Alternative Energy Based Expeditionary Power Solutions

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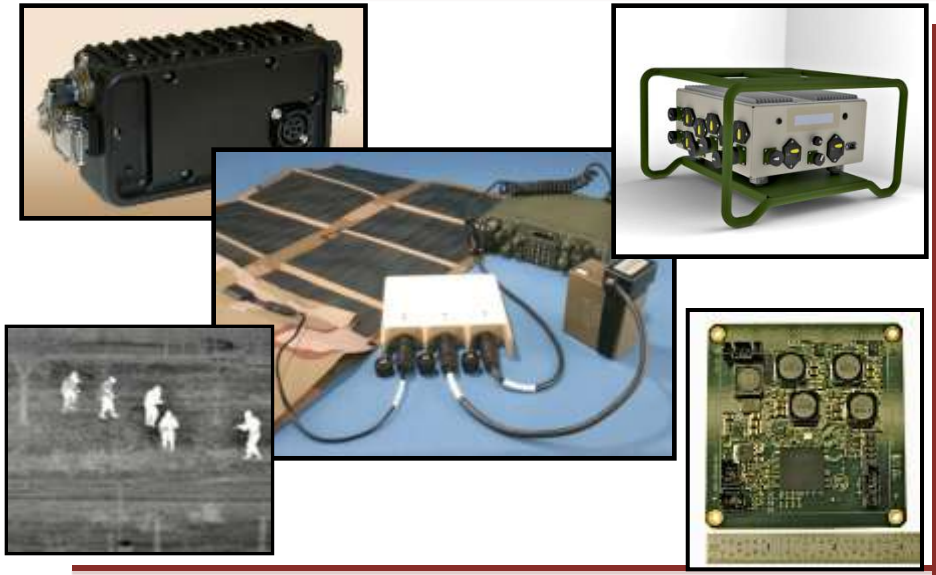
Agenda

SPACES Training
Photo by Sgt. Heather Golden; used with permission.

- Introduction
- StarPower™ technology and applications, including SPACES
  - Man-portable
- StarBase™ technology
  - FOB-level
- High Efficiency Renewable Energy System (HERES)
  - New USN SBIR Phase I Program
- Questions

Aerospace Expertise Directly Benefits Solar Products



Vision: Deliver innovative solutions to our customers on budget and ahead of schedule.

Products and Services: Military power inverters, tactical radio adapters, high speed digital electronics, STE, space electronics, EO/IR subsystems, cryogenics, and advanced thermal management.

Key Customers: USMC, Missile Defense Agency, US Army, Navy, and Air Force, Teledyne, Raytheon, GenCorp Aerojet.

Iris Technology Corporation

Corporate Overview:

- Established in 1986
- TS/SCI Clearances
- Located in Irvine, California
- 25 Employees ~ $10M Revenue
- Classified as “Small Business”
- DLA Best Value Award 5 years

Our unique combination of ***high volume military production*** and ***custom electronics for space*** yields a unique blend of talents and capabilities.

Talent
Technology
Cost Effective Solutions

Our corporate culture is characterized by innovation, customer focus, fast response, technical excellence, and a sense of patriotic duty.

StarPower™

Mobile, Lightweight, and Rugged

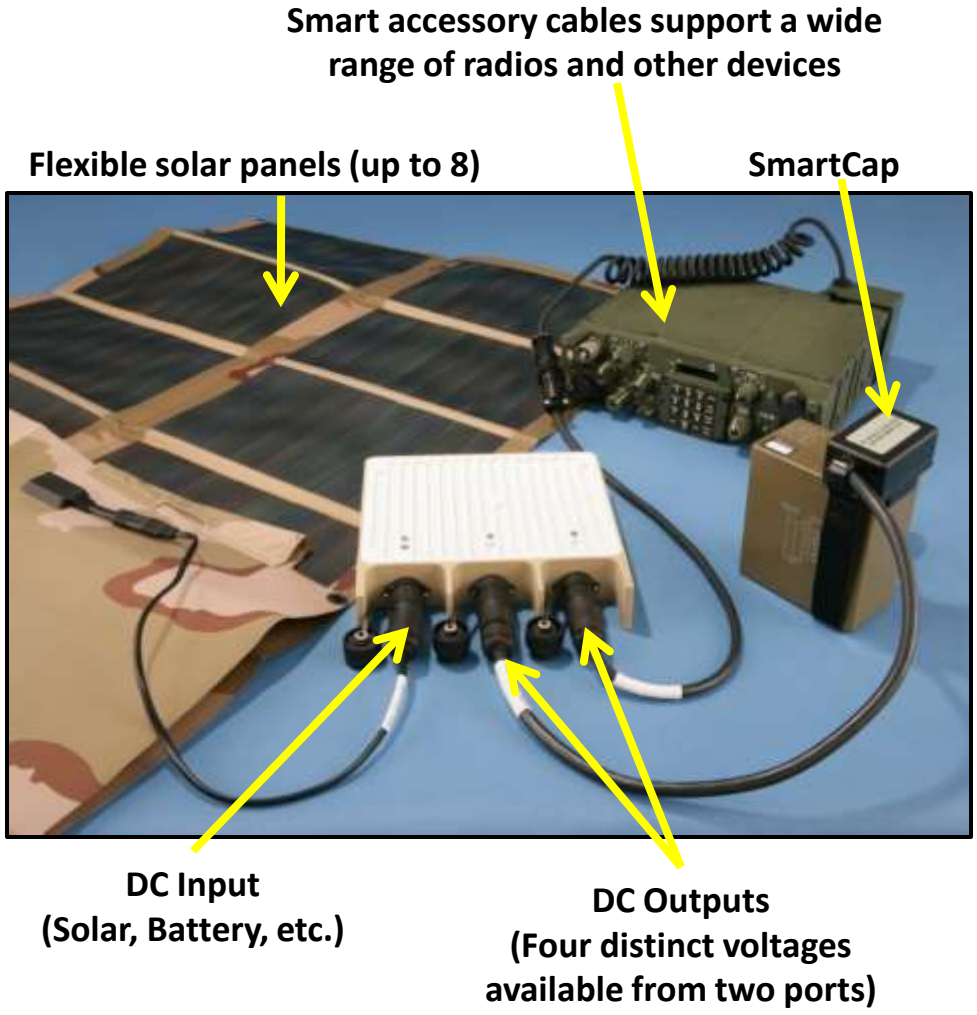
- 2.6 pounds
- 8 x 8 x 1.6 inches

Versatile Power – Combat Ready

- 9 to 35 VDC input
- 12 to 32 VDC output
- Up to 320 W output power
- Supports multiple battery chemistries
- Supports mixed state-of-charge

Power Anywhere

- Acts as a uninterruptable power supply (UPS) when configured as shown



USMC SPACES (Solar Portable Alternative Communications Energy System)

Photo taken by Gunnery Sgt. William Price
Helmand Province, Afghanistan

Product Objective: Provide a mobile solar power solution for the warfighter

Customer: USMC (PM: Malar Motley)

Dates: 2007 to Present

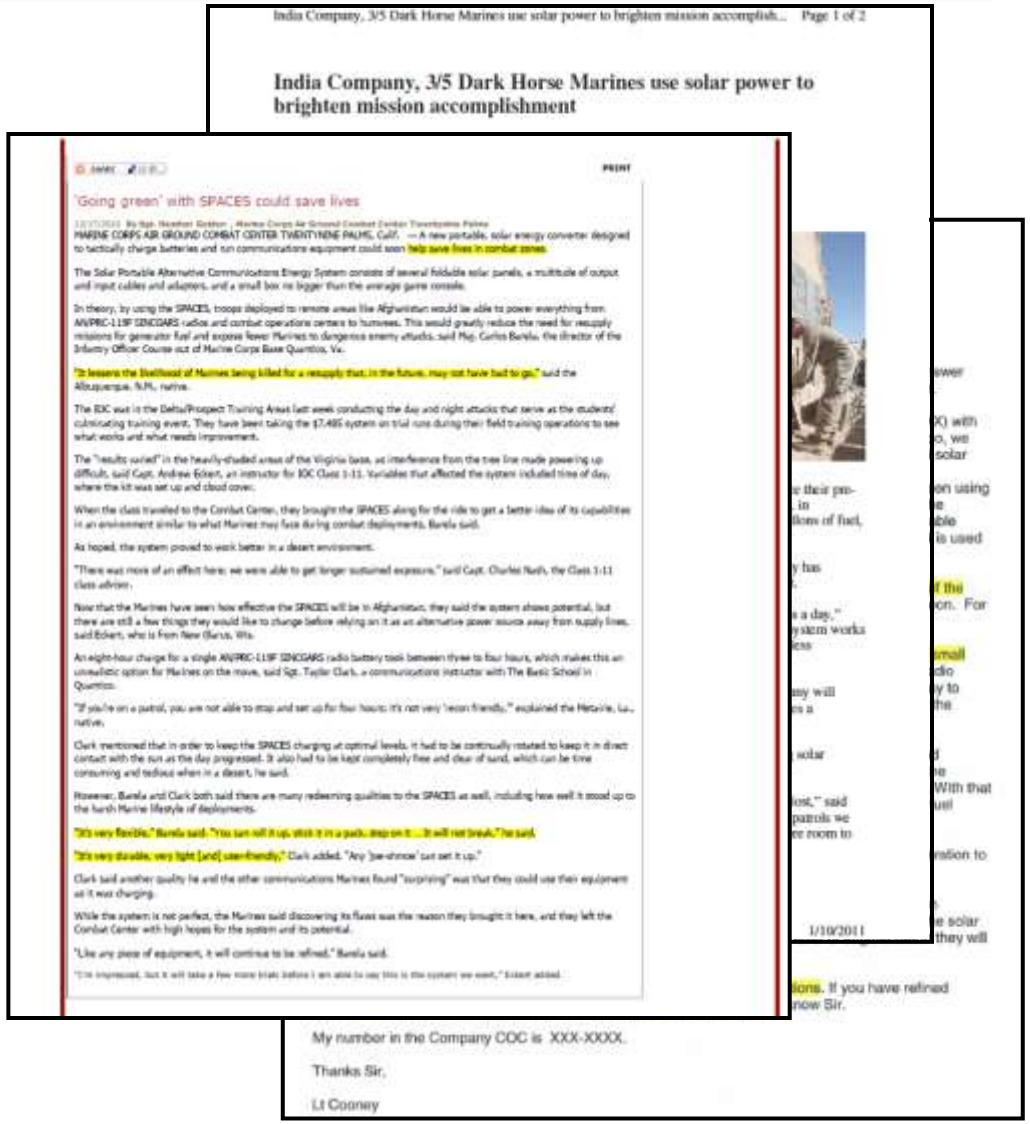
Capabilities: Receives power from solar panels or other DC source to charge batteries and power equipment

Quantity Delivered: Over 2000 to date; over 1300 delivered to combat theatre

Training @ Camp Pendleton

USMC Raves about SPACES

- “Biggest asset”
- “Help save lives in combat zones”
- “Durable, light weight (and) user friendly”
- “We all see how crucial and important renewable energy is”
- “It lessens the likelihood of Marines being killed”


India Company, 3/5 Dark Horse Marines use solar power to brighten mission accomplish... Page 1 of 2

India Company, 3/5 Dark Horse Marines use solar power to brighten mission accomplishment

PRINT

'Going green' with SPACES could save lives

MARINE CORPS AIR GROUND COMBAT CENTER TWENTYNINE PALMS, Calif. — A new portable, solar energy converter designed to tactically charge batteries and run communications equipment could soon help save lives in combat zones.

The Solar Portable Alternative Communications Energy System consists of several foldable solar panels, a multitude of output and input cables and adapters, and a small box no bigger than the average game console.

In theory, by using the SPACES, troops deployed to remote areas like Afghanistan would be able to power everything from AN/PRC-119F SINCGARS radios and combat operations centers to humvees. This would greatly reduce the need for resupply missions for generator fuel and expose fewer Marines to dangerous enemy attacks, said Maj. Carlos Barela, the director of the Infantry Officer Course out of Marine Corps Base Quantico, Va.

"It lessens the likelihood of Marines being killed for a resupply that, in the future, may not have had to go," said the Albuquerque, N.M., native.

The IOC was in the Delta/Prospect Training Areas last week conducting the day and night attacks that serve as the students' culminating training event. They have been taking the $7,495 system on trial runs during their field training operations to see what works and what needs improvement.

The "results varied" in the heavily-shaded areas of the Virginia base, as interference from the tree line made powering up difficult, said Capt. Andrew Eckert, an instructor for IOC Class 1-11. Variables that affected the system included time of day, where the kit was set up and cloud cover.

When the class traveled to the Combat Center, they brought the SPACES along for the ride to get a better idea of its capabilities in an environment similar to what Marines may face during combat deployments, Barela said.

As hoped, the system proved to work better in a desert environment.

"There was more of an effect here; we were able to get longer sustained exposure," said Capt. Charles Nash, the Class 1-11 class advisor.

Now that the Marines have seen how effective the SPACES will be in Afghanistan, they said the system shows potential, but there are still a few things they would like to change before relying on it as an alternative power source away from supply lines, said Eckert, who is from New Berus, Wis.

An eight-hour charge for a single AN/PRC-119F SINCGARS radio battery took between three to four hours, which makes this an unrealistic option for Marines on the move, said Sgt. Taylor Clark, a communications instructor with The Basic School in Quantico.

"If you're on a patrol, you are not able to stop and set up for four hours; it's not very 'recon friendly,'" explained the Metairie, La., native.

Clark mentioned that in order to keep the SPACES charging at optimal levels, it had to be continually rotated to keep it in direct contact with the sun as the day progressed. It also had to be kept completely free and clear of sand, which can be time consuming and tedious when in a desert, he said.

However, Barela and Clark both said there are many redeeming qualities to the SPACES as well, including how well it stood up to the harsh Marine lifestyle of deployments.

"It's very flexible," Barela said. "You can roll it up, stick it in a pack, step on it ... it will not break," he said.

"It's very durable, very light [and] user-friendly," Clark added. "Any 'Joe-shmoe' can set it up."

Clark said another quality he and the other communications Marines found "surprising" was that they could use their equipment as it was charging.

While the system is not perfect, the Marines said discovering its flaws was the reason they brought it here, and they left the Combat Center with high hopes for the system and its potential.

"Like any piece of equipment, it will continue to be refined," Barela said.

"I'm impressed, but it will take a few more trials before I am able to say this is the system we want," Eckert added.

My number in the Company COC is XXX-XXXX.

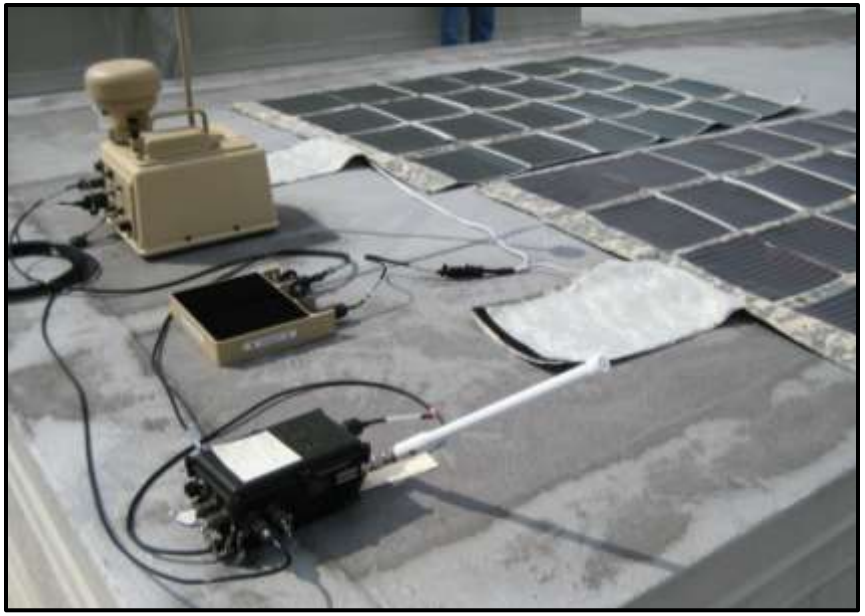
Thanks Sir,

Lt Cooney

Other Applications of SPACES Equipment

SPACES, originally developed to support communications equipment, has proven readily adaptable to numerous other applications.

Surefire HellFighter®: Heavy Gun WeaponLight



Joint Biological Tactical Detection System (JBTDS)

SPACES Has Even Been Scaled Up to Support Over 300W Applications

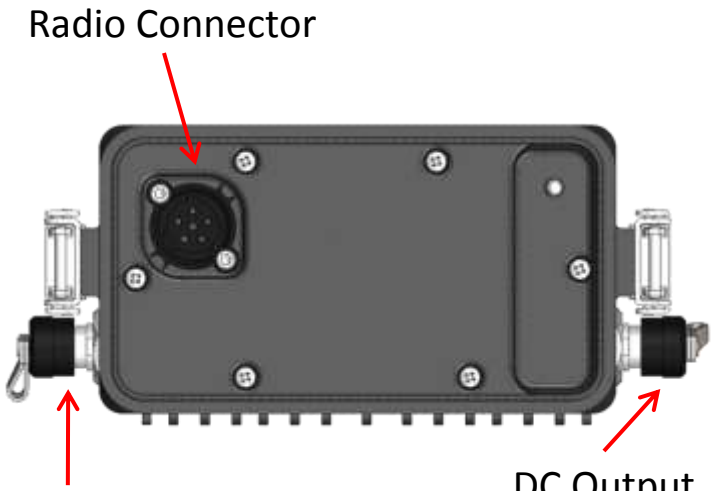
M777a2 Howitzer

Photos taken November 2010 at 29 Palms. SPACES provided remote power to M777a2 howitzers during a weeklong artillery training exercise for 2nd Battalion, 10th Marines.

StarPower™ → Merlin™ Radio Power Adapters

Merlin-3™: AN/PRC-117G RPA

- **Uses standard full-size batteries and existing battery box**
- **Hot swap capable**
- **SPACES interoperable**
- **Merlin-2TM (AN/PRC-117F RPA) also available**



Merlin is basically StarPower™ packaged in a specific form factor and designed for extremely low EMI.

StarBase™

StarBase™ System

- Controller, batteries, solar panels, and generators
- Functions as a DC UPS
- Reduces fuel consumption with smart control over generator operation

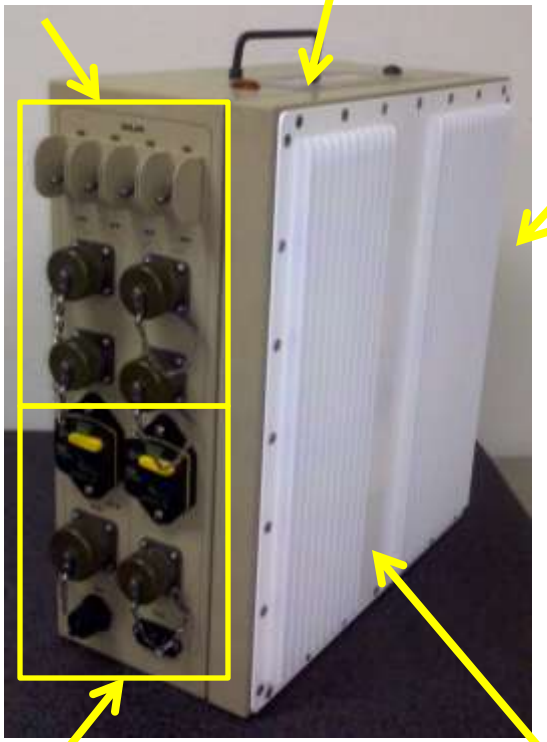
Controller Electronics

- 96-98% power conversion efficiency
- 3-kW input capable (2 kW solar + 1 kW generator)
- 1 kW peak output; 500 W continuous

Flexible Architecture

- Lithium ion or lead acid batteries
- Optimized load balancing
- Plug and play

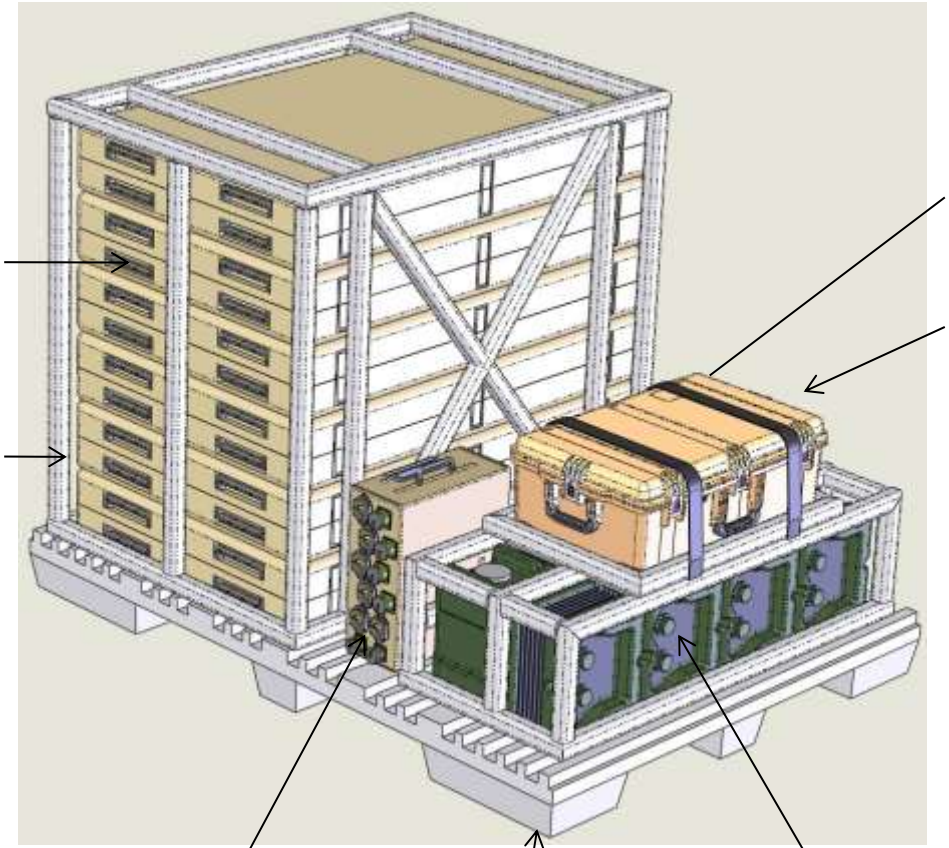
Prototype "StarBase™" Controller



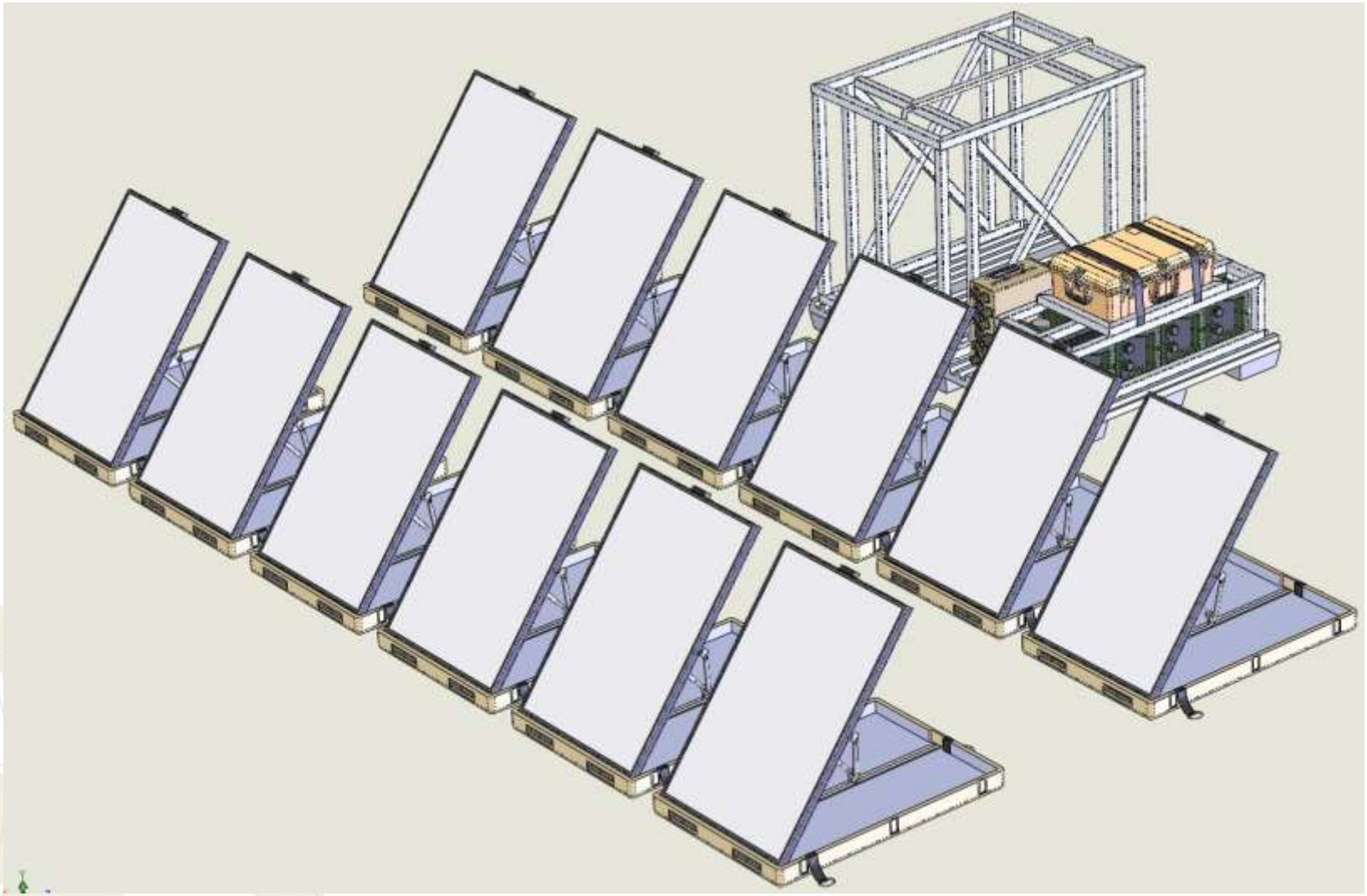
Comparison of StarBase™ System Options

Component/Capability	GREENS (USMC Program)	StarBase™ I (Present Technology)	StarBase™ II (Future Growth)
Controller			
AC Input Power Capacity	1.0 kW	1.2 kW	2.0 kW
DC Input Power Capacity	1.0 kW	1.2 kW	2.0 kW
Solar Channel Capacity (ea)	500 W (Qty. 4)	645 W (Qty. 4)	860 W (Qty. 4)
Battery Channel Capacity (ea)	500 W (Qty. 4)	645 W (Qty. 4)	860 W (Qty. 4)
Peak Output Power	1 kW @ 24VDC	2 kW @ 28 VDC	2 kW @ 28 VDC
Batteries - Low Cost Configuration			
Type	AGM	AGM	AGM
Quantity	8	10	10
Energy Capacity	1.2 kW-hr ea (9.6 kW-hr TTL)	1.2 kW-hr (12.0 kW-hr TTL)	1.2 kW-hr (12.0 kW-hr TTL)
Batteries - Low Mass Configuration			
Type	Li-Ion	Li-Ion	Li-Ion
Quantity	4	5	3
Energy Capacity	1.8 kW-hr ea (7.2 kW-hr TTL)	2.5 kW-hr (12.5 kW-hr TTL)	4.4 kW-hr ea (13.2 kW-hr TTL)
Solar Panels			
Quantity	8	12	12
Power Capacity	215 W/ea (1660 W TTL)	215 W/ea (2580 TTL)	215 W/ea (2580 TTL)
System			
Typical daily solar (6 hrs @ peak)	9.9 kW-hr	15.48 kW-hr	15.48 kW-hr
Continuous power	300 W	500 W	500 W
Daily energy output	7.2 kW-hr	12 kW-hr	12 kW-hr
Daily battery charge (SOL-Load)	2.7 kW-hr	3.48 kW-hr	3.48 kW-hr

Packaging Example: StarBase™ Palletized Option



StarBase™ Palletized Option - Deployed

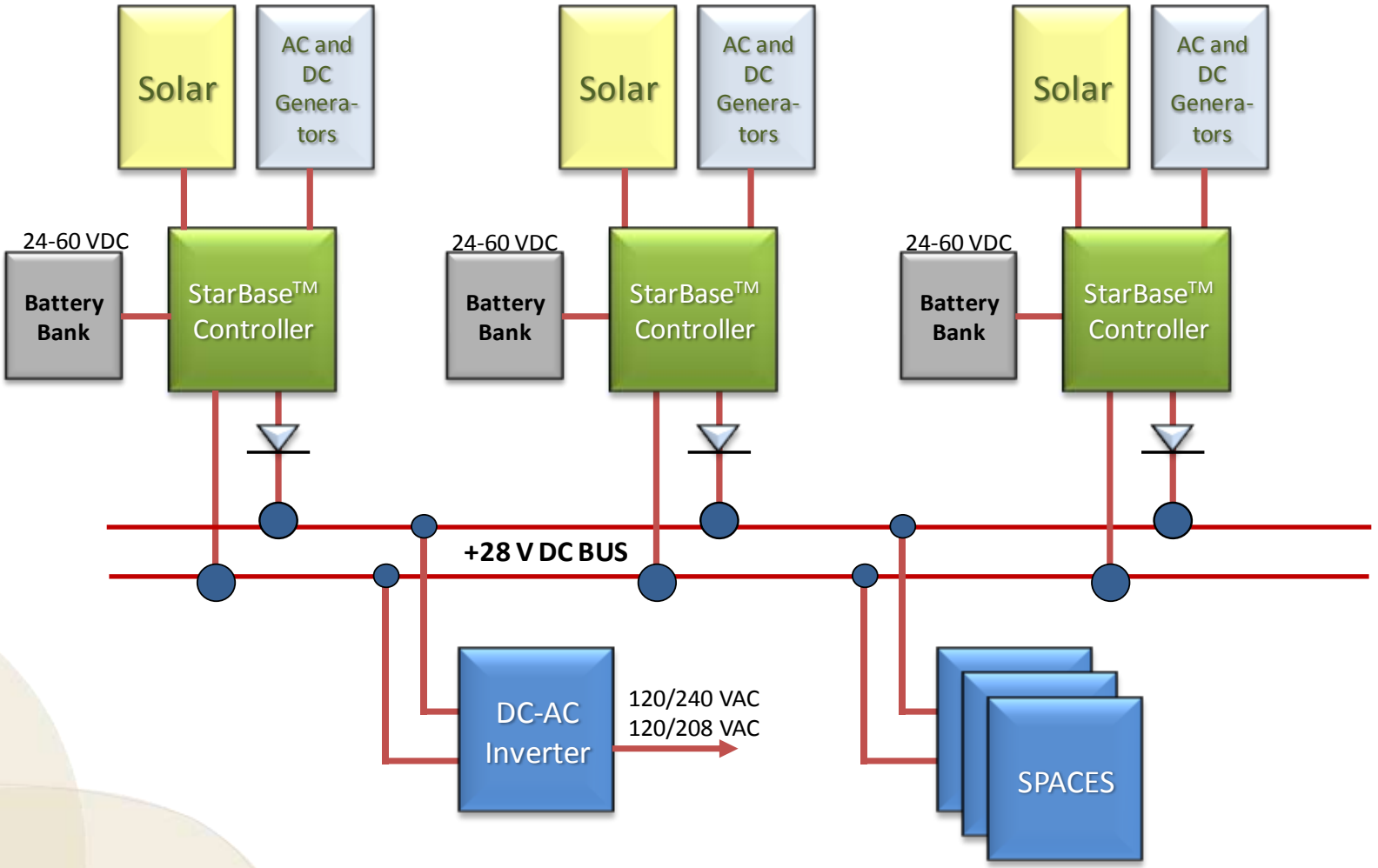


StarBase™ Controller Packaging Option

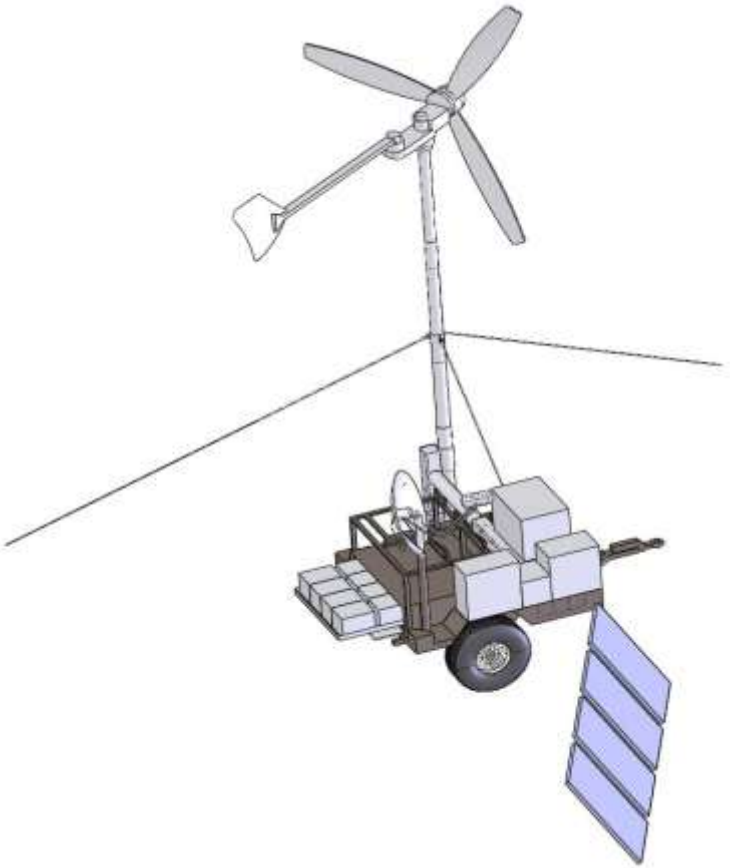
- Robust physical design
- Excellent thermal design
- Accessible connectors for fast setup
- IP-67
- MIL-STD-810F

For stand-alone applications, controller (solar generator) can be packaged in a frame with shock mounts, just like a traditional generator.

Integrated SPACES - StarBase™ Architecture



HERES (High Efficiency Renewable Energy System)



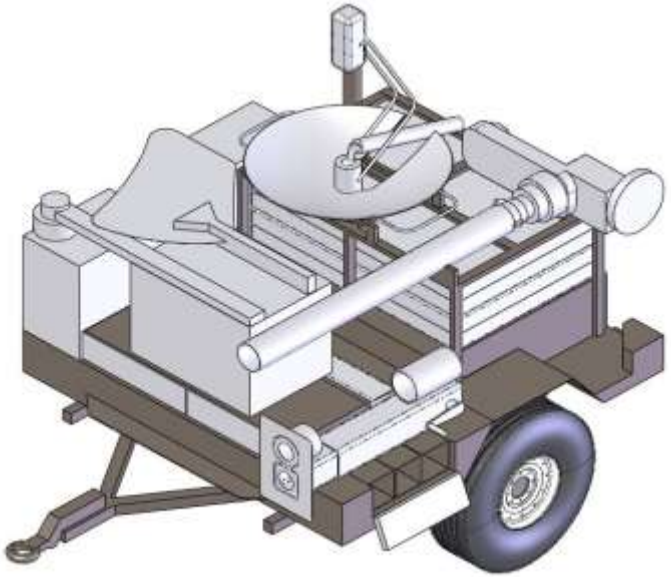
HERES - Deployed

Product Objective: 10 kW class, HMMWV trailer-mounted renewable energy system

Customer: USMC (PM: Justin Govar)

Dates: New SBIR Phase I Program; expected start in May/June 2011

Capabilities: Optimally utilize PV, wind, solar reflective, batteries, and generators to meet the HMMWV packaging and USMC power requirements



HERES - Stowed

Summary

- StarPower™ / SPACES is Technology Readiness Level (TRL) 9 technology
  - In theatre and performing very well
- Merlin™ products closely related to SPACES
  - Interoperable with SPACES
  - Electronics and software designs derived from SPACES
- StarBase™ now available for FOB-level alternative energy needs
- HERES will build on StarBase™, introducing additional alterative energy technologies beyond photovoltaic