



# Powering Warfighters

**LIKE CIVILIANS, SOLDIERS NOW CARRY LOTS OF ELECTRONIC GADGETS WITH DIFFERENT POWER SOURCES.**

*By HENRY CANADAY, GCT CORRESPONDENT*

All the new electric gadgets infantrymen carry dramatically increase effectiveness in combat and save U.S. lives. But enhanced capabilities require more power, which has meant more batteries, more weight, more complexity and more logistic burdens. Planners are now trying to lighten the load and simplify systems, for both individual soldiers and the forward bases that keep them charged.

“A soldier is a platform but, unlike a vehicle, must carry power systems around in austere environments and do it easily,” explained Colonel Brian Cummings, project manager, mobile electric power (PM MEP). “Reliability and weight are very important.”

Like their civilian counterparts, soldiers now carry many pieces of electric equipment with many different power sources. “One frustrating challenge is there are so many power sources and so many different ways of charging them,” Cummings noted. On long missions, soldiers need sources with long lives or must take several, adding weight.



**Col. Brian Cummings**



**Cory Goetz**

To better power individual soldiers, PM MEP works with Program Executive Office Soldier Warrior and with Nett Warrior, a program of record, explained Cory Goetz, product director for batteries. “Some of the efforts we are working on include solar power and new COTS [commercial off-the-shelf] soldier portable generators [SPGs], modified to burn military fuel, for more reliable power,” Goetz said. SPG is a 1kW generator weighing less than 40 pounds. “We are also working with the Marine Corps on that.”

Another project is the soldier worn integrated power equipment system (SWIPES), which powers multiple systems from a single battery. “It doesn’t save a lot of weight until the soldier is confident he does not need extra batteries,” Goetz said. “But from the start he does not have to change batteries every 45 minutes, just monitor one battery.” SWIPES can maintain other batteries at an 80 percent charge.

Another device, squad power manager (SPM), allows the soldiers to tap power flexibly, from solar, fuel or used batteries. “In the past, we have





More than 5,000 of Electric Fuel Battery's soldier worn integrated power equipment systems have been fielded. [Photo courtesy of Electric Fuel Battery Corporation]

seen batteries thrown away with 90 percent of power left," Goetz noted.

"Individual soldier power problems are really about batteries and recharging batteries," Goetz said. PM MEP is now testing the conformal warfighter-worn battery, of which a soldier could carry one or two to top off other batteries. "That should enter the field soon."

Programs like Nett Warrior will increase the power requirements of an individual soldier by 500 percent, Cummings estimated. The only practical way to provide that much reliable power is with rechargeable batteries, which is difficult with different battery types. "We need to get batteries down to one family, just as we have with generators, and then require devices to use a standard type." The Maneuver Center of Excellence at Fort Benning is drafting requirements for such devices.

Similar power challenges confront small-base operations. In Afghanistan, PM MEP executed Operation Dynamo, evaluating the power needs of forward bases for company level and below units, which have limited re-supply by air or land. PM MEP developed blueprints for more efficient fuel use of existing systems and provided new generators and power-distribution systems resulting in more reliable mobile electric power.

Mike Gallagher, product manager of expeditionary power systems at Marine Corps Systems Command (MARSYSCOM), said his service is making an enterprisewide effort to provide lighter, better electric power for Marines on the future battlefield.

MARSYSCOM is working with the Office of Naval Research and the Naval Surface Warfare Center to assess a prototype of the squad electric power network and expects to deliver in 2014 a personal power system (PPS) to manage power for soldier-worn battery powered devices.

Gallagher said the key to the PPS is a central, conformal battery to support batteries for each device. This conformal battery is being operationally evaluated and being tested for safety at the Naval Surface Warfare Center. The Army and Marines are collaborating on this conformal battery.

To support in-field charging of rechargeable batteries, MARSYSCOM began fielding expeditionary solar systems in 2010. Solar portable alternative communications energy system is a rucksack portable system with fold-out solar blankets to charge different batteries.

David Karcher, director of expeditionary energy and counter improvised explosive devices, said MARSYSCOM is doing early work on integrating smart textiles into Marine uniforms and equipment. "When a Marine enters a Marine Corps tactical vehicle and sits in designated seats, smart textiles will support recharging individual batteries via an internal network integrated into the cloth of both the seat and the Marine's individual clothing, without the Marine removing a battery and plugging it into a separate adaptor and battery charger," he said.

Private firms have been critical to power progress.

Electric Fuel Battery, a division of Arotech, makes high-density batteries, chargers and SWIPES, of which more than 5,000 have been fielded, according to Sales Director Jeff Jubin. Units already equipped with SWIPES include the 82nd Airborne Division, the 173rd Airborne Brigade, the 10th Mountain Division and the 75th Ranger Regiment.

Jubin cannot predict whether SWIPES will go to all relevant Army units as there is now a next-generation upgrade, SWIPES 2PD. The new version merges both power and data with one set of cables and one hub. A prototype of 2 PD has been produced and Jubin expects it to be deployable in late 2013 or early 2014.

SWIPES 2 PD was designed to work with the new Rifleman Radio, aggregating data from any devices on the soldier and then transmitting it without duplicated cables. It will continue to centralize power management, enabling reduced battery weight.

EFB has also added new batteries to its portfolio. One powers small electric submarines that can deliver SEALs. "It's modular, affordable and easy to maintain," Jubin stressed. "It's a smart battery, you get the power you need by stacking batteries, and it can be used on land too."

EFB also offers a man-packable, tank-starting battery that weighs only 30 pounds but can start an M1 Abrams.

Reducing weight and complexity by universalizing power is still a main thrust in powering the individual soldier, according to Phil Robinson, vice president of Defense Power Systems at Protonex Technology. "Another new issue is cost," Robinson said. "It is very expensive to distribute energy to the tip of the spear."

Robinson defines universalizing power as getting power from any source—fuel, alternative energy, vehicles or scavenged energy from local grids—and putting it on one battery to charge other batteries.

Protonex does this with its squad power manager (SPM-612), of which the Army has fielded more than a thousand. SPMs have also gone to Navy Explosive Ordnance Disposal, Special Operations Command (SOCOM) and medic teams. Robinson thinks the intent is to distribute SPMs to all infantry brigades. "We get two reactions from the field. Soldiers say it saves weight and leaders like it because it cuts costs. One 82nd officer said SPM allowed him to stop the re-supply of batteries."

A new version, SMP-622, was made for SOCOM. It has more power than the -612 and is fully submersible.

A variant called VPM-402 is designed to be worn as a vest, not carried, and has been deployed by the Army, Air Force and Marines. "The -402 is like SWIPES on steroids," Robinson explained. "It can be charged by solar and vehicle batteries and charges other batteries. It increases capability and decreases complexity."

Protonex also makes the M300, methanol fuel cartridges that cost and weigh a fraction as much as the equivalent in standard BA-5590s batteries. Robinson describes the M300 as a "low signature APU [auxiliary power unit] and charger." He said it is attracting interest from the military chiefly to power silent-watch missions by vehicles. "You do not need to start up the vehicle engine to generate power." The M300 has been deployed by the Army and SOCOM.

For the future, Protonex has been working with the Army on biometric harvesting. This means putting devices on soldiers' knees, rucksacks and boots to exploit power generated by movement. "You might get very little from each device, but add them up and you have something," Robinson noted. "Some will not work or be too clunky, but some will."

Another research project is getting more efficiency from solar panels, which would allow smaller panels that might be put on helmets, uniforms or rucksacks.

PulseTech provides two important products to support mobile power in the field, according to Senior Field Service Representative Roy Johnson.



Electric Fuel Battery's lightweight improved releasable plate carrier features adjustable padded shoulder straps that allow for eight inches of adjustments for proper placement of the front and rear plates. [Photo courtesy of Electric Fuel Battery Corporation]

The company makes solar panels that can keep batteries on diesel generators topped up when they have been idle for a long time. "This enables generators to start up suddenly when they have been left out. These generators are backups for other power sources and to start they need fresh batteries," Johnson explained.

PulseTech can also recharge otherwise dead batteries and bring them back to as-new condition, a big cost saver as tank batteries, for example, cost more than \$400. "The Army does not maintain batteries very well and the Marines did not either until recently," Johnson said. "Last year we recovered \$7.2 million worth of batteries."

Special recharging techniques are needed because many dead batteries are severely sulfated. "If you just charge them, it will be a surface charge and will not last," Johnson said. "We desulfate the battery as we charge and make it like new." PulseTech saved 80 percent of batteries in Kuwait that would otherwise have been thrown away. The company also trains logistics staff on use of its recharging equipment.

Worldwater & Solar makes highly mobile equipment that can both provide power and purify water in remote locations. As Chairman and Chief Executive Officer Quentin Kelly noted, places where power is scarce are often places where drinkable water is also scarce, and vice versa.

The company's Mobile MaxPure (MMP) unit provides up to 3.2 kilowatts (kW) of power and up to 30,000 gallons per day of pure water from fresh water or 3,000 to 4,000 gallons from saline water. Thirty-seven MMPs were used for civilian purposes in Iraq and eight in Afghanistan.



From MMP, the company has developed highly portable and rugged systems for military use. These include the prepositioned expeditionary assistance kit (PEAK), the solar hybrid expeditionary power and purification system (SHEPS) and the miniature deployable assistance system (MiDAS).

“They produce electric power from multiple sources, mostly solar, and also purify water,” Kelly said. “They can purify fresh water, brackish water or sea water. PEAK and MiDAS also have communication systems, allowing the team to talk to each other and via satellite.”

The military units differ in size and capabilities. The two-ton PEAK has a 2.1kW solar array, an 18kWh lithium-ion battery bank and a 2kW multi-fuel auxiliary generator. Its reverse osmosis unit treats up to 1,500 gallons per day of salt or fresh water. The half-ton MiDAS has four 120w and one 30w crystalline solar modules and a 2kW auxiliary generator and treats up to 1,440 gallons per day of freshwater and 432 gallons per day of seawater. The much smaller SHEPS comes in two or three suitcases with a 480w solar array and can treat 60 gallons of fresh water or 18 gallons of salty water per hour.

The units can charge cell phones, laptops, soldier radios and vehicle batteries, but water purification is also key, stressed Vice President of Production Michael Ingles. The firm recently demonstrated MiDAS to the U.S. Marines and Philippine forces in the Balikatan exercises. The Marines purchased one unit and Ingles expects to them to buy three more soon.

The two larger units include diesel generators and batteries for backup, so they can work 24/7. In addition to solar panels they can also tap wind power and other energy sources, such as military vehicles. “PEAK and MiDAS can use any flavor of power in world, 12 or 24 volts, AC or DC,” Ingles noted. “They can take it in or put it out so they can mesh with the local power system anywhere in the world.”

The Army has installed two PEAK systems in Latin America. Kelly said Marines appreciate the silence of MiDAS, and SHEPS was designed for SOCOM.

Oshkosh Defense developed its ProPulse hybrid diesel-electric technology to increase energy-efficiency, explained John Bryant, senior vice president, Defense Programs. “The technology has the potential to make fleets leaner, more robust and less reliant on in-theater fuel convoys and trailer-mounted generators,” Bryant said. ProPulse increases fuel efficiency by up to 20 percent and delivers up to 120 kW of exportable



Worldwater's Sheps unit at work during 2013 Marine PACOM Conference at the old Clark Air Base and Subic Bay, in Olongapo, Zambales, Philippines. [Photo courtesy of Worldwater & Solar Technologies Inc.]

military-grade energy, enough for an airfield, hospital or command center.

ProPulse uses a diesel engine to power an electric generator, which delivers power directly to axles. This eliminates several components, including automatic transmission, transfer case, torque converter and drive shafts. The vehicle is lighter, easier to maintain and more flexible in design, because packaging ProPulse is easy. Rather than batteries, ProPulse uses rechargeable ultra-capacitors that can charge and discharge power in seconds. These can be recharged millions of times.

Oshkosh worked with the Marines to equip the medium tactical vehicle replacement (MTVR) with on-board vehicle power (OBVP) kits using ProPulse for testing. The MTVR is a primary mover of troops, materials and equipment for Marines and Navy Seabees. OBVP kits support mobile radar systems, command centers, IED-defeat systems and other applications. OBVP-equipped MTVRs completed 2,000 hours of generator operation and nearly 17,000 miles of durability and other testing by the Marines.

Oshkosh has tested an optional ProPulse power-train in its light combat tactical all-terrain vehicle (L-ATV). This option can maximize L-ATV's efficiency with improved fuel economy, plenty of exportable power and lower life-cycle costs. ProPulse on the L-ATV could export 30 to 70kW of military-grade power. ★



John Bryant

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