



Research Article

ESTIMATION OF ANNUAL ENERGY GENERATION FROM A SMALL GRID CONNECTED SOLAR PHOTOVOLTAIC POWER PLANT IN PATIALASouvik Ganguli^{1*}, Sunanda Sinha²**Address for Correspondence**^{1*}Assistant Professor, Department of Electrical & Instrumentation Engineering, Thapar University, Patiala²Lecturer, Department of Electrical Engineering, Chitkara Institute of Engineering & Technology, Rajpura

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ABSTRACT

This paper reports a proposed grid connected solar photovoltaic power plant at Thapar University, Patiala that would utilize a vacant area of about 100 m² available on the terrace of the academic wing of the building. The SPV power plant with proposed capacity of 9 kWp would be connected to grid. No battery storage has been considered in this work. It would meet partial load of the building during working days and feed the surplus power available to the grid during weekends and other holidays. The grid connected SPV project would be a demonstration plant to harness renewable energy and the data on generation would be utilized for analysis of the various aspects of operation as also that of availability of power. The 9 kWp SPV power plant is estimated to afford annual energy feed of 11.76 MW-hr considering efficiency of the solar module as 14.3 %, inverter or power conditioning unit (PCU) as 94% and losses as 3% in the DC and AC system. The plant would operate at an annual capacity utilization factor of 19%. The energy available from the plant varies from a minimum of 0.53 MW-hr during the month of December to a maximum of 1.35 MW-hr during the month of April.

KEYWORDS Annual Energy Generation, Grid-connected Photovoltaic (PV) System, Power Conditioning Unit (PCU), Solar Photovoltaic (SPV) Power Plant

INTRODUCTION

Harnessing of non polluting renewable energy resources to control green house gases is receiving impetus from the Government of India. The solar mission, which is part of the National Action Plan on Climate Change has been set up to promote the development and use of solar energy in for power generation and other uses with the ultimate objective of making solar energy competitive with the fossil-based energy options. The solar photovoltaic device systems for power generation had been deployed in the various parts in the country for electrification where the grid connectivity is either not feasible or not cost effective as also some times in conjunction with diesel based generating stations in isolated places and communication transmitters at remote locations. With the downward trend in the cost of solar energy and appreciation for the need for development of solar power, solar power projects have recently been implemented. A significant part of the large potential of solar energy in the country could be developed by promoting grid connected solar photovoltaic power systems of varying sizes as

per the need and affordability coupled with ensuring adequate return on investment [1]. It has been proposed to set up a 9 kWp grid connected solar photovoltaic power plant on the roof top terrace of the academic wing of Thapar University, Patiala using an available area of 100 sq. m [2].

The 9 kWp SPV system at roof-top of Thapar University, Patiala is estimated to afford annual energy generation of 11.76 MW-hr and operate at a capacity factor of 19%. The SPV system is estimated to cost Rs. 22.68 lakhs [3].

METHODOLOGY

In this paper, the annual energy generation from a grid connected solar power plant has been worked out based on the data obtained from the mean global solar radiant exposure over Patiala district of Punjab. Considering the efficiency of PV module as 14.3% [4], the monthly average energy export to grid is calculated. The annual energy generation feed into the grid is then estimated. This takes into consideration the efficiency of the power conditioning unit (PCU) as 94% and losses in the DC and AC system as 3% each up to the point of interconnection [1].

RESULTS & DISCUSSIONS

The mean global solar radiant exposure varies from 1.99 KW-hr/m² /day in the month of December to 5.1 KW-hr/m²/day in the month of April. The month-wise mean global solar radiant exposure in Patiala district of Punjab is given in Table 1. Considering the efficiency of PV module as 14.3% the monthly average energy export to the grid is 0.98 MW-hr. The annual energy generation feed into the grid is estimated as 11.76 MW-hr. This takes into consideration an efficiency of the power conditioning unit (PCU) as 94% and losses in the DC and AC system as 3% each up to the point of interconnection. The month wise energy generation during the year is given in Table 2. The graph in Fig. 1, shown below represents the month wise variation of energy fed to the grid.

Table 1: Mean Global Solar Radiant Exposure Patiala

Months	Daily Solar Radiation in KW-hr/m ² /day
September	4.65
October	3.81
November	2.59
December	1.99
January	2.31
February	3.98
March	4.89
April	5.10
Monthly Average	3.67

Table 2: Pattern of Energy Generation

Month	Export to Grid (MW-h)
September	1.23
October	1.01
November	0.69
December	0.53
January	0.62
February	1.06
March	1.30
April	1.35
Monthly Average Generation	0.98
Annual Generation	11.76

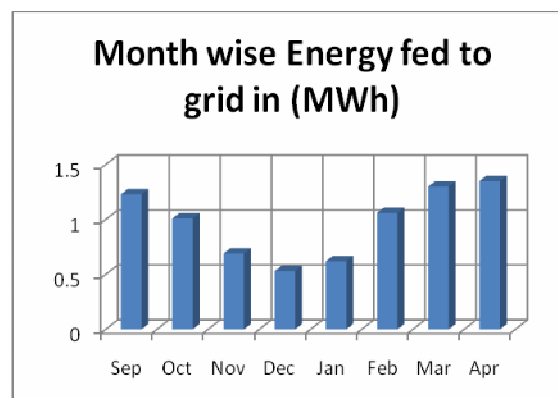


Fig.1: Month wise variation of Energy fed to Grid CONCLUSIONS

The energy available from the SPV power plant thus varies from a minimum of 0.53 MW-hr during the month of December to a maximum of 1.35 MW-hr during the month of April. Due to the short time span four months of the year are missed in this analysis. The results would have been far more accurate had these readings been available.

REFERENCES

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