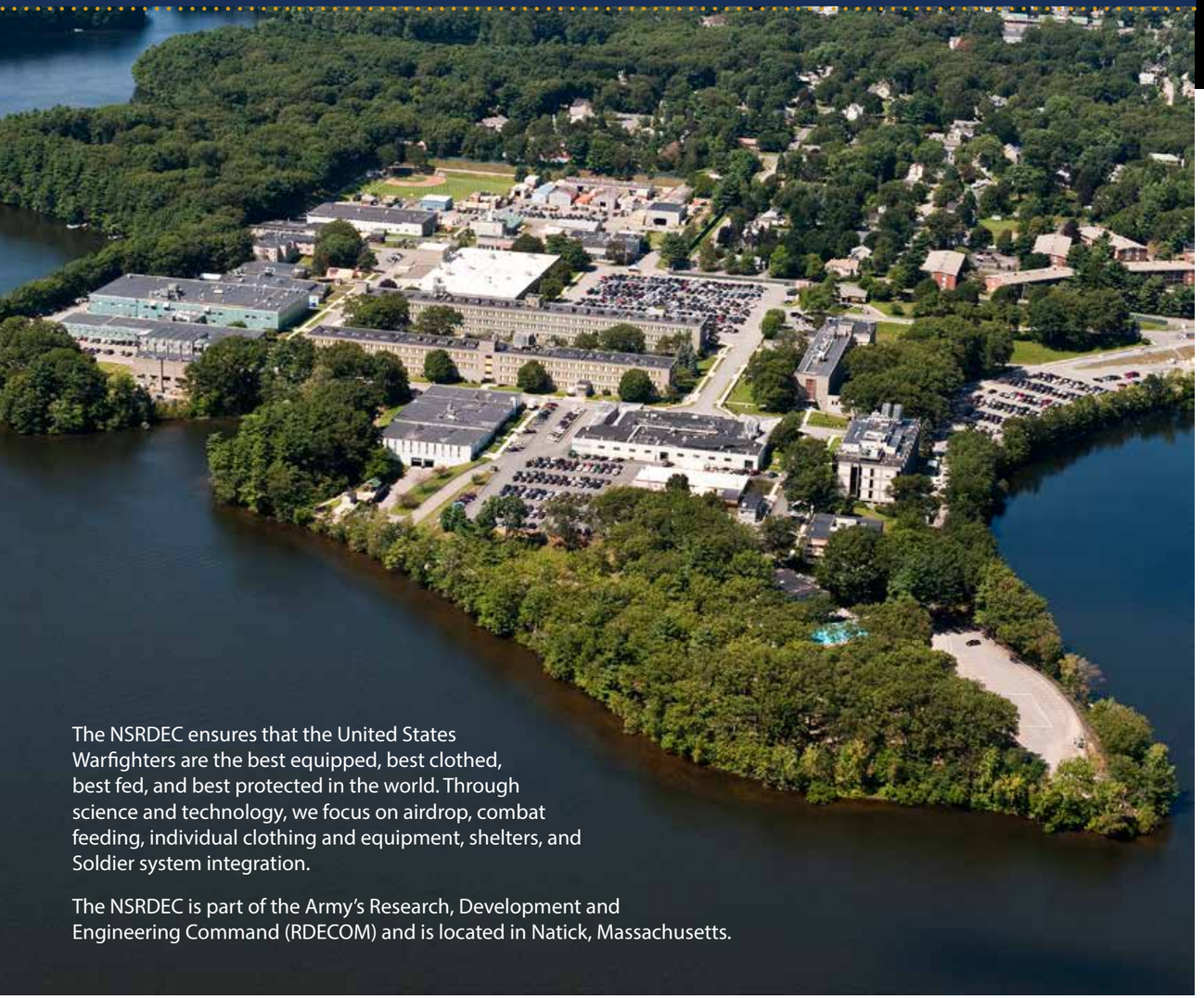
Spring 2015

Soldier Science & Engineering

Science and Technology News from the Natick Soldier Research, Development and Engineering Center (NSRDEC)

Up on the Roof

U.S. ARMY NATICK SOLDIER RESEARCH, DEVELOPMENT & ENGINEERING CENTER (NSRDEC)



The NSRDEC ensures that the United States Warfighters are the best equipped, best clothed, best fed, and best protected in the world. Through science and technology, we focus on airdrop, combat feeding, individual clothing and equipment, shelters, and Soldier system integration.

The NSRDEC is part of the Army's Research, Development and Engineering Command (RDECOM) and is located in Natick, Massachusetts.

OUR MISSION

Research, Development and Engineering (RD&E) to maximize the Warfighter's survivability, sustainability, mobility, combat effectiveness and field quality of life by treating the Warfighter as a system.

ADDING VALUE THROUGH:

- Basic Science
- Technology Generation, Application, and Transition Enabling Rapid Fielding of the Right Equipment
- Soldier Systems Technology Integration and Transition
- Solving Field Problems Rapidly

OUR VISION

The leader in empowering the world's most capable Soldiers

OUR FOCUS

Deliver world-class research, development and systems engineering and services, with a unique warrior-centric focus.

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Science and Technology News from the Natick Soldier Research, Development and Engineering Center (NSRDEC)

From the air to the ground to the ocean

As the director of Outreach & Business Development at the Natick Soldier Research, Development and Engineering Center, I have the opportunity to witness our scientists and engineers mature innovative technological advances empowering our Soldiers.

In this issue of Soldier Science & Engineering, you will discover how NSRDEC is preserving fruits and vegetables aboard Navy ships, improving Soldier load carriage, developing energy-harvesting technologies, containing Ebola, conducting surveys to improve warfighter food, developing wearable technologies and sensors, and reducing waste and energy use in base camps. You'll read about our commitment to innovation and generating new ideas through our Bootstrap Initiative and our commitment to R&D collaboration with UMass Lowell. You will also learn about Natick's Aerial Delivery Directorate's leading role in an award-winning joint aerial delivery effort.

From the air to the ground to the ocean, Natick's science, technology and engineering presence is worldwide. Innovation, collaboration, enthusiasm and commitment are values at the heart of our unwavering dedication to technologically empower our nation's warfighters.

Benjamin C. Hall
NSRDEC Strategic Outreach Leader

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Questions regarding NSRDEC Science & Technology?

RDECOM

NSRDEC is part of the U.S. Army Research, Development and Engineering Command, which has the mission to develop technology and engineering solutions for America's Soldiers.

RDECOM is a major subordinate command of the U.S. Army Materiel Command, whose mission is to develop and deliver global readiness solutions to sustain Unified Land Operations, anytime, anywhere.

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Photo: Jeff Sisto, NSRDEC Public Affairs

Bright Ideas

Natick pitches innovation in forum

By Jane Benson, NSRDEC Public Affairs / NATICK, Mass. (Dec. 31, 2014)

The U.S. Army Natick Soldier Research Development and Engineering Center, or NSRDEC, has come up with a new way to spark out-of-the-box thinking, risk-taking, and employee participation. The center implemented the "Bootstrap Initiative and Pitch Day."

The Bootstrap Initiative encourages innovation and creativity while streamlining processes and minimizing bureaucracy. The program accepts ideas from government civilian NSRDEC employees, who are allowed to submit proposals for a new technology, research project, business process, or administrative process that supports NSRDEC's mission, which includes researching and developing cutting-edge food, shelter, clothing and airdrop technologies and products.

Employee enthusiasm, participation and empowerment are at the heart of the initiative. Employees propose ideas and vote on which ideas receive funding.

NSRDEC's Dr. Ken Desabrais, a research aerospace engineer, conceived the idea and led the Bootstrap Implementation Team.

"The Bootstrap Initiative was conceived of as a way to bring the crowdsourcing concept to NSRDEC, to find innovative and creative ways within our organization to solve a spectrum of problems, from technical challenges to improvements in our business and administrative processes and tools," Desabrais said. "Our intent with the initiative was to encourage the sharing of ideas and help nurture a culture of collaboration amongst our colleagues to identify and find solutions to the problems we see in achieving our mission of helping the Soldier, while also empowering people to pursue and make decisions about those ideas.

"The Bootstrap Implementation Team did an exceptional job in pulling the initiative together in a very short time frame. We were able to implement and execute the initiative in about three months from start to finish, which is a testament to the dedication and commitment everyone put into the effort, including all the people [who] participated in submitting ideas and voting for proposals."

Although Bootstrap is intended to encourage originality and ingenuity, there are still some submission restrictions. For instance, ideas must be able to be carried out for $50,000 or less. Funding cannot be used to fund a contractor or external contract.

NSRDEC's Pitch Day provided a unique forum for both proposal creators and voters. During Pitch Day, proposers garnered employee voter support for their ideas by making posters, displaying prototypes, creating interactive displays and conducting show-and-tell sessions.

"This was a great effort to bring people together in a new and exciting way," said Donna Bulger, associate director for NSRDEC Operations and Outreach. "Giving the workforce an opportunity to have a voice in what efforts move forward generated some great discussion, and I am sure [it] will spark some new ideas for the next cycle."

Pitch Day showcased many project home runs, but not every project could be a winner. Funding was limited and the competition was steep, with 37 groundbreaking ideas being submitted.

In the end, there were 18 winning proposals, ranging from zero-waste cafeterias to a low-altitude, high-accuracy airdrop activation device.

"The workforce's response to the Bootstrap program far exceeded my expectation," said Dr. Charlene Mello, NSRDEC chief scientist. "It has brought together the business, administrative and technical communities to collaboratively execute our mission. I am eager to follow the progress of funded ideas and generation of new ideas for future Bootstrap submissions."

Megan Hoey, an NSRDEC research chemical engineer, submitted a Bootstrap project entitled "Friend or Foe in Fibers," which was one of the projects chosen by NSRDEC employee voters for funding.

"The Bootstrap Initiative has provided an avenue for me to start some work on developing fibers with specific optical additives in order to inform and prepare for a larger-scale 6.2 friend vs. foe identification effort that is on hold. If funding becomes available for that effort, Bootstrap will have enabled me to hit the ground running and effectively and efficiently transition into the full-scale Warfighter Improved Combat Identification Development 6.2 project."

The Consumer Research Team at the Natick Soldier Research, Development and Engineering Center developed an online questionnaire to ask Soldiers about hygiene issues in the field.

Photo: Patrick A. Albright, U.S. Army

Natick asks Soldiers about hygiene issues

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (Nov. 25, 2014)

In its effort to combat body odor and skin irritation affecting Soldiers in the field, the Army has developed antimicrobial treatments for such items as T-shirts, socks and sleeping bag liners, but little is known about the extent of such personal hygiene issues or their effects on warfighters.

"That information doesn't really exist right now," said Wendy Johnson of the Consumer Research Team, or CRT, at the Natick Soldier Research, Development and Engineering Center. "Right now, we're trying to get to the baseline of what the problem is."

The CRT will gather data straight from the sources. Team members have developed an online questionnaire for Soldiers throughout the Army who have deployed or taken part in field exercises, and they hope that thousands will respond.

The questionnaire, in development since last fall, can be found at https://surveys2.natick.army.mil/Surveys/antimic.nsf (CAC required), or at https://surveys.natick.army.mil/Surveys/antimic.nsf.

According to Johnson, the CRT will collect data for at least two weeks.

"Currently, the military doesn't have any requirements for (antimicrobial treatments)," Johnson said. "And so the question is, should the military have requirements? What should they be? How do we know that this stuff is good enough, is doing what it's supposed to do?"

To identify problems in the field, the CRT will ask questions about such afflictions as foot or body odor, athlete's foot, jock itch and skin rash. Soldiers will also be queried about what antimicrobial products — those that kill organisms and inhibit their growth — and how they use them.

"What do they expect from them?" said Johnson of the products. "Do they expect to be cleaner? Do they expect to be more healthy? Do they expect that it will control foot and body odor. When they use them, do they use them in the field? Do they use them while they're camping or hunting?"

It might be down and dirty work for the CRT, but it's necessary to find out how these hygiene issues affect Soldiers' performance and their ability to sleep in the field.

"We think that some of these things are going to get very low incidence rates, so we want thousands of Soldiers to answer this questionnaire for us," Johnson said. "We would want everyone, pretty much, who has been in the Army, who has been deployed or has at least been in field training under situations where this has been a concern."

Photo: Tazanyia Mouton, USAG-Natick Public Affairs

Pack Man

Landry designs new rucksack for paratroopers

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (Jan. 30, 2015)

He used to be one of them, so when paratroopers from the 82nd Airborne Division asked Rich Landry to design a rucksack to meet their needs, he was thrilled.

"That's my past," Landry said. "This … is my favorite kind of work, because the whole parachute (piece) is just such an interesting dynamic when you start talking about load and how all the pieces have to work together.

"It's a huge challenge, but when it's a lot of fun, it's certainly easier."

An individual equipment designer in Load Carriage Systems, Product Manager Soldier Clothing and Individual Equipment, Natick Soldier Systems Center, Landry spends most of his time thinking about how to lighten the Soldier's load.

"One of the things we always say is, we don't do all the critical design work here," Landry said. "It's Soldiers that do that. We put it into something tangible."

In this case, Soldiers were telling Landry that the Modular Lightweight Load-carrying Equipment, or MOLLE, large and medium rucksacks in the Army inventory were too large and small at 3,000 and 5,000 cubic inches, respectively, for their purposes.

And the MOLLEs, as well as other existing systems, had to be fitted with the current Harness, Single-Point Release, or HSPR, that wrapped around the rucksacks and secured them to the parachutes, making them difficult to pack and unpack. Soldiers also wanted a design that interfaced well with body armor and was as comfortable as possible.

"It took time to set up existing rucksacks with the HSPR," Landry said. "So that was one of the problems that the 82nd Airborne Division had. They needed flexibility to rig, to de-rig, and to possibly reconfigure the rucksack loads at various phases before the airborne operation. The ability to reconfigure the load was critical."

Enter the MOLLE 4000, a 4,000-cubic-inch rucksack that Landry designed, using a frame already in the U.S. Marine Corps inventory as a foundation. In fact, Landry had worked on that pack, as well.

Soldiers also had asked for a permanent harness for airborne operations on the outside of the new rucksack, but Landry's solution was a removable harness that looked permanent.

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Photo: Julie Skarratt Photography, Inc.

Up on the Roof

Natick airbeam technology at Carnegie Hall

By Jane Benson, NSRDEC Public Affairs / NATICK, Mass. (Jan. 26, 2015)

The wide-reaching, overarching success of airbeam technology is music to Natick's ears. The technology has made its debut in a new incarnation as a part of a surprisingly luxurious rental tent used for a gala on the rooftop of Carnegie Hall.

Airbeam technology consists of inflatable, high-pressure arches. The arches replace metal frames in tents and can be deployed rapidly. The airbeams come in small, lightweight packages. Large shelters and shelter complexes can be set up quickly and with fewer personnel than metal frames.

The Natick Soldier Research, Development and Engineering Center, NSRDEC, along with its industry partners, has a long history of developing the very best shelters to protect the nation's Soldiers and their equipment. Many of the technologies developed by NSRDEC and industry for the military have directly and indirectly resulted in commercial applications.

Todd Dalland, co-founder and president of Pvilion of Brooklyn, New York, designed the groundbreaking rental shelter for the Carnegie Hall rooftop event.

"The special event tent that Pvilion designed and produced for the rooftop of Carnegie Hall in midtown Manhattan uses airbeams developed by Federal Fabrics-Fibers for its structural supports instead of aluminum frames," said Dalland. "This represents the first time that high-pressure airbeam technology has crossed over from military applications, associated with Natick, to commercial applications."

"This was really an eye-opening demonstration of what this technology can do in the rental tent industry," said Jean Hampel, team leader of the Fabrics Structures Team, part of NSRDEC's Expeditionary Basing and Collective Protection Directorate, and a longtime expert in military airbeam shelters. "It shows the cost is coming down so it can be used in rental tents, and that's a really big commercial application."

Pvilion designed, engineered and produced the shelter, which is the first practical and affordable rental tent using high-pressure airbeams. The company enlisted Federal Fabrics-Fibers to fabricate the airbeams and Anchor Industries to fabricate the fabric top. Stamford Tent installed the shelter at Carnegie Hall.

"Since it's on a rooftop, you can't lay out many large pieces of framework," said Hampel. "Basically, with this, you just unroll it, inflate, and it stands up on its own. This was a very unique capability."

Pvilion began working on various types of shelters with Natick in the late 1980s. Pvilion has collaborated with Natick in three areas, including General Purpose Tents, Flexible PV Fabric Tents, and Airbeam-Support Tents. Pvilion has been involved in the development of high-pressure airbeams for more than 20 years.

"I think Natick may be the best new tent technology incubator in the world," said Dalland. "Natick has the best understanding of where military tents need to go in the future, and they are able to help support small, new tech companies with projects that move tents closer to Natick's vision."

Federal-Fabrics-Fibers of Lowell, Massachusetts, has also been involved in key textile technology collaborations with NSRDEC, including the airbeams used in the Pvilion tent.

NSRDEC, a pioneer in airbeam technology (and shelters in general), guides industry partners with its vast knowledge of military requirements and military textiles to oversee the technology development, the results of which have included airbeam-based military medical shelters, chem-bio protective shelters, aircraft shelters and expeditionary shelters.

"It's safer than a metal frame tent in a storm," said Hampel. "If you're in a metal frame tent, you could have metal falling down on you or what's stored in the tent. With airbeams, they'll bend and pop back up. It's a big advantage."

Natick has been improving and perfecting airbeam technology since the 1970s and began working with Federal-Fabrics-Fibers in the early 1990s. The late Zvi Horovitz established Federal-Fabrics-Fibers with his wife,

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Photo: Julie Skarratt Photography, Inc.

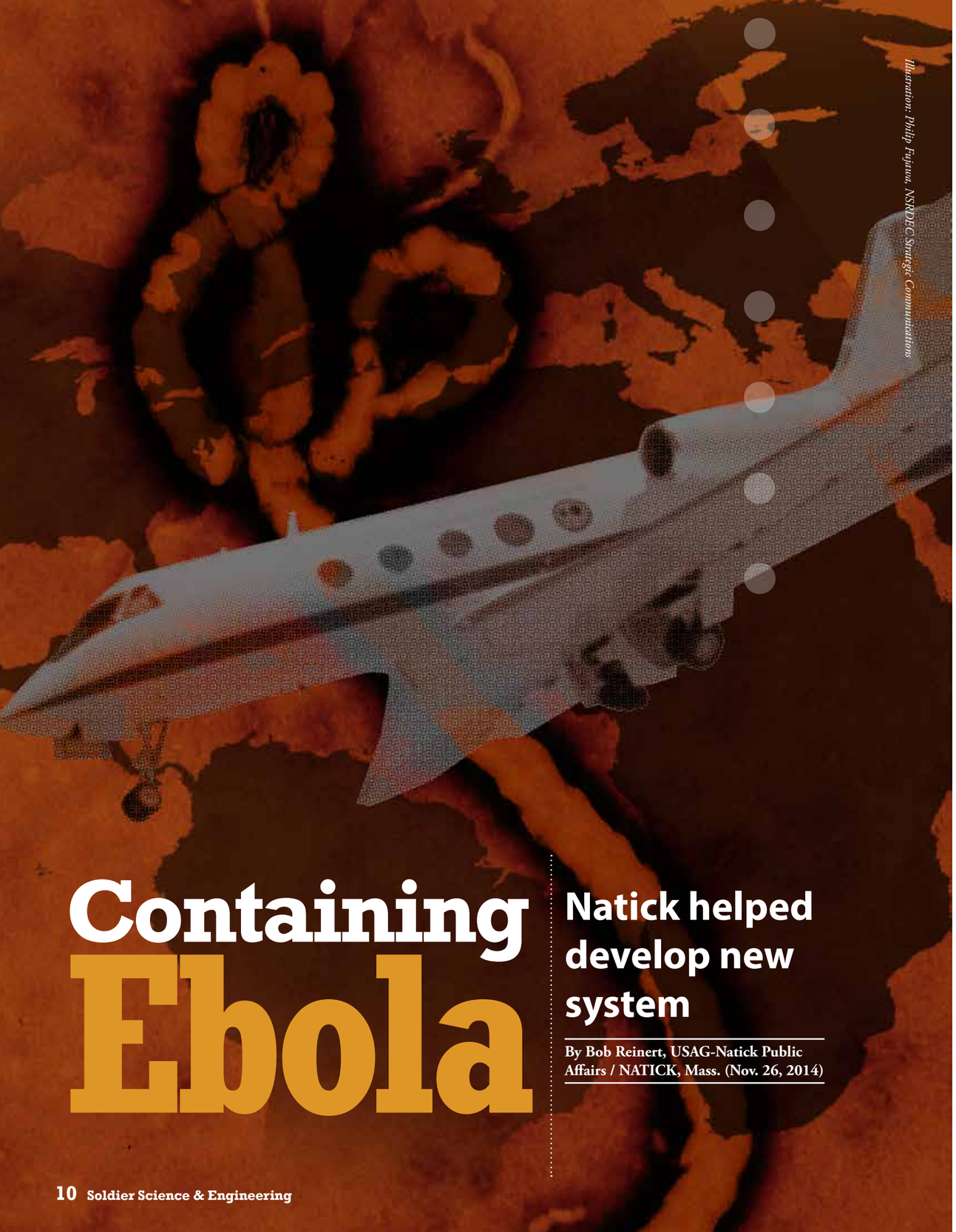

Illustration: Philip Fujitsu, NSRDEC Strategic Communications

Containing Ebola

Natick helped develop new system

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (Nov. 26, 2014)

A containment system used to quarantine Ebola virus patients being transported out of West Africa was developed with help from the Natick Soldier Research, Development and Engineering Center.

The Aeromedical Biological Containment System, or ABCS, manufactured by Production Products of St. Louis, can be hoisted into a specially modified Gulfstream III air ambulance and flown by Phoenix Air Group back to the U.S., or other countries, where patients can receive more intensive treatment. Several successful missions have already been conducted.

"We've designed a lot of chem-bio defense systems for Soldiers, like those for the Deployable Medical Systems, but it's all been ground based," said Tom Larkham, an equipment specialist on the Fabric Structures Team of the Expeditionary Basing and Collective Protection Directorate at NSRDEC. "There (were) a lot of things (with the ABCS) that had to be tested for that we had never really had any experience with."

NSRDEC began working on the concept in 2007, with the Centers for Disease Control and Prevention, the Joint Project Manager for Collective Protection, and the U.S. Army Edgewood Chemical Biological Center.

As Larkham explained it, CDC was concerned about being able to transport its personnel home if they became sick while deployed overseas battling infectious diseases. Ebola had yet to become the focus.

"At the time, what they were worried about was (severe acute respiratory syndrome)," Larkham recalled. "And the other one was the avian flu, or bird flu. So they were really concerned about those more infectious airborne diseases taking off."

The ABCS went operational in 2012, but had never been used prior to the Ebola outbreak, Larkham said. The tent-like, modular system keeps the patient under negative pressure, isolating and filtering the air inside, and protecting the aircrew and medical personnel aboard.

"The materials themselves are impermeable but not really chem-bio resistant," Larkham said. "They're just inexpensive, general purpose tentage-type fabrics. What they do is they strip that fabric off and they incinerate it per (Environmental Protection Agency) standards when they come back."

The air inside the 190-cubic-foot patient compartment passes through a high-efficiency particulate air, or HEPA, filter.

"There's a front airlock so that medical attendants can go in and out during the flight," Larkham said. "That's at one negative pressure, which is slightly higher than the negative pressure that the patient's actually at. That way, they can move from the positive pressure inside the aircraft into where the affected patient is, and then come back out again."

As Larkham pointed out, it was the first time that Natick had worked on something that needed to maintain negative pressure in an aircraft as cabin pressures change.

"There's also a small, lightweight low-pressure, high-pressure alarm system that's in there that we developed here at Natick, and Janet O'Callahan was the project engineer for that particular item," Larkham said. "It gives a visual and an audio tone when the pressure varies from where it's supposed to be."

According to Larkham, one of the biggest design problems involved the zippers.

"The zippers are all hermetically sealed, waterproof/vapor tight zippers," Larkham said. "You can get these style zippers, but to get them to go around corners, to get them to operate easily for people that are dressed in protective garments where they can barely see where they're going is always difficult."

Photo: CDC

The Aeromedical Biological Containment System, which has been used to transport Ebola patients to the U.S. from West Africa, sits next to the Gulfstream III aircraft that carries it.

> **"I felt great about it, being involved with the program, and having that system there, and having those people be able to be brought back and saved."**
>
> Tom Larkham, Expeditionary Basing and Collective Protection Directorate at NSRDEC

Larkham found the work that he did on the project to be personally rewarding.

"I felt great about it, being involved with the program, and having that system there," said Larkham, "and having those people be able to be brought back and saved."

Photo: Patrick A. Albright, U.S. Army

'Speed Bag'

Aerial resupply for troops on the battlefield

By Jeff Sisto, NSRDEC Public Affairs / NATICK, Mass. (March 10, 2015)

The U.S. Army is streamlining efforts to provide squad- and platoon-level ground Soldiers operating in austere environments with an organic aerial resupply capability that will empower and sustain them on the battlefield.

The Enhanced Speed Bag System, or ESBS, fills this capability gap by drastically increasing the survivability rate of critical resupply items such as water, ammunition, rations and medical supplies, which must be air-dropped from helicopters to small units on the ground. The system includes a hands-free linear brake, rope, and a padded cargo bag that can hold up to 200 pounds and be dropped from 100 feet.

ESBS was originally developed by engineers from the Natick Soldier Research, Development and Engineering Center's Aerial Delivery Directorate and the Armament Research, Development and Engineering Center's Logistics Research and Engineering Directorate to standardize the improvised airdrop methods used in theater to resupply units in remote locations where traditional resupply methods, such as truck convoys, are too impractical or threat laden.

"The goal was to standardize ad-hoc techniques used with body bags and duffle bags by providing a material solution and giving units enough knowledge and training to utilize it," said Dale Tabor, NSRDEC's Aerial Delivery Design and Fabrication team leader.

"We originally received this need from the field, specifically for emergency ammunition resupply," said Bob Forrester, an engineer with ARDEC's Logistics Research and Engineering Directorate at Picatinny Arsenal, New Jersey. "We received the requirements, found the funding, and teamed with Natick as the technical lead.

"Essentially, we worked the ammunition survivability piece, and NSRDEC worked the aerial delivery piece," Forrester said.

At an evaluation conducted in July 2013 at Fort A.P. Hill, Virginia, teams packed six ESBS cargo bags with 12,720 rounds of ammunition, each distributed based on a squad-level basic load, and dropped from a 100-foot crane. They thoroughly inspected the rounds and conducted a live-fire to determine the ammunition system's effectiveness.

The results were a 98-percent survivability rating of ammunition dropped with the ESBS — a vast improvement from the 50-60 percent experienced with ad-hoc methods.

Subsequent evaluation at Army Expeditionary Warfighting Experiment Spiral I 2014, prompted ARDEC to "recommend the immediate fielding of ESBS to deployed Soldiers," Forrester said.

"What we have done is taken resupply to the lowest possible level — the squad and platoon levels," Tabor said.

"Soldiers at unit level are trained how to get the system packaged, loaded in the aircraft, and delivered," Tabor said. "In this way, ESBS provides an organic resupply capability."

Advancement of the system gained increased momentum through the involvement of the U.S. Army's Rapid Equipping Force, or REF, an organization uniquely chartered to combine requirement validation, acquisition authority and flexible funding under one roof.

REF's mission to "harness current and emerging technologies to provide immediate solutions to the urgent needs and capability gaps faced by Soldiers deployed globally" led it to the ESBS.

"REF received a 10-liner requirement from a unit that needed a safe and reliable way to resupply water and other critical items to ground Soldiers, in a location where traditional resupply options, such as convoys, were not practical due to environmental factors and threats," said REF project manager Todd Wendt. "The unit was aware of NSRDEC's Enhanced Speed Bag System and identified it as a possible technology solution. Upon mission analysis and further market research, REF identified ESBS as a good candidate solution."

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Food for Thought

Research team shapes future of combat rations

By Bob Reinert, USAG-Natick Public Affairs / NATICK, Mass. (Jan. 21, 2015)

What kinds of rations might the military be using to feed its warfighters 15 years from now?

Seeking to provide a window into the future of combat feeding, the Consumer Research Team, or CRT, working on behalf of the Combat Feeding Directorate of the Natick Soldier Research, Development and Engineering Center, developed an online questionnaire for current and former military members.

A more detailed version of the questionnaire can be completed by Department of Defense personnel whose work involves military field feeding.

"This is a great opportunity," said CRT's Wendy Johnson. "It's very unusual, in my experience, that we stop and we think 15 years ahead and say, 'What can we do?' Taking a look at the long term is very interesting, and I think it'll be very beneficial in the long run."

As Johnson pointed out, the Future General Purpose Operational Ration, or FGPOR, could take any form.

"We try not to say MREs [Meals, Ready-to-Eat] because we're trying to think outside the box," Johnson said. "It doesn't have to be an MRE. They can look very, very different.

"Do we have to give them meals? Can we think about it in a different way? And can we give them a bunch of foods that maybe they can graze on?"

The CRT began its process about 18 months ago with a series of focus groups. The participants were told that rations could take on virtually any configuration.

"They were pretty interesting," Johnson said. "There were a lot of things that came up. What we were looking for were things that came up maybe multiple times."

Among the concepts that interested the focus groups were just-in-time delivery of rations, producing food with 3-D printers, and tailoring rations to parts of the world or missions.

Johnson said she was surprised by how much the groups focused on education.

"They're talking about educating the Soldiers, for one thing, and also educating their chain of command, so that everybody is aware of the importance of nutrition and how the rations fit into that," said Johnson, noting that this aspect of combat feeding is "not always fully understood."

Jeannette Kennedy, a senior food technologist at Combat Feeding, added that field rations are about "performance fueling and performance nutrition."

With data from focus groups in hand, four members of the CRT went to work fashioning the questionnaire.

"We went over every, single idea and talked it over and made sure that it was as clear and as concise as possible," Johnson said. "That took up a lot of time. I think we've got a good set of ideas from that whole process."

The basic questionnaire consists of 14 random questions and takes five to seven minutes to complete. The extended version, for subject-matter experts, asks them to rate 14 ration ideas, and they also have the opportunity to identify any obstacles they see to making each of those ideas a reality. This version of the questionnaire takes seven to 10 minutes.

Johnson said the questionnaire will be online through March.

"We tried to streamline it and make it go as quickly as they wanted it to go," Johnson said of participants. "Some people like to linger and think things over, and they're free to do that.

"We hope they'll be interested, and we hope that they take it seriously and they give us good, accurate answers."

CAC users can access the questionnaire at https://surveys2.natick.army.mil/Surveys/rations.nsf. Those without CACs can find it at https://surveys.natick.army.mil/Surveys/rations.nsf.

Following data analysis on the completed questionnaires, CRT will deliver actionable requirements and concepts to Combat Feeding. These requirements will form the basis of future science and technology programs, which one day will lead to a FGPOR aligning with requirements projected today.

"This is another opportunity for us to gather information from our military customers on their requirements, in particular their future requirements," said Kennedy, "so that we can focus our efforts on meeting those needs."

Photo: Michael Stephen, Combat Feeding Directorate

The Consumer Research Team at the Natick Soldier Research, Development and Engineering Center has posted an online questionnaire that will help the center's Combat Feeding Directorate determine the direction it will take with future operational rations.

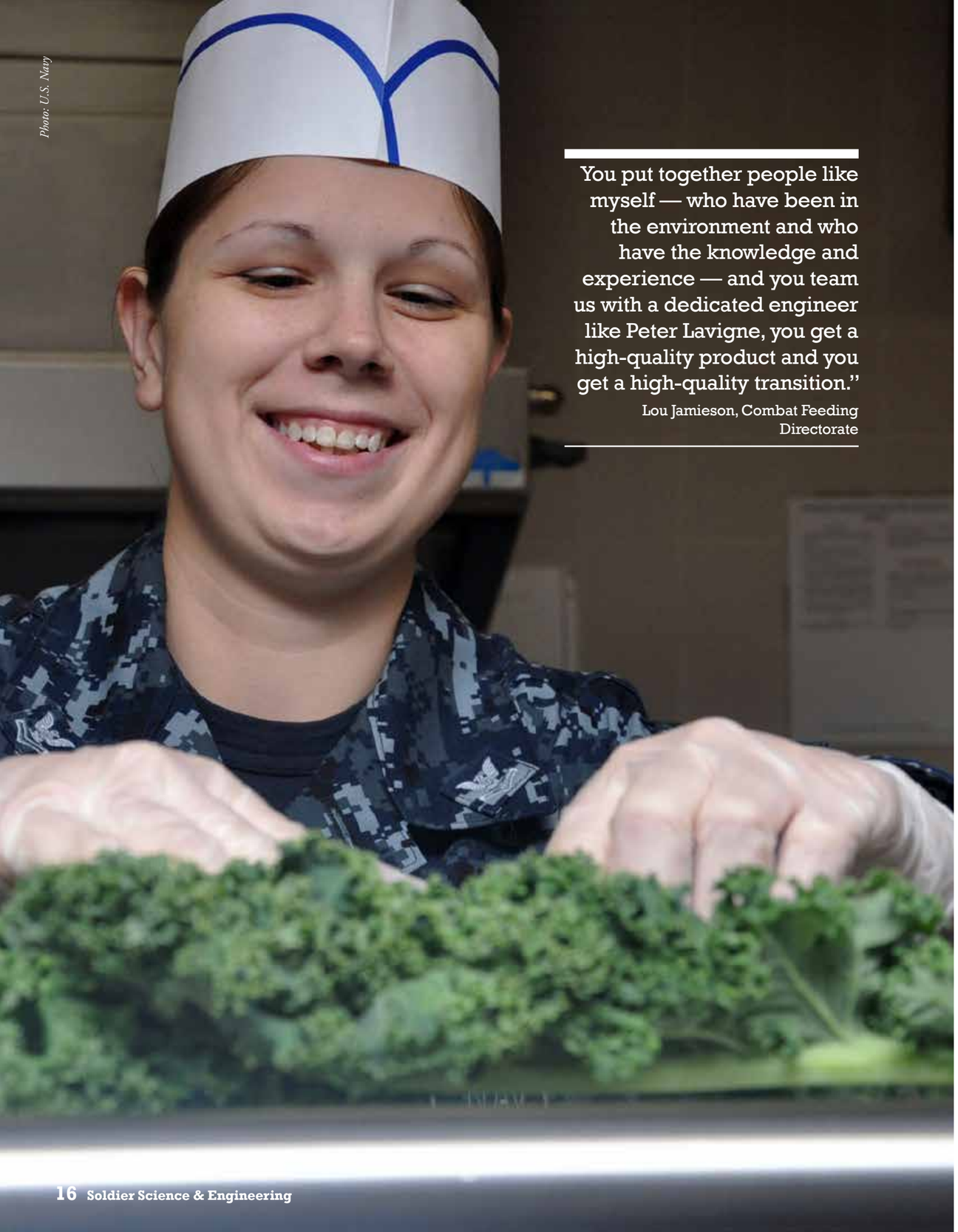

Photo: U.S. Navy

> You put together people like myself — who have been in the environment and who have the knowledge and experience — and you team us with a dedicated engineer like Peter Lavigne, you get a high-quality product and you get a high-quality transition."
>
> Lou Jamieson, Combat Feeding Directorate

Ocean Fresh

Combat Feeding helps Navy keep produce from spoiling

By Jane Benson, NSRDEC Public Affairs / NATICK, Mass. (Dec. 16, 2014)

Researchers at the Natick Soldier Research, Development and Engineering Center, or NSRDEC, are working to make sure fresh produce isn't lost at sea.

Fresh fruits and vegetables are diet essentials, but keeping produce fresh can be particularly challenging aboard Navy aircraft carriers. Refrigeration helps prolong the shelf life of produce, but a technology was needed to help combat the effects of ethylene gas. Ethylene is a naturally occurring plant hormone that helps plants ripen but also leads to spoilage. Certain types of produce, such as bananas and apples, produce large amounts of ethylene and can accelerate the spoilage of nearby produce, as well. Even low levels of ethylene can destroy a produce shipment in less than a day, but reducing the presence of ethylene can extend shelf life by days and even weeks.

To help extend the shelf life of refrigerated produce aboard Navy aircraft carriers, researchers in NSRDEC's Combat Feeding Directorate, or CFD, partnered with Primaira of Woburn, Massachusetts, to scale up extended preservation technology originally developed under an Army Small Business Innovation Research, or SBIR, contract.

"The technology is based on ultraviolet, or UV, light," said Peter Lavigne, a chemical engineer on CFD's Equipment and Energy Technology Team, who has researched extended preservation technology since 2006. "It scrubs the air and eliminates the ethylene gas. Another strong benefit of UV light is its antimicrobial activity and associated ability to reduce mold growth and even inactivate spores that may be present in the air."

This Ethylene Control Device, or ECD, safely and rapidly oxidizes ethylene to carbon dioxide and water vapor. By continually removing ethylene, the device slows the spoiling process, keeping produce aboard ships fresher longer.

The ECD has been configured as a modular enhancement kit that is inserted into existing refrigerated containers aboard ships. With a small amount of electrical power, the ECD safely decomposes the volatile and microbial contaminants yet avoids the labor-intensive and material-handling challenges presented by traditional ethylene-control practices, which include blankets, filters and pellets that chemically bind or absorb ethylene and moisture. For a ship at sea for long periods, these practices have posed significant logistical burdens attributed to stocking, maintaining, and ultimately disposing of materials that are in some cases regulated as hazardous waste.

The ECD was specifically developed to avoid these challenges and provide an effective, compact, low-power, low-cost, and easy-to-maintain solution.

"You're reducing costs of losses by not having to throw it away," said Lavigne. "With this technology we see a marked reduction of browning, wilting, and mold growth."

"They don't have to replenish as often," said Lou Jamieson, a retired Navy master chief petty officer and a CFD Navy project officer on the Systems and Engineering Team. "So if you think about this in the case of a ship with a critical mission, it could be in one ocean and then might have to head full speed to another ocean. You may have to forgo your scheduled replenishment. So this technology can help in those types of situations."

"When they are deployed 30-plus days, the extended shelf life is critical," said Lavigne.

"Another major benefit of this technology insertion is a reduced workload for the warfighter," said Jamieson. "An annual bulb change-out is the only maintenance. It is mounted and then it just runs and they can forget about it."

The device has been installed on two Navy aircraft carriers and will ultimately be installed on all eleven in the fleet. CFD has teamed with Primaira to help Sailors properly install and operate the ECDs and will continue to monitor the performance and overall results achieved.

"What we are doing right now is an at-sea evaluation," Jamieson said. "It's currently deployed on one carrier and recently installed on another. Eventually, it will be installed on all the carriers in the Navy. From on-board data collection and observation of produce quality, we intend to determine actual mixed-load (assorted produce) life extension. How much less did they have to order during deployment (due to less spoilage)? How many times did they have to replenish?"

In addition to use on ships, the technology can also be inserted into refrigerated containers for use by the Army, other services, and even commercial refrigerated assets, ensuring the highest-quality fresh produce can be delivered to Soldiers operating in remote forward areas.

Improving quality of life for all service members motivates both men.

"That's why I'm here" said Lavigne. "It's incredibly rewarding to see our work making a difference for our military."

"As a retired Navy master chief petty officer, I'm really enjoying having an impact on all the warfighters and improving their quality of life," said Jamieson. "Our job is to lighten the workload for warfighters and to give them the best quality equipment and technology that we can. We're huge on that. You put together people like myself — who have been in the environment and who have the knowledge and experience — and you team us with a dedicated engineer like Peter Lavigne, you get a high-quality product and you get a high-quality transition."

Soldier Power

Energizing our fighting forces

By Jeff Sisto, NSRDEC Public Affairs / NATICK, Mass. (Nov. 17, 2014)

Wearable technologies may provide U.S. Soldiers with on-the-move, portable energy and reduce the weight of gear they carry into combat.

Researchers at the Natick Soldier Research, Development and Engineering Center are developing Soldier-borne energy-harvesting technologies.

During the Maneuver Fires Integration Experiment, a combined, multi-phase joint training exercise held in September 2014, at Fort Benning, Georgia, researchers tested prototype energy-harvesting technology solutions.

"My initial impression is that they fulfill a need for instant power generation on long-range missions when displaced from traditional resupply methods," said Sgt. 1st Class Arthur H. Jones, an infantryman with the Maneuver Center of Excellence who participated in the demonstration.

A sharp rise in Soldier-worn power capabilities has resulted in a dramatic increase in the number, variety and weight of batteries carried by warfighters in the field.

This weight prompted NSRDEC researchers to begin developing and evaluating small, lightweight, efficient, on-the-move, portable energy-harvesting and distribution systems that eliminate the need to carry extra batteries.

Energy harvesting works by capturing small amounts of energy that would otherwise be lost as heat, light, sound, vibration or movement. It uses that energy to recharge batteries and provide power for electronic devices such as a Soldier's communication equipment, sensors, or battlefield situational displays.

Researchers first demonstrated the concept to Army and government representatives at Fort Devens in April 2014. The demonstration consisted of experienced Soldiers wearing three energy-harvesting devices while traversing a four-mile course that included hard surfaced roads, lightly wooded areas, open fields and hilly terrain.

The technologies, which included wearable solar panels, backpack and knee kinetic energy-harvesting devices, are now being tested at MFIX as ways to reduce the weight and number of batteries Soldiers must carry to power electronic devices.

Lightning Pack's Rucksack Harvester relies on the weight of the backpack to produce kinetic energy when the backpack oscillates vertically in response to the Soldier's walking or running stride. As the backpack is displaced vertically, a rack attached to the frame spins a pinion that, in turn, is attached to a miniature power generator. It is capable of producing 16 to 22 watts while walking, and 22 to 40 watts while running.

Bionic Power's Knee Harvester collects kinetic energy by recovering the power generated when walking. The articulating device is attached to both the upper and lower part of each leg and extracts energy when the knee is flexed. Through software control, the knee harvester analyzes the wearer's gait and harvests energy during the phase of the stride when negative work is being performed. This attests that the Soldier is exhibiting less metabolic activity descending when compared with descending without wearing the device.

MC-10's photovoltaic Solar Panel Harvester operates by converting sunlight into electrical energy. The panels, which cover a Soldier's backpack and helmet, are constructed from thin gallium arsenide crystals that provide flexibility to the panel's material and allow it to conform to a Soldier's gear. Under bright sunlight conditions, with the PV panel facing the sun, the backpack panel is capable of delivering 10 watts while the helmet cover panels provides seven watts of electrical power.

At MFIX, NSRDEC researchers collected power-management data and assessed user feedback from the Soldiers wearing the technologies. Once the energy-harvesting technologies themselves are validated, the next step will be to sync with the Integrated Soldier Power Data System as a way to distribute the energy to a Soldier's electronic devices.

Additionally, "MFIX is looking at new concepts with energy-harvesting devices and how they fit in a tactical environment," said Noel Soto, project engineer, Power and Data Management Team of the NSRDEC Warfighter Directorate.

"MFIX is an important opportunity that allows us to quantify the energy-harvesting technologies that generate Soldier power on the move," said Henry Girolamo, lead, Emerging Concepts and Technologies, Warfighter Directorate, who has been involved with the effort since 2011. "The MFIX Data collected in the experiment will inform us of the power harvester efficiency by comparing energy harvester equipped Soldiers and non-energy harvester equipped Soldiers and states of charge from the energy harvesters versus discharge from non-energy harvester equipped Soldiers."

A Soldier navigates an obstacle course, which is part of the Load Effects Assessment Program, or LEAP. The LEAP includes the most common and most challenging activities that warfighters perform in combat.

Looking before they LEAP

Assessing Soldier load at Natick

By Jane Benson, NSRDEC Public Affairs / NATICK, Mass. (Nov. 25, 2014)

Researchers from the Biomechanics, Human Factors and Anthropometry Teams at the Natick Soldier Research, Development and Engineering Center are conducting a reliability assessment of the Load Effects Assessment Program, or LEAP.

NSRDEC researchers want to determine if the tool, which was developed by the Marines, can be adapted to meet Army needs and provide a reliable method to measure the impact of clothing and individual equipment, or CIE, on Soldier performance.

By understanding how CIE affects the warfighter's ability to move and maneuver through the LEAP obstacle course, scientists and engineers will be able to implement modifications to optimize the design and integration of CIE — thus, improving Soldier-System interface and performance. The reliability assessment is just one in a series of assessments that will be conducted using the LEAP system.

"Natick has partnered with PEO Soldier Product Director Soldier Systems Integration; Maneuver Center of Excellence — Maneuver Battle Lab; and the Army Research Laboratories — Human Research and Engineering Directorate to share the knowledge learned about using the tool and to develop a standard methodology for product assessment using the tool," said Blake Mitchell, a human factors engineer and acting team leader for NSRDEC's Human Factors Team. "This information will also be fed to an international working group consisting of Australia, Canada, New Zealand, the United Kingdom, and the United States, who hope to be able to use the LEAP tool as a joint data-collection tool."

Based on Marine input, the LEAP tool consists of a series of obstacles and mission-relevant activities to resemble challenges that warfighters face in current combat situations. Soldiers participating in NSRDEC's LEAP assessment navigate stairs, ladders, tunnels, windows, walls and balance beams. They also perform a myriad of mission-related tasks, including load transfers, simulated casualty drags, low crawls, high crawls, back crawls and sprints.

"The activities that are part of the LEAP were developed to mimic the most common, as well as the most challenging, activities that warfighters perform in combat," said Mitchell. "This condenses many potential movements and activities of a mission into a single tool. The warfighter's performance, including subjective opinions, provides insight into his or her range of motion, comfort, mobility and endurance, as impacted by the CIE configuration worn."

As part of the reliability assessment, Mitchell and her team documented how many times Soldiers had to go through the course before data was consistent.

"Our research program has many facets to it, and this is just the first step," said Mitchell. "In order to implement the tool, we need to understand some of the scientific underpinnings of it. And in this case, (we) want to better understand if consistent data can be collected, and if so, how many times do individuals need to complete the course to perform consistently? As a first step, this is being accomplished with the Soldiers wearing minimal equipment, but as we move forward, it will be investigated with additional CIE and loads."

Tyler Brown, a research physiologist on NSRDEC's Biomechanics Team, is working on a second research project based on the LEAP tool. He is not using the LEAP tool as a whole for research, but is conducting a laboratory-based study mimicking movements taken directly from select LEAP tasks.

"The overarching purpose is to establish a scientific understanding for why differences in weight between various configurations of clothing and individual equipment impact Soldier performance," said Brown. "The clothing and individual equipment Soldiers wear can have different weight, stiffness and bulk characteristics. All of which may impact physical performance. With this study, we are trying to establish how Soldiers' performance, especially their trunk and lower limb biomechanical profile, is impact by small changes in the weight of CIE."

"Researchers may be able to compare whether a bulkier configuration of CIE has a significant reduction in physical performance compared to less bulky configuration," said Brown. "Researchers may also be able to compare performance on specific tasks embedded in the LEAP. For instance, they might be able to compare whether the bulky configuration had a significant impact on performance during the agility run, or why performance between the bulky and less bulky configurations of CIE was not different on a vertical jump."

The tool may prove to be a LEAP forward.

"LEAP is a tool that can be useful for future clothing and individual equipment studies to better understand the effects that CIE has on Soldier performance," said Mitchell.

Photo: Edwin Aguirre

HEROES Working Together

Quoc Truong, a physical scientist at Natick Soldier Research, Development and Engineering Center, or NSRDEC, is shown working with Colleen Cannon, who is pursuing her M.S. in plastic engineering at the University of Massachusetts Lowell. NSRDEC and UMass Lowell are working together to improve life for the Soldier.

NSRDEC, UMass Lowell combine forces

By Jane Benson, NSRDEC Public Affairs / NATICK, Mass. (Jan. 29, 2015)

The Natick Soldier Research, Development and Engineering Center, or NSRDEC, and the University of Massachusetts Lowell are working together to make life better for the Soldier.

The two organizations are collaborating as part of a joint research and development initiative called Harnessing Emerging Research Opportunities to Empower Soldiers, or HEROES.

"This unique partnership benefits all by being able to effectively combine the best of both organizations — people, facilities and expertise — to work together to find creative and innovative solutions to improve the safety, mobility and sustainability of our warfighters," said Lynne Samuelson, Ph.D., NSRDEC co-director of the HEROES program and an NSRDEC senior scientific adviser. "HEROES also helps draw in other external partners in academia and industry to all work together to advance (science and technology) for our warfighters."

Through the HEROES program, dozens of engineers and scientists from NSRDEC and faculty members and students from UMass Lowell are working together to solve complex scientific and engineering challenges.

"As NSRDEC co-director of HEROES, I am thrilled to be able to work with the UML co-director, Professor Ramaswamy Nagarajan and the team at UML, to identify, establish, mentor, and provide continual scientific, programmatic and logistical oversight to valuable and mission-relevant HEROES collaborations that will advance Soldier (science and technology)," said Samuelson.

Areas of collaboration include Soldier protection (flame and thermal, environmental, chemical/biological, ballistic and antimicrobial protective materials), and Soldier sustainability (airdrop parachutes and parafoils, nutrition, power-generating nanocomposites, wearable thermo-electrics, as well as combat rations, combat ration safety, and novel food packaging).

"It is anticipated that new, exciting advancements will be made in each of these areas that will benefit our warfighter," said Samuelson.

One of the NSRDEC scientists participating in the collaboration is Quoc Truong. Truong believes that the program brings together complementary expertise. The professors teach theory and concepts while NSRDEC scientists are working to develop practical applications.

"By working together, it's like the right hand working with the left hand," said Truong. "It makes things more complete."

"I am currently working with Quoc Truong on a project developing environmental, chemical/biological protective membranes that will be comfortable to wear, be selectively permeable, allowing breathability while protecting the Soldier from toxic chemicals, viruses/bacteria, liquids, vapor," said Bridgette M. Budhlall, Ph.D., associate professor, UMass Nanomanufacturing Center at UMass Lowell. "Being able to leverage my research's group expertise in polymer coatings to help and protect the Soldier is an honor for me."

"The UMass Lowell/NSRDEC collaboration provides the opportunity to work with an excellent scientist on projects that are important for our nation's well-being," said Nese Orbey, Ph.D., associate professor, chemical engineering, University of Massachusetts Lowell, who is also working with Truong.

Students benefit from the program, as well.

"HEROES is a great opportunity for NSRDEC (scientists and engineers) to provide UML students valuable firsthand experience in research, innovation and potential commercialization of promising Soldier technologies," said Samuelson. "For many of these students, it is their first exposure to a laboratory outside of academia, and through HEROES they are able to apply their studies to exciting real-world military applications. Our NSRDEC (scientists and engineers) also benefit from the fresh ideas, dedication, passion and excitement that the students bring to each project. Ultimately, the DoD may benefit from the development of future DoD scientists."

Continued on page 31

Photo: Australian Army WO2 Andrew Hetherington

Neutral Ground

Women in Service Review rollout due January 2016

By Amaani Lyle, DoD News, Defense Media Activity / WASHINGTON (Jan. 12, 2015)

Following the 2013 repeal of the Direct Ground Combat Definition and Assignment Rule, the secretary of defense is scheduled to announce final decisions to integrate remaining closed occupations and any approved exceptions to policy on or about Jan. 1, 2016.

Juliet Beyler, the Defense Department's director of Officer and Enlisted Personnel Management, reported "good progress" in the Women in Service Review, which validates all occupational standards to ensure they are operational, relevant and gender-neutral by September 2015.

"Throughout the course of the review of the regulations governing women in the military, we determined that the time had come to do away with the direct ground combat rule and open all positions to women instead," Beyler said.

The goal, she explained, is to expand opportunities to ensure that all service members are eligible to serve in any capacity based on their abilities and qualifications, and to "remove those old gender-based barriers to service that no longer made sense."

When Chairman of the Joint Chiefs of Staff Gen. Martin E. Dempsey and former Defense Secretary Leon E. Panetta removed the direct combat ground rule in 2013, they realized the need for a deliberate and measured approach to ensure the smoothest transition, Beyler said.

U.S. Army 1st Lt. Audrey Griffith points out an area of interest during a force protection drill to Spc. Heidi Gerke along the perimeter of Forward Operating Base Hadrian in Deh Rawud, Afghanistan, March 18, 2013. Both women are members of the 92nd Engineer Battalion from Fort Stewart, Ga.

The services, she said, have been conducting various studies in order to review, validate and complete their occupational standards by the fall of 2015. "We're on track and moving toward that goal," Beyler said.

Since rescission of the definition and rule, Beyler said, the DoD has notified Congress of the integration of about 71,000 positions previously closed to women. This development, she said, can positively affect the force by allowing people to serve based on their ability.

"Expanding opportunities to women, to include the 71,000 we've already opened since 2013," Beyler said, "[gives] a wider pool of qualified people so that commanders have greater flexibility … and it'll strengthen the all-volunteer force."

More than 280,000 women have been deployed to Iraq and Afghanistan, including Beyler, who's a two-time combat veteran.

"I like to say that women have been serving in combat since the Revolutionary War, but the 280,000 that we've recently seen deployed have contributed in immeasurable ways," Beyler said.

She said there were various ways in which women were restricted from occupations under the direct ground combat rule, primarily preclusion from assignments to combat units below the brigade level.

"But there were other restrictions, such as for physical requirements or positions associated with special operations or long-range reconnaissance," she added. "We are reviewing all of the occupational standards."

The services, she said, "are expending a good amount of their time on those 100-percent closed occupations."

Historically, the department had opened positions by exception, but it now has acknowledged it would make more sense to "flip the presumption," Beyler said, so that all positions will be open to women unless there's a reason that they should be closed.

Guidance to the services and to U.S. Special Operations Command includes a provision in which a military department secretary or service chief can request an exception to policy to keep a position closed, Beyler said.

"But any exception is going to have to be rigorously justified and will have to be based on the knowledge, skills and abilities required to perform the duties of the position," she said.

Regarding assignments, training, and accessions, Beyler said those elements have been and will continue to be service responsibilities.

As defense secretary, Panetta directed each of the services and SOCOM to develop individual implementation plans tailored to their unique requirements, she said.

"As we have with the positions we've already opened and the ones that we'll continue to open throughout the next year and beyond," Beyler said, "each service will use the regular accession and training assignment pipelines and timelines that they've always used."

The process of opening more military occupations to women is about maintaining the all-volunteer force and readiness, Beyler said.

"More than 90 percent of our occupations are already open to women and 15 percent of our forces are women," she said. "By removing these antiquated gender-based barriers to service, it can only strengthen the all-volunteer force and allow people to serve based on their ability and their qualifications."

Reducing Waste

Army conducts base camp technology demonstrations

By Jeff Sisto, NSRDEC Public Affairs / NATICK, Mass. (Dec. 19, 2014)

The Army took another step toward increasing self sustainment, while saving energy at its contingency bases overseas.

Army researchers recently completed Demonstration 1, the first in a series of demonstrations looking at energy-saving technologies, which will reduce the fuel, water demands and the waste generated for backhaul currently experienced at small base camps in forward operational environments.

The demonstrations support the Sustainability Logistics Basing, Science and Technology Objective-Demonstration, known as SLB-STO-D (formerly TECD 4a). The program was initiated by the Army in 2012, to reduce the cost and risk associated with mounting resupply burden at expeditionary bases, and serves as the guiding framework for the effort.

"The Army needs improved capability to enable independence/self-sufficiency and to reduce sustainment demands at contingency bases," asserts the SLB-STO-D problem statement collectively developed by the Army Science and Technology Advisory Working Group. "It is too costly, too unpredictable, and too labor intensive for a small unit to carry all required consumables to last for weeks or months at a combat outpost or patrol base. Storage facilities and systems do not meet the needs of these small bases, and resupply efforts are highly unpredictable."

The primary objective is to reduce fuel consumption by 25 percent, water demands by 75 percent and generated waste for backhaul by 50 percent at extra-small and small bases — all while maintaining standards for Soldiers' quality of life, or QoL.

Pursuing this objective required a lead organization that understands the relationship between base camp efficiency and QoL measures, provides data-based technology analysis, and has the ability to leverage collaboration with key science and technology partners across the operational spectrum.

The lead for this highly collaborative effort went to the Research, Development and Engineering Command, or RDECOM, and is being managed by the Natick Soldier Research, Development and Engineering Center, or NSRDEC.

"Integrated base camp technology solutions are an enduring problem that impacts Soldier readiness," said Gregg Gildea, the SLB-STO-D lead for NSRDEC. "We are addressing it through a model-based, systems engineering approach that uses data collection and analysis of both materiel and non-materiel solutions, along with operationally relevant physical demonstrations."

"The results of operationally relevant Demonstration 1 will provide input to modeling and simulation applications, which will validate the methods used to address this challenge," explained Gildea. "Army leadership and policy makers will make informed decisions based on the data collected and presented by SLB-STO-D and QoL information."

NSRDEC's Experimentation, Demonstration, and Validation Team, or EDVT, is leading the integrated field demonstrations that make up Demonstration 1, which seeks rigorous data collection and analysis of technologies identified as potential solutions to the Army's operational energy gaps.

"The purpose of the demonstration was to collect data on select candidate technologies in an operationally relevant environment," said Bill Harris, EDVT lead. "It's an opportunity to showcase the maturity of these technologies to our partners and analyze their effectiveness."

In order to replicate relevant field conditions, Demonstration 1 was conducted at the Base Camp Integration Lab, or BCIL, at Fort Devens, Massachusetts, which features two 150-man "Force Provider" base camps designed for testing and evaluating Army expeditionary basing programs. While one camp contains the current operational baseline that acts as a control, the other offers an experimental platform to insert and assess energy-saving technologies of the future.

The BCIL's size and versatility offered an ideal venue to conduct the first phase of Demonstration 1, which focused on extra-small base camps of 50 to 299 Soldiers. Starting with a 50-man base camp allowed SLB-STO-D researchers to establish a baseline of interest and collect data to calibrate technologies for subsequent demonstrations of larger base camps.

"Force Provider is a 300-man camp with structures, but we used it as a surrogate for a 50-man camp located in an austere environment, to demonstrate where technology can fill energy gaps," said Gildea.

Several of the candidate technologies at Demonstration 1 were developed by partners at the Communications-Electronics Research, Development and Engineering Center, or CERDEC, and the Tank Automotive Research, Development and Engineering Center, or TARDEC. These included solar shades and micro-grids designed to fill energy gaps supporting fuel, water and waste reduction.

The Renewable Energy for Distributed Under-Supplied Command Environments, or REDUCE, is a mobile, scalable, intelligent framework of solar panels that enables remote power generation through a 1.5kW power solution. REDUCE features upgraded energy storage devices and power management controls that reduce the power requirements from generators and provide users with power-status information. The system will reduce the cost and logistic burden of delivering fuel to small base camps.

The On-Board Vehicle Power/Tactical Vehicle-to-Grid Module, or OBVP/TV2GM, is a mobile, bi-directional power generation and management system that generates power from the vehicle's transmission and accepts multiple electrical power-generating input sources. OBVP allows Soldiers to utilize vehicles, solar power systems, tactical generators and host-nation grids to more efficiently distribute the energy needed to power heating, air conditioning and lighting requirements at small base camps. This means that less fuel and maintenance is needed for existing generators.

The JP-8 Fueled, Man-Portable Genset for Power Generation for Expeditionary Small Unit Operations is a lightweight, Soldier-portable, JP-8 fuel conversion kit that adapts gasoline engines for JP-8 fueling. Utilizing this fuel conversion technology will provide Soldiers with more self-sufficiency and reduce the logistical demands of fuel requirements.

Soldiers from the 542nd Quartermaster's Force Provider Company, were trained on these power management technologies and provided invaluable feedback through a focus group session.

While innovative technologies improve energy-saving capabilities, they do not fully address the QoL issues facing Soldiers at contingency bases, such as the availability of hot and fresh food, the ability to take showers and access the Internet.

For this perspective, NSRDEC utilized the expertise of its Consumer Research Team, or CRT, which develops and conducts surveys that measure Soldier insight about the QoL aspects of a new technology or concept.

"Base camp conditions drive the Soldier's quality of life," said Justine Federici, a researcher with the CRT. "QoL affects sleep, hygiene, morale and other factors impacting Soldier readiness."

"Surveys are designed around seven categories that impact Soldier-QoL, including billeting, security, hygiene, work area, medical care, morale and recreation opportunities," said Federici.

The survey data and feedback collected at Demonstration 1 will provide researchers with critical input to conduct a "tradeoff analysis" between saving energy and preserving certain QoL standards, Federici explained.

"A QoL model will be provided to the SLB-STO-D and the contingency basing community," said Federici.

The next phases of Demonstration 1 are scheduled for April 2015, and July 2015, when researchers collect data at 600-1000-man camps and 150-599-man camps, respectively.

The SLB demonstrations will serve decision makers with validated, scientific analysis that balances the energy saving capabilities and QoL standards necessary to make contingency bases more self-sufficient and Soldiers more resilient.

Feeding Frenzy

Natick hosts Food Science & Industry Day

By Jane Benson, NSRDEC Public Affairs / NATICK, Mass. (Nov. 7, 2014)

Science and the spirit of collaboration ruled the day on Oct. 30 at the first Food Science and Industry Day held by the Combat Feeding Directorate, Natick Soldier Research, Development and Engineering Center.

To provide the warfighter with the highest quality food that science can offer — including optimal nutrition, taste and freshness — NSRDEC CFD combines its impressive knowledge of food science and technology with that of industry and academia. CFD's core competencies include applied nutrition and biochemistry; food engineering preservation and stabilization; food protection, defense and microbiology; food service equipment engineering; food packaging and polymer science; and product development, technical evaluation and ration design.

"Our mission in hosting the first-ever Food Science & Industry Day was to use it as a means of communication with which to deliver project updates, strategic vision, future areas of effort, and overall program goals," said Jeremy Whitsitt, team leader, Office of the Director, CFD. "It also provided a unique forum wherein CFD project officers could engage in valuable dialogue directly with our visitors. Using various methods of communication such as poster presentations, hands-on demos, and laboratory tours, we tried to provide an interesting, thought-provoking, and overall fun experience for all involved."

Food Science and Industry Day provided the approximately 100 attendees with the chance to learn the particular challenges and constraints of developing combat rations and equipment for the nation's warfighters, who often operate in remote locations under austere conditions, as well as information on how to do business with the government.

"Our partners in operational ration research, development, test, evaluation, and production are extremely critical to the success of our total life-cycle joint program," said Whitsitt. "We know that we can't do this alone. Our unique mission requires that we leverage both financial and intellectual resources in order to be effective. Our partners — whether they are from academia, industry, or other government agencies — bring a lot to the table. Any collaborative endeavor requires effective and consistent communication."

John McNulty, executive director of Research & Development Associates for Military Food & Packaging Systems, Inc., attended the event. R&DA is a national trade association whose members include major food manufacturers and suppliers who provide food and rations to the U.S. government in the military marketplace. McNulty had high praise for the event.

"Sixty-three key industry players, who are intimately involved in the production and distribution of military rations and food, got to see first-hand, the extensive research — both tech base and production and engineering research — that goes into the development of military specification rations," said McNulty. "It was an eye-opening experience for everyone participating."

At the heart of the event was CFD's ongoing commitment to the Soldier.

"It's a great feeling that our work helps (improve) the rations and nutrition for our warfighters," said Ken Racicot, a CFD food technologist/nutritional biochemist. "I'm always thankful for the opportunity to be a part of this program."

"Nothing tops the fulfillment of seeing the Soldiers maintain their top condition, physically and mentally, by eating the rations we improved or developed," said Dr. Tom Yang, a senior CFD food technologist.

Speedbag

The ability to directly engage with deployed units and access business practices across the Army's functional areas allowed the REF to facilitate a comprehensive approach to ESBS validation.

"By leveraging an existing Army effort, REF is able to give deployed Soldiers solutions even faster than if we started a project from scratch. This also means we can help our friends at NSRDEC Aerial Delivery Directorate, by getting their design into the hands of Soldiers and collecting operational feedback. It's just one example of how REF can address an urgent need, but at the same time, also help advance a technology and support a big Army solution," Wendt said.

In December 2014, Tabor's team led a Train-Up event at the Rhode Island Air National Guard base in Quonset Point, Rhode Island. The multi-organizational event included personnel from NSRDEC, ARDEC, U.S. Army Mountain Warfare School, Vermont National Guard, Rhode Island Air National Guard and the REF. The purpose was to train REF tiger teams and members of the Army's MWS on the proper use and deployment of the ESBS.

The training focused on receiving the ESBS kit, unpacking it, setting up the rigging in the aircraft and learning the packing procedures — skills that will be passed on to Soldiers who will use the system.

The ESBS training will provide the MWS instructors a period of instruction on small unit resupply that meets the needs of mountain Soldiers, while the REF trainers will take the knowledge they gained directly in theater to train units requesting the capability.

"The initial info seemed complex, but today, I definitely feel sufficient to train Soldiers on this system," said Dusty Hunt, training consultant, Rapid Equipping Force, Tiger Team, at Fort Benning, Georgia. "With the old methods, they were losing 50 to 60 percent of the supplies. Finally, there is a good solution in the ESBS, which we will take to Afghanistan to train the unit's trainers."

"We rehearsed on the ground, and conducted a final check for rigging and spotting," said Jason Miller, training consultant, REF, Tiger Team, at Fort Bragg, North Carolina. "From the aircraft, we looked at how the bundles fell and responded to the drop."

In an after-action review, or AAR, the REF trainers had positive and insightful comments about the system.

"We learned that rigging the system is key to a successful drop. So attention to detail in how it's rigged is important," Miller said.

Photo: Patrick A. Albright, U.S. Army

"Also, more elaborate communication with the pilot and the aircrew should be explored."

"There were weather limitations, but the job went well," Miller said. "We lost only one water bottle out of more than 240 and additional five-gallon jugs dropped. It was an outstanding result — we had no issues."

"The benefit is the simplicity of it," Hunt said. "You can take a regular Soldier and train them on ESBS, as long as they are comfortable in the aircraft."

"Aerial resupply also means one less convoy needed on the road, and that's a good thing," Tabor said.

The ESBS will undergo further testing throughout 2015. If the system is selected for fielding, a formal program of record, or POR, will be established, and the REF will have met the immediate need.

Natick researchers integrate Soldier sensors

By Jeff Sisto, NSRDEC Public Affairs / NATICK, Mass. (Jan. 6, 2015)

To the modern, dismounted warfighter, the saying "knowledge is power" is true, especially when making quick decisions based on limited information.

Scientists and engineers from the U.S. Army Natick Soldier Research, Development and Engineering Center, or NSRDEC, are working hard to make information assets a fundamental component of the Soldier's kit.

"The ability to collect, process and share battlefield information can greatly improve the chances of mission success and troop survival," said Dr. David Darkow, the Mission Information team leader with NSRDEC's Warfighter Directorate.

Army researchers are developing a fully-integrated, mobile platform that provide dismounted Soldiers at the squad level with organic and shared sensor information to enhance situational awareness on the battlefield.

During a November 2014 experiment at Fort Benning, Georgia, Natick researchers teamed Soldiers with unmanned vehicles and brought Full Motion Video, or FMV, sensing sources to the Nett Warrior system — a smartphone-based device that supports advanced navigation, friendly-force tracking, command and control communications, and other sensor-fed information portrayals to Soldiers on the ground.

The Natick team developed the components that integrated with Nett Warrior's software architecture. The system is scheduled to transition to the Army's Project Manager Soldier Warrior where it will be one step closer to fielding.

The Nett Warrior Future Initiatives Team was key to ensuring the experiment resulted in the successful integration and transition of the FMV information portrayal concept into the Nett Warrior system, Darkow said.

"NSRDEC's role is to improve the Soldier experience," he said. "We provided support that helped transition the concept and we continue to support the NWFI team with its development by focusing on the Soldier's perspective of the system."

The team's goal was to achieve full integration of various intelligence surveillance reconnaissance sensor feeds into the Nett Warrior platform to maximize the tactical information available, while supporting the broader objective of getting this capability into the hands of Soldiers at the squad level, he explained.

The NSRDEC Mission Information Team also linked video feeds from squad-organic sensors such as the Dragon Runner 20 Unmanned Ground Vehicle and the Cargo Pocket-Intelligence, Surveillance and Reconnaissance, as well as an overwatch capability from Raven unmanned aerial vehicles.

To do this, Darkow's team developed and incorporated into the Nett Warrior platform a mobile, plug-in software application, called the Tactical Video Viewer, which auto-populates what sensor feeds are available and links users to the source's live video feed.

In this way, Nett Warrior "acted as a full-motion video server that rebroadcast those video streams on demand to other Soldiers in the squad," Darkow said.

"Soldiers see a moving map application that displays blue (friendly)-force tracking, C2 (command and control) information, and full-motion ISR video feeds," Darkow said. "Instead of just following dots on a map, Soldiers at the small unit and company levels can be viewing the same emerging battle space picture."

More work is still needed to expand integration and control of battlefield sensors that will enhance the tactical information portrayal for viewing by dismounted Soldiers in austere environments, Darkow said.

"The team provided the first opportunity to put this emerging NSRDEC technology into a Soldier's hands at the squad level within an operationally relevant context," he said. "It awent really well."

The Tactical Video Viewer is scheduled to transition to Nett Warrior and Project Manager Soldier Warrior, where the system will be optimized for Soldier performance.

Natick leads aerial delivery joint team of the year project

By Jane Benson, NSRDEC Public Affairs / NATICK, Mass. (Feb. 23, 2015)

The High Speed Container Delivery System Joint Capability Technology Demonstration, or HSCDS JCTD, Team has been chosen by the Office of the Secretary of Defense, or OSD, for the 2014 JCTD Team of the Year award.

The JCTD Program encourages joint service efforts to effectively and efficiently meet the needs of the joint warfighter.

The HSCDS JCTD Team technical manager was Mike Henry, a research aerospace engineer in the Aerial Delivery Directorate at the Natick Soldier Research, Development and Engineering Center, or NSRDEC.

"Airdrop, by nature, is a joint effort, and HSCDS is no different," Henry said. "U.S. Transportation Command and USAF Air Mobility Command work closely together to support the airdrop mission. While the Air Force executes most of the airdrops, it is common for the Army to be the recipient on the ground and can be viewed as the end user."

The new system is more efficient at faster aircraft speeds and lower aircraft altitudes than standard airdrop and enhances the safety of ground forces.

"By flying faster, the aircrew is exposed to the ground threat for less time, the aircraft is more maneuverable, and it has a greater rate of climb to fly out of terrain, enabling access to more drop zones and reducing the need for ground convoys," Henry said. "Also, the automated release sequence greatly reduces the variance seen during a manual release process, resulting in a more consistent and accurate delivery of payloads on the ground. More accurate payloads means the ground forces need to secure a smaller area on the ground and can recover the bundles faster, reducing their exposure to threats."

The system benefits the Army and the Air Force.

"HSCDS provides an airdrop capability that is low and fast to enhance aircrew survivability and effectiveness while also making it more accurate for the users on the ground, meeting the needs of users from both services," Henry said.

The HSCDS JCTD Team included people from multiple services.

"Our operational manager was from USTRANSCOM, who also supported this effort with funding," Henry said. "Our deputy operational manager was from the Air Mobility Command. In addition, Air Force Test and Evaluation was our independent assessor for the effort. NSRDEC was the technical manager for the effort, while Product Manager Force Sustainment Systems was the transition manager for HSCDS. All of the organizations worked to develop the HSCDS capability, in addition to keeping our USSOCOM users in the loop on the development."

The resulting product integrates several different technologies that enhance airdrop for aircrews and ground warfighters.

The Aerial Delivery Directorate at NSRDEC has an excellent track record of successful joint aerial delivery project execution across DOD. The directorate has now executed three ACTD/JCTDs for OSD as technical manager and has garnered "Team of the Year" awards for all three efforts, including the Joint Precision Air Drop System, or JPADS, in 2009, the Joint Medical Distance Support and Evaluation, or JMDSE, in 2011, and now HSCDS in 2014.

"I'm extremely proud of the HSCDS Team being recognized with the JCTD Team of the Year award," said Richard Benney, director of the Aerial Delivery Directorate at NSRDEC. "This OSD/USTRANSCOM-funded JCTD required a significantly challenging technical design and schedule, coordination with many partner organizations, and an enormous dedication of time and effort by all team members to meet this warfighters' joint challenge. We look forward to supporting the PM-FSS formal program of record, which has just started to formally field the HSCDS capability to the joint warfighter."

"The team had great people who stayed focused on who we were all there to serve: the joint warfighter," Henry said. "Everyone recognized that fact, and it helped inspire a can-do attitude. The team had a great mix of experience and expertise to develop a product that provided new capability but was also usable in the field."

For Henry, seeing great ideas become a reality for the warfighter is what it's all about.

"I like being able to see a project over the course of various phases of development within S&T," Henry said. "I like the fact that I can be in a room with folks drafting up an idea and then I can follow that idea through to fabrication, lab testing and, when that idea fully comes to fruition, I can be in the back of the plane, watching it go rolling out."

"Why should we have two to three pounds of excess equipment permanently attached on that rucksack that they've got to carry around with them?" Landry said. "This is so simple. It's a (minute-long) process. Normally, when you're rigging a rucksack with the removable standard (HSPR), it can be as long as a 10-minute process, especially when you've got new … paratroopers that haven't done it before or haven't done it very often."

Landry said the removable system is more cost effective than a permanently sewn harness, which could add as much as $200 to the cost of a rucksack. He added that any failure in either the pack or the harness would leave the other reusable, avoiding replacement of the entire $400 system.

The MOLLE 4000 tested well, but Soldiers recommended a few more modifications, such as a stronger carry strap, side compression straps and — most importantly — a flap closure on top to replace the original zip closure. The flap will allow for load flexibility when necessary and be more durable when released and lowered to the bottom of a 15-foot lowering line during a jump.

"We got it right (as) to what their concept was, but then we learned in the technical testing that we needed to change the design slightly," Landry said. "We all learned something, and that's fine. That's what you want. That's why you test."

The current version will go into safety certification testing during March and be operationally tested in late spring at Fort Bragg, North Carolina. Upon completion of a yearlong user assessment, airborne units could receive their first MOLLE 4000s before fiscal year 2017.

The final product could have applications beyond airborne operations.

"This pack can be used by any unit in the Army if they've got a size requirement like this, and all they do is remove the harness," Landry said. "It can be an Army common item at some point in time, and wouldn't that be great?

"Once it gets on the ground, it must carry the load efficiently, because once a paratrooper lands, the pack's job really begins, and the mission is to be as fast and effective as possible in the fight."

And Landry said he hopes that others might see the utility in that.

"To have a service-common pack of this design," Landry said, "would be really the ultimate goal."

Bracha Horovitz, in 1991, and NSRDEC's collaboration with Horovitz resulted in key innovations.

Hampel said that the circular loom used by Horovitz was much better suited for inflatable fabrics than the usual flat loom and that Horovitz developed a computer-controlled device that could weave a curve into a tube. The innovation greatly advanced and improved airbeam technology, making airbeam shelters more durable, easier to set up, move and maintain.

"As we were working with Zvi, we guided the research with our expertise in military textiles — it must be flame resistant, abrasion resistant, etc.," said Hampel. "We added that knowledge to make sure we ended up with a product that would work in a military environment."

NSRDEC and Federal-Fabrics-Fibers also overcame the big challenge of preventing air leaks through seams by creating seamless airbeams.

Bracha Horovitz serves as president and CEO of Federal-Fabrics-Fibers and continues the company's dedication to serving the needs of both the military and commercial sector.

"Zvi was an innovative guy who generated the idea, and Bracha has kept the technology alive and made many improvements," said Hampel.

"We feel exceptionally fortunate to have a successful relationship with NSRDEC and are proud to make such an impact in the world of military shelters in creating an automatic-deploying tent that fulfills the needs of our warfighters on expeditionary operations," said David Retter, director of sales and marketing at Federal-Fabrics-Fibers.

Hampel has seen impressive developments in airbeam technology over the years. One application, in particular, stands out most in her mind.

"The Chemically and Biologically Protected Shelter, which incorporates Federal-Fabrics-Fibers airbeam technology, is the first type of medical facility that a Soldier would see in the field," Hampel said. "These shelters were used during the first Gulf War and saved lives as they provided an environmentally conditioned environment, which prevented shock and provided a capability for advanced medical care."

Photo: Edwin Aguirre

"It was a great experience to work with Quoc and the program," said Cody Langlois, who is majoring in plastics engineering at UMass Lowell. "Quoc was always focused on the final goal of the project but made sure that the different team members understood the individual steps to reach that goal. He was always friendly and helped give me a look at what a career at Natick Labs looks like."

"By being at the university, we have access not only to the professors, but also a pool of students," said Truong. "Many of them are very bright, and they really work hard."

The relationship between the university and NSRDEC also fuels brainstorming. NSRDEC organized a Human Augmentation Roundtable. The event was an open and welcoming venue for discussing ideas and presenting differing perspectives. The aim of the Army's human augmentation effort is to merge human and machine to enhance endurance, speed, agility and accuracy, while reducing potential injuries faced by Soldiers.

"HEROES is a win-win for all: win for NSRDEC Scientists to tap into UML faculty, students, expertise and facilities to create new solutions to Soldier needs; Win for UML faculty to apply their valuable academic research and expose their students to real-world military problems; and most importantly, a win for our Soldiers, who will be the benefactors of cutting-edge research and innovation to improve their safety, agility and sustainability in the field," said Samuelson.

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