Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 6, Issue 8; July-September, 2019, pp. 517-522

http://www.krishisanskriti.org/Publication.html

Forcasting analysis for Grid Tied SPV Generation to Improve Infrastructural Planning & Define Mitigation Measures

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Abstract—*Grid tied roof top SPV system is the fastest growing RES. SPV system is proliferating the energy but challenges are present for utility distribution network. Some time high penetration of generated energy is causing problem for operational grid to maintain voltage levels within the limits. Hence, Power management is the biggest challenge to improve infrastructural planning and defining expected mitigation measures. The prediction about the yield from roof top SPV generation on a particular day throughout the year to tune with fossil fuel based generation and to minimize the atmospheric pollution. This paper presents a model to predict the yield from a SPV plant of 100/82 Kwp installed at ABIT, Delhi based on weather forecast for given location. This model is used for management of distributed energy generation and to define mitigation measures. The methodology for this model is simple to use because it uses performance data from SPV plant installed at Arya Bhatt Institute of Technology, G.T. Karnal Road, New Delhi. The weather forecasting or climatic parameters data including temperature, humidity and Cloud cover fraction (CCF)..etc. is available with Meteorological department. So that forecasting analytics is helpful to improve the infrastructural planning and defining mitigation measures.*

Keywords: *DEG (Distributed Energy Genereation), RES (Renewable energy Sources), SPV (Solar Photovoltaic), prediction of yield, Power management)*

1. INTRODUCTION

SPV system performance depend on solar irradiance that is function of many factors such as latitude, season, air pollution and cloudiness. The yield from SPV system also depend on photo conversion efficiency. The efficiency of module is approx.. 16% with cooling and 13% without cooling as per data available on site. After data aggregation, modelling and analytics there are the ways to handle the situation. By aggregating meter level consumption, customer load shape can be modeled at particular point on a day to determine more accurately. Aggregating distributed generation separate from load can provide more accurate power flow simulations and more accurate advance distribution management system. The optimization functional knowing location of roof top SPV system throughout utilities distribution area make it possible to moderate or smooth the effect of cloud cause intermittencies.

Finally the utilities are beginning to use big data analytics to forecast location based growth of RES within distribution territories based on specific load policies, census data and economic growth. Our country is rapidly moving towards sustainable energy generation and reduction of green house gas (GHG) emission.

The power demand at particular location is mix of power from many resources, can be represented as:

$$P= aP_F + bP_S + cP_W + dP_O$$

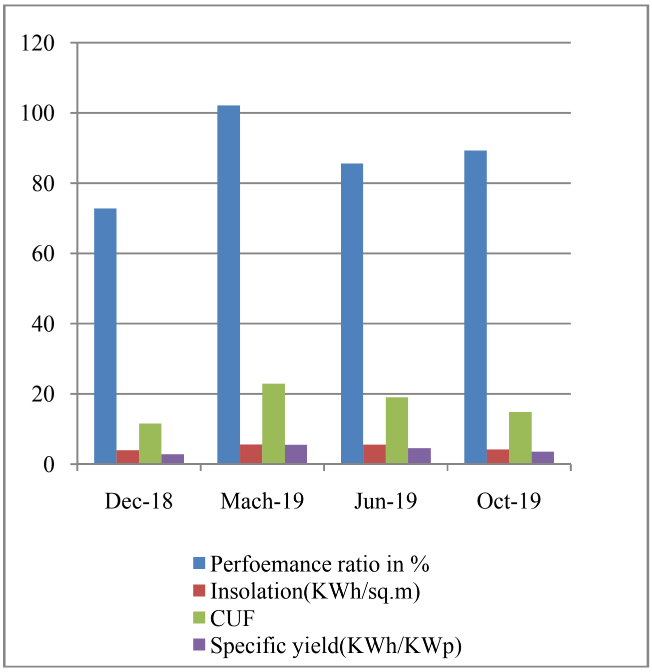
Where P_F,P_S,P_W,P_O are installed capacity of fossil fuel plant, Solar Installation, Wind Installation and other sources or import respectively and a,b,c,d are the percentage of utilization. Here 'a' and'd' must be reduced to decrease the polluting gas(GHG).

SPV systems are dependent on environmental/ climatic parameters. These parameters are not under human control and there is no way to increase or decrease electricity based on demand. Therefore, it is very essential to forecast the yield of SPV systems that will help to assist the utility in reserve requirement estimation, unit commitment analysis, solving voltage issues and contingencies analysis. A prediction Model is used for GRID Tied interactive Roof Top SPV Plant i.e.100/ 82KWp installed at Arya Bhatt Institute of Technology (ABIT), G.T. Karnal road, Delhi .

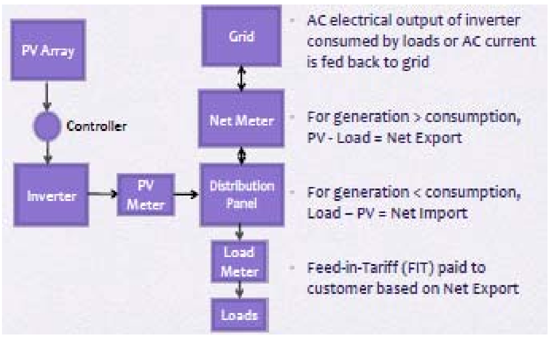
Technical specifications:

PV Modules	315
PV Technology	Polycrystalline 320Wp
No. of module in series	20
Parallel string	16
Plant Rated Power	100/82 kWp
Area	400.0 m2
Tilt angle	25.0^0
Tracking System	Without Tracking System
Number of Inverters	(PCU) 2
Inverter Manufacturer	DELTA
Number of MPPTs	2

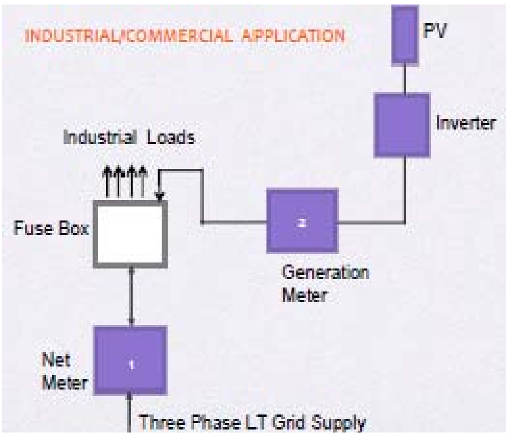
2. SEASONAL PERFORMANCE SPV PLANT INSTALLED AT ABIT



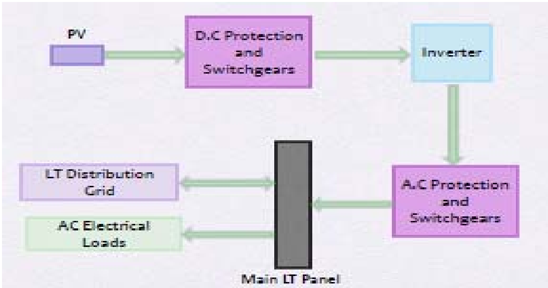
3. ROOFTOP SPV POWER SYSTEM



4. ENERGY METERING

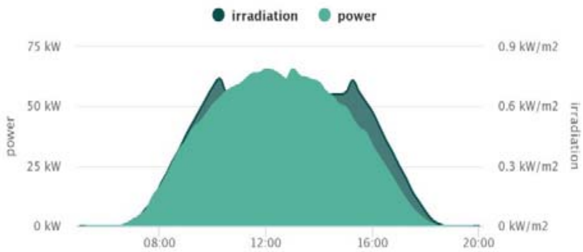


5. GRID CONNECTION



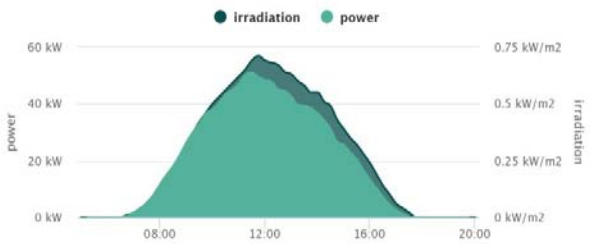
6. IRRADIATION POWER ON AVERAGE

March-2019



June-2019

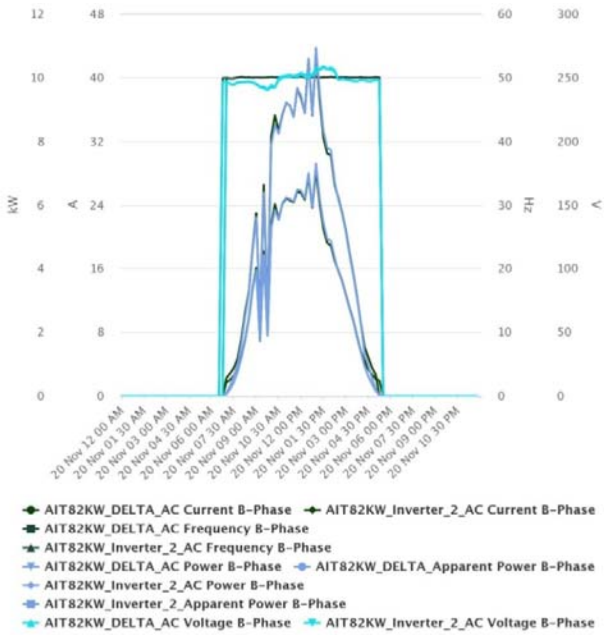
Oct-2019



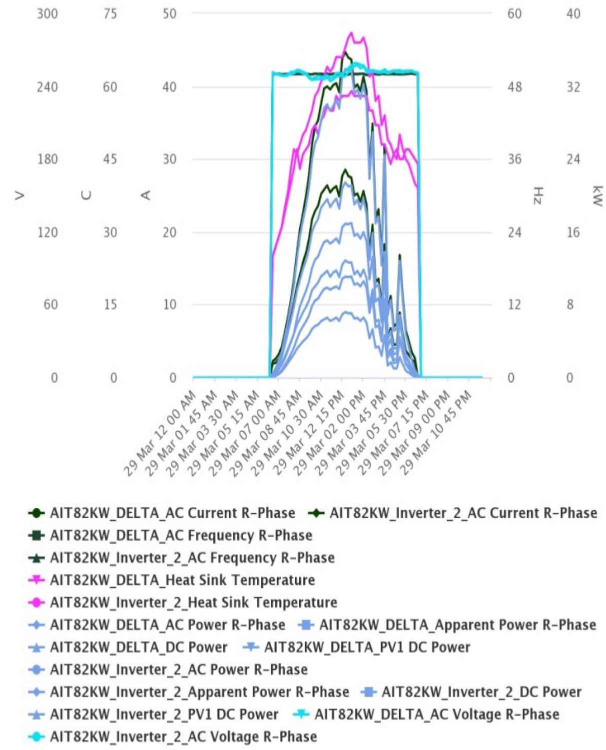
Dec-2018

7. INVERTER PERFORMANCE GRAGH

20th Nov 19

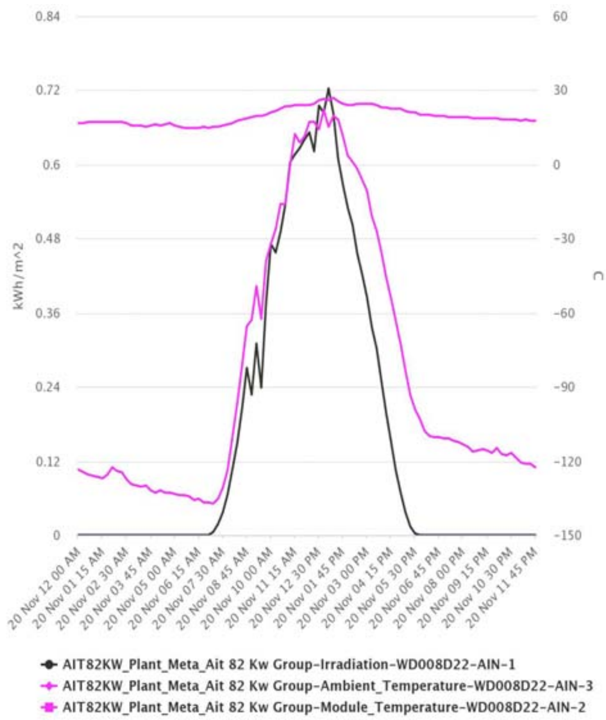


29th March 2019

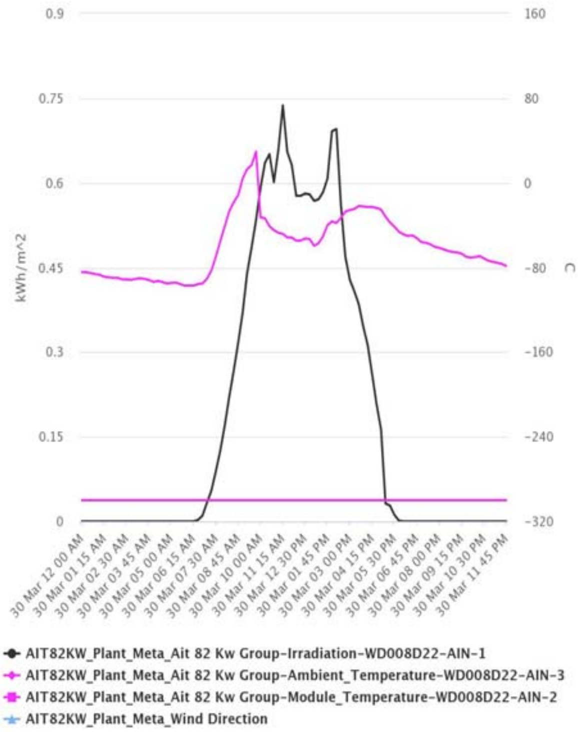


8. WEATHER DATA

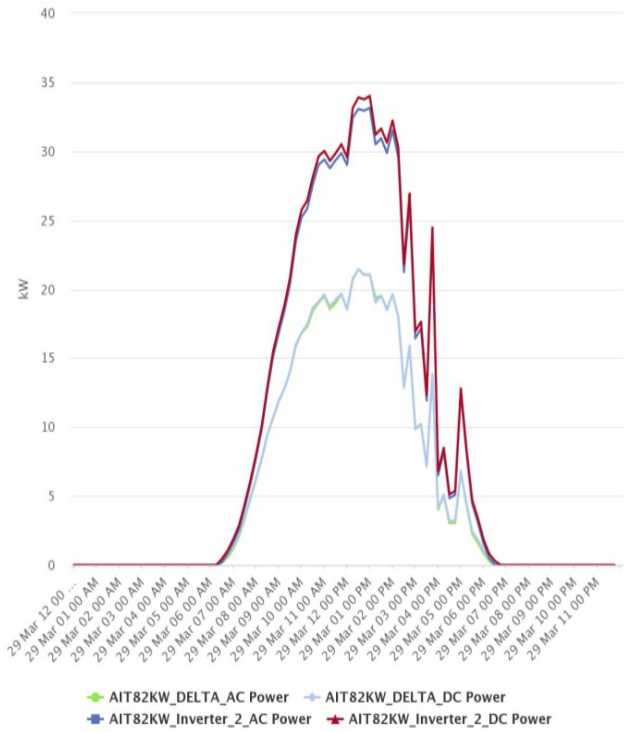
20th Nov.2019



March 2019

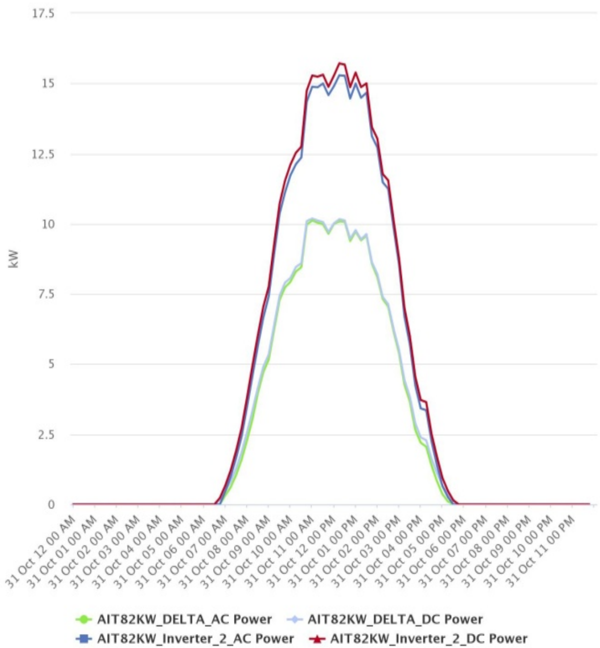


March 2019

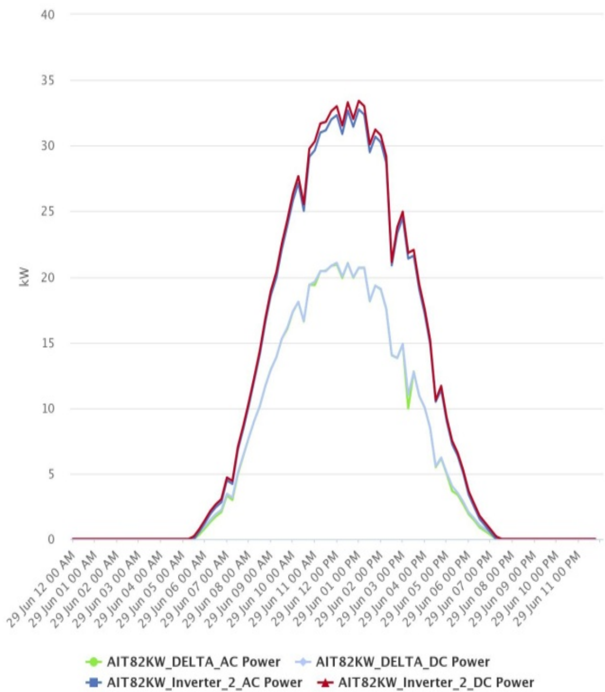


9. DC /AC POWER GENERATION BY SPV PLANT

Oct.2019



June 2019



10. CONCLUSION

Power management at a particular location have many challenges. Net power generation is the combination of conventional and non conventional energy sources including SPV. The excess power generation is not only the wastage of power unnecessarily but creating problem for the utility GRID. So it is essential to optimize usage of energy sources, and it is important to predict the power generation from RES. Reduce the burden of conventional energy sources to reduce CO_2 emission. The other issues of challenges besides of load matching and voltage profile are: Reverse power flow, Reduced switching flexibility, Lack of visibility of actual load circuit caused by net energy metering, increased O& M for voltage regulation equipment and transmission level aggregation issues. An empirical relationship of climatic condition like humidity, temperature and Cloud cover fraction that decide the yield from the SPV system. It is observed that yield from SPV system decreases linearly with increase of humidity and Cloud cover fraction, the module temperature also influence SPV module efficiency. The forecast model based to monitor round the year performance of SPV system. Few important parameters such as performance ratio is varying from 72.81% to 102.15%, Capacity utilization factor(CUF) is varying from 8.29 to 22.9 and specific yield is varying from 1.99 to 5.49.(Courtesy: Hero future Energy and Data Glen)

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