Solar Thermal Radiant Floor Heating

In remote locations, where fuel transport is cost prohibitive or increases risks to the health and safety of DoD personnel, renewable solar energy can be used to offset utility costs and decrease dependence on fossil fuel supplies. The NDCEE is currently working with the U.S. Army to demonstrate/validate commercial solar thermal radiant floor heating at the Pohakuloa Training Area (PTA) in Hawaii.

Problem Statement

U.S. Army Garrison-Hawaii's PTA is located in a rural, high elevation area on Hawaii Island. Previously, space heating was supplied by electric heat pumps. Electricity prices in Hawaii are more than twice the national average, and nearly two-thirds of the electricity provided by the local utility, Hawaii Electric Light Company (HELCO), is generated by imported oil.

Technology Description

The NDCEE will demonstrate and validate a solar thermal radiant heat flooring system at the PTA, which is located in a rural area on Hawaii Island. The NDCEE is currently installing the solar thermal radiant heat flooring system in one of PTA's barracks buildings. Following a technology assessment, the team selected a closed loop system with heat transfer fluid. The main components of the system are solar collectors, a storage tank, a radiant heat emitter in the floor, circulation pumps, a thermostat and electronic controls, and a heat dissipater. In addition to supplying heat, the system could be modified to include domestic water heating.

The system design includes seven 4-foot by 10-foot flat panel collectors with an output of 35,600 BTU/day. They are arranged side-by-side on the south-facing pitch of the roof and are racked at a 30 degree angle to maximize collection of winter sun. Based on the flow rate of the system and the number of collectors, a tank capable of storing approximately 600 gallons was selected. This tank has a vertical orientation for a small footprint and better stratification. Cross-linked polyethylene (PEX) tubing was installed over the existing concrete floor, and a layer of concrete was poured over the tubing. Solar-heated fluid is flowing through approximately 4,000 feet of tubing in the floor, emitting heat to the room at night.

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

- **ESOHE Benefit**. Using solar-based technology instead of electricity provided by HELCO will reduce GHG emissions and reliance on foreign oil.
- **Cost Benefit**. Using solar-based technology instead of commercially-generated electricity will reduce PTA's electricity costs. Upon completion of the project, the NDCEE will conduct a cost-benefit analysis to include a lifecycle cost and performance evaluation.

Technology Benefits and Advantages

- Potentially decreases reliance on petroleum and increases the usage of renewable energy
- May prove to be a cost-effective, environmentally-friendly, efficient way to heat barracks and other buildings in remote locations

NDCEE
National Defense Center for Energy and Environment

DoD Executive Agent
Office of the Assistant Secretary of the Army for Installations, Energy and Environment

the NDCEE is operated by:

CTC Concurrent Technologies Corporation

www.ndcee.ctc.com

Technology Limitations

- Relatively new technology with unknown performance, system integration, and life cycle cost

Accomplishments

- Designed and sized the demonstration system
- Coordinated the technology installation, which was completed in December 2010
- Installed data logging equipment to monitor the system performance for one year

Technology Transition Opportunities

This technology could have wide implementation applications, especially at installations in cold-but-sunny climates. Further, to facilitate technology transition, the NDCEE will share information on the technology selection process, system performance, lifecycle costs and benefits, and potential DoD applications.

Points of Contact

- Gene Arter, U.S. Army, 808-969-2480, eugene.arter@us.army.mil
- Heather Brent, NDCEE/*CTC*, 412-992-5352, brenth@ctc.com

Installed copper under soffit to equipment pad

Solar panels attached to existing metal roof with special clips

Setting equipment at pad

Installed solar panels

Rev. 5-11