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Design & Development of 200KW Solar Power Plant

V.V. Sangle
UG Student,EED,AISSMS IOIT
Pune, India
sanglevaibhav211@gmail.com

Dr. Ashpana Shiralkar
Head, EED,AISSMS IOIT
Pune, India
ashpana.shiralkar@aissmsioit.org

P. S. Kanakdande
UG Student,EED,AISSMS IOIT
Pune, India
pkanakdande@gmail.com

M.P. Ambhore
UG Student,EED,AISSMS IOIT
Pune, India
maheshambhore1441@gmail.com

S.S. Rathod
UG Student,EED,AISSMS IOIT
Pune, India
Shubhamrathod267@gmail.com

***Abstract*— In this paper, a detailed case study has been presented on the design and development of a 200KW solar power plant at Baramati, Pune. This paper deals with the sizing of various equipment as well as the specification of the Solar Panel, Inverter. Electricity one of the needs of the modern world, without electricity all of the latest technologies not worked. People cannot be depending on fossil fuels, because when fossil fuels run out, People need to find out new sources. There are a lot of renewable sources like wind energy, solar energy, tidal energy. There is a lot of sunlight in the world and this sunlight can transfer to the electricity with help of solar PV cells. There is one biggest advantage of this renewable source is that there is no end to this energy. This energy cannot be produced pollution on the earth that's why all developed as well as non-developed countries works on this energy.**

Keyword- On Grid connected, Equipment, Renewable Energy

I. Introduction

Solar power is a conversion of solar energy from sunlight into electricity. Directly using photovoltaics (PV) or indirectly using concentrated solar power, or a combination of both. Concentrated solar power systems use lenses or mirrors and solar tracking systems to focus a large area of sunlight on a small beam.

Every second 650 million tons of hydrogen are converted to 653 million tons of helium in the sun. The missing 40 lacs tons are converted to light and heat energy via Einstein's theory and this energy radiated into space. At an average distance of 15 Cr km from the sun, the earth collects approximately 4 lbs of total energy, which supports life on earth. It can be any residential house that generated electricity by using a solar power system. As per data from renewable consultancy Bridge to India, around 9% of India's installed solar rooftop capacity, pegged at 521 MW as of September 2018. Currently, about 20 % of the houses in Pune are using solar water heating units.

India being a tropical country receives adequate solar radiation for 300 days, the average intensity of solar radiation received in India is 200 MW/km square. The geographical area of India is 320 thousand km square, so a total of 62 Cr MW power can be generated per year. However, 88% of the land is used for agriculture, forests, other lands, and 7% for housing, industry, and 5% is barren, snow bound, or generally inhabitable land. Thus only 13 % of the land can be used for solar power which is 4 lacs km square can be used for solar energy installations. Gujarat states received the highest solar radiation in India.

Now a day's need for electricity energy sources and only 17.5% of energy is produced by renewable energy sources. Due to the use of more amount of non-renewable energy sources pollution goes on the increase. To control this pollution, the Indian government is mainly focused on renewable energy sources.

II. Design Methodology

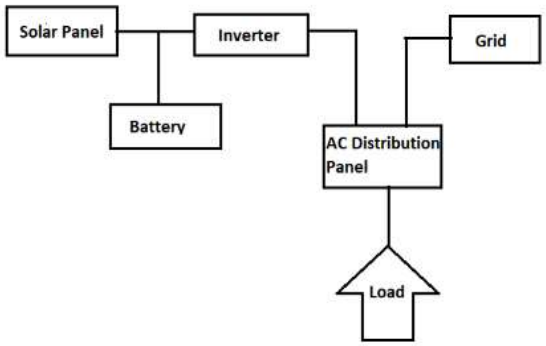

Fig. 1 Schematic Diagram of On-Grid PV System

The methodology for designing a 200 KW grid-connected Photo Voltaic System at Baramati. PV system is connected to the on-grid system which is directly provided by Maharashtra State Electricity Distribution Company Limited (MSEDCL).

III. Functional Component

- Solar panels
- Inverter
- AC Distribution Panel
- DC Distribution Panel
- Net meter
- Mounting Structure

A. Solar Panel

Solar Panel is basic equipment used in the solar system. The solar panel is a set of the solar photovoltaic module which is used to generated electricity using solar radiations. There are two types of solar panels.
1) Mono-Crystalline
2) Poly Crystalline
Monocrystalline and Polycrystalline solar panels have cells made of silicon wafers. To construct a Monocrystalline or Polycrystalline solar panel, wafers are assembled into rows and columns to form a rectangle, covered with a glass sheet, and framed together. The monocrystalline panel typically has the highest efficiencies and power capacity. Monocrystalline solar panels have efficiencies higher than 20 %, while polycrystalline solar panels usually have efficiencies between 15 to 17 %. Monocrystalline solar cells are more efficient than polycrystalline solar cells because they are cut from a single source of silicon. Polycrystalline solar cells are blended from multiple silicon sources that's why polycrystalline solar cell has less efficient. Monocrystalline panels are Made of single silicon cells. All cells are black and Perform better even in low light. Polycrystalline panels are built up of multiple silicon cells it looks blueish in colour and also performs low in cloudy weather.

Table 1 comparison between monocrystalline and polycrystalline panel

Parameters	Monocrystalline	Polycrystalline
Cost	High	Low
Efficiency	High	Low
Appearance	Black color panels	Bluish color panels
Lifespan	Minimum 25 years	Up to 25 years
Temperature Coeff.	High	Low

Specification

- Module Type – Monocrystalline.
- Efficiency – 20.75%
- Wattage - 420 W
- Temperature – 25 °C
- Single Solar Cell Voltage – 0.6 V
- Current Density – 30 mA/cm² to 36 mA/cm²
- Current – Nearly 3.5 A

B. Inverter

Electricity generated by solar panels is direct current (DC), and most household appliances require alternating current (AC), an inverter is necessary to change the current from direct current (DC) to alternating current (AC). There are three types of inverters. All these inverters are currently available in the market.

1) string (also known as centralized) inverters
2) power optimizer systems
3) microinverters.

Most people used string type inverter because of less cost and also good efficiency and also String inverter technology has been used for decades. It is a very reliable, tried-and-true technology string inverters are the most commonly used type of inverter. Under this PV setup, your solar panels are wired together through a common "string," and all of the energy the panels produce is sent to a single inverter. Microinverters are set up in the opposite as a string inverter. Solar PV systems with a microinverter have an individual "micro" inverter placed at the site of each solar panel. String inverters send energy from every panel to a single inverter, a PV system using microinverters converts the DC solar energy to AC energy on the spot.

Power optimizers have primary features of both string inverters as well as microinverters. power optimizers are located on the roof alongside or integrated with each solar panel. Microinverters that do the DC to AC conversion at the site of the solar panel. Power optimizers optimize DC before it is sent to the string inverter for conversion of Direct Current into Alternating Current. This leads to a much more efficient conversion process.

Specification

- Nominal AC Output Voltage – 415V
- Phase – 3 Phase
- Frequency – 50 HZ
- Accuracy of AC voltage control - ±1%
- Inverter Efficiency - >95%
- Maximum Input DC Voltage – 1000V

C. Protection and Controls

- Inverter is provided with an islanding protection to disconnect it from the grid in case of supply failure,

voltage fluctuations so that there will not be any chance of human accident.

- PV systems are provided with adequate rating of fuses, fuses on input side (DC) as well as output side (AC) side for overload and short circuit protection.
- The switches are provided to each array of solar panels connected to inverters so that they can be isolated during maintenance.
- Each solar panels mounted structure are earthed properly and the entire plant is also protected with an lightening arrester.

D. AC Distribution Panel

A distribution board is also known as a breaker panel or panel board. The AC Distribution Board receives the AC power from the solar inverter and directs it to AC loads through the distribution panel. It is a component of an electricity supply system which is divided electrical power into secondary circuits while providing protective devices such as a fuse or circuit breaker (CB). It is used to provide overload and short circuit protection.

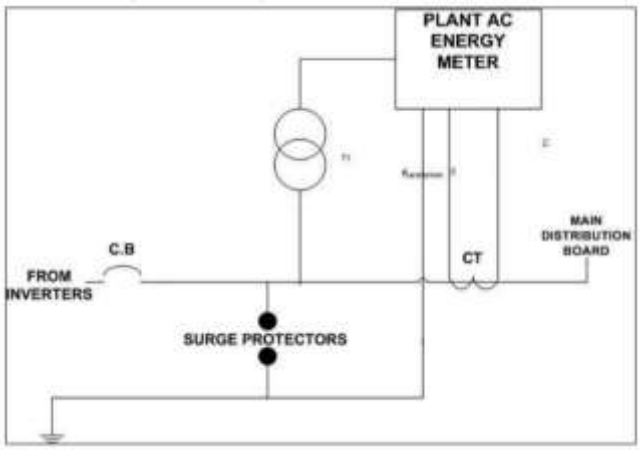

Fig. 2 Schematic Diagram of ACDB

E. DC Distribution Panel

The flexibility for the operator of the solar power plant to disconnect and connect both the inward solar supply and battery terminals is provided by the direct current distribution panel. Direct Current Distribution Panel has MCCB and a fuse of proper rating depending upon the capacity of the power plant and the battery bank is used.

F. Net Meter

A measuring meter will calculate how much energy you have taken from the grid and also supplied to the grid.

Net Meter is also capable of recording both the import and export data of electricity or a pair of energy meters. one for recording an import and the other for a recording of export of electricity.

Fig.3 Net Meter Device

F. Mounting Structure

A mounting structure is the support structure that holds the solar panel. A mounting structure can be fixed or variable tracking. Fixed tilt mounting systems are simpler. Fixed tilt mounting structure systems also low maintenance and cheaper than tracking systems. Due to these reasons in this solar plant fixed systems were used.

G. Lightning protection

There needs to be the required number of suitable lightning arrestors installed in the array area. Lightning protection needs to be provided by the use of metal oxide arrestors with suitable earthing such that induced transients use for find an alternate route to the ground. Protection safety rules follow as per the Indian Electricity Act.

H. Lightning protection

Each PV panel should be grounded/ Earthing properly as per IS:3043- 1987. The lightning arrester should also be provided inside the array field. Provision should be kept for shorting and grounding of the PV Panel at the time of maintenance work. All-metal casing/shielding of the solar plant should be thoroughly grounded in accordance with the as per rule of the Indian electricity Act/IE Rules. Earth Resistance should be tested in presence of the representative of the Department by calibrated earth tester. Inverter, ACDB, and DCDB should also be earthed properly.

IV. MONTHLY ENERGY GENERATION

The monthly energy generation from the solar power plant will be nearly from march to June nearly 27000 KWh (Unit), and from July to October energy generation will be nearly 22000 KWh (Unit), and from November to march energy generation will be nearly 21000 to 22000 KWh (Unit).

V. Conclusion

This paper suggests a method of design and development of solar power plants. Solar PV is suggested for roof-top installation. The benefit of the solar plant is economically better. The Limitation of a solar power plant is cloudy whether as well as in night there is no irradiation. Installation of 200 KW solar PV power generation resulted in a substantial saving of 2.5 lacs Rupees per month in energy billing charges. The payback period for the investment will cover in the next 4 years.

References

[1] Dr. M. Chakravati, K. V. Ramana Murthy, B. Neelima Devi "Design. Erection, Testing and Commissioning of 200Kwp Rooftop Grid Tied Solar Photovoltaic System at Vasavi College of Engineering ," IEEE, vol 25, pp 146 to 152, Dec 2015

[2] Malvika Satish, Sharon Santosh, and Apurva Yadhav "Simulation of a Dubai Based 200 KW Power Plant Using PV System Software ,"2020 7th International Conference on Signal Processing and Integrated Networks (SPIN),IEEE, vol.21, pp 824 to 827.Jan 2020.

[3] Philips Schewes and Philip Schmidt, Install Your Own Solar Panels: Designing and Installing a Photovoltaic System to Power Your Home, 1st ed., Storey Publishing, LLC. 30 june 2017.

[4] S.P.Sukhatme and J.K.Nayak., "Solar Energy," fouth edition, McGraw-Hill Education, 15-Sep-2017.