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Design, Installation & power quality analysis of Solar Panel for Rooftop Application

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ABSTRACT

This project presents a design and installation of solar panel for Oriyana apartment, Pimple Gurav, Pune. The electric load demand considered, was about 45kw. On analysis of storage, distribution system, solar panel for 35kw, consisting 106 solar panels mounted in 6 parts of area. Power quality disturbance is become major problem in electrical system.It is mainly caused due to nonlinear load and quality of power also be affected by solar rooftop PV system integrated to distribution network. This paper also presents m power quality analysis of a rooftop solar PV system.

Keywords: power quality, solar PV, Net Meter

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I. INTRODUCTION

Electrical energy is one of the basic need in our daily life, due to which demand is increasing. In present, the total installed capacity in India is 364.9GW as of 31 August 2019, where, share of nonrenewable sources is 79.8% and share of renewable sources is 20.2%[2].

The major source of electricity generation is fossil fuels which is depleting gradually and raising environment concern. Due to the combustion of fossil fuel such as coal for generation, gases like carbon di-oxide(CO2), sulphur oxide(Sox), CFCs, are emitting, resulting into Global warming[3]. These reasons are forcing towards the development of renewable sources.

Renewable energy sources are wind, solar, water, biomass, etc. Out of which solar is fastest growing and cheapest source. For sustainable energy growth of countries like, India, it is required to use renewable sources like Solar PV power plant, which provides stable power during day hours. If SPV is implemented with grid interactive system, power during non solar hours can be imported from grid or excess power can be fed back into grid.

II. DESIGN CALCULATIONS

In our site, there are 6 areas on which solar panels are to be mounted. Out of them 4 areas (1,2 & 5,6) are having approximately same dimensions.

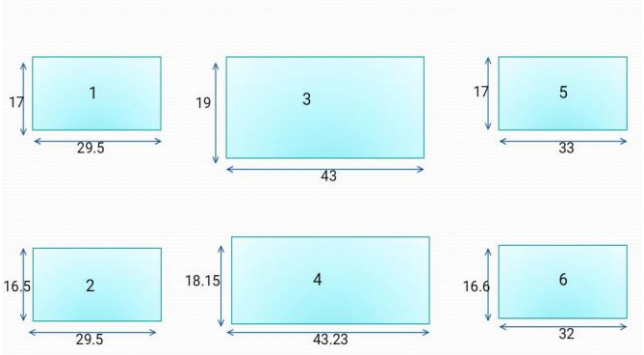

Fig. 1 Design scheme.

1. Area=30ft*17ft=510 sq. ft.
   1kw=100 sq. ft.
   X=510sq. ft. i.e. X=5kw.
   (where, X is energy to be generated from respective Area)

   Each module has rating of 330wp
   No. of modules required= 5000/330= 15 nos.

2. Area=43ft*19ft=817sq.ft.
   1kw=100sq.ft
   X=817sq.ft.=8.17kw
   No. of modules required= 8170/330=25 nos.

III. COMPONENTS USED

1.Solar Panel – There are 3 types of solar panel :

i) Polycrystalline solar panel

ii)Monocrystalline solar panel

iii)Thin film solar panel

Here, we are using Polycrystalline solar panel.

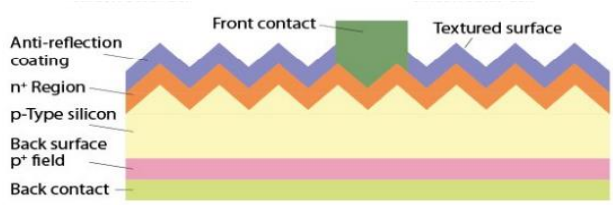

Fig. 2 Solar panel construction.

Using polycrystalline boron doped p type silicon substrate , standard cells are produced. Polycrystalline cells are made from square silicon substrate[1]. Front structure of cell is covered with pyramid size to reduce incident light's reflection loss.

2.Inverter –

The inverter used here is grid tie inverter. This inverter is associated with grid. The power generated by solar PV cells i.e. DC voltage is converted into AC. Various manufacturers of inverters are available like, Grow watt, SMA, Kslore, Fronius, out of which Fronius inverter with tier 1 quantity is used here. It is grid interactive type with all protections like anti-islanding: 3ph, 35kw capacity.

Fig. 3 Installed inverter.

3. Solar ACDB –

It is an important part of solar PV system. It gives extra protection to the system in case of failure. ACDB is made up of breaker, isolator, voltage and current monitoring etc. Along with fuse, it has provision for surge protection. ACDB consist of energy meter, which gives information about usage of energy.

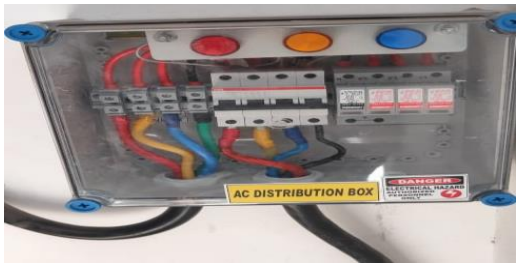

Fig. 4 Installed ACDB

4. Solar DCDB –

For protecting the DC side against any fault causing failure, DCDB is used. It is very crucial part of solar PV system because adequate protection is must on DC side. It consist of isolator which protects the system under faulty condition, energy meter which gives information regarding exact PV array voltage and current obtaining.

Fig. 5 Installed DCDB

5. Net Meter –

Net meter is bidirectional meter, which records the energy imported from grid to fulfill the load demand and excess energy that is exported energy to grid after self-consumption.

6. Mounting Structure-

There are various mounting structures for solar module like, Rooftop, Tin shade, single pole, Ground mounted structures. Out of this rooftop mounting structure is used, in which solar panel are mounted on rooftop with few inches gap with surface of roof and in parallel with it. This structure is easy to install as it uses only mechanical system of assembly with use of nu and bolt. This is highly durable with the use of Pre-galvanized steel for purlins and Aluminum clamps for module mounting.

IV. OPERATION

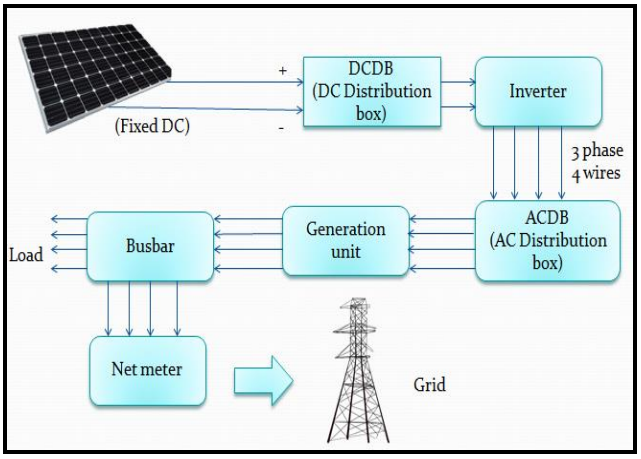

Fig. 6 Flow Chart

Solar panel consist of layer of silicon, a metal frame, glass casing.Silicon photovoltaic cells absorbs solar radiations. When sun rays interact with the silicon, electrons begin to

move, creating the flow of electric current. The generated DC voltage is then fed to the inverter by using TUV certified cables via DC distribution box. It consists of fuse,MCB,SPD. DC voltage is then converted into AC voltage using inverter. This converted AC voltage is then given to busbar through AC distribution box. After ACDB, generation unit is connected, which gives the amount of electricity generated from the solar PV cells. The load is fed from busbar. For four quadrant energy metering, the net meter is connected prior to the grid connection.

V. CONCLUSION

This papers presents a design and installation of solar panel for Oriyana apartment, Pimple Gurav, Pune. Solar PV is suggested for roof top installation. The benefits of the proposed system are reliability, economy, simplicity and adoptability. The limitations of the proposed system is PQ related issues, which require detailed research and development.

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