RDECOM magazine
A publication of the U.S. Army Research, Development and Engineering Command (Provisional)
February 2004

Contents

IN THE FIELD

- Vehicles in Iraq go from workhorse to warrior with new kits
- TARDEC teams fortify HMMWVs; kit to become standard stocked hardware
- Sensor technology can detect and identify targets faster, farther
- Energy-restoring CarboPack heading to Iraq
- These boots are made for flying: Rotor blades get new protective shields

IN THE LAB

- ARL scientists and engineers develop liquid armor based on nanotechnology
- ECBC team develops method to simultaneously detect up to four biological agents
- This upcoming 'STORM' provides protection
- Battlefield communication takes a leap forward with MOSAIC

PARTNERSHIP

- ECBC team sharpens skills with artistic endeavor that benefits charity
- RDECOM technology helps NASA reach for the stars

PEOPLE

- Needy families benefit from ARL generosity

Vehicles in Iraq go from workhorse to warrior with new kits

U.S. Army Research, Development and Engineering Command Public Affairs Office

ABERDEEN PROVING GROUND, Md. – Soldiers in Iraq have an extra layer of protection thanks to work done at the U.S. Army Research, Development and Engineering Command.

Spc. Matther McLean, left, and Spc. Jerry Poland of the 988th MP Company, /fort Benning, Ga., were the first two soldiers to receive the Armor Survivability Kit RDECOM prototype, at the U.S. Army Material Command HMMWV Service Center, Camp Anaconda, Iraq, in October. Photo courtesy U.S. Army Research Laboratory.

"The goal is to transform a regular truck into a warrior truck," said Maj. Dan Rusin, leader of the Expedient Armor Survivability Kit Team at RDECOM's U.S. Army Research Laboratory at Aberdeen Proving Ground, Md. The team created armored steel plating that can be installed in the field on the High Mobility Multipurpose Wheeled Vehicle.

"Think of it as body armor for a HMMWV," Rusin said.

Since October, the kits have been installed on scores of vehicles at the U.S. Army Materiel Command's HMMWV Service Center at Camp Anaconda, Iraq, a two-hour operation that even includes a tune-up and oil change.

The project began in August, when the ARL team created a prototype system to reinforce the HMMWV, a lightweight tactical vehicle that is useful behind the lines. However, as Rusin pointed out, "There is no 'behind the lines' in Iraq. That supply sergeant over there has to drive through that same bad neighborhood as the military police." While the HMMWV family includes the M-1114 armored truck, there aren't enough to go around.

The Expedient Armor Survivability Kit arrives in Iraq in a heavy wooden crate containing the components to transform a typical HMMWV into an imposing vehicle that can go into the bad parts of town. The ARL team raced 39 crates containing the first kits to Iraq in October, along with a team to install them.

Meanwhile, RDECOM's U.S. Army Tank Automotive Research, Development and Engineering Center in Warren, Mich., further refined the design and cranked out 100 additional kits by the end of November. Now, the Army Depot System is producing thousands of kits in upcoming months.

The goal was to counter the threat HMMWV crews face in Iraq, including improvised explosive devices, or IEDs, which often come from the side of the road. That led to the new doors, plus additional armor beneath the doors and a plate on the back.

Patrick Webber, left, and Timothy Johnson are two of the expert civilian employees from Anniston Army Depot, Ala., who are installing the Armor Survivability Kits at the U.S. Army Material Command HMMWV Service Center at Camp Anaconda, Iraq. Photo courtesy U.S. Army Research Laboratory.

“We tried an assortment of products – aluminum, composites, a lot of fancy stuff. But we came back to the same armored steel that you make tanks from,” Rusin said.

Ultimately, Soldiers needed a kit created quickly and simple to install in a field environment, without adding too much weight. A two-door kit weighs in at 900 pounds, a four-door at 1,300 pounds. The team at APG loaded test vehicles with steel plates to see how they handled the additional weight, then used their own versions of IEDs to test the effectiveness.

The work at APG began on a hot day in August, in a cavernous warehouse filled with equipment. Rusin, ARL employee Chet Benjamin, and Grat Blackburn, Kenny Dudeck and Dale Smith, ARL contract employees with Dynamic Science, discussed numerous ideas, choosing the best for testing.

“It was gratifying to take come up with an idea on Monday morning at 7 a.m., build it that afternoon, have it installed by the following morning, and blow it up,” Rusin said. “It’s all about using the right level of technology for the right reasons. It’s better to ship a solution now and get it out there to protect Soldiers, rather than working on it until it’s perfect.”

By the end, more than 80 people were involved, from the testers who quickly helped determine the best solution, to the carpenters who built the sturdy crates for shipping, to the transportation personnel who ensured that every kit arrived at Camp Anaconda, just three days from when they left Maryland. The result is an impressive door with a thick plexiglass window, known in the industry as “transparent armor.”

“This not only provides more protection, but it also looks sturdier,” Rusin added. “That may help protect them as well.”

Soldiers at Camp Anaconda expressed their gratitude for the vehicles, sending messages and photographs back to the team. Dudeck said this is the first time he has seen a product he’s worked on have immediate application in the field.

“We got photos of the vehicles with the new doors, and when you see the name of that Soldier on the windshield, it really means a lot to you,” he said.

The team’s typical projects run eight months to a year, this project was in the hands of Soldiers in two months, which Blackburn added was unprecedented in his career.

"It's the first time I've been able to see a product start to finish," Blackburn said. "To field this kind of kit, and then talk to the people who received it, makes it kind of personal."

Meanwhile, the team is back to work, designing other items that will help protect Soldiers deployed overseas.

"This is the best job in the Army. I've waited 16 years for this job," Rusin said. "This kit increases the confidence of the crews, and supplies extra protection. Everybody seems to love it. And nobody's asked for their old door back."

From left, GratBlackburn Dale Smith, Maj. Dan Rusin, Chet Benjamin and Kenny Dudeck pose with a door that's ready to ship to Camp Anaconda in Iraq. Photo by Karen Drewen.

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TARDEC teams fortify HMMWVs; kit to become standard stocked hardware

By Paul D. Mehney, U.S Army Tank Automotive Research, Development and Engineering Center

WARREN, Mich. -- Kicking up a cloud of dust, a convoy of High Mobility Multipurpose Wheeled Vehicles rolled out of Camp Anaconda, Iraq, in early November 2003—a common occurrence at Anaconda, but something was different about this convoy.

Soldiers stared at the vehicles as if they had never before seen a HMMWV, and “Look at the doors,” was a frequent comment. Indeed the HMMWV doors on this convoy were different—they were armor.

Responding to Soldiers’ comments that the standard HMMWV doors -- cloth or metal -- did not protect the driver or passengers from small arms or explosive device fragment threats, designers and engineers at the U.S. Army Research Development and Engineering Command’s Tank Automotive Research, Development and Engineering Center and Army Research Laboratory swung into action to provide technology for a solution to the threat.

Tank Automotive Research, Development and Engineering Center personnel from a variety of teams worked with the Army Research Laboratory and other Army Materiel Command elements to create a solution for armored doors for High Mobility Multipurpose Wheeled Vehicle. Photo courtesy of TARDEC.

Testing of an armor door system began at Maryland’s Aberdeen Test Center. The original prototype design was a two-door kit, providing maximum protection and producibility by making the left and right doors interchangeable. TARDEC engineers subsequently teamed with ARL to lend their expertise in design, integration and manufacturing.

On Oct. 10, 2003, TARDEC Design and Digital Mock-up Team engineers Mike Manceor and John Edry, setting aside their plans for the upcoming three-day weekend, flew to ARL to talk to the designers and look at the prototype doors they had fabricated. They were keen to determine how to enhance the design to address vehicle integration, producibility and operational issues. The ARL design basically consisted of a flat, square-shaped door that had been rapidly prototyped, performance tested and quickly shipped to Iraq.

Well received and much appreciated by Soldiers, the doors were soon dubbed the Armor Survivability Kit (ASK).

Concurrent with ARL’s ongoing activity, TARDEC initiated a detailed door design review and evaluated all associated vehicle integration efforts.

"A variety of factors were addressed, including door form and fit issues, door latch assembly safety concerns and the usability of the door's reinforced windows," Manceor said.

Without compromising ARL's survivability standards, TARDEC engineers went to work using computer-based Pro/E Computer Aided Design 3D modeling to integrate form, fit and functionality issues into a redesigned door kit.

The first convoy of vehicles outfitted with the new expedient Armor Survivability Kits leaves the U.S. Army Materiel Command HMMWV Service Center in Camp Anaconda, Iraq, in October. The supply vehicles are part of the 18th Military Police Brigade. Photo courtesy U.S. Army Research Laboratory.

Keeping in mind that Soldiers need to quickly install the doors without any special equipment, TARDEC engineers looked at ways to fit the armor doors to the contour of the vehicle; making them more functional, without compromising quick installation. Within a matter of days, TARDEC engineers had a door design that included bends which matched the HMMWV's shape. Weather strips were even added to keep out environmental infiltration.

Window usability was also a major concern. The initial design called for a reinforced door window, however, once assembled, the window only provided a small opening, preventing the Soldier from using it as a firing port. This problem was identified during ARL testing and was echoed in Soldiers' comments from the field. To enable the reinforced window to be used as a firing port, TARDEC designed and created a unique new mechanism that allowed for it to open and lock in several positions.

Finally, a more robust door latch system that stood up to rigorous safety standards was needed. Partnering with safety engineering, TARDEC engineers designed a heavy-duty latch capable of withstanding the weight of the armor door.
"We used many of the parts already being used on the existing HMMWV latch," Manceor said, "but after making sure that the latch could keep the heavy door closed during impact testing, it was discovered that we needed to revise the design slightly for an even heavier latch."
The result was a safe, strong and easily installed door latch made of existing and new rapid prototyped parts.
While addressing major design issues, TARDEC also worked closely with the Army's Product Manager-Light Tactical Vehicles to tackle the PM's concerns. Noting that there are more four-door HMMWVs than two-door models, engineers designed rear passenger doors — allowing the creation of four-door kits. Soldiers in Iraq also seconded this need, commenting they often travel with more than two Soldiers to a HMMWV, so a four-door kit was needed to protect rear passengers.

For added protection, the ASK also includes seat back and rocker-panel protection kits. These panels, which were designed and fabricated in just 20 days, were also integrated into the vehicle, said Jim Soltesz, TARDEC associate director of Design and Manufacturing.

The fast turnaround was possible, he added, "due to the use of TARDEC's computer numerically controlled lathes, vertical mills and water jet cutting systems. This technology enabled the data developed by our state-of-the-art CAD stations to migrate to the shop floor with only minor manipulation by mechanical engineering technicians."

After 1,650 miles of simulated rigorous drive testing conducted by TARDEC's Ground Vehicle Simulation Lab, actual drive testing at Aberdeen Proving Ground and additional ballistic testing at ARL, the redesigned armor kits were ready for deployment to Iraq. On Nov. 13, 2003, 15 of the new kits were shipped to Camp Anaconda where a TARDEC/ARL team awaited them to begin installation. Eighty-five more kits, manufactured by TARDEC's Physical Prototyping Team, followed to destinations in Iraq and Kuwait.

Once thought to be only a temporary solution to threat issues in Iraq, Manceor said, "The ARL/TARDEC design is well-integrated into the vehicle, affordable and effective. It has led the Product Manager-Light Tactical Vehicles to decide that this kit will become standard stocked HWWMV hardware."

As a result of increased Defense and Army funding, TARDEC engineers have handed off design plans for 4,010 kits to government fabricating facilities at Anniston Army Depot, Rock Island Arsenal and Red River Army Depot for early 2004 production.

To bring more armor kits to the Soldier, ARL, TARDEC and the product manager team has been working since September 2003 on a two-prong approach, where depot production will be supplemented by commercial armor solutions. Dedicated testers at Aberdeen Test Center are testing a variety of commercial kits around the clock. The kits are being held to the same rigorous standards set by the ASK, and the Army is close to making a decision on what industry partner will be producing kits of their own design.

Steve Roberts, assistant product manager for HMMWV Armor Kits said the driving factor behind the project "is protection for the Soldier.

"The combination of depot and industry production allows for the maximum number of vehicles to be kitted in the shortest time possible," he said. "The operation of the acquisition, research and test community to quickly get Soldiers the required equipment has been truly outstanding."

TARDEC Executive Director for Development Thomas Mathes described the project as "the way these things are supposed to work.

"It was a total RDECOM and product manager team experience for total success," he added.

ARL developed a technology solution, TARDEC refined the design and integrated it into the vehicle and the Tank-automotive and Armaments Command's Ground Systems Industrial Enterprise is now taking the resultant technical data package and making the kits in quantity.

"The Army's most valuable resource is our people, who did what it took to get the Soldier what was required," Mathes said.

Looking at feedback received to date, Soldiers in the field agree and as more armored convoys roll out of Anaconda, Soldiers comment that they feel not only a bit safer but, most important, listened to.

TARDEC, the nation's laboratory for advanced military automotive technology, is part of the Army Materiel Command's Research, Development and Engineering Command. Headquartered at the Detroit Arsenal, Warren, Mich., TARDEC is located in the heart of the world's automotive capitol. Its engineers and scientists investigate, evaluate, mature, demonstrate and integrate emerging technologies for transition to field. TARDEC's technical staff leads research in not only combat and tactical vehicle technology, but also a wide variety of logistics equipment, water generation and purification, fuels and lubricants, military bridging, countermine equipment, and much more.

Sensor technology can detect and identify targets faster, farther

By Martha McCaslin, Communications-Electronics Research, Development and Engineering Center, Night Vision and Electronic Sensors Directorate

FORT BELVOIR, Va. -- Mounted on the ground vehicle of the future is a sensor suite based on the Multi-Function Staring Sensor Suite technology. This MFS3 technology can detect and identify targets faster and at longer ranges than any currently fielded system.

Future sensor suites also provide the ability to see throughout the extended 360-degree three-dimensional battle space while on the move. Targets such as occluded armored vehicles and helicopters and UAVs are also detected.

The suite of sensors includes a multiple-field of view staring thermal imaging sensor, an eye-safe laser rangefinder, acoustic cueing devices, and multi-spectral Aided Target Detection and Aided Target Recognition algorithms. It can be operated manually or automatically in the wide area search mode, both while on-the-move.

In the Wide Area Search mode, multi-spectral Aided Target Detection uses infrared imagery to detect objects of interest in the medium field of view and recognize objects in the ultra-narrow field of view Mid-Wave Infrared; the recognized objects are presented to the operator for identification.

Over the past two years several data collections have been conducted to obtain manual mode and wide area search mode imagery, providing useful information. Manual mode imagery has been used for perception tests to demonstrate compliance with the long-range target identification exit criteria. These results have demonstrated that MFS3 meets the minimum long-range requirement at 90 percent confidence. Wide area search mode imagery has been used in training and evaluation of the Aided Target Detection and Aided Target Recognition algorithms.

Recently NVESD took delivery of the MFS3 test bed hardware and has integrated it into an M113 for additional field tests.

In the future, a simultaneous dual-band FPA will be inserted for rapid on the move capability. The MFS3 testbed serves as the pathfinder for the third generation sensor technology ground applications test bed. It is the defining medium for third generation component specifications for both air and ground platforms.

Energy-restoring CarboPack heading to Iraq

NATICK, Mass. -- Extra energy for strenuous military operations is now conveniently supplied with the Carbohydrate Supplement Pack, or CarboPack, developed at the U.S. Army Soldier Systems Center.

The CarboPack contains one carbohydrate-rich bar and two packages of flavored carbohydrate-electrolyte sports beverage powder to mix two eight-ounce servings, and is intended to complement current and future military rations.

“Studies show that Soldiers in intense, prolonged physical activity for more than three hours need the calories beyond what’s provided in rations,” said Julie Edwards, a food technologist at the Department of Defense Combat Feeding Directorate. “Most of what they need is provided in their rations. This is designed to make up the difference in calorie needs during prolonged exercise.”

The CarboPack adds another 400 calories to the battlefield diet. By comparison, a day’s worth of Meals, Ready-to-Eat, MRE, is more than 3,600 calories. Research that went into the CarboPack will give troops a product that’s proven to perform while saving troops money.

“We identified a need because Soldiers were buying their own bars and drinks,” Edwards said, which opened up potential pitfalls. “By providing soldiers with the right products we can decrease the chances that the Soldier will bring the wrong type of item to the field with them that may potentially hurt their performance.”

Combat Feeding’s Individual Combat Ration Team, the U.S. Army Research Institute of Environmental Medicine at Natick, Office of the Surgeon General and Army Center of Excellence Subsistence worked together on product guidelines.

The drink mix is similar to Gatorade, with a combination of electrolytes and carbohydrates meeting military specifications, Edwards said, and has a lower sugar content than an MRE mix. Fruit punch, grape, orange and lemon-lime flavors were chosen because they are the most popular for this type of beverage, and each CarboPack holds two different flavors.

Each mix is stored in a trilaminate pouch with a tear-off top used to pour in water, shake and drink so warfighters can avoid using a separate drink holder, such as their canteen cup.

A resealable drink pouch was one of the recommendations of Soldiers from Fort Campbell, Ky., and Fort Polk, La., who participated in focus groups and evaluations, and is in development, Edwards said.

The drink pouches are folded over twice and fit inside another trilaminate pouch along with the bar wrapped in the original manufacturer’s package.

Chocolate and apple cinnamon HooAH!, and oatmeal-raisin and chocolate bars similar to Gatorade and PowerBar brands were chosen as the energy bars because of their nutritional content, acceptability rating in taste-testing and ability to reach at least a two-year shelf life, Edwards said.

All three types in their respective flavors will be represented in the CarboPacks. Having a variety of products and flavors for the drinks and bars helps increase acceptability and consumption, she said.

HooAH! is a creation of the Combat Feeding food scientists and is getting another opportunity to be fielded as a new commercial manufacturer has picked up the production.

Another product evaluated was commercial gels, but they were a concern of the Soldiers because the gels would burst inside their full rucksacks, Edwards said. They will be considered again when the packaging of the product has improved.

The first 42,000 CarboPacks are scheduled for delivery to Iraq in January after receiving an urgent request last July for the product from the 101st Airborne Division and 3rd Corps Support Command.

For more information on the Soldier Systems Center, please visit our website at <http://www.natick.army.mil>.

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These boots are made for flying: *Rotor blades get new protective shields*

By Jim Bowne, Public Affairs Office, U.S. Army Aviation and Missile Command

A CH-47 Chinook operating in desert brownout conditions.

REDSTONE ARSENAL, Ala. -- The “corona effect” is characterized by distinctive glowing rings along metal or fiberglass rotor blades operating in desert conditions.

The glowing rings are made up of numerous small sparks resulting from grains of sand striking a normally-operating rotor blade, meaning the corona effect can be seen only at night.

“The corona effect has been seen from about a half mile away on a CH-47 Chinook hovering at about 1,700 feet,” said Mike Hoffman, “and that’s without the aid of night vision goggles.”

Hoffman, an engineer and manager of special projects in the Aviation Engineering Directorate, Aviation and Missile Research, Development and Engineering Center, noted that while the glow may be an interesting sight, the cause is devastating to rotor blades.

“The intensity of the illumination of the individual sparks varies with the number and size of particles passing through the rotor system,” Hoffman explained. “The corona glows brighter as the numbers and sizes of the particles in the air increase.”

A method to fix the problem can save half a million dollars per aircraft. Leading edge “molded boot” technology already exists and has been tested and approved on several helicopter types.

The current Task-L101 polyurethane molded form of the boot is better than its predecessor, the Task-L100, which required a brush application.

The newer molded boots prevent the corona effect and resist rotor blade erosion in desert conditions. One of the biggest pluses for the new boots is the resulting decrease in repair time and maintenance costs.

“Before we had these new boots,” Hoffman said, “it took about 26 man hours to remove the rotor blade system, repair the blades, and replace the blade system. Now, we just put the boots on the blades and repair them without removing them, and the helicopter is ready for flying again in the time it takes for the polyurethane to cure.”

The cost of protecting the blades of an Apache with boots, including the main and tail blades, is about $6,900 in material and labor. The cost of a new rotor blade system is about $500,000 per aircraft.

Hoffman said that after Operations Desert Shield and Desert Storm in the 1990s, and Iraqi Freedom and Enduring Freedom in the early part of the 21st Century, the degradation of rotor blades has become one of the single largest logistics and maintenance burdens experienced by Army Aviation. But he first saw the damage that sand was causing to rotor blades more than 10 years prior to Desert Storm.

“What we saw were huge rings of white fire above the rotor head. At the time, I didn’t know what it was, but I knew we had to fix it. Subsequently, in 1981, at Fort Rucker, Alabama, the first tests were conducted using a polyurethane material to protect the blades from the grinding sand.

"The tests were successful, but back then our focus was on Europe and the Cold War," he said. "So, problems about sand erosion actually didn't come up again until about 1990."

However, in the past few months, due in large measure to Hoffman's efforts, the sand erosion problem has surfaced again in a big way.

Not only has the requirement for the boots been approved, but the funding has been approved as well.

"We're really happy about receiving the funding from DA [Department of the Army]," Hoffman said. "We received funding in both [fiscal year] 03 and FY 04. We're currently planning to install the boots on the Black Hawk, Chinook, and the Apache. The Kiowa is already protected by the polyurethane coating."

The corona around a Ch-47 Chinook provides easy detection at night, placing the rotorcraft at a tactical disadvantage.

Hoffman said rotor blade engineering goals continue to remain at the forefront of emerging technologies that will help and protect our Soldiers.

"I'm proud of all our folks who are on the front lines, whether here at the AMRDEC, or in Iraq and elsewhere," he added. "We feel good about what we are able to achieve, working together as a team, to ensure that our Soldiers have the best equipment, the best service, and the best technology in the world."

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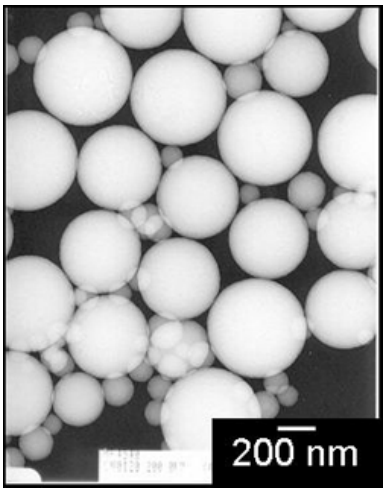
ARL scientists and engineers develop liquid armor based on nanotechnology

By Tonya Johnson, ARL Public Affairs Office



Scanning electron microscope image of the silica nanoparticles used in liquid armor.

ADELPHI, Md. -- Liquid armor for Kevlar vests is one of the newest technologies being developed at the U.S. Army Research Laboratory to save Soldiers' lives.

This type of body armor is light and flexible, which allows Soldiers to be more mobile and won't hinder an individual from running or aiming his or her weapon.

The key component of liquid armor is a shear thickening fluid. STF is composed of hard particles suspended in a liquid. The liquid, polyethylene glycol, is non-toxic, and can withstand a wide range of temperatures. Hard, nano-particles of silica are the other components of STF. This combination of flowable and hard components results in a material with unusual properties.

"During normal handling, the STF is very deformable and flows like a liquid. However, once a bullet or frag hits the vest, it transitions to a rigid material, which prevents the projectile from penetrating the Soldier's body," said Dr. Eric Wetzel, a mechanical engineer from the Weapons and Materials Research Directorate who is the head of the team on this project.

To make liquid armor, STF is soaked into all layers of the Kevlar vest.

The Kevlar fabric holds the STF in place, and also helps to stop the bullet. The saturated fabric can be soaked, draped, and sewn just like any other fabric.

Wetzel and his team have been working on this technology with Dr. Norman J. Wagner and his students from the University of Delaware for three years.

"The goal of the technology is to create a new material that is low cost and lightweight which offers equivalent or superior ballistic properties as compared to current Kevlar fabric, but has more flexibility and less thickness," said Wetzel. "This technology has a lot of potential."

Liquid armor is still undergoing laboratory tests, but Wetzel is enthusiastic about other applications that the technology can be applied to.

"The sky's the limit," said Wetzel. "We would first like to put this material in a Soldier's sleeves and pants, areas that aren't protected by ballistic vests but need to remain flexible. We could also use this material for bomb blankets, to cover suspicious packages or unexploded ordnance. Liquid armor could even be applied to jump boots, so that they would stiffen during impact to support Soldiers' ankles."

In addition to saving Soldiers' lives, Wetzel said liquid armor in Kevlar vests could help those who work in law enforcement.

"Prison guards and police officers could also benefit from this technology," said Wetzel. "Liquid armor is much more stab resistant than conventional body armor. This capability is especially important for prison guards, who are most often attacked with handmade sharp weapons."

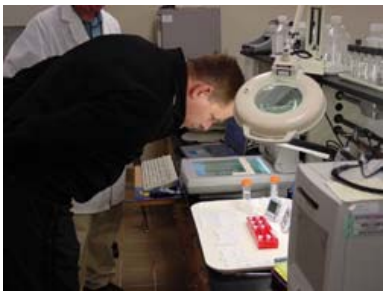
Normal Kevlar fabric after impact by a fragment simulating a projectile.

For their work on liquid armor, Wetzel and his team were awarded the 2002 Paul A. Siple Award, the Army's highest award for scientific achievement, at the Army Science Conference.

Kevlar fabric with shear thickening fluid, after impact by a fragment simulating projectile.

ECBC team develops method to simultaneously detect up to four biological agents

Edgewood Chemical and Biological Center Public Affairs Office



Brig. Gen. Stephen Reeves, Joint Program Executive Office for Chemical/Biological Defense, examines test tickets capable of detection multiple agent

ABERDEEN PROVING GROUND, Md. – Edgewood Chemical Biological Center staff supporting the Joint Service Agent Water Monitoring Program is making revolutionary strides in the biological detection arena. Most recently the team developed a hand-held microarray capable of detecting up to four biological agents in a water sample on one test ticket, an advancement that can potentially save millions of dollars in detection equipment.

But the innovation doesn't stop here. Through cross-team collaboration staff further developed new test analysis methods leading to additional cost savings.

While industry had been striving for years to develop a protein microarray for multiple biological agent detection, staff attributed their rapid success in doing so to the diverse scientific expertise at ECBC. A huge hurdle in developing this new capability was the control of protein orientation on a solid surface and denaturization, or unfolding of protein and loss of 3-D structure. Specialized nanomanipulation materials and techniques were used to overcome this hurdle.

To augment expertise in the behavior of biological receptors at the nano-scale level, the team collaborated with ANP Technologies, a company working promising nanomanipulation methods. The partnership proved a success as researchers enhanced bioassay performance through unique manipulation of biological receptors.

A second hurdle in developing the protein microarray was procurement of a scanner/reader that could read both line and microarray formats. The ECBC Passive Standoff Detection Team's Dr. James Jensen combined specialized signal processing algorithms with inexpensive commercial scanning technologies to create a new a reader that provides readout signals and enables detailed analysis of sensor performance.

Upon briefing the acquisition community of these latest developments the JSAWM team was quickly assigned the daunting task of developing a multiplexed assay microarray within 30 days. The effort encompassed not only developing the assay, but also fast-tracking rigorous analysis of the technology's performance.

"Our realization of this feat was almost serendipitous," said Janet Jensen, JSAWM project lead. "I don't think we would have been able to develop the detection technology in such a short time-frame had all the players across the detection business area not been present."

Researchers began developing the hand-held assay using the novel nanomaterial technology. Within record time they were able to detect up to four agents with comparable or improved sensitivity with less reagent. According to researchers, this maneuver alone could result in considerable cost savings by consolidating four separate biological agent tests into one unit.

The new assays were smaller and lighter than standard test tickets and more effectively reduced cross reactivity which can lead to poor test results. Further, the new tickets successfully tested untreated water, including tap water. Standard test methods ordinarily test samples treated with a pH buffered saline only.

In the past, the JSAWM team conducted validation testing of detection tickets using a manual scanner. To circumvent this time-consuming process, the team tapped the vast skill sets offered by the passive standoff detection team to develop an improved reader that ran on semi-automated imaging software. The replacement package not only reduced operational costs, but also reduced equipment costs—the updated scanner is priced at $100 while the original scanner is priced at $35,000.

By the close of their 30-day deadline, the ECBC/JSAWM team successfully developed a multiplexed hand-held assay microarray that is lighter, more effective, and cheaper than the single agent detection ticket. They likewise reduced test validation costs and performance.

This upcoming 'STORM' provides protection

Edgewood Chemical Biological Center Public Affairs Office

Many components of the successful Automated Biological Agent Testing System, shown here, will be incorporated into the fully mobile Stations of Robotic Monitoring—or STORM—system.

ABERDEEN PROVING GROUND, Md. -- ECBC is taking unique biological agent testing anywhere it is needed with the new Stations of Robotic Monitoring—or STORM—system.

Based on the successful Automated Biological Agent Testing System, ABATS, STORM is a self-contained and mobile high-throughput automated testing system. Housed in a 28-foot trailer, the STORM can be towed by conventional light-duty trucks to any remote location, where it is powered by its own 30,000 -watt generator.

The features that make it unique—in addition to its portability—are similar to those of the original ABATS. STORM uses robotics and off-the-shelf analytic equipment to automate the complex biological analysis process, which pays huge dividends in efficiency and safety.

"Biological agent testing is very labor intensive," said Ray Mastnjak, head of the Chemical-Biological Support Division of ECBC's CB Services Directorate. "Simply preparing the samples takes hours, and confirmations take time. The STORM manages to find tremendous efficiencies in automation."

In fact the STORM, when staffed with two technicians, can process 150 samples per day, testing for seven unique threat agents simultaneously. To achieve the same results using classic microbiology techniques would require six laboratories and 12 technicians. In addition, STORM's robotics allow parallel preparation and analysis of 98 samples. A traditional laboratory setting can accommodate only 10 samples at the same time.

STORM can be used as the first step to analyze a large number of samples, to whittle down the small percentage that constitute a threat. Such front-line testing leads to results known as presumptive positives; in other words, the early testing indicates it is likely a target substance is present in the sample and should be confirmed with more decisive tests. STORM, which operates at Biological Safety Level 2 standards, allows for fast weeding-out of the 98 percent of test results that come back negative, leaving confirmatory testing for the 2 percent appearing to be positive. The high-throughput structure reduces strain on labs that conduct confirmatory testing, such as ECBC's Biological Safety Level 3 facility, which can perform more labor intensive tests and thus can handle a far lesser analysis load.

The STORM, with its proven system of off-the-shelf equipment and established procedures, will join ECBC's wide-ranging set of CB service offerings later in 2004.

Battlefield communication takes a leap forward with MOSAIC

By Larry Muzzelo, Communications-Electronics Research, Development and Engineering Center

FORT MONMOUTH, N.J. – A recent demonstration showed how multiple types of traffic will share the same network resources on the future battlefield, ensuring high priority messages get where they need to go quickly.

MOSAIC, the Multifunctional On-the-Move Secure Adaptive Integrated Communications, was demonstrated by the Communications-Electronics Research, Development and Engineering Center's Space & Terrestrial Communications Directorate and Rockwell Collins, Inc.

MOSAIC is developing and demonstrating both a mobile networking architecture and the underlying advanced networking technologies. These technologies will enable military communications in support of a mobile, geographically dispersed battle-force for the Future Combat System and the Future Force without depending on a fixed communications infrastructure.

The MOSAIC Technology Readiness Level 6 demonstration, held at Rockwell Collins' facility in Richardson, Texas, showcased Rockwell Collins' Internet Protocol Quality of Service and routing solutions and Telcordia Technologies' IP mobility software integrated onto a surrogate single channel Software Communications Architecture 2.2 compliant Joint Tactical Radio System prototype, the Wideband JTRS Prototype Radio.

Using a number of vehicles and dismount nodes organized into three simulated cells that converged on an objective area, the test scenarios showed how high priority messages such as a nuclear, biological and chemical alert could traverse a congested network and still meet service requirements.

The scenarios also demonstrated ad-hoc radio networking capabilities, how on-going application sessions emanating from dismount nodes persisted during routing changes while still maintaining their requested Quality of Service.

Thomas Mims, deputy director of Battle Command Battle Lab Gordon, said he was impressed by the demonstration, noting that development of these types of systems takes about four years, and produces "what I consider to be very little progress over typical commercial developments."

But the MOSAIC TRL-6 demo was the exception, he added.

"In fact, it was the most impressive tech base demo I have ever seen," he said.

He noted that MOSAIC has significant application to networked communications modeling, and is a key to the complex, technically challenging world of high fidelity network modeling. MOSAIC's goal is to develop IP-based Quality of Service, Mobile Ad-hoc networking technologies, and Advantaged (airborne) Node networking technologies.

"Bottom line is that it is my opinion that this MOSAIC ATD is making real progress developing mobile ad-hoc networking protocols and dynamic quality of service mechanisms that are key to achieving the networked centric concept of the Future Force," Mims said.

Warfighter benefits of the MOSAIC Quality of Service technologies are that different classes of traffic, such as voice, situational awareness and video, can share the same network resources, yet be classified on an individual basis to assure high priority traffic gets the needed bandwidth and speed of service during periods of network congestion.

The ad-hoc networking technologies will allow for networks to automatically self-organize to reduce the network planning burden and allow for task reorganization without operator intervention. MOSAIC's advantaged node technologies also will enable efficient and seamless use of airborne nodes as part of the overall network resources.

In attendance at the demonstration were the Fort Gordon Battle Command Battle Lab, the Battle Command and Awareness Division of the U.S. Army Training and Doctrine Command Futures Center, Space and Naval Warfare Systems Command, Air Force Electronics Systems Command, Program Manager Warfighter Information Network-Tactical, Lockheed Martin, General Dynamics, Joint Tactical Radio System Cluster 1 prime contractor, Boeing, Future Combat Systems Lead System Integrator, BAE Systems, Harris Corporation, and the MITRE Corporation.

The MOSAIC ATD will perform its exit demonstration at Laguna, N.M., and the C4ISR On-The-Move Test-bed at Fort Dix, N.J., in May and August 2004, respectively, using terrestrial systems airborne nodes, and space-based assets to demonstrate an integrated mobile networking system at Technology Readiness Level 6.

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ECBC team sharpens skills with artistic endeavor that benefits charity

Edgewood Biological and Chemical Center Public Affairs Office

ABERDEEN PROVING GROUND, Md. -- When there is a lull in priority military client work, the Edgewood Chemical Biological Center's Advanced Design and Manufacturing team welcomes opportunities to sharpen its capabilities and add new skills by working with commercial customers.

The project to create a bust of Baltimore Ravens football player Ray Lewis involved work by ECBC plus several companies.

Little did the team know that while honing these skills, they also would rub elbows with NFL football superstar Ray Lewis of the Baltimore Ravens.

The ADM team was approached by CRADA partner Direct Dimensions to assist with a pro-bono project benefiting underprivileged children. The task was to co-create a one-of-a-kind life-size marble bust of the football player that would be auctioned at the Second Annual Ray Lewis Foundation Auction. Proceeds were to go to the Ray Lewis Foundation, a non-profit charity organization dedicated to providing assistance to disadvantaged youth.

Upon receiving an electronic 3D model of the star's head and shoulders, the ADM team fabricated it in plastic. Because ECBC policy dictates that charity work be performed after hours, project leads Rick Moore and Lester Hitch spent time on weekends and evenings tackling the job.

"In the business of rapid response, we're used to tough deadlines," said Hitch, a student contractor.

Once their contribution was completed, the team sent the prototype pattern to a third partner, a noted plastic surgeon and sculptor who cast the pattern in marble resin.

The finished piece was auctioned at the gala and sold at a winning bid of $7,000, the highest among hundreds of autographed sports memorabilia. Present at the benefit, Moore and Hitch met Lewis and shared in the excitement of the charity contribution in which they played a role.

Moore said the challenges the team faced in crafting the bust prototype were invaluable to their client work.

"Our CRADA partner is an expert in reverse engineering," Moore said. "Through this initiative, we collaborated on the laser scanning of a human being. As we fine-tune our ability to manipulate unique geometric files, imagine what we can do with this knowledge. For example, we could investigate the feasibility of scanning soldiers and developing custom-fitted protective equipment."

To learn more about the Ray Lewis charity project, or ADM team capabilities contact Mark Schlein at 410-436-5707 or Rick Moore at 410-436-5517.

ECBC's Lester Hitch, left, and Rick Moore pose with Ray Lewis at the Ray Lewis Foundation auction.

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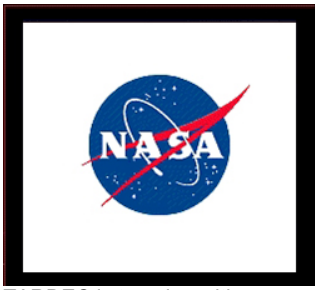
RDECOM technology helps NASA reach for the stars

By Rae Higgins, contractor, U.S. Army RDECOM-Tank Automotive Research, Development and Engineering Center

WARREN, Mich. – The Tank Automotive Research, Development and Engineering Center has long been a leader in collaborating with other organizations to develop and mature mutually beneficial technology. Now, under a new agreement TARDEC literally is reaching for the stars.



TARDEC is teaming with NASA to enhance its capability to remotely detecting debris and ice on the external fuel tank prior to launch.

The Michigan-based organization, part of the U.S. Army Research, Development and Engineering Command, entered a partnership with the National Aeronautics and Space Administration that applies TARDEC technology to the Space Shuttle program, and transfers NASA technology to Army ground vehicle development. The results of this partnership will have an impact not only the lives of countless Soldiers, but also will affect the future and safety of space exploration.

Dr. Richard McClelland, TARDEC director, and Dr. Grace Bochenek, technical director, met with James Kennedy, director, NASA Kennedy Space Center, in late 2003 to sign the Space Act Agreement.

Dr. Thomas Meitzler, who heads TARDEC's Visual Perception Laboratory and leads this effort on behalf of TARDEC, the purpose of this agreement is to contribute to the nation's "Return to Flight" program by working with NASA engineers in several areas:

- remotely detecting debris and ice on the external fuel tank prior to launch;
- using TARDEC experience with color-image processing to suggest methods to augment existing shuttle tile inspection methodology;
- and, using 3-D technology and displays to assist with space station and satellite deployment and maintenance.

TARDEC's in-house expertise in identifying, testing, and selecting imagers, digital visual imaging, photosimulaton and 3-Ddisplays resides within its Visual Perception Lab. It also has experience testing multiband imaging and digital color imaging and displays.

Conversely, NASA has expertise in Space Shuttle and other space vehicle maintenance launch site processing, as well as in space operations under demanding and extreme conditions. Meitzler said he and his team are enthusiastic about this agreement because the U.S. Army will benefit from the experience and knowledge gained from working with NASA engineers and scientists. TARDEC can apply NASA technologies to the military ground systems it develops.

All involved, Meitzler added, expect the exchange of technology and information to be mutually beneficial, because the Army and NASA both need to remotely assess vehicles. NASA needs this capability because of the extreme nature of pre- and postlaunch conditions; TARDEC can use this technology to enhance existing and future military ground systems. This initiative to develop and test video and other sensor system technologies to determine vehicle state will help the users -- Soldiers and astronauts -- to make more informed decisions about their respective vehicle systems.

Technologies identified and developed in this research agreement have the potential to contribute to NASA pre- and post-launch processing, vehicle and crew safety assessments, and operations for a variety of space vehicle systems. The Army gains by using newly derived applied and enhanced technologies for a variety of local and remote operational objectives, including Identification of Friend-or-Foe and battlefield vehicle damage assessment.

TARDEC, the nation's laboratory for advanced military automotive technology, is part of the Army Materiel Command's Research, Development and Engineering Command. Headquartered at the Detroit Arsenal, Warren, Mich., TARDEC is located in the heart of the world's automotive capitol. Its engineers and scientists investigate, evaluate, mature, demonstrate and integrate emerging technologies for transition to field. TARDEC's technical staff leads research in not only combat and tactical vehicle technology, but also a wide variety of logistics equipment, water generation and purification, fuels and lubricants, military bridging, countermine equipment, and much more. TARDEC provides superior technology for a superior Army.

This photo of the shuttle Discovery on the Kennedy Center launch pad was taken from NASA's current camera pad IR system view. TARDEC hopes to integrate its equipment in time for the next shuttle launch, slated for September. Photo courtesy of NASA.

Needy families benefit from ARL generosity

By Stephany Jaramillo, ARL Public Affairs

ADELPHI, Md. -- Personnel at the Adelphi Laboratory Center, where the Army Research Laboratory is headquartered, joined schools, businesses, churches, civic and community organizations, and individuals to prepare and distribute holiday food baskets and gifts to needy families.

Holiday food baskets in reality are copier paper boxes and grocery bags brimming over with holiday dinner supplies and a little more for good measure. Each box number represents a family; each family found its number and picked up all the boxes and bags. A holiday greeting message, computer generated with a brightly colored holiday border, is tucked in with each order, written confirmation that someone cares. Photo courtesy ARL.

Part of the Beltsville Project for the Needy, the Women's Community Club of Beltsville has coordinated food baskets for the needy for Thanksgiving and Christmas, plus family gifts, for more than 20 years.

Thanksgiving food baskets were provided to 20 needy families in the Beltsville-Adelphi area. ARL staff contributed seven boxes full of food to the Thanksgiving Drive, and $215 to purchase turkeys.

In December, they donated an additional 10 boxes full of food and $275 to provide 35 families with holiday dinners and gifts for each member of the family, festively wrapped by volunteers. The families range in size from two to 12.

Recipient families were extremely grateful for their holiday dinners and gifts, expressing their heartfelt thanks and appreciation in warm thank you notes to their unknown benefactors:

"We want to extend our gratitude to you. Your generosity and help wouldn't be overlooked. Thank you for all the goods, your kindness and love. May God bless you bountifully."

"Thank you so much for making this Christmas Season so blessed for me and my family. We thank God for you all."

"Just a note to thank you for the many kindnesses. We will never forget the holidays you saved."