

“500 KW Grid Connected SPV Plant at Integral University Lucknow: Performance Evaluation and Improvement Suggestion”

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Abstract: The study work is done to determine the performance of Grid Connected SPV Plant installed at Integral University Lucknow under Green University Project. To determine the overall performance of the system some performance parameters are considered. The software tool used PV*SOL Premium is used to simulate the performance parameters of the system. The simulation results of actual and modified plant are compared to optimize the performance of the plant. The performance parameters considered are Performance ratio, Annual capital saved, Annual Yield, Annual Specific Yield, Annual CO₂ Emission Avoided and Solar Fraction. The modification in the plant is in the tilt angle of the modules. The performance evaluation of the plant at actual or original tilt has been done and then at different tilt angles same procedures are done. The best possible tilt angle based performance of the plant is compared with the actual plant and the differences obtained in the results of the two plants are summarized. In the end the simulation results of actual and modified plants are compared. And finally improvements are suggested.

Keywords: Grid connected SPV plant, Tilt, Simulation, Solar Fraction, Production forecast, Performance Ratio, Yield.

INTRODUCTION

Integral University Lucknow has joined in hand with Solar Target of India under “Target 2020”. For this the University has adopted a project called “Green University Project” under which it installed a sum of 500 KW SPV roof top plant in the campus in four parts at four different buildings namely 198 KW at Academic Block, 111 KW at Civil Block, 91 KW at BNL Block and 100 KW at Integral Hospital of the university. All these can be visualized in the figure 1. The study here is oriented towards the upgradation of the plants without costly modifications. For this some important performance parameters of the system are considered and evaluated using a software “PV*SOL Premium”. These parameters are Performance ratio, Annual Yield, Specific Annual Yield, Solar Fraction, Annual Capital saved and Annual CO₂ Emissions Avoided. These parameters of the plant with actual tilt of the modules are simulated using PV*SOL Premium and then all these parameters of the same plant with a different modified tilt of the modules are simulated in the same software. Then all these parameters are summarized and performances are compared between the plant with actual tilt and plant with modified tilt. The best possible nominal modification to improve the performance of the plant are suggested.

PERFORMANCE EVALUATION OF PLANT WITH ACTUAL TILT OF 15⁰:

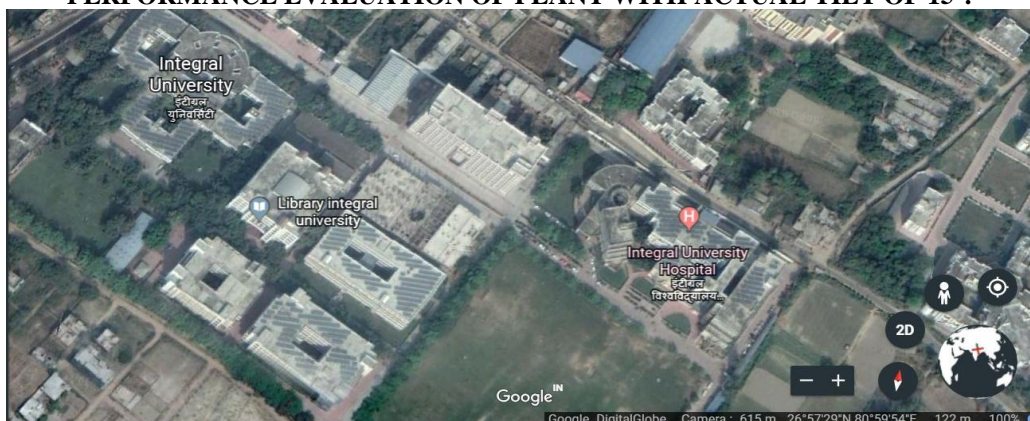


Fig 1: 500 KW SPV Roof Top Plant at Integral University Lucknow (Four Roof Tops)

Data like Energy Consumption, Module specifications, Inverter specifications, configurations, cables, type of plant, location etc are fed into the PV* SOL Premium tool. The Tilt angle of the modules is fed as 15 degrees. Simulation of the software is run and the results are obtained as follows:

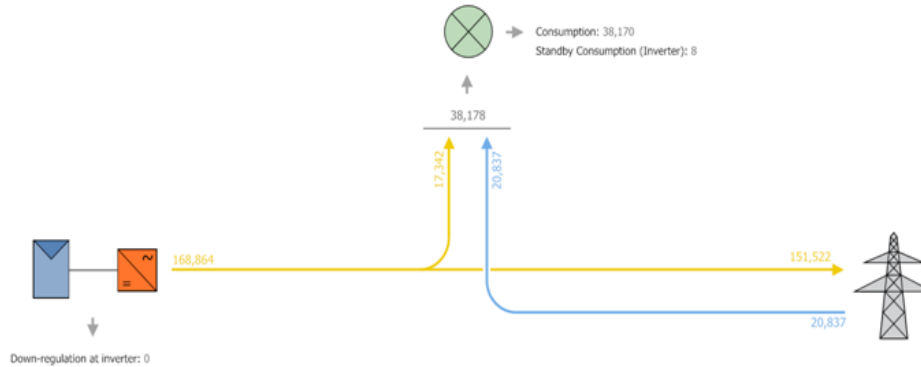


Fig 2 : Energy flow graph of the actual plant (15 degrees tilt)

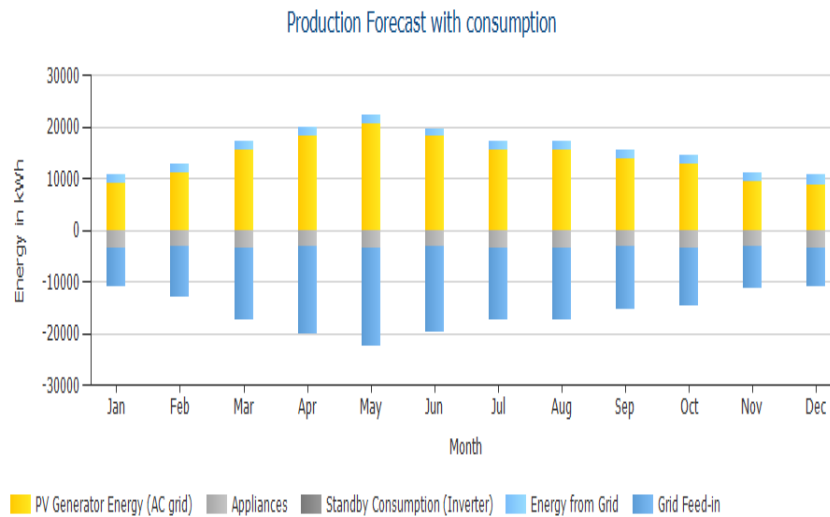


Fig 3 : Production forecast with consumption of the actual plant

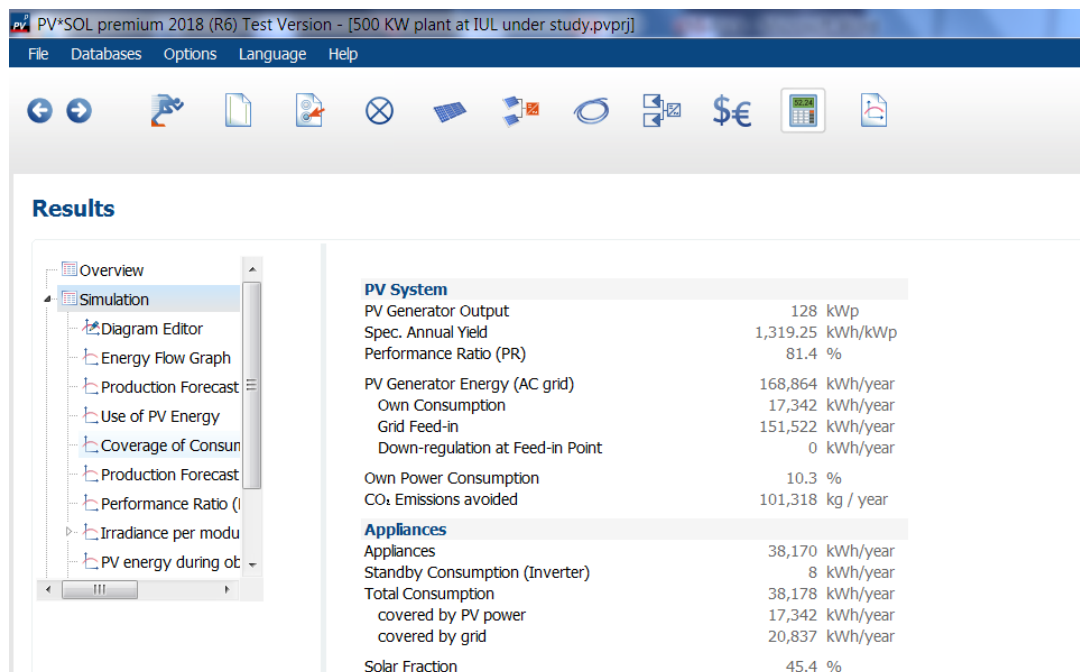


Fig 4 : Simulation data results of Actual plant

PERFORMANCE EVALUATION OF PLANT WITH MODIFIED TILT OF 10°

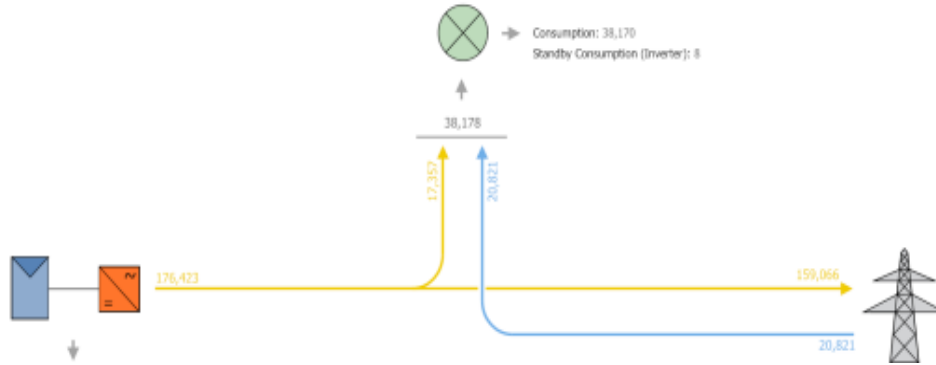


Fig 5 : Energy Flow Graph of the plant with modified tilt (10 degrees)

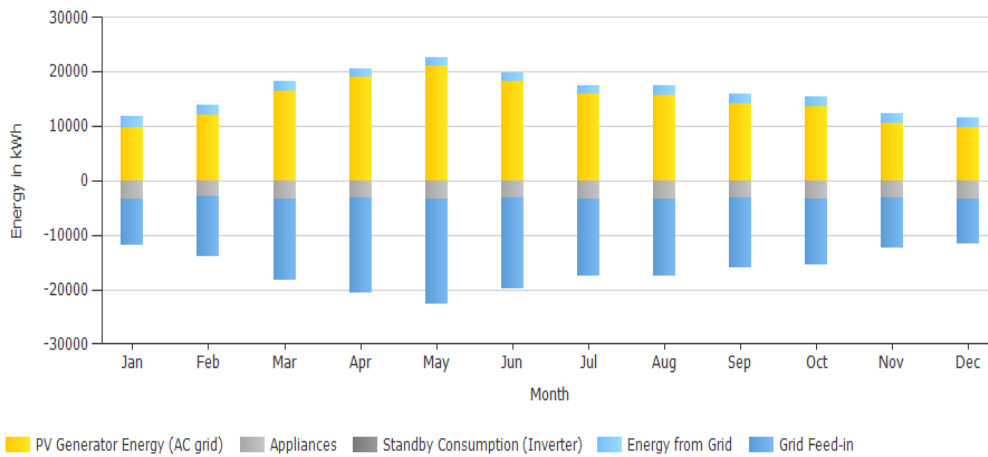


Fig 6 : Production Forecast with consumption of plant with 10 degree tilt

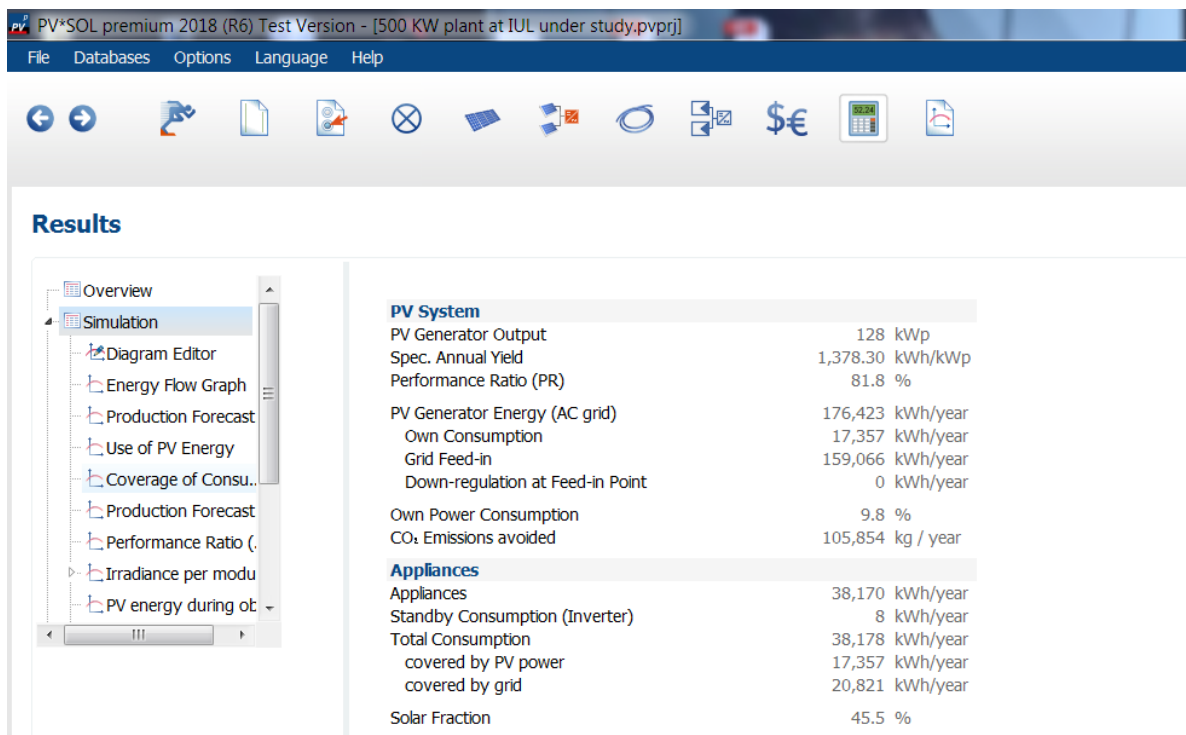


Fig 7 : Simulation data results of plant with 10 degree tilt

COMPARISON OF SIMULATION RESULTS

Performance Parameters	Actual Plant (15° Tilt)	Modified Plant (10° Tilt)	Notes and Discussion
Annual Yield (kWh)	168864	176423	7559 units more production at 10 degree tilt
Annual Sp. Yield (kWh/kW _p)	1319.2	1378.3	59.1 units more at 10 degree tilt
Solar fraction (%)	45.4	45.5	0.1 % more at 10 degree tilt
CO ₂ Emissions avoided (Kg/yr)	101318	105854	4536 kg more at 10 degree tilt
Annual Capital Saved (INR)	1045480	1105960	Rs 60480 more savings at 10 degree tilt
Performance Ratio (%)	81.4	81.8	0.4 percent better performance at 10 degree tilt.

CONCLUSION

- The Annual yield, Specific Annual Yield, Solar Fraction, Performance Ratio, Annual capital Saved and Annual Carbon-dioxide Emissions Avoided were considered as the performance parameters.
- The performance of the system installed at 15 degree tilt is good.
- The performance as simulated using PV*SOL software at 10 degree tilt shown better results.
- The performance evaluation is equally applicable to the 500 KW plant at the University as a whole.
- The performance ratios, the main parameter of performance evaluation, of actual plant at 15 degree tilt and modified plant at 10 degree tilt are 81.4 and 81.8 % respectively.

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