

## DESIGN AND OPERATION OF MICROGRID

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### Abstract

*The need for new generation systems has motivated the development of microgrids. This new concept may provide significant benefits such as losses compensation, achieving high degree of efficiency and reliability to the transmission and distribution networks. This novel idea provides more advantages about Microgrids like general structure and different topologies. Also an original methodology for facilitating its design is proposed. Finally Simulink model of Microgrid is designed and then analyzed.*

**Key words:** Microgrid, Diesel generator, wind turbine, batteries and converters.

### Introduction

Due to the benefits like high reliability, good power supply, environmentally friendly and low cost energy the distribution generation technologies such as photovoltaic (PV), Wind power system (WPS) and fuel cells have gain popularity, but with increasing the amount of individual distributed generation will many problems regarding its control and protection of microgrid. Its control will be complex.

In order to solve these problems microgrid technology comes into play. Microgrid has two modes of operation one is grid connected and other is islanded mode. Due to this it increase the reliability of energy supplies by disconnecting it from the grid during the network faults.

A microgrid is the combination of electrical sources; loads and energy storage system operate in grid connected scenario or in islanded mode [1].

Micro-grid offers different important advantages. Microgrid operates mostly connected with high voltage distribution network but can also be operate in islanded mode. Until now the generating capacity of microgrid is 1MW [2].

Microgrid is the smaller version of electrical main grids in many aspects. Like main electrical grid system they are also consists of power generating system, distribution system, converters and controls and protection. There difference in between main grid system and microgrid is that microgrid is used closer to the power use as compared to the main grid system which are connected far away from the power use mean the power generation is at the large distance from the power use while in microgrid there is low transmission loss as well as high efficiency due to this factor. Microgrid can be design from conventional and renewable sources but now a days researches are done by using renewable sources [3].

According to [4] microgrid is the system consisting of generating system, storage system, and load connected. For microgrid we can use backup system during peak hours. Main grid, batteries can be used as a backup system for microgrid. Energy sources use in microgrid can be renewable and also conventional.

## Results and Discussions

The sources used in microgrid are diesel generator and wind power system. As both the sources have output AC voltage. To connect two AC sources at a single point they must be synchronized in order to avoid blackout. The output of wind turbine is variable; to stabilize the output voltage of wind turbine FACTS devices are nowadays commonly used. In simulation as shown in fig 1 the wind speed and pitch angle is taken as constant value i-e 12 m/s and  $0^0$ . As shown in the figure 2 the output voltage and current of wind power system is shown hence pitch angle and wind speed is taken as constant so the output voltage is constant.

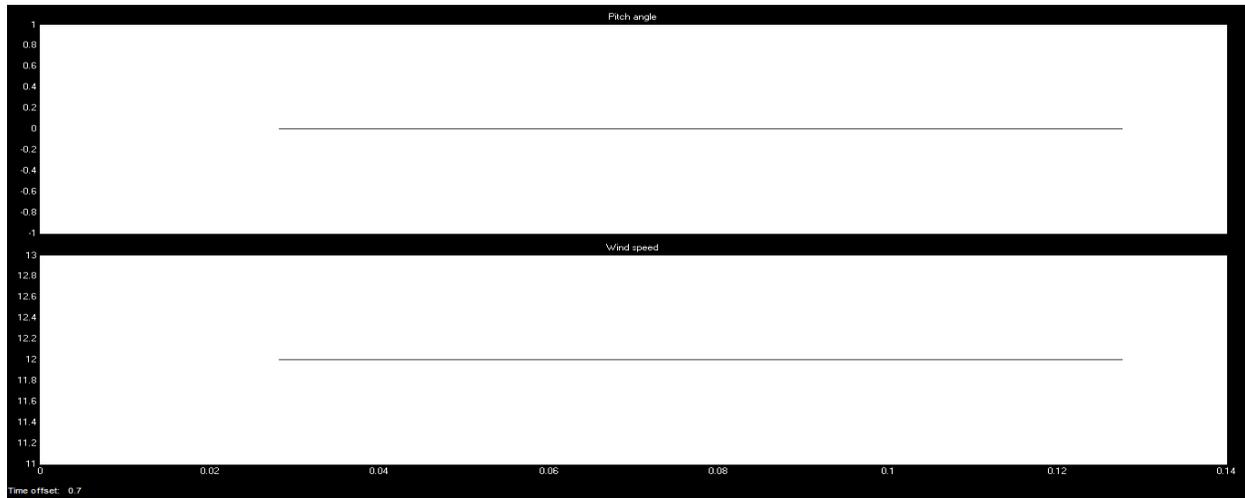


Figure 1. Wind Speed and Pitch Angle Wave Form.

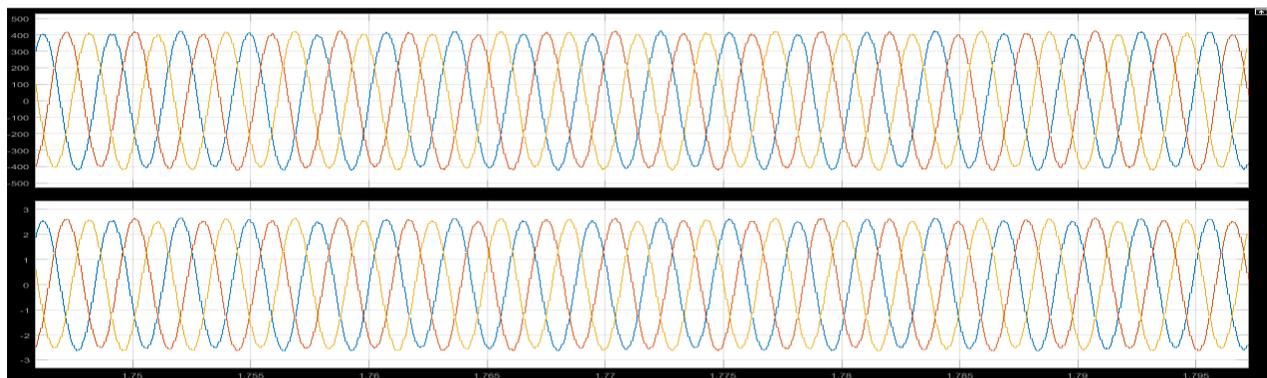


Figure 2. Output Voltage and Current Wave Form.

The overall Simulink model of microgrid is shown in fig 3 Diesel generator and wind power system are the sources used in microgrid, batteries are used which can be charged from the wind power system and we can connect DC load from its output.

As shown in the fig 3 universal bridge is used. The universal bridge block is a universal three-phase power converter, consists of up to six power switches connected in bridge configuration.

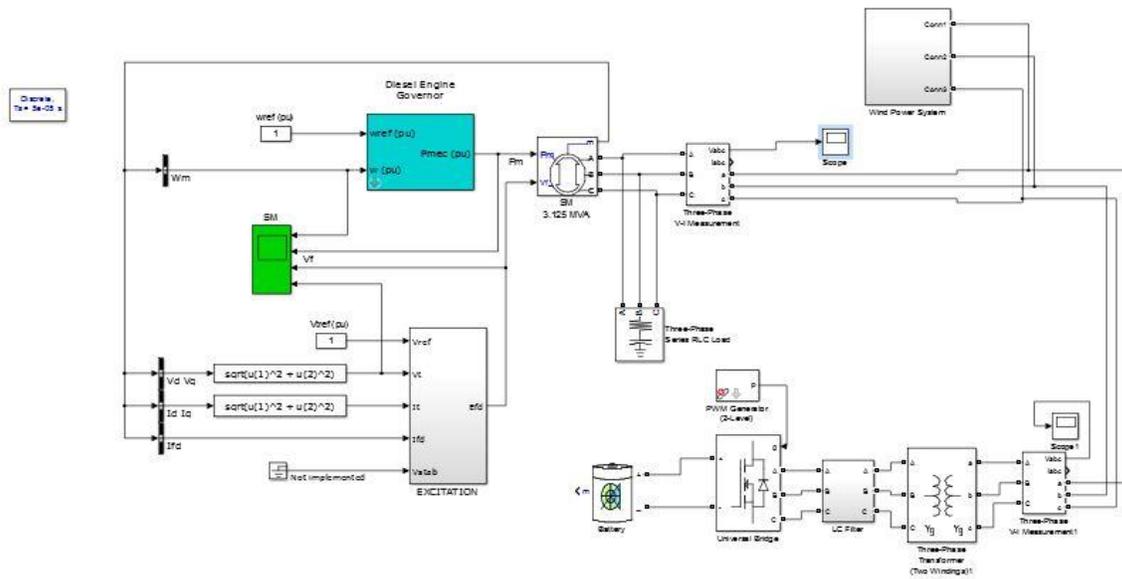


Figure3. Simulink Model of Microgrid.

Fig 4 shows the stable sinusoidal output voltage of the microgrid i-e the output voltage waveform of Diesel generator, wind power system and battery system. As the output voltage of microgrid is stable so we can easily connect it with grid station through synchronization during peak demand on the grid station.

During the base load the Diesel generator will supply enough power to the consumer and at that time wind power system (WPS) will be disconnected from the load and will charge the batteries. During the peak load the load current is increased as a result relay will send signal to circuit breaker and circuit breaker will closed down and wind power system and diesel generator both will supply power to the load. Batteries can be discharged across DC Load or we can use it to meet the required demand of consumers during peak hour by converting it into AC using DC-AC converter or inverter.

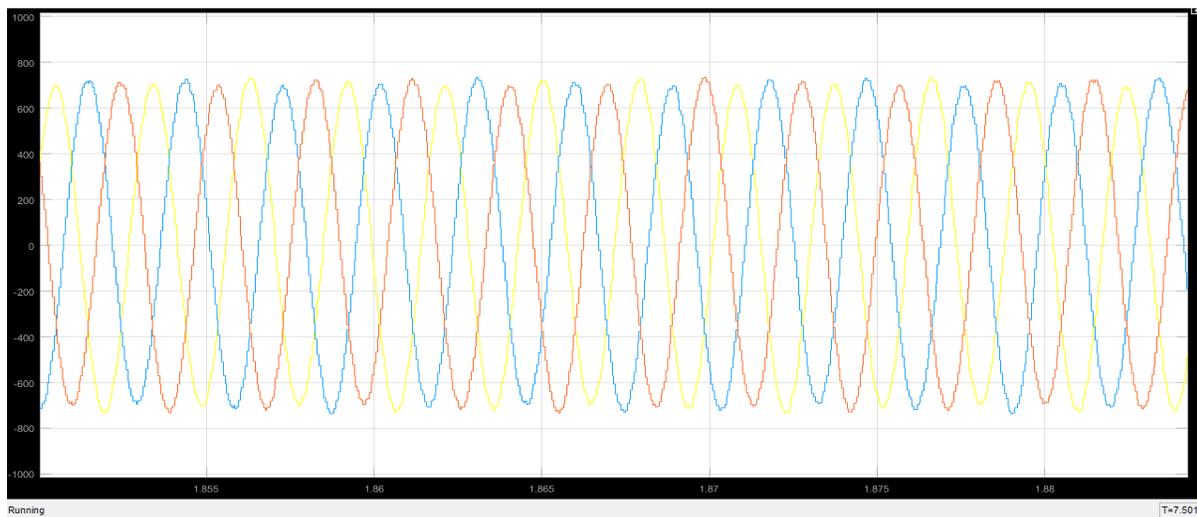


Figure 4. Output Voltage of Microgrid.

Comparison with other microgrid designs, the microgrid we design can give both AC and DC output voltage at the same time. We can get DC output from the output of storage device i.e batteries. During peak load there is no need of other backup system the charge stored in batteries can be used as a backup system for microgrid.

### Conclusion

Microgrids are a future power system configuration providing clear economics and environmentally friendly i.e providing environmental benefit compared to the modern large power systems. Development of microgrid concepts needs to resolve different economic, commercial and technical challenges. Microgrid plays important role in places which are currently poorly served by the main or large power system.

Microgrid can be used complementary network of utility to improve the power supply reliability and power quality. Its control is not complex, microgrid has plug and play control i.e it doesn't require site engineers for it. Most of the researches are concentrating on the control of microgrid but the protection microgrid is still stagnating at the theoretical stage [5]. A modern way of generating large scale electrical power from renewable and conventional sources.

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