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SPV based water pumping system for an academic institution

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Abstract: This paper presents the water pumping system based on solar photovoltaic (SPV) to cater the need of water in an academic institution for various applications like irrigation, drinking, washing etc. In this paper a case study of Faculty of Engineering and Technology (FET), Jamia Millia Islamia, New Delhi, India is carried out. Presently water is pumped with the help of grid power supply resulting huge energy consumption. As solar water pumping has several advantages over conventional water pumping systems, apart from economical advantages, therefore an attempt has been made to develop SPV based water pumping system to meet daily water needs of the institute. A techno-economic analysis of SPV based water pumping system and comparison of proposed system with the conventional one is also discussed in this work.

Keywords: SPV System; Water Pumping System; Decentralized Application; Environmental Benefit

1. Introduction

Photovoltaic pumping systems provide a welcome alternative to grid power supply based water pumping systems or hand pumps. They provide the most water precisely when it is needed the most that is when the sun shines the brightest. The generation of solar electricity coincides with the normal peak demand during daylight hours in most places, thus justifying peak energy costs, brings total energy bills down, and obviates the need to build as much additional generation and transmission capacity as would be the case without PV Solar pumps. Advantages of using PV-powered pumps include low maintenance, ease of installation, reliability and scalability. A SPV water pumping system consist of a DC / AC surface mounted / submersible / floating motor pump set, electronics if any, interconnect cables, a on-off switch and a PV array mounted on a suitable structure with a provision of tracking. A SPV water pumping system is expected to deliver a minimum of 65000 liters per day for a 900 watts panel and 135000 liters per day for an 1800 watts panel from a suction head of 7 meters and total head of 10 meters on a clear sunny day. In case of deep well submersible pumps, the water shall be a minimum of 45000 liters from 1200 Wp. The discharge from the pump would vary with the intensity of the sunrays from morning till evening. India being a tropical country receives adequate solar radiation for 300 days, amounting to 3,000 hours of sunshine equivalent to over 5,000 trillion kWh. Almost all the regions in India receive 4-7 kWh of solar daily radiation per sq meters depending upon the location. In India there is an acute shortage of power. The per capita annual energy consumption of the country is hardly 779 kWh whereas world average is 2600 kWh. During last decade, a lot of industrialization took place in the country but growth suffered due to lack of power [1]-[2]. To bridging the gap between demand and supply, use of renewable resources is becoming important keeping in mind the environmental benefits. Major types of renewable energy sources include solar, wind, hydro and biomass, all of which have huge potential in India to meet future energy challenges. Solar power is one of the most promising and more predictable than other renewable sources and less vulnerable to changes in seasonal weather. Generation of power from other renewable sources is limited to sites where these resources exist in sufficient quantities whereas solar energy can produce power at the point of demand in both rural and urban areas [3].

A review of solar water pumping systems is presented for Palestine [4]. Feasibility analysis is carried out for solar water pumping systems. In this paper the water pumping system is proposed at low cost. In addition, the information about the conventional pumps is also presented.

PV water pumping systems for energy conservation is also presented [5]. Two pumps of 7.5 kW total 15 kW were replaced by solar PV pump to lift the water. Operating the PV pump for only 10 hours in a day yielded a net saving of