

# A Controller to Integrate Renewable Energy with Grid

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**Abstract** – Power generation in the developing country is still depending mostly on non renewable sources, but it is not favorable as it is harmful for the environment as well as extinct for the future generation. So, consumption of energy with the renewable sources will be more beneficial. This paper illustrates a theory based concept for designing a controller to integrate Renewable energy with Grid and some of the challenges faced by renewable energy as they are unpredictable in nature. The system is based on the fact that it will produce power according to the availability of sources. It will be so designed that it will extract much of the solar power during the sunny day with the MPPT and simultaneously charge the battery for backup system. During the cloudy weather or night time grid will supply the power. This system will serve as both on-grid and off-grid system.

**Key Words:** Grid, Integration, PLL, Renewable Energy.

## 1. INTRODUCTION

With the ever increasing population, it becomes a big problem to live modern life without skilled technologies, infrastructure and new innovates, for which requires more and more power. The generation of power mainly depends on conventional resources like fossil fuels. Though fossil fuels are exhaustible these resources are most demandable because these are affordable, easy to store and easily accessible. But if these are used continuously will degrade the environment as it releases harmful gases and once depleted cannot be regenerated. Renewable sources must be used for fulfilling basic needs and to solve the problem of energy crisis.

Renewable Energy is the energy that is collected from nature. These resources are in-exhaustible and provide energy for indefinite time. They can be regenerated and their supply is unlimited. They also help in conserving nation's national resources. Some of the renewable energies are solar energy, wind energy, tidal energy, geothermal energy, and biomass. Use of renewable energy instead of fossil fuel will be a good solution for the control of environment, social and economical problem of our communities [1].

Like other countries India too utilizing Renewable Energy to serve the entire population and progressing fast to level up generation with demand of power and energy, to raise

the living of people to a standard by providing cleaner as well as more reliable electricity.

Renewable Energy can provide energy either directly or indirectly and to get continuous power it is important to integrate it with grid. Grid integration of renewable energy is the efficient way to get surplus energy, where stability and reliability of the system is maintained and the cost effectiveness is maximized.

Generally, under different variable Renewable Energy Scenario a grid integration study, simulate the operation of the Power System. It identifies reliability constraints and also evaluates the cost of action to alleviate those constraints [2].

The 2022 electrical power targets include achieving 227 GW of energy from renewable energy sources, nearly 113 GW through solar power, 66 GW from wind power, 10 GW from biomass power, 5 GW from small hydro and 31 GW from floating solar and off-shore wind power [3].

The aim of Renewable Energy integration is to advance system design, operation of the electric grid to reduce release of harmful gases, enhance reliability, use of the electric vehicle operation and supporting reduction in use of oil and increase asset use through integration of distributed system and lower the cost of electricity.

The technical and economic viability of integration 175 GW of Renewable Energy into India's electricity grid by 2022 is confirmed by an NREL [4].

## 2. INTEGRATING RENEWABLE ENERGY: CHALLENGES AND ISSUES

Renewable Energies are varying in nature and are unpredictable so it is necessary to couple these resources with energy storage systems but it is challengeable. It has to face lots of difficulties and issues like uncertainty, variability of its occurrence and need to be overcome. With a developing grid system and things like distributed energy storage system, the grid will be much better in the future.

Some issues are mentioned in ref [5] related to integrating renewable energy system. Crisis for energy supply demand a holistic, systematic & integrated approach to deal. This

will not only increase fuel depletion but also pollution level and related disasters. The factors are discussed which are directly and indirectly affect the use of energy sources.

Though energy from renewable sources is unlimited but to invest in energy production is a major task. Installation cost of these sources is high, makes the utilities harder to justify the investment. But it can be feasible if investments to the lifespan of energy projects are taken into account.

One of the biggest challenges with renewable sources of energy is its availability and irregularity and because of these nature of the sources we cannot guaranteed that resources to be there when needed. But by the use of energy storage system these issues can be reduced and utilize it whenever needed. Another challenge may also include location of renewable energy where the area major population lives is not close to the high renewable energy generation potential. This creates losses in transmission because of far away from densely populated area [6].

The workforce in institutes, agencies is not sufficient in number and their lack of co-operation and co-ordination progress in renewable energy development is limited. In 2018-2019 standard and quality control orders have been issued and it says that there number of institution and laboratories are not sufficient to use renewable energy technology and to give certification and validate the quality and suitability [7].

### 3. RELATED WORK

In this paper, the design is elaborated with the theory concept. The whole system is divided into 2 parts: one for the on-grid system i.e. integration of renewable energy with the grid and the other is off-grid system i.e. charging and discharging of the battery with PV control. The flowchart of the whole system is shown in the figure 1.

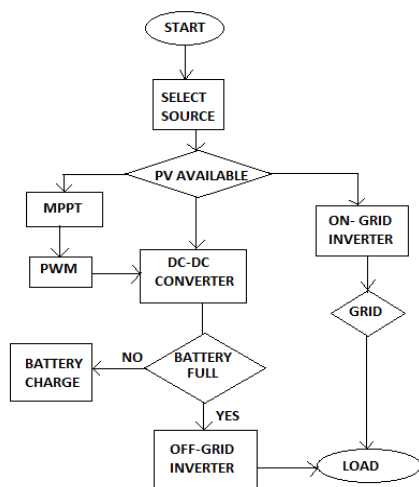


Figure 1: Flowchart of the system

The integration of PV with grid will be done by an on-grid inverter and phase locked loop (PLL) method. The on-grid inverter is a 3 phase inverter which takes power from the PV array and converts it to a 3 phase AC current which can be used to run AC loads and can be transfer the power from PV to the grid. In order to transfer synchronization of phase, frequency, voltage is to be done between on grid inverter and the grid by the method called PLL. The excess power generated from PV is transferred to the grid. This system has a facility to run the household loads even in the less power from PV because it can take power from the grid to fulfill the power requirements of the basic need of electricity.

The second system is based on the charging state of the battery by PV system using MPPT controller. A DC-DC converter will be used for controlling the output of PV array which give a controlled DC output to charge the battery. The operation of the DC-DC converter will controlled by MPPT Perturb and Observe (P&O) method. MPPT algorithm generates a duty cycle which is synchronized with a PWM pulse from a PWM generator. That PWM pulse will control the IGBT switch of the DC-DC converter to control the PV DC power. A constant DC voltage will charge a battery efficiently. Thus the battery can be used for backup system whenever the solar power is absent and grid system will fails.

### 4. CONCLUSION

Due to the periodic nature of the solar system it cannot be predicted that it will be available whenever required so to reduce the problem it is to integrate with grid. This paper simply elaborates the system which will be used to deliver uninterrupted power supply to run the household as well as 3 phase system. The integration of renewable energy with grid is not that easy it is challengeable and to get continuous power a battery system is to be used for backup.

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