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Operational Experienced of a Grid-Connected Photo Voltaic Array

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Abstract. The Earth receives solar energy by way of radiated energy. Refers to quantum theory, light is made up of packets of energy, called photons, whose energy depends only upon the frequency or color of the light. In this research, evaluation of 3 PV modules technologies performed based on energetic points of view in 2011. The efficiency of the mono crystalline module field was calculated, the efficiency of the poly crystalline module field and the amorphous module field were calculated.

Keywords: photovoltaic, solar energy

Introduction The Earth receives solar energy (energy from the sun) by way of radiated (light) energy. Refers to quantum theory, light is made up of packets of energy, called photons (tiny particles having no mass), whose energy depends only upon the frequency or color of the light. The energy of visible photons is sufficient to excite electrons, bound into solids, up to higher energy levels where they are relative free to move so that an electrical current can be produce (Nelson, 2003). Life on Earth is based on solar energy. The outer limit of Earth's atmosphere receives almost a constant amount of radiation of 1352 W/m^2 , of which the 23% is absorbed by the atmospheric gases, 26% is reflected, so 51% reaches the Earth's surface in the form of direct or diffuse radiation. In Hungary, the number of sunny hours is 1900-2200 hours per year, the average irradiation intensity is around 1200 Kwh/m^2 . (Hagymássy and Fórián, 2009). The Sun emits electromagnetic light in various wavelengths: UV (<400 nm); visible (400-800 nm); infrared (>800 nm). (Rusirawan et al., 2011). Presently, the direct conversion of solar energy into electricity is being accepted as an important form of power generation. This electricity generated by a process known as the photovoltaic effect using photovoltaic (PV) system (cells/modules/panels/array), which are made from semiconductor materials. (Rusirawan and Farkas, 2011). **Aims and objectives.** Information's are given about the photovoltaic (PV) system main operational characteristics and operation experiences. In this research, evaluation of 3 PV modules technologies i.e. monocrystalline PV technology (ST-40), polycrystalline PV technology (KC-120), and amorphous silicon PV technology (DS-40) performed based on points of view energetic in 2011. The produced DC, and AC power, together with the produced energy are as well, and the efficiency can be determined for each used PV technology.

Material and Method. There is a demonstration center in the Department of Agricultural-machinery of Educational Research Center where students, teachers and those who interested get an overview of the topic of renewable energy potential and the necessary technological solutions. The total surface of 8.64 kWp grid-connected PV array system is $A=110 \text{ m}^2$. The PV system is structured into 3 subsystems (fields). The first subsystem has 24 pieces of Kyocera KC 120 W type modules, the second subsystem has 72 pieces of Siemens ST 40W, and the remaining has 72 pieces of Dunasolar DS 40W. In order to be operable independently of each other three inverter modules (SB 2500) had been installed. The

measured operating and meteorological dates are collected by Sunny Boy Control, produced by the SMA. The Sunny Boy Control has eight analogue and eight digital inputs and eight digital outputs. One of the eight analog inputs is used to measure the air temperature, and one of them measuring the Module temperature.

Results and Discussions. The amount of produced electrical energy is measured. The energy productions of the subsystems are measured continually and the subsystems are measured separately. As an expected, the produced energy of polycrystalline -Si PV module and monocrystalline -Si PV was higher than amorphous-Si PV module. It is well known that energy analysis is more suitable for energy balance when we design a system, because of this we contribute with the local entrepreneurs helping those designing systems.

The energy of a PV system depends on two major components namely electrical energy and thermal energy (Rusirawan, 2012). While the electricity is generated by photovoltaic effect, the PV cells also get heated due to the thermal energy present in the solar radiation. The air temperature and the temperature of the panels and the global irradiation conditions were measured. In summertime the panel temperature reaches 60-80 degrees in a sunny day. The panel temperatures are in a spring sunny day approximately 30-40 degrees. It can be concluded that the global irradiation is a major impact feature to influence the amount of energy produced.

The efficiency depends on several parameters (spectral distribution of the incoming light, temperature values, etc.). As the PV system is a multi-component system, the efficiency of the different parts can be calculated and the multiplication of these values provides the system efficiency. In our case not all the part efficiencies are determined, but calculations were carried out for the module efficiency and for the inverter efficiency. The time dependence of the efficiency during a month is calculated.

The energy efficiency of a PV system in general can be defined as the ratio of the output energy of the system to the input energy received on the photovoltaic surface. As an expected, the energy efficiencies of polycrystalline -Si PV module and monocrystalline -Si PV was higher than amorphous-Si PV module. Based on our study, in general it can be concluded that the energy efficiency is lower than theoretical.

Conclusion The data logging system of a 8.6 kWp grid-connected PV system were discussed in this paper, together with the details of the measured quantities. Based on measurements the distribution of the total energy production was presented together with the distribution of the energy production among the different subsystems. The energy productions of the subsystems are measured continually. By measuring irradiation and DC and AC power of the system, the efficiency of the two important parts of the system (the PV array and the inverter) were determined. The efficiency of the mono crystalline module field was calculated, the efficiency of the poly crystalline module field and the amorphous module field were calculated.

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