A 20 KW ROOF TOP GRID CONNECTED SOLAR POWER PLANT AT ACE ENGINEERING COLLEGE

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Abstract— This paper presents installation and operation of a 20 kW roof top solar power plant with grid connection by Net metering system at ACE Engineering College, Hyderabad, India. The major disadvantage of conventional power generation is scarcity of power, which is because of the depletion of natural fuel sources like Coal, Petrol, and Uranium. Therefore, the demand for electrical power generation from solar cells is increasing rapidly. Some of the advantages of solar based power generation are one-time investment, independent power generation and less maintenance. Owing to the above said advantages, ACE Engineering College has established 20kW grid connected power plant.

Index Terms— Roof Top Solar Plant, 20 kW grid connected Solar Plant, Solar Power Plant, Net metering system

I. INTRODUCTION

To encourage the renewable energy sources a 20 kW solar plant is established in ACE Engineering College. This plant is connected to grid by using net metering system. This paper presents the solar system planning, output, daily load curves and monthly load curves. The main intension of this paper is to give clear idea about solar plant investment, advantages, power generation to the customers who are interested to establish solar plant on their buildings or offices or organizations.

ACE Engineering College is established in the year of 2007. Since establishment it is encouraging renewable energy source. In that process it is already established 10kW solar plant with battery storage in the year 2013. Now it is established 20kW solar plant and further it is connected to grid. In future also it is planning to establish 50kW in the campus and 2MW at Mahaboobnagar.

The ACE engineering college Lat-Long (Latitude and Longitude) point of the location is 17.437738 and 78.716161 respectively. And, normal temperature of the location (during middle of the summer season) lies around 38˚C to 41˚C. Distribution of maximum and minimum temperatures over last ten years [1] i.e. 2007 to 2017 is given in Figure 1 and Figure 2 respectively. Figure 2 represents the Average distribution of maximum and minimum temperature over a year [2].we can observe from Figure 1 and Figure 2, and normal temperature of the location site at which solar power plant is to be installed is around 25˚ C, this is sufficient temperature to establish solar plant.

The ambient temperature for generation of electricity required by the solar cell used in this paper is 27.8˚C.

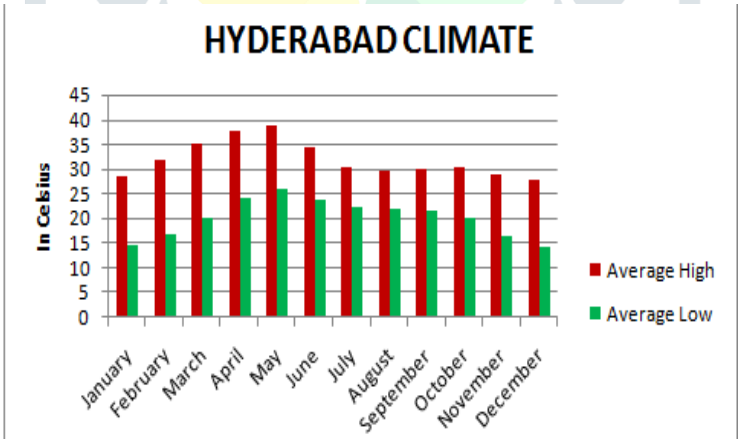

Figure 1 Maximum and minimum Temperature of Hyderabad climate

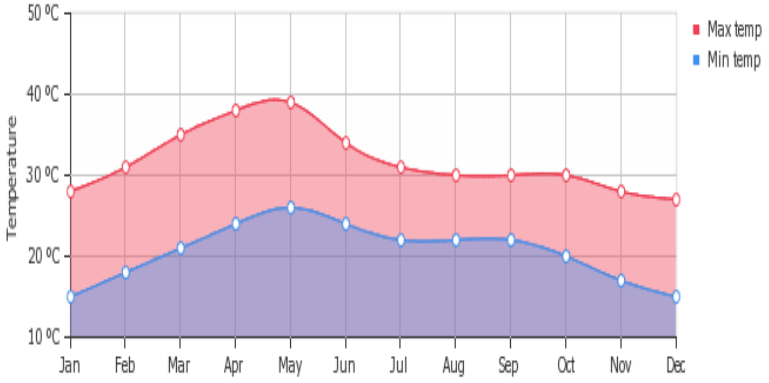

Figure 2 Average Temperature Distribution for the year Over the Last Ten Years

II. LOAD DETAILS

The electrical load of the college comprises of lighting, electrical machinery based laboratory, air-conditioners, ceiling fans and Computers. The power consumption of these loads is given in Table 1. It can be seen that the total power consumed by the lighting and fans is 1.69 kW and can be met by the installed roof top solar power plant. The solar power plant can also be used to meet the power demand of (i) some of the experiments being carried in the electrical machinery based laboratory, and (ii) the air-conditioners. However, during operation of the plant the total power demand should not exceed the capacity of solar plant.

Table 1 Load-Power Consumption

Load	Power Consumption (in W)
Lighting	55
Ceiling Fans	75
Air-Conditioners	1430
Electrical Machinery based Laboratory	30
Computer	100

III. SOLAR POWER PLANT

The roof top solar power plant constitutes solar panels, inverter, earth pits and net metering system.

i. Solar Modules

The installed capacity of roof top solar power plant is 20 kW Arrangement of solar modules of the plant is shown in Figure 4. The number of modules used is 80. The short circuit current of each module is 8.498 A. Current at maximum power is 8.98 A. The open circuit voltage of each module is 38.1 V. Voltage of a module at maximum power is 30.2 V. The modules are arranged in '16 rows' and '5 columns'. With the voltage of 30.2 V per module, the maximum (output) power of each module is 250 W. The total output power from all the modules is 20 kW. The voltage at which a row of the solar modules operated is 610 V. This voltage is obtained by multiplying the maximum voltage of a module with the number of modules in a row. The stranded test values are placed in table 2.

Table 2 Electrical parameters at standard test conditions

Nominal power output (W)	250
Power tolerance (%)	± 2.5
Module efficiency (ŋ%)	15.00
Voltage at PMAX VMPP (V)	30.7
Current at PMAX IMPP (A)	8.16
Open-circuit voltage VOC (V)	38.1
Short-circuit current ISC (A)	8.58

The instantaneous production values on 7th December are shown in figure3 and figure 4. The daily, monthly and yearly load curves are shown in figure 5, 6 and 7. The solar module at ACE Engineering College is shown in figure 8.

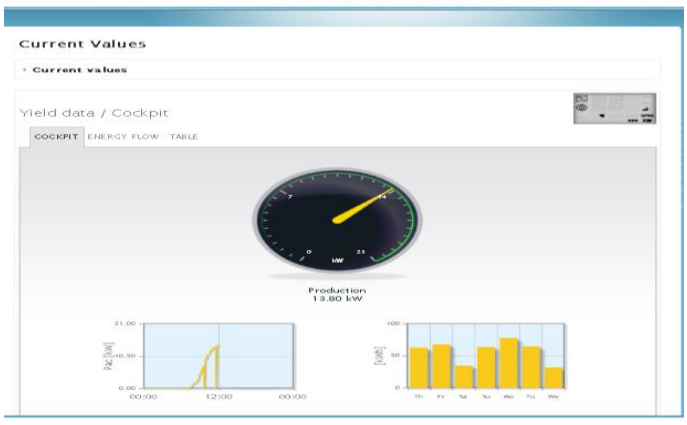

Figure 3 Instantaneous values of solar output

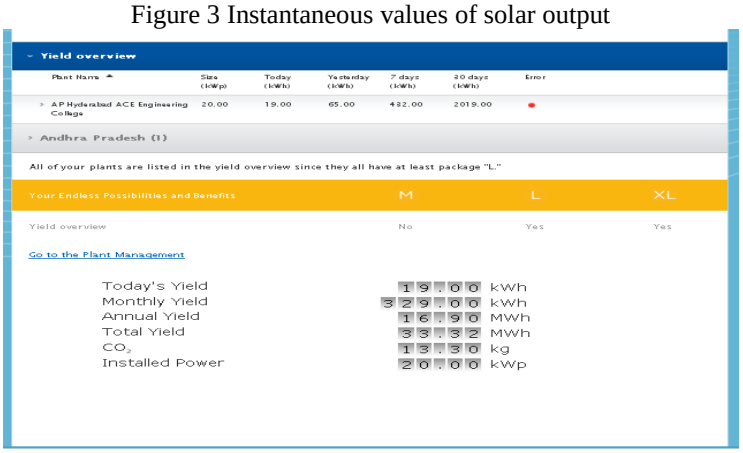

Figure 4: Output values of solar plant in numerical values

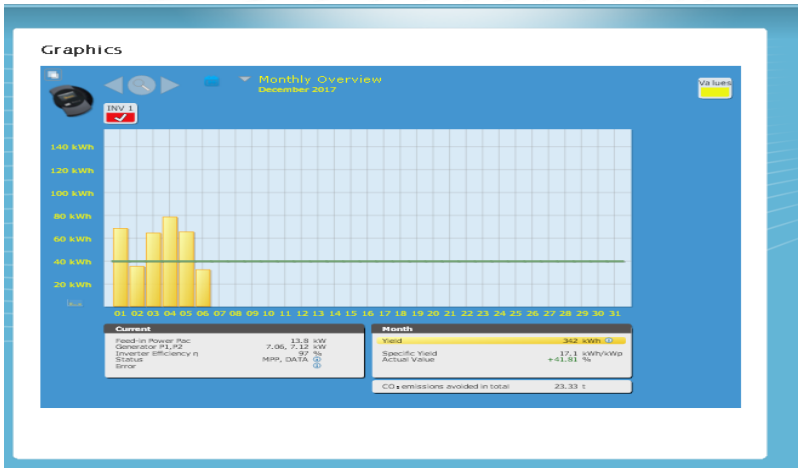

Figure 5 Daily load curve in the month up to 8th December 2017

Figure 6 Monthly load curve in the month November 2017

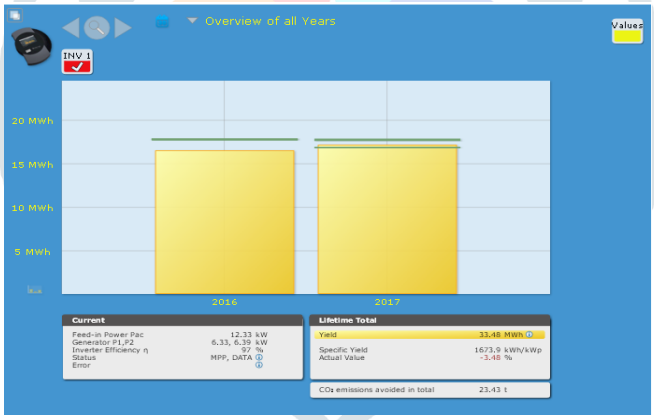

Figure 7 Yearly load curve up to 8th December 2017

Figure 8 Solar Modules

ii. Inverter and Control Unit

The maximum output power of the inverter is 21 kVA. The battery or DC side maximum voltage is 1000 V. Efficiency is more than 90 %. The output of the inverter provides a 3-phase supply. The maximum output voltage of inverter is 230 for single phase and 400 volts for 3 phases. The inverter unit at ACE engineering college is shown in figure 9 and specifications are shown in figure 10.

Figure 9 Invertor Unit

Figure 10 Invertor Specifications

iii. Net Metering

By using the net metering the excess power that is available can sent to grid. The main advantages are

1. If energy generation > energy consumed:, the excess power transferred to grid. So, it generates income.
2. In a grid connected solar PV system, any excess energy generated can be fed back to local utility grid and can be taken back at later stage when required. Thus, there is no need to store the surplus energy in batteries for later use
3. During summer energy may be transfer to grid, in winter it will be taken back. So, the overall amount to be paid per annum to the electricity board will be decreases.

This plant is connected to grid. Figure 11 shows the amount of output power transpiring to Grid.

Figure 11Power transpiring to grid from solar plant

IV. CONCLUSION

In this paper, the authors presented 20 kW roof top solar grid connected solar power plant at ACE Engineering College located in Hyderabad City, India. Installation of the 20 kW solar power plant is the second phase of the process in which the college is heading towards the electrical power generation through renewable energy sources and by the same time college is benefitted by reducing the amount payable towards DISCOMS by implementing Net metering system in this process whatever may be the generation of electricity by using solar power plant that should be reduced on final consumption of power.

As per the data total generation of solar power plant is given below.

Plant installation on : 16 April 2016
Annual yield :16.90 MWh
Total yield up to DEC 2017: 33.32MWh
CO_2 emission :13.30 kg
Installed capacity :20 kwh

According to above analysis the total investment returning in 10 years, the life time of plant is 25years. Government also encouraging solar plants and giving many concessions. So use of solar plant gives economic benefits, pollution free environmental. This analysis is very useful for institution, organization, which are interested to establish to give clear idea about solar plant.

V. ACKNOWLEDGMENT

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