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Simulation of 5KWp Grid Connected Rooftop Solar Power Plant using PV Watts India

Abstract: - In grid connected rooftop solar PV system, available rooftop area on buildings is used for setting up solar power plant and DC power generated from solar photovoltaic (SPV) cells is converted to AC power by solar grid inverter and is fed to the grid during day time. In night when solar power is not sufficient, loads are served by drawing power from grid. In this paper, the Simulation analysis of 5 KWp solar photovoltaic roof top grid connected power plant at Sharad Institute of Technology college of Engineering, Ichalkaranji city is carried out using PV Watts India simulation software. The simulation results of DC energy output of PV module and AC energy output of inverter are presented. From the simulation, the annual average solar irradiation is 6.02 kWh/m2/day. Total annual DC energy output of the PV array is 8301 Kwh and the annual output of the inverter is 7922 KWh. The system losses are 14.08% and the capacity factor is 18.1%.

Keywords: Solar, Grid, AC Output, solar radiation, System losses. DC Array output

I. INTRODUCTION

Sharad Institute of Technology college of Engineering, Ichalkaranji city is located at latitude of 16.7 0N and longitude of 74.47 0E and at an elevation of 539 m from sea level. [1]. Electric utilities are finding it difficult to meet rise in peak demand and as a result, most of cities and towns are facing severe electricity shortages [2].

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II. ON - GRID SOLAR ROOF TOP POWER PLANTS

A grid-connected photovoltaic (PV) system, also known as a grid-tied or on-grid solar system (Fig.1) is a renewable energy system that generates electricity using solar panels [9]. The generated electricity is used to power homes and businesses, and any excess energy can be fed back into the electrical grid[3]. In this way, grid-connected PV systems play an important role in reducing carbon emissions, promoting energy independence, and increasing access to clean energy [7]

A grid-connected PV system typically consists of solar panels, an inverter, a charge controller, a monitoring system, and an electrical distribution panel. When exposed to sunlight, solar panels produce direct current (DC) electricity [4]. The inverter then converts this DC electricity into alternating current (AC) electricity, which is what is used in most homes and businesses. The charge controller regulates the flow of electricity between the solar panels, the inverter, and the electrical distribution panel [5]. The monitoring system tracks the performance of the system, and the electrical distribution panel connects the system to the electrical grid [6]

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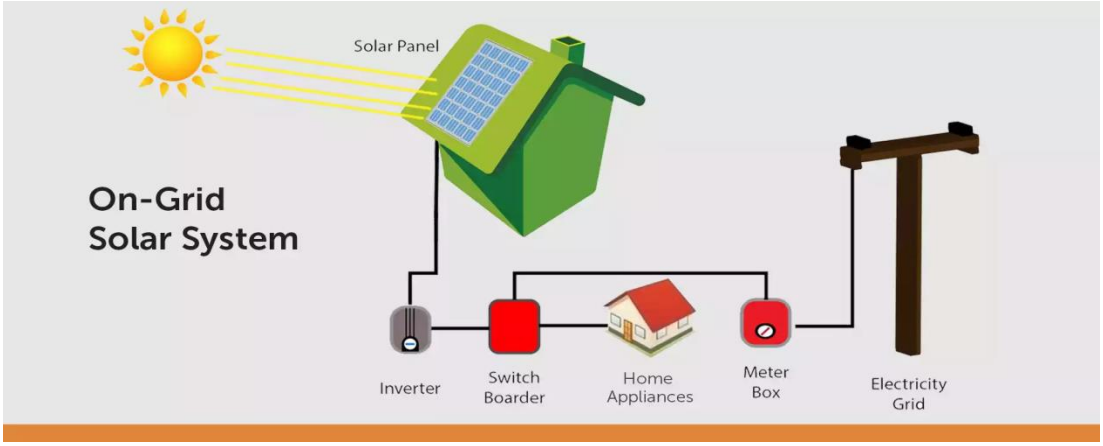

Fig1. A Schematic diagram of a Grid connected Solar Roof Top Photo Voltaic Power Plant.

One of the main advantages of a grid-connected PV system is that it allows you to use solar power even when the sun is not shining. When the sun is shining, the system generates electricity that is used to power your home or business. If the system generates more electricity than you need, the excess energy is fed back into the electrical grid. When the sun is not shining, you can draw electricity from the grid to meet your energy needs. This means that you do not need to store large amounts of energy, which would require batteries and other expensive components.

Another advantage of a grid-connected PV system is that it can reduce your energy costs. By generating your own electricity, you can lower or even eliminate your dependence on the electrical grid, and reduce your monthly energy bill. Additionally, many utility companies offer net metering programs, which allow you to receive credits on your bill for the excess energy that you feed back into the electrical grid

Finally, grid-connected PV systems are relatively easy to install and maintain. Unlike off-grid systems, grid-connected systems do not require batteries, and they do not need to be connected to a backup generator. This means that they are typically less expensive and less complex than off-grid systems [8]

III. SIMULATION ANALYSIS RESULTS USING PV WATTS INDIA

PV Watts India software is one of the simulation software developed by NREL to estimate the Performance of the solar power plant

A. Resource Data and System info

The resource data and system info for inputs considered for 5KWp roof top solar power plant are shown in Fig.2 & 3[8]. Sharad Institute of Technology college of Engineering, Ichalkaranji city is located at latitude of 16.7 0N and longitude of 74.47 0E and at an elevation of 539 m from sea

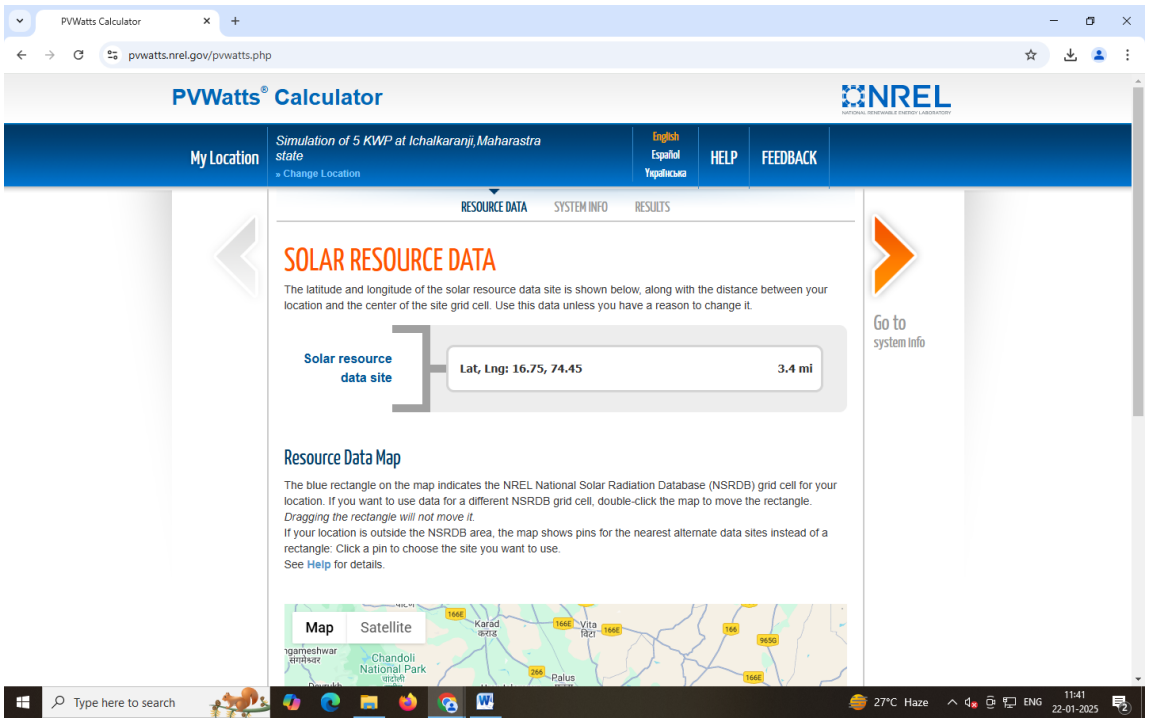

Fig.2 Resource data of 5 KWp solar rooftop plant

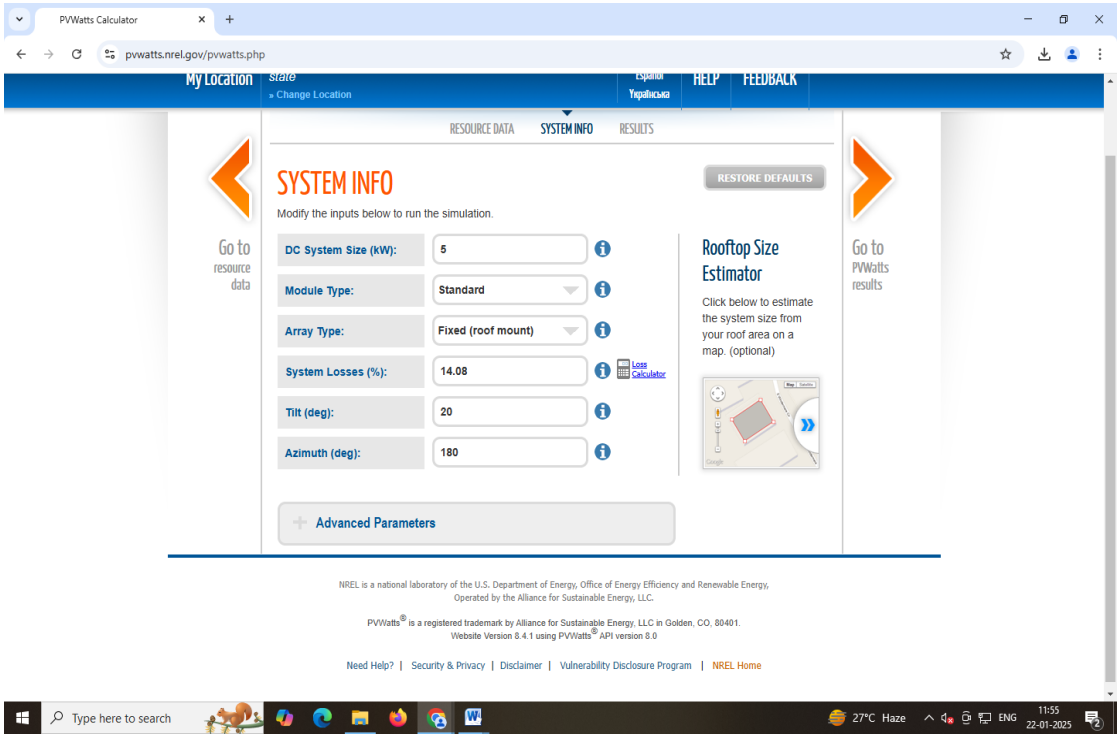

Fig.3 System info of 5 KWp solar rooftop plant

The system considered is DC system size 5KW, module type is standard, and array type is Fixed (Roof Mount) with tilt angle 200 and Azimuth angle 1800. The system losses are calculated as 14.08%.

B. Results of 5KWp rooftop solar plant

The maximum energy is generated in the month of March is 754 KWh and minimum energy generated in the month of July is 533KWh. The total amount of energy generated from 5KWp plant for annually is 7922 KWh is shown in Fig.4

Fig.4 Simulation results of 5KWp Solar rooftop plant

The location and PV system specifications are given in Fig.5

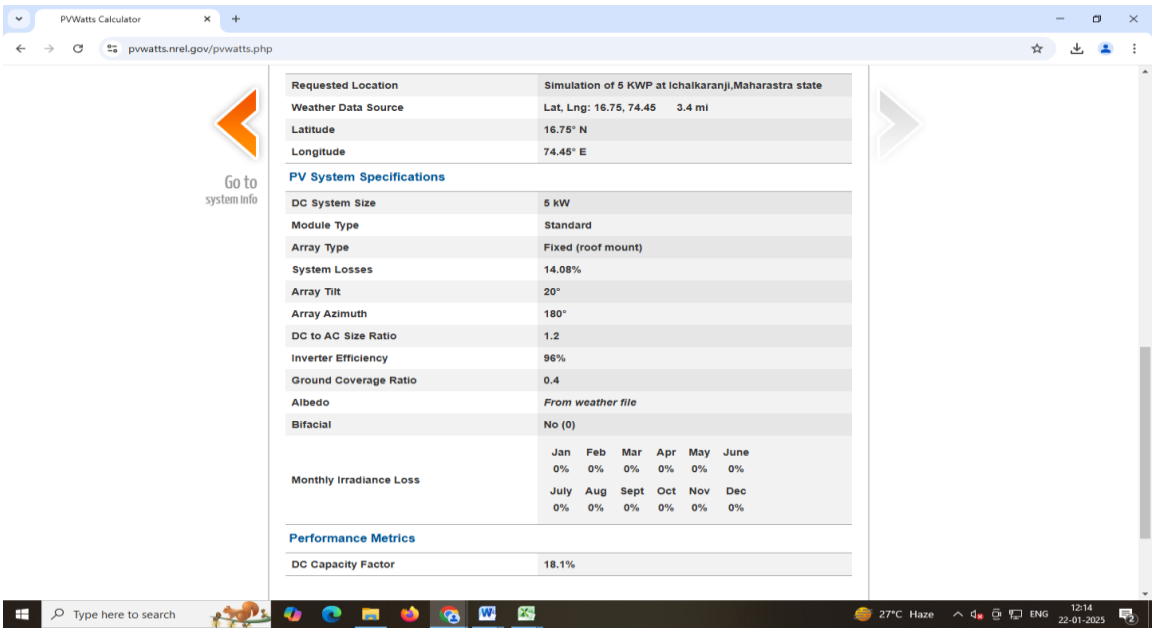

Fig.5. The location and PV system specifications

The Simulated results of DC array output and Inverter output of 5KWp rooftop solar plant are shown in Table 1.

Table 1. Simulated results of DC array output and Inverter output of 5KWp rooftop solar PV plant

Month	Solar radiation KWh/m^2/day	DC Array output (KWh)	AC Output of PV array(KWh)
Jan	6.704	784.936	750.365
Feb	7.22	735.91	703.73
March	7.102	788.45	753.656
April	6.708	720.55	687.714
May	6.335	738.351	704.228
June	4.867	566.302	538.507
July	4.542	560.378	532.535
Aug	4.715	578.685	550.315
Sep	5.628	657.375	627.315
Oct	6	702.727	671.069
Nov	6.092	698.586	667.302
Dec	6.349	768.91	734.907
Annual	6.02	8301	7922

The solar radiation is 6.02 kWh/m2/day. The solar energy incident on the solar panels will convert into electrical energy. The capacity factor PV array is 18.1% and system losses are 14.08%. After the inverter losses the annual available energy obtained at the inverter output is 7922 KWh and the annual DC output of array is 8301 KWh/year as observed from Table 1.

IV CONCLUSIONS

The Simulation analysis of 5KWp solar photovoltaic roof top grid connected power plant at Sharad Institute of Technology college of Engineering, Ichalkaranji city is carried out using PV Watts India simulation software. The following conclusions are drawn from the study.

- The maximum energy is generated in the month of March is 754 KWh and minimum energy generated in the month of July is 533 KWh.
- From the simulation, the annual average solar irradiation is 6.02 kWh/m2/day. Total annual DC energy output of the PV array is 8301 Kwh and the annual output of the inverter is 7922KWh.
- From the simulation, the system losses are 14.08% and the capacity factor is 18.1%. The inverter efficiency is 96%
- The DC to AC Size Ratio is 1.2

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