

DESIGNING AND MODELLING OF MICROGRID FOR WIND AND SOLAR POWER INTEGRATION

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ABSTRACT

In today's era the role of energy becomes very crucial. It is the key element for designing and constructing industry. So energy plays a most important role in the GDP growth and development of any country. The renewable energy resources are the best alternative resources to the non-renewable energy resources. The solar power, wind power, etc. are the example of the renewable energy resources. We use the renewable energy resource so that we can get the energy that does not produce any pollution to the world. We use them because they will never end and we can get energy from them so many years. India is a country which has many natural resources; it is also surrounded by the water from three sides. India is country that there is a ample amount of wind power, solar power, hydro power etc.

In this thesis hybrid connection is present for reducing the cost and makes the system reliable and efficient. Hybrid technology provides the sustainable power to the customers.

In the present work the combination of the solar panel, wind power system and the backup battery storage for providing the sustainable energy to the consumers is present. PMSG is used in wind power system, lead acid battery for backup the power, a three phase six pulse inverter combination with the pulse generator. Filter is used for removing the unwanted signal. A grid for synchronization of power and distribution of power to the different loads is present in this model.

Keywords: wind-turbine; battery; online simulation tools.

I. INTRODUCTION

In today's era of life, the role of energy becomes very crucial. It is the key element for designing and constructing industry. Presently the main focus is to generate energy efficiently with the available energy resources. If any country optimized its use of energy resources then the economy of that country becomes better. So energy plays a most important role in the GDP growth and development of any country. The

energy is available in different form on the earth. To make it available for human utilization, it is converted to from one form to another like in hydro plants potential energy is converted into kinetic energy and further into electrical energy for human uses.

A. Electrical Energy

Electrical energy is a different type of energy it is stored in the form of charged particles in the electrical field. The electrical field is created by the charged particles. The electrical field is generated when the one charge particle exert a force on the other charge particles. The produce energy is stored in the form of electrical energy and that energy is uses for do any work.

B. Electricity From Solar Energy

The sun is the most effective and always available source of energy, we can generate the electricity with the help of the solar energy by photo voltaic, solar cells photo voltaic and solar cells are use to converting the solar energy into the useful electric energy. In India the photo voltaic cells are mostly used for irrigation, drinking water supply and rural electrification. The process of generation electricity is as follows: the photons emitting from the sun are absorbed in the semiconductor materials, they produced the free electrons. The free electrons have a ample amount of energy than the electron. Free electrons required an electric field to flow out from the semiconductor to do useful work.

C. Electricity From Wind Energy

Energy extracted from the wind is economically used for the generation of electrical energy. The capacity of wind energy as a source of power is very much large. The wind energy is a clean and easily available source of energy. In the wind power plant we use a turbine, the wind is strike on the blades of the wind turbines the wind turbine is connected to a doubly fed induction generator, this generator convert the power of the wind energy into the useful electrical energy. We can easily store this energy in the form of direct current in the storage devices. We can use this energy whenever we required this energy for doing other useful work.

II. WIND POWER

We all know that there is the kinetic energy is present in the wind. The energy has a magnitude. The magnitude of the present power in the wind can be obtained by this equation:

$$P_{wind} = 0.5R^2V^3\pi\rho_{air} \quad (1)$$

This equations shows the magnitude of the power where,

$$\rho_{air} = 1.225 \text{ kg/m}^3$$

R= radius of the rotor of the turbine

V= velocity of wind

The rotor can convert some amount of this power into the mechanical power. So the conversion factor is known as the:

$$\text{Conversion factor}(C_p) = P_{mech}/P_{wind} \quad (2)$$

By using these equations we can get an equation like this:

$$P_{mech} = 0.5C_pR^2V^3\pi\rho_{air} \quad (3)$$

According to the Albert Betz calculation, we can get maximum power from wind when the conversion factor is 16/17 or 59.30%. this limit can be known as the Betz limit.

INVERTER

The inverter is used as an electronic device for converting the direct current in the form of alternating current. Inverter can be a fully electronic or sometimes the combinations of the some mechanical effects. We do not obtain any power from the inverter; the power is given by direct current source.

STEADY STATE ANALYSIS OF SINGLE PHASE INVERTER:

In figures we can see that the waveform of the load does not depends on nature of load. The load voltage is defined as, V_s as a source voltage, V_o as the output voltage, T is total time period.

The output voltage equations for the half bridge inverter,

$$V_{o=} = 0.5 V_s \quad 0 < t < T/2 \quad (5)$$

$$V_{o=} = -0.5 V_s \quad T/2 < t < T \quad (6)$$

The output voltage equations for the full bridge inverter,

$$V_o = V_s \quad 0 < t < T/2 \quad (7)$$

$$V_o = -V_s \quad T/2 < t < T \quad (8)$$

But the load current is depending upon the nature of the load. For the different types of load the nature is also different.

CONVERTER

Converter is defining as a system which can transform the electrical energy in one form to the other form of the electrical energy. We can convert AC into DC and vice versa with the help of the converters. The conversion from AC to DC is known as the rectification and on the other side the conversion from DC to AC is known as the inversion process.

III. GRID

The interconnected network for providing electricity to the consumers from the suppliers is known as the electric grid. The electric grid consist of the supply side resources like

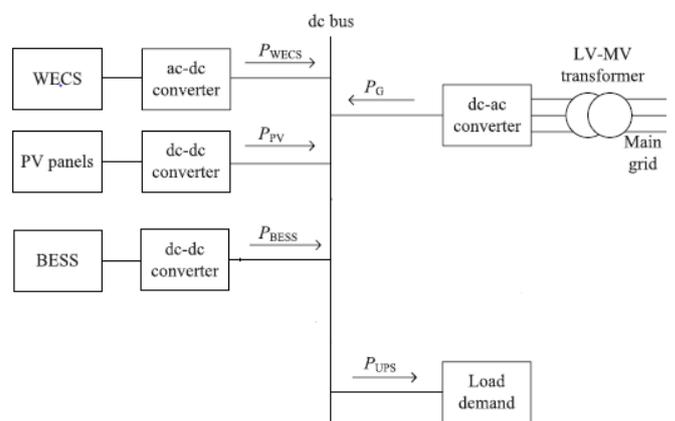
energy source, generating stations, high voltage lines for carry the power from one place to another.

In past the electric power was generating near the device. In 1880 electric lighting became beneficial compared to gas lighting. For long distance transmission of power, it became plausible to connect the stations to the balanced loads for improving the power factor.

MICRO GRID DESIGN

Microgrids can be defines as the discrete system which consists of many types of the distributed sources and the different types of loads which are capable of operating in the parallel operations. In this way the generation of power, storage of the power and the demand management of the total energy become very easier. The main purpose of the microgrid is to provide the reliable and ductile solutions for the industrial and the government consumers. Microgrid also have the other energy resources like solar power, wind power etc. The microgrids can also be operated with the SCADA technology. The efficiency of the microgrids is also very much high. The operations of the microgrid are very easy. The reliability of the power is also very much high. In present the microgrid is used in the commercial building, residential etc.

Modelling of Micro grid



IV. ENERGY STORAGE SYSTEM

The capture of the energy produced by the sources at the one time and can be use this energy at another time can be done by the energy storage system. Sometime the energy storage devices are known as the accumulator. Energy can be anything like radiation energy, electricity, kinetic energy and many other form of energy. Energy storage consist the process to convert the one form of energy into other form so that we can use it later on time.

With the revolution comes in the power sector the need of the storage becomes very much necessary. The energy storage devices are different in types:

MECHANICAL ENERGY STORAGE:

We can store the mechanical energy in the form of electrical energy. And whenever we require that energy we can convert the energy into kinetic energy. It is also of many types

- compressed air energy storage
- fireless locomotive
- flywheel energy storage
- hydraulic accumulator
- pumped storage hydro electricity

THERMAL STORAGE:

It is define as the temporary storage it can store the heat of the water. It is also of many types:

- brick storage heater
- cryogenic liquid air or nitrogen
- molten salt
- solar pond
- steam accumulator
- ice storage
- seasonal thermal energy storage

ELECTRICAL STORAGE:

We can store the electricity in the form of DC supply and other form of electric energy. We can store energy in the form of magnetic field, electrostatic field and many other form of energy. We can store the energy in the super capacitor the work of the super capacitor is provide the constant voltage. The super capacitor can be charged in the fractions of seconds that's the reason this the best option for storage of energy.

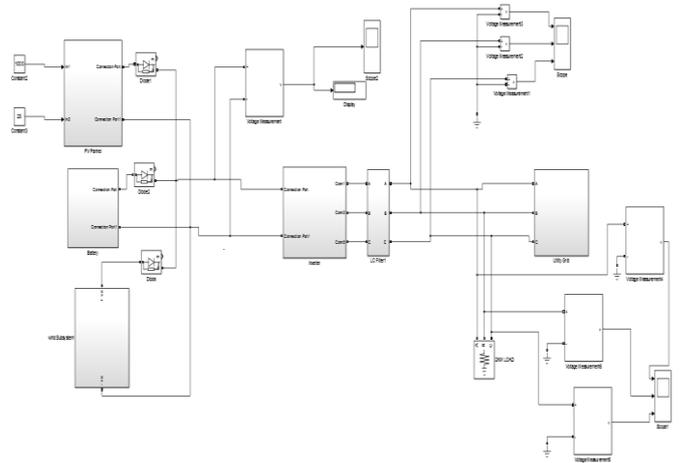
- Capacitors
- Super conducting magnetic
- Super capacitor

ELECTRO CHEMICAL STORAGE:

This type of storage also has many types some of them are shown below.

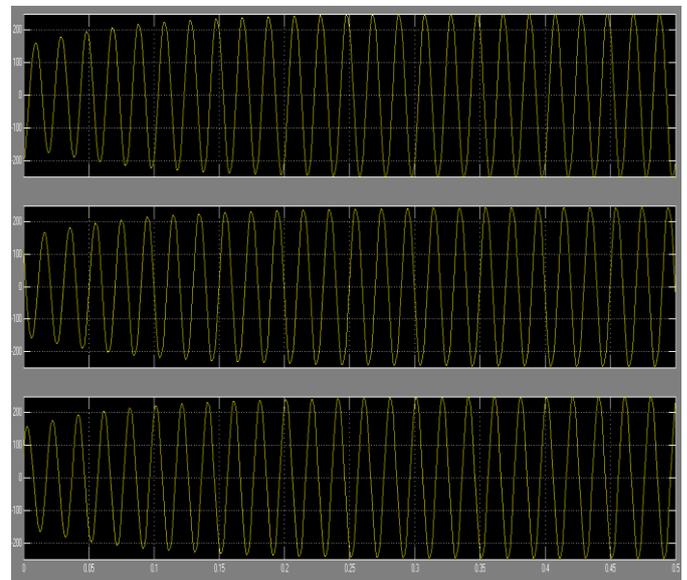
- Rechargeable battery
 - Lead – acid battery
 - Nickel – cadmium battery
 - Lithium – ion battery
 - Lithium-ion polymer battery
- Flow battery
- Super capacitor
- Ultra battery

V. SIMULATION MODEL



VI. RESULTS

We have one inverter which is used to convert DC into AC. After that we introduce one filter that is LC in nature, this is used to remove the not desirable part of the signal. We got the output in pure sinusoidal waveform which has the constant amplitude and the waveform is displaced by the 120 of angle. The simulation result is shown below:



VII. CONCLUSION

Now it is very much clear that the solar and wind energy is become a good and fine source of resources of producing the electrical energy. Due to their eco-friendly nature now every country is giving more attention to develop their alternative sources like (wind, solar, hydro, fuel cell etc.).

In next few years the growth of the electricity production will increase by using renewable energy resources. These resources also prove their ecofriendly nature. The main focus

must be to increasing the efficiency of wind and solar energy by making them in hybrid form in order to fulfill the requirement of the energy need. This is presented in this paper. Hybrid model is the widely uses as a research topic. With the help of this thesis we can change the electricity pattern in the villages. Solar energy and wind energy power generation has proves their ability to generate the power. With the help of this thesis we can use the different renewable energy resources combined together to produce the electrical energy reliable and efficient.

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