International Journal for Innovative Engineering and Management Research

PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL

www.ijiemr.org

IJIEMR Transactions, online available on 07th Nov 2023. Link :http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue11

10.48047/IJIEMR/V12/ISSUE 11/14

TITLE: Design of Solar Water Pump using PVSYST Software

Volume 12, ISSUE 11, Pages: 115-118

Paper Authors **Dr.K.Ranjith Kumar1, Mr.Nagaraju Budidha2, Mr.K.Prakash Chary**

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Design of Solar Water Pump using PVSYST Software

Dr.K.Ranjith Kumar[1], Mr.Nagaraju Budidha[2], Mr.K.Prakash Chary[3]
[1, 2 & 3] Asst. Professor in EEE Dept., Vaagdevi College of Engineering

ABSTRACT
While farmers continue to rely on conventional irrigation methods, India's demand for water for agriculture, livestock, rural areas, and irrigation continues to rise daily. However, due to its long product life and low maintenance costs, solar photovoltaic water system pumping (SPVWPS) is an appealing alternative for irrigation and other purposes in rural areas due to rising fuel and electricity costs. Using PVSYST software, the goal of this study is to design and simulate an SPVWPS. The area of Bollikunta close to Warangal region in Telangana, India, (17.8896° N, 79.6151° E) was chosen for the contextual analysis and simulation. The SPVWPS system is affected by a variety of performance parameters, including temperature and global and diffuse irradiation. As a result, solar photovoltaic water system pumping may be able to meet India's rising water demand for livestock, agriculture, rural areas, and irrigation.

Key words: Solar PV Water Pump, PVSYST and Irradiation.

1. Introduction

In developing nations, the issue of inadequate water supply has emerged as a pressing concern as a result of the rapid increase in population [1]. Additionally, the need for renewable energy sources has been emphasized as a result of the depletion of fossil fuels. In this unique situation, sun powered water pump frameworks have arisen as a critical answer for tending to the flow water supply difficulties. Sun based controlled water pumps have acquired expanding prominence because of their capacity to outfit spotless and feasible energy. In nations like India, the interest for water in regions, for example, water system, animals cultivating, provincial networks, and horticulture is consistently rising. Notwithstanding, regular water system strategies vigorously depend on fuel and power, bringing about raising expenses. Additionally, the lack of grid connections in many rural areas makes solar-powered water pumping systems an appealing alternative [2].

These frameworks offer long item life ranges and low support costs, making them financially suitable over the long haul. This presentation will focus on using PVSYST software to model and simulate a solar-powered water pumping system. With the end goal of this contextual analysis, the town of Bollikunta close to Warangal region in Telangana, India was chosen as the area (arranges: 17.888 N, 79.6151 E). By leading reproductions and investigating the information, this study means to exhibit the effect of different boundaries on framework execution, including worldwide and diffuse radiation levels, as well as temperature changes [3].

Manufacturers frequently depend on standard framework setups or their own restrictive ways to deal with dissect the presentation of sun based water pumpss over the course of the day. A software tool known as PVSYST has been created to address this issue. PVSYST is versatile and can be used for the design analysis of a variety of systems, including water pumping systems, grid-connected systems, and standalone systems. It also assists in the pre-sizing of solarwater pumping systems and provides detailed reports on system performance and efficacy [4].

PVSYST has a number of features and functions that make designing and analyzing solar water pumping systems easier. The product's reproduction capacities empower exact displaying and recreation, considering boundaries like sun-oriented radiation, temperature

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

varieties, and framework arrangement. In addition, PVSYST provides comprehensive reports on energy production, efficiency, and water delivery rates, allowing users to evaluate the system's effectiveness. In addition, the software aids in the proper sizing of system components to guarantee compatibility and optimal resource utilization [5].

II. Solar PV Water Pump

An environmentally friendly method for pumping water is the Solar Photovoltaic Water Pumping System. Figure 1 addresses the schematic of SPVWPS.

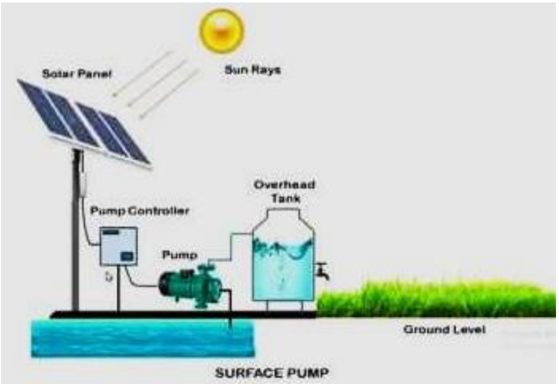

Figure 1 schematic of SPVWPS

The primary components of a system are a solar PV panel, pump controller (MPPT), centrifugal surface pump, storage tank, and pipes.

1). PV solar panel: PV panels come in a variety of shapes and sizes, including monocrystalline, polycrystalline, thin-film, and bi-face varieties. Bi-facial is a recent fad for sun powered PV board which is more efficient similarly [10]. For the water pump, the choice of PV board relies on everyday water prerequisite, the efficiency of the pump and so on.

2). Controller for maximum power point tracking (MPPT): The point of MPPT is to move the greatest power from the PV framework to stack utilizing various calculations [11]. The input impedance ought to be the same as the net impedance of the solar modules in order to achieve maximum power transfer.

3). Surface centrifugal pump: It is used to raise a liquid from a low level to a high level or to cause flow. Using a motor, it turns rotational energy into energy in a moving fluid. Pipes for storage tanks can be chosen based on the user's requirements. The friction losses change and are not the same for a different kind of pipe material. friction losses are also the result of elbows in the pumping system.

III. Solar PV Water Pump Design

Sunlight based water pump is to be planned here utilizing PVSYST 7.4. The geographical Meteo-database will choose the simulation's starting point. The coordinates of the district Warangal in the state of Telangana are used for the solar pump design in this study. Plane direction in which slant point and sort of plane assumes a vital part to enhance sun powered energy.

Step 1: Calculate the amount of water needed/day

- Total amount required per day=30*40=1200 m^3/day

Step-2: calculate flow rate of water in m3/hour

Assume number of peak sun hours=5

Water flow rate (Q)=1200/5=240 m^3/hour

Step-3: calculate pipe diameter

- Pipe diameter= 10 inches

Step-4: calculation of Total Dynamic Head (TDH)

TDH=static head +suction head+ friction losses

static head +suction head=40+7=47 m

$$h_f = 10.67 \left(\frac{Q_{m3/s}}{C}\right)^{1.852} \frac{L}{D^{4.87}}$$

Q=Flow rate in m3/s
D:pipe diameter in m
L:length of pipe in m
f:friction factor
C:Hazen-William coefficient
Assume C=140 and L=150 m
Flow rate Q=240 m3/hour
Q=240/(60*60) =0.06667 m3/s

D in meters: converting inch into meters=0.254 m
1 inch=2.54 cm
By substituting all the values, we will get friction losses=0.297 m
Therefore
TDH=47+0.297=47.297 m

Step-5: calculate required pump power

$$Power\ in\ kW = \frac{0.002725 \times TDH \times Q}{Pump\ effciency}$$

TDH in m and Q in m3/hour
TDH=47.297 m
Q=240 m3/hour
Efficiency=85%
Therefore, power required=36.39 kW
Convert to HP by dividing 746 watt
HP=36390/746=48.78=50 HP required
Motor will be 50 HP which is equal to 37.3 kW
Assuming inverter efficiency =85%
Therefore inverter power required = 37.3/0.85= 43.88 kW=45 kW
So solar panels required = 45 kW
We will use 250 W, 30.53 V and 8.19 A panel
Number of panels=45000/250=180 panels
Rated current=71 A, so number of parallel strings= 71/8.19=8.669 =8
We will chose lower value in order to not exceed 71 A
Number of panels in each string = 180/8=22.5 or 23 panels in each string
Voltage in each string=23*30.53=702.19 V
Power produced=250*8*23=46 kW

IV. Results

The sunlight based photovoltaic water pump framework was intended for the horticulture purposes and to fulfil the water necessity 1200 m3/day with a profound well to stockpiling type framework at a well static profundity of 47 m. According to the need, choice of pump with a legitimate head, determination of PV module and MPPT regulator is done likewise and further, the impact of various boundaries on SPVWPS has been examined. The following figures shows the step by step simulation procedure of solar water pump design.

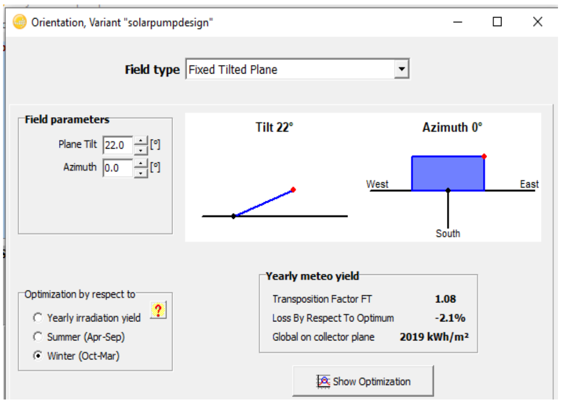

Figure 2 Orientation of solar panel according to chosen location

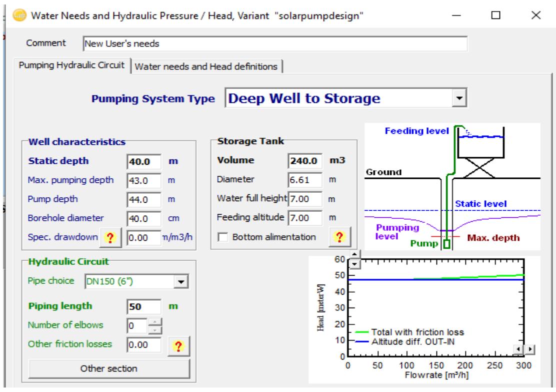

Figure 3 Hydraulic details

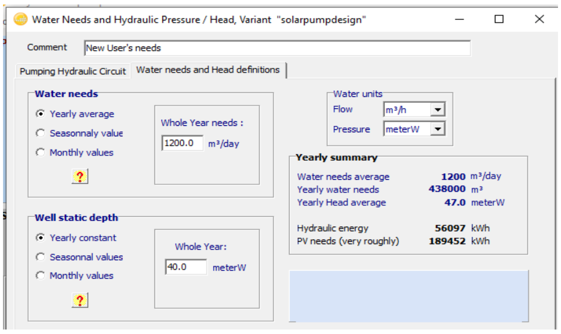

Figure 4 water needs

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

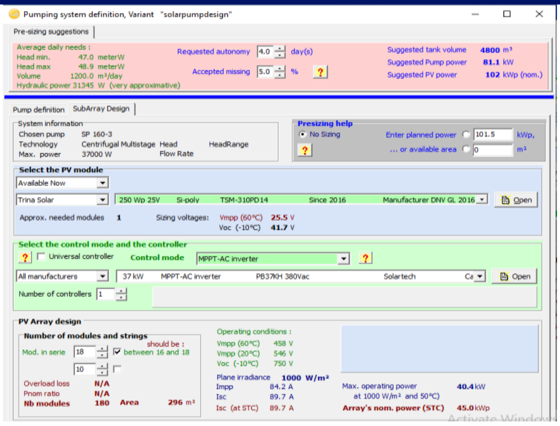

Figure 5 PV Design

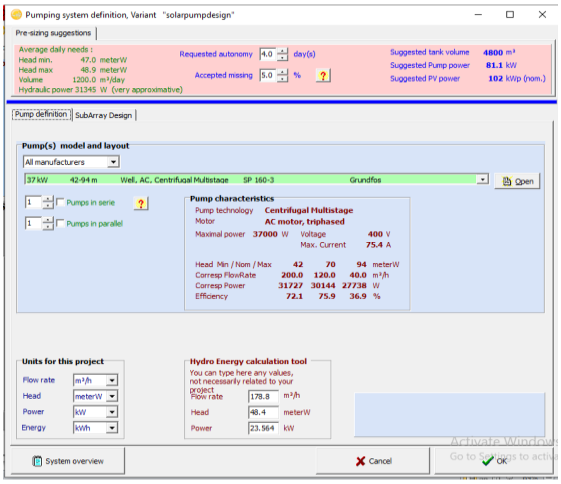

Figure 6 Pump Design

V. Conclusion

There should be an alternative to conventional water pumping methods as the demand for water continues to rise and fossil fuels run out. This work has proposed a technique by PVSYST to plan a sunlight based photovoltaic water pump which works at an efficiency of 59.3 % and performance ratio of 0.494. Water necessity is 438000 m3/year and water pump is 417256 m3/year consistently. Therefore, there is a loss of water of 20744 m3/year, or 4.7 percent throughout the year. The design of SPVWPS with the fewest losses, the reduction of water loss, improvement of the performance ratio of stand-alone SPVWPS, and other goals are the focus of future work.

Reference

[1]V. C. Sontake and V. R. Kalamkar, “Solar photovoltaic water pumping system - A comprehensive review,” Renew. Sustain. Energy Reviews, 2016, vol. 59, pp. 1038–1067.

[2]T.P. Correa, S.I Seleme and S.R Silva, "Efficiency optimization in stand-alone photovoltaic pumping system", *Proceeding of International Conference on Renewable Energy*, vol. 41, pp. 220-226, May 2012.

[3] H. Singh, B.K Saxena and K.V.S Rao, "Performance Study of a Solar Photovoltaic Water Pump used for Irrigation at Jaipur in Rajasthan India", *Proceeding of International Conference on advancements in Power and energy Tap Energy IEEE*, pp. 1-6, 2017.

[4] M. Saputra, A. Syuhada and R. Sary, "Study of Solar and Wind Energy Using as Water Pump Drive-Land for Agricultural Irrigation", *Proceeding of 4th International Conference on Science and Technology (ICST) IEEE 2018*, pp. 1-4.

[5]R M Moharil and P S Kulkarni, "Design and performance of Solar photovoltaic water pump", *Proceeding in Journal of Institution of Engineers (India)*, pp. 25, 2005.