Daffodil international University

Department of Electrical & Electronic Engineering

Course Code: EEE 450

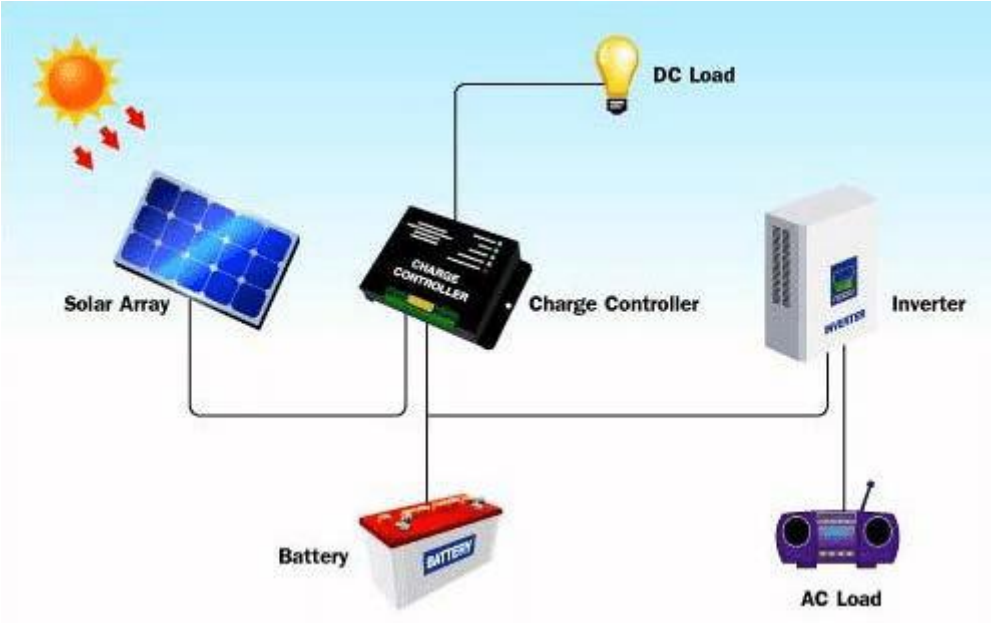
Course Title: Power Plant Engineering Lab

Experiment 08

Study of working principle of Solar PV system

Objective: To gain exposure to actual Solar power plant systems and its operation.

Schematic Arrangements:



Types of PV Systems

Photovoltaic-based systems are generally classified according to their functional and operational requirements, their component configuration, and how the equipment is connected to the other power sources and electrical loads (appliances).

The two principle classifications are

I. Grid-Connected and
II. Stand Alone Systems.

I. **Grid Connected:** Grid-connected or utility-intertie PV systems are designed to operate in parallel with and interconnected with the electric utility grid. The primary component is the inverter, or power conditioning unit (PCU). The inverter converts the DC power produced by the PV array into AC power consistent with the voltage and power quality required by the utility grid. The inverter automatically stops supplying power to the grid when the utility grid is not energized. A bi-directional interface is made between the PV system AC output circuits and the electric utility network, typically at an on-site distribution panel or service entrance. This allows the power produced by the PV system to either supply on-site electrical loads, or to back feed the grid when the PV system output is greater than the on-site load demand. During periods when the electrical demand is greater than the PV system output (night-time), the balance of power required is received from the electric utility This safety feature is required in all grid-connected PV systems, it also ensures that the PV system will not continue to operate and feed back onto the utility grid when the grid is down for service or repair.

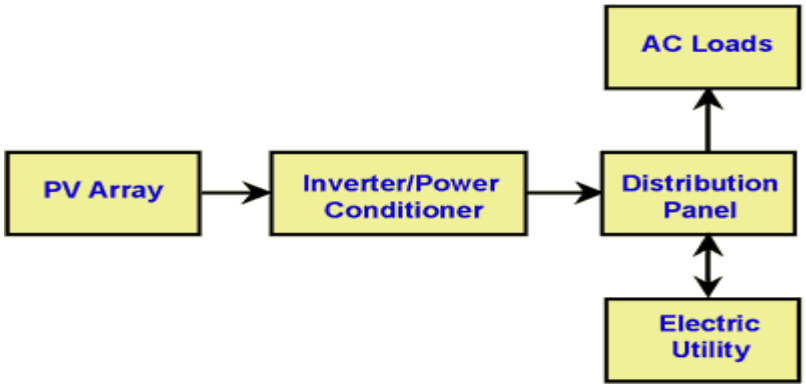


Figure 1. Diagram of grid-connected photovoltaic system.

II. **Stand Alone System**: Stand-alone PV systems are designed to operate independent of the electric utility grid, and are generally designed and sized to supply certain DC and/or AC electrical loads. Stand-alone systems may be powered by a PV array only, or may use wind, an engine-generator or utility power as a backup power source in what is called a PV-hybrid system. The simplest type of stand-alone PV system is a direct-coupled system, where the DC output of a PV module or array is directly connected to a DC load.

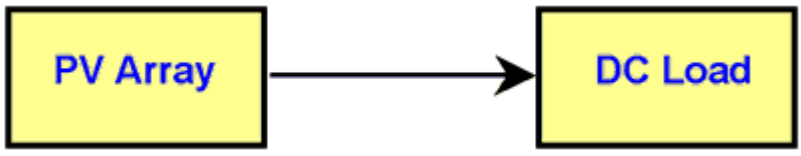


Figure 2. Direct-coupled PV system.

Since there is no electrical energy storage (batteries) in direct-coupled systems, the load only operates during sunlight hours, making these designs suitable for common applications such as ventilation fans, water pumps, and small circulation pumps for solar thermal water heating systems. Matching the impedance of the electrical load to the maximum power output of the PV array is a critical part of designing well-performing direct-coupled system. For certain loads such as positive-displacement water pumps, a type of electronic DC-DC converter, called a

maximum power point tracker (MPPT) is used between the array and load to help better utilize the available array maximum power output.

In many stand-alone PV systems, batteries are used for energy storage. Below is a diagram of a typical stand-alone PV system with battery storage powering DC and AC loads.

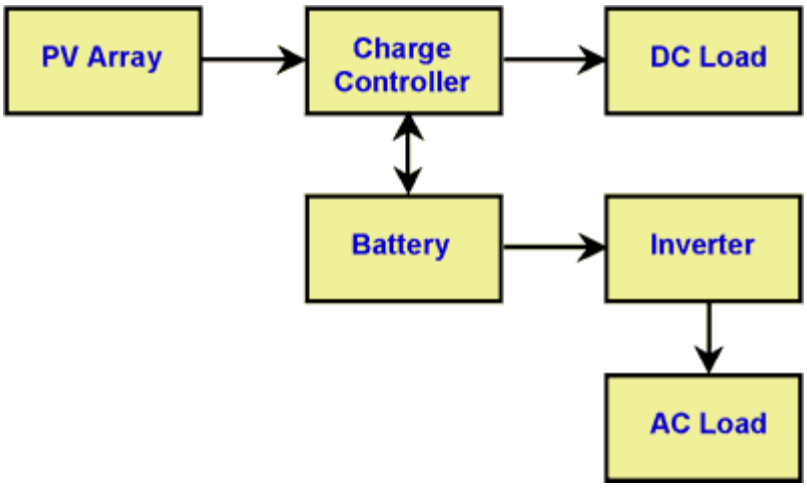


Figure 3. Diagram of stand-alone PV system with battery storage powering DC and AC loads.

Below is a diagram of a Photovoltaic Hybrid System with battery storage powering DC and AC loads and using a using a backup power source (wind, engine-generator or utility power)

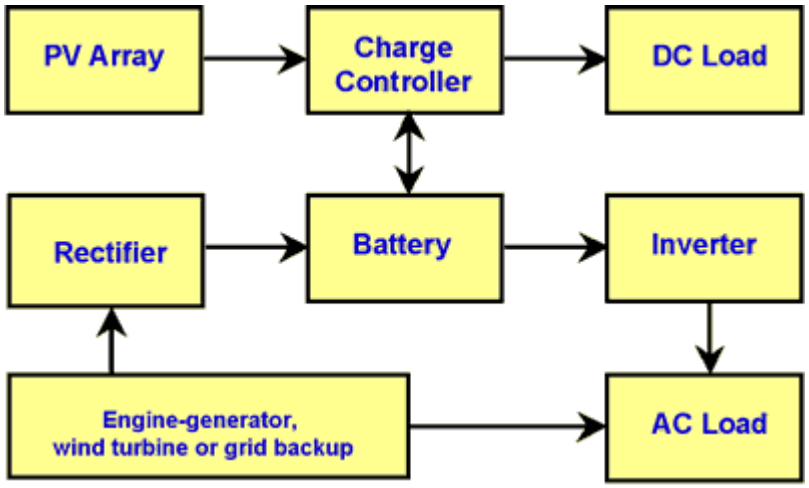


Figure 4. Diagram of photovoltaic hybrid system.

Reports:

Study on working of solar PV system and

1. Familiarization with PV cell.
2. Familiarization with charge controller
3. Familiarization with battery and inverter