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A Review on Grid Connected 100 kW Roof Top Solar Plant

Himanshu Bhardwaj, Tanuj Manglani, Neeraj Kumawat
Department of Electrical Engineering, Yagyavalkya Institute of Technology, Jaipur (India)

***Abstract* - Currently the whole world is suffering from a huge energy crisis. To cope up this energy crisis, it is required to develop alternative energy resources to meet the current load demand. Solar energy production is the best option to generate among all renewable energy resources. Photo Voltaic effect is used to convert the solar radiation into electric power directly by solar cell which is further converted into AC with the help of inverter which is situated between module and grid system. The objective of this work is to review the scope and the advantages of 100 kW roof top solar plant installed at Yagyavalkya Institute of Technology, Jaipur, Rajasthan (India).**

***Keywords*- Grid connected solar plant, PV plant, Roof top solar plant, Solar energy, solar plant installation, solar system.**

I. INTRODUCTION

In India, the electricity demand is increasing per day at an alarming rate. The energy generation resources like coal, Liquid fuels, Gaseous fuels etc. are in a limited position. These resources are decreasing with time where as demand is increasing continuously so renewable energy resources are the best option to adopt. According to Indian climate, Sun is the best alternative for energy production. The sun produces clean and eco-friendly energy. Some part of solar energy reaches on earth. This part is called solar irradiance. This solar energy has an intensity of 1360 W/m^2 [1].

A single solar or PV cell gives an output in a small fraction of power. So to increase the output power fraction, we connect large amount of PV cell on a plate. That plate is called PV module. In order to increase output power i.e. to increase voltage and current these PV modules are connected in series or parallel depending on the demand of power [2].

A solar mission program is launched by Government of India that is "Jawahar Lal Nehru National Solar Mission (JNNSM)".The purpose of this program is to increase the use of renewable energy resources. A target of 20,000 MW solar power generation is set up in this mission with the reduced cost [3].

II. TYPES OF SOLAR PLANT

Solar plants are divided in two types based on storage systems.

a) OFF Grid Solar Plant - In OFF Grid Solar Plant whole system does not connect to the local grid. In this we have to use local batteries to store solar power for consumption during clouding days or in night time. OFF Grid solar plant is costly because the storage system like batteries must replace with in a particular time for better efficiency [4].
b) ON Grid Solar Plant - A Grid Tie System or Integrated System is called ON Grid Solar Plant. In this plant whole system is connected to the local grid for consumption of electricity during cloudy days or in night time. ON Grid Solar system is most efficient and cheap as no batteries are required [5].

III. SOLAR PANEL CHARACTERSTICS

The typical I-V curve and P-V curve for a solar panel are shown in fig. 1. [9].

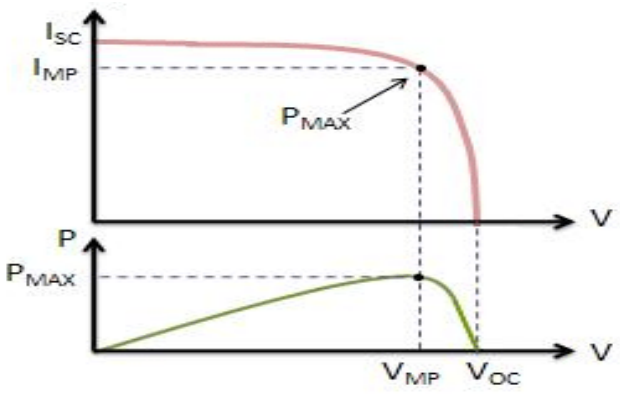

Fig.1. P-V and I-V curve of a solar cell at a particular temperature & irradiation

In the above figure, there is a power point on the knee of I-V curve. This point is called "maximum power point" (MPP) [10]. In the curve, I_{sc} is the solar panel circuit current in short circuit condition & V_{oc} is the solar panel circuit voltage under open circuit condition.

I_{MP} and V_{MP} are the tracking point for maximum current and maximum voltage respectively and can be track by MPPT system. Thus, the multiplication of both I_{MP} and V_{MP} gives the condition of maximum power for solar module as-

$$P_{MAX} = V_{MP} * I_{MP} \quad \text{watt}$$

IV. FACTORS AFFECTING PERFORMANCE OF SOLAR MODULE

Solar irradiation and Temperature are main factors which affects the performance of solar module.

(i) Solar Irradiation: If the solar irradiation is higher then solar input to the solar cell will also be higher and hence power magnitude will increase for same value of voltage. When there is more solar irradiation then due to high temperature the mobility of electrons increases thus more power generates [11].The effect of solar irradiation is shown below-

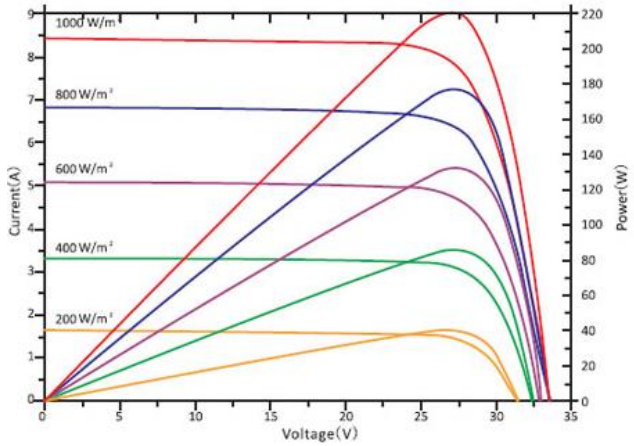

Fig.2. Effect of solar irradiation on solar cell

(ii) Temperature: Temperature also affects the performance of solar cells. Increment in temperature has negative impact on the capability of power generation. Generally solar cell is made of silicon so when temperature increases then band gap of material also increases so a much higher energy is required to cross the barrier for electrons. So the efficiency of cell reduces and hence power generation reduces [12].The variations due to temperature on solar cell is shown below-

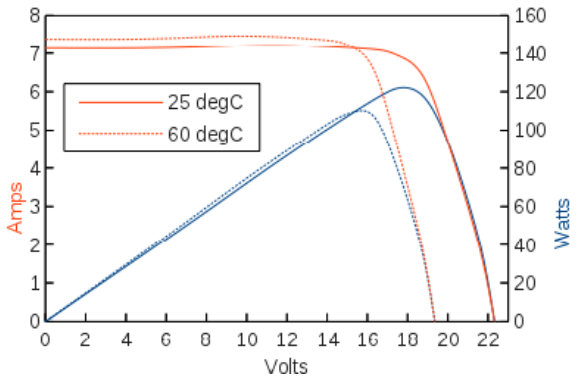

Fig.3. Variation due to Temperature on Solar cell

(iii) Other Factors: There are some other factors by which the performance of solar panels is also affected. The performance of solar system is affected largely by shading. A small amount of shadow on a part of a solar panel affects the entire solar plant. A panel which consists solar cells are connected in series and due to series connection the current of entire panel is affected by shading. Due to series connection of panels, shaded panel acts in reverse biased mode. This reverse biasing reduces the efficiency of solar plant [13]. Other than shading there are also some other losses by which the performance of solar plant is affected. These losses are-

- Inverter losses (4% to 10 %)
- DC cables losses (1 to 3 %)
- AC cables losses (1 to 3 %)
- Losses at weak radiation (3% to 7%)
- Losses due to dust, snow etc.(2%)

V. SPECIFICATION OF INSTALLED SOLAR PLANT

Table I shows the specification of 100 KW Roof top solar plant installed at YIT, Jaipur. Power Generation by 100 kW solar power plant at YIT in the month of April 2017 is shown in Table II.

Table I

Average generation per day	3.5-5 units
Expected electricity generation (annual)	120000 - 150000 units/year
No. of solar panels	318
Capacity of solar panels	315 W per panel
Total module area	636 square meter
Net metering	RSEB
System size	100 kW
Plant life	25 Year
No. of Inverters	2
Size of each Inverter	50 kW
Area covered by one panel (PV)	2*1 square meter
Cost of installation	Rs 1.8/watt
Cost of transportation	Rs 15,000
Cost including project management and commissioning	2-4% of total project cost
Mounting structure	7 tone 85-90 Rs/kg
Cost of remote control and monitoring system	Rs 20000
Main junction box rating	200 A, SFU
Energy Monitoring System Net meter & Solar meter	Rs 15,000
Protection switches ratings	200 Amp, inbuilt in inverter
Cost of 1W Roof Top solar plant	Rs 68.35/watt
System cost(100 KW)	Rs 68,35,000
Subsidy	Rs 20,50,500
Net cost after subsidy	Rs 48,32,500

Table II

S. No.	Date	Generation
1.	01-Apr-2017	508.70
2.	02-Apr-2017	481.70
3.	03-Apr-2017	485.50
4.	04-Apr-2017	467.00
5.	05-Apr-2017	482.20
6.	06-Apr-2017	506.70
7.	07-Apr-2017	452.00
8.	08-Apr-2017	519.00
9.	09-Apr-2017	535.10
10.	10-Apr-2017	344.80
11.	11-Apr-2017	516.20
12.	12-Apr-2017	499.50
13.	13-Apr-2017	482.90
14.	14-Apr-2017	472.40
15.	15-Apr-2017	481.30
16.	16-Apr-2017	482.30
17.	17-Apr-2017	480.20
18.	18-Apr-2017	486.90
19.	19-Apr-2017	483.00
20.	20-Apr-2017	462.10
21.	21-Apr-2017	479.90
22.	22-Apr-2017	479.70
23.	23-Apr-2017	469.00
24.	24-Apr-2017	404.20
25.	25-Apr-2017	327.30
26.	26-Apr-2017	410.70
27.	27-Apr-2017	487.90
28.	28-Apr-2017	478.90
29.	29-Apr-2017	381.20
30.	30-Apr-2017	427.70

VI. CONCLUSION

A clean energy is generated by solar power plant without affecting the environment. This system can easily be installed on the roof top of the buildings. Solar energy production has a very less maintenance and useful life of 25 years. Table II shows that the lowest generation of 327.30 units was on 25-April-2017 and maximum generation of 535.10 units was on 09-april-2017. Total generation in April month was calculated to be as 13976 units. The 100 kW roof top solar plant installed at Yagyavalkya Institute of Technology, Jaipur, India has the following advantages:

(i) Generating clean electricity without emission of harmful gases in the environment

(ii) Sharing load demand of the institute during day time.

(iii) Reducing monthly electricity bill by consuming less units from local grid.

(iv) Supplying excess generated units to the connected grid under low load demand of YIT.

(v) Giving opportunities to students to increase their technical capabilities in the field of solar system.

Government must come forward to provide a sufficient knowledge regarding solar power production to the people and provides subsidies, incentives on solar generation, so that more solar power generation can be generated.

VII. ACKNOWLEDGEMENT

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