

Running Status Analyzing of Solar Village PV System in Inner Mongolia Cooperated by Sino-Italy

Mingzhi Zhao Zhizhang Liu

School of Energy and Power Engineering, Inner Mongolia University of Technology, Hohhot, China, zhaomingzhi2020@163.com

ABSTRACT: The project of solar village PV system in Inner Mongolia is one of science and technology cooperation programmes on environmental protection which is cooperated by the Ministry of Science and Technology (MOST) of China and the Italian Ministry for the Environment and Territory (IMET). The project of solar village PV system was finished in Inner Mongolia. According to experiment and demonstration of PV system in the remote area of Inner Mongolia China, PV systems not only offered local people's simple electricity demand but also improved standard of living of local people. According to tracking and testing to the project's process, running status of project was analyzed, and interrelated conclusion and suggestion were found in paper, which can offer valued experience for popularizing PV system in the remote area.

Keywords: PV system, project, running status, testing, analyse

1. INTRODUCTION

The project of solar village PV system in Inner Mongolia is one of science and technology cooperation programmes on environmental protection which is cooperated by the Ministry of Science and Technology (MOST) of China and the Italian Ministry for the Environment and Territory (IMET). This project was finished in SuNiTeYou county Xilinhaote Inner Mongolia in 2005. Inner Mongolia Natural Energy Institute from China and EniTechnology Company from Italy are partners of this project. The successful execution of project reached the electricity demand of some local people and improved the herdsman's living condition in the remote area in Inner Mongolia. The purpose of the electrification of the rural villages and single isolated houses situated in the extreme north of the Chinese province of

Inner Mongolia is to improve the living conditions of the local inhabitants and promote the sustainable economic development of the region. The project thus intends to experiment the application of a model, extendable and repeatable on a large scale, of economic development of residential communities of great poverty, at the same time reducing the exploitation of the natural resources of the planet and the emission of polluting substances into the atmosphere. For this reason the electrification will be carried out using renewable energy sources, such as solar energy produced by photovoltaic modular elements. The application of development models based on energy production from renewable sources implies an acquisition of the concept of energy that makes evident the use of resources necessary for its production, and thus implicitly stimulates a more rational use of them, avoiding useless waste.

2. PROJECT SEGMENTS

The scale of project is 100kW, which is an integrated project consisting of 3 components. They are Solar Village System, Solar Home Systems, and Pumping System.

2.1 Solar Village System

The electrification of the village in the solar village system will provide the users with a series of services listed below, plus an energy surplus, and will be achieved through the installation of an electrical distribution network, or power grid, connected to a generator of electricity from a renewable source; the services will consist of:

- Public street lighting for the village;
- Lighting of 38 village dwellings;
- Electrification of a community entertainment and communication centre equipped with a television receiver and radio equipment;
- Pumping system for irrigation;

The electric generator will supply through the power conversion equipment, perfectly sinusoidal electrical quantities, qualitatively comparable to those supplied by the national power distributor's grid, which is obviously not present in the village. It will be possible to connect to the village's electric grid all the equipment and devices necessary for guaranteeing the above-listed services. A diesel generator will be present in the electric generation, and will go into operation only in the unusual event of an excessive discharge of the accumulators.

The main characteristic of the production plant is the creation of a three-phase 230V/50Hz AC electrical grid referred to hereinafter as the AC BUS. The AC BUS will be created in each of its phases by a device consisting of a DC/DC converter, an AC/DC bridge inverter, and a control system. The device, powered by the batteries, will hereinafter be referred to as the battery inverter. This device will be

capable of generating a sinusoidal voltage of 230V at a frequency of 50Hz, behaving like a voltage generator, using the accumulation system as a buffer, and supplying the active and reactive power required by the users. In order to obtain a three-phase AC BUS, it will be necessary to make a star, or Y, connection between the three battery inverters. The energy coming from the photovoltaic field will be put into the AC BUS network using power converters, hereinafter referred to as string inverters, controlled by the network itself.

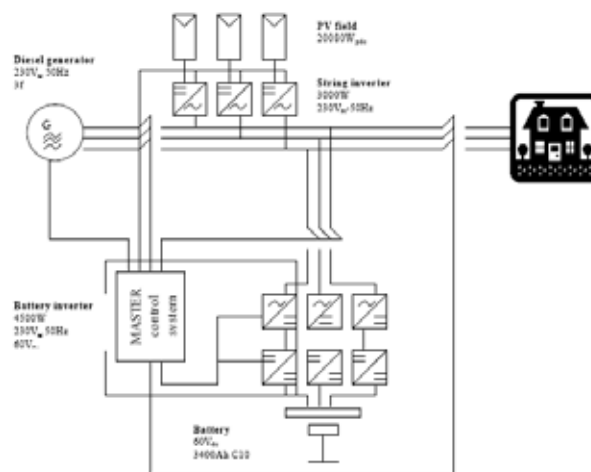


Figure 1: A general outline of solar village system

2.2 Solar Home System

Solar Home System was sized two typical systems, first one with PV generator of 350Wp, and second one with PV generator of 500Wp. Electrical loads supplied is the same for each type of systems, the power generated from PV systems is redundant like required from local people, in mode to offer at final customer the possibility to increase loads; the difference is the power availability to supply others eventual loads, at subject discretion like TV, videotape recorder, radio, others.

2.3 Pumping System

The possibility of use of the water resource, even if little in the region, by the use of pumping systems for the irrigation

can allow an attempt of diversification in the only present economic activity of the region, the sheep-rearing, permitting also an improvement of the environmental situation of the territory, highly being in the process of desertification. The solar-energy pumping unit is extremely simple and is constituted by an electric generator made with photovoltaic modular elements, a variable frequency power AC/DC conversion system, an electro-pump for the water pumping from the well, an accumulation tank, the supply pipes from the well to the accumulation tank, an electro-pump for the water distribution from the accumulation tank. The distribution pipe should be supplied by the end user, and are not included in the present specification. The limit of the supply is the accumulation tank. The following Figure 2 schematically shows an example of pumping system for the irrigation.

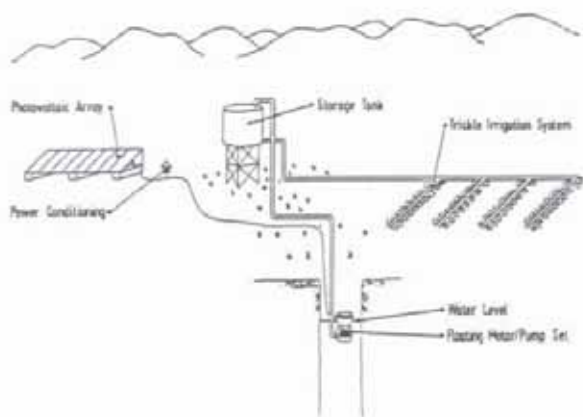


Figure 2: Pumping System for the Irrigation

3. OPERATING CONDITIONS

This project was finished at the beginning of 2005 after one and half years' preparation. Three systems are also can work well in one month after the system was installed successful. One month later after the system was installed Solar Village System and some of Solar Home System, which has energy storage system, can not offer sufficient electricity to user. Through detailed analysis of the investigation to the

system which can not work well, the result shows that the fault of battery is the main reason that system can not work well.

Under the variable sunshine surrounding off-grid PV system can supply continuously electricity to household by via of energy storage system to adjust power supply, as the energy system, the working performance of battery is very important, which will influence whether the system supply electricity to user or not. Low temperature condition and non-normal uses of system are the key of battery fault in this project. The appropriate measure was taken to the systems which can not offer sufficient electricity to user.

Up to now three systems operate well after the suitable measures were taken to improve the overall performance of the whole system.

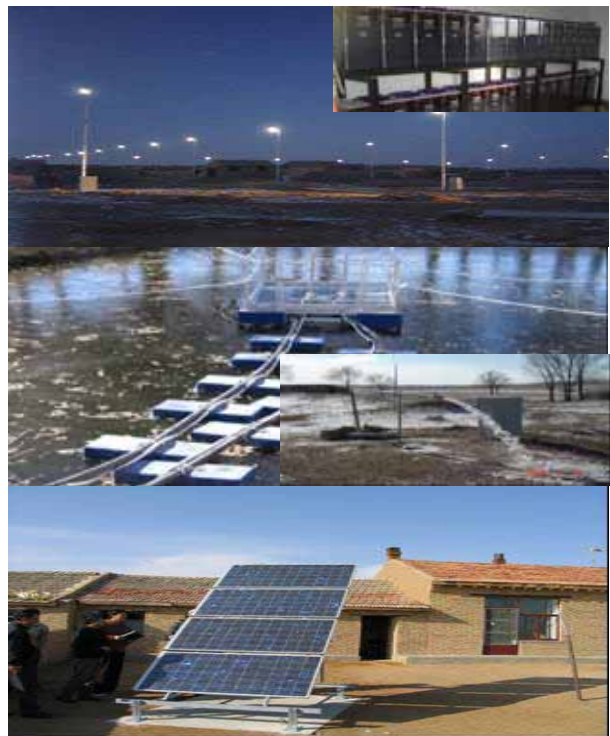


Figure 3: Three Systems of project

4. CONCLUSION AND SUGGESTION

After two years' preparation, one year's implement and three years' examination and test the project of solar village PV system in Inner Mongolia performed perfectly in Inner Mongolia although conditions were changing all the time, such as the SARS occurred in China in 2003, EniTechnology Company from Italy was restructuring in 2004 and so on during the six years.

The project of solar village PV system in Inner Mongolia has benefited more than 570 people in 13 villages after its execution. The problem of 37,000 domesticated animals' dysdipsia was solved and 53 acres land was irrigated by using the Pumping system. It is the first time that 151 households which located in the remote area can use the electricity to improve their living condition by using the Solar Home System. There are some suggestion which will be good to the implement of project cooperated by different countries.

(1) Start-up project

As an international cooperation project, set-up project planning at project start-up is to determine the critical project parts to guide project management. Weekly update report is necessary for all projects. On the other hand, fixed contact person and fixed contact method are also very important for the international cooperation project.

(2) As a new technology application, everything is new to the local people from remote area in Inner Mongolia. So Solar Home System of the project should be done from one point to the whole area. The process step by step will help the local people in the remote area to know the system.

(3) As a new technology application, Solar PV system is new to the local people from remote area in Inner Mongolia. Most of local people do not know how to use this kind of new system, which will affect the working performance and life of system. So the user of system should be trained about

how to use the system before the system was operated.



Figure 4: Training for user

(4) The battery is the main equipment that can guarantee the system well operation. According to analyse of fault in this project, the capacity of battery is the crucial factor whether can guarantee the system well operation or not, so battery should be chosen reasonable in order to adjust to the whole system, on the other hand the site that the battery was installed is also important, which will affect the working condition of battery leading to the use life of battery.

REFERENCES

- [1] G. Lesino, V. Nunes, R. Roman, "Sustainable Energy Supply to Isolated Communities to Enhance Productive Activities: First Year Advances" ISES 2005 Solar World Congress, Orlando, Florida, USA, August 2005.
- [2] Kpeith F. Principles of Solar Engineering. McGraw-Hill Book Company, 1978
- [3] G. Lesino, M. E. de Castel, V. Nunes, "Energy Supply to Rural Community Centers", ISES 2005 Solar World Congress, Orlando, Florida, USA, August 2005.