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Pmsm Drive Based D-Statcom In Combination With Renewable Energy Sources To Enhance Power Quality

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Abstract:

The power quality plays a vital role in industries as well as transmitting the generating power to the utility it is necessary to minimize the power quality issues such as power losses , harmonics , power factor , reactive power flow through the transmission line etc…In this paper mainly concerned with the power quality improvement in a multi machine system using a FACTS based STATCOM device with an wind turbine(WT) is connected to the grid this is helps to maintain the voltage stability and also improvement in the power factor and harmonic reduction in the source and load side.

Keywords - FACTS, STATCOM, SVC, Wind energy, Multi-machine.

1. INTRODUCTION

During past decades there is no consideration about the power quality issues and at that time there is no usage of the power electronic devices but nowadays it plays a vital role due to its simplicity and flexibility mostly in industries they are preferred to use the Intelligent Electronic Devices(IED'S) because of this impact there is a possibility of harmonics are generated in power system network to avoid this problem many research workers found that by means of using the proper designed filter, it can be avoided and also depends on the type of load it will tends to change the load angle it affects the power factor. In distribution side one of the most important affect is a flow of the reactive power through the transmission line it affects the system performance and it reduces the efficiency of the system. Injection of the wind power into an electric grid affects the power quality. The performance of the wind turbine and thereby power quality are determined on the basis of measurements and the norms followed according to the guideline specified in International Electro-technical Commission standard, IEC-61400. The influence of the wind turbine in the grid system concerning the power quality measurements are-the active power, reactive power, variation of voltage, flicker, harmonics, and electrical behavior of switching operation and these are measured according to national/international guidelines. The paper study demonstrates the power quality problem due to installation of wind turbine with the grid. In this proposed scheme STATIC COMPENSATOR (STATCOM) is connected at a point of common coupling with a battery energy storage system (BESS) to mitigate the power quality issues. The battery energy storage is integrated to sustain the real power source under fluctuating wind power. 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 . Today, more than 28 000 wind generating turbine are successfully operating all over the world. In the fixedspeed 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 vari- able 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 gen- erator connected directly to the grid system. The induction gen- erator has inherent advantages of cost effectiveness and robust- ness. 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.

2. RELATED WORK

A distribution system suffers from current as well as voltage related power quality (PQ) problems, which include poor power factor, distorted source current, and voltage disturbances A DSTATCOM, connected at the point of common coupling (PCC), has been utilized to mitigate both types of PQ problems .When operating in current control mode (CCM), it injects reactive and harmonic components of load currents to make source currents balanced, sinusoidal, and in phase with the PCC voltages. In voltage control mode(VCM),the DSTATCOM regulates PCC voltage at a reference value to protect critical loads from voltage disturbance such as sag , swell and unbalances [2]. Rolling mill and electric arc furnace (EAF) are typical impact loads with capacities from several to hundred MVA. The reactive power may step from zero to their ratings within one or two cycles. Such strong reactive power impulses cause voltage fluctuations and voltage flickers, which make negative influences on the active power delivery to the loads. Poor power quality might degrade product quality, reduce equipment lifetime and increase power loss. To restrain the voltage fluctuations, Static Var Compensator (SVC) were developed in the late 1960s to provide dynamic reactive power compensation for large EAFs. Since SVC is a kind of thyristor based passive compensator, its response time is generally beyond one cycle and its reactive power output directly depends on the Point-of-Common-Coupling (PCC) voltage. Therefore, the dynamic performance of SVC has a ceiling in principle. Still, the control strategy of SVC may be improved to some extent. An outer regulation loop consisting of an AC voltage regulator and a DC voltage regulator. The output of the AC voltage regulator is the reference current Iqref for the current regulator (Iq = current in quadrature with voltage which controls reactive power flow). The output of the DC voltage regulator is the reference current Idref for the current regulator (Id = current in phase with voltage which controls active power flow).

3. PROPOSED SYSTEM

In many of the case studies of power quality they implemented only in the single machine system with respect to grid based wind energy system the main aim of this three machine nine bus system is to study the power stability under different faults. The wind turbine (WT) is connected to the system is to achieve the voltage stability with respect to the point of common coupling. Consider the nonlinear load i,e loads having constant impedance load based on this the power factor tends to vary, by connecting STATCOM at any of the buses with respect to PCC it may suppress the reactive power or it injects the reactive power based on the requirements To control the reactive power by means of maintaining all the bus voltages same. It will actuate both generator and transmission network voltage regulators; the generator speed variations will actuate prime mover governors; and the voltage and frequency variations will affect the system loads to varying degrees depending on Power system stability is the ability of the system, for a given initial operating condition, to regain a normal state of equilibrium after being subjected to a disturbance. Stability is a condition of equilibrium between opposing forces; instability results when a disturbance leads to a sustained imbalance between the opposing forces.

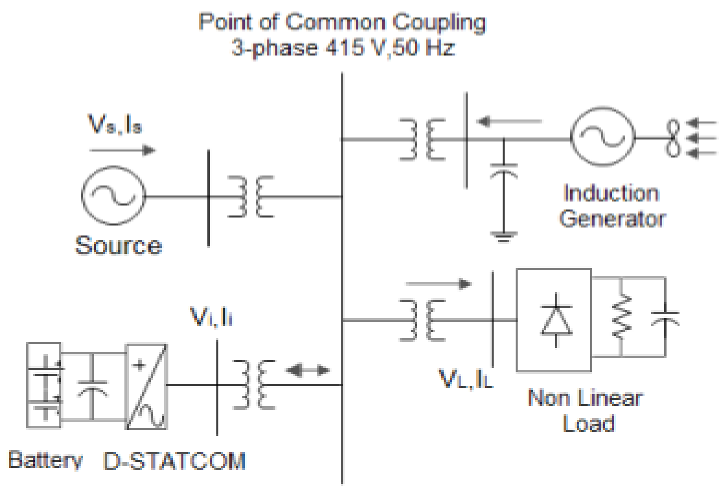

Fig.1.Grid connected system

The response of the power system to a disturbance may involve much of the equipment. For instance, a fault on a critical element followed by its isolation by protective relays will cause variations in power flows, network bus voltages, and machine rotor speeds; the voltage variations their individual characteristics. Further, devices used to protect individual equipment may respond to variations in system variables and thereby affect the power system performance.

4. ANALYSIS

A typical modern power system is thus a very high- order multivariable process whose dynamic performance is influenced by a wide array of devices with different response rates and characteristics. Hence, instability in a power system may occur in many different ways depending on the system topology, operating mode, and the form of the disturbance.[5]. In order to determine the stability status of the power system for each contingency of any disturbance occurs in power system, many stability studies are defined. Power system stability analysis may involve the calculation of Critical Clearing time (CCT) for a given fault which is defined as the maximum allowable value of the clearing time for which the system remains to be stable. The power system shall remain stable if the fault is cleared within this time. However, if the fault is cleared after the CCT, the power system is most likely to become unstable. Thus, CCT estimation is an important task in the transient stability analysis for a given contingency. In this paper for the Transient Stability Analysis, an IEEE 9 Bus system is considered.

The most important part of electric power system from the point of view of its consumers is power distribution systems. In the recent years, however, the advances in power electronics and signal processing have led to the widespread usage of power electronic equipments which generally draw non-sinusoidal currents from the source leading to presence of harmonic currents in the system. In addition to that, unbalanced distribution of highly reactive linear loads on different phases of the three-phase power distribution system leads to problems such as high reactive power burden, load unbalancing, poor power factor etc. Due to the non-ideal nature of transformers, conductors, feeders and bus-bars used for power transmission and distribution, the voltages in the distribution systems also experience power quality problems such as poor voltage regulation, harmonics, unbalance, flicker, sag and swell etc. In addition to the above mentioned problems, the presence of unbalanced and non-sinusoidal currents in three-phase four-wire power distribution systems mainly used for supplying single-phase low voltage loads, leads to significant neutral current. The presence of unbalanced voltages, which is very common in power distribution systems, aggravates the situa- tion due to the presence of zero sequence voltage leading to direct presence of zero sequence current even due to linear loads. Power factors below unity due to the presence of harmonics and reactive load currents not only degrade the power quality but also require the utility to generate more than the minimum volt-amperes necessary to supply the real power (watts).In this paper, by analysing the voltages inside a Zig-Zag transformer a novel neutral current compensation scheme is proposed to ensure exact zero source neutral current in the presence of unbalanced utility voltages.

Also, a reduced rating DSTATCOM controlled using instantaneous symmetrical components theory is used for load balancing in the presence of unbalanced voltages[19]. Improvement of power quality is the greater concern in advanced power system element, it is essential to congregate the need of energy by employ the renewable energy generating sources like pv, fuel cell, biomass, wind, etc and utilizing many more applications like grid interconnected systems, power quality improvement. The situations like harmonic, reactive power exchanging, power factor correction, balancing the load & so on, due to greater effect on highly susceptible loads are to be encouraged in power distribution system. To enhance these circumstances, custom power appliances are used to achieve high grid stability. In that CHB based D-STATCOM is a meticulous power appliance for enhancing harmonic distortions from high power semiconductor switching device, exchanging the both active & reactive power, defend the gird stability by implementing DG technology, to regulate the PQ issues.

CONCLUSION

This survey analyzes the stability of the system with different types of load connected at various buses from this system and helps to differentiate at which bus the reactive power flow is high. Using this study, if the STATCOM is connected at that particular bus there is a possibility of attaining a stable power system network, thereby reducing the harmonics and improving the power factor. By connecting an efficient STATCOM at the bus with respect to point of common coupling wind turbine grid issues can be avoided.

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