International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

ENERGY MANAGEMENT OF A HYBRID ACTIVE WIND GENERATOR

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ABSTRACT

Wind power generation or Wind energy generation system are passive energy generation system it does not require any kind of grid, it is only requiring Turbine system to convert energy form from Mechanical energy to Electrical Energy. But its generation is depending on wind condition and it is fluctuant with wind. In this paper we studied on hybrid system and we studied that DC coupled generator. To control the generated power, we need external sources and specially their power exchange to make controllable. The most special thing we can built grid to provide constant supply with the help of wind generator and external energy source. As per planning and study we found source-following method has better performance as compare to another for Hybrid power regulation and control.

INTRODUCTION

Renewable energy is the most efficient system and it is attracted whole world in their two goals. The Reducing combustion of fossil fuel and achieve more power generation; the reduction of the emission of greenhouse gases to reduce the combustion of fuels. E.g-CO2 from the burning of fossil fuels. With the help of wind energy generation we can increase efficiency to reduce their cost and increase performance as wel, the main drawback of renewable energy generators is contrability of the system. Their connection into the utility network can lead to grid instability or even failure if they are not properly controlled. Moreover, the standards for interconnecting these systems to the utility become more and more critical and require the external system to maintain the service like DG system or any kind of external source of power to provide constant supply, like frequency and voltage regulations of the local grid. Wind energy is the fastest growing energy source of world, expanding global rate of generation is 25%–35% annually

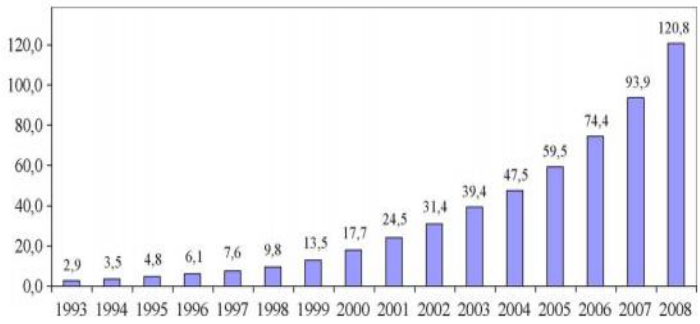

Fig. 1. Total wind power (in Giga watts) installed in the world since 1993

The classical wind energy conversion systems work like passive generators. Because of the uncertainity and fluctuant wind speed for generators, they cannot offer any ancillary services to the electrical system in a micro grid application, As per study and as per solution active power of hybrid wind generator has work in following two method.

(1) different Energy storage systems are used for store compensate or absorb the difference of power generation and power consumption of generated wind power and the required grid power to the consumers.

(2) Energy management Technique are used to control the power exchange between wind generator, energy storae system and different sources and to provide some services to the grid in case of no generation of energy through wind generator, because have to maintain the constant power supply with the help of external power supply like burning of fossil fuel external thermal power plant etc.

HYBRID POWER SYSTEM

The availability of renewable energy sources are fluctuating and intermittent. Hybrid Power Systems (HPS) may be a good energy source to provide high level energy. Hybrid Power Systems (HPS) consists the mix of various

generation systems. It also insures the maximum reliability of power supply. There are two kinds of hybridization of power sources are used:

- Renewable energy sources and backup power units.
- Renewable primary sources.

HYDROZEN ELECTRIC ECONOMY

Hydrogen is a good source of energy and so can be used as an energy carrier, this Phenomena is called Hydrogen Electric Economy. Using hydrogen as an energy carrier has the following advantages:

- Hydrogen is produced from a clean energy sources;
- Hydrogen can be distributed and stored in a variety of ways;
- Hydrogen can replace fossil fuels to provide electricity and transportation fuels;
- Domestic resources can be used for hydrogen production to lead to energy independence.

WIND ENERGY CONSERVATION SYSTEM

A wing Energy Conservation System has a setup of
- 3-blade turbine,
- Electrical machine,
- Gearbox,
- Three-phase rectifier,
- Three-phase inverter,
- DC-bus capacitor,

Which are connected to a grid through a grid transformer.

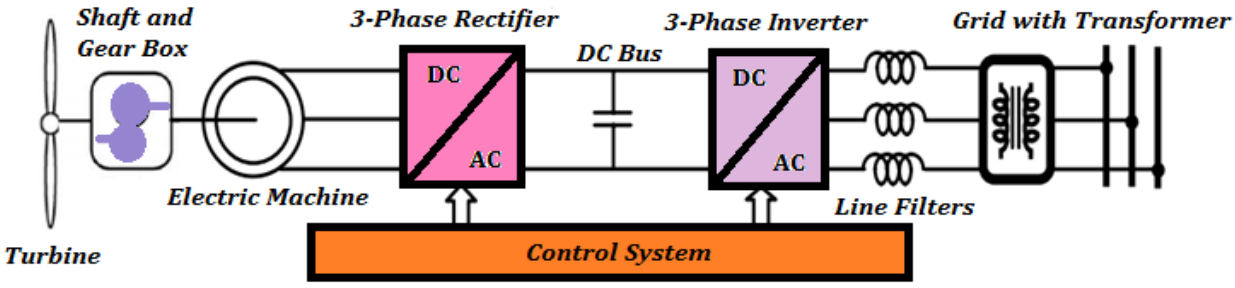

Fig: - A classical wind energy conversion system

For a wind energy conversion system, the average modeling of the electrical power conversion is obtained by using equivalent average models.

An electrical machine and a three-phase voltage source containing grid transformer has three-phase current sources. For the main power control two back to back voltage source converter are responsible for introducing control inputs. We can have three different subsystems with their inner dynamic and control tasks because of DC bus having slow dynamic. These three different subsystems are:

The wind generator,

The grid connection system and

The DC bus.

FUEL CELL SYSTEM

Since the demand of oil supply is incresing day by day and so is the price, it emphasized the need of an alternative energy source and ecomonicsl in financial aspect. Hydrogen is a possible alternative energy carrier because of the progress in fuel cell technologies. For a power plant and automobile industry the generation of fuel power has became intresting and promising. In this study, the fuel cell system is proposed as an energy backup solution.

TECHNOLOGIES

The discovery of the fuel cell is generally attributed to Mr. Willia m GROVE in 1845. But there was no industrial development before 20th century of Fuel cell because the steam engine and internal combustion engine was already successful. In 20th century six type of fuel cells are

developed. They can be classified either y type of electrolyte or operational temperature.

1. Molten Carbonate Fuel Cell (MCFC)
2. Direct Methanol Fuel Cell (DMFC)
3. Phosphoric Acid Fuel Cell (PAFC)
4. Solid Oxide Fuel Cell (SOFC)
5. Proton Exchange Membrane Fuel Cell (PEMFC)
6. Alkaline Fuel Cell (AFC)

OPERATING PRINCIPLE

The reaction mechanisms may be differ from each other due to diffrenet types of fuel cell and used fuel . For this experiment Proton Exchange Membrane Fuel Cell (PEM) is beimg used to consider the operation description, but the concept for other fuel cell will be the same. As the schematic diagram of . The processes occuring is shown below in a PEM fuel cell which shows the electricity generation by converting hydrogen and oxygen into water.

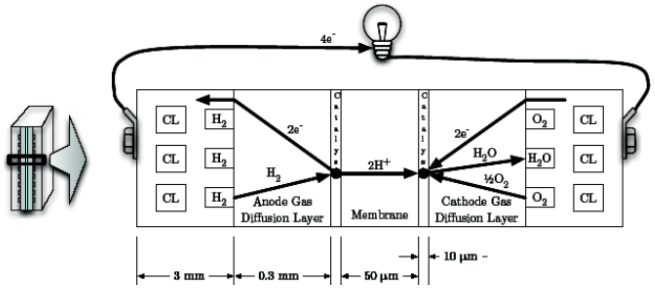

Fig:- Schematic representation of a PEM fuel cell

ACTIVE WIND GENERATOR MODELING

The long-term energy storage system is hydrogen based and includes fuel cells and electrolyzers. It is integrated into hybrid power system which is wind/s upper-capacitor based. The DC-coupled structure is used because of many advantages. Through different power converters DC bus is connected to different sources:

- The fast-dynamic energy storage system: super-capacitor (SC);

- The renewable energy conversion system: wind generator (WG);

- The grid as a three-phase voltage source.

- The long-term energy storage system: fuel cell system (FC) and electrolyzer system (EL);

To participate in grid management the hybrid power system must work like a classical active generator. To make this work, since the coordination of these different sources is very important the control and modelling of each source's power conversion system should be studied as well as the energy management strategies and overall power balancing.

Since the super-capacitors are having high power dynamic, used for the transient regulation tasks. With the "grid following" strategy super capacitor can help to regulate the grid active power and with the "power dispatching" strategy can also help regulating DC-bus voltage resulting active wind generator work in both power balancing strategies.

The energy availability of the active wind generator is ensured by the hydrogen based energy storage system because of its high energy capacity. The storage level of the super-capacitor has not varied much due to the help of the fuel cells and the electrolyzers. It gives the advantages of long time continue use of super-capacitors against continuously fluctuant wind power. With this phenomena, to provide uninterrupted active wind generator can work like a classical power generator services to the power system active wind generator can work like a classical power generator to ensure the system's power quality.

METHODOLOGY

METHOD

These following step we have been followed:

1) At firstly with the help of mathematical equations and modeling tools we will design the system model for generation in order to make appear necessary and useful properties.

2) A real-time emulator of perticular parts of the system is designed as per mathematical equation and corresponding modeling equations in order to make a fast performance of the experimental platform for reducing cost and risk reasons to make system efficient.

3) With the behaviors of the studied real systems in the same conditions the emulators are validated by comparing the obtained performances of the designed system model with the help of system model equation and their absolute performance.

4) The control algorithms for certain wished performances of the system modeling is also used to design the system model as per equation and requirements.

5) The control system can be firstly implemented on the experimental platform with real time emulators to test the performances. This can be considered as the demonstration of the control performances because normally the same control performance can also be obtained when the control system is implemented on the real system.

6) To make system hybrid used the grid system and grid system will be working automatically or manually to switch the system into wind generation power supply to external energy sources or storage device to maintain constant energy supply and there is a external storage device is directly connected to the wind generator system to maintain the difference of production and consumption.

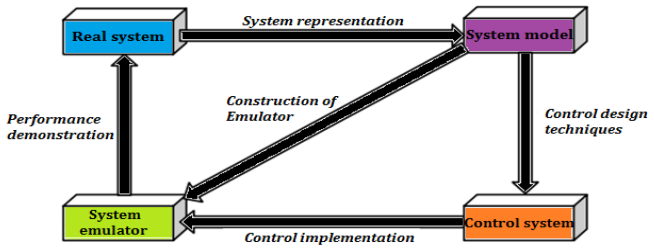

Figure: Methodologies

TOOLS

a) Equivalent average modeling
b) Graphical tools for system modeling and control design
c) Real-time emulator for flexible experimental assessment.
D) External storage source for conservation of difference of wind generator and grid integration.

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