Photovoltaic Systems

The NDCEE is demonstrating a photovoltaic (PV) system at Fort Hood, TX and at Camp Katuu, Palau.

Problem Statement

Executive Orders (EO) 13423 and 13514, the Energy Policy Act of 2005, and Army policy require more energy-efficient/less polluting buildings. Improving energy efficiency reduces electricity use and costs, increases energy security and supply stability, reduces greenhouse gases, and improves the living environment for soldiers and their families. Military outposts on remote islands face challenges in providing the power and energy that they need to perform their missions. Since most islands do not have fossil fuel resources, fuel for vehicles and generators must be shipped in; a costly option for the DoD.

Technology Description

PV solar cells convert the light of the sun directly into electricity. Numerous types of PV technologies are available to collect and use solar energy.

In 2010, two types of PV technologies, thin film and crystalline panels, were installed on a carport at Fort Hood. Monocrystalline PV panels are covered with single-cell silicon crystal wafers; thin film panels have one or more layers of a thin film—amorphous silicon in the NDCEE demonstration—applied to a substrate. The system components include: monocrystalline PV panels, thin film PV panels, direct current (DC) combiner boxes, a DC disconnect to isolate the PV panels from the inverter, an alternating current (AC) disconnect to isolate the inverter from the utility grid, and an inverter to convert the DC power generated by the PV panels into AC electricity to be used by the site. The NDCEE gathered data during the demonstration period to quantify installation issues, hourly power generation, peak power generation, total energy generation, efficiency, output degradation, maintenance requirements, and cost savings (procurement, maintenance, output).

At Camp Katuu, the PV array has a nominal DC rating of 42kW, and is roof mounted on the Builder's Shop. Final power rating and design of the PV system was based upon capabilities and requirements associated with base loads, base generation, and the local utility to ensure compatibility. The system was designed to maximize the system rating while including access ways for easy installation, maintenance, and repair. A pre-engineered roof top fall protection safety rail system was also incorporated to enhance sustainability by supporting PV panel's installation and maintenance requirements. Since Palau is a warm, humid climate with salty sea air, corrosion of the PV array is a concern. To mitigate the corrosion concern, the selected PV module has been tested and verified to withstand corrosion by the manufacturer. In addition, a barrier material was installed between roof connections to prevent galvanic corrosion. Finally, the fastening hardware for the frame mounting system was assembled and subjected to ASTM B117 corrosion testing to confirm system's ability to limit corrosion levels.

Environmental, Safety, Occupational Health, and Energy (ESOHE) and Cost Benefits

- **ESOHE Benefit**. The use of solar energy reduces the need for utility-provided electricity and consequently reduces the pollution associated with burning fossil fuels.
- **Cost Benefit**. Despite high startup costs, a well-designed PV system can reduce electricity use and costs, increase energy security and supply stability, reduce greenhouse gases, and improve living environments. A cost-benefit analysis of the two PV systems at Fort Hood is being conducted to inform the Army's decision support process for future PV technology implementation projects.

NDCEE
National Defense Center for Energy and Environment

DoD Executive Agent
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the NDCEE is operated by:

CTC Concurrent Technologies Corporation

www.ndcee.ctc.com

Camp Katuu's currently relies on power provided by the Palau Public Utility Company's unreliable grid and a 60 kW generator for backup power. The camp's electricity costs average $7,500 per month or 33% of the operations budget; this does not account for the fuel required to run the generator. To reduce Camp Katuu's monthly operating budget and its diesel fuel dependency and to increase energy reliability, solar energy was selected as a potentially viable option.

Technology Benefits and Advantages

- Eliminates air pollution associated with grid-provided electricity
- Uses solar energy, which is unlimited

Technology Limitations

- Photovoltaics can be expensive to purchase and install. They are a long-term investment.
- Shady areas or locations with extended cloudy seasons have lower PV benefits than places with more sunshine.

Accomplishments

Fort Hood:

- PV panels were installed in conjunction with Fort Hood personnel to ensure correct system operation.
- Metering equipment compatible with the existing control system at Fort Hood was installed for data acquisition and data collection started in June, 2010.

Camp Katuu:

- The NDCEE teamed with PACOM and A/249th Engineering Battalion (Prime Power) to execute a design validation for a PV System based on a technical site visit to Palau in November 2010.
- The NDCEE is providing engineering support for the demonstration by collecting and analyzing operational data.

Technology Transition Opportunities

The NDCEE trained members of the A/249th Engineering Battalion to install and operate the PV power system and oversee the installation of the system, which will be conducted by the A/249th Engineering Battalion with assistance from Civil Action Team (CAT) on ground at Camp Katuu. PV demonstrations will provide data to help the DoD evaluate lifecycle costs of these systems and the value of using them at remote military installations. The technology can be transitioned across the military services.

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Building-integrated PV systems, like the carport at Fort Hood, have a small ecological footprint because they are part of the building structures.

Before the photovoltaic array was installed at Camp Katuu, PACOM and A/249th Engineering Battalion designed and incorporated modifications to reinforce the roof to support the additional weight of the solar panels and mounting equipment, currently estimated to be 10,500 pounds.

Validating the applicability of PV arrays to reduce electricity costs at remote locations, particularly locations with adequate daily periods of sunshine, may allow the technology to be used to reduce the environmental footprint of contingency bases.

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