Power Quality Improvement in STATCOM Based PQ-controller For Grid connected to Wind Energy System

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Abstract—Generally, the non-conventional energy sources area unit being extensively utilized in case of power converter primarily based distribution systems. This paper chiefly focuses on the wind energy system integration with grid connected system and additionally improvement of power quality options. The wind energy power station is modelled supported associated equations. The electrical {converter} here is therefore utilized as an influence converter primarily based shunt active power filter and wont to inject power to transmission grid. Of these functions could also be performed either severally or at the same time. The Shunt APF is controlled on the idea of PWM controller that is meant supported the conception of PQ theory. Therefore with such an impression, a balanced load currents area unit obtained even within the presence of non-linear load. The experimental setup is completed in Matlab and verified the simulation results.

Index Terms— STATCOM, distributed generated system (DG), distribution system, and renewable energy.

1 .INTRODUCTION

Generally, with increase within the power demand because of increase in population, utilization, the Generation of power was very a challenge currently daily. Because of high utilization of non-conventional energy supply's as a 1 of the distribution energy source, might causes the soundness issues like voltage regulation and alternative power quality issues. Therefore, the ability electronic based mostly forced commutated converters square measure most popular in distribution system for maintaining the system stability, reliable performance and economical work and conjointly improvement of power quality at purpose of common coupling.

The present distortions in non-linear load might result same distortions within the system voltages and in some cases conjointly shows the intense impact on power grid. Generally, these power quality issues square measure a lot of complicated and even have tough to spot the matter once we integrate the wind energy system with grid association. If this issues continuous, it's primarily causes the injury of system and conjointly reduces the system potency. The advance of power quality is obtained by dominant the transmission parameters such as magnitude of the system voltage, line electrical resistance and load angle. Looking on the management capability and association of the compensating device to the system, these converters square measure classified into 2 ways that known as shunt and series converters.

A shunt device could be a compensating device i.e. that is connected between the grid connected purpose known as PCC and therefore the ground. Shunt convertor has the potential of either generate or absorb reactive power at the purpose of association. As a result of the bus voltage magnitude will solely be varied inside bound limits, dominant the facility flow during this means is proscribed and shunt devices in the main serve different functions.

Figure 1 shows the fundamental diagram for the shunt connected electrical converter primarily based grid connected.

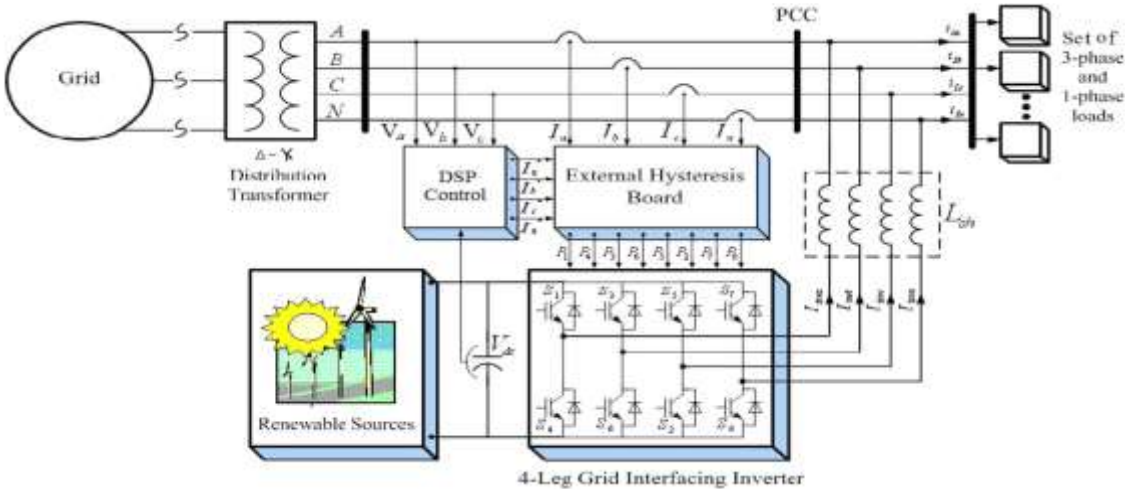

Fig 1: basic schematic diagram for the proposed renewable energy system.

2. GRID INTERCONNECTION TO WIND ENERGY SYSTEM

Recently grid connected wind system are spreading in residential areas and in industrial areas. Thus we've got to search out an appropriate MPPT technique that offers a stronger power output once connected is to search out. For a grid connected system there are bound factors that are thought-about such DC-AC conversion with highest output power quality with the correct style of filters System main dominant factors like MPPT. Grid interface inverters that transfers the energy from the wind energy generation system to the grid by maintaining constant of dc link voltage. For a grid connected system the utility network principally demands for higher power quality and power output. Within the case of voltage fluctuations management of grid parameters is extremely tough. Thus for a wind system that's connected to a grid 1st stage is that the boosting stage and also the second stage is DC-AC device. AN output filter is sometimes utilized that reduces the ripple elements because of change issues. The matter related to the grid connected system is that the dc link voltage that has to be oscillates between the 2 levels that depends on the operational climate (ambient temperature & irradiance) electrical converter which acts U.S.A. an influence controller between the dc link and also the utility.

2.1 Wind Energy System:

The generation of electric power is obtained principally in 2 ways in which i.e one is typical supply and different is non- typical energy sources. The generation of electricity victimization non-renewable resources like coal, gas, oil then on, shows nice impact on the setting by production of pollution from their general gases. Hence, by considering of these conditions the generation of electricity is obtained from the renewable energy sources.

Basically, out of all renewable energy sources the turbine plays a crucial role for generating electricity. And conjointly from economical purpose of read the turbine has low maintainece value as a result of it wants no fuel so it's pollution free. Mostly, in gift world 50-60 p.c of energy is generated from turbine as compared with all different renewable energy sources.

The standard layout of alternative energy generation is shown below.

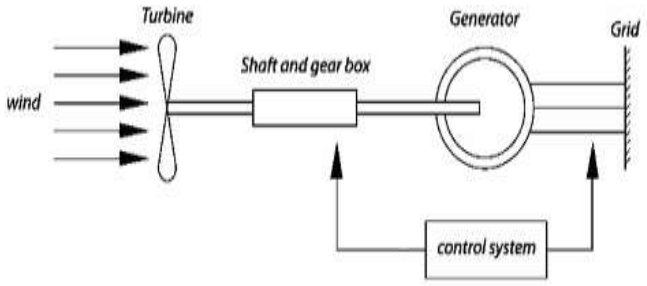

Fig.2 basic schematic diagram of wind turbine

The wind turbine converters wind energy to electrical energy and the generator mechanical shaft power is obtained by the following expression:

$$P_m = 0.5\rho A C_p v^3$$

Furthermore, the coefficient of power likewise assumes a key job for wind framework and the fundamental least estimation of intensity coefficient is 0.5. The power coefficient is acquired by the proportion of tip speed proportion to pitch point. The pitch edge is the point is utilized for adjusting the turbine cutting edges to regard to its longitudinal hub and altering of twist course. The tip speed proportion is characterized as proportion of direct speed of the rotor to the breeze speed.

Figure 3 demonstrates a common waveform for coefficient of intensity regarding the tip speed proportion.

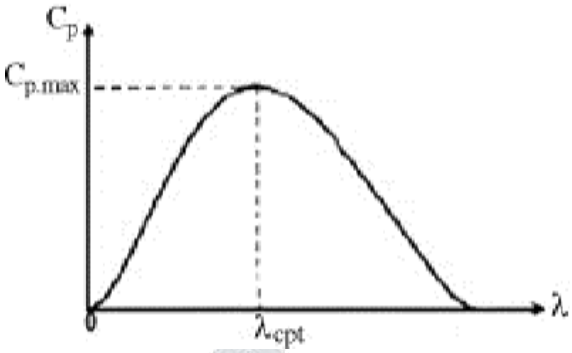

Fig 3: Power coefficient Vs Tip Speed Ratio

2.2 STATCOM and its Control Technique:

A STATCOM is a one of the repaid gadget which is acquired from the FACTS family and is a mix of intensity electronic converter alongside reactor. For the most part, the converter is built by the utilization of completely controlled gadgets, for example, GTO, IGBT or MOSFET. The primary motivation behind this STATCOM converter control method is utilized to remunerate the deviations in power framework for enhancing power quality. In this paper lattice interfaced wind turbine based STATCOM control plot is proposed for enhancing the unwavering quality of electrical power.

• Maintenance of unity power factor at grid side.

• The Dc voltage is obtained for STATCOM is generated from Solar Cells.

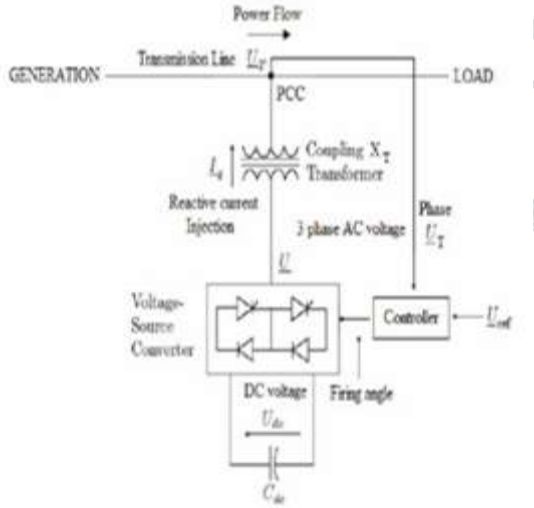

Fig 4: basic block diagram for static compensator.

In view of the use of electrical load in three stage framework, it delivers an unbalances in flow, which causes the temperamental in power, at long last it decreases the productivity. In this manner for keeping up the electrical unwavering quality the statcom controller assumes a key job. In this statcom control procedure, the reference voltage and dc connect capacitor voltages are looked at and the outcome got from this is converter to two stage organizers called as symmetrical vectors.

As appeared in figure 4, the aggregate dynamic power is gotten from the idea of symmetrical voltage and current, which are acquired from the line voltages and flows. What's more, from this power the reference vector flows are acquired and by contrasting this reference flows and real load flows and are changed over to entryway beats for converter.

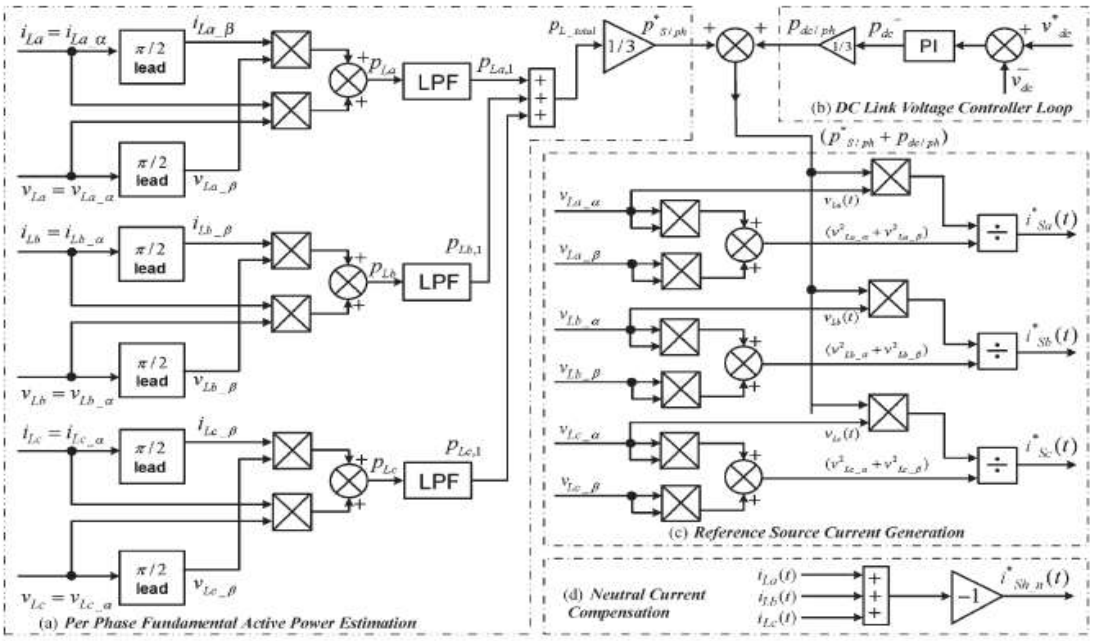

Figure 4: Control Diagram for statcom converter

3. SIMULATION STUDY

Case 1: Simulation result with use of Statcom Converter

The simulation is done based on the fig 1, and it shows in figure 5 and the obtained power quality is shown below simulation waveforms.

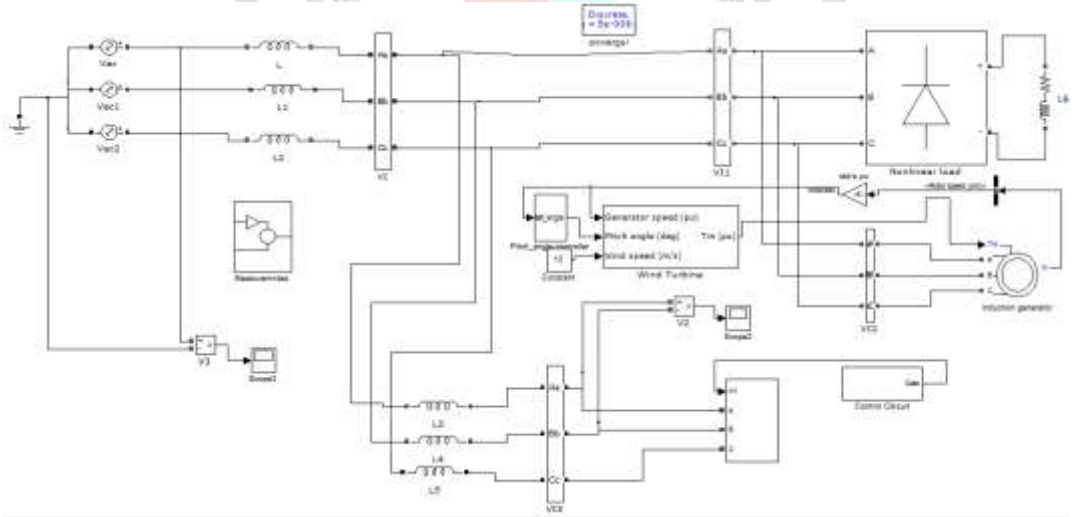

Fig 6: Simulation Diagram with Statcom

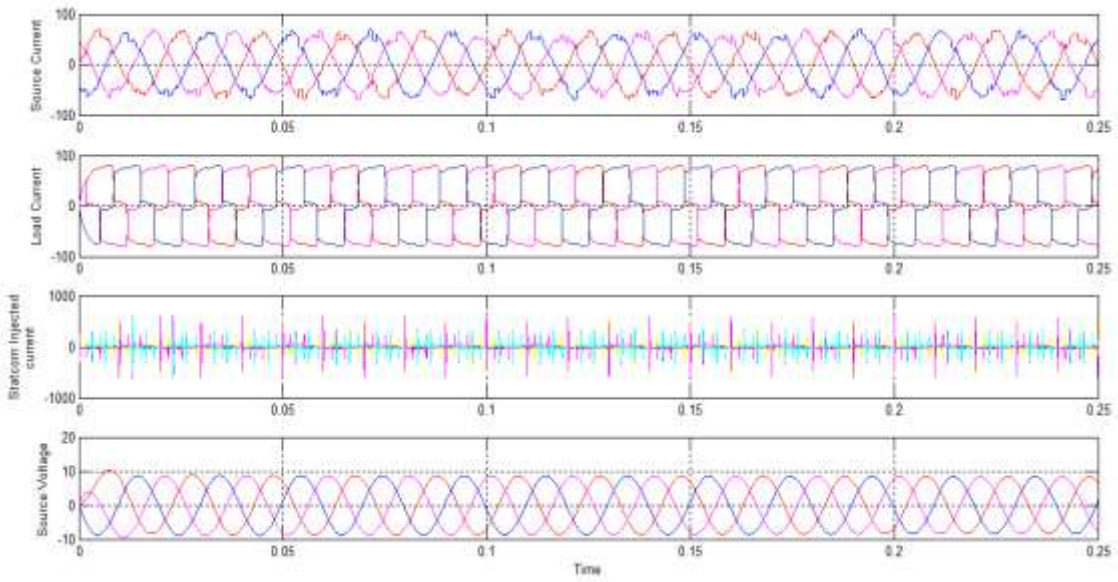

Fig 7: Results for Wind Energy System with Statcom

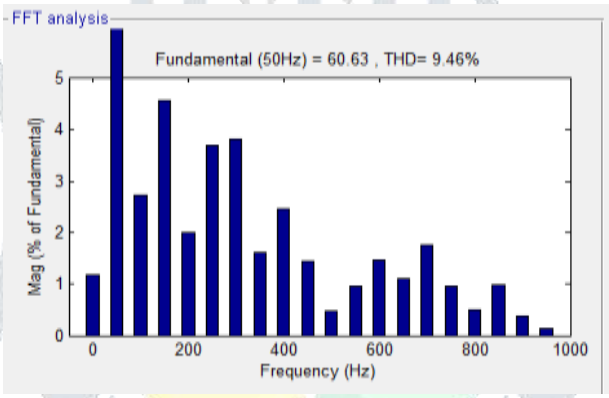

Fig 8: FFT analysis for Source current.

Case 2: Simulation Diagram and results with Statcom using PQ-Control theory

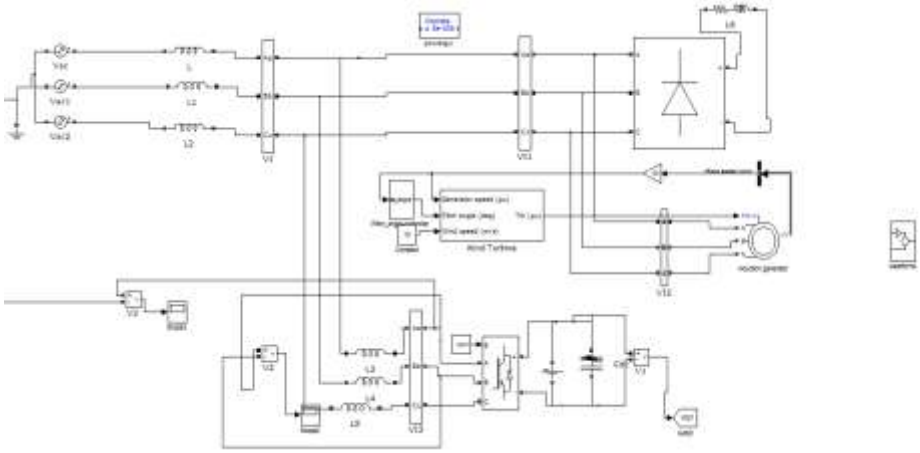

Fig 9: Over All Circuit Diagram in Simulation with Sub Systems

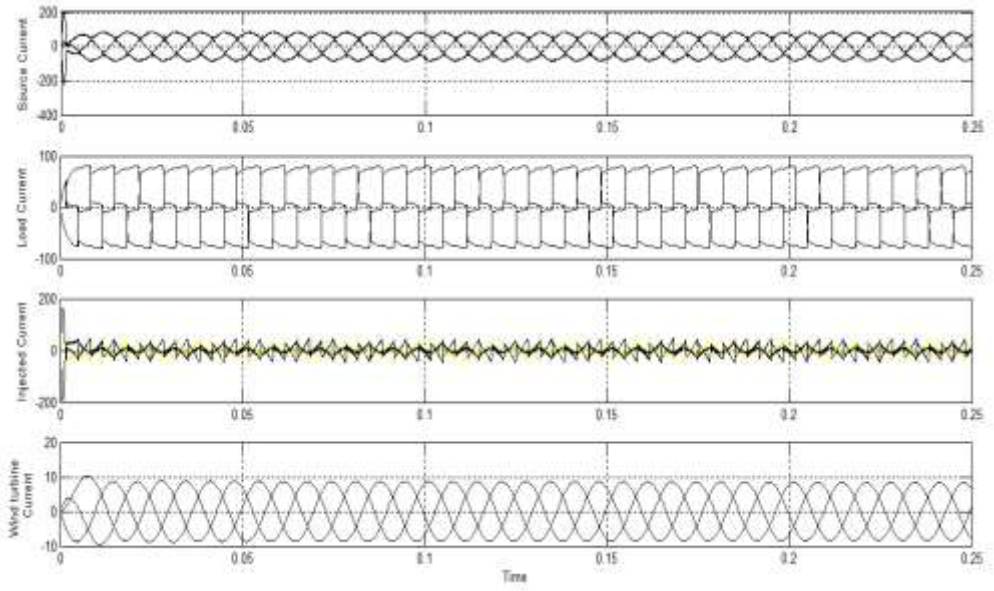

Fig 10: simulation result for current.

Fig 10 shows the result for source current, load current, injected current and current from the wind system.

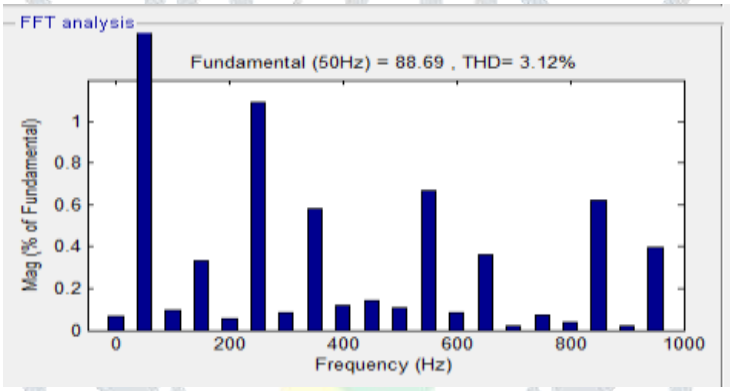

Fig 11: FFT analysis for Source current.

Case 3: Simulation Diagram and results with PQ-Controller based Statcom

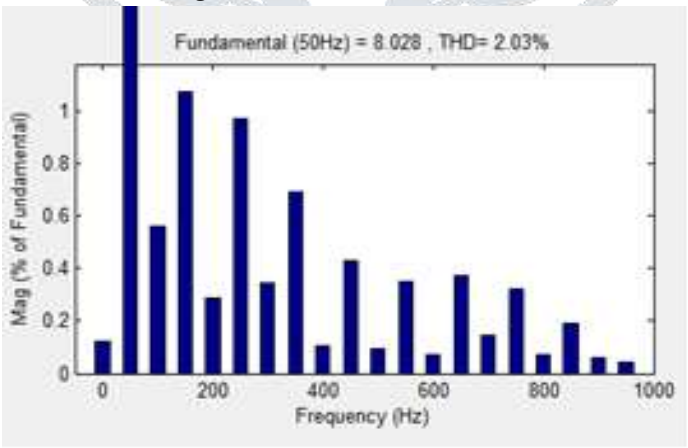

Fig 12: FFT analysis for Source current.

CONCLUSION

This paper proposes a novel idea of framework interfaced wind vitality framework based STATCOM controller for enhancing framework soundness consequently enhanced the unwavering quality. This paper additionally demonstrates the idea of intensity quality issues and their concern impact on the purchaser and electric utility frameworks are displayed. Along these lines, bends in flows are wiped out and kept up voltage and current are in same stage for enhancing power factor so that and responsive power

interest for the breeze generator and load at PCC in the matrix framework. Thus, the incorporated breeze age and FACTS gadget demonstrated the extraordinary execution in keeping up the PQ profile according to necessity. The activity of the STATCOM based network associated wind vitality framework was for all intents and purposes created and actualized in Matlab/Simulink and watched the reproduction results. With this proposed PQ hypothesis based statcom controller the THD is diminished to 3.12%.

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