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A Review: Hybrid Power System with Different Controllers and Tracking Methods

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Abstract: The best option is to satisfy the global demand for alternative energy system. Hybrid energy system is the integration of different renewable sources of energy from wind, solar, hydro, etc. to the existing distribution system. This paper is a study of the hybrid power system's stability. This paper addresses the question of stability and various controls influencing the output power of the hybrid power system. Stability and power quality are the main problems of the hybrid system. Many types of facts devices and other methods are used to improve these issues. Hybrid power system is increasingly being used nowadays. Most of the work is based on the use of different controllers and control techniques used to generate maximum power of a hybrid system with good power quality

Keywords — MPPT, Facts devices, multilevel-inverter, fuzzy logic, neural network.

I. INTRODUCTION

Hybrid power systems provide clean and environmentally friendly energy. These hybrid systems can be either stand-alone or connected to the grid. This combination of conventional and renewable energy sources such as wind, solar, hydro etc. The grid hybrid powered system provides continuous power into the grid because the loads are connected directly to the grid if there is an electricity shortage or malfunction in the renewable energy sources. As the wind and the sun are not constant every day, this causes the hybrid system to have stability problems. Different types of FACTS tools are used to boost the stability issue in the process. The UPFC, IPC, Fuzzy logic, SVC, STATCOM etc are used for maintaining the stability of the system. And maximum power point monitoring strategies are used for maximum power generation and continuous operation with maximum extraction of wind and sunlight to produce full hybrid system power

II. CONTROLLER FOR SOLAR AND WIND HYBRID POWER SYSTEM

The main problems with wind and solar hybrid power systems are the quality of power and the stability of the voltage. Since both sources are intermittent, each source's production depends on nature. The wind speed at all times is not constant and the daylight often varies throughout the day. The solar power system will not operate in the rainy season. Due to this, voltage will not be constant and power quality is affected. For this purpose, different controllers are used to maintain stability and improve the quality of the power. UPFC D-STATCOM, IPFC, SVC, SSSC, Fuzzy logic controllers are used to balance power and improve the quality of power. Due to the voltage swell, sag and the harmonics generated in the system, the voltage stability of the power system is reduced. Before the load is supplied, the FACTS devices are attached to the inverter's output terminal. Such FACTS devices help to reduce the harmonics present in the current waveform which improve the quality of the power. The STATCOM used is a Static Synchronous Compensator that is used as a shunt compensating tool to minimize reactive energy compensation, increase the system's stable state, as well as transient stability. It is used for the compensation of reactive and active power.

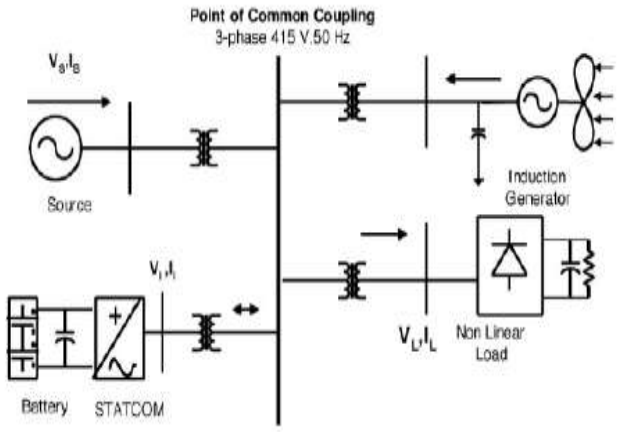

Fig.1.Grid connected FACT System for power quality improvement

A. *Fuzzy logic controller for Hybrid system*

The main energy sources are hybrid systems consisting of PV and wind. PV output is dc but wind output is ac, with the aid of the inverter this ac is converted to dc. This unit also connects the dc to dc converters. And attach to the grid side inverter to convert dc to ac. Using the fuzzy logic controller, the energy is regulated in the process. The

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reliable and stable Fuzzy logic controller. They have low power dissipation and optimized cost. They are based on the theory of fuzzy set and it is a non-linear method of control. This is used to provide knowledge that is constant. Fuzzy logic controller controls the power in the process. Fuzzy logic controller has 3 steps,

1.Fuzzification

2.Fuzzy inference system

3.Defuzzification

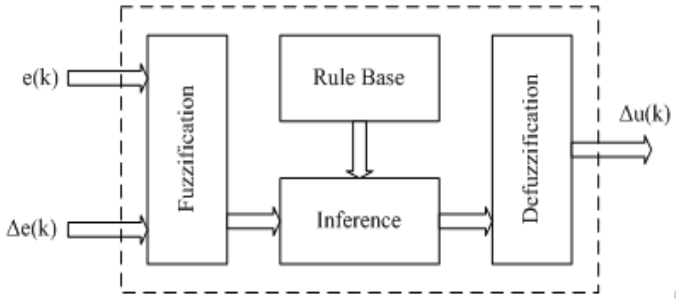

Fig.2.Structure of Fuzzy Logic Controller

Fuzzification involves designing the membership function of input and output. Classical software preserves the fuzzy data. The relationship between input and output membership features is designed in the Fuzzy inference system. The rules of control are combined with the functions of membership. The output of the fuzzy logic controller is obtained in Defuzzification. The lookup table is used for the input and the value is determined using different methods.

III. IMPROVEMENT OF POWER QUALITY IN HYBRID SYSTEM WITH MULTILEVEL INVERTER

Multilevel inverter's power quality depends on the number of levels. Multilevel inverter's main advantage is that low harmonics can generate output voltages. These inverters are used for high-power applications. The harmonics cause the current to rise, resulting in a neutral increase in current. The sources are connected to the dc-dc converter in the hybrid system first and then to the multilevel inverters. Various converter topologies are used, such as Two-Level Voltage Source Converters; Three-Level Diode Clamped Voltage Source Converters, Four-Level Voltage Capacitor Source Converters, and Series Connected H-Bridge Voltage Source Converters. The most widely used topology for multilevel converters is the diode-clamped inverter, whereby the diode is used as the clamping tool for clamping the dc bus voltage so that steps can be taken into consideration in the output voltage level three. The frequency of the low order harmonics will decrease as the rate number increases. Since high frequency harmonics are easy to filter, usually a low pass filter accompanies the inverter used. Thus, multi-level inverter performance can be improved by reducing harmonics of lower order. It is also possible to use the PI controller to control the DC bus voltage at a constant value.

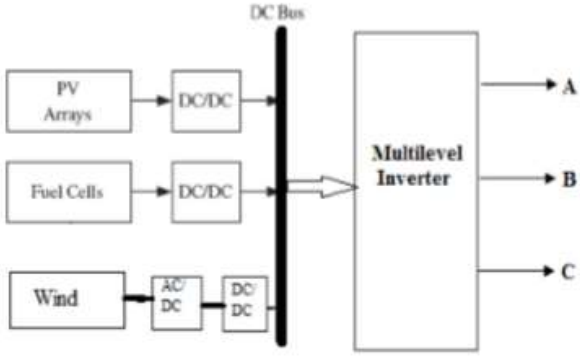

Fig.3.Block diagram of Hybrid system with multilevel inverter

IV. MAXIMUM POWER POINT TRACKING (MPPT) IN WIND AND SOLAR HYBRID POWER SYSTEM

Due to the limited use of conventional energy sources, renewable energy sources are increasingly being used. The main sources are the hybrid energy system, but mainly wind and solar sources are used. These sources of energy are variable in nature. Throughout the day, the wind speed and sunlight are not constant, it changes all the time. There is therefore a question in the production from these sources of maximum power. We use the maximum power tracking system to extract maximum energy from wind and solar. As a result, the hybrid system's electrical power output is increased. The MPPT used in solar energy provides the dc to dc converter with the control signal and these controlled outputs are given to the grid or the load. Similarly, maximum power point tracking is also used for wind energy by controlling wind speed to get maximum power. The MPPT maximizes the system's efficiency. There are numerous algorithms that help track the PV module's maximum power point. They are as follows:

1.P&O algorithm

2. IC algorithm

3. Parasitic capacitance

4. Voltage based peak power tracking

5. Current Based peak power tracking

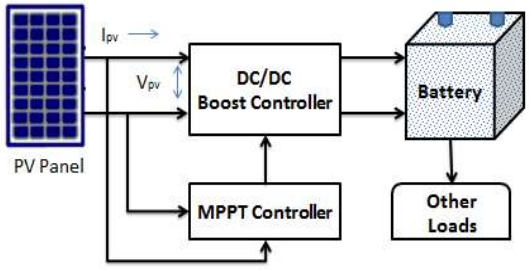

Fig.4.MPPT For Solar Energy Source

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MPPT for conversion of wind energy can be done in three ways: control of tip speed ratio (TSR), control of power signal feedback (PSF) and control of hill-climb search (HCS). The wind energy conversion system's TSR control method controls the generator's rotational speed to sustain the TSR at an optimal value at which the extracted power is peak. In the PSF control method, the awareness of the maximum power curve of wind turbines is required and this curve is monitored through its control mechanisms. And the third hill climb search control algorithm is continually searching for the wind turbine's peak power in the system.

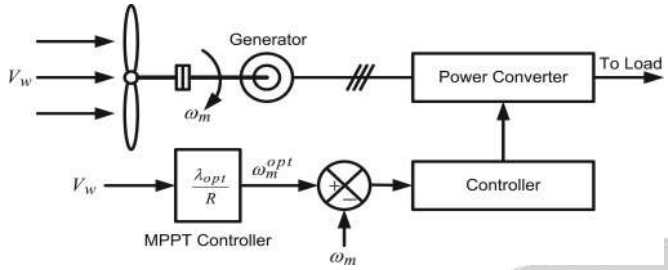

Fig.5.Tip speed ratio control of WECS

V. USE OF HYBRID FILTERS

Using hybrid filters can increase the power efficiency. The dc-dc converter and hybrid filter link the renewable energy sources to the grid. The hybrid system gate pulses are operated using the hysteresis controller. The reference current for the hysteresis controller is obtained by using synchronous reference frame. The hybrid controllers are used not only to control harmonics, but also to compensate for the reactive power of the positive and negative sequence. Hybrid filters are of various types, shunting the active power filter and acting as a hybrid filter. It ensures that the source current harmonics are compensated. This hybrid system removes sequence and parallel resonance. The active and passive filters are connected in Series and parallel to the grid the structures are related. The non-linear loads that produce the harmonic current are reduced because of these filters.

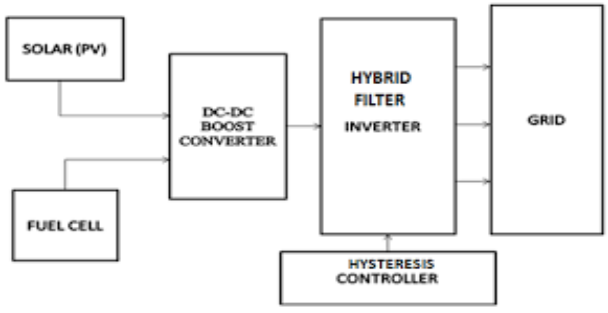

Fig.6. Block diagram of Hybrid system

VI. ECONOMIC EVALUATION OF THE HYBRID SYSTE

The cost of the hybrid system keeps the cost of investment, cost of maintenance and cost of replacement. By using renewable energy sources, wind and solar are the key means of reducing detrimental environmental effects. The wind and solar hybrid plant linked to the whole network is evaluated. All analysis done by HOMER software. The economic analysis is carried out using the approach of costing the life cycle. It includes all the costs involved in the lifetime in this method. For the hybrid power system, this method is used. Economic analysis of the hybrid power system is thus carried out.

VII. CONCLUSION

This paper discusses the improvement of the power quality of the hybrid power system. By using different FACTS device types. The Fuzzy logic controller is used to control the power in the system and to stabilize the system. The maximum power point tracking method for maximum wind and sunlight for hybrid power system was also discussed in this paper. The harmonics in the hybrid power system are growing, and the use of multi-level inverters increases the energy performance. The use of hybrid filters is another way of improving the energy performance in the hybrid power system. The economic assessment of the hybrid power system can be carried out using the cost method of the life cycle.

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