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Designing and Analysis of Pumping Solar Pv System Using Pvsyst Software

G Divya Teja[1], N Mahesh Kumar[2] and G Vishnu Pramod Teja[3]

[1]*M.Tech Student, Department of Mechanical Engineering, Sri Venkateswara College of Engineering and Technology, Srikakulam Dt. 532001, Andhra Pradesh, India.*
[2] *Associate Professor & HOD, Department of Mechanical Engineering, Sri Venkateswara College of Engineering and Technology, Srikakulam Dt. 532001, Andhra Pradesh, India.*
[3] *Guest faculty, Department of Mechanical Engineering, College of Engineering, Dr. B. R. Ambedkar University, Srikakulam Dt. 532001, Andhra Pradesh, India.*
Corresponding Author: G Divya Teja

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ABSTRACT: Solar energy is radiant light and heat from the sun that is harnessed using a range of technologies such as solar power to generate electricity. In the Present study of UT Agro Farms Pumping PV system are taken at Turakapeta, Amadalavalasa Mandal of Srikakulam district, Andhra Pradesh, India and accordingly design and analysis in the PVsyst V 6.81 Software. Analysis of Performance ratio and losses were done using PVsyst V 6.81 Software. From the obtained results, the average annual water requirement in the UT Agro Farms is 4380m^3 and the water pumped is 4248.3m^3, whereas drawn by user is 4250.5m^3 a little less than the required load. The performance ratio analysis reveals that the highest PR was recorded in the month of July is 67% and lowest PR, 44% was obtained in the month of February, whereas the average PR for year is 52.1% for Pumping PV system.

KEYWORDS: Solar energy, Pumping PV system, Performance ratio and losses.

I. INTRODUCTION

Pumping PV systems is widely used in now a days to fulfil the demand of water in field of irrigation and livestock watering. The design of the system using simulation software helps to get the best result from available resources. Software results help to rectify problems of the system before on field installation. Many software packages are available which give a platform to design the balance of system for solar photovoltaic (PV) water pumping system (SPVWPS). In the PVsyst software package designing process of system is easy and its comprehensive design process also includes explanation for each component using graphs.

Economic growth of any country is driven by its sources of energy. Globalization and industrialization has led to depletion of non-renewable sources of energy. All countries are now looking for alternate sources of energy, among them solar energy is the one source and its harnessing is growing around the world. The total energy that can be intercepted from sun is 1.8 × 1011 MW, much more than what is required by humans on the earth for their consumption. Moreover, it is a clean and reliable source of energy that has the capability to meet the future needs. Solar energy can be utilized directly, into thermal and photo voltaic energy, as well as indirectly into water power, biomass, wind, wave energy, ocean thermal and marine currents [1].

Harnessing of solar energy has great scope in India. Out of total installed renewable energy, 87669MW till 30th June 2020, solar energy has a share of 34811.78MW till April 2020 [2].

Rakhi Sharma et al. [3] designed the solar PV water pumping system is done by simulation software tool PVsyst 5.52. This simulation software helps to design the system and shows how the different parameters affect the system performance results. Selection of PV array, controller, pumping unit, water supply network is needful to fulfill design requirements. The performance evaluation of a system located at Karansar, Jaipur (Rajasthan) is done with help of simulation software by using existing local data. The theoretical and simulation results are used to understand the system design and its performance by taking different parameters into consideration.

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From the literature review, it is understood that a few research work was focus on both Stand-Alone and Pumping PV system using PVsyst V 6.81 Software. Hence, this research study mainly focused on Pumping PV system using PVsyst V 6.81 Software to find performance ratio and system losses.

II. PVSYST SOFTWARE

PVsyst is simulation software that was first of all designed in Geneva that was first of all designed in Geneva and helps in calculating the working and operations of PV system. This software helps in designing the configuration of the system and also enables to calculate the amount of energy generated. The output is based on the simulation of the sizing system which further depends mainly on geographical site location of PV system. Results may include several simulation variables that can be displayed in monthly, daily or hourly values. The ‘‘Loss Diagram” predicts the weaknesses in the system design. Simulation in PVSyst for Pumping is carried out in following steps.

i. Defining the Project:

Different sites and metro files are already present in the PVSyst databases but one can create his own projects depending upon the location of the site and metro files that are to be used.

ii. Creating a system variant:

Calculation version of the project created in step 1 is created by the user. Module orientation, system configuration and loss parameters are to be defined by the user.

iii. Running the simulation:

Simulation generates different graphs and reports for the PV system. The user can analyse the results in the program, export them to a different program or save the results for further evaluation.

III. PUMPING PV SYSTEM DESIGN

Pumping systems work on solar pumping unit, solar modules, controller and inverter as main components.

i. Geographical location

The pumping PV systems geographical location taken at UT agro farms Turakapeta, Srikakulam Dt. (AP) lies between 18.44^0 latitude and 83.85^0 longitude with altitude is 31m is given to PVsyst software.

ii. Tilting of solar module

The filed structure is a fixed tilted plane of tilt 28^0 and plane orientation azimuth 0^0 as shown in fig. 1. The optimization is done for whole year with respect to optimum loss zero percent and energy collector on plane is 1930 kWh/m^2 as shown in fig. 1.

fig. 1. Module orientation and tilt angle

iii. Designing

A. Water needs

The specification of the solar pumping unit is shown in the table.1. It gives to the PVsyst Software.

B. System configuration

The specification of a PV module system shown in the table 2.

The universal controller V DC-AC converter of 1000W and 24V is used to Solar Pumping PV system. It changes to the DC to AC.

Details of Pumping system	
Company	Shakti
Type of pump	Centrifugal Multistage submergible
Specification about motor	AC Motor, Triphased
Volume of storage tank	$14m^3$
Diameter	2.99m
Height	2.00m
Feeding altitude	2.00m
Total length of pipe	35m
. **Size of pipe**	1”
Borewell diameter	10cms

Table 1 Details of Pumping system

Details of PV modules	
Brand	Vikram Solar
Model No	Eldora Grand
Material	Silcion
Type	Polycrystalline
No. of cells	72
Solar Power	330W
Output Voltage	32V
Length	1956mm
Width	992mm

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Weight	19.5 kg

Table 2 Details of PV modules

C. Detailed losses

The losses give to PVsyst software in the thermal parameters select the "default option free mounted module with air circulation" is selected and yearly soiling losses gives 2%.

D. Horizon and Near shadings

The horizon portion gives by the software is shown in the fig and it is shows how much value the sun is really accessible and design the Photovoltaic components in near shadings in the PVsyst software is shown in the fig. 2. and 3.

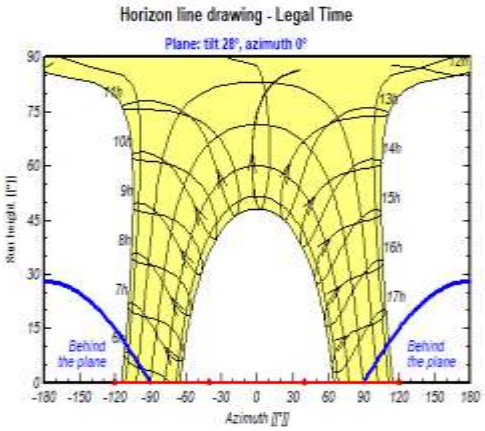

fig. 2. Horizon

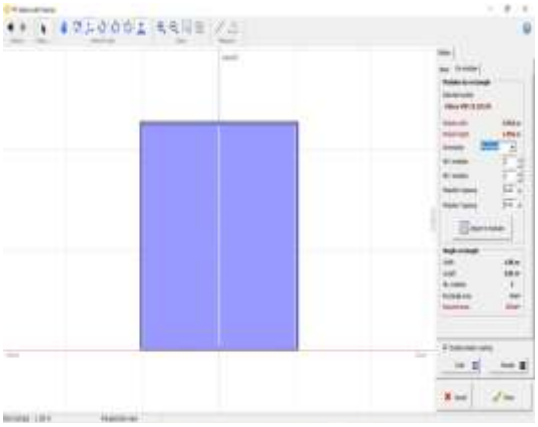

fig. 3. Near shadings

iv. Simulation

Running the simulation in the PVsyst Software it generates the results such as Solar yield, Performance ratios and system losses.

IV. PVSYST RESULTS

The system efficiency is 61.7%. The average annual water requirement in the UT Agro Farms is 4380m^3 and the water pumped is 4248.3m^3, whereas drawn by user is 4250.5m^3 a little less than the required load shown in the table. 3.

The performance ratio analysis reveals that the highest PR was recorded in the month of July is 67% and lowest PR, 44% was obtained in the month of February, whereas the average PR for year is 52.1% for Pumping PV system shown in the graph.

	GlobEff kWh/m²	EArrMPP kWh	E_PmpOp kWh	ETkFull kWh	H_Pump meterW	WPumped m³	W_Used m³	W_Miss m³
January	177.7	104.7	56.28	29.50	29.06	372.7	369.2	2.79
February	169.0	99.1	50.45	31.87	29.15	336.0	336.0	0.00
March	176.4	102.4	54.80	29.16	29.04	359.8	359.8	12.20
April	165.1	96.1	54.58	26.95	29.06	360.0	360.0	0.00
May	151.5	88.3	57.61	20.70	28.89	370.4	370.6	1.39
June	117.3	69.3	53.60	7.79	28.66	329.1	336.6	23.39
July	113.9	67.4	52.60	6.90	28.71	324.6	317.8	54.19
August	125.3	74.3	56.56	9.34	28.74	353.9	360.9	11.07
September	134.4	79.2	56.60	11.92	28.84	360.4	352.4	7.57
October	152.7	89.5	56.07	19.75	28.91	359.7	360.2	11.78
November	160.4	94.2	53.63	24.88	29.07	355.2	354.9	5.15
December	174.8	103.0	55.67	29.78	29.06	366.5	372.0	0.00
Year	1818.4	1067.4	658.45	248.54	28.92	4248.3	4250.5	129.52

Legends:
GlobEff Effective Global, corr. for IAM and shadings
EArrMPP Array virtual energy at MPP
E_PmpOp Pump operating energy
ETkFull Unused energy (tank full)
H_Pump Average total Head at pump
WPumped Water pumped
W_Used Water drawn by the user
W_Miss Missing water

Table 3. Yearly equalizations and fundamental results of pumping PV system

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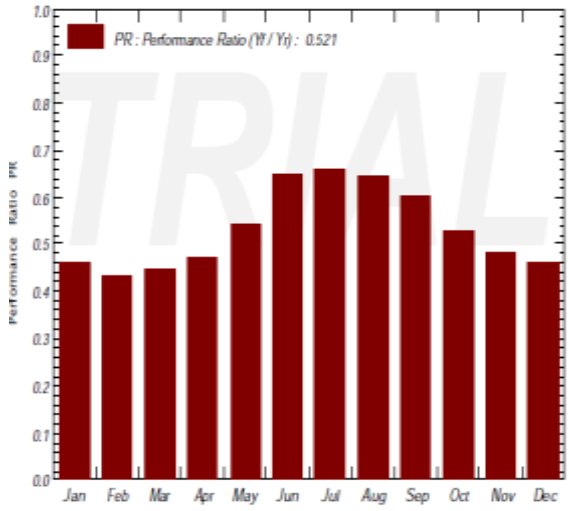

Graph. Performance ratio

Loss diagram helps to identify quality of solar pumping system design. Different losses are indentified in the loss diagram. The loss diagram shows fig. 4.

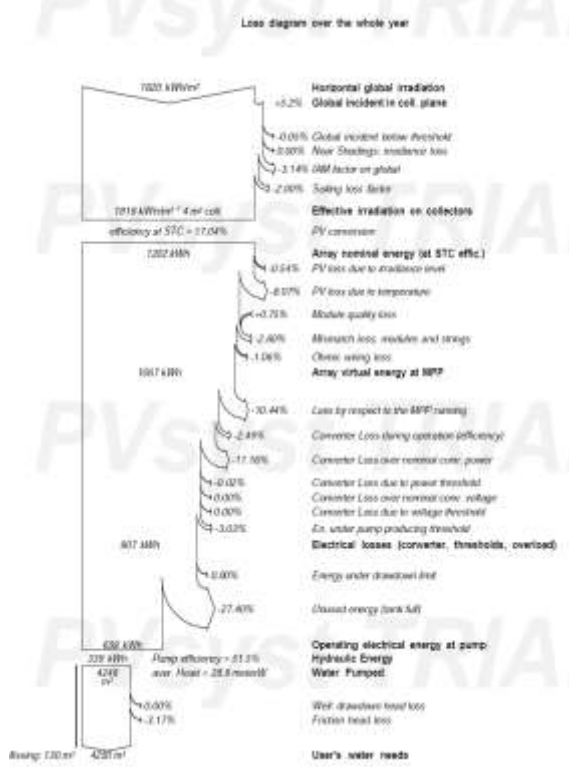

fig. 4. Loss Diagram

V. CONCLUSIONS

The aim of the project is to study the major vital parameters namely performance ratio and system losses for Pumping PV system using PVsyst V 6.81 software.

- The average annual water requirement in the UT Agro Farms is 4380m^3 and the water pumped is 4248.3m3, whereas drawn by user is 4250.5m^3 a little less than the required load.
- The performance ratio analysis reveals that the highest PR was recorded in the month of July is 67% and lowest PR, 44% was obtained in the month of February, whereas the average PR for year is 52.1% for Pumping PV system.

- Pre-design development using software helps to get predictions about possible outcomes for real time system.

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