

PROFESSIONAL TRAINING REPORT

Sathyabama Institute of Science and Technology

(Deemed to be University)



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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VATIO®



Certificate OF INDUSTRY INTERNSHIP

This is to certify that

I.HAMEED FAZIL

Studying **3rd Year, B.E, EEE** in **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY**

has successfully completed the Industry Internship Programme at VATIO Energy India Pvt Ltd, Chennai
through Online from 21st July to 05th August 2021 in the area of
"Solar Photovoltaic system & its Design Practices"

Best wishes from VATIO Energy for future endeavors !

G.Rajaganesan, Director - Technical
VATIO Energy India Pvt Ltd.



05th August 2021

Date

Solar Panel

A solar panel consist of many solar cells with semiconductor properties encapsulated within a material to protect it from the environment. These properties enable the cell to capture light, or more specifically, the photons from the sun and convert their energy into useful electricity through a process called the photovoltaic effect. On either side of the semiconductor is a layer of conducting material which "collects" the electricity produced. The illuminated side of the panel also contains an anti-reflection coating to minimize the losses due to reflection. The majority of solar panels produced worldwide are made from crystalline silicon, which has a theoretical efficiency limit of 33% for converting the Sun's energy into electricity. Many other semiconductor materials and solar cell technologies have been developed that operate at higher efficiencies, but these come with a higher cost to manufacture.



Inverters

An inverter is an electrical device which accepts electrical current in the form of direct current (DC) and converts it to alternating current (AC). For solar energy systems, this means the DC current from the solar array is fed through an inverter which converts it to AC. This conversion is necessary to operate most electric devices or interface with the electrical grid. Inverters are important for almost all solar energy systems and are typically the most expensive component after the solar panels themselves. Most inverters have conversion efficiencies of 90% or higher and contain important safety features including ground fault circuit interruption and anti-islanding. These shut down the PV system when there is a loss of grid power.



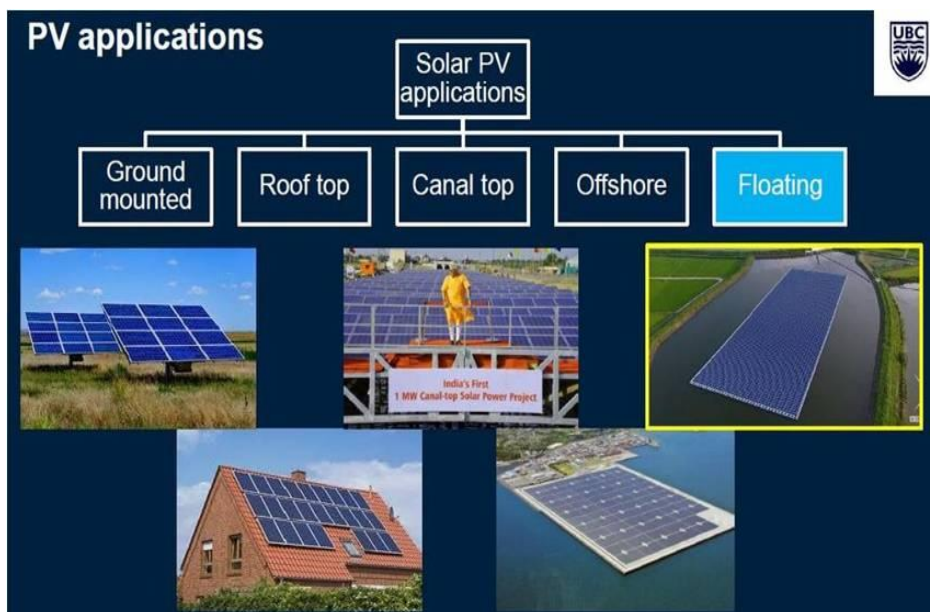
Photovoltaic System

A **photovoltaic (PV) system** is composed of one or more solar panels combined with an inverter and other electrical and mechanical hardware that use energy from the sun to generate electricity. PV systems can vary greatly in size from small rooftop or portable systems to massive utility-scale generation plants. Although PV systems can operate by themselves as off-grid PV systems, this article focuses on systems connected to the utility grid, or grid-tied PV systems



PV Applications

- Solar Farms. Many acres of PV panels can provide utility-scale power—from tens of megawatts to more than a gigawatt of electricity
- Remote Locations
- Stand-Alone Power
- Power in Space
- Building-Related Needs
- Military Uses
- Transportation



Racking

Racking refers to the mounting apparatus which fixes the solar array to the ground or rooftop. Typically constructed from steel or aluminum, these apparatuses mechanically fix the solar panels in place with a high level of precision. Racking systems should be designed to withstand extreme weather events such as hurricane or tornado level wind speeds and/or high accumulations of snow. Another important feature of racking systems is to electrically bond and ground the solar array to prevent electrocution. Rooftop racking systems typically come in two variations including flat roof systems and pitched roof systems. For flat rooftops it is common for the racking system to include weighted ballast to hold the array to the roof using gravity. On pitched rooftops, the racking system must be mechanically anchored to the roof structure. Ground mounted PV systems, as shown in figure 4, can also use either ballast or mechanical anchors to fix the array to the ground. Some ground mounted racking systems also incorporate tracking systems which use motors and sensors to track the Sun through the sky, increasing the amount of energy generated at a higher equipment and maintenance cost.

Advantages of solar PV

- PV panels provide clean – green energy. During electricity generation with PV panels there is no harmful greenhouse gas emissions thus solar PV is environmentally friendly.
- Solar energy is energy supplied by nature – it is thus free and abundant!
- Solar energy can be made available almost anywhere there is sunlight
- Solar energy is especially appropriate for smart energy with distributed power generation – DPG is indeed the next generation power network structure!
- Solar panels cost is currently on a fast reducing track and is expected to continue reducing for the next years – consequently solar PV panels has indeed a highly promising future both for economical viability and environmental sustainability.
- Photovoltaic panels, through photoelectric phenomenon, produce electricity in a direct electricity generation way
- Operating and maintenance costs for PV panels are considered to be low, almost negligible, compared to costs of other renewable energy system

Components

The remaining components of a typical solar PV system include combiners, disconnects, breakers, meters and wiring. A **solar combiner**, as the name suggests, combines two or more electrical cables into one larger one. Combiners typically include fuses for protection and are used on all medium to large and utility-scale solar arrays. **Disconnects** are electrical gates or switches which allow for manual disconnection of an electrical wire. Typically used on either side of an inverter, namely the "DC disconnect" and "AC disconnect" these devices provide electrical isolation when an inverter needs to be installed or replaced. Circuit breakers or **breakers** protect electrical systems from over current or surges. Designed to trigger automatically when the current reaches a predetermined amount, breakers can also be operated manually, acting as an additional disconnect. An **Electric meter** measures the amount of energy that passes through it and is commonly used by electric utility companies to measure and charge customers. For solar PV systems, a special bi-directional electric meter is used to measure both the incoming energy from the utility, and the outgoing energy from the solar PV system. Finally, the **wiring** or electrical cables transport the electrical energy from and between each component and must be properly sized to carry the current. Wiring exposed to sunlight must have protection against UV exposure, and wires carrying DC current sometimes require metal sheathing for added protection.

Further Reading References:

- [ISE Energy Charts](#)
- [Study: Levelized Cost of Electricity - Renewable Energy Technologies](#)
- [Recent facts about photovoltaics in Germany](#)
- [Power Generation from Renewable Energy in Germany](#)
- [What will the Energy Transformation Cost? Pathways for Transforming the German Energy System by 2050](#)
- [Sustainable PV Manufacturing in Europe –An Initiative for a 10 GW GreenFab](#)
- [Meta Study: Future Crosssectoral Decarbonization Target Systems in Comparison to Current Status of Technologies](#)
- [Study: Current Status of Concentrator Photovoltaic \(CPV\) Technology](#)