PROJECT SOLARLAND

TA-NOO VICHARANGSAN

Energy Industry Development Office, Ministry of Industry, Rama 6 Rd., Bangkok 10400 (Thailand)

Introduction

A key factor in achieving the successful application of solar energy in remote rural areas is the energy storage medium. In the case of solar photovoltaic (PV) power generation, the energy converted from sunlight can be effectively stored in lead/acid batteries. In particular, satisfactory results have been obtained in Thailand by employing conventional car/truck batteries. This paper describes systems of solar energy conversion in which such lead/acid batteries play a major role.

Role of small renewable-energy packages

In Thailand, small, renewable-energy conversion units have been used for many years. Small, wind-driven, water-lifting devices were, and still are, the mainstay of the salt-making industry. Water wheels taking water from creeks for irrigation have been popular in certain regions.

With the rise in oil prices, increasing interest has been shown in the development of small, renewable-energy packages. Apart from serving as alternatives to the provision of power at a lower cost than oil, these packages are also considered as a means of supplying power to locations where conventional methods are not available, or can only be installed at high cost. Therefore, there has been a steady increase in wind-pumping installations for the provision of water for both consumption and irrigation. Wherever possible, hydro power is tapped through mini- and micro-hydro generating facilities. Also, the country has numerous solar photovoltaic systems to provide much needed electricity to remote communities.

In short, small, renewable-energy packages are used to:

(i) ease the pressure of high-cost, conventional energy;

(ii) provide remote communities with the facility to generate the energy to supply their needs.

"Project Solarland" was conceived with the second objective in mind. It is intended to draw the attention of the government to the benefits of solar energy so that support for its use may be provided.

0378-7753/88/$3.50

Project Solarland

With the abundance of sunshine, the equivalent of five hours of noon-sun on almost every day of the year, Thailand is well placed for solar-energy utilization. Solar energy can be collected and utilized in various ways, *e.g.*, as heat for drying agricultural and marine products and to evaporate sea water in salt making, to heat water for residential and industrial activities, and to provide electrical power for lighting and other purposes.

The aim of Project Solarland has been to demonstrate to the Thai population that a number of problems of rural living might be solved through the use of solar energy, and that its widespread use should be encouraged and promoted.

Nakhon Ratchasima, a principal province in north-eastern Thailand, was designated as the site of the initial stage of Project Solarland which started in 1983. Most of the solar energy systems to be installed at various locations in this province were planned as PV-based systems, and Thailand's first solar PV-powered television set for public viewing was installed there in 1982. Since then, 25 more solar PV-powered television receivers have been commissioned at un-electrified villages, together with one PV-lighting system (10 sets of outdoor and indoor lighting) at one village. All these systems employ lead/acid batteries for energy storage. Recently, two small PV-powered water-pumping systems were added to help with crop planting, also with lead/acid batteries for buffer storage. At the same time, other government agencies built a number of solar-PV systems, such as water pumping and remote-village electrification, thus enhancing the project's intensity.

Since then, Project Solarland has spread into nearly all remote regions of the country, mainly to provide electricity for village use and for telecommunications. Altogether, some 60 systems have been installed in 23 provinces, including Nakhon Ratchasima. Other government and volunteer agencies have fitted some 300 more systems, mainly for telecommunications purposes. Added to these are an unknown number of private installations, these being used predominantly for lighting and television reception.

Examples of systems in Project Solarland

Village television sets

Solar PV-powered television sets have helped to create an awareness of the potential of solar energy, and considerable impact is always made whenever a unit is installed in a remote village. A typical set comprises the following items:

(i) a 17 - 18 in. black-and-white television receiver consuming 14 - 16 W of 12 V, d.c.;

(ii) a multi-channel antenna and a 12 m high mast made of steel tubing;

(iii) a panel of 30 - 35 Wp solar PV cells generating d.c. for 12 V applications;

(iv) A 12 V, 100 A h lead/acid truck battery for energy storage.

Such an arrangement results in adequate energy storage and supply for viewing. At present, total telecasting time in Thailand amounts to some 80 h per week. Batteries in this application exhibit good service life, *i.e.*, on average, 3 - 5 years.

Remote-village electrification

Rural villages require a minimal amount of electrical energy; this is mainly used for lighting households, operating circulating fans in hot weather, running television sets and radio/cassette players and, in a few cases, running water pumps and medical refrigerators. The extension of the electricity transmission lines by scores of kilometers at great capital cost for a consumption of 200 - 300 kW h per month is a low priority activity, and most often villages are left un-electrified. In such cases, the off-grid consumers have to electrify their own homes using lead/acid batteries to store and dispense electric power for their daily needs. A 12 V car battery is usually sufficient to light a couple of small fluorescent lamps or to run a small television set for about a week. Re-charging the battery is a tedious affair, as it must be sent to an electrified community up to 30 km away, and a total expense of U.S.$ 72 - 90 is incurred each time.

Village solar station for battery charging

As a pilot project, a number of remote villages have been provided with small solar PV arrays (0.5 kW peak capacity) to serve as central power sources (Fig. 1). Each morning, those villagers whose turn it is for re-charging take their batteries to the centrally located solar station. The 12 panels of parallel-connected 40 Wp solar cells can fully charge 6 sets of 50 A h batteries per day, on average, resulting in savings of U.S.$ 4 - 5 per day. At this rate, total investment of U.S.$ 5000 will be amortized in about 4 years.

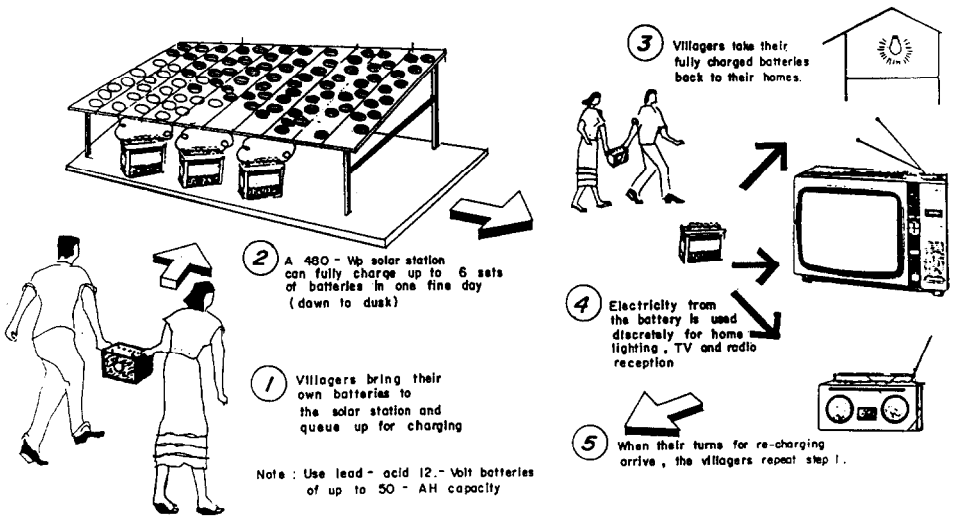

Fig. 1. Solar station for remote villages.

The equipment installed at each solar station consists of:

(i) twelve panels of 40 Wp photovoltaic cell modules connected in parallel;

(ii) a metal framed support for the above panels fixed on a concrete slab;

(iii) a terminal box with 3 pairs of 2 m long charging cables and clips;

(iv) a red lamp for automatic signalling of the fully-charged condition;

(v) a barbed-wire compound fence (8 m × 12 m) complete with a metal-frame gate;

(vi) simple battery-monitoring instruments, *e.g.*, a portable d.c. multimeter and a hydrometer.

In this system, the villagers maintain their own batteries, and no great difficulties have been encountered except for occasional meltdown of sets using the wrong voltage.

Conclusion

It is considered that lead/acid batteries are effective energy storage devices in renewable-energy systems, especially those of small scale that are used for remote-area electrification. Project Solarland owes its existence to energy storage by lead/acid batteries. Also, such facilities are currently enabling a vast number of households in rural Thailand to enjoy home-lighting, as well as radio and television entertainment.