RESEARCH ARTICLE

STUDIES ON PARAMETERIZATION, OPERATION AND MAINTENANCE OF SOLAR POWER PLANT

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Abstract: Solar energy is clean, inexhaustible and environment friendly potential resource among renewable energy options. But neither a standalone solar photovoltaic system nor a wind energy system can provide a continuous supply of energy due to seasonal and periodic variations. Therefore, in order to satisfy the load demand, off grid energy systems are now being implemented that combine solar and conventional conversion units. In one minute, the sun provides enough energy to supply the word's energy needs for one year. In one day, it provides more energy than the world's population could consume in 27 years. The energy is free and supply is unlimited. All we need to be find a way to use it.

Keywords: Operation, Parameterization, Solar power plant

INTRODUCTION

The Sun is the most plentiful energy source for the earth. All fossil fuel, wind, hydro and biomass energy have their origins in sunlight. Solar energy falls on the surface of the earth at a rate of 120 petawatts, (1 petawatt = 10^{15} watt). This means all the solar energy received from the sun in one days can satisfied the whole world's demand for more than 20 years. In just one year the Earth's surface receives as much solar energy as two times the total reserves of the Earth's non-renewable resources of coal, oil, natural gas, and mined uranium combined.

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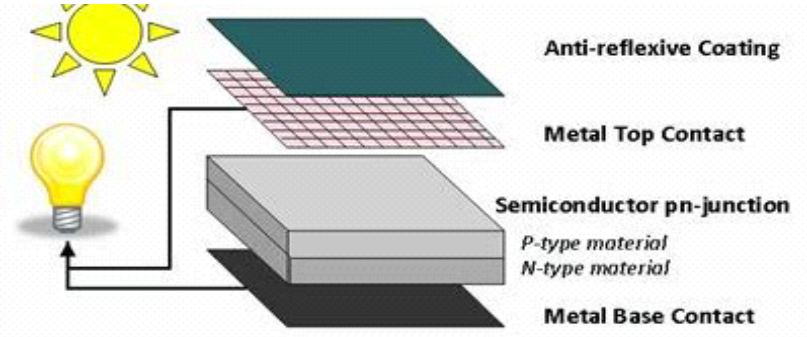
India, due to its geo-physical location, receives solar energy equivalent to nearly 5,000 trillion kWh/year which is equivalent to 600 GW. This is far more than the total energy consumption of the country today. Solar PV solution has the potential to transform the lives of 450 million people, who rely on highly subsidized kerosene oil and other fuels, primarily to light up their homes.

MATERIALS AND METHODS

The solar panels, also known as photovoltaic modules (or PV modules), convert sunlight into electricity, and they have been the backbone of renewable energy for decades. The Photovoltaic Effect (how sunlight is converted into electrical energy) was discovered over a hundred years ago. Yet widespread implementation of this technology has been very gradual. Only in very recent years has photovoltaic's gained wide popularity as an alternative way to produce electricity.

Composition of a Solar Cell

A. Encapsulate - The encapsulate, made of glass or other clear material such clear plastic, seals the photovoltaic cell from the external environment.



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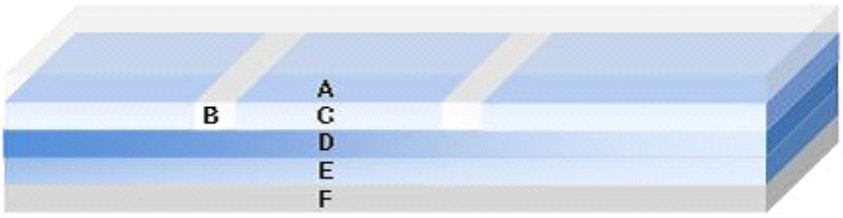


Fig. 1. Composition of solar cell.

B. Contact Grid- The contact grid is made of a good conductor, such as a metal, and it serves as a collector of electrons.

C. the Antireflective Coating (AR Coating) - Through a combination of a favorable refractive index, and thickness, this layer serves to guide light into the photovoltaic cell. Without this layer, much of the light would bounce off the surface of the cell.

D. N-Type Silicon - N-type silicon is created by doping (contaminating) the silicon with compounds that contain one more valence electrons* than silicon does, such as with either phosphorus or arsenic. Since only four electrons are required to bond with the four adjacent silicon atoms, the fifth valence electron is available for conduction.

E. P-Type Silicon- P-type silicon is created by doping with compounds containing one less valence electrons* than Si does, such as with boron. When silicon (four valence electrons) is doped with atoms that have one less valence electrons (three valence electrons), only three electrons are available for bonding with four adjacent silicon atoms, therefore an incomplete bond (hole) exists which can attract an electron from a nearby atom. Filling one hole creates another hole in a different Si atom. This movement of holes is available for conduction.

F. Back Contact - The back contact of a photovoltaic cell is made out of metal that covers the entire back surface and acts as a conductor.

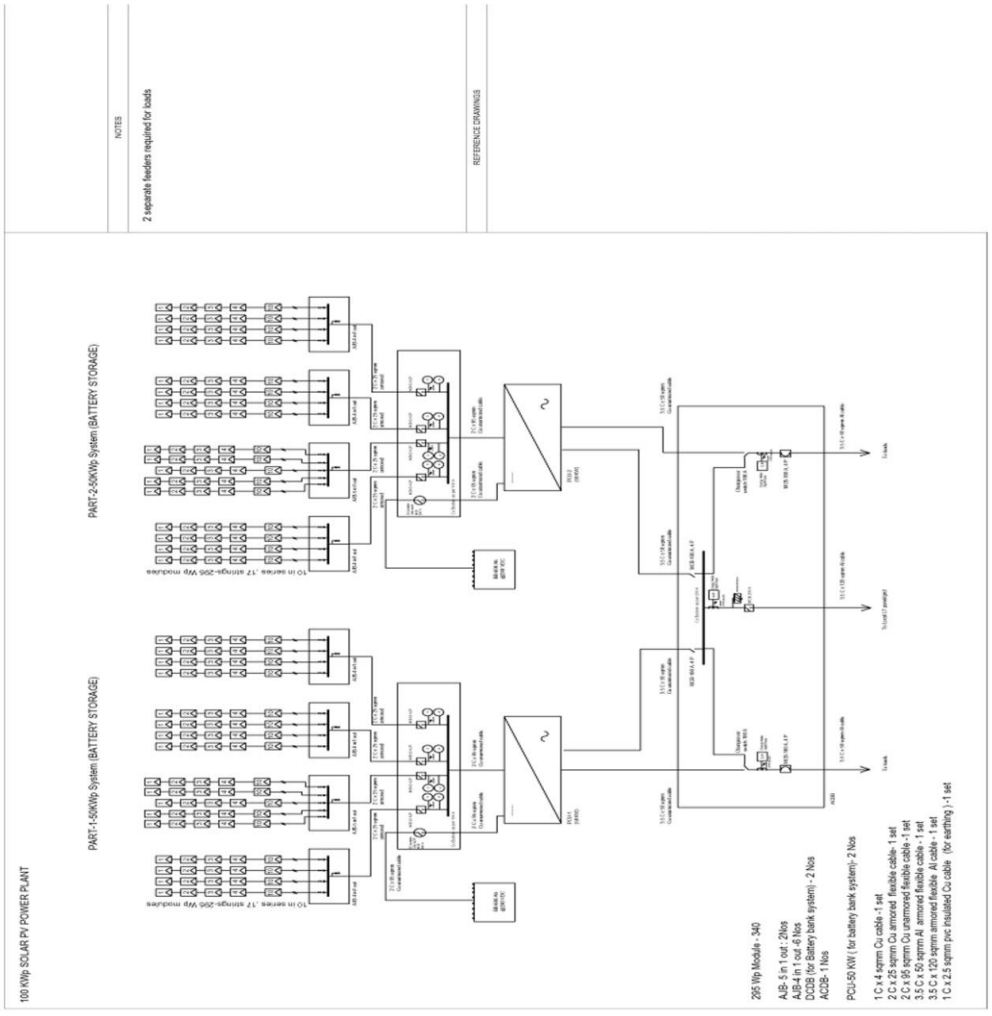


Fig. Electric wire connectivity

System Design

Desired power, voltage and current can be obtained by connecting indivisual PV modules in series and parallel. When circuits are wired in series (positive to negative), the voltage of each panel is added together but the amperage remains the same. When circuits are wired in parallel (positive to positive, negative to negative), the voltage of each panel remains the same and the amperage of each panel is added. This wiring principle is used to build photovoltaic (PV) modules. In the existing structure total number of module is 340. Each module consist 72 PV cells. Now to form a string 10 modules are connected in series through 4 mm^2 1 core cu cable . Thus, there are total 34 strings. These strings or arrays are connected in parallel to an array junction box (AJB). In the present structure there are total 8 AJBs. Out of 8 AJBs , 6 AJBs connect 4 strings while 2 AJBs connect 5 strings in parallel. From an array junction box a single output 2 core x 25 mm^2 Cu armored flexible cable is joined to DCDB (Direct Current Distribution Board) . There are 2 DCDB units which are connected to PCU (Power Conditioning Unit) through 2 core x 95 mm^2 Cu unarmored flexible cable. For the battery backup ,connection is provided between PCU and battery bank through a 2 core x 95 mm^2 Cu unarmored flexible cable.PCU is connected to ACDB (Alternating Current Distribution Board) through an input and an output 3.5 core x 50 mm^2 Al armored flexible cable each. Finally, from ACDB 3.5 core x 50 mm^2 Al armored flexible cable goes to load and a 3.5 core x 120 mm^2 armored flexible Al cable goes to grid connection.

Plate: Installation of Structure

Plate: Cable connection

Plate: Computer system and DCDB box

Electricity Production

Since, each module contains 72 PV cells and each cell is rated with 0.5 volt. So total 72 PV cells connected in series will produce 72 x 0.5 = 36 volts.

Now, 10 modules are connected in series to form a string. So, total output from a string is

10 x 36 =360 volts.

Now, the rated power of single module is 295 Wp .So, we can predict the current from single module as 295/36 =8.19 Amp.

Since, there are 34 parallel connections and we know that in parallel connection voltage is same but amperage will be add. So , total expected maximum output without losses from solar PV structure will be :

Total voltage is 10 x36 =360 Volts.

Total current is 8.19 x 34 =278.5 Amp.

The output from solar photovoltaic structure is fluctuated output, because it depends on irradiance of solar energy on the structure. So output may fluctuate with weather conditions. This fluctuation should be within specified range.

RESULTS AND DISCUSSION

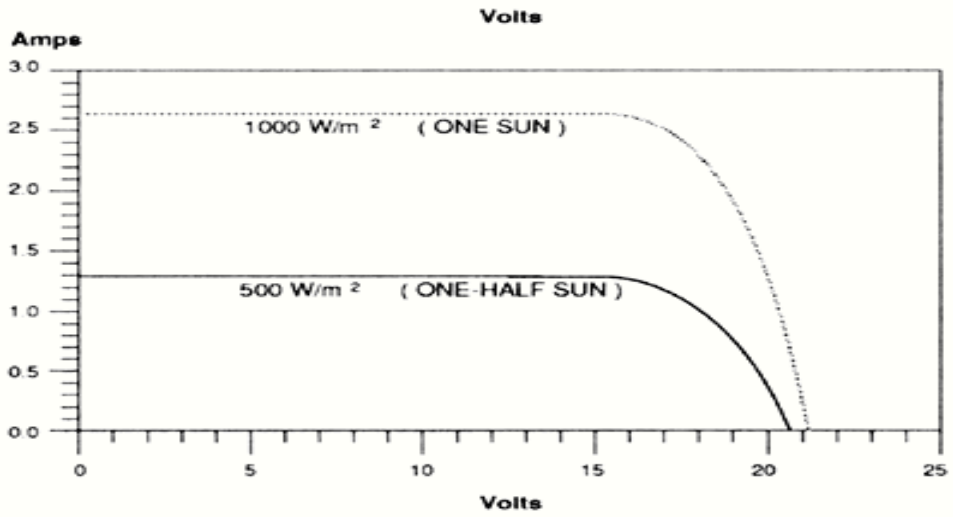
System sizing and specification

Table. Site summary

S. No.	Attributes	Details
1	Site	BRSM CAET Campus
2	Location	Chatarkhar (C.G.)
3	Coordinates	
4	Elevation from sea level in (Meters)	300
5	Site Disposition	Ground Mounted

Impact of Solar Radiation on V-I Characteristic Curve of Photovoltaic Module

Standard sunlight conditions on a clear day are assumed to be 1000 watts of solar energy per square meter (1000 W/m2). This is sometimes called "one sun," or a "peak sun." Less than one sun will reduce the current output of the module by a proportional amount. For example, if only one-half sun (500 W/m2) is available, the amount of output current is roughly cut in half. For maximum output, the face of the photovoltaic modules should be pointed as straight toward the sun as possible.



Graph: Change in Photovoltaic module voltage and current on change in solar radiation

Table. Project Overview

S. No.	Attribute	Details
1	Solar PV System Description	100 KWp Solar PV Power Plant
2	Scope of Work	Layout Design Study on Erection, Operation and Maintenance of Solar Power Plant
3	Location	BRSM CAET Campus Chatarkhar, Mungeli (C.G.) – 495334
4	Services	LANCO SOLAR ENERGY PVT LTD
5	Life of System	25 Years
6	System Cost	1 Crore 25 Lakh

Maintenance

Both the three phase GSC and HPC systems incorporate a robust, low maintenance design. The level of maintenance depends entire upon the actual installation location and prevalence to dirt and dust.

The major purpose of maintenance on the system is to ensure that the integral cooling system remains properly functional. In order to achieve this, it is important to understand the factors that affect the operation of cooling system.

Ventilation: There will be a number of air inlet vents with filters located on the front and possibly the side of the cabinet. The filters need to be checked periodically and found to be dirty then cleaned by washing with warm soapy water and then thoroughly dried before fitting back into the system. It is critical that no restrictions are imposed on the air flow through the filters at any point in time.

Fans: Depending on the type and capacity of the system, the air inlet vents located at the rear of the cabinet or alternately on the top or side of the cabinet have thermostatically controlled cooling fans fitted. In ideal installations the fans will provide many years of reliable service. If the system is to be installed in a situation where the humidity is high and corrosion could occur, the fans should be periodically checked by removing the fan cover and manually rotating the blades to ensure free bearing operation and minimal lateral axis movement.

Precautions

- All electrical wiring required for the installation of this equipment should be carried out by a qualified electronics in the system enclosure. Unauthorized tampering will void the warranty.
- Do not put the system and batteries together in fully enclosed airtight container. Ensure that they are installed in a well ventilated area or enclosure.
- Ensure that the system is adequately ventilated and that it is installed in a dust and dirt free environment. The system should not be subjected to excessive heat. Avoid (if possible) installing the system in the same container or room as a generator as this may leave generator fume residue on the printed circuit boards inside the inverter.
- Good earthings is essential for safety and minimization of electrical noise and must be installed in accordance with local electrical requirements.
- Any untrained person entering the power station should at all times remain in the attendance of authorized personnel and should obey all instructions given.
- Appropriate isolation procedures must be followed before carrying out service or maintenance on equipment.

CONCLUSION

An understanding about layout design, erection procedure, electricity generation and its distribution, operation and maintenance is developed. Various factors affect the output electricity such as temperature, sun angle and orientation of structure, sunshine hour, intensity of solar radiation, AC to DC conversion losses, dirt and dust, shading. Before starting electricity production it is essential to verify that the system has been installed according to the manufacturers procedures. A system can be checked with some fairly simple test equipment to verify proper installation and performance.

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