Green Solutions for Shelter Systems

DoD is eyeing renewable energy sources and more efficient sub-systems.

By Marty Kauchak, Editor

There is a subtle revolution occurring in the power production, management and storage systems supporting U.S. DoD shelter systems. As wind, solar and other renewable energies are harnessed to provide power, other efforts are improving energy management and storage solutions for the department's systems.

DoD's Items of Interest

The Joint Committee on Tactical Shelters (JOCOTAS) is one of DoD's premier initiatives to gain material system efficiencies through inter-service dialogue and actions. The committee, formed in 1975 at the direction of the Office of the Secretary of Defense, fulfills these major responsibilities:

- Advance the state of the art in shelter design and shelter ancillary equipment;
- Search for common solutions to identified user needs;
- Reduce and eliminate duplication of shelter research, development, test and evaluation;
- Create a standard shelter family and maximize its use within DoD; and
- Share information and expertise to solve shelter problems

Frank Kostka, JOCOTAS executive secretary, provided a state of the art overview of technology focal points within the Department. "The services are working aggressively to reduce energy usage across the board and in the shelter area the focus has been on cutting air infiltration by tightening up seals between shelter panels barrier materials that block solar loading on the outside surfaces of shelters, maintaining steady state temperatures inside by developing high performance flexible high performance insulation that reduces cooling and heating requirements, photovoltaics arrays that both reduce thermal loading and produce power and, smart power distribution grids that efficiently provide electricity produced by a bank of generators that turn off and on depending on system draw." Kostka emphasized that all materials being evaluated are subject to strict safety and fire code requirements.

Two energy management and power generation projects that capture ongoing 2010 service activities are the Joint Capabilities Technology Demonstration (JCTD) Net Zero that is managed by the DoD Power Surety Task Force and the Marine Corps ExFOB project [editor's note: see the accompanying article on the Marine Corps' ExFOB in this issue]. The JCTD Net Zero for expeditionary shelters has been underway at the National Training Center (NTC) located at Fort Irwin, CA since the spring of 2009.

Lori Biszko, an Army representative on the JOCOTAS, provided highlights from the JCTD Net Zero program. "The Army is aiming to achieve a 'Net Zero' base camp: a forward operating base (FOB) that is energy independent from power generation. In order to accomplish this, the FOB will need to produce the same amount of energy that it consumes."

Biszko pointed out the U. S. Army Research, Development and Engineering Command's (RDECOM) Natick Soldier Research & Engineering Center (NSRDEC) has been evaluating a number of energy saving technologies through various programs, one of which is the JCTD Net Zero Plus program. "The objective of this program is to collect energy usage data for environmental control units,

evaluate advanced lighting systems, and determine general electric load inside the shelters. This information will then be applied to the development of Net Zero base camps," she added.

NSRDEC is gathering energy usage data for energy efficient shelter systems and comparing this to baseline systems in order to recommend the best approach to reducing energy usage in the field. Some of the technologies that are being demonstrated though this program are advanced insulation, advanced shading, smart power management, renewable solar, wind, and geothermal energy, LED lighting and electroluminescent lighting systems. Ideally, by utilizing and combining these technologies, the energy loads necessary to run FOBs will be reduced and Net Zero base camps will become a reality.

NSRDEC is collaborating with the Air Force and Marine Corps on these efforts. NSRDEC started the evaluation in April 2009, with the Air Force joining in November 2009 and the Marine Corps in June 2010. "A variety of configurations of shelters and technologies are set up at the National Training Center at Ft. Irwin for the evaluation. The testing will continue until December 2010," said Biszko.

JOCOTAS-guided efforts have produced significant deliverables to the department. Thermal blocking materials supported by standalone structures that are designed to shade open spaces that were evaluated during the assessment include the Advanced Solar Cover (ASC) and the Army's Ultra Lightweight Camouflage Net System (ULCANS). Wrap around versions of solar blocking fabrics using similar materials were also were also assessed.

"Thousands of the ASC's are deployed in Iraq and Afghanistan. It blocks approximately 60 percent of the solar load on a testing (according to a TECOM test report) showed that this was adequate to bring surface temperatures down to ambient. The cover is extremely porous allowing good air flow and reducing the requirements for heavy support poles needed to resist wind loads associated with denser materials," said Biszko.

She also pointed out the ULCANS nets provide a greater blocking capability (90 percent) when compared to the ASC due to the need to match the thermal gradient of the surrounding surfaces. "Support poles are loosely constrained and free to float in the breeze," explained Biszko.

Power Generation

Military shelter system manufacturer DHS Systems (DRASH) has provided the U.S. DoD with reliable, rapidly deployable mobile infrastructures through its line of Deployable Rapid Assembly Shelters (DRASH) and Utility Support Transport (UST) trailers for more than 20 years.

Recognizing the military's objective of achieving greater efficiency on the battlefield and dire need to reduce the logistics burden of deployed forces, DRASH is one company that is actively pursuing energy efficiency technologies to incorporate into its shelter systems.

The company's initial effort to gain energy efficiency is at the point of power generation. DRASH Intelligent Power Technology (IPT) trailers incorporate digital smart systems for greater power generation efficiency and demand management on the battlefield.

The company's IPT generator strategy goes beyond the legacy concept of battlefield generators – which run in "island mode" - operating independently of one another and creating multiple power grids within a single facility. These generators are sized to run peak loads, continuously running on partial loads and producing power less efficiently.

C. Richard Chou, Vice President for DHS Systems Engineering, said the company's line of IPT generators reduce unnecessary fuel consumption and establish more efficient, flexible mobile facilities. "Digital smart systems allow users to parallel generators to operate as a single power grid that only supplies the power needed to meet a facility's immediate operational requirements. More simply put, the IPT system allows users to connect multiple generators and will automatically turn off unneeded units," she explained, and added, "This ensures that a facility will only generate the amount of power it needs to operate - no more, no less. Additionally, no generators are operated with small partial loads, so all power generated is done in the most efficient manner possible, allowing field operators to get the most out of their limited fuel resources. The IPT system has the potential to reduced fuel consumption by 40 percent or more in small deployable grids" (Based on testing performed at DHS

utilizing representative brigade load profiles and a 3-generator set system.)

While relatively new, DRASH IPT Trailers are already in deployment under the Terminal High Altitude Air Defense (THAAD) and Harbormaster Command and Control Center (HCCC) programs.

Another power generation trend is improving solar, wind and hybrid power production systems.

Efforts at Solar Stick led to a major redesign of the company's flagship rigid panel-based Solar Stik systems, which come in solar only and solar/wind hybrid versions. "The purpose of this redesign was to make the systems more compact and portable, making them a better choice for portable applications, including tactical shelters. The Solar Stiks can be very quickly deployed within 50 feet of the supported shelter systems to provide power for lights, computers, communications equipment, and troop comfort items such as small scale refrigeration, water purification, and non-A/C cooling applications," said Al Zaccor, CEO, Solar Stik.

As this issue was being published, Solar Stik was releasing a wind-only version of its generators, provisionally called the Wind Stik. The product was unveiled at the September 2010 Modern Day Marine Expo at Quantico.

"This will support shelters that already have another solar application (a solar tent roof, for example), but wish to add small scale wind to the equation. These devices, like our Solar Stiks, and unlike our competitors' wind solutions, will be very quick to deploy and redeploy, in minutes and without any tools," pointed out Zaccor.

Solar Stik also released a new version of its flexible solar panel-based systems, called the Shelter Pak. This system pairs a Solar Stik Power Pak with two 190-Watt amorphous silicon flexible solar panels from PowerFilm. Zaccor noted the configuration is ideal for quick deployment on top of small shelters, such as used by platoon and company level command posts, combat outposts, and other remote forward locations. "Like all of our other systems, multiple units can be daisy chained to provide more power. The Shelter Pak is a superior solution to solar systems built into tent roofs for a variety of reasons." At the top of Zaccor's list was the ability to deploy the Shelter Pak on top of a shelter, on the ground, or staked to the south side of a shelter, etc., making it a more flexible and adaptable system.

The Shelter Pak was released earlier in 2010 under that name. "A DoD entity did deploy the product (under another name) to Haiti in the aftermath of the earthquake there, but almost certainly used it in a non-shelter application (on the ground)," said Zaccor.

Power Management and Storage

Industry continues to grapple with the vexing challenge of managing and storing power generated by solar or wind for shelter systems.

Solar Stik's solution to this challenge is its Power Paks – compact 500 or 1000-Watt-hour storage units that include integrated solar charge controls, battery monitoring, and multiple power output options, including AC, DC, and programmable circuits. Zaccor said the the storage capacity of these Power Paks can be easily expanded by the addition of modular Expander Paks in 500 or 1000-Watt-hour increments, using plug and play connectors. He continued, "The compact nature of the Power and Expander Paks makes them easier to transport and more flexible in application. They can be placed in various parts of a shelter (in each corner or along each wall, for example), rather than concentrated all in one place. You can temporarily remove an Expander Pak to give you a mobile source of power at a remote location, and then return it to the shelter power system for recharge."

Solar Stiks, Power Paks and Expander Paks, as well as most of the company's flexible panel systems (Scout, Recon, and Patrol Paks) are in production and have already been deployed to DoD units.

The company has also engineered a line of inverter/charger/UPS devices called P.R.O.-Verters. These devices provide various levels of power management and controls, but are primarily useful in integrating additional sources of power to supplement the solar and wind power provided by Solar Stik's renewable energy generators. "The P.R.O.-Verters enable Solar Stik's power systems to act in a hybrid configuration, combining renewable energy and conventional generators in a highly efficient way," emphasized Zaccor.

Various versions of Solar Stik's P.R.O.-Verters have been in use by DoD organizations for more than two years. The latest version, the P.R.O.-Verter 3000APM AGS, was being turned over to the government for testing as this issue was published.

Stopping the (Energy) Loss

Current designs of energy efficient systems also seek to minimize lost energy, in particular, in extreme environmental conditions. To maintain ambient temperatures within field facilities when deployed in extreme climates, a significant amount of heating or cooling must be produced, which uses a significant amount of energy. DRASH is incorporating advanced thermal insulation into its shelters to help reduce this demand. "Already able to offer an R-value of 3.1 and actively seeking advanced technologies for further improvement, this enhanced insulation helps to reduce the heating and cooling loads significantly," said DRASH's Chou.

DRASH is also working on the next generation of environmental control units (ECU), which will incorporate the latest technologies to improved cooling capabilities and increased efficiency and reliability. C. Richard Chou pointed out, "By addressing both the thermal losses within the shelter and improving the efficiency of the ECU, DRASH is on the leading edge of creating a complete, energy efficient mobile facility that can be deployed anywhere in the theater of operations."

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