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Experimental Investigation of Standalone PV System Using PVsyst Software

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ABSTRACT

Solar energy has become one of the most popular renewable energy processes. The Present study of load requirement of UT Agro Farms Stand-Alone PV system is taken at Turakapeta, Amadalavalasa Mandal of Srikakulam district, Andhra Pradesh, India and designed accordingly and analysed 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 energy requirement in the UT Agro Farms is 919.80 kWh and the energy available through solar panel is 1015.2 KWh, whereas energy supplied to the user is 781.13 kWh a little less than the required load.. The reduced power capacity of the system is happened due to different kinds of losses, The performance ratio analysis reveals that the highest PR was recorded in the month of June is 71% and lowest PR, 57% was obtained in the month of March, whereas the average PR for year is 61.8% for Stand-Alone PV system.

KEYWORDS: *Solar energy, Design, Software of PVsyst, Standalone, Performance ratio and losses*

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1. INTRODUCTION

A Standalone PV system is widely used in present days. The design of the system, using simulation software, helps to get the best result from the available resources. Software results help to rectify problems of the desired needs of the system before field installation. Many software packages are available which give a platform to design the balance of system for solar photovoltaic standalone system (SPSS). The PVsyst software package and the process of designing system is so easy and comprehensive. The design process also includes explanation for each component by 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. Most of the countries are now looking for alternate sources of energy as the stocks are going to be exhausted, Among them solar energy is the one of the source and its harnessing is growing to use around the world. The total energy that can be obtained from the sun is 1.8 × 1011 MW, which is much more than what is required by humans on the earth for their regular consumption. Moreover, it is a reliable source of energy that has the capability to meet the future needs. Solar energy can be utilized directly and converted into thermal and photo voltaic energy, as well as indirectly into water power, biomass, wind, wave energy, ocean thermal and marine currents [1].

In India there is a great opportunities and scope to harness the solar energy. Out of total installed renewable energy, 87669MW till 30th June 2020, solar energy has a share of 34811.78MW till April 2020 [2].

Ravi Kumar et al. [3] Studied the load requirement in mechanical department office of an engineering college, Bikaner and accordingly, designed and installed the standalone solar PV System. Analysis of performance ratio and losses has also been estimated

and suggested by using PVsyst simulation software. The average annual energy requirement in the studied office is 1086.24 kWh and the energy available through solar panel is 1143.6 KWh, whereas energy supply connected to the user is 1068.12 kWh, a little less than the specified load. The performance ratio analysis reveals that the highest PR was recorded in the month of December is 86% and lowest PR, 64% was recorded in the month of April, whereas the average total PR for year is 72.8%. The reduced power capacity of the system is happened due to different kinds of losses.

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

2. 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 and the configuration of the system and also enables to calculate the amount of energy generated by the PV module. The output is based on the simulation of the sizing system mainly depends on geographical site location of PV system. Results may include several simulation variables that can be displayed in hourly, daily or monthly values to calculate. The ‘‘Loss Diagram” emphasis the weaknesses and suggests the alternations in the system design. Simulation in PVSyst for standalone is carried out in following steps.

A. 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 meteo files that are to be used.

B. CREATING A SYSTEM VARIANT:

Calculation version of the project created in step 1 is created by the customer or user. the user defines the Module orientation, system configuration and loss parameters.

C. RUNNING THE SIMULATION:

As per the given data, Simulation generates different graphs and reports for the the PV system. The user can analyze the results, export them to a different program or save the results for further evaluation.

3. STAND-ALONE PV SYSTEM DESIGN

Roof top standalone systems are not connected to any electricity grid and can have capacities from few mille-Watts to several kilo-Watts. Roof top standalone systems work on batteries and it has solar modules, controller and inverter as main components. The solar modules are mounted can produce DC power. Charge controller charges the battery and channels the power. Controller has dual function to perform; those are to charge the battery and to prevent overcharging of batteries. They also eliminate any of the reverse current flow from batteries back into the solar modules during night. The energy stored in the battery during day time can be used during day and night. The inverter can invert the energy stored in the battery to VAC current used to run AC appliances.

A. GEOGRAPHICAL LOCATION

The stand-alone PV systems geographical location taken at UT agro farms located at the village of Turakapeta, Srikakulam Dt. (AP) lies between 18.440 latitude and 83.850 longitudes with altitude is 31m given to PVsyst software.

B. TILTING OF SOLAR MODULE

The filed structure is a fixed tilted plane of tilt 280 and plane orientation azimuth 00 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/m2 as shown in Fig. 1.

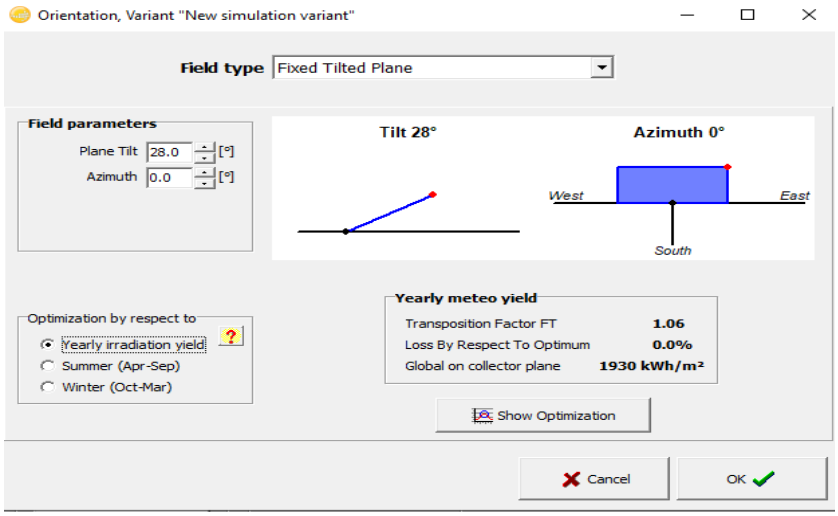


Fig 1 Module orientation and tilt angle

C. DESIGNING

I. LOAD CALCULATION:

The daily minimum load consumption required in the UT agro farms is as detailed in the table 1.

S. NO	Appliance	Power (W)	Number	Daily use (hour/day)	Daily energy required (wh/day)
1	Lamps (LED)	15	10	4	600
2	FAN	2	2	14	56
3	LED TUBE LIGHT	22	2	3	132
4	Lamps (INDCANESCENT)	60	4	4	960
5	CHAFF CUTTER CUM PULVERISER	1496	1	0.5	748

Table 1 Daily minimum load consumption

II. SYSTEM CONFIGURATION

The specification of PV module and battery set for the Stand-alone PV system shown in the table 2 and 3.

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
Weight	19.5 kg

Table 2 Details of PV modules

Details of battery set	
Manufacture	Exide Classic opzs solar 140
Batteries in series	2
Batteries in parallel	1
Total no of Batteries	2
Voltage	12V (Each Battery)
Global Capacity	103AH (Each Battery)
Battery type	Lead acid

Table 3 Details of Battery set

The universal controller MPPT converter of 1000W and 24V is used to design the stand-alone PV system having maximum charging and discharging current i.e 32A to 20A.

III. 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%.

IV. 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.

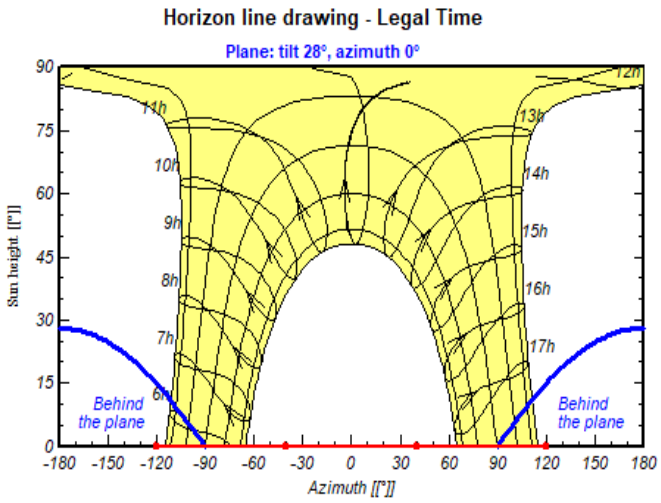


Fig. 2.Horizon

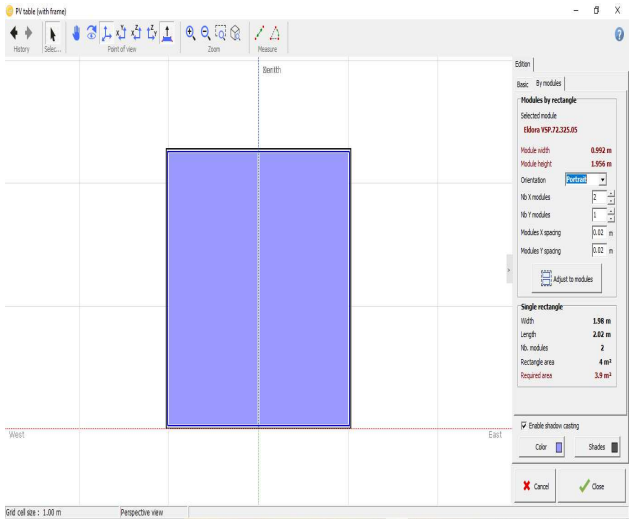


Fig. 3.Near shadings

4. SIMULATION

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

5. PVsyst RESULTS

The average annual energy requirement in the UT Agro Farms is 919.80 kWh and the energy available through solar panel is 1015.2 KWh, whereas energy supplied to the user is 781.13 kWh a little less than the required load shown in the table 4 .The reduced power capacity of the system is because of different kinds of losses shown in losses diagram.

The performance ratio (PR) is the ratio of the final PV system yield (Y_f) and the reference yield (Yr).

$PR = Y_f/Y_r$

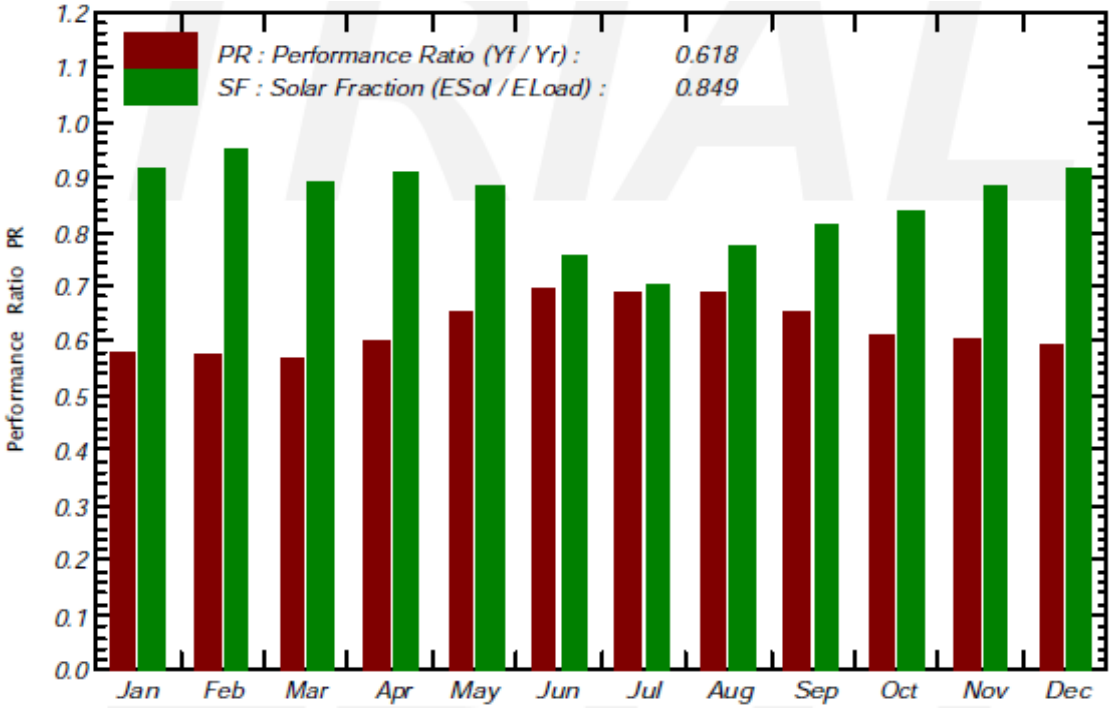
The solar fraction is the amount of energy provided by the solar energy by the total energy required.

$SF = E_{sol}/E_{load}$

	GlobHor kWh/m²	GlobEff kWh/m²	E_Avail kWh	EUnused kWh	E_Miss kWh	E_User kWh	E_Load kWh	SolFrac
January	144.9	177.7	100.8	23.51	7.03	71.09	78.12	0.910
February	149.7	169.0	95.5	22.08	3.78	66.78	70.56	0.946
March	174.5	176.4	98.1	22.12	8.77	69.35	78.12	0.888
April	183.2	165.1	91.8	16.97	6.96	68.64	75.60	0.908
May	182.3	151.5	83.6	9.29	8.99	69.13	78.12	0.885
June	143.9	117.3	64.5	3.69	18.59	57.01	75.60	0.754
July	137.5	113.9	62.3	2.87	23.26	54.86	78.12	0.702
August	143.5	125.3	69.4	5.10	17.96	60.16	78.12	0.770
September	142.3	134.4	74.6	8.42	14.25	61.35	75.60	0.812
October	145.1	152.7	85.1	14.77	13.21	64.91	78.12	0.831
November	135.5	160.4	90.2	17.23	8.84	66.76	75.60	0.883
December	137.7	174.8	99.1	20.85	7.03	71.09	78.12	0.910
Year	1820.1	1818.4	1015.2	166.90	138.67	781.13	919.80	0.849

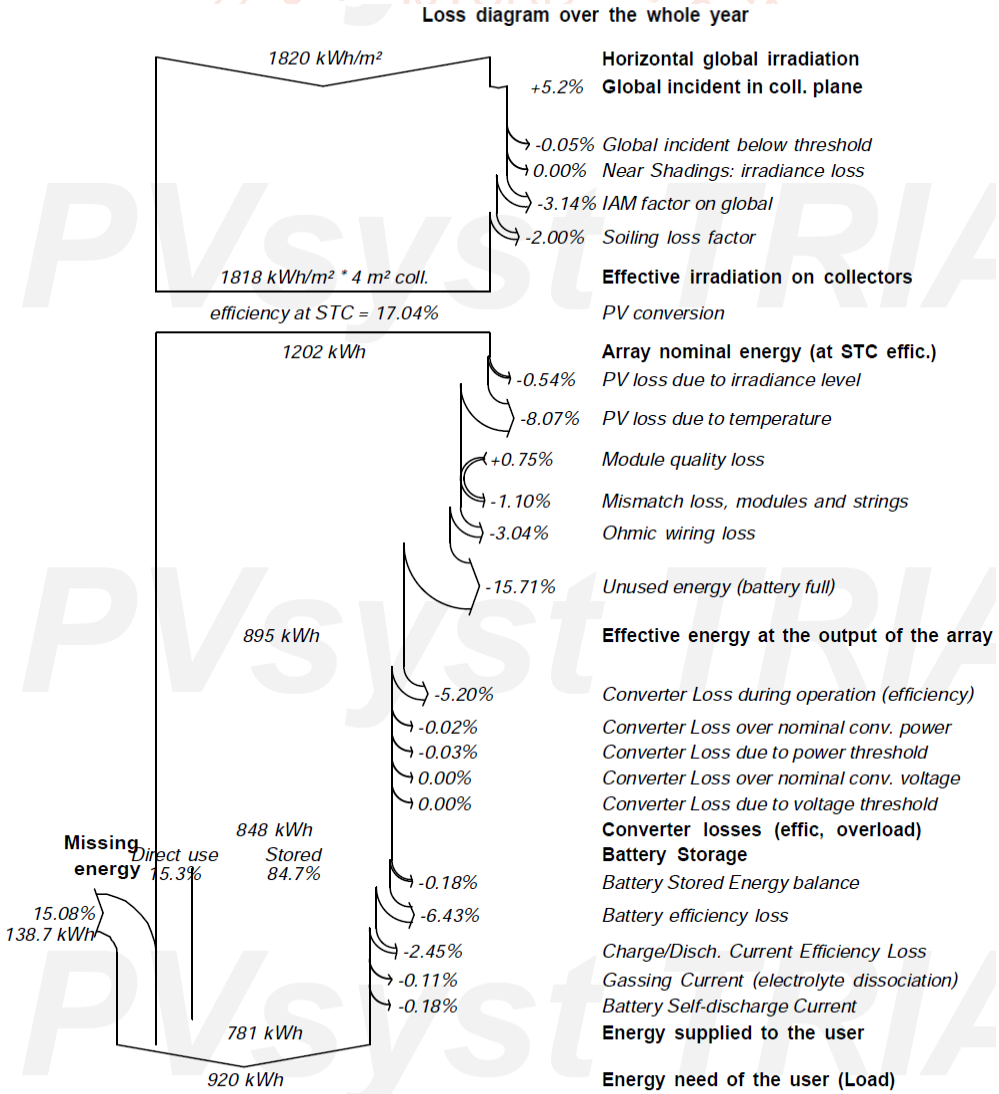
Legends:				
	GlobHor	Horizontal global irradiation	E_Miss	Missing energy
	GlobEff	Effective Global, corr. for IAM and shadings	E_User	Energy supplied to the user
	E_Avail	Available Solar Energy	E_Load	Energy need of the user (Load)
	EUnused	Unused energy (battery full)	SolFrac	Solar fraction (EUsed / ELoad)

Table 4 The yearly equalizations and fundamental results of Standalone PV system.



Graph. Performance Ratio and solar Fraction

The performance ratio analysis reveals that the highest PR was recorded in the month of June is 71% and lowest PR, 57% was obtained in the month of March, whereas the average PR for year is 61.8%. The Solar fraction the highest SF was recorded in the month of Feburary is 96% and lowest SF, 78% was obtained in the month of March, whereas the average PR for year is 84.9%. The both PR and SR is shown in graph.



Losses Diagram

CONCLUSIONS

The aim of the project is to study the three major vital parameters namely solar yield, performance ratio and system losses for Stand-Alone using PVsyst V 6.81 software.

- From the obtained results, the average annual energy requirement in the UT Agro Farms is 919.80 kWh and the energy available through solar panel is 1015.2 KWh, whereas energy supplied to the user is 781.13 kWh a little less than the required load. The reduced power capacity of the system is due to different kinds of losses.
- The performance ratio analysis reveals that the highest PR was recorded in the month of June is 71% and lowest PR, 57% was obtained in the month of March, whereas the average PR for year is 61.8% for Stand-Alone PV system
- Pre-design development is used in the software helps to get predictions about possible outcomes for real time system.

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