TROPEC Cycle 13.2 Lab Summary

Mission: *Reduce Operational Energy Consumption in tropical environments while maintaining or improving warfighter capability.*

Goal: *Reduce operational energy consumption at PACOM expeditionary basing by 25% in 32 months.*

Method: *By combining Department of Energy's expertise in energy efficiency & demand reduction with PACOM and SED's expertise in operations in tropical environments and through a process of technology identification, review and assessment, provide strategy and acquisition professionals with insight and information on materiel and non-materiel solutions.*

Background: Oak Ridge National Laboratory (ORNL) and Lawrence Berkeley National Laboratory (LBNL) are Department of Energy (DOE) laboratories that provide technical support to the TROPEC program. ORNL is the lead laboratory and focuses on technologies for expeditionary shelters, Environmental Control Units (ECUs), and base camp "hotel" loads including kitchens, laundry equipment, water heating, and water pumping. LBNL focuses on energy efficient technologies for lighting, data processing and communication systems, electronics, and power distribution systems. Each lab conducts laboratory assessments of Innovations Network (I-Net) technology applicants in their respective technical areas, and assists PACOM and MEC in field assessments of these technologies. Cycle 13.2 was open for technology applications from July through September 2013. Specific focus areas were: ECUs, high temperature electronics, and off-grid shelter loads. Technology applications were screened and then select technologies recommended for either lab or field assessment.

LBNL - Laboratory Assessments:

- Performed laboratory testing of alternative field server cooling technologies in specialized environmental chambers. The chambers were used to simulate typical tropic temperature and humidity extremes. Five different alternative approaches were tested and the resulting data generated was analyzed and summarized in formal lab reports.

- Conducted assessments of four efficient lighting technologies for shelter and area lighting. The area lighting technologies tested were part of a complete, self-powered solar and battery system mounted into a trailer.

Testing Liquid Cooling Technology

- Conducted paper and lab bench studies of energy efficient memory chips used in computers and servers.

LBNL - General Findings/Recommendations:

- Results overall demonstrated strong potential for not only energy savings but also operational/tactical benefits. Four of the five technologies also cooled effectively throughout all temperature and humidity test points. By eliminating the need for cooling delivered through a COC Tent environmental control unit (ECU), a long chain of potential energy and operational/tactical benefits can be realized.

- Lighting technologies showed strong potential for energy and operational benefits. The solar-powered area lighting technologies enabled potential new FOB security benefits.

Testing Solar Powered Efficient Area Lighting

- Though relatively small, efficient memory appears to be a good investment. Even small savings in a FOB setting can yield benefits.

Lab Bench Test of Efficient Memory Chips 1

TROPEC Partners

TROPEC Cycle 13.2 Lab Summary

ORNL - Laboratory Assessments:

- Executed a paper assessment for conditioning a highly insulated containerized living unit utilizing a high SEER ductless split system. The analysis included modeling three different possible HVAC unit sizes. Modeling was done for eight climate conditions in the PACOM AOR, one CONUS and one AFRICOM AOR location.

- Conducted two assessments of different coating technologies that could be applied tents or B-Huts. Measured material properties of a sample of one coating and transferred the measured properties to detailed EnergyPlus models of tents and B-Huts. The modeling was conducted for 16 different tropical climate locations in the PACOM AOR.

Measuring Solar Reflectance of Standard Tent Fabric

- Assessed via modeling a DC powered air conditioning system that is used in conjunction with a solar PV system and battery array. The assessment leveraged existing B-Hut models as basis for the modeling.

- Prepared modeling based assessments of two different tactical microgrid products which include solar PV components along with controls for grid management. Performance was modelled using HOMER simulation software for solar PV systems. Simulations were run for six locations in the PACOM AOR with varying climate conditions and a wide range of latitudes.

ORNL - General Findings/Recommendations:

- For containerized living units that are highly insulated, it is possible to minimize HVAC unit size to closely match cooling loads across a wide variety of climate conditions in the PACOM AOR with only a very few hours when cooling requirements would not be met.

- Low emittance coatings show promise as a technique to reduce solar loads to a structure without requiring a separate radiant barrier layer.

Measuring Thermal Emittance of Coating Tent Fabric

- Reflective coating performance varies considerably based on climate conditions and may reduce or sometimes increase energy use depending on the location.

ORNL - Laboratory Assessments - Findings:

- Low emittance coatings have the potential to reduce HVAC energy consumption by 6%-16 % depending on climate location.

- Fuel savings by applying a DC powered ductless split system to a B-Hut could be approximately 30% (again climate dependent). This assumes a sufficient sized PV array and battery bank to power the system overnight.

- Modelled hybrid microgrid performance indicated a daytime only use scenario could provide fuel savings of approximately 60%. However this does not take into account a nighttime depletion of battery charge, therefore field assessment would be necessary to better assess performance under actual operating conditions.

TROPEC Partners