

# INTEGRATION OF PV SYSTEM TO GRID USING BATTERY ENERGY STORAGE SYSTEM

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**Abstract** – Solar Photovoltaic systems combined with Battery Energy Storage System will play predominant role for obtaining economical operation of the electrical utility system and boosting reliability with different energy sources. This paper introduces economical opportunities for the domestic-user who can use both solar Photovoltaic system and Battery energy storage system, which gives user the chance to change his load profile. The system could operate in numerous operation modes like coordinate management of each Battery energy storage system and grid inverters. A grid connected PV system encompass photovoltaic panels, batteries energy storage system, maximum power point tracking. The main objective of this paper is to providing continues power to the end user and minimizing his electricity cost with the help of renewable energy source such as supply photovoltaic system combined with battery energy storage system. Also the solutions being planned to enhance the performance electrical supply system connected to domestic load.

**KeyWords:** Photovoltaic system, Battery Energy Storage System (BESS), Maximum Power Point Tracking (MPPT).

## 1. INTRODUCTION

Solar Photovoltaic energy is one form of Nonconventional energy which is attracted in the last years have interest because of its free accessibility and eco-friendly nature to its easy use as compared to other electricity sources, and their inexpensive operation on the whole earth. So it's necessary to attracts their operation, application and evolution, its benefits, and moreover its capability to resolve many issues on the electrical grid. Now a days, the employment of renewable energy is considerably increasing day by day in various countries, because of the fast growing of energy demand and continues depletion of fossil-fuel reserves. Among of all remaining resources, the PV energy is one of the best suited for domestic application as compared with alternative resources as a result of low price of installation and maintenance. The disadvantage of PV energy is that the output power depends on the weather and cell temperature. The output of PV falls in case a little a part of PV module or PV array is shaded though it is within the sunlight. Therefore, there is a limit to provide stable power to the load and grid. So, the Battery energy storage system has been enforced in order

to beat these inherent drawbacks. However, in domestic applications, a grid connected Photovoltaic systems, contrary to the complete systems, has many benefits. It provides power from Batteries to native load once it generates power from PV. Therefore, the grid-connected system is comparatively stable and effective to share load as compared with stand-alone system and has the economic potency since it will sell power generated by PV once the utility rates are severally pricy. For this reasons, the installation of the grid-connected PV system using Battery energy storage system is necessary as shown in fig.- 1

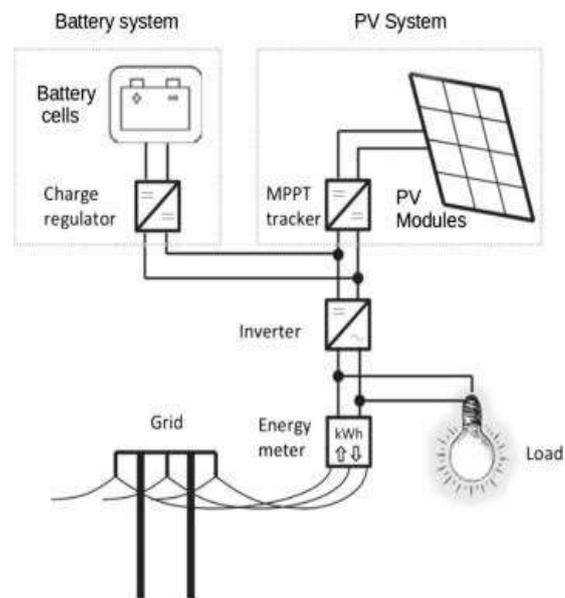


Fig -1: PV-SYSTEM using BESS connected to the GRID

### 1.1 PV panel and MPPT

The power generation of the PV Panel is tracked by P&O MPPT technique using DC-DC Boost converter. Both the voltage and current of PV panel is sensed and the signals are send to the MPPT algorithm, in which it will generate duty ratio according to power and voltage variations. The variation of the voltage i.e previous and present values of voltage is computed  $V_{old}-V_{new}$ . Also, the power difference is computed by  $P_{old}-P_{new}$ . If there is change in power is positive and change in voltage is negative, it indicates that the operation is in the left side of maximum power point. MPPT algorithm changes duty ratio of boost

converter for increasing the operating voltage of PV panel. By increasing the operating voltage, power delivery will increase as shown in Fig. 2. In the same way, if operating point is in the right side to maximum power point, MPPT algorithm changing duty ratio of boost converter to adjust appropriate operating voltage of PV panel. The algorithmic steps are as shown in Fig. 3. In which MPPT tracks for different irradianations.

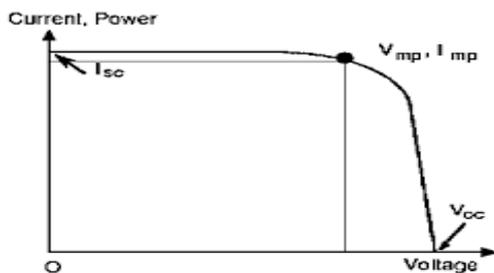


Fig -2: Model graph of Current, Power Vs Voltage of PV panel

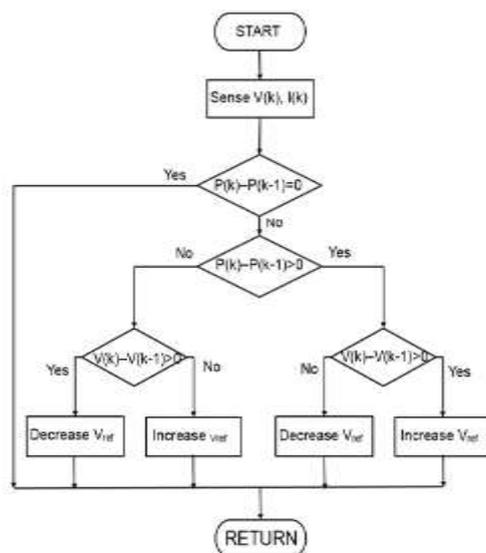


Fig - 3: Algorithm of P&O MPPT method

## 2. LITERATURE REVIEW

Tara M. Jackson: presented Integration of Photovoltaic systems with battery as energy storage in the distribution network will be essential to allow for continued uptake of domestic PV system installations.

Aijun Zhang: Introduced development of new energy technologies and power generation technologies, distributed generation will become competitive power generation and play important roles in modern power system.

G. M. Tina: presented Photovoltaic systems which is combined to either some form of storage, such as Batteries or with direct load control can play a role in achieving

economical operation of the electric utility system with improving reliability with additional energy sources.

Chawin Prapanukool: presents PV is one of the most attractive renewable energy sources in many countries. One of the most attractive and high efficiency solutions is the installation of Battery as a energy storage system, however, with the high cost of Battery energy storage system, the methodologies to investigate an appropriate battery capacity is proposed. Also the performance of BESS can be described in terms of State of Charge, battery capacity, C-Rate, State of Health and type of Battery, as follows.

### a) Battery Capacity

Battery capacity is the amount of energy that the battery can be fully charged or discharged at time  $t$ . Generally battery capacity is measured in Ampere Hours (Ah). However, for the applied system voltage, the battery capacity can be measured in kilowatt-hours (kWh).

### b) State of Charge

State of Charge of battery is the current stored energy in the battery divided by current battery capacity Basically, *State of Charge* is the opposite the *Depth of Discharge* of the battery.

### c) C-Rate

Charging/discharging speed is the specification given from manufacturer in term of *CRATE*, which is simply called *C*. The reciprocal of *CRATE* is the minimum time to fully charge a battery from empty to rated capacity.

### d) Lifetime of Battery/State of Health

Lifetime of battery can be performed in two different viewpoints, calendar life and cycle life. Calendar life is expressed in term calendar year. This viewpoint is independent of how much battery charge or discharge. Cycle life is expressed in term of number of cycles.

Angel A. Bayod-Rújula: presents a review of the recent developments of photovoltaic systems connected with batteries and related to feed-in tariff policies. Focusing on the residential customers who have installed PV Rooftop, BESS is able to economize electricity charge of the customers which is the valuable benefit. Appropriate battery capacity and operation schedule of BESS for PV Rooftop is determined

Abdul-Kadir Hamid: presented PV systems can mitigate their production unpredictability with storage system employment. Installation of storage systems need to be designed with precise energy storage system (ESS) rating. To manage the integration of grid connected PV-Batteries system; a precise energy forecasts is required to improve the power quality, security and reliability.

P VenkataSubramanyam: In this paper, the working of a Bi-directional AC-DC converted is discussed for a considered Load Curve. For various combinations of power generated by the solar photovoltaic panel, available grid power, SOC of battery and load demand, the operation of the converter is analyzed in detail. With this it can be concluded that the algorithm works fine for varying load and power availability conditions.

AdamantiosBampoulas: presents the EMS designed takes into account the available power from the PV system and the grid, the domestic load, the current SoC of the batteries and a preset driving range adjusted by the user. Key elements of the developed algorithm were the maximization of the on-site use of PV power, the minimization the power absorbed by the grid.

### 3. CONCLUSION

The battery as energy storage system plays important role in the reliable operations of solar photovoltaic system connected to grid. Battery will reduces cost of the electricity, using as energy storage system also it will requires minimum maintenance, the life of battery depends upon charging and discharging with the specified limit. From this paper idea has been identified that Battery used as energy storage system will helpful in managing the the balance of power system.

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