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SOLAR WATER PUMPING SYSTEM

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Abstract - *Agricultural technology is changing rapidly. Farm machinery, farm building and production facilities are constantly being improved. Agricultural applications suitable for photovoltaic (PV) solutions are numerous. These applications are a mix of individual installations and systems installed by utility companies when they have found that a PV solution is the best solution for remote agricultural need such as water pumping for crops or livestock. A solar powered water pumping system is made up of two basic components. These are PV panels and pumps. The smallest element of a PV panel is the solar cell. Each solar cell has two or more specially prepared layers of semiconductor material that produce direct current (DC) electricity when exposed to light. This DC current is collected by the wiring in the panel. It is then supplied either to a DC pump or AC pump (after conversion), which in turn pumps water whenever the sun shines use by the pump. The aim of this article is to explain how solar powered water pumping system works and what the differences with the other energy sources.*

Key Words: Solar Panel, Centrifugal Pump, Inverter, MOSFET.

1. INTRODUCTION

A solar energy-powered water pump is a water pump running on the electricity that is generated by solar photovoltaic modules. Solar photovoltaic (PV) systems can be an attractive complementary energy source deployed alongside diesel pumps in areas with plenty of sunshine and where the cost to run power lines is high. Photovoltaic systems have the benefit of being scalable, with capacity ranging from a few watts for applications such as automated farm gates or timers, to hundreds of kilowatts for the homestead and farm sheds. Rather than having one large centralized system, a number of distributed PV systems can be deployed at pump sites.

Solar pumping systems are best suited for transfer operations (to pump water out of bore, for instance, or transfer it from dam to storage tank) in which pumps run continuously for most of the day. Applications that require water to be pumped at night are not as well suited to solar-powered pumps, as storage solutions such as batteries and storage tanks can add significantly to the cost of the system. Although these energy storage solutions can be expensive, they allow for greater utilization of the PV system. Depending on the application, stocked water can be fed by gravity when there is insufficient sunlight to power the solar pumps, thus reducing diesel consumption further. Due to the high capital costs that are still associated with solar systems, simple paybacks of seven to eight years are generally achievable only where pumping currently occurs for more than half the year. These costs are expected to reduce over the coming years as price reductions occur within the solar PV and commercial battery storage industries.

1.1LITERATURE REVIEW

1.1.1. System Overview

Photovoltaic water pumping system are comprised of various segments. There is a photovoltaic array which changes over solar energy straight forwardly into electricity as DC. The pump will have an electric motor to drive it. The attributes of these segments should be coordinated to get the best performance. The pump motor unit will have its own particular ideal speed and stack contingent upon the sort and size of the pump. Motor can be DC or AC. On the off chance that an AC motor is utilized then an inverter is likewise required. Ac motors are all the more broadly accessible. Inverters have gotten to be modest and proficient and solar pumping system use exceptional electronically controlled variable-frequency inverters which will improve coordinating between the panel and the pump. The most effective kind of DC motor is a permanent magnet motor, These are getting to be mainstream in solar pumping system. All present day, commercial PV devices use silicon as the base material, basically as mono crystalline or multi-crystalline cells, however all the more as of late additionally in amorphous structure. Different materials, for example, copper indium diselenide and cadmium telluride are being produced with the point of decreasing expenses and enhancing efficiencies. An array can change from maybe a couple modules with a yield of low or less, to an immeasurable bank of a few kilowatts or even megawatts.

2. Control Technique/ Method/Strategy

Ideas identified with the sun oriented vitality have always been under overwhelming innovative work. The essential goal is to improve the vitality delivered from photovoltaic cells, by making the general frameworks more productive and cost effectives. Here different processes are proposed to achieve the efficient water pumping system followed by technology regarding to its system components. The framework involves the accompanying parts:

1) Photovoltaic panels
2) DC/DC converter
3) DC/*AC* inverter
4) Induction motor
5) Centrifugal pump.

Powerful execution of photovoltaic evaluating so as to pump system is done a few control methodologies and enhancement procedures. They identified with the outline of the step-up converter and improvement of the induction motor productivity. Concerning converter design, They have demonstrated that when the dc-transport differs with accessible power, it is conceivable to enhance its proficiency. For induction motor control, three sensorless alternatives methods are discussed, also shown that Indirect Field Oriented Control method combined with the q-axis voltage model was the most stable at start-up. Another point explained is power factor optimization with feedback loop, which demonstrates the best arrangement as far as pumping system effectiveness. At the point when utilizing balanced current, it is not important to set any reference value, which results in a less complex plan than power factor modification on the grounds that it needs a reference esteem that is difficult to figure over the entire working reach. It was impractical to apply an inquiry calculation effectively because of autonomous nature of solar radiation. There are favorable circumstances in maintaining a strategic distance from the utilization of expansive banks of lead acid batteries, which are overwhelming and costly and have one fifth of the lifetime of a photovoltaic panel. It is critical, that the absence of batteries does not bargain the effectiveness of the end-to-end power conversion chain, from panels to mechanical pump. Hybridization through combining photovoltaic and fuel cell energy sources in one supply system. The system displayed is a water pumping system without battery module, utilizing a six-step inverter to change the frequency and track the crest power of the PV exhibit. With batteryless system, the power produced by the PV Array must be utilized totally to pump the water; thus, the water capacity tank can be utilized as a circuitous vitality stockpiling gadget. The extent of the capacity tank ought to be contingent upon size of the PV Array and the yearly local sunlight based radiation level. Here, peak power tracking is done by utilizing the dc-ac inverter. Another work of inverter is to conform the frequency of the induction motor to change for the peak power output of the PV array, in the nonappearance of battery, the voltage across the dc bus might fall when there is an uneven information yield power relationship in the dc bus. Along these lines, the control of the system is more confounded than that for the system with a dc battery on the dc bus. Here to build the output of the water pump, the speed of the water pump is expanded by modifying the frequency of the inverter is recommended. The output of the inverter is variable frequency ac which is done by operating the six-step square wave inverter, furthermore utilizing the inverter as the peak power tracker, the quantity of switches and the switching losses can be minimized. The output power of the PV Array, the dc voltage, and the dc current are nourished back to the controller, to change the frequency yield of the inverter and keep the system working at a maximum power point tracking.

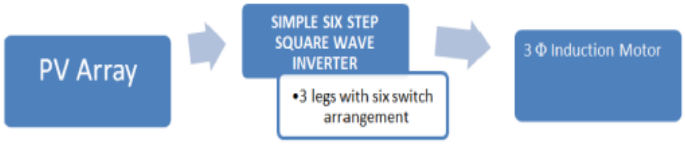

Fig-1: Six step square wave inverter

3. PROBLEM IDENTIFICATION

Mostly, the batteries utilized as apart of framework have a low life time, about two years, which is to a great degree low contrasted with the helpful existence of 20 years of a PV module. Also, installation and upkeep of such frameworks make the expense considerably high. Besides, if there should arise an occurrence of crisis the absence of battery swap is in charge of the disappointment of such frameworks in separated ranges.

The large portion of business frameworks utilize low voltage dc motors, consequently keeping away from a support stage between the PV module and the motor. Unfortunately,dc motors have lesser effectiveness and highest upkeep prize contrasted with affectation motors and are not best choice for applications in detached zones, where there is no master staff for working and keeping up these motors. Another issue is that low-voltage dc motors are not standard things in the nearby markets. We can supplant these motors by Permanent Magnet DC motor or (PMSM) however these are minimal unreasonable. While contemplating converter topology it is found that the majority of framework comprise of isolated voltage-fed converters which have a high input current ripple, it forces to utilize extensive data filter capacitors in framework & regularly they are electrolytic, which have a little lifetime , it straightforwardly influence general life time of converter. Also voltage-fed converters have inherent step-down characteristic, for this huge transformer turns proportion expected to support the output voltage, the high output diode voltage stress, and the interest of a LC output filter make it to fee I that as second decision for this application. Comparatively, current-fed converters have some advantage. As they have an inductor at the input, which has tendency to have data current ripple as low as required, in this manner precluding the need of the input capacitor at the board voltage, they are picked up from the boost converter, having a basic high step-up voltage ratio, which dispose of the required transformer turns ratio. To ensure the maximum utilization of the available energy dc/dc converter with a higher voltage transformation ratio is suggested. It is due to the low-voltage property of the PV panels and small input current ripple so that it does not oscillate over the maximum power point (MPP) of the PV module.

2.1 Working

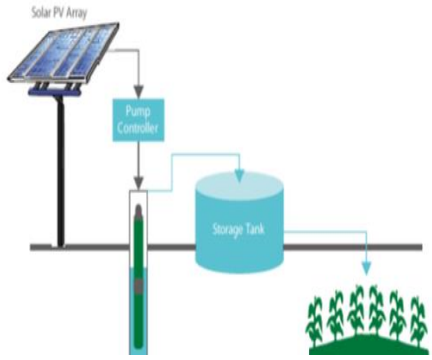

Fig-2: Solar water pumping by using photovoltaic system.

The figure shows the simplified diagram of solar water pumping system. The energy from the sun is converted into the electrical energy in the form of DC voltage which fed to the battery and inverter at same time. Battery store this energy and inverter convert this DC voltage into AC voltage, which is input to the AC pump. Inverter is required between the PV panel and the motor to convert from the direct current generated by the solar panel to the alternate current required by the electric pump motor.

System components:

Photovoltaic array: An array of photovoltaic modules connected in series and possibly strings of modules connected in parallel.

Controller: An electronic device which matches the PV power to the motor and regulates the operation, starting and stopping of the PVP. The controller is mostly installed on the surface although some PVPs have the controller integrated in the submersible motor-pump set:

A. DC controller: usually based on a DC to DC controller with fixed voltage set point operation.

B. AC controller (inverter): converts DC electricity from the array to alternating current electricity often with maximum power point tracking.

Pump: The most common pump types are the helical rotor pump (also referred to as progressive cavity), the diaphragm pump, the piston pump and the centrifugal pump.

CONCLUSION:

From above discussion it has been cleared that Non-conventional energy sources degraded day by day, so it's mandatory to move conventional energy sources like solar, wind, tidal, etc. For that purpose we used solar energy to produce electricity to run the pump.

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