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Review On Control Scheme for AC-DC Grid Connected Hybrid Energy System for Power Quality Improvement

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Abstract-

Renewable energy sources such as air, solar, water, biomass, etc. are essential for sustainable development and social progress, as well as meeting energy needs through the use of renewable energy sources. Comprehensive renewable energy such as wind energy is needed in the energy system to reduce environmental impacts. The project proposes the STATCOM control plan for grid-connected wind power systems to increase power quality. The bang-bang controller was developed for STATCOM based on the hysteresis current control scheme. STATCOM has been merged with Common Coupling (PCC) to reduce power quality issues. The STATCOM manipulate scheme applied for the grid linked wind power generation system (WEGS) used to beautify the power best is simulated the use of the MATLAB / Simulink within the strength device block set. This proposed scheme guarantees an increase in energy quality in production output.

***Keywords – FACTS devices, Power quality issues, AC-DC Microgird , STATCOM, Wind turbine, Point of Common Coupling* etc.**

1. Introduction

A bridge, a structure of public engineering, a To have sustainable growth and social progress, it is necessary to meet the energy need by utilizing the renewable energy resources like wind, biomass, hydro, co-generation, etc In sustainable energy system, energy conservation and the use of renewable source are the key paradigm. The need to integrate the renewable energy like wind energy into power system is to make it possible to minimize the environmental impact on conventional plant [1]. The integration of wind energy into existing power system presents a technical challenges and that requires consideration of voltage regulation, stability, power quality problems. The power quality is an essential customer- focused measure and is greatly affected by the operation of a distribution and transmission network. The issue of power quality is of great importance to the wind turbine [2].

There has been an extensive growth and quick development in the exploitation of wind energy in recent years. The individual units can be of large capacity up to 2 MW, feeding into distribution network, particularly with customers connected in close proximity [3]. Today, more than 28 000 wind generating turbine are successfully operating all over the world. In the fixed-speed wind turbine operation, all the fluctuation in the wind speed are transmitted as fluctuations in the mechanical torque, electrical power on the grid and leads to large voltage fluctuations. During the normal operation, wind turbine produces a continuous variable output power. These power variations are mainly caused by the effect of turbulence, wind shear, and tower-shadow and of control system in the power system. Thus, the network needs to manage for such fluctuations.

The power quality issues can be viewed with respect to the wind generation, transmission and distribution network, such as voltage sag, swells, flickers, harmonics etc. However the wind generator introduces disturbances into the distribution network. One of the simple methods of running a wind generating system is to use the induction generator connected directly to the grid system. The induction generator has inherent advantages of cost effectiveness and robustness. However; induction generators require reactive power for magnetization. When the generated active power of an induction generator is varied due to wind, absorbed reactive power and terminal voltage of an induction generator can be significantly affected. A proper control scheme in wind energy generation system is required under normal operating condition to allow the proper control over the active power production.

In the event of increasing grid disturbance, a battery energy storage system for wind energy generating system is generally required to compensate the fluctuation generated by wind turbine. A STATCOM based control technology has been proposed for improving the power quality which can technically manages the power level associates with the commercial wind turbines. The proposed STATCOM control scheme for grid connected wind energy generation for power quality improvement has following objectives.

- Unity power factor at the source side.
- Reactive power support only from STATCOM to wind Generator and Load.
- Simple bang-bang controller for STATCOM to achieve fast dynamic response.

2. Problem Statements

Injecting wind energy into the power grid affects the quality of electricity. The performance and power quality of the wind turbine are determined based on measurements and the

standards are followed in accordance with the International Electro-Technical Commission standard, IEC-61400. Power quality measurements related to wind turbine impact in the grid system - active power, reactive power, variation of voltage, flicker, harmonics and electrical behavior of switching operation and are measured according to national / international guidelines. The paper study shows the energy quality problems caused by the installation of wind turbines along the grid. The static compensator (STATCOM) is integrated with the common battery power storage system (BESS) to reduce power quality problems in the proposed scheme. Battery power storage has been integrated to maintain a real power source under wind power fluctuations.

3. Objectives

Grid-connected wind power generation system using STATCOM has the following objectives to improve power quality

- Unity is the power factor towards the source.
- Wind generator and support for reactive power from STATCOM for loading.
- Simple bang-bang controller for STATCOM to reduce overall harmonic distortion.
- To eliminate the harmonic contents (flickers, variation of voltage, active and reactive power) by using STATCOM with Battery Energy Storage System(BESS).

4. Literature Review

Bhagyashree Parija et al. 2019, In this work a hybrid model of wind and Photo-voltaic system has been presented. This kind of system is very beneficial and useful to the remotely located or islanded areas where grid integration is not very economical. However, the interfacing of power electronic devices to DG systems induces very severe power quality problems, such as, harmonic generation and the reactive power compensation that disturbs the power distribution system. In this work, a simulation model of hybrid wind-PV generation system of capacity 750 KW has been presented. The performance of this system with grid connected mode is analyzed. The power quality of the wind-SPV hybrid system has been evaluated by calculating the total harmonics distortion (THD) at different wind speed. Power quality of this hybrid system has been improved by using D-STATCOM.

Burudi Jahnavi et. al. 2021, In this paper, Distribution Static Compensator (DSTATCOM) has been presented with a combination of proportional resonant (PR)-controller and comb filter. The proposed controller reduces the complexity in the tuning of the resonant controllers and also provides better current harmonics response. Multiple harmonic compensations in the grid current have been achieved by implementing a comb filter, which does not require tuning for individual harmonics compensation, unlike PR-controller. Two different forms of comb filters, such as feedforward and feedback form are implemented and results are compared in this paper. The D-STATCOM topology used a constant switching technique i.e. the sinusoidal pulse width modulation (SPWM) switching technique for reactive power and harmonic compensation. MATLAB/Simulink results are presented to validate the theoretical claims.

Dr. Lakshman Naik Popavath1, et.al. 2020 , In this paper , Utilisation of Renewable Energy sources have been increasing exponentially to reach the world power demand. Less utilization of rating of power converters in renewable energy system forces the researchers to develop new applications like power quality improvement. Power pollution is the key problem because of distorting or non-linear loads and distributed generation. The major power quality issues like wave form distortions (harmonics) and reactive power demand can be completely neutralized by the Custom power devices like Statcom. In this paper PV Solar Farm is performing as a PV-Statcom to elevate qualitative power in Grid coalesced Wind-PV system. The PV-Statcom control strategy results amplification of power quality. The results are obtained using Matlab/Simulink. The effectiveness of present concept gesture towards that improvement in PF and reduction of THD values.

Wesam Rohouma et.al. 2020, In this paper , Ensuring high power quality (PQ) is becoming an increasingly important task as the number of power quality sensitive loads increases. Mitigating power quality problems and providing the required compensation locally within the distribution network (near the source of the problem) reduces the total system losses and other undesirable effects caused with the reactive current flow in the electrical network. In this paper, a three-phase capacitorless matrix converter (MC) has been employed as a distribution-system static compensator (D-STATCOM) to provide reactive power compensation in the low voltage distribution network. To achieve a long service life, energy is stored in chokes instead of capacitors. The inductive-loaded D-STATCOM is controlled using model predictive control (MPC) to supply reactive power to the distribution network. To verify the proposed approach, experimental studies were performed and the results obtained from 7.5KVA test prototype showed the effectiveness of the proposed technology in reactive power compensation.

5. Research Methodology

Fuzzy Logic Controller is designed to improve the profile of source current in STATCOM. The purpose of the proposed scheme is to relate the main supply source through the supply and reactive power demand of the feedback generator and the reduction of THD (total harmonic distortion) in the source current of the system.

Achieving supportive development and social progress requires renewable energy sources such as solar, wind, biomass, hydro, co-generation, etc. to meet energy demand through the asset energy system, energy conservation and so on. Renewable energy. Sources are important models. Renewable energy, such as wind energy, needs to be incorporated into the power system to create the potential to reduce the environmental impact on

standard power plants [1]. Due to electricity demand and environmental concerns, wind power generation is growing rapidly and large-scale wind plants around the world are being connected to power networks. By injecting alternating energy into the utility grid, the power quality is violated due to the nature of the air fluctuations. According to the IEC standard, power quality is determined by wind generator performance. During this work power quality issues such as voltage variation, flicker, harmonics are demonstrated by installing a wind turbine with a grid. Fact's equipment can be used to overcome these energy quality issues. The project proposes the STATCOM control scheme for grid connected wind power systems to improve power quality. The project aims to eliminate harmonic content (flicker, voltage variation, active and reactive power) using STATCOM with Battery Energy Storage System (BESS). The simulation takes place in the MATLAB / Simulink block set. STATCOM has been shown to enhance the power quality of power grids by connecting primarily based wind plants.

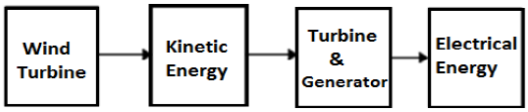

Fig. 1. Basic Flow diagram of Wind Power Generation

Wind power is the use of wind turbines to develop electrical energy, the use of wind power for mechanical power, and the conversion of wind energy into useful forms such as air pumps or vessels for water pumping or drainage. Let's go further. Wind form means a pair of wind turbines in the same place used to generate electricity. A big wind farm consists of numerous hundred-character wind generators and covers an area of masses of rectangular miles, but the land between the mills may be used for agricultural or other purposes. Wind farm is also offshore.

Many wind turbines are running successfully around the world. In the operation of fixed-speed wind turbines, all fluctuations in wind speed accelerate mechanical torque fluctuations, grid-side power and large voltage fluctuations. Power quality issues can be seen with air production, transmission and distribution network concerns such as voltage sag, swelling, flicker, harmonics. Non-wind generators introduce disruptions in the distribution network. One of the simplest ways to operate a wind generation system is to use an induction generator (IG) that is directly connected to the grid system.

6. Conclusion

The operation of control system developed for STATCOM-BESS on MATLAB / SIMULINK to protect power quality. It has the ability to cancel the harmonic components of the load flow. It maintains the source voltage and current phase and supports the reactive power demand for the wind generator and load on the PC in the grid system, thus giving it the opportunity to increase the transmission line consumption factor. Integrated Wind Generation with BESS and STATCOM showed excellent performance. Therefore, the proposed scheme in the grid-connection system satisfies the power quality.

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