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Design and Analysis of Hybrid Microgrid for Remote Area in Odisha

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Abstract

In this study, our focus on the electricity generation unit, microgrid from solar power and wind power. The electricity is one of basic need of society, the need of electricity increases day by day. The industrialization, urbanization are key factor of the increase in the need. The major generation source of electricity either hydro based or thermal based station. Still there is many remote places in India or across the globe, where is the electricity yet to be reach, which is many factors for this. The transmission and distribution is not cost effective is one of them. To provide the electricity to these places, the microgrid is a better solution and it's cost effective also. The commonly used source of microgrid for power generation is solar based, wind power, bio-gas, more. Here we consider construction of microgrid, based a solar power and wind power combine.

Key-words: Electricity Generation, Solar Power, Wind Power, Microgrid, Green Electricity, Green Technology, Pollution.

1. Introduction

In today world, the technology is changing rapidly, which make effect in our day to day life. In present time the urbanization is increases rapidly with the industrialization. Electricity is a key component in development of modern world. The electricity power generation and distribution is a tedious task. Still the power supply to remote place is a key issue. The generation of electricity project is generally hydro based or thermal one. The hydro based project required a huge area for water storage, which requires a long time for development, whereas thermal project require huge amount of coal, is make these expensive and longtime establish time, is a good solution and long term

solution for the demands[1]. The hydro based or thermal based generation unit establishment need a huge amount of area, generally this leads to deforestation, which is a cause of pollution. The thermal unit of power generation also leaves pollutant to air and the residual part of coal wastes also cause pollution in land and water, if water body is present nearby. The power transmission and distribution is another issue for a remote place. The cost for power transmission and distribution is quite high, with maintenance of the power supply line need to consider, is a difficult and expensive factor[2]. The micro-grid is good solution to this problem; it is taking less space as compare to hydro or thermal project for electricity generation. The construction of microgrid depends upon the local factors and resources. The low cost installation and maintenance make to more suitable to the problem.

2. Concept of Microgrid and Power Generation

A. Microgrid

Nicolas The microgrid concept is started to generation of power for a house of fewer houses and uses it. The major sources power generation is from solar, wind power, bio-gas etc., and the microgrid need a very litter space or area to install. With the advance of the technology the instrument or machine use to generate the power is sufficient if we consider the local factor and availed resources properly[4]. The microgrid can be used only one resource or combine of more one resource, known as hybrid microgrid[5-6]. Here we are discussing a hybrid microgrid modeling for a remote place in Odisha.

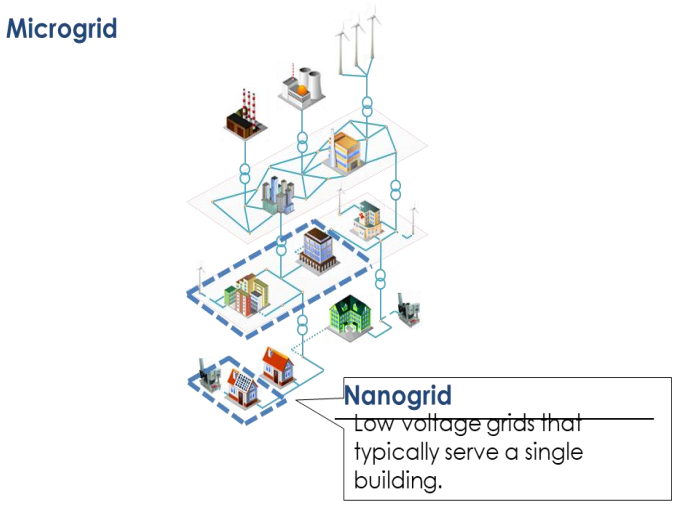
The operation goal of microgrid as follow[3]:

- Access to electricity
- Maximize reliability
- Uninterrupted supply
- Reduce environmental impact
- Maximize renewable energy contribution
- Fuel & cost savings
- Fuel independence
- Provide grid services

The microgrid needs to maintain the ethics of [3]:

- Stabilizing
- Spinning reserve
- STATCOM (static synchronous compensator)
- Seamless transition between islanded and grid-connected states
- Standalone operation
- Smoothing
- Shaving
- Shifting

Figure 1 - Architecture of Microgrid (According to Definition and Standardization from ABB Corporation)



B. Solar Power

The power generation from the Sun's radiation energy, use PV cell array plates, each plate have rating, according to rating its produces or generate electricity. The PV cell act as a diode, to derive maximum power, the PV cell array use MPPT (maximum power point trackers) controller to generate maximum power from the Sun's radiation[7-8-9]. The PV array plate need to be place properly so that it will exposed to sun ray maximum time. The isolation and cooling of PV array need to take care[5-9].

C. Wind Power

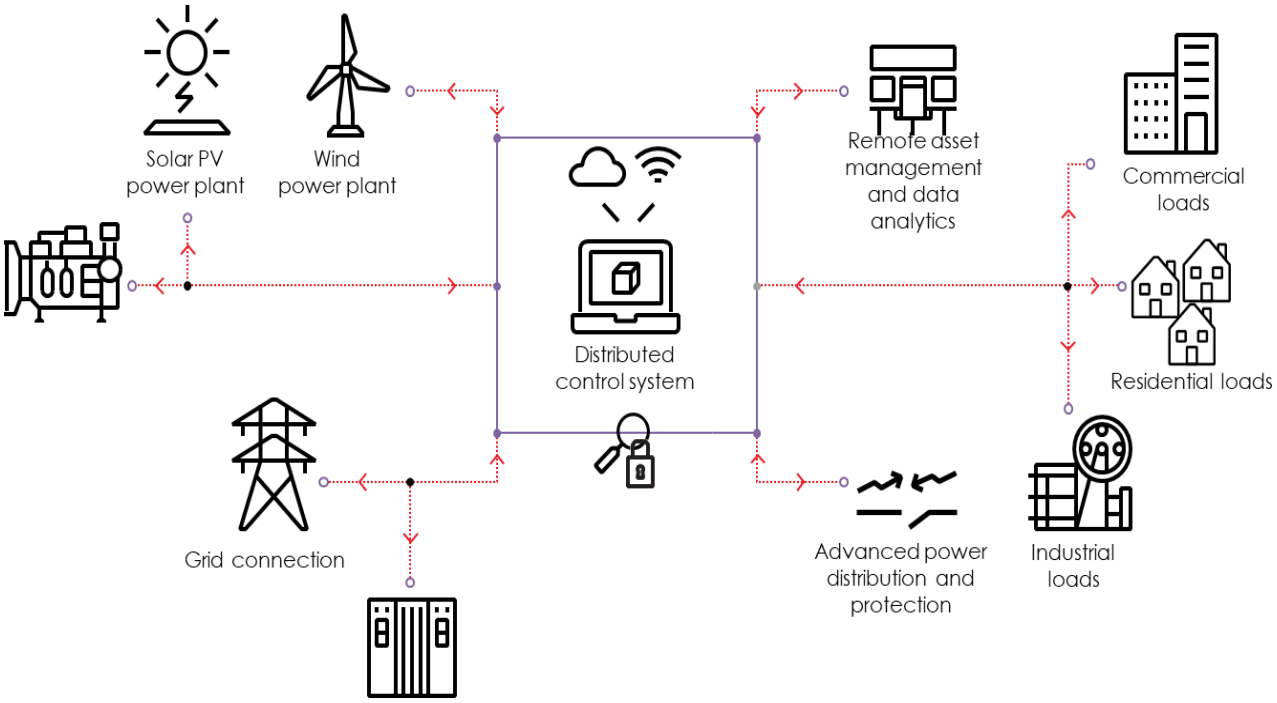
The power generation from wind, is depend upon the speed of the wind to the wind firm fan, as wind speed is varies all the time, variable speed wind generation system based on Doubly Fed

Induction Generator (DFIG) is used to generate electricity. Now days, DFIG in industry, are three-phase wound-rotor induction machines and most commonly used in wind turbine, with a advantage of output voltage amplitude and frequency remain constant over other generator.

D. Construction of Hybrid Microgrid for a Remote Place of Odisha

The state, Odisha present in the eastern part of the India, we consider a place where the average temperature is varies from 15degree to 35 degree Celsius over the year. The wind speed average 20-40km/hour. In the rainy and winter season the temperature decreases and wind speed increases in rainy season. Considering these fact we find a hybrid model of the microgrid will be suitable, hence we carry out the modeling and simulation given in below[12].

Figure 2 - Architecture of Hybrid Microgrid Schematics as a Solution for Remote Area of Odisha (According to Definition and Standardization from ABB Corporation)



3. Design Issue and Modelling

The Hybrid Microgrid is design with above discuss theory and its application is modelled simulated accomplished using MATLAB-SIMULINK computing tool based on algorithm discuss in previous chapter. The results obtained in each case are compared with those published in the literatures[10-11].

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Figure 3 - Microgrid TOP Layout Connect to Grid in MATLAB

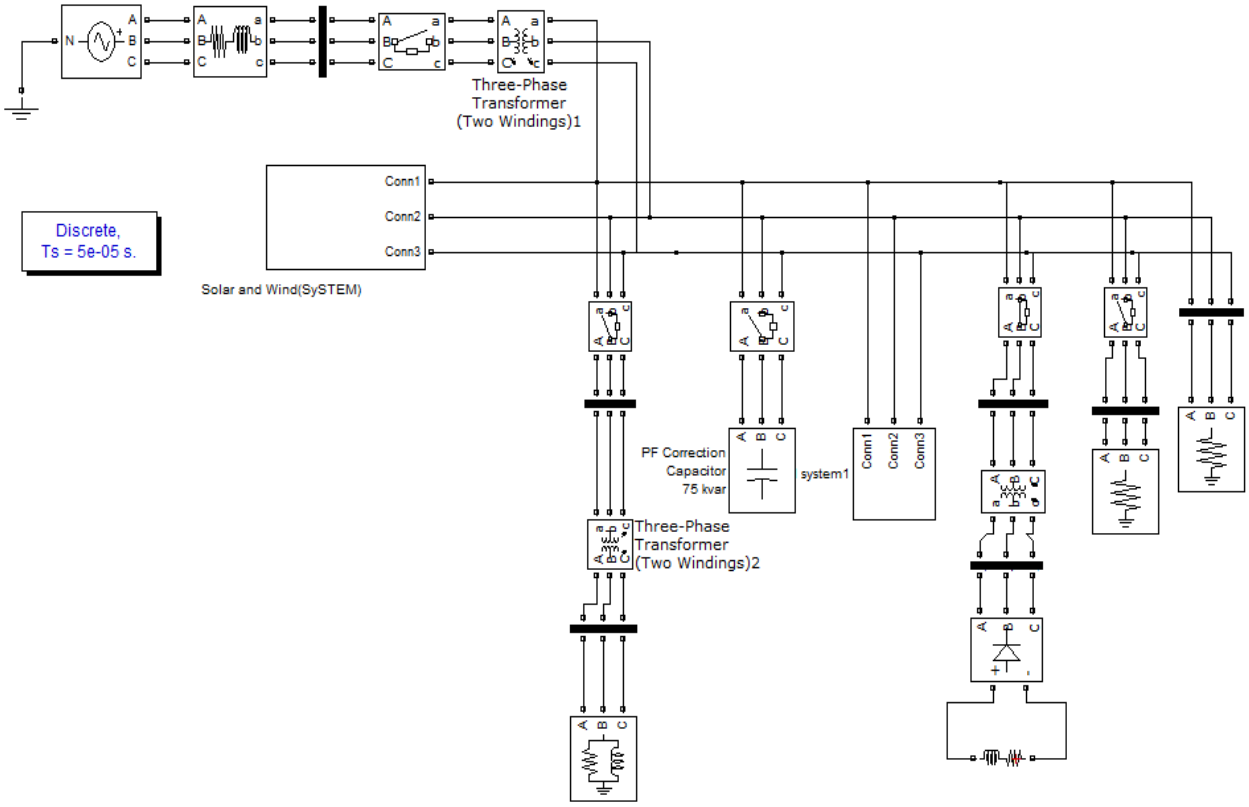

Figure 4 - Solar and Wind Combine Generator Section

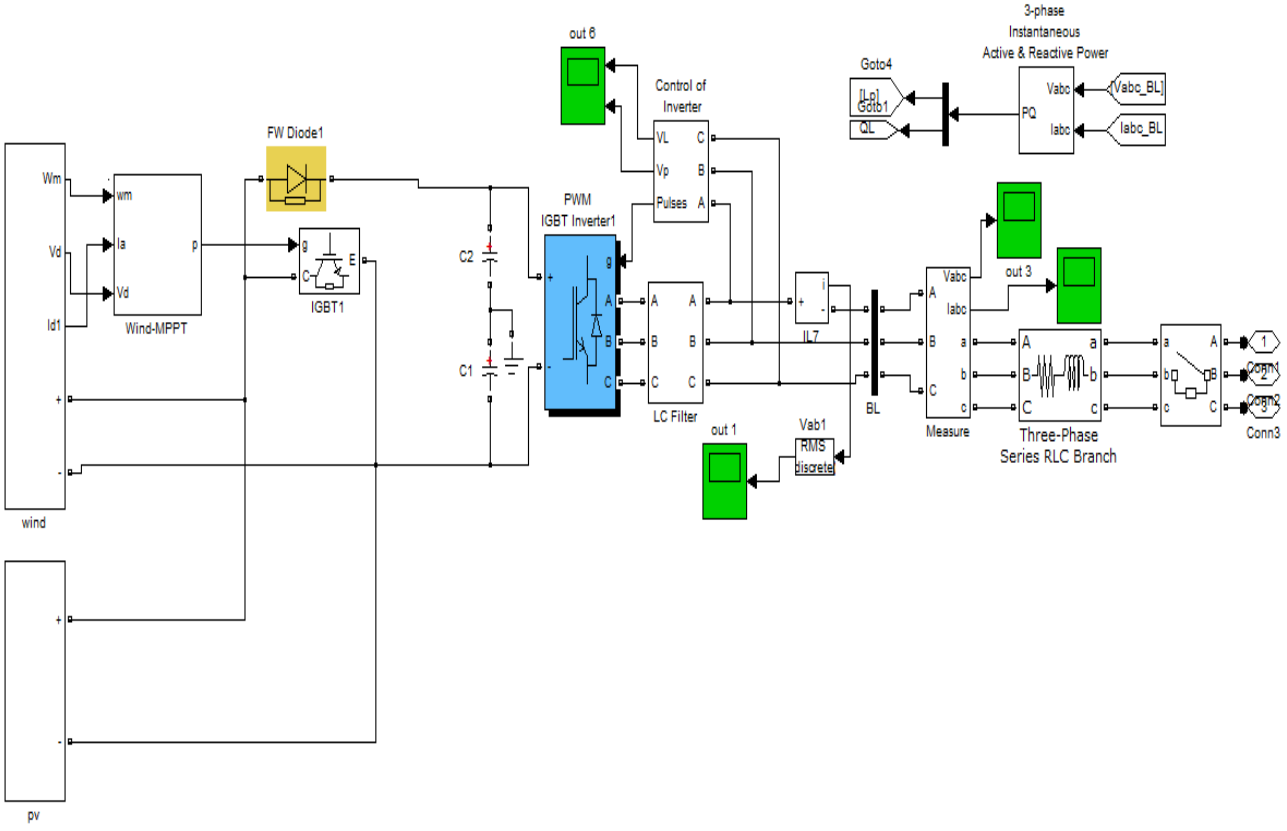

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Figure 5 - Wind Generator Section of Microgrid

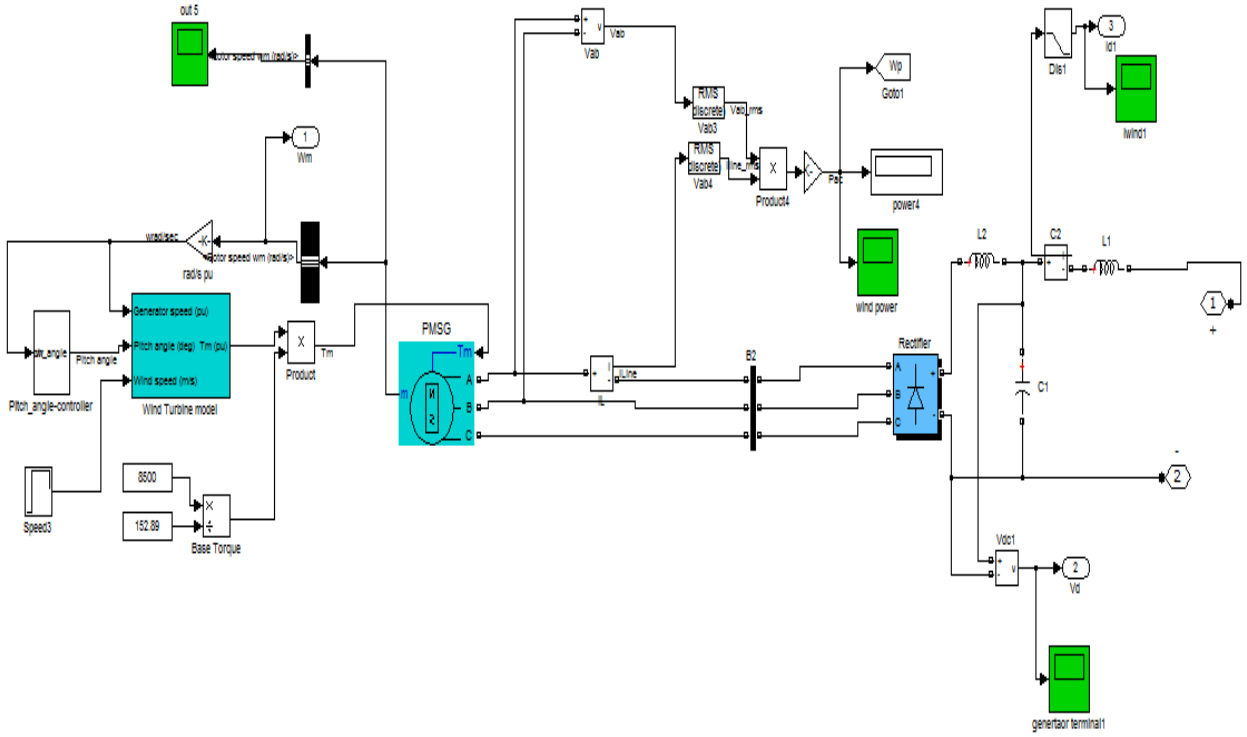


Figure 6 - The Output of Wind Section DC Current

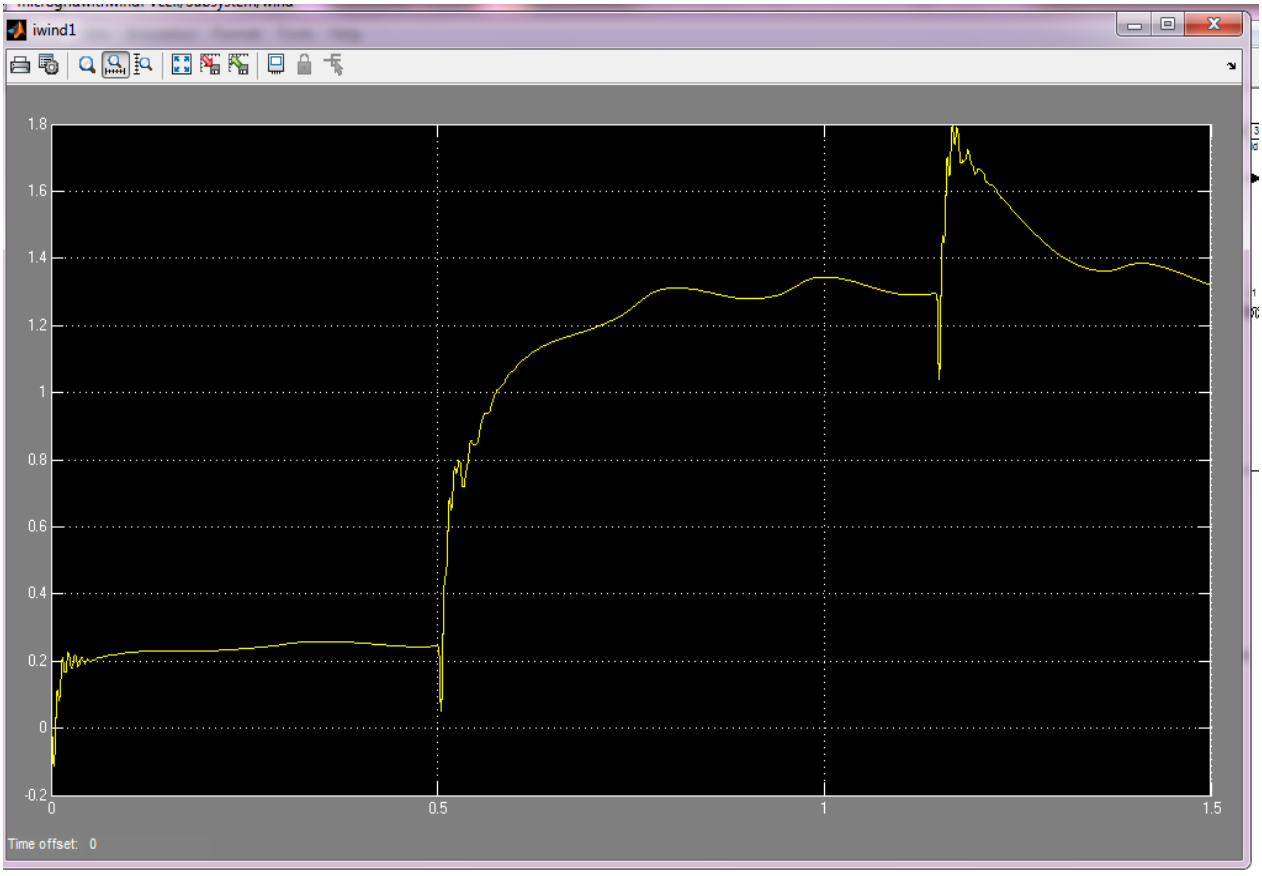


Figure 8 - The Output of Wind Section DC Voltage

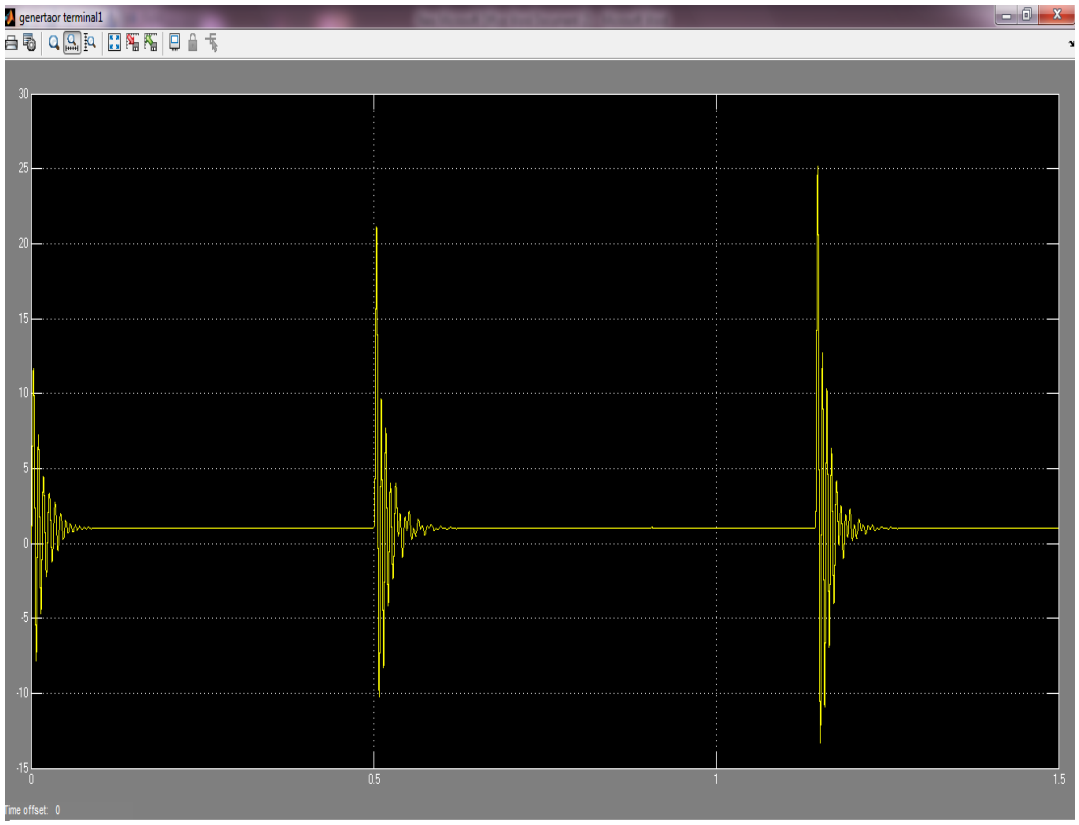


Figure 9 - Solar PV Array Solar Power Generator Section

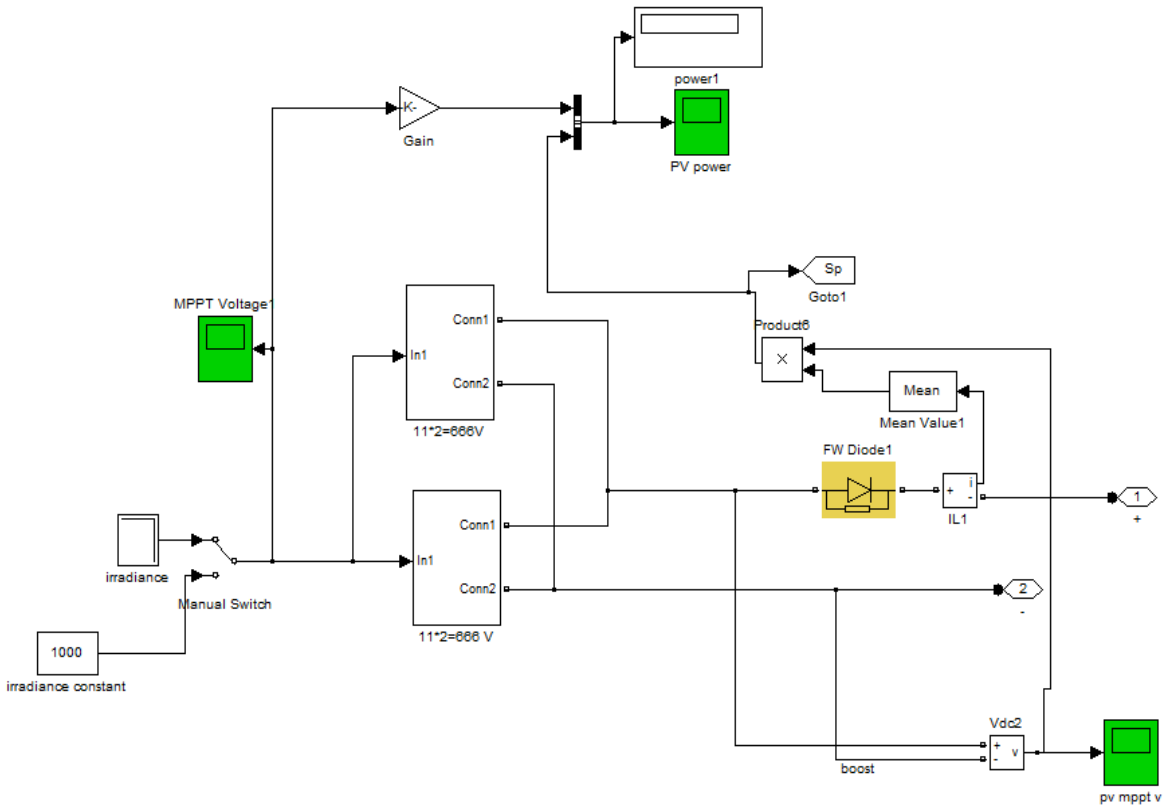


Figure 10 - The Output of Solar Section MPPT Voltage

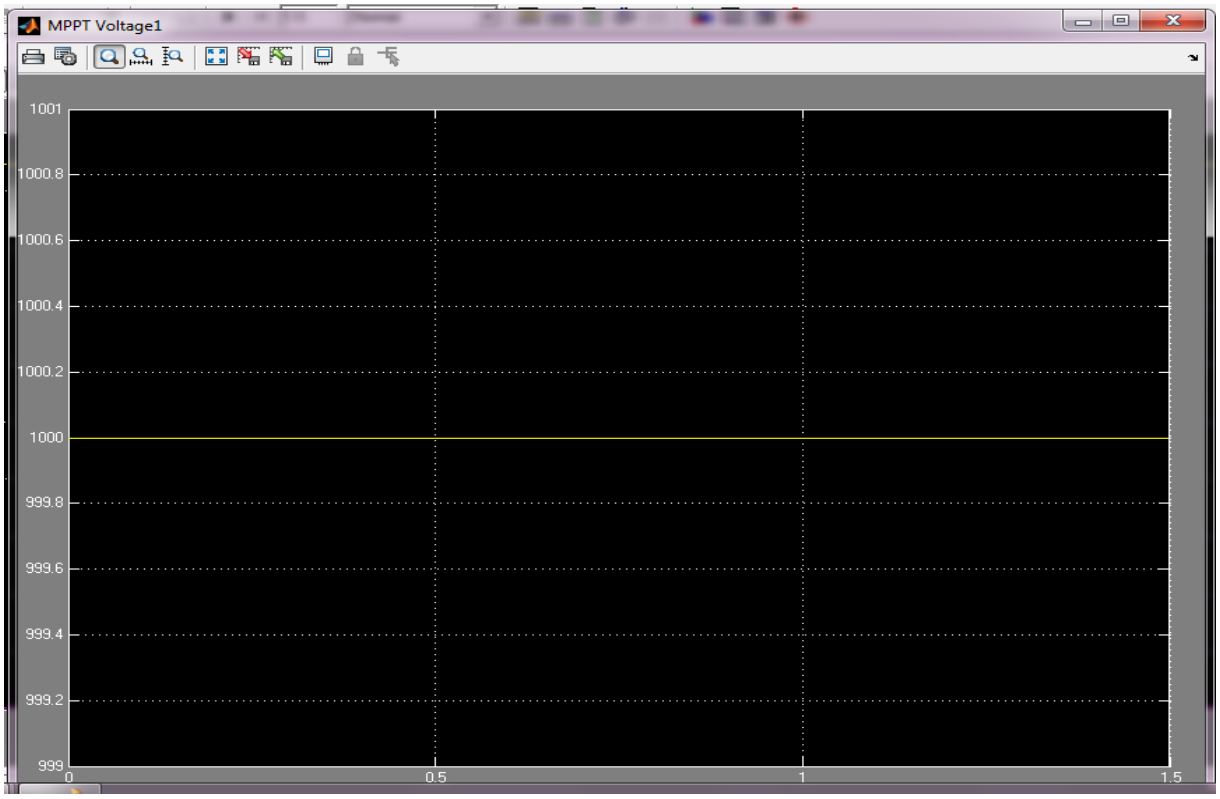
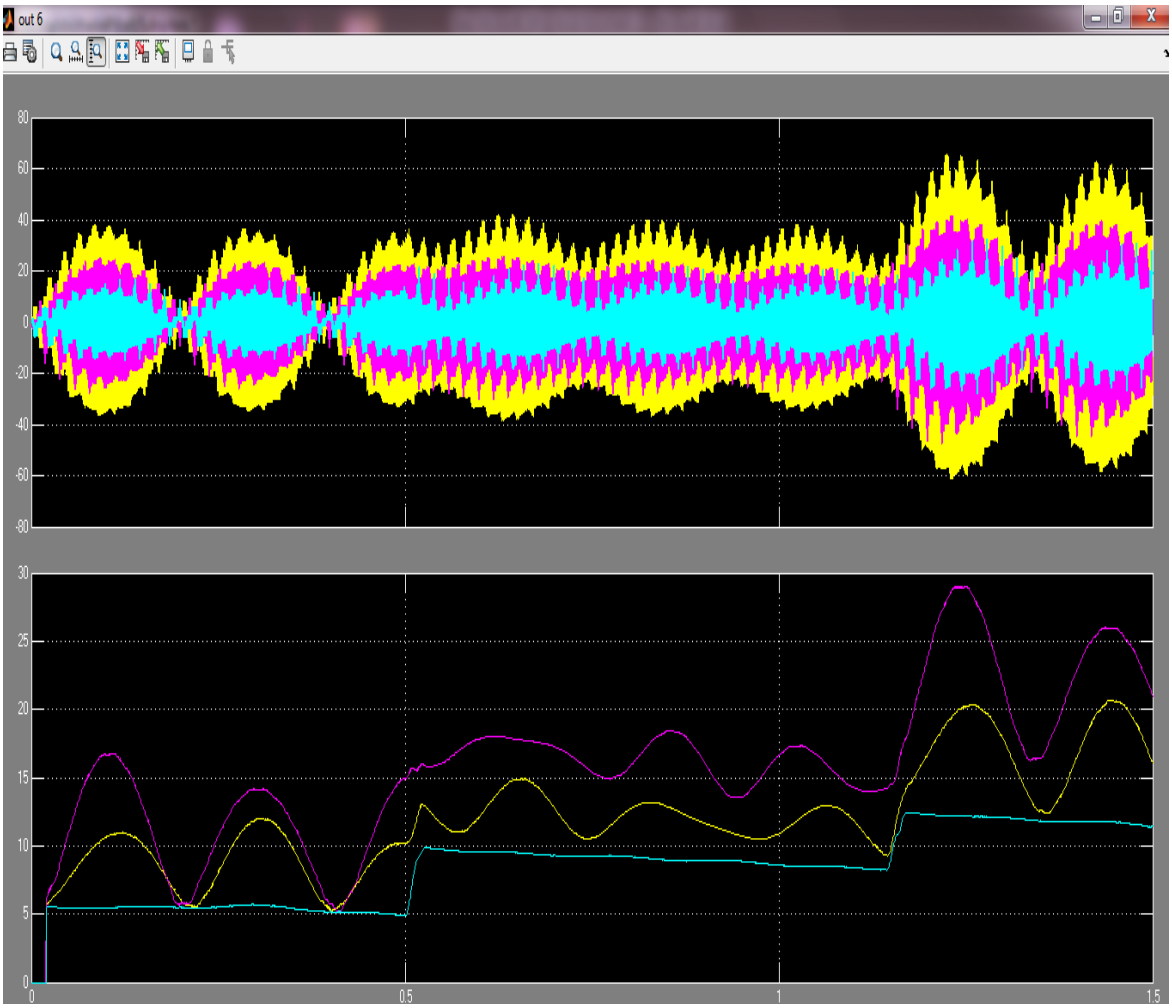


Figure 11 - The Output of Solar Section mppt Power

Figure 12 - The Output of PWM Inverter to Load after the Transmission



4. Conclusion

In this work, we study different alternative methods of generation of power for a remote area or micro-grid. We consider the solar and wind power as generation together, this leads to modeling in Matlab-Simulink environment and the result observed. This simulation model need to implement in real-time and there should be sufficient work is on battery technology, which is leads the implementation of this is more useful. This kind of work will help electrification of green energy for isolated or remote need.

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