future hope that a single jacket design will be able to be utilized across various environmental locations.

FUTURE PROTECTION

"The Army has come a long way in 12 years," Adams said. "They say that wars advance technology and medicine, and it certainly has. We are kitted immensely better than we were in say 2003, we are so much better and a lot of that has to do with the efforts of the different RDECs and particularly NSRDEC as the focus of everything that touches a Soldier's skin is done here."

The future of the Army is ever-changing, and NSRDEC

remains as versatile as ever to support Soldiers' needs.

"At NSRDEC we take great pride in being the lead organization for protecting the Soldier," Kimball said. "We have a narrowly defined range of science and technology objectives: Our mission is the Soldier."

NSRDEC's unique set of requirements is based on the human system platform that is the foundation of its mission.

"We are first and foremost public servants who value the privilege of being trusted with protecting America's sons and daughters serving in the Military," Kimball said. "We are honored and humbled by their service, bravery and dedication, which provides inspiration and challenges us to pursue science and technology solutions that will enhance their safety, comfort and effectiveness.

"Just like our Soldiers, regardless of the challenge, we are driven to succeed by the importance of our mission." ■

Many Soldiers personally attest to protection from Natick that saved their lives. In an exclusive interview with CBS Boston's WBZ TV station Staff Sgt. Brian Scott, who is currently serving in the 344th Military Police Company in Afghanistan, said, "It was the advanced combat helmet that saved my life and that was designed here (at Natick)." (U.S. Army photo by David Kamm)

The Special Tactical Assault Team Element of the Maryland State Police test their Millennium masks in the corn oil chamber at ECBC's Protection Factor Testing Facility. (U.S. Army photo)

PROTECTING THE SOLDIER, PRESERVING THE NATION

BY ECBC COMMUNICATIONS

From individual to collective protection, ECBC at Aberdeen Proving Ground, Md., has advanced the development of equipment for 96 years by working safely with chemical and biological agents in research, engineering and operations for the Department of Defense and the nation.

The gas mask has been the most proven chemical defense for Soldiers since World War I, when more than 3 million protective masks issued to U.S. forces. As warfare modernized, the center expanded its mission to include protection against biological materials. Protective equipment evolved to include respirators, filtration systems and barrier materials that provide a level of safety between individuals and contaminants.

FROM THE TRENCHES TO THE DESERT: THE NEXT GENERATION OF SOLDIER PROTECTION

A blinding flash of light pierces the sky. Several seconds later, a launched projectile

reaches its target: a unit of American troops. Smoke blurs the landscape as other munitions explode in the air and on the ground. More flashes, choking gas and a sharp odor of sour milk lingers in the air. One officer dives to the bottom of the trench and begins to scream. Two other Soldiers run to his aid and try to adjust his respirator before donning their masks. The screaming man is carried out of the area, but soon dies; the two others are left severely injured.

These Soldiers were among the 85 casualties and eight deaths suffered by U.S. forces on February 26, 1918, when the German army fired approximately 250 phosgene and chloropicrin projectiles against American troops near Boise de Remieres, France.

It was the beginning of World War I and the first time the U.S. Army had been introduced to chemical warfare. Since this era, ECBC has made it its mission to better protect Soldiers. The center is part of the U.S. Army Research, Development and Engineering Command, which develops technology and

engineering solutions for America's Soldiers.

Imagine another scenario sometime in the future: The atmosphere is hot and humidity is near 100 percent. American Soldiers are in unfamiliar landscape wearing full combat gear, including a helmet and mask that covers their entire head.

The protective gear is suffocating in the heat and sweat pours as they run, climb and crawl through enemy territory. Suddenly, a fan turns on inside the mask, bringing the relief of soothing air across their faces underneath the tight-fitting protective gear. In the event of a chemical or biological attack, there would be no screaming or the need to adjust equipment. Everything would be cool. All Soldiers would be safe.

DESIGNING COMFORT FOR THE 21ST CENTURY

The center is designing concepts for the next generation of chemical, biological, radiological and nuclear respirators by embedding

a fan within the mask's filtration system that brings vital relief to Soldiers.

The system uses less power, weighs less and is more compact than traditional powered-air purifying respirators that use a hose to connect the face mask to a blower unit and battery pack attached to the Soldier's hip or back. Instead, mini-blower technology pulls air in through the filtration system on the side of the mask and sweeps 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 facepiece, preventing potential outside contaminants from entering the mask should there be a break in the seal.

This novel next-generation air-management system will improve Soldier comfort when performing simulated, operationally relevant activities such as crawling, running, rifle exercises and combat maneuvers. Able to maintain effectiveness during demonstrations that collect real-time data, this technology will enhance mask protection factors, thermal sensations and overall comfort.

This isn't the first time ECBC has addressed comfort concerns while maintaining the effectiveness of protective gear. The center's individual protection teams focuses on the sustainment and fielding of the M40 mask, Joint Service General Purpose and the Joint Service Aircrew Mask. Initiated in 1999 when ECBC provided a new mask design for the DoD flight crews, the JSAM program addressed comfort, thermal, thirst, bodily waste and claustrophobia issues for the warfighter during Operations Desert Shield and Desert Storm.

Since then, Don Kilduff, program manager for the JSAM Apache mask system, and Jon Sampson, the deputy for the



The Special Tactical Assault Team Element of the Maryland State Police test their Millennium masks in the corn oil chamber at ECBC's Protection Factor Testing Facility. (U.S. Army photo)

JSAM Rotary Wing mask system, have been working on a new design that allows flight crews to don and dock their masks in-flight without removing their helmets. A removable face plate that can easily attach and detach from the hood mitigates many of the comfort and functionality issues.

The Army started the Apache program in 2007, and the JSAM has undergone several redesigns, with a new mask anticipated to be fielded in 2014.

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

ECBC provides an improved product within a manageable

budget by using rapid prototyping capabilities that allow the teams to perform weight, space and compatibility assessments of the model assembly. From there, the Army is able to test the equipment using several state-of-the-art onsite facilities that provide the data that advanced designs in protective gear will ensure the safety of Soldiers from chemical or biological threats.

UNPARALLELED TESTING CAPABILITIES AND CUSTOMIZED TRAINING

ECBC uses 26 test chambers that replicate environmental conditions to ensure military equipment such as backpacks, masks and detectors can withstand any natural elements.

The chambers include temperature and humidity, salt, fog, sand and dust, solar radiation, altitude, rain, and harsh hot and cold conditions—with temperatures

ranging from negative 60 degrees to 300 degrees Fahrenheit.

Army researchers also use shock, vibration, and rough handling testing to simulate travel of equipment in a steady state, transient vibration or loose cargo tests.

ECBC offers testing services to organizations both within and outside of the center. The Protection Factor Testing Facility is designed to qualitatively evaluate chemical protective capabilities of personnel protective equipment. To simulate exposure to chemical and biological agents, test subjects don their masks and are exposed to corn oil aerosol, which has a mass mean particular size that replicates various agents like anthrax.

"With the corn oil chamber we measure the ratio of the chamber concentration versus whatever concentration gets inside the mask, resulting in a PF number. So, if the mask is properly fitted



A dust test at one of the environmental chambers in ECBC's Environmental and Field Branch evaluates the seal of the Joint Service General Purpose Mask. (U.S. Army photo)

and working correctly, no aerosol gets inside the mask and a large PF number is generated," said Steve Yurechko, protective factor test team leader. "Protection factor is the pass/fail criteria for a mask."

"Each mask has a minimum PF associated with it that it should meet when somebody wears it correctly. That's what we verify here."

The assessment includes 10 one-minute exercises designed to stress the mask's ability to seal the subject's face. These exercises include actions like normal breathing, deep breathing, sighting the rifle, reaching for the floor and ceiling, facial expressions, and moving the head in different directions.

During protection factor testing, ECBC personnel are able to measure particular concentration levels in real-time and troubleshoot observed anomalies on the spot.

FILTER SYSTEMS AND FACILITY PROTECTION IN THE FIELD

ECBC has more than 70 years of experience in development, testing and application of collective protection systems, including building protection projects that have occurred on more than 100 facilities in the United States and abroad.

The center has a team specializing in the protection of people. It focuses in three major areas: sustainment of legacy collective protection equipment, support to active acquisition programs, and support to protected fixed-site facilities. Each heavily focuses on fielding and maintenance of various collective protection systems, such as protective filtration systems incorporated into the heating, ventilation and air conditioning system of a protected building.

"If there was an attack, these filters are there to protect the

people," explained John Clayton, Collective protection Sustainment and Fixed Site team leader. "The systems filter incoming air and provide overpressure in the protected space. As pressure is increased, air travels from the protected area to the contaminated area through any leaks, so we don't have to worry about absolutely sealing every leak point. This results in protected space for work and relief from wearing IP equipment."

To ensure the efficacy of these systems, the team also conducts semi-annual leak tests and periodic surveillance involving removal and tests of filters to analyze degradation and predict when they should be replaced. These tests indicate how well the system is performing; some systems use hundreds of individual filters.

If the filters need to be replaced, the team coordinates with TACOM to order replacements and conduct change outs—an

area of growth for the team, Clayton said. An Interagency Agreement is in review to provide support to the State Department Bureau of Overseas Buildings.

The team is currently working with the Chemical Biological Radiological Filtration Branch to develop new filtration technologies, including work on new absorbents to address a change in threat. Jerry Young, a collective protection team member, is working with the branch to develop the Rapid Filter Protection Assessment Tool, which is a smartphone app that will assist users by estimating filter life in given potential field scenarios.

"We execute against user requirements, leverage what they develop, and work to field the technology," Clayton said. He also noted that customers within the Joint Project Manager-Protection have expressed interest in the new absorbent technologies with the hope of being transitioned into a more advanced mask series.

By reorganizing the collective protection and individual protection teams, ECBC provides a unique blend of seasoned engineers to apply their expertise and collaborate in order to solve customer's most complex protective equipment problems.

SHAPING THE NEXT GENERATION

ECBC has protected American forces from the threat of chemical and biological weapons for more than 96 years. With current scientific knowledge and proven test beds, the center continues to provide CBRNE protection for future Warfighter. From individual to collective protective gear, ECBC has the experience to test new technologies and train personnel in order to shape the next generation of protective equipment against tomorrow's threats. ■

Putting New Boots on the Ground

Three new styles are now being evaluated at the National Training Center putting new boots on the ground.

BY BOB REINHART, USAG-NATICK PUBLIC AFFAIRS

What it all comes down to is keeping Soldiers' minds on their missions in Afghanistan, rather than on their feet.

That's how Ben Cooper views the development of the Hot Weather Mountain Combat Boot at NSRDEC, which began in spring 2011. Cooper thought it was so important that he got permission to continue working on the boot after leaving the Footwear Performance Laboratory at NSRDEC to become a senior materials engineer for the Air Force, still situated at Natick, Mass.

"Ben was so involved in the early phases of this and had been really running this project superbly, I thought that it was a good idea that he was able to continue on this project," said Bob Hall, the current Army footwear engineer.

"Obviously, in these fiscal times, being able to join together and work toward a common goal for the warfighter and for our country, I think, is the most important thing," Cooper said. "My supervisors have been very supportive about me taking time to help out and support the Army with this effort, and we're all happy to do it."

"The Air Force has been a team player in this," he continued. "It's a sister service—one team, one fight."

Cooper and Hall are working with Program Executive Office Soldier and Product Manager Soldier Clothing and Individual Equipment to unveil phase two of the boot. Phase one—a lighter, more breathable version of the popular Mountain Combat Boot—has been issued to every Soldier deploying to Afghanistan for the past year. As many as 200,000 pairs of the boots have been fielded with great success.

"[For] the amount of boots that are out there, we've had very, very few complaints," Hall said.

"Soldiers will give you honest feedback," Cooper said. "We haven't heard bad things. In this business, silence is a great thing."

"We were trying to develop and identify the salient characteristics of a Hot Weather Mountain Combat Boot," Cooper said. "Since it was a new item, it's not commercially available. We evaluated three different material solutions at that time from three different manufacturers."

Using Soldier feedback from phase one, which included requests for more breathability, Cooper and Hall confidently strode into phase two.

"We cherry-picked the very best features on each of the boots, and we provided that feedback to industry," Cooper said. "They responded and provided new solutions, updated solutions."

Each boot is nearly a half-pound lighter than the original mountain boot.

"Due to Afghanistan's unique climate and environment, they needed a boot that not only would provide them ankle stability and traction and durability, but they also needed greater breathability," Cooper said. "It's a



Ben Cooper (left) and Bob Hall have been working on the development of phase two of the Hot Weather Mountain Combat Boot at Natick, Mass. (U.S. Army photo by David Kamm)

balancing act. We were constantly walking that fine line. I think that we have worked with industry tirelessly on trying to make sure that we accomplish exactly what the warfighter wants and needs."

Industry made the boots more breathable by including moisture-wicking linings, perforating the leather, and inserting textiles wherever possible between the leather and rubber, without compromising stability.

"It took some creative approaches to be able to do that," Cooper said. "If you're kicking rocks, and you're crawling, and you're in the prone position, you need to be able to not have this thing rip."

Cooper recently traveled to Fort Irwin with Chris King, of the Operational Forces Interface Group at Natick, to collect data from Soldiers on the 285 pairs of boots that had been issued to them.

"We're going to go meet them as soon as they get out of the box at NTC," Cooper said. "I think the phase one boots were fairly well received. We would expect to find more positive feedback. We're hopeful that we're going in the right direction."

The goal is a technical specification for a boot that could be supplied by any manufacturer. When it's achieved, said Cooper, it will be because of the "collaborative atmosphere" at Natick.

"I think that's just part of the culture that is here, and I'm proud to be a part of that," he continued. "We were able to leverage all the resources that we have available to us." ■

Christopher Hurley, CERDEC electronics engineer, demonstrates how batteries seamlessly fit into a Soldier's gear. (U.S. Army photo by Conrad Johnson)



CONFORMAL BATTERY

BY DAN LAFONTAINE, RDECOM PUBLIC AFFAIRS

The U.S. Army is developing a battery to improve Soldiers' agility on the battlefield while meeting the demands of an increased power burden stemming from new networked electronic devices.

The Conformal Wearable Battery, or CWB, is flexible and integrates into a Soldier's body armor. It conforms to the body, which Army officials say is a significant upgrade to traditional batteries that are rectangular and bulky.

RDECOM and PEO Soldier partnered to fulfill the requirements of today's networked Soldier with the CWB.

ERGONOMIC BATTERY INTEGRATED INTO UNIFORM

Developing a battery that fits seamlessly into a Soldier's uniform was one of the project's priorities, said Christopher Hurley, an electronics engineer who leads the battery development projects team at CERDEC.

"Our role is to develop smaller, lighter, cost-effective power sources," Hurley said. "Providing a wearable, ergonomic, comfortable footprint is key. [We took] that big, bulky battery and made it conformable and more comfortable to be worn by the Soldier."

The CWB provides more power, reduces the need for battery re-charging and spares, and serves as a single source of power for all worn electronic devices, Hurley said.

Hurley said the Army's standard batteries, the BA-2590 and BA-5590, were designed to be placed in battery boxes and large communication equipment and not to be worn by the Soldier to power his electronics.

The CWB, however, is made specifically to be worn within a tactical vest, said Steve Mapes, product director for Soldier Power within PEO Soldier's Project Manager Soldier Warrior.

"[The conformal battery] allows the Warfighter to share space with other equipment that he has to carry on his load carriage,"

Mapes said. "A traditional 2590 or 5590 does not share space on the body armor. It requires its own committed space on the load carriage.

"When you slip a conformal battery into the protective vest and over the [Small Arms Protective Insert] plate, it's virtually invisible and transparent to the Soldier. Now the Soldier can still hang his magazine, grenades or flashlight over the battery. The conformal battery allows the Soldier to share valuable, limited real estate."

SINGLE SOURCE OF POWER

Hurley and his fellow CERDEC engineers have developed six CWB prototypes since 2008. During each iteration, the goal has been to demonstrate a battery that is smaller, lighter, provides longer-lasting power and eliminates the need for a separate battery for each electronic device, he said.

"We look to reduce a Soldier's load with the number of batteries [Soldiers] carry and

consolidate that into as few batteries as we can," Hurlley explained. "The conformal battery is a centralized power source for all the things that a Soldier needs to carry—GPS, smartphone, radio, other electronics, [and] eliminate the extra batteries for each individual item."

"No longer do you need to carry extra radio or GPS batteries," he continued. "You only need to carry spares for the conformal battery."

CERDEC accomplishes these advancements through experimenting in the laboratory with different chemistry formulations that yield a high-energy, high-power battery that is safe, Hurlley said. The target is a battery that enables 72 hours of continuous operation.

MEETING NETWORKED SOLDIERS' POWER REQUIREMENTS

The Army's conventional batteries can no longer handle the power demands for worn devices such as Nett Warrior, a handheld tool that provides situational awareness and mission command capabilities, Mapes said.

These networked systems are always sending and receiving data, similar to leaving a cell phone on during a flight. They continuously search for a signal, which rapidly drains the battery.

"The introduction of 'Soldier in the network' brings with it an unprecedented level of capability and amount of power consumers that are worn on the individual warfighter," Mapes said. "You have a power burden that has never before been imposed upon Soldiers, particularly the small-unit leaders. The traditional power strategy for the individual warfighter was fast becoming impractical and irrelevant."

SUPPORT THROUGH DEFENSE ACQUISITION CHALLENGE

Mapes said the Defense Acquisition Challenge Program, or DAC, helped the Army accelerate the battery's progress and ultimately deliver them to Soldiers sooner. DAC provided a portion of the project's funding from 2010 to 2012.

"DAC allowed us to take samples earlier for testing and validation," Mapes said. "[We received] preliminary Soldier feedback so we could make some immediate improvements on the battery and get a more production-representative version out to the formations. We leveraged everything we could to accelerate



U.S. Army standard batteries, such as the BA-2590 and BA-5590 developed by CERDEC, were designed to be placed in battery boxes and large communication equipment and not to be worn by the Soldier to power his or her electronics. The Army designed the Conformal Wearable Battery specifically to be worn by a Soldier within a tactical vest. (U.S. Army photo by Conrad Johnson)

tests, user feedback, exposure of the battery to the formation."

"Bottom line, we wouldn't have had the batteries available to go through these tests and get the Soldiers to use and evaluate them had it not been for these earlier efforts," Mapes continued.

The Department of Defense established DAC in 2003 in response to a Congressional mandate for a program that was innovative, flexible, competitive and affordable to integrate mature technologies into the acquisition cycle.

The Office of the Secretary of Defense Comparative Technology Office evaluates the proposals and selects candidates for funding. The RDECOM Global Technology Integration Team manages the program for the Army. DAC was funded through fiscal year 2012.

BENEFITS OF ARMY R&D CENTER

Hurlley emphasized that working with an Army research, development and engineering center includes complete program management—development, prototyping, engineering support, in-house testing and evaluation.

"Not only do we have the expertise of developing batteries and other power sources, but we also understand how these come

together in a Soldier network for something like Nett Warrior," Hurlley said. "We understand the integration and how the battery marries up with the other Soldier-borne electronics."

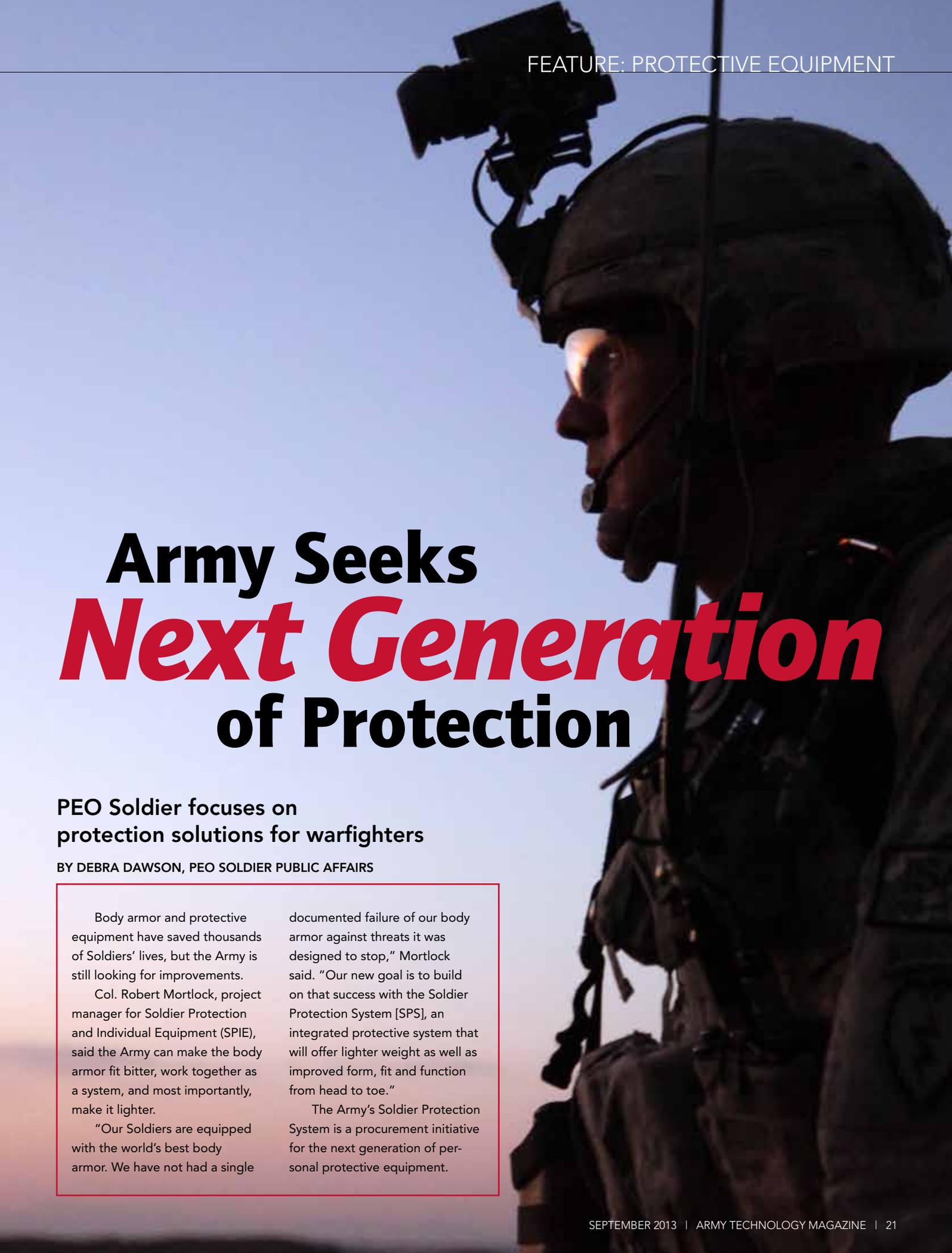
"Our lab is different because we develop complete products. We do not develop a single component. We are a product-oriented organization."

FUTURE OF CONFORMAL BATTERIES

PEO Soldier and CERDEC have taken the CWB to large Army demonstrations and exercises such as the C4ISR Network Modernization, Army Expeditionary Warrior Experiment and Network Integration Evaluation. These tests allow the organizations to capture Soldiers' feedback that will shape future versions of the battery.

Mapes said the battery will make a significant improvement in Soldiers' missions.

"We have already realized gains in the area of Soldier load and reduction in the numbers and types of battery. I'm very encouraged by the feedback. I don't have to sell it. I find myself in the pleasant position of not having to convince Soldiers that they need this. They're requesting it. It's very gratifying," he said. ■



Army Seeks *Next Generation* of Protection

PEO Soldier focuses on protection solutions for warfighters

BY DEBRA DAWSON, PEO SOLDIER PUBLIC AFFAIRS

Body armor and protective equipment have saved thousands of Soldiers' lives, but the Army is still looking for improvements.

Col. Robert Mortlock, project manager for Soldier Protection and Individual Equipment (SPIE), said the Army can make the body armor fit better, work together as a system, and most importantly, make it lighter.

"Our Soldiers are equipped with the world's best body armor. We have not had a single

documented failure of our body armor against threats it was designed to stop," Mortlock said. "Our new goal is to build on that success with the Soldier Protection System [SPS], an integrated protective system that will offer lighter weight as well as improved form, fit and function from head to toe."

The Army's Soldier Protection System is a procurement initiative for the next generation of personal protective equipment.

“Because heavy burdens affect Soldier mobility and endurance, the Army is working hard to lighten the Soldier’s load,” Mortlock said. “To do this without sacrificing protection, we are relying on new materials, high tech and improved engineering.”

The SPS includes helmets, ballistic eye protection, body armor, pelvic protection and protection of extremities.

The gear will be designed to address threats to Soldiers that include conventional fragmenting munitions, small-arms ammunition and blunt impact.

Unlike present components, which may be complementary, but are not integrated to augment their capability, SPS equipment will be designed to work together and meet three criteria: modularity, scalability and tailorability.

Modularity means all SPS equipment will be made to be easily rearranged, replaced, combined or interchanged to fit mission needs—working together as a system.

Modularity will make the SPS scalable. Combining or changing components will allow Soldiers to easily upgrade or reduce protection based on an assessment of enemy threats.

Scalability will make SPS equipment mission tailorable. Soldiers will be able to upgrade or modify their body armor to make it suitable for a particular mission or threat environment.

For example, Soldiers on long-range patrols might trade some protection for lighter weight to allow them to travel farther. Others may choose to add armor or adapt their armor coverage for particular missions.

Today, Soldiers use the Improved Outer Tactical Vest or the lighter Soldier Plate Carrier System. With SPS, Soldiers would have a single vest that could be modified.

In addition to meeting the criteria of modularity, scalability and tailorability, SPS protective equipment will offer enhanced form, fit and function and lower weight. Additional sizes, including designs to fit women, will allow Soldiers to select the protective equipment that provides them superior mobility, comfort and defense against enemy threats.

WEIGHT REDUCTION

By using advanced fibers, improved ceramics and optimized integration techniques, Army officials are looking to reduce body armor weight by 10 percent by 2015. Weight reduction of 15 percent are possible.



A U.S. Soldier on patrol in Afghanistan depends on Interceptor Body Armor for added protection. (U.S. Army photo)

The SPS torso protection vest will be substantially lighter than the present IOTV.

The Army is also looking for lighter materials for helmets. The goal is to have helmets that provide enhanced protection with a 5 to 15 percent weight reduction.

The Enhanced Combat Helmet, developed jointly with the U.S. Marine Corps, has ultra high-density polyethylene construction provides 35 percent better ballistic and fragmentation protection than the standard Advanced Combat Helmet, yet it weighs substantially the same as the existing helmet.

Soldier protection seeks additional improvements in pelvic protection and ballistic eye protection. It protects against bullets, blasts, fragmentation, fire and water.

All SPS equipment will be manufactured from flame-resistant materials, and the system is exploring a passive flotation capability that will function as a life preserver.

All SPS gear will undergo intensive user evaluations. Human factors engineering and Soldier integration events will gather Soldier feedback on critical internal and external interfaces. This integration feedback will be used to tweak developmental subsystem designs to ensure acceptance of the SPS.

The SPS program will also harness advanced electronics to enhance Soldier protection.

The Army is currently fielding a Gen II Helmet Sensor, which records forces exerted on

a Soldier’s head by blasts, vehicle accidents or other traumatic incidents to help medical personnel learn more about detecting and treating traumatic brain injury.

The SPS envisions an integrated sensor capability to detect and record forces exerted on the Soldier’s body and head, and possibly monitor a Soldier’s health.

The SPS may also use advanced capabilities to provide Soldiers with hearing protection without degrading their ability to hear what is going on around them.

In July 2013, PM SPIE’s chief scientist, Dr. James Q. Zheng, visited Aberdeen Proving Ground, Md., to witness testing of how the ARL is integrating ceramic, composite and novel adhesive treatment technologies in the development of Enhanced Small Arms Protective Inserts. The prototypes are 10 percent lighter than current protection systems in use by Soldiers. Army officials said this is a “significant step forward” in meeting PEO Soldier’s SPS goals.

“Soldier Protection is our passion at PM SPIE,” Mortlock said. “Many of us have been in theater. We have friends and family who have either been in, or are heading into harm’s way so we have a personal stake in this program.”

“All of us at PEO Soldier are working hard to ensure that Soldier Protection System ensures the American Soldier continues to have the best protective equipment in the world and that it will be as light as possible.” ■

Software Model Tests Lethality

BY T'JAE GIBSON, ARL PUBLIC AFFAIRS

Military analysts now have a tool that brings together unprecedented modeling and simulation features to help them better choose, or build weapons to overpower future threats.

Such features allow military researchers to analyze, for example, how a grenade, artillery round or any other weapon performs—or falls short—against moving targets in complex battlefield scenarios, which is one of the biggest challenges the military faces today.

With this information, researchers say, Army leaders can identify future technology investments early on, whether that is modifications to existing weapons or replacing them altogether.

“The Smart Weapon End-to-End Performance Model, or SWEEMP, developed by the U.S. Army Research Laboratory, known as ARL, is a set of files and software that cover all impacts associated with firing a round and anything that affects the delivery of that round,” said William F. Oberle, Ph.D., Advanced Weapons Concepts branch chief within ARL’s Weapons and Materials Research Directorate.

Oberle said the model’s versatility sets it apart from other force-on-force models that military planners use to practice sustained operations. With SWEEMP, as it’s called, researchers can model the overall effectiveness of all types of munitions

Soldiers use a laser targeting system, which integrates a Vector Binocular Laser Rangefinder with a Precision Lightweight GPS Receiver to provide target grid coordinates. (U.S. Army photo)

throughout the entire target engagement, from target detection through damage estimation with a modular Monte Carlo simulation.

Using the model, researchers can look at a conceptual or actual guided artillery round, its guidance system and its performance, for example. Ballistic engineers provide information on how the round would be used in an attack, against a tank or truck for instance, and insight on the current inventory of the round. Other variables such as material composition of the round, muzzle velocity, how Soldiers aim and fire weapon systems, weather, stationary or moving targets are incorporated as part of a total system analysis that once encoded, helps researchers determine effectiveness scenarios, or situations that indicate the amount of damage the round causes.

“One of the missions of the Advanced Weapons Concepts Branch is to develop modeling and simulation tools to perform our performance/effectiveness analyses. Being able to perform these analyses in a timely manner requires that we look out and forecast what type tools we will need in the future,” Oberle said.

“In 2008, ARL recognized a void in modeling and analyzing smart weapon systems from target acquisition through damage estimation,” Oberle said. “Since a large segment of the divisions work in the future would involve smart weapons and no existing model could be found, we chose to start development of what is now termed SWEEP.”

The Army completed SWEEP in April 2013.

“It’s unique in that it was developed as a modular tool capable of being changed and adapted to model new concepts with minimal turn-around time,” said Mary K. Arthur, principal investigator who is credited with developing SWEEP by discreetly integrating legacy and newly developed software.

SWEEP currently employs two trajectory models, she said, a basic, fast-running 3DoF model used primarily in the development of SWEEP, and a more complex, modified point mass model which includes a GPS navigation model and control forces for terminal guidance.

“Other submodels that can be easily changed out or modified include a target motion model, scout and rangefinder models, damage estimation models, and a recently added in-flight autonomous targeting model.”

Last month, SWEEP was transitioned to ARDEC’s, System Engineering Directorate in Picatinny, N.J., on the heels of Army leadership’s renewed emphasis on force-on-force warfare, which had taken a backseat to counterinsurgency operations.



A Soldier assigned to the 3rd Brigade Combat Team, 25th Infantry Division, aims his M320 40 mm grenade launcher at a target during Bronco Rumble, a company-level combined arms live-fire exercise, at Schofield Barracks, Hawaii, May 8, 2013. (U.S. Army photo by Sgt. Brian Erickson)

ARL and ARDEC are both elements of RDECOM.

According to an ARDEC spokesperson, engineers there are in the midst of reviewing the tool for formal adoption, given the high performance computing, or HPC, capabilities of SWEEP are of interest to the engineers and analysts at ARDEC.

“The ability to run SWEEP on HPC assets at ARDEC allows for the stochastic evaluation of weapon performance by incorporating the real world randomness of target motion, target acquisition and projectile flight,” said Ingrid M. Dombroski, competency manager in ARDEC’s System Analysis Division. “SWEEP is representative of the ever growing collaboration between ARDEC and ARL, where a shared need is met through the individual excellence of each center. In the case of SWEEP, ARL brought forward their expertise in HPC; guidance, navigation and control, and target effects while ARDEC provided a world class user base for beta testing, programmatic support, and analytical and technical proficiency to meet a common Army need.”

Currently, ARL is using the model in a study requested by the Maneuver Center of Excellence at Fort Benning, Ga., to look at performance variables for the 40 mm grenade. The center conducts research, development and experimentation to ensure our future maneuver force is prepared and equipped to fight and win in a complex future environment.

Plans are underway to incorporate the tool in an analysis of a conceptually guided artillery round, created by ARL designers, where control forces are going to be required to address hitting moving targets. The in-house concept will attempt to define requirements of an actual round to meet certain performance goals, and the results will be fed into programs managed by ARL’s Guidance Technology and Flight Science branches. ■

Quick Detection System for Soldier Protection

Army scientists are working on an accurate, quick detection system to protect Soldiers. RDECOM has the foremost specialists in the country dedicated to accomplishing this goal.

At ECBC, researchers with the Research & Technology Directorate Laser Spectroscopy Branch conduct fundamental spectroscopic research

as well as to test and evaluate systems that specialize in detection from proximal (sub 250 meters) to standoff (> 250 meters) distances.

This ability is vital to a Soldier's safety, as it can warn the Soldier to don hazardous material clothing and protective equipment before being exposed to the chemical threat.



The primary goal of the Laser Spectroscopy Branch is to conduct fundamental spectroscopic research as well as to test and evaluate systems that specialize in detection systems that can warn Soldiers to don hazardous material clothing and protective equipment. (U.S. Army photo)

Duplicating Parts to Speed Repairs

New technology being developed by research engineers at the U.S. Army Research Laboratory and Purdue University will soon help just about any Soldier deployed in far-off locations to immediately spot and fix damaged aircraft and ground vehicle parts.

Researchers found that combining the general purpose, finite-element analysis software ABAQUS with Python, an open-source code used to optimize logical structures such as topologically interlocked structures, improves energy absorption and dissipation, productivity and lower maintenance costs.

The combination of ABAQUS and Python provides an automated process for auto-generation of the geometries, models, materials assignments and code execution, said Ed Hattour, a research engineer with U.S. Army Research Laboratory's, or ARL's, Vehicle Technology Directorate at Aberdeen Proving Ground, Md.

Read more: <http://1.usa.gov/14CupDk>

Jyuji Hewitt New RDECOM Deputy Director



RDECOM welcomed Jyuji D. Hewitt as its deputy director July 14.

Before assuming the position at RDECOM, Hewitt served as executive director for support, Office of Security Cooperation-Iraq in Baghdad, Iraq. Also, he was deputy to the commander and executive director for Ammunition, U.S. Army Joint Munitions Command, Rock Island Arsenal, Ill. The Army selected him for the Senior Executive Service in January 2007.

Hewitt earned master of science degrees in strategic studies from the U.S. Army War College in 2001, physics (nuclear) from the University of New Hampshire in 1990 and systems management from the Florida Institute of Technology in 1988. He earned a bachelor of science in chemistry from the University of Maine in 1978 as well as a U.S. Army commission as a second lieutenant in the Ordnance Corps through the ROTC program. He retired from the Army as a colonel.

The position of deputy director had been vacant since Gary Martin departed in November 2011; however, several RDECOM senior executives served as acting deputy director in the interim.

Bio: <http://1.usa.gov/17PNpjK>

Novel Power Unit

RDECOM recently hosted a demonstration of a novel power unit for its Department of Defense partners at Aberdeen Proving Ground, Md.

CERDEC engineers demonstrated a tubular Solid Oxide Fuel Cell 10 kW power unit, which exhibits high efficiency, a low acoustic signature, a low visible signature, and weighs approximately 960 pounds dry with a volume of 38 cubic feet.

Comparatively the Army's 10 kW Tactical Quiet Generator Set weighs 1,100 pounds dry with a volume of 41 cubic feet.

Read more: <http://1.usa.gov/14CCvfg>

Robo-Raven Glider

A robotic bird created by Army and University of Maryland researchers is tricking real flocks—and hawks—midair, making it a potential unsuspecting future war agent.

Robo-Raven glides, soars and flaps like a real bird. Complete individual wing control allows for extreme aerobatics that no other mechanical bird has ever been able to perform, Army researchers claim. But its ability to hide in plain sight and light weight is what excites researchers most.

“It already attracts attention from birds in the area which tends to hide its presence,” said John Gerdes, a mechanical engineer with the ARL Vehicle Technology Directorate at APG.

Seagulls, songbirds and sometimes crows tend to try to fly in a formation near the bird during testing, but birds of prey, like falcons and hawks take a much more aggressive approach toward test flights.

Read more: <http://1.usa.gov/19vRtwo>



ARL's John Gerdes teamed with University of Maryland fellow graduate student researchers Luke Roberts and Ariel Perez-Rosado to develop the Robo-Raven, a robotic bird that glides, soars and flaps like a real bird. (Photo courtesy of the University of Maryland)

Process Improvements to Deliver \$2 Million in Savings

While completing requirements for Lean Six Sigma Green Belt certification at the Aviation and Missile Research Development and Engineering Center, John Braswell implemented process improvements for the missile design trade study process that promise the Army savings of about \$2 million over the next seven years.

Over the course of six months, Braswell managed a program entitled “Improved Systems Analysis Process for Early Missile Development” that looked at the amount of time required to turn customer requirements into functional requirements. This information is used to create an engineering tradespace that can help narrow down the possible solution set that can meet the stated user needs.

“This process has been very effective but not always efficient. At times the process requires too much time to generate a complete tradespace using the current tool set. My project was able to utilize a government off the shelf solution from the AMRDEC Collaborative Environment team called the Missile Design Tool. It's a graphical user interface that links medium and low fidelity design tools, that are widely used in the lab, together using the Python scripting language,” Braswell said.

Read more: <http://1.usa.gov/14Cwcsi>

M320 Holster

When the M320 40 mm grenade launcher began replacing the M203 in 2009, it put a new and more lethal weapon into the hands of the Soldier. There was one question: How would Soldiers carry it?

Darren Bean, equipment specialist with PM SCIE has been working at the Natick Soldier Systems Center since November 2012 on the M320GL Holster Soldier Enhancement Program, or SEP.

The detachable M320, named one of the Army's top 10 inventions of 2009, comes equipped with a sling to carry it when not mounted to the M4 carbine or M16 rifle, according to Bean.

Read more: <http://1.usa.gov/14CARUq>



Darren Bean, an equipment specialist with Product Manager Soldier Clothing and Individual Equipment at Natick Soldier Systems Center, Mass., has been working since November 2012 on the M320GL Holster Soldier Enhancement Program. (U.S. Army photo by David Kamm)

Working to Reduce Head and Neck Strain

Gunners, patrol personnel, cooks, medics and other Soldiers who wear helmets for long periods of time could get much needed head and neck relief from a revolutionary device developed by ARL researchers, a new study found.

The Vertical Load Offset System—or VLOS, a prototype exoskeletal device designed to displace the static load of the helmet onto the shoulders, proved in recent studies to reduce apparent strain overall on a Soldier's head and neck. Some Soldiers reported both the sensation of lighter head-borne weight and more helmet

stability. Achieving these results—given the dynamic movement of the head in combination with helmets loaded with equipment such as night vision devices, batteries and other equipment—is a major step forward, researchers said.

APG Soldiers reported these and other immediate benefits of the archetype during a week-long human-factors evaluation conducted earlier this summer on the Soldier Performance Equipment Advanced Research obstacle course and at the SPEAR Biomechanics Laboratory.

Read more: <http://bit.ly/16hkqHI>



Soldier test subject with Vertical Load Offset System prototype. (U.S. Army photo)

Heftier Unmanned Ground Vehicle

A small car can't pull a heavy trailer. Sports utility vehicles don't have a compact car's fuel efficiency. A perfect, one-size-fits-all vehicle doesn't exist. The same goes for unmanned ground vehicles, known as UGVs.

Soldiers use UGVs—such as the 40-pound PackBot or the larger, 115-pound Talon—to detect and defeat roadside bombs, gain situational awareness, detect chemical and radiological agents, and increase the standoff distance between Soldiers and potentially dangerous situations. Just as SUVs offer utility smaller cars can't match, larger UGVs provide capabilities not available with smaller platforms.

The 300-pound iRobot Warrior, developed in partnership with TARDEC, is a large UGV that offers more lifting and carrying power, as well as the potential for better dexterity to grab items or open and close doors.

The Warrior's capabilities combine that of a TARDEC-developed map-based navigation and those of the Warrior's predecessor, the Neomover, which was larger than a PackBot and could perform several dexterous tasks with its robotic arm.

Currently, one of TARDEC's Warriors is undergoing final software testing. The other is at Re2's facility supporting two small business initiatives TARDEC manages on semi-autonomous door opening and enhanced manipulation feedback. They are also being used to support an innovative project in developing a new gripper design.

Ensuring Top Radio Performance

To keep Soldiers safe and lines of communication open, frequent testing of radios used on the battlefield is imperative, Army researchers say.

Testing is becoming more automated and efficient with updates to the Communications Electronic Warfare Instrumentation System, or CEWIS, a suite of test equipment developed by ARL.

The Communications Electronic Warfare Branch of ARL's Survivability/Lethality Analysis Directorate first brought the CEWIS capability online in the mid-1990s

and has continually evolved the technology to keep up with the times, said Jim Lurski, electrical engineer. "The newer test equipment is more automated and more capable."

In CEWIS, a variety of test equipment like spectrum analyzers, signal generators and oscilloscopes is combined into a single system. It allows analysts to assess the robustness of a communication link.

For example, two radios may be brought into the lab and CEWIS is used to inject a

jamming signal to disrupt their communications. The jamming signal starts low and is increased until the communication fails. Researchers inform the customer (for example, a program manager or the Army Evaluation Center) of results such as the radios' ability to maintain their link up to a specific level of jamming.

To achieve precision in the testing process, CEWIS transmits several hundred messages at each level of jamming signal. With that many messages, it is important that the process be automated.

Another system for which CEWIS has been invaluable is Nett Warrior, which provides situational awareness and mission command for dismounted Soldiers on the battlefield. ARL pre-tested the Nett Warrior system for the most recent previous Network Integration Evaluation, or NIE, in November 2012, providing useful data for the test planners. Because this approach allowed the Army to track down and eliminate problems encountered in earlier NIEs, it's now being generalized.

Hostile Fire Detection

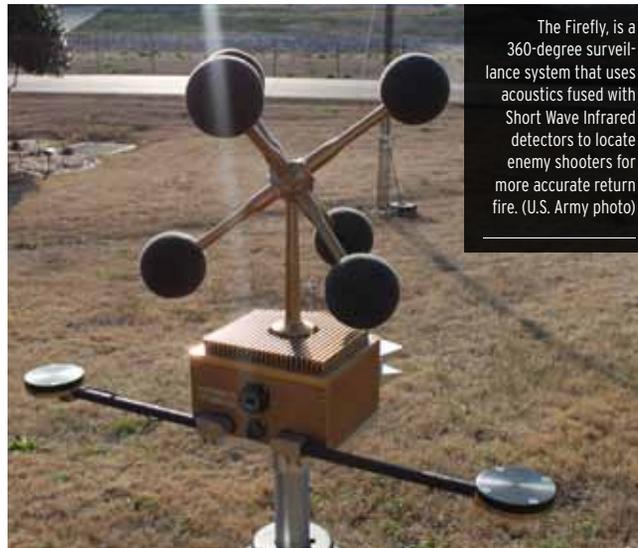
The Army is harnessing the elements to help reduce casualties from sniper attacks on forward operating bases.

ARL, AMRDEC and CERDEC have integrated and deployed wind and solar harvesting systems to provide continuous energy to company-level, force protection systems used by U.S. Army combat units in theater.

The Hostile Fire Detection Sensor, or Firefly, is a joint venture by ARL, AMRDEC and industry, featuring a 360-degree surveillance system that uses acoustics fused with shortwave Infrared detectors to locate enemy shooters for more accurate return fire.

Firefly detects line-of-sight and non-line-of-sight hostile fire and classifies these as small arms, heavy machine gun or rocket/mortar. It calculates geo-location of the shot and provides self-position and heading in a standard cursor-on-target format. Firefly can be either a mobile or fixed system, attached to the Soldier's backpack while on patrol, or mounted at forward operating bases.

Read more: <http://1.usa.gov/14CCGqX>



The Firefly, is a 360-degree surveillance system that uses acoustics fused with Short Wave Infrared detectors to locate enemy shooters for more accurate return fire. (U.S. Army photo)

Supercomputing Research Center

Supercomputers Army Research Laboratory engineers rely on to influence the direction of future armor solutions and other unprecedented capabilities for the Soldier moved into a space large enough to house five supercomputers each with 4,000 to 20,000 processors each. In the next four years, the center will quadruple its computing capacity.

Sen. Ben Cardin (D-Md.) vowed continued congressional support during his remarks at the ARL Supercomputing Research Center ribbon cutting and open house here today. His visit comes on the heels of a national cyber security dialogue with China during a recent congressional visit there.

"Cyber security work done here is critically important to our national security," Cardin said.

Army researchers use the center's supercomputing systems, also known as high performance computers, to design and develop military technologies, such as future armor systems and other unprecedented capabilities for the Soldier.

The center will provide key enabling computational technologies in support of ARL's cyber security collaboration research alliance with academia, industry and other government research organizations to develop a fundamental understanding of cyber phenomena, including aspects of human attackers, cyber defenders and end users, so that fundamental laws, theories, and theoretically grounded and empirically validated models can be applied to a broad range of Army domains, applications and environments.



White Hawk to Receive Common Avionics Architecture System

The primary aircraft in the U.S. President's rotary wing fleet is the VH-60N, also known as the White Hawk, and to support its mission planning, the Navy called upon members of the U.S. Army Aviation and Missile Research, Development and Engineering Center Software Engineering Directorate.

The "White Hawk" is a Black Hawk-based helicopter and through the U.S. Navy's Cockpit Upgrade Program it will be receiving the Common Avionics Architecture System.

The Aviation Mission Planning System team at AMRDEC's Software Engineering Directorate has extensive experience developing mission planning software for CAAS cockpits, including the Marine Corps' heavy lift helicopter CH-53E Super Stallion; the ARH-70A next-generation armed reconnaissance helicopter; and the CH-47F Chinook, which closely resembles the VH-60N in avionics and data load specification.



A VH-60N White Hawk executive transport helicopter, assigned to Marine Helicopter Squadron One, flies over the Potomac River in Washington, D.C., en route to the White House. (U.S. Navy photo)

ARMY TECHNOLOGY MAGAZINE

the exclusive authorized civilian enterprise magazine
for RDECOM and its subordinate centers.

2013 ISSUE THEMES

October 2013 ISSUE 2

CYBER

Highlights: RDECOM develops cyber security solutions

Interview: Cyber Command CG

December 2013 ISSUE 3

POWER & ENERGY

Highlights: Army researchers seek energy from alternative, renewable sources

Interview: Assistant Secretary of the Army for Installations, Energy & Environment Katherine Hammack

2014 ISSUE THEMES

ISSUE 4

PARTNERSHIPS

Highlights: RDECOM partners with key government organizations, academia and industry to develop the best technology solutions

ISSUE 5

FUTURE WARRIOR

Highlights: Special Operations Command turns to RDECOM to develop innovative solutions

ISSUE 6

SELF-SUSTAINED FORWARD OPERATING BASE

Highlights: RDECOM researches a fully integrated and deployable solution

ISSUE 7

LETHALITY

Highlights: ARDEC works to develop long-range fires capability in a GPS-denied environment

ISSUE 8

ROBOTICS

Highlights: RDECOM looks to develop a robotic team member with the capability to provide logistics support, situational awareness and direct and indirect fires for the small unit

As of August 2013 – Subject to change

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"The Army has global responsibilities that require large technological advantages to prevail decisively in combat—'technological overmatch,' if you will. Just as airmen and sailors seek supremacy in the air and on the seas, Soldiers must dominate their enemies on land. Modernizing, especially as end strength is reduced, is the key to ensuring that the Army's dominance continues."

— Gen. Raymond T. Odierno, Army Chief of Staff