TARDEC Quarterly

October - December 2008

Creating Collaborative Environments

As we all know, successful Army partnerships have great potential to drive the future of military ground vehicle mobility. We have chosen this issue of *TARDEC Quarterly* to illustrate the many ways in which the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) strives to engage industry, academia, governmental agencies and other research facilities in partnership so that, together, we can better support our mission to be the provider-of-first choice for all Department of Defense (DOD) ground vehicle systems.

Creating collaborative environments with our partners allows us to utilize each others' talents and research skills and, thereby, fill technology gaps and derive the sort of true innovation that can only come from openness and cooperation.

The common thread that weaves throughout this issue is TARDEC's National Automotive Center (NAC). Founded in 1993, the NAC was chartered to serve as the Army's focal point for collaborative ground vehicle research and development (R&D). It acts as a hub, linking industry, academia and government agencies in the development and exchange of automotive technologies. In fact, almost all of TARDEC's collaborative efforts begin with the NAC, as it provides the primary gateway for working with TARDEC.

In its role as catalyst, the NAC offers a variety of options for leveraging investments in automotive technology R&D and initiating shared technology programs, including collaborative automotive technology contracts, Small Business Innovation Research contracts, Cooperative Research and Development Agreements and other cooperative agreements.

Another way in which the NAC fosters relationships is engaging with organizations such as the Society of Automotive Engineers, U.S. Council for Automotive Research, Center for Automotive Research, California Fuel Cell Partnership, American Trucking Association's Technology and Maintenance Council, Automation Alley®, Hybrid Truck Users Forum, NextEnergy, U.S. Auto Parts and other automotive manufacturers and suppliers.

Through these efforts as well as others, we cultivate partnerships with an end goal in mind — aligning our performance goals with our strategic partners' needs and requirements both here at the TACOM Life Cycle Management Command and across the Army and DOD. By effectively coordinating resources, we can deliver fully integrated solutions and offer our partners a single point of entry into our organization. The further we advance our technological solutions, the better we support Soldiers.

I invite you to read these articles to gain a better understanding of how the NAC serves the Army and our Nation. Likewise, you will gain a much greater appreciation for the dynamic relationship building NAC associates have accomplished with their industry, academia and government agency partners.

Dr. Grace M. Bochenek
TARDEC Director

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UNITED STATES ARMY TARDEC
TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

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FEATURES

National Automotive Center — TARDEC's Connection Point to Industry and Academia

Paul Skalny

E-ONE, Inc.'s E-ONE Hybrid Energy Command Center is the only hybrid vehicle designed for fire, rescue and homeland security applications. E-ONE representatives demonstrated the truck at the 2007 Hybrid Truck Users Forum (HTUF) with a "Ride and Drive" event and a presentation on their exclusive hybrid technology. (Photo courtesy of HTUF.)

In 1993, the National Automotive Center (NAC) was chartered by Congress to be the focal point for the development of dual-use automotive technologies and their applications to military ground vehicles. Since then, NAC has been industry, academia and other research organizations' connection point to the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC). NAC's mission is to serve as the Army's focal point for developing dual-use automotive technologies for military ground vehicles. NAC enables better interchange between government and industry, government and academia, and government and other Armed Services.

NAC programs are all aimed at supporting TARDEC's five principle technology focus areas: condition-based maintenance, power and mobility, intelligent ground systems (robotics), maneuver support and sustainment, and survivability. To this end, NAC personnel interact with all of TARDEC's Business Groups to build relationships within the organization that will tie industry, academia and other government agencies into TARDEC programs.

TARDEC's customers at the TACOM Life Cycle Management Command — Program Executive Office Ground Combat Systems (PEO GCS), PEO Combat Support and Combat Service Support, Integrated Logistics Support Center, Future Combat Systems (Brigade Combat Team) and the U.S. Marine Corps (USMC) — look to NAC to use its relationships and agreements with the automotive industry, academia and other research organizations to find innovative solutions to gaps in its ground vehicle technology. Through NAC, TARDEC seeks to close technology gaps by facilitating joint efforts among industry, government and academia in basic research, collaboration, technology, industrial base development and professional development.

The investment that is being made to support commercial vehicles will push TARDEC much more quickly into solutions for the military — potentially at commercial prices.

NAC's University Team facilitates efforts between government and academia in basic and applied research and collaborative technology to bring research results into TARDEC programs.

Collaboration with Academia

A recent example of TARDEC and NAC working closely with academia occurred at the 2008 Society of Automotive Engineers World Congress in April. TARDEC Director Dr. Grace M. Bochenek introduced a new event, the First Annual Advanced Planning Briefing for Academia (APBA), which was designed to help academic institutions gain an understanding of TARDEC's research and development (R&D) requirements so that through cooperative development, TARDEC can advance technology for U.S. Army and USMC ground combat vehicle systems and robotics. The event drew 150 professors and deans who represented more than 30 universities.

Bochenek emphasized the necessity for TARDEC to form more partnerships with leading technology universities to address internal engineering associates' career and professional development needs. "We are committed to establishing programs that provide innovative research and development to meet critical Army needs through a variety of cooperative and collaborative programs, including the Small Business Innovation Research [SBIR] program, Cooperative Research and Development Agreements [CRADAs] and contracts," Bochenek explained.

Industry and Government Collaboration for Energy Efficiency

TARDEC worked collaboratively with the Department of Energy (DOE), U.S. Air Force, Chevron Technology Ventures and Hyundai-Kia American Technical Center to participate in DOE's Freedom Car Demonstration program at Selfridge Air National Guard Base (SANGB) in Michigan. The project began when TARDEC entered into two CRADAs with Chevron in 2005 and Hyundai-Kia Motors in 2006. TARDEC also entered into an

Eaton Corporation's hybrid hydraulic shuttle bus, built in partnership with NAC, is based on a Ford E-450 chassis and uses the Eaton Hydraulic Launch Assist system. The vehicle is part of the Army's HAMMER project, which has the goal of increasing fuel economy by 25-30 percent in this platform, while also reducing hydraulic system noise. (Photo courtesy of HTUF.)

inter-agency agreement with SANGB to serve as the cold-weather test site for DOE's Freedom Car Demonstration.

Hybrid vehicles themselves have become a very important piece of the Army's self-sustainment. A hybrid vehicle with exportable power now has the potential to run on military bases. By doing so, they become part of the solution for energy-independent bases in conjunction with solar and wind power generation, the use of alternative fuels, microgrids with vehicles and plug-in hybrids. If done right, the Hybrid Truck Users' Forum's work with commercial suppliers to meet commercial fleet owners' demands will be easily leveraged for transition to the military. The investment that is being made to support commercial vehicles will push TARDEC much more quickly into solutions for the military — potentially at commercial prices. One recent example is the participation of two TARDEC-provided hybrid High Mobility Multipurpose Wheeled Vehicles in the Air Assault Expeditionary Force military exercise. One of the vehicles continuously powered a battalion-sized Tactical Operations Center for an extended period of time.

Energy storage remains the critical piece to using hybrid vehicles — on both the commercial and military sides. Commercial fleets are looking for a significant amount of increased fuel efficiency. The military is interested in exportable power. For both parties, so much is dependent on the energy storage piece. Power and energy is one of TARDEC's top five technology thrust areas and is made up of four major domains: the primary power plant, nonprimary power, energy storage, and power and thermal management.

Advanced batteries will allow hybrid vehicles to have more power and energy at a reduced weight. TARDEC is partnering with industry on projects to improve overall battery performance, safety and reliability. Because of NAC's technology assessments, we know industry is going to invest in batteries, so TARDEC is working with a U.S. company to automate its production of Lithium-ion batteries. This helps the government avoid costs and redundancy in R&D and work on a dual-use technology that will benefit the military and commercial industry. All of this commercial investment will help the hybrid solution move forward in the military.

Putting the Right Information at Everyone's Fingertips

NAC is developing a database assessment and forecasting tool that gives an overview of current projects and hot topics in the automotive industry, Army, other Armed Services, other government agencies and academia. This includes links to CRADAs and SBIRs, existing databases, academia and industry. Ultimately, this will help TARDEC maximize the capabilities of industry partners and begin an infusion of commercially viable equipment into the military.

Paul Skalny is Director of TARDEC's National Automotive Center. He has worked at TARDEC for the past 20 years, holding a number of key acquisition positions. He has a B.A. in economics and an M.S. in industrial engineering/operations research, both from Wayne State University.

Hybrid Truck Users Forum (HTUF)

Among NAC's many collaborative initiatives is its partnership with CALSTART WestStart on the HTUF. The forum provides an opportunity for commercial fleet owners to meet with military fleet managers to discuss their needs for fuel-efficient vehicles. The HTUF meets annually to showcase current hybrid trucks and share information on truck performance, testing, reliability and maintenance. The commercial and military fleet managers work to share their many commonalities.

For instance, in the area of condition-based maintenance, where it's important to put sensors on vehicles to monitor vehicle health, the military is closely watching the results that commercial hybrid vehicles are providing. Commercial fleet owners sometimes ask why the military is interested in bucket trucks or refuse vehicles. The answer is that many of these trucks are used on military bases, and the government is also searching for ways to become increasingly energy efficient.

The efforts HTUF has made in sensor and hybrid technology have increased the commercialization of medium and heavy hybrid vehicles by approximately two years. TARDEC has been involved working on hybrid High Mobility Multipurpose Wheeled Vehicles, Family of Medium Tactical Vehicles, the Heavy Expanded Mobility Tactical Truck, Utility Variants and Maneuver Sustainment Variants from the Future Tactical Truck Systems. All of these vehicles are now undergoing testing at Aberdeen Proving Ground.

Maximizing Critical Core Competencies — New Small Business Innovation Research (SBIR) Process Focuses on TARDEC Strategic Technology Thrust Areas

Jim Mainero and Martin Novak

A Beachwood, OH, company, Think-A-Move Ltd. (TAM), is developing a field-deployable prototype of its hands-free and heads-up system for controlling a military robot, the iRobot® PackBot®, with speech commands. The U.S. Army currently utilizes military robots, also known as Unmanned Ground Vehicles (UGVs), for improvised explosive device detection and surveillance in Iraq and Afghanistan. More than 1,000 PackBots have been deployed, mainly in Iraq and Afghanistan, since the war began.

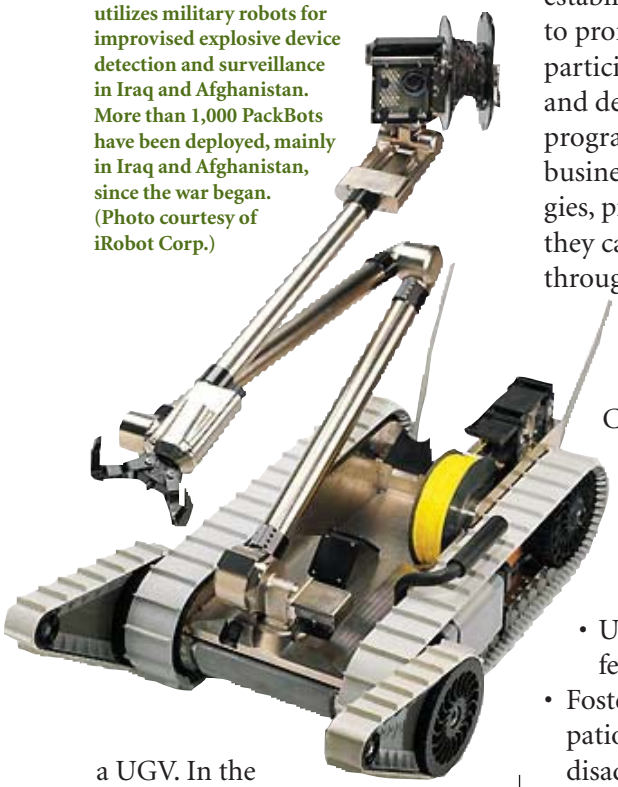
TAM received SBIR contracts to develop the hands-free prototype. TAM's President Jim Harris commented that "This demonstrates the value the Army places on developing a hands-free and heads-up control system for military robots. [TAM's] system provides the robot operator with increased situational awareness and potentially decreases the size of the security detail required to guard the operator. This enables the Army to increase the number of Soldiers effectively able to engage the enemy."

As one of the Army's participating agencies, the U.S. Army Tank Automotive Research, Development and Engineering and Development Center (TARDEC) uses the SBIR program to facilitate TARDEC transformation by filling technology gaps and identifying mature technology for possible insertion. In 2007, a new SBIR topic development process was implemented that focuses on TARDEC Strategic Technology Thrust areas to maximize critical core competencies.

The process also focuses on developing TARDEC-led SBIR topics that are aligned to support TACOM Life Cycle Management Command ground vehicle program executive offices (PEO), such as PEO Ground Combat Systems, PEO Combat Systems and Combat Support Systems and Program Manager Future Combat Systems (Brigade Combat Team). As a result, the new process ensures that the topics generated will increase technology transition and commercialization success with private industry, while also accelerating the fielding of capabilities to Soldiers that will benefit the Nation through stimulated technological innovation, improved manufacturing capability and increased competition, productivity and economic growth.

One of TARDEC's Strategic Thrust areas is Intelligent Ground Systems, which provides solutions to operational requirements that utilize intelligent, automated ground systems capable of engaging threats while interacting with an operator. TARDEC continues to push the boundary of robotic technology with developments such as a hands-free and heads-up control system for a small UGV.

TARDEC awarded a Phase I contract to TAM on Jan. 31, 2005, to investigate the development of a hands-free system for controlling



A PackBot with ICx Fido Explosives Detection Kit. The U.S. Army currently utilizes military robots for improvised explosive device detection and surveillance in Iraq and Afghanistan. More than 1,000 PackBots have been deployed, mainly in Iraq and Afghanistan, since the war began. (Photo courtesy of iRobot Corp.)

a UGV. In the Phase I effort, TAM demonstrated the feasibility of its concept. In Phase II, TAM further developed and delivered a prototype of its hands-free and heads-up system that recognizes air pressure changes within the ear canal and converts those changes into electronic signals to control tele-operated or semi-autonomous military robots. With Phase III funding of $340,000 provided by TARDEC's Joint Center for Unmanned Systems on Oct. 24, 2007, TAM is providing further capability and beginning integration of its system into iRobot's small UGV control system. TAM has recently been chosen for further funding (approximately $600,000) by the Army SBIR office's Commercialization Pilot Program to make its system field-deployable. The TARDEC point of contact for this technology and TAM is Dr. Robert Karlsen, Robert.Karlsen@us.army.mil.

The federal SBIR program is an extramural program reserved for small businesses. Congress established the program in 1982 to promote U.S. small business participation in federal research and development (R&D). The program's goal is for these small businesses to develop technologies, products and services that they can then commercialize through sales in the private sector or utilize for the government.

Congress designated four objectives when establishing the program:

- Stimulate technological innovation.
- Use small business to meet federal R&D needs.
- Foster and encourage participation by minorities and disadvantaged persons in technological innovation.
- Increase private-sector commercialization of innovations derived from federal R&D.

To participate in the SBIR program, small businesses must:

- Be U.S.-based, for-profit businesses of 500 or fewer employees.
- Perform the work in the United States.
- Perform two-thirds of the effort during Phase I, the feasibility study, and half the effort during Phase II, the major R&D effort.
- Ensure principal investigators spend more than half of their time employed by their respective SBIR-enrolled businesses.

Government agencies with an extramural R&D budget of at least $100 million must participate in the SBIR program and reserve 2.5 percent of this budget for competitively selected awards to small businesses. Each year, the Army SBIR participating organizations develop a set of research topics that represent the Army's current and anticipated warfighting technology needs. These topics are included in the Army portion of the Department of Defense SBIR solicitation.

The SBIR program has three phases. Proposals submitted by small businesses in response to solicitation topics are competitively selected for Phase I awards. Phase I is a feasibility study in which the small business receives up to $70,000 for a 6-month project to demonstrate the selected concept's scientific, technical and commercial feasibility. An option is available for up to $50,000 for interim activities between Phase I and Phase II.

Companies that successfully complete Phase I are invited to participate in the next phase of the SBIR program. Phase II represents a major R&D effort, culminating in a deliverable prototype. The small business will receive up to $730,000 over a 2-year period to develop a technology, product or software that addresses the needs of the Army and has potential for commercialization.

Commercialization is the ultimate goal of every SBIR effort. While no SBIR funding is available in Phase III, private sector funding is pursued to commercialize Phase II projects, or a federal agency may fund Phase III activities to enable its own application of the innovation.

Jim Mainero is a TARDEC SBIR Manager within the Army SBIR program. TARDEC's SBIR program is managed by the TARDEC NAC Mechanisms and Partnerships group.

Martin Novak is a TARDEC SBIR Manager within the Army SBIR program. TARDEC's SBIR program is managed by the TARDEC NAC Mechanisms and Partnerships group.

Understanding TARDEC's Cooperative Research and Development Agreement (CRADA) Program

Peter G. DiSante

U.S. Army soldiers from Bravo Battery, 1st Battalion, 37th Field Artillery Regiment, 2nd Infantry Division pull outer cordon security from an up-armored High Mobility Multipurpose Wheeled Vehicle (HMMWV) on the roads that pass by an insurgent operation point next to Rashidiya Lake, Iraq. TARDEC CRADAs have been used to explore improvements to the HMMWV in areas such as suspension, shocks and on-vehicle radar. (U.S. Army Photo by SGT Rachl M. Ahner.)

A top priority for the U.S. Army Tank Automotive Research, Development and Engineering Center's (TARDEC's) National Automotive Center (NAC) is developing and leveraging relationships with industry, academia and other government agencies to create and optimize technology for Soldiers. One important tool for achieving this mission is the CRADA, which allows TARDEC to enter into agreements with parties of interest for a whole host of purposes.

TARDEC's extensive CRADA use has encompassed all Technology Readiness Levels, from basic research to integration studies of commercial off-the-shelf products. TARDEC currently is using CRADAs to examine many new technologies in such areas as battery systems, hybrid vehicles, protection systems, unmanned vehicles and vehicle component design. CRADAs also have been written to take advantage of assets belonging to a partner, such as subject-matter experts, vehicle fleets, armored vehicles and testing capabilities. Another CRADA use has been to enter into agreements with "common goal" organizations for determining improvements and developing standards for vehicle components and manufacturing methods; providing exhibits, training and mentoring; and exploring options regarding alternative fuels.

The CRADA is a non-acquisition contract between a federal research and development laboratory and one or more partners from industry, academia or non-profit organizations, among others.

Under a CRADA, the federal lab and the CRADA partner may

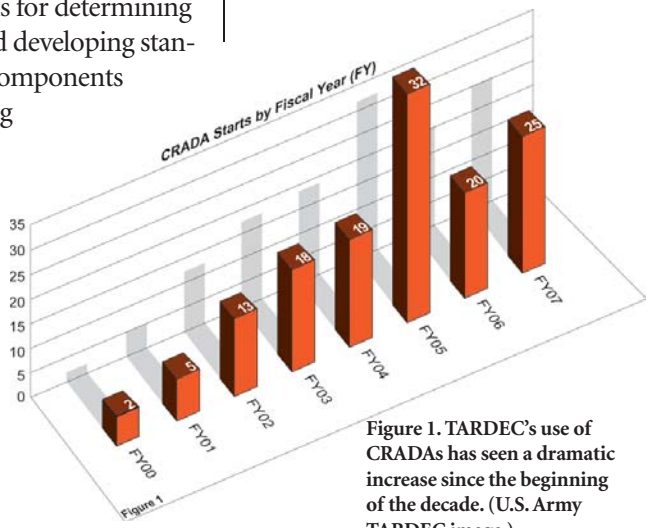


Figure 1. TARDEC's use of CRADAs has seen a dramatic increase since the beginning of the decade. (U.S. Army TARDEC image.)

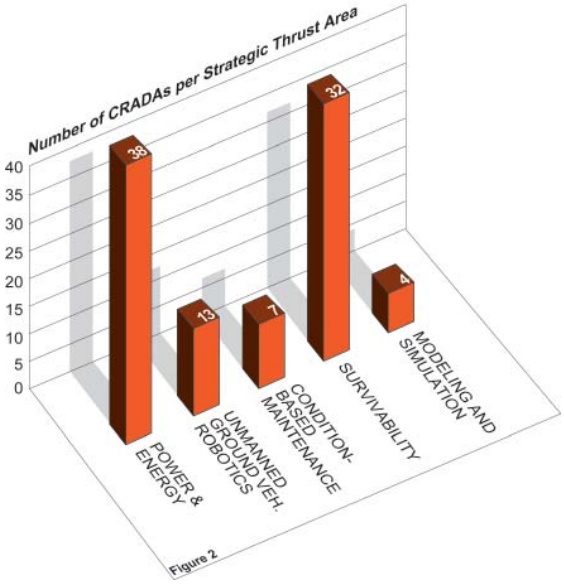


Figure 2. A breakdown of how current, active TARDEC CRADAs align with TARDEC Strategic Thrust Areas. (U.S. Army TARDEC image.)

provide expertise, testing, data, equipment or facilities. The partner also may provide reimbursement for government-incurred expenses. However, CRADAs do not allow government funding to be provided to a CRADA partner. Thus the agreements can be created and approved by an individual federal lab.

The initial step in developing a CRADA is finding a partner match for the desired cooperative research and development project. Once the interest of a technology partner has been established, a statement of work (SOW) is developed. This is typically an engineer-to-engineer agreement describing the work objectives and defining the specific tasks to be performed by each party.

Next, the SOW is added to the CRADA's contractual portion that ensures the safety of the CRADA partner's proprietary information and patent rights. It also provides for the resultant technology's royalty-free licensing to the government for government purposes. At TARDEC, a boilerplate CRADA document is used as a template for creating the contract and SOW. The CRADA's contract portion can be negotiated with a partner's legal representatives if requested. However, the CRADA's boilerplate consists of requirements stipulated by legislation, specifically, 15 *United States Code 3710a*. The TARDEC CRADA boilerplate is readily available on the shared drive, on Army Knowledge Online (AKO), from the TARDEC legal office and from the NAC CRADA Manager. It is approved for general distribution.

CRADAs allow TARDEC to explore technologies that have potential for military use. They also allow for transfer of TARDEC technologies for dual-use development. The CRADA partner retains all intellectual property rights to its inventions and is given first opportunity to own the rights to joint inventions and to license exclusively TARDEC inventions made under the CRADA. They are a fairly low-risk undertaking, since, typically, no money changes hands, and either party is allowed to unilaterally terminate the agreement with 90 days notice.

TARDEC's use of CRADAs has seen a dramatic increase since the beginning of the decade as depicted in Figure 1. A large number of CRADAs have been used to obtain and test technologies of interest. Through testing, the partner gains valuable data relating to military technology use, which provides insight into potential improvements towards producing a marketable product. TARDEC gains test results that are most meaningful from a military perspective. This familiarization often can assist with preparing future requirements and specifications. A breakdown of how current, active TARDEC CRADAs align with TARDEC Strategic Thrust Areas can be seen in Figure 2. A breakdown of the partner types for current TARDEC CRADAs is shown in Figure 3.

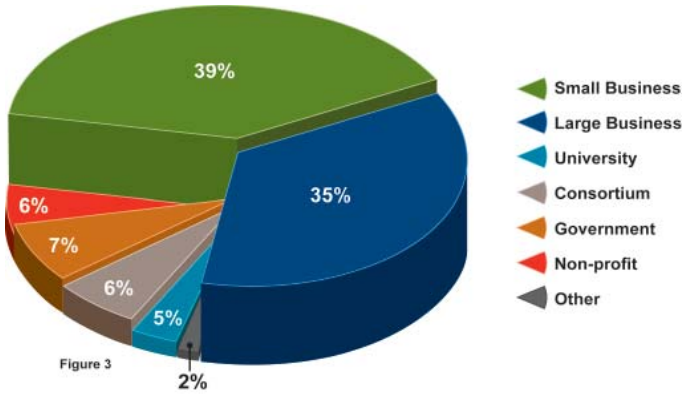


Figure 3. A breakdown of the partner types for current TARDEC CRADAs. (U.S. Army TARDEC image.)

CRADAs

The CRADA is one method of formalizing cooperation. It provides a simple and straightforward agreement to allow the partners to begin working soon after establishing their common interests. Any questions regarding the TARDEC CRADA program can be answered by NAC Collaborative Mechanisms and Partnership Team member Peter DiSante, who can be reached by phone at 586-574-8958 or e-mail at peter.disante@us.army.mil.

Peter DiSante is Manager of TARDEC's Cooperative Research and Development Agreements Program, a division of TARDEC's National Automotive Center's Technology Transfer group.

TARDEC Presents 2008 Dual Use Briefings to Highlight the Army's CRADA and SBIR Programs

Carrie Deming and Alicia Price

SBIR award recipient Mark Stanczak demonstrates the power management technology that his company produced for the U.S. Army at the TARDEC booth during the Society of Automotive Engineers World Congress held in Detroit in April. (U.S. Army photo by Elizabeth Carnegie.)

The U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) presented its 2008 Dual Use Briefing at Automation Alley® in April and at Macomb Community College in May. At both events, TARDEC National Automotive Center (NAC) Director Paul Skalny presented a NAC overview to more than 75 people involved in small and large businesses and academic groups from Michigan and across the country. TARDEC Cooperative Research and Development Agreement (CRADA) Manager Pete DiSante presented the CRADA program, and TARDEC Small Business Innovation Research (SBIR) Program Manager Jim Mainero presented the SBIR program. TARDEC reaches out annually to businesses and organizations that would like to work with the government and helps to explain the proposal writing process to make it less intimidating and easier to understand for interested parties.

"We want to deliver technology solutions to the Soldier, and we will make a difference for you because you make a difference for the Soldier," Skalny remarked during the NAC overview. "The Department of Defense [DOD] has gaps in its technology, and we are looking to fill those gaps with the most innovative technology, because safety for the Soldier and survivability for the Soldier are our main objectives."

CRADAs

"The CRADA Program is a way for the government and organizations to work together on a technical objective," DiSante explained. "CRADAs are established between federal laboratories and commercial, academic or nonprofit partners to facilitate technology transfer for each party's mutual benefit. Under a CRADA, the partner may contribute resources such as personnel, services, property and funding to the effort. The government may contribute all of the above except funding," he continued.

A most desirable CRADA feature for many organizations is its function as a conduit for combin-

ing the technical partner's and military's research and development efforts toward a common objective. Patent and intellectual property rights belong to the inventor, and the partner has the opportunity to own the rights to joint invention.

SBIRs

The SBIR program's goal is to tap into the innovations and creativity of small businesses to help meet TARDEC's research and development (R&D) objectives and to develop technologies, products and software that can be commercialized through sales in the private sector or to the government. TARDEC scientists and engineers develop topics that address technology needs. Recently, new topics have been posted to the Internet. Once a company writes a competitive proposal towards a topic, the proposal goes through a comprehensive review process. One in 10 quality proposals are awarded a Phase I contract. Phase I is a feasibility study in which a small business will receive up to $70,000 for a 6-month project to demonstrate the selected concept's scientific, technical and commercial feasibility.

Successful Phase I projects are invited to participate in Phase II, which represents a major R&D effort, culminating in a deliverable prototype. The small business will receive up to $730,000 over a 2-year period to develop a technology, product or software that addresses specific TARDEC and Army requirements, but also has potential for commercialization. Approximately 50 percent of reviewed projects are selected and funded for Phase II awards.

Phase III commercialization is every SBIR effort's ultimate goal. While no SBIR funding is available in Phase III, private-sector funding is pursued to commercialize Phase II projects, or a federal agency may fund Phase III activities to enable its own innovation applications.

TARDEC NAC Director Paul Skalny, left, speaks with U.S. Marine Corps MG (Ret.) Bradley M. Lott, Director, DC3 Technology Initiative, at the Dual Use Conference. (U.S. Army photo by Alicia Price.)

Mainero and his team presented the steps required to research and write a successful proposal. Automation Alley's John Bedz reiterated that his organization was on board with the SBIR program's goal and could be used as a resource to facilitate finding resources for help with proposal development.

Mark Stanczak, Global Embedded Technologies, a past SBIR award recipient from Farmington Hills, MI, gave attendees his perspective on the SBIR process from beginning to award and beyond. "The SBIR program has been an enabler to branch out into other companies," he remarked.

The May workshop at Macomb Community College in Clinton Township, MI, featured an added presentation by U.S. Marine Corps MG (Ret.) Bradley M. Lott, Director, Defense Contract Coordination Center (DC3) Technology Initiative, which is dedicated to meeting the needs of military and civilian acquisitions leaders, staff and prime contractors, and providing solutions for requirements and acquisition challenges.

At both events, Skalny's closing remarks addressed the important role Michigan plays in the Nation's military technology field. "The government has a budget of more than $2 billion for the SBIR program, and, of that, DOD was allotted $1.15 billion," Skalny reflected. "Michigan is the manufacturing capital of the world, and I know that together with small businesses we can accomplish safety and survivability of Soldiers through technology. We are looking for the most competitive proposals, and we are taking proposals from across the country, but Michigan businesses already have the resources and industry to accomplish this goal."

For more information on the Army's CRADA and SBIR programs, go to: **http://tardec.army.mil/crada.asp** and **http://tardec.army.mil//sbir.asp**.

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Alicia Price is a Senior Account Executive for BRTRC, Inc. in support of TARDEC's National Automotive Center.

How to Make Connections

Alicia Price

TARDEC Nonprimary Power Team Lead Kevin Mills (center) explains the Patrick Auxiliary Power Unit technology to (from right) TARDEC Director Dr. Grace M. Bochenek, TACOM Life Cycle Management Command Commanding General (CG) (then) BG Scott G. West and former TACOM LCMC CG MG Mike Lenaers. (U.S. Army TARDEC photo by Elizabeth Carnegie.)

How does the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) find ways to connect with the automotive industry, academia and other government agencies? The answer is a unique group of people within TARDEC who provide engineering, research and development, and technology integration support through the National Automotive Center (NAC).

The NAC participates in many forms of technology outreach, including conferences, symposiums and forums. Each of these endeavors provides an opportunity for making connections through point targeting. NAC doesn't participate in every event that comes along; there is careful consideration based on Soldiers' needs and TARDEC's technical thrust areas for research, development and engineering — vehicle electronics and architecture, force projection technology, ground vehicle power and mobility, ground vehicle survivability and intelligent ground systems.

TARDEC, headquartered at the Detroit Arsenal in Warren, MI, is the Nation's laboratory for advanced military automotive technology. Its mission is to research, develop, engineer, leverage and integrate advanced technology into ground vehicle systems and support equipment throughout their life cycles.

From left: TARDEC Executive Director of Engineering Mag Athnasios, former TACOM LCMC CG MG Mike Lenaers, TACOM LCMC CG (then) BG Scott G. West, TARDEC Director Dr. Grace M. Bochenek and NAC Director Paul Skalny listen to TARDEC Intelligent Ground System Mission Payload Integration Team Lead William Smuda talk about robotics at TARDEC's 2008 SAE World Congress exhibit. (U.S. Army TARDEC photo by Elizabeth Carnegie.)

In 1993, the Secretary of the Army chartered NAC with a mission to serve as the Army focal point for the development of dual-use automotive technologies and their applications to military ground vehicles. NAC's principal focus is on facilitating joint efforts between industry, government and academia in basic research, collaboration, technology, industrial base development and professional development. NAC works closely with TARDEC staff to support the needs of Soldiers.

Based on TARDEC's technical thrust area needs and NAC's mission to make connections, one of the best ways to present current technology partnerships to potential future partners is to participate in conferences, symposiums and forums. Through the careful selection of key events and conferences, NAC continues to make significant connections en masse with partners that often turn into lasting partnerships resulting in the development of many current, Soldier-supporting technologies.

TARDEC/NAC schedules several key events throughout the year, including: Society of Automotive Engineers World Congress, Society of Automotive Engineers (SAE) Commercial Vehicle Engineering Congress and Exhibition, American Trucking Association – Truck Maintenance Council (ATA-TMC), Ground-Automotive Power and Energy Symposium, and the Hybrid Truck, Commercial Construction Equipment and Class 8 Truck Users Forums. Some examples of previous TARDEC/NAC booths that displayed successful partnerships based on connections are SAE World Congress, where Engineering Machine Product displayed the OilMate™ and an engine cooling system, and the SAE Commercial Vehicle Show, where International MXT displayed a medium-duty vehicle.

TARDEC/NAC takes its partnerships seriously. In addition to event participation, the organization takes advantage of all networking, research and educational opportunities for its associates. This gives the associates an opportunity to learn what other government agencies and industry are working on for the future, particularly at events where papers and seminars are being presented. When paper presentations are scheduled, attendance is highly recommended for engineers in relevant fields.

TARDEC/NAC also encourages associates to write papers and present them at conferences, as sharing this type of information is very helpful in the search for new technology partnerships. Some of today's TARDEC/NAC partnerships are the result of an initial meeting at a conference or symposium where the parties involved viewed one another's

An International Truck and Engine Corporation MXT-MV truck being used to demonstrate the full-series hydraulic hybrid technology of Bosch Rexroth.

The TARDEC/NAC exhibit drew thousands of visitors during this year's SAE World Congress. Pictured is an International Truck and Engine Corporation MXT truck, which demonstrates cutting-edge hydraulic hybrid technology. (U.S. Army TARDEC photo by Elizabeth Carnegie.)

booth displays and discovered ways to combine the different technologies presented to build a newer, better engineered product benefiting both the technology provider and the Army.

At this year's SAE World Congress, NAC Director Paul Skalny had several opportunities to collaborate with the automotive community. In the FEV, Inc. theater, Skalny moderated a session titled "The Military: Is it Becoming the New Test Bed for Future Transportation Technologies?" This event drew a full house of more than 150 attendees, making it one of the most widely attended sessions in that theater. In addition to moderating presentations from Badenoch LLC, AM General LLC, ESG Automotive Inc. and L-3 Communications, Skalny presented the newest military program available to the automotive industry — the Fuel Efficient ground vehicle Demonstrator (FED) program. FED highlights technologies that can be applied to ground vehicles to reduce the amount of fuel used on the battlefield and is another example of how connections are being made.

The 2008 SAE World Congress also included a new event that TARDEC introduced — the first annual Advanced Planning Briefing for Academia (APBA). Held April 15, 2008, the APBA was designed to help universities, colleges and academic institutions gain an understanding of TARDEC's research and development requirements and how to develop cooperative relationships with TARDEC that will, in turn, advance and improve the technology that TARDEC provides for U.S. Army Soldier and U.S. Marine Corps ground combat vehicle systems and robotics. More than 150 guests representing 30 universities and colleges attended the event.

As evidenced by the APBA, TARDEC/NAC continues to look for the best outreach avenues to create connections with technology partners. The groundbreaking programs created through these partnerships command high performance and offer long-lasting solutions to support our Soldiers today and in the future. Connections and targeted communications make it all happen, and NAC is making those connections count.

Alicia Price is a Senior Account Executive for BRTRC, Inc. in support of TARDEC's National Automotive Center.

TARDEC Partners With Universities to Leverage Research and Development (R&D) for Future Army Requirements

Mike Letherwood and Dariusz Mikulski

Dr. Grace M. Bochenek, TARDEC Director, addresses the Automation Alley/SAE-sponsored luncheon on Monday, April 14. (U.S. Army TARDEC photo by Elizabeth Carnegie.)

Following the U.S. Army Tank Automotive Research, Development and Engineering Center's (TARDEC's) recent reorganization, the Development Business Group's (DBG's) National Automotive Center (NAC) created the Automotive Research Center and University Team to act as TARDEC's focal point for university outreach by facilitating efforts between government and academia in basic and applied research and collaborative technology.

The team's primary mission is to develop and expand collaborative relationships with universities involved in ground vehicle research that supports TARDEC's strategic thrusts and technology interest areas. Team members coordinate and establish innovative R&D programs with high-tech, U.S.-based and international universities to meet critical Army needs through Cooperative Research and Development Agreements, Department of Defense Small Business Innovation Research programs, contracts, technical events and forums. Team employees meet periodically with TARDEC's research community for guidance, to ensure that university research programs and TARDEC programs are in alignment and so key participants can strategize for future activities.

The team's efforts include identifying new university research thrusts and coordinating with existing university partners to define, develop and integrate key research and development into TARDEC programs. The team also promotes interaction among TARDEC scientists and engineers and Historically Black Colleges and Universities and minority institutions, which represent just 7 percent of the Nation's institutions of higher learning.

Team members coordinate and establish innovative R&D programs with high-tech, U.S.-based and international universities to meet critical Army needs through Cooperative Research and Development Agreements, Department of Defense Small Business Innovation Research programs, contracts, technical events and forums.

Established in 2007, one of the team's first projects was to figure out what types of active university programs were already established at TARDEC and to focus these programs on the strategic thrust and potential technology gap areas. Consequently, the team gathered critical information about each program and cataloged it in a set of data sheets, available upon request, that consolidate information on all funded research and development activities with universities. By providing a window into current activities, the data sheets allow for better outreach activity management and execution. The team is also developing an online database, accessible by everyone at TARDEC, that will capture current TARDEC/university collaborative work and allow simple search capabilities. The database will be updated periodically by program mangers and TARDEC associates, who can archive new information for others' future reference.

When considering which institutions to target and approach, team members developed specific selection criteria. Due to limited staffing levels and resources, initial efforts focused primarily on university centers and consortiums where considerable investments had already been made by universities in partnership with industry and other government entities, thereby leveraging the activities and successes already obtained. This selective funding of small efforts where there is joint activity and interest by partners from industry, academia and other government agencies fits the overall NAC model of promoting efforts that can produce dual-use technologies crucial to the commercial market and the Army's Future Force. Selection criteria also include research and development activities that address at least one technology/capability gap identified by TARDEC senior leadership.

Foster-Miller, Inc. representative Bob Quinn explains the TALON® robot to Sen. Carl Levin, D-MI; U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) Director Dr. Grace M. Bochenek; TARDEC Joint Center for Robotics Director Dr. James Overholt; and state Sen. Liz Brater, MI-District 18, at the University of Michigan College of Engineering's Michigan Robotics & Autonomous Technologies Conference, Aug. 11. TARDEC develops and expands collaborative relationships with universities involved in ground vehicle research that supports TARDEC's strategic thrusts and technology interest areas. (U.S. Army TARDEC photo by Elizabeth Carnegie.)

Programs capable of integration with any of these efforts will involve key TARDEC scientists and engineers who will work closely with the university on program development. Overall, the team is moving forward with implementing partnering strategies and developing collaborative relationships with university partners to increase Army readiness by leveraging research that will provide the technological innovations necessary to make transformation a reality and to spiral mature technology into Soldier ground vehicle systems.

TARDEC Director Dr. Grace M. Bochenek addresses International Ground Vehicle Competition participants from 41 different academic institutions. This event is just one of the many efforts TARDEC makes to facilitate collaboration between government and academia in basic and applied research and collaborative technology (U.S. Army TARDEC photo by Elizabeth Carnegie.)

Mike Letherwood is Acting Associate Director for the TARDEC NAC Collaborative Mechanisms and Partnerships group, a division of DBG.

Dariusz Mikulski is a University Relations Liaison with the TARDEC NAC University Programs team, a division of DBG's Collaborative Mechanisms and Partnerships group.

Making Better Use of Resources and Improving the Flow of Good Ideas

Derhun Sanders

One of TARDEC's collaborative efforts is the TAGS-CX2 Bobcat tool interface robotic vehicle, which was displayed at the Association for Unmanned Vehicle Systems International's exhibition in San Diego, CA, June 10-12, 2008. This vehicle will undergo a series of field experiments during the second quarter of fiscal year 2009 to test its decontamination capabilities. (Photo courtesy of Foster-Miller, Inc.)

The U.S. Army Tank Automotive Research, Development and Engineering Center's (TARDEC's) National Automotive Center (NAC) is aspiring to a culture of true collaboration with other government agencies to maximize resources through its Federal/State/Local (FSL) team.

The FSL team is pursuing TARDEC's goal of "focusing on facilitating joint efforts between industry, government and academia" by proactively seeking and making connections among these types of organizations. Additionally, the team strives to foster partnerships with other federal agencies such as the U.S. Army Research, Development and Engineering Command (RDECOM) Systems of Systems Integration, Program Executive Offices (PEOs) and other research, development and engineering centers within RDECOM.

The FSL team develops these partnerships through RDECOM integrated product teams (IPTs), National Defense Industrial Association conferences, Association of the United States Army events and one-on-one meetings with industry and academia partners. By doing so, TARDEC ensures that RDECOM is a fully integrated organization that maximizes every dollar of investment possible by leveraging opportunities with other government agencies and services.

To this end, all aspects of TARDEC are aligned toward achieving the same vision. Additionally, the FSL team has underlying goals of its own. The first goal is to make better use of resources by eliminating duplication and/or contradiction between different programs. This is achieved primarily through focusing the use of congressional appropriation dollars toward core Army programs of record.

A side view of the TAGS-CX2 with Bobcat tool interface robotic vehicle. The platform's robotic control software was fully installed in July, enabling the system to potentially support combat and combat service support missions. (Photo courtesy of Foster-Miller, Inc.)

A second goal is to improve the flow of good ideas and cooperation between different stakeholders in particular engineering areas, thus producing synergy or smarter ways of working. The team will leverage TARDEC's Intranet, using it to make information available for sharing among team members and internal partners.

Collaboration is Key

The key to achieving both of these goals and TARDEC's overarching goal of facilitating joint efforts is collaboration — working collaboratively with other government agencies to find ways to integrate programs and projects between portfolios and achieve more efficient and effective deliverables. This can be both within TARDEC and across government organizations with similar thrust areas.

The intense focus on collaboration signals an important paradigm shift where TARDEC moves beyond agency-bound limits to its thinking and embraces problem solving that is integrated, efficient and focused on achieving shared outcomes across technology areas and across territorial boundaries. One such example is TARDEC's actively taking lead roles in RDECOM IPTs and seeking input through its newly aligned Enterprise Integration Business Group.

TARDEC already is an active participant in several key Army IPTs, leading the Power and Energy IPT and working with other Army and government agencies that have similar challenges. TARDEC has worked with the Defense Advanced Research Projects Agency as well as the Department of Energy to leverage research dollars. Examples

A close-up view of the TAGS-CX2 with Bobcat backhoe robotic vehicle. (Photo courtesy of Foster-Miller, Inc.)

Another view of the TAGS-CX2 with Bobcat backhoe robotic vehicle. This vehicle is being developed under a Joint Ground Robotics Enterprise program between MANSCEN and TARDEC. (Photo courtesy of Foster-Miller, Inc.)

of TARDEC's work with other federal agencies include:

- Tactical Wheeled Vehicle System — TARDEC is working jointly with the Army Research Lab, Edgewood Chemical Biological Center, U.S. Army Combined Arms Support Command, U.S. Army Engineer Research and Development Center, Communications-Electronics Research, Development, and Engineering Center, Joint PEO for Chemical and Biological Defense and U.S. Army Materiel Systems Analysis Activity.
- Jet propellant 8 fuel reformation — TARDEC is collaborating with the U.S. Air Force Research Laboratory for the solid oxide fuel cell powered unmanned aerial vehicles.
- Power and Thermal Management Technologies Army Technology Objective — TARDEC is working with Oak Ridge National Laboratory on carbon foam and waste heat recovery development.
- Automotive ground vehicles — the Army National Guard has been leveraging opportunities with TARDEC by allowing TARDEC to test and demonstrate several of its ground vehicle technologies.

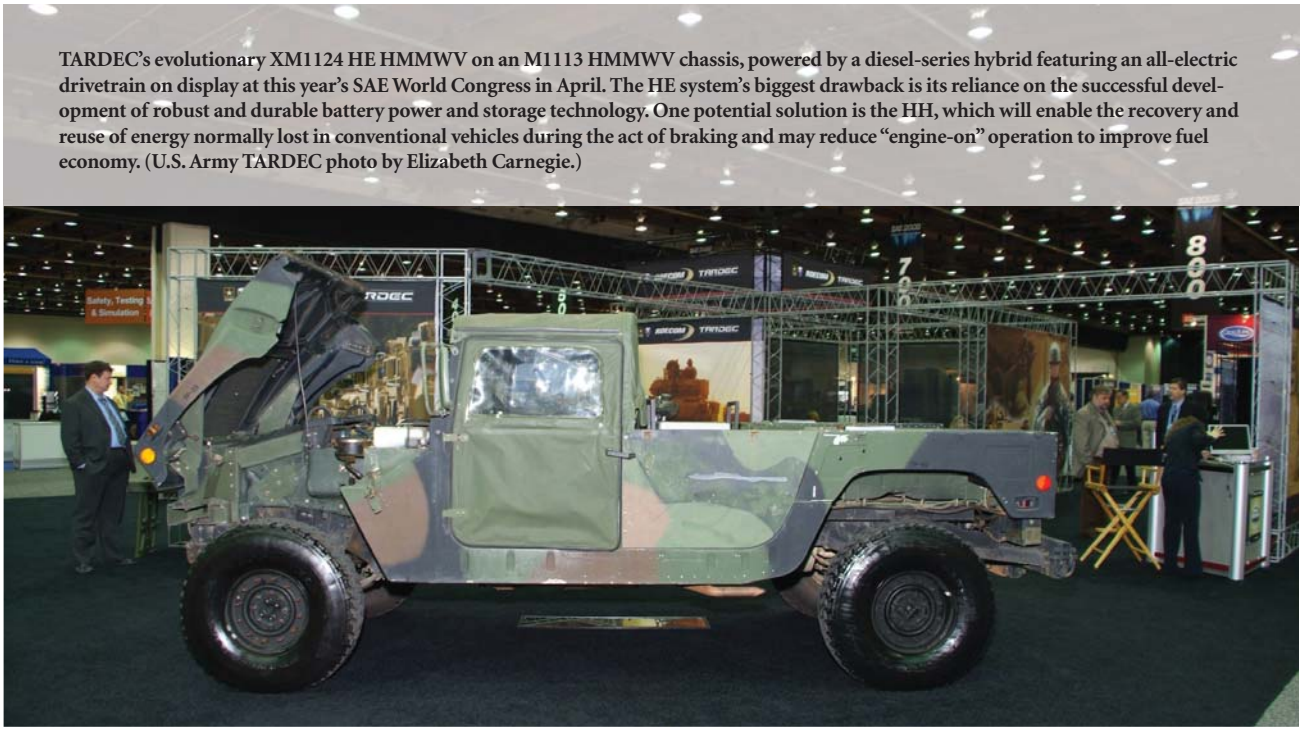
Another collaborative effort is the TAGS-CX2 with Bobcat tool interface robotic vehicle, which was displayed at the Association for Unmanned Vehicle Systems International's exhibition in San Diego, CA, June 10-12, 2008. The platform's robotic control software was fully installed in July, enabling the system to potentially support combat and combat service support missions. During fiscal year 2008's fourth quarter, under a Joint Ground Robotics Enterprise program between the U.S. Army Maneuver Support Center (MANSCEN) and TARDEC, robotic vehicular decontamination capabilities will be developed, including chemical and biological agent detection sensing and semi-automated (i.e., assisted tele-operation) vehicular cleaning and decontamination. A MANSCEN field experiment will be conducted during the second quarter of fiscal year 2009. The program has been coordinated with the U.S. Army Edgewood Chemical Biological Center, which will make the decontamination system recommendation.

Looking to the future, the FSL team is seeking improved communications with economic development corporations throughout the continental United States, which will increase leveraging of potential state funding with future projects. At the state level, the team will be supporting the next Michigan Defense & Innovation Symposium held among members of academia, industry and the federal government. Locally, team members will increase collaboration with the community through several outreach activities. By adding to its already impressive list of successful collaborative projects, the FSL team is advancing the capabilities and status of NAC, TARDEC and the U.S. military.

Derhun Sanders is Team Leader for the TARDEC National Automotive Center Federal/State/Local/Congressional team, a division of the Enterprise Integration Business group.

What Can NAC Do for Brown? Drive Military's Use of Hydraulic-Hybrid Technology

Heather McKee



TARDEC's evolutionary XM1124 HE HMMWV on an M1113 HMMWV chassis, powered by a diesel-series hybrid featuring an all-electric drivetrain on display at this year's SAE World Congress in April. The HE system's biggest drawback is its reliance on the successful development of robust and durable battery power and storage technology. One potential solution is the HH, which will enable the recovery and reuse of energy normally lost in conventional vehicles during the act of braking and may reduce "engine-on" operation to improve fuel economy. (U.S. Army TARDEC photo by Elizabeth Carnegie.)

By now, most people have heard of or seen hybrid-electric (HE) passenger vehicles driving on American roadways. What most people probably haven't heard about, however, are hydraulic-hybrid (HH) vehicles.

At present, there are two variants of hybrid vehicle technology — HE and the lesser known HH. There is no question that hybrid technology can provide substantial fuel economy improvement. However, the electrical hybrid system's biggest drawback is its reliance on the successful development of robust and durable battery power and storage technology that can provide worthwhile fuel economy benefits under extreme weather conditions.

On the other hand, an HH system will store and retrieve energy through the use of hydraulic components such as pumps and accumulators, enabling the recovery and reuse of energy normally lost in conventional vehicles during the act of braking. It can eliminate idling and reduce "engine-on" operation to improve fuel economy.

The need for the greater fuel efficiency that hybrid vehicles provide is crucial for the Nation and our warfighters. To this end, the U.S. Army Tank Automotive Research, Development and Engineering Center's (TARDEC's) National Automotive Center (NAC) is currently working on several initiatives in the HH area. One such project is the result of NAC's memorandum of understanding with the U.S. Environmental Protection Agency Office of Transportation and Air Quality in Ann Arbor, MI. This mechanism provides a means of collaboration and support for advancing HH technology, including

The XM1124 HE HMMWV on display at SAE World Congress 2008. The need for the greater fuel efficiency that hybrid vehicles provide is crucial for the Nation and our warfighters. (U.S. Army TARDEC photo by Elizabeth Carnegie.)

their joint demonstration of Eaton's series HH technology on a United States Parcel Service™ (UPS) delivery vehicle, which is currently experiencing a 60- to 70-percent improvement in fuel economy and a 40-percent reduction in greenhouse gases.

NAC also recently signed a Cooperative Research and Development Agreement (CRADA) with the Michigan-based Hybra-Drive company. The company is developing a unique hydraulic pump and motor technology that could improve fuel economy on the Army's High Mobility Multipurpose Wheeled Vehicle platform. NAC is supporting the deployment of HE and series HH fleet vehicles through its membership in the NextEnergy Hydraulic Hybrid Working Group and oversight of the WestStart/CALSTART Hybrid Truck Users Forum.

Several years ago, NAC launched a program in which a Ford E-450 shuttle bus was outfitted with an Eaton Corporation parallel HH launch assist configuration. Currently, NAC is developing a CRADA with Eaton to further this technology's development. In addition, NAC is kicking off a new program with Eaton for demonstrating the series technology on a military tactical platform.

NAC also has a program with Bosch Rexroth, which is currently installing its series HH technology on an International Truck and Engine Corporation MXT-MV medium-duty truck. The MXT-MV vehicle will be operational in fiscal year 2009.

UPS delivery vehicle is using Eaton Corporation's series HH technology. (Photo courtesy of UPS.)

The series HH is a traditional engine combined with a unique hydraulic propulsion system that replaces the conventional drivetrain and transmission. Hydraulic pumps and storage tanks accumulate the energy, acting in a similar capacity to electric motors and batteries in HE vehicles. The parallel configuration of an HH achieves a 25-percent improvement in fuel economy, and the series configuration is reporting results of at least 50 percent.

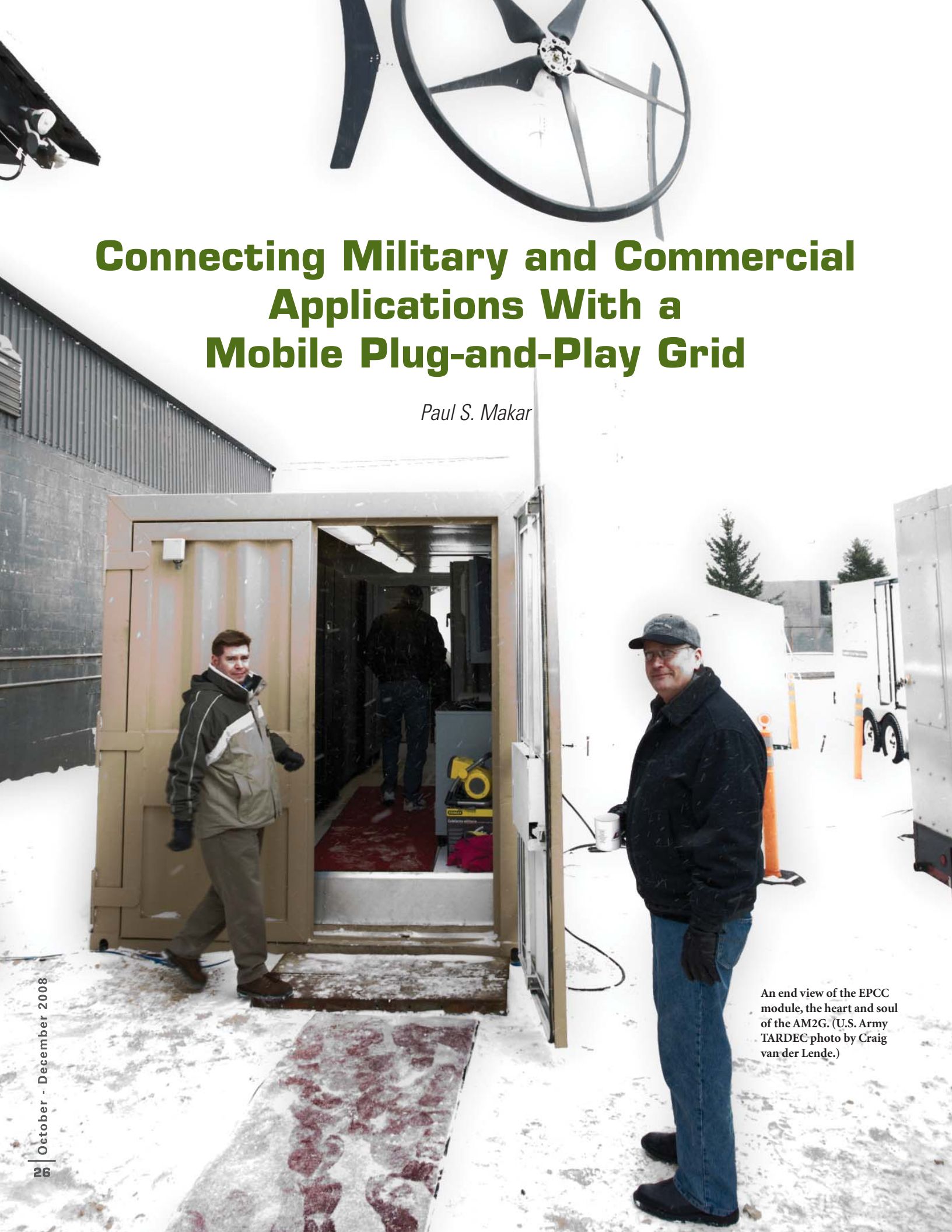
Although passenger car hybrid variants are becoming more common, that same penetration has not yet happened in the medium- and heavy-duty commercial sectors, such as vocational vehicles and semi-trucks. A reason for this is that hybrid drivetrain technology can't be retrofitted easily to existing vehicles. Also, in these sectors, vehicle turnover is relatively low because HE commercial vehicle cost is substantially higher at present due to low market volume. Additionally, there is no economy of scale, even with government subsidies and tax benefits. Another drawback is the lack of confidence in a battery technology that can meet the demands of these larger and much heavier vehicles that potentially run 24/7.

With continued TARDEC/NAC support of alternative-fuel vehicle technologies, the future of the Nation's military vehicle fleet is looking cleaner, more energy efficient and mission ready.

Heather McKee is a Mechanical Engineer for the TARDEC National Automotive Center Power and Energy Technologies team, a division of the Enterprise Integration Business group.

Connecting Military and Commercial Applications With a Mobile Plug-and-Play Grid

Paul S. Makar



An end view of the EPCC module, the heart and soul of the AM2G. (U.S. Army TARDEC photo by Craig van der Lende.)

Imagine hardware that provides a plug-and-play interface to monitor and control nearly any source of electrical power and electrical load within an electrical grid. Now imagine that the same hardware is capable of deployment, anywhere in the world, within 48 hours. This may sound like something from a science fiction movie, but it is rapidly approaching reality.

The U.S. Army Tank Automotive Research, Development and Engineering Center's (TARDEC's) National Automotive Center (NAC) and its partner NextEnergy Center are nearing completion of the first Advanced Mobile Micro Grid (AM2G) demonstration hardware. NextEnergy developed this project conceptually with NAC as an innovative, portable alternative energy generation source and secured funding for its development through the Department of Defense (DOD).

NextEnergy has turned to Michigan companies to assist with the project's implementation, including Grand Rapids-based Coffman Electrical Equipment for system integration, Muskegon-based Newkirk Electric for assembly and testing and Howell-based Marelco Power Systems, Inc. for custom transformers and control systems. Additional NextEnergy partners include Southwest Research Institute, located in Ann Arbor, Nextek Power Systems in Detroit, NOVI Energy in Novi, Northern Electrical Testing in Troy and Titan Energy Development in Detroit.

The demonstration prototype began initial evaluation and testing in January 2008. Three additional modules were delivered to Selfridge Air National Guard Base in Michigan in June 2008 for more comprehensive evaluations.

Planning began in 2005 for a mobile distributed power management system based on numerous homeland security-related inquiries. While all DOD installations use a host grid with back-up generators, the AM2G can connect these generators and other diverse power sources to the grid with complete monitoring and control. Any source of power, alternating current (AC) or direct current (DC), can be put into the AM2G. Ultimately, the AM2G units, using smart software, will utilize the most efficient, clean and effective power sources available, such as sun, wind, vehicles, flight-line generators, back-up generators and the grid, to stabilize and maintain digital power quality together or independent of a grid.

AM2G's heart and soul is the electric power control and conditioning (EPCC) module. NextEnergy, a Michigan non-profit organization charged with accelerating the research, development and manufacturing of alternative energy technologies, is coordinating the efforts of several Michigan innovators to build the EPCC system, which will be used by the military and eventually developed into non-military applications, enabling power supply to remote locations and disaster areas. The EPCC takes AC or DC power and converts it to one common DC voltage and then inverts it to a 480-volt AC. This universal AC power is distributed to the grid.

The EPCC system provides key components for the AM2G, including the ability to optimize power distribution and energy supplies such as batteries, generators, hybrid vehicles and various other alternative energy sources. This type of power control and conditioning enables generators and other power sources to operate more efficiently. The internal components are designed to level the flow of energy as new loads and sources are brought online, protecting against brownouts and losses of power to critical military operations including data and medical centers.

DOD recently acknowledged the need for such technology by supplying an additional $4.4 million to continue advancement of this technology.

Ultimately, the AM2G units, using smart software, will utilize the most efficient, clean and effective power sources available, such as sun, wind, vehicles, flight-line generators, back-up generators and the grid, to stabilize and maintain digital power quality together or independent of a grid.

Paul Makar is a Senior Project Engineer on the TARDEC National Automotive Center International Cooperative Research and Development and Special Initiatives' Advanced Energy Initiative team, a division of the Enterprise Integration Business group.

Manufacturing and Robotics Technology Team (MRTT) — Advancing Army Vehicle Systems and Processes

Benedict DeMarco and Tom Altobelli

The MRTT's mission within the U.S. Army Tank Automotive Research, Development and Engineering Center's (TARDEC's) National Automotive Center (NAC) is to assist the military industrial complex in identifying and implementing advanced manufacturing technologies into U.S. Army vehicle systems and processes. MRTT maintains a diverse network of partners, including depots, academic institutions and private industry. Its goal is to leverage partnerships and relationships to quickly deliver critical repair parts and technology, resulting in U.S. industrial base reinforcement.

MRTT is involved in several Army initiatives, including the High Mobility Multipurpose Wheeled Vehicle Improvement Program (HIP), and industry outreach activities, such as the United States Council for Automotive Research (U.S. CAR), an umbrella organization for collaborative research among Chrysler LLC, Ford Motor Company and General Motors Corporation. Other MRTT projects include the 12-screw extruder for Advanced Ceramics Manufacture, the composite structures

Chief of Staff of the Army GEN George W. Casey Jr. unveiled the FCS NLOS-C outside the U.S. Capitol in Washington, DC, June 11, a significant milestone in the FCS timeline. "After a decade of hard work, planning and effort, the FCS is real," he announced. Under TARDEC MRTT's leadership, the ALSI team has attained numerious successes, including initial designs for the FCS NLOS-C integrated turret and lower mission module. (U.S. Army TARDEC photo by Paul Tremblay.)

initiative, non-destructive evaluation and material characterization, combat vehicle research, friction stir welding and high-strength power metal gears.

Through industry and academic partners, MRTT monitors advances in manufacturing technology for possible use in U.S. Army vehicle systems. Under MRTT's leadership, Alcoa Technical Center is collaborating on the Aluminum Lightweight Structures Initiative (ALSI) with several ground vehicle original equipment manufacturers, including BAE Systems, Oshkosh and General Dynamics Land Systems (GDLS).

The ALSI team has attained numerous successes, including a preliminary Heavy Expanded Mobility Tactical Truck A3 cab structure redesign and initial designs for the Future Combat Systems (FCS) Non-Line-of-Sight Cannon (NLOS-C) integrated turret and lower mission module.

MRTT is involved in several Army initiatives, including the HIP and industry outreach activities, such as U.S. CAR, an umbrella organization for collaborative research among Chrysler LLC, Ford Motor Company and General Motors Corporation.

The ALSI team also worked with GDLS to fabricate and test an FCS lower hull design and assisted in a Mounted Combat System turret support structure redesign.

MRTT is in constant communication with government depots and arsenals to gauge their needs and respond with technology solutions. Its Rapid Optimization of Commercial Knowledge (ROCK) Program includes a manufacturing consortium in Rockford, IL, that was formed under MRTT and Northern Illinois University's (NIU's) leadership to develop technologies for the military. ROCK also competitively supplies replacement parts to the Department of Defense.

NIU has a rich history of collaboration with the Army. In 2005, Rock Island Arsenal (RIA) Joint Manufacturing and Technology Center formed a strategic partnership with NIU-ROCK to find solutions for several RIA manufacturing challenges, such as supplying RIA with components for weapons systems, including the M119 howitzer. When RIA was encountering difficulties with the single-plate P900 armor casting, NIU-ROCK leveraged their employees' years of casting experience to assist RIA and provide Soldiers with 21st-century armor solutions. Through the partnership, NIU is developing a new advanced-technology manufacturing lab at RIA and is at the forefront of micromachining

U.S. Army Soldiers with Alpha Battery, 3rd Battalion, 7th Field Artillery Regiment, prepare an M119 Howitzer for a live-fire exercise near Kirkuk, Iraq. MRTT's ROCK Program was formed under its and NIU's leadership to develop technologies for the military. In 2005, RIA Joint Manufacturing and Technology Center formed a strategic partnership with NIU-ROCK to find solutions for several RIA manufacturing challenges, such as supplying RIA with components for weapons systems, including the M119 howitzer. (DOD photo by Air Force SSGT Dallas Edward.)

U.S. Army Soldiers assigned to A/Battery, 2-319th Airborne Field Artillery Regiment make final adjustments for fire on the M119A1 105 mm Lightweight Towed Howitzer during *Operation Iraqi Freedom*. MRTT's ROCK Program has been instrumental in identifying and implementing advanced manufacturing technologies for U.S. Army artillery and howitzer systems. (DOD photo by Air Force MSGT James M. Bowman.)

research. RIA also is supplying the military with many applications, from military electronics to medical uses. The NIU-ROCK partnership is one of several that MRTT utilizes to ensure that the U.S. Army is at the leading edge of manufacturing technology and can provide warfighters with the most advanced weapons systems in the world.

Currently, MRTT is managing a program designed to assist Anniston Army Depot (ANAD) by characterizing modified and battle-damaged vehicles returning from Southwest Asia through the Scanning Technology for Accelerated Reset (STAR) project.

STAR is a collaboration of MRTT, South Carolina Research Authority and ANAD that uses laser scanning technology to create three-dimensional models of vehicles and parts. The models are instrumental in the remanufacturing process since they are transferred into the International Organization for Standardization product data representation and exchange format and can be shared among several depot departments. Much of the standard format's development was funded through an MRTT-managed project. When deployed to ANAD, STAR will reduce the labor hours, or "touch time," for physical parts, vehicles and electronic data sources such as Computer-Aided Design files, reducing reset time and improving quality.

With projects such as ROCK, STAR and numerous others, MRTT members are continuously seeking to identify new technologies, establish a need for them and facilitate their implementation into the U.S. Army architecture. MRTT is able to do this by maintaining a diverse network of partners and leveraging relationships with and among them to deliver critical repair parts and technology quickly.

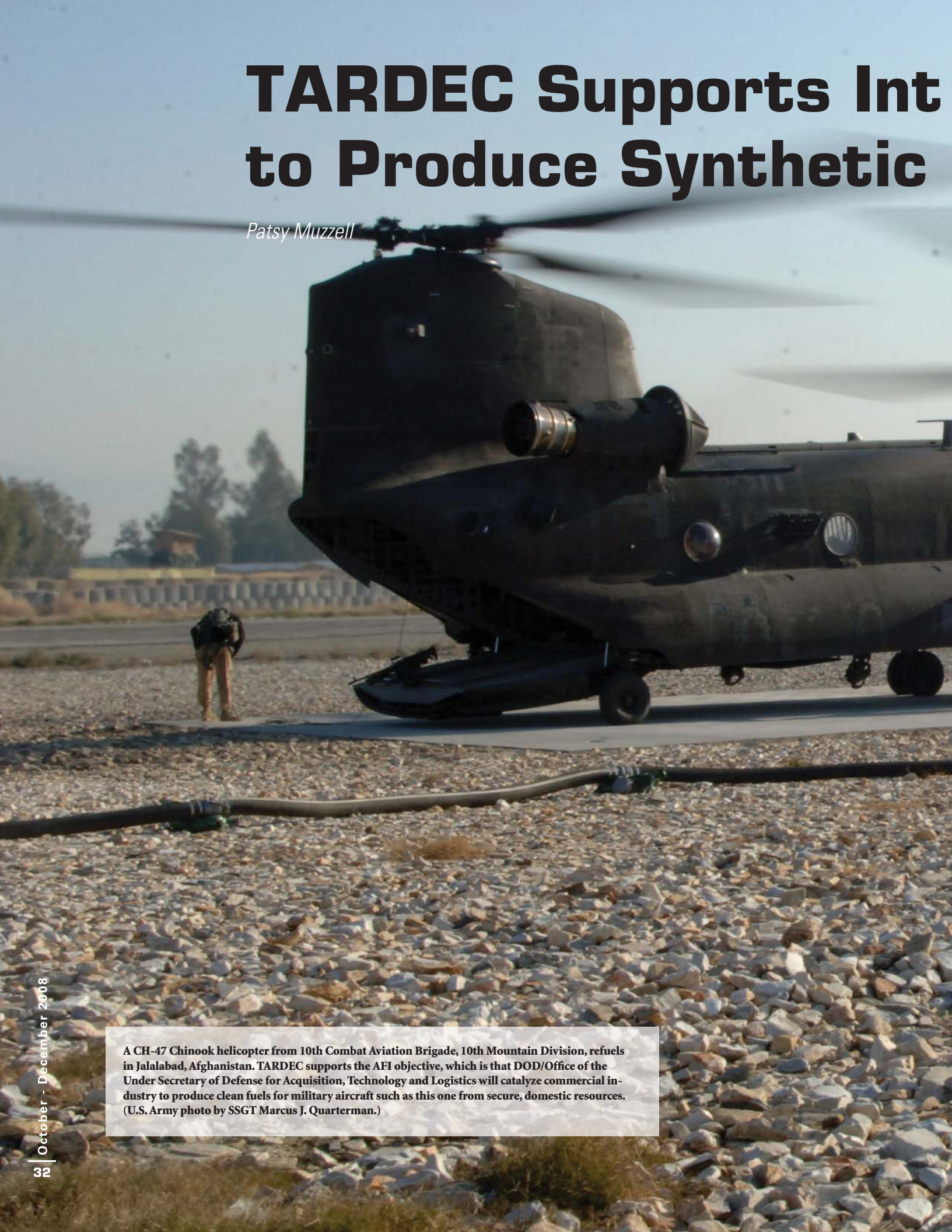
For more information about MRTT projects and initiatives, please contact Associate Director Benedict Demarco at benedict.demarco@us.army.mil or Team Leader Tom Altobelli at tom.altobelli@us.army.mil.

Ben DeMarco is an Associate Director for NAC's Automotive Technology group, a division of the Development Business group.

Tom Altobelli is TARDEC's Team Leader for Advanced Manufacturing and Robotics. The manufacturing program is managed by TARDEC's NAC.

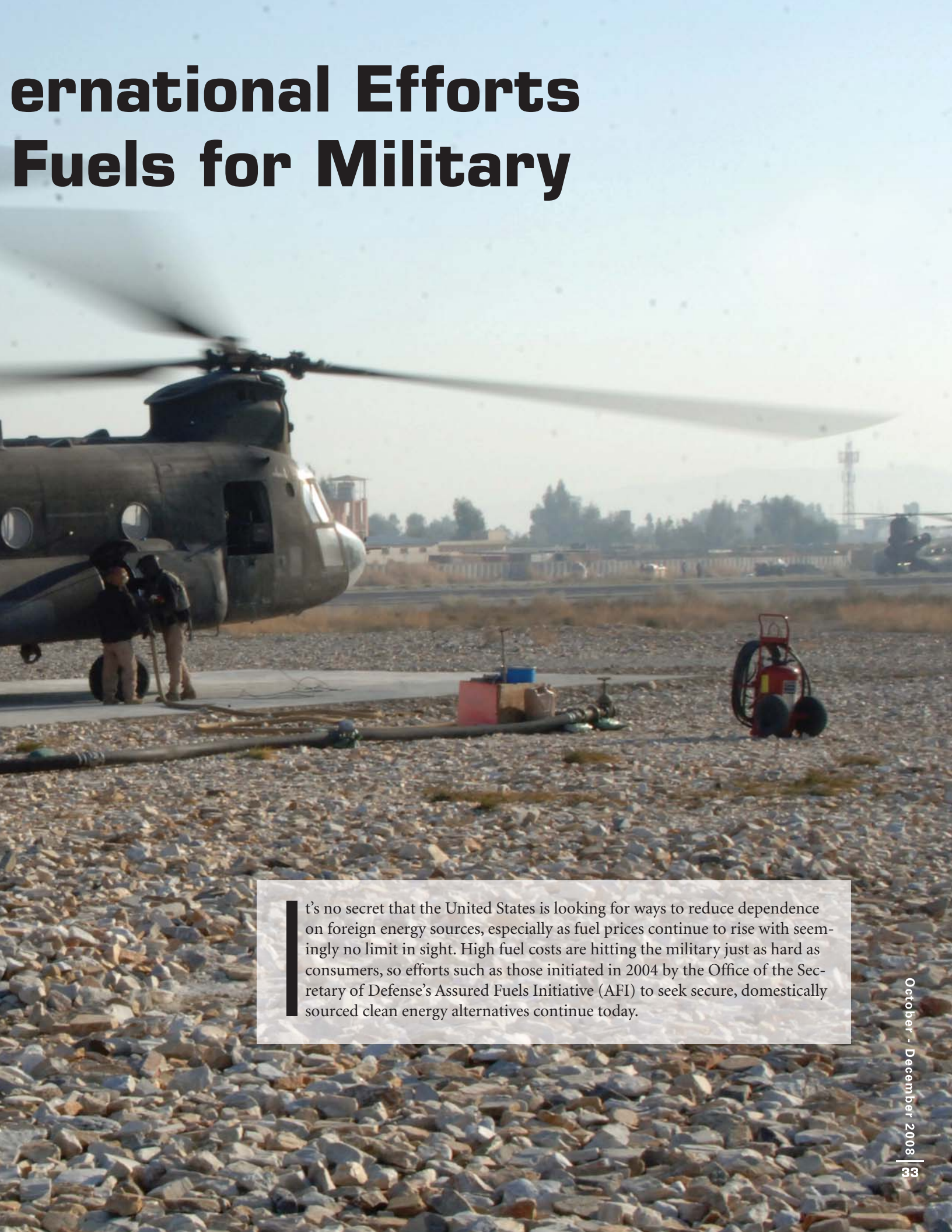
TARDEC Supports Int to Produce Synthetic

Patsy Muzzell



A CH-47 Chinook helicopter from 10th Combat Aviation Brigade, 10th Mountain Division, refuels in Jalalabad, Afghanistan. TARDEC supports the AFI objective, which is that DOD/Office of the Under Secretary of Defense for Acquisition, Technology and Logistics will catalyze commercial industry to produce clean fuels for military aircraft such as this one from secure, domestic resources. (U.S. Army photo by SSGT Marcus J. Quarterman.)

ernational Efforts Fuels for Military



It's no secret that the United States is looking for ways to reduce dependence on foreign energy sources, especially as fuel prices continue to rise with seemingly no limit in sight. High fuel costs are hitting the military just as hard as consumers, so efforts such as those initiated in 2004 by the Office of the Secretary of Defense's Assured Fuels Initiative (AFI) to seek secure, domestically sourced clean energy alternatives continue today.

An AH-64D Apache Longbow helicopter from 1st Battalion, 101st Aviation Regiment, based at Forward Operating Base Speicher, Iraq, flies a mission to support troops on the ground. TARDEC has embraced the international effort for R&D of non-petroleum-derived kerosene (synthetic jet fuel) through its efforts under the AFI, which could benefit helicopters such as the Apache Longbow. (U.S. Army photo by Air Force TSGT Andy Dunaway.)

The U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) has embraced the international effort for research and development (R&D) of non-petroleum-derived kerosene (synthetic jet fuel) through its efforts under the AFI. The AFI objective is that the Department of Defense (DOD)/ Office of the Under Secretary of Defense for Acquisition, Technology and Logistics catalyzes commercial industry to produce clean fuels for the military from secure, domestic resources. DOD's role as the catalyst in attaining this vision is threefold:

- Engage in the development of alternative fuel specifications.
- Certify, qualify and demonstrate the use of alternative fuels in DOD tactical vehicles, aircraft and ships.
- Implement the use of alternative fuels in DOD tactical vehicles, aircraft and ships operating throughout the continental U.S.

TARDEC has been a key participant in the AFI, beginning in 2003 with laboratory evaluations of synthetic fuel, namely Fischer-Tropsch (FT) synthetic kerosene, which preceded the AFI. The coordination of DOD synthetic fuel specification development with that of the commercial aviation industry was spearheaded by TARDEC's National Automotive Center (NAC) in May 2003 and continued into 2007.

This coordination was established through the Aviation Committee of the Coordinating Research Council (CRC-AC), which includes representation from the airframe and jet engine original equipment manufacturers (OEMs), jet fuel producers and government agencies such as the Tri-Services, Defense Energy Support Center, NASA and Federal Aviation Administration. Although CRC-AC is not responsible for regulation, hardware or fuel development, or in setting standards, its efforts in directing engineering and environmental studies indirectly influences these areas. ASTM International, which maintains the fuel specification used by U.S. commercial aviation, looks to CRC-AC to provide guidance regarding non-petroleum derived kerosene and its potential suitability for use by U.S. commercial aviation.

The effort under the AFI carries forth today, underpinned by the

TARDEC has been a key participant in the AFI, beginning in 2003 with laboratory evaluations of synthetic fuel, namely FT synthetic kerosene, which preceded the AFI. The coordination of DOD synthetic fuel specification development with that of the commercial aviation industry was spearheaded by TARDEC's NAC in May 2003 and continued into 2007.

Royal Netherlands Air Force airmen board a U.S. Army CH-47 Chinook helicopter from Bravo Company, 1st Battalion, 69th Aviation Battalion out of Hunter Army Air Field, GA, TARDEC supports the AFI objective, which is that DOD/Office of the Under Secretary of Defense for Acquisition, Technology and Logistics will catalyze commercial industry to produce clean fuels for military aircraft such as this one from secure, domestic resources. (U.S. Air Force photo by TSGT Alex Koenig.)

Air Force objective as stated by former Secretary of the Air Force Michael W. Wynne in July 2007: "The Air Force is committed to completing its testing and certification of our aircraft fleet for alternative fuels by 2011. Working with industry, we can accomplish this goal. Once accomplished, we look forward to buying domestically produced synthetic fuel at competitive market prices from manufacturing facilities that engage in effective carbon dioxide capture and reuse."

In January 2008, CRC-AC published a report, Development of the Protocol for Acceptance of Synthetic Fuels Under Commercial Specification. This protocol is intended to establish that once a synthetic fuel (including blends of synthetic and petroleum-derived fuel) is accepted as suitable for use by the aircraft engine OEM and written into fuel specifications and/or service bulletins, the fuel will automatically be an approved fuel under the fuel specification for U.S. commercial aviation (ASTM D1655-08, *Standard Specification for Aviation Turbine Fuels*). This is a significant AFI-supporting milestone, because having an agreed on and documented protocol for acceptance of synthetic jet fuel is a critical step in establishing a market for it.

Between the commencement of TARDEC evaluations of synthetic kerosene and coordination of fuel specification development through CRC-AC, NAC represented TARDEC efforts targeting AFI goals in other forums with international ties. In 2003, 2005 and 2007, NAC participated in the biennial conference of the International Association for the Stability, Handling and Use of Liquid Fuels, which promotes research and experimentation on scientific and operational factors affecting the stability, handling and use of fuels from manufacture to end use and disposal. The most recent conference in October 2007 focused on alternative fuels. More than 50 speakers presented highlights from their R&D areas, including FT synthetic fuels.

NAC presented two posters, one of which highlighted TARDEC evaluations of FT synthetic kerosene. The second poster highlighted results of a study examining the potential to use up to 50 percent, by volume, of FT synthetic kerosene in blends with the jet propellant 8 (JP-8), a commercial jet fuel (Jet A-1) with military-approved additives that is typically used at the five U.S. Army installations included in the study.

NAC also participated in the 2005 Aviation Fuel Forum of the International Air Transport Association (IATA), which is comprised of 270 member airlines representing 94 percent of scheduled international air traffic and has a mission to lead, represent and serve the airline industry. IATA's Aviation Fuel Working Group (AFWG) formulates the technical basis for an international specification guide for aviation turbine fuels that IATA develops and maintains. In May 2005, NAC introduced the AFWG to AFI's vision and goals. At that time, the AFWG had already been considering use of synthetic jet fuels for commercial aviation, primarily based on the successful use of FT kerosene in blends with Jet A-1 at Johannesburg International Airport in Johannesburg, Gauteng, South Africa. Since JP-8 is derived from Jet A-1, it is essential that both the U.S. military and the commercial aviation industry nationally and worldwide are aligned in requirements for synthetically produced Jet A-1.

Through its involvement with forward-thinking projects such as the AFI, TARDEC is, once again, asserting its position at the forefront of emerging alternative energy R&D and implementation.

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NAC and Industry Working Toward Improved Vehicle Platforms

George Loewen and Linda Hefferan

An armored MXT vehicle arrives at Kaneohe Bay, Ouahu, HI. Several demonstration vehicles based on the International MXT platform were produced for the Army under a contract to Government Support Services, Inc., a government prime contractor. (U.S. Army TARDEC photo by George Loewen.)

The military and industry continue to build relationships to create products that are beneficial to both warfighters and consumers, and the U.S. Army Tank Automotive Research, Development and Engineering Center's (TARDEC's) National Automotive Center (NAC) are taking the lead when it comes to ground vehicle platforms. TARDEC follows guidance from the Army as a whole and focuses on Program Executive Office Strategic Thrusts at the U.S. Army TACOM Life Cycle Management Command to determine technology needs. This focus drives the definition of technological need thrust areas, which establishes part of the framework for the NAC's project and research and development (R&D) portfolio.

For NAC, industry encompasses ground vehicle manufacturers, their tier suppliers and independent engineering and testing resources, which are not, primarily, traditional military contractors. NAC uses its partnerships with the automotive industrial base to discover the latest commercial technologies as they are being developed by original equipment manufacturers, tier suppliers and independent entrepreneurs. By working in partnership with these developers, NAC can influence the basic design and integration requirements so that the finished products are applicable to military and commercial customers with the highest degree of commonality and thus the lowest expected cost.

Although military applications for these developing "dual use" technologies are sometimes difficult to imagine, this is where the NAC's mission is focused. By recognizing these technologies' value and impact early on, NAC effectively leverages its all-encompassing experience with complete vehicle platforms during the initial development stages. NAC blends selected technologies into vehicle platforms that are then used as demonstrators by the end-user communities. User evaluation results provide the impetus for commercially based technologies, achieving a new capability level that supports Soldiers' emerging mission needs. TARDEC programs that support Army needs can then access the results and incorporate these technologies into their planning and implementation schedules.

Southeast Michigan is the U.S. automotive industry's bastion, including the major auto manufacturers and their major tier supply partners. Many of the industry's most

Drivers test an Integrated Concepts & Research Corporation (ICRC) LASSO® vehicle scaling a severe, off-road track with a rock step incline. Through various agreements, NAC collaborates with numerous end users by providing them with full-platform demonstrators to expose and verify the emerging technology's utility and possible value to Soldiers. (Photo courtesy of ICRC.)

pertinent technological developments are initiated within this core community. Medium- and heavy-duty commercial truck manufacturers, although not located primarily in Michigan, are also part of the industrial base with which NAC collaborates. Many of the tier supply partners are common to both ground vehicle communities. Additionally, many medium-duty truck platforms share common roots with the automotive manufacturers.

NAC's interface with industry takes many forms, such as society/association memberships (Society of Automotive Engineers (SAE) and National Defense Industrial Association), user forums, university research support programs (Oakland University, Lawrence Technological University and Michigan State University) and other outreach programs (Automation Alley® and Focus: HOPE). NAC is a contributing member to SAE, a primary body for collaboration with the automotive community, through participation in standards committees, publication of papers and sponsorship of displays. NAC has also initiated partnership with the truck industry in many ways, including membership in the Truck Maintenance Council and Hybrid Truck Users Forum. Ongoing partnerships through Cooperative Research and Development Agreements and Small Business Innovation Research efforts also provide NAC with access to additional technologies while they are being formed strategically.

Through various agreements, NAC collaborates with numerous end users by providing them with full-platform demonstrators to expose and verify the emerging technology's utility and possible value to Soldiers. Collaboration agreements such as memoranda of agreement document a given project's mutual and unique goals. By putting them to use at various sites, limited user evaluations also impel further technology refinement.

The user communities evaluate the demonstrators through a combination of static displays and dynamic ride-drive demonstrations at venues that include trade shows, industry and Army test sites, training bases, National Guard venues and contractor-designated sites. As development matures through demonstration iterations, limited testing is sometimes used to reach specific technology readiness levels. This may be at the component-, sub-system or full-system level, depending on TARDEC's or the end user's project needs. Recently, these full platforms have included vehicles such as the International MXT, Land and Sea Special Operations (LASSO), Joint All-terrain Modular Mobility Asset (JAMMA), light utility hybrid, hybrid-electric Gator and others.

There are instances where NAC works with industry

MillenWorks' Light Utility Vehicle is being mobility tested in the Southern California mountains. By working in partnership with these vehicle manufacturers and developers, NAC can influence the basic design and integration requirements so that the finished products are applicable to military and commercial customers with the highest degree of commonality and thus the lowest expected cost. (Photo courtesy of MillenWorks.)

An unarmored MXT vehicle being tested for ride quality in TARDEC's Physical Simulation Lab in Warren, MI. NAC collaborates with numerous end users by providing them with full-platform demonstrators to expose and verify an emerging technology's utility and possible value to Soldiers. (U.S. Army TARDEC photo by George Loewen.)

to develop technologies for the Army and other Department of Defense customers so that a current need can be filled by a commercial off-the-shelf (COTS) solution due to an Army decision not to fund a particular approved requirement through the standard Program Objective Memorandum (POM) budgetary process. NAC will then collaborate with industry partners to develop a COTS-based solution to meet existing military or other government agency requirements.

LASSO Vehicle

One such instance is the LASSO vehicle, under development by Integrated Concepts and Research Corporation, a subsidiary of VSE Corporation. This vehicle is aimed at supplanting and/or supplementing the commercial solutions in the field today, such as all-terrain vehicles (ATVs) and motorcycles, with more robust, higher-performing technology based on the Light Utility Mobility Enhancement Requirements Document and Lightweight Tactical All-Terrain Vehicle's requirements. The ultimate intent is to demonstrate the technology's performance and utility to influence the user and requirements community, resulting in a budgeted, POM Program of Record. The benefit to the user is a system that is supportable and better performing and has a longer service life than current commercial solutions.

The LASSO vehicle is a purpose-built, high-capacity, 6-wheeled, ATV-type vehicle. The vehicle, which is off-road capable, is designed to be used as a cargo support vehicle in combat support and combat service support roles to fill the mission gap between Soldiers on foot and High Mobility Multipurpose Wheeled Vehicles. Its unique, continuously variable transmission with fully independent suspension enables the vehicle to maneuver over all types of terrain and grades. Its cab and cargo were designed for ease of separation to allow for servicing the engine power pack and removing the roll bar for transportability in the V-22 Osprey aircraft as well as Family of Medium Tactical Vehicles.

JAMMA Vehicle

There are other instances where industry reacts to military requirements as they continuously evolve. An example of this is the JAMMA vehicle project. The JAMMA vehicle is a commercially based proposed solution to the Internally Transportable Vehicle Joint Operational Requirements Document's requirement to fill the mission gap for a Joint service-level, V-22 aircraft-transportable vehicle. Although all services may have a common mission gap, their differing and unique mission needs make it challenging to fill these gaps.

For the Army, several demonstration vehicles based on the International MXT platform were produced under a contract to Government Support Services, Inc., a government prime contractor. After running several initial demonstration tests to determine mission capability and Federal Motor Vehicle Safety Standards and Regulatory compliance, these vehicles have been deployed to several user communities to better understand requirements and capabilities.

These platforms have also been equipped with secondary technologies such as seat-mounted seat belts, magnetic-rheological shock absorbers, integrated communications packages and a laser-powered night vision system. Vehicles are now in use by Michigan, Indiana and California National Guard units, the U.S. Marine Corps Experimentation Center and the U.S. Air Force.

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We're currently seeking articles for the January-March 2009 issue. The theme for this edition is Strategic Transformation and the redefinition of the TARDEC business model and requisite process changes. Submission deadline is Oct. 31, 2008.

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