# POWER QUALITY IMPROVEMENT IN HYBRID POWER SYSTEM USING D-STATCOM

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**ABSTRACT**

The emanate use of distributed energy sources in electricity grid has created new ultimatum for the utility load as regard to power quality, voltage stabilization and efficient energy utilization. Wind and Solar are considered as the most assuring source of renewable energy. However, the standalone operation of either Photovoltaic or wind energy system does not offer a very reliable source of electricity production, mainly due to the unpredictability over the availability of the wind and solar irradiance. Thus, an assortment of wind and solar power generation structure can form a very much potential and reliable source of electricity. In this work a hybrid model of wind and Photo- voltaic system has been presented. This kind of systems 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 DSTATCOM.

## INTRODUCTION

Hybrid power systems are becoming increasingly popular due to their ability to provide reliable and efficient power supply to remote and off-grid areas. However, these systems are often plagued with power quality issues such as voltage sags, harmonics, and flicker. These power quality issues can cause significant problems for the operation of electrical equipment, leading to increased maintenance costs and reduced system lifespan.

One solution to these power quality issues is the use of a D-STATCOM (Distribution Static Compensator). A D-STATCOM is a power electronic device that is used to regulate voltage and current in electrical systems. It can provide reactive power compensation, voltage regulation, and harmonic filtering, all of which can help to improve the power quality in hybrid power systems.

The primary function of a D-STATCOM is to inject a current into the power system that is out of phase with the system voltage. This current can be used to regulate the voltage at the point of connection and to compensate for reactive power. The D-STATCOM can also be used to filter out harmonics and other high-frequency disturbances from the power system.

In a hybrid power system, the D-STATCOM can be connected in parallel with other power sources such as solar panels, wind turbines, and batteries. By controlling the output of the D-STATCOM, the system can be operated in a more stable and efficient manner, reducing power quality issues and improving the overall performance of the system.

In conclusion, the use of a D-STATCOM can be an effective solution for improving power quality in hybrid power systems. By providing reactive power compensation, voltage regulation, and harmonic filtering, the D-STATCOM can help to ensure a reliable and efficient power supply to remote and off-grid areas.

## LITERATURE SURVEY

Distributed generation units in micro-grid can be connected to utility grid as alternative energy sources besides providing power to their local loads.The distributed generation units are interfaced with utility grid using inverter. With inverter control, both active and reactive power pumped into the utility grid from the distributed generation units can be controlled. Reactive power flow control allows the distributed generation units to be used as static var compensation units besides energy sources. This paper has presented a power flow control approach for a DG unit in micro-grid. The proposed approach achieves decoupled P and Q control under grid-connected mode, an integral approach to conduct the power flow control has been developed to control P by adjusting the power angle and control Q by adjusting the filter capacitor voltage. This paper has described control system algorithm for the proposed power controller. Simulation and experiment results have demonstrated strong P and Q regulation capability, fast enough response, and purely sinusoidal linecurrent.

[2] A distributed control strategy to balance the active and reactive power of autonomous microgrid is given out. The solution is based on node voltage regulation. An active source whose

active power is controllable will regulate its node voltage through the output of its active power, which can maintain thelong tern voltage level of microgrid. The short term voltage level is maintained by storage sources through active power they inject into the grid, while one of them will operate in the voltage source mode, which keep the magnitude and phase of its node voltage unchanged to balance the reactive power requirements. The clean sources, whose outputs of active power are generally uncontrollable, will inject all their energy absorbed from the outsideworld. The distributed control of charge and discharge of storage sources, is conducted by adjusting their voltage set pointsto be inverse ratio to their level of energy storage. The distributed control schema, along with unit control of different kind of micro sources, is verified by simulation performed under SIMULINK platform

**PROPOSED SYSTEM**

Usually a STATCOM is installed to support electricity networks thathave a poor power factor and often poor voltage regulation. There are however, other uses, the most common use for voltage stability. A STATCOM is a voltage source converter (VSC)-based device, with the voltage source behind a reactor. The voltage source is created from a DC capacitor and therefore a STATCOM has very little active power capability. However, its active power capability can be increased if a suitable energy storage device is connected across the DC capacitor. The reactive power at theterminals of the STATCOM depends on the amplitude of the voltage source. For example, if the terminal voltage of the VSC is higher than the AC voltage at the point of connection, the STATCOM generates reactive current; conversely, when the amplitude of the voltage source is lower than the AC voltage, it absorbs reactive power. The response time of a STATCOM is shorter than that of a static VAR compensator (SVC), mainly due to the fast switching times provided by the IGBTs of the voltage source converter. The STATCOM also provides better reactive power support at low AC voltages than an SVC, since the reactive power from a STATCOM decreases linearly with the AC voltage (as the current can be maintained at the rated value even down to low AC voltage).

A static VAR compensator can also be used for voltage stability. However, a STATCOM has better characteristics than an SVC. When the system voltage drops sufficiently to force the STATCOM output current to itsceiling, its maximum reactive output current will not be affected by the voltage magnitude. Therefore, it exhibits constant current characteristics whenthe voltage is low under the limit. In contrast the SVC's reactive output is proportional to the square of the voltage magnitude. This makes the provided reactive power decrease rapidly when voltage decreases, thus reducing its stability. In addition, the speed of response of a STATCOM is faster than thatof an SVC and the harmonic emission is lower, however STATCOMs typically exhibit higher losses and may be more expensive than SVCs, so the (older) SVC technology is still widespread.

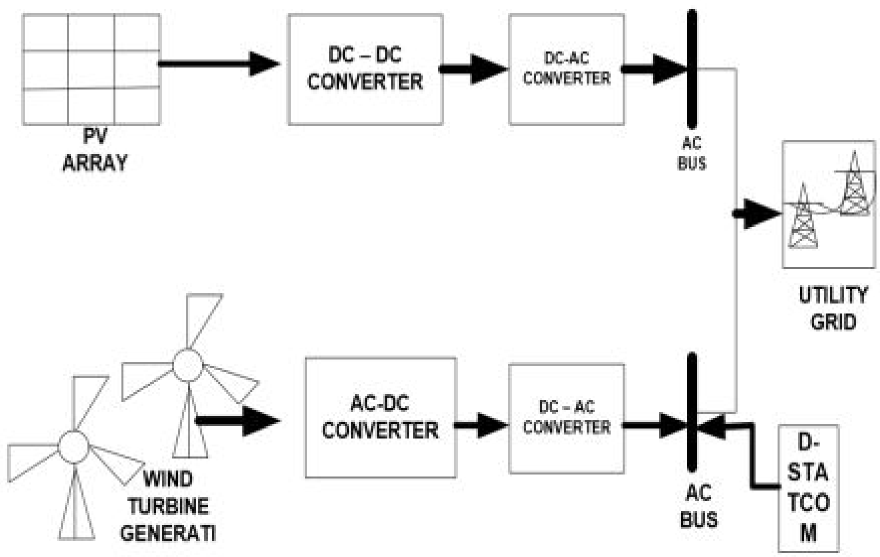
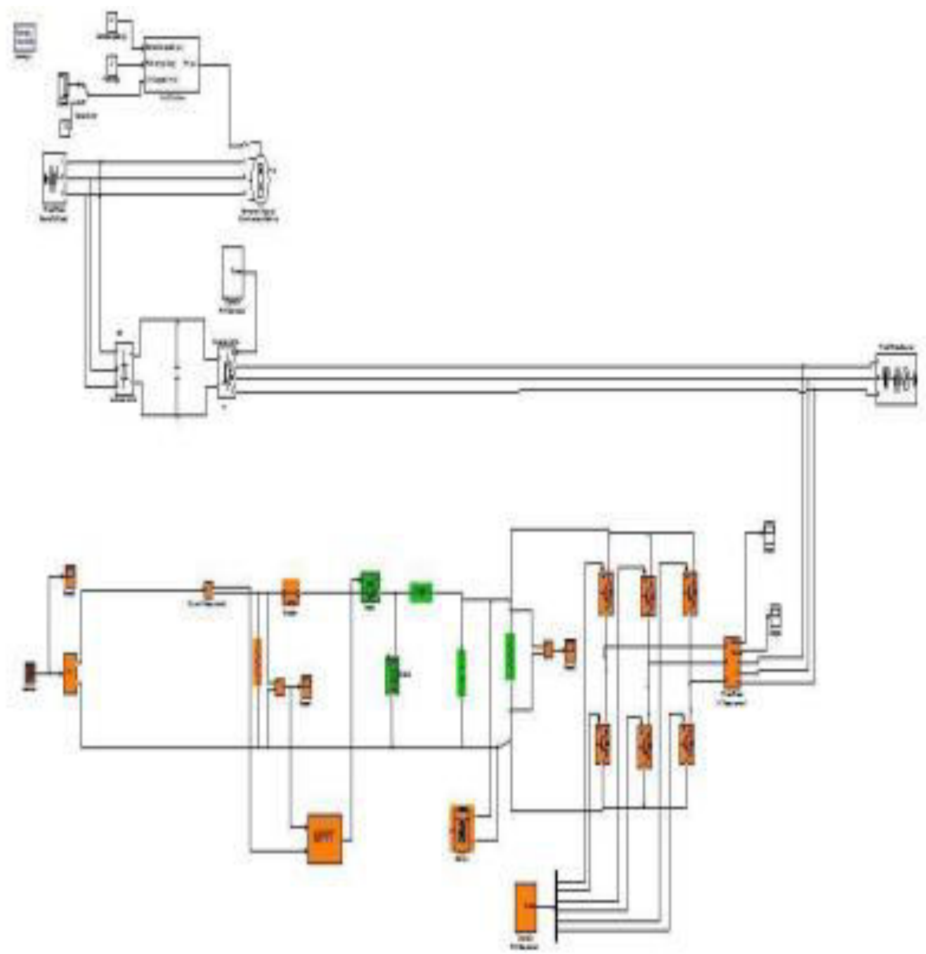


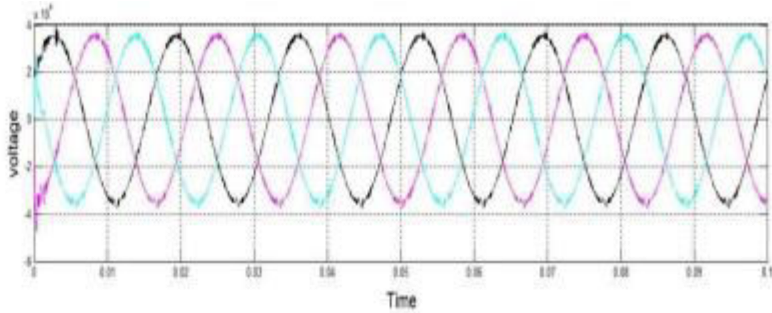

Fig.1: block diagram of hybrid power system

A power quality site survey can help you determine what, if any, power quality problems your plant has on both sides of the power meter. Mostsurveys require the installation of power quality monitoring equipment or software. Not only does the survey help determine the presence and the extentof harmonics, but it also reveals other power quality problems such as voltage sags, power interruption, flicker, voltage unbalance, transients, poor wiring, and poor or inadequate grounding. Harmonics can be minimized and to some extent prevented by: 1. Designing electrical equipment and systems to prevent harmonics fromcausing equipment or system damage. 2. Analyzing harmonic symptoms to determine their causes and devise solutions. 3. Identifying and reducing or eliminating the medium that is transmittingharmonics. 4. Using power conditioning equipment to mitigate harmonics and other power quality problems when they occur. When the electrical transmission and distribution system acts as a conduit for harmonics, any user connected to the grid could be responsible forgenerating them. In this case, work with your utility to identify sources of harmonics and minimize their influence on your plant's electrical system. However, if harmonics are generated within your plant, it's up to you to mitigate them effectively. Attacking the harmonics problem at the source is always the best way to go. At your plant, minimizing harmonics is better for your equipment and the price you pay for electricity. Beyond that, it is your responsibility to keep your harmonics from feeding back into the electrical distribution medium, thereby affecting power quality of others connected to the grid. Therefore , thesupply current has harmonics that will produce undesirable effects, such as source voltage fluctuation, signal interference, supply distortion, additionalheating and so on. In order to overcome such problems, a filter is used.

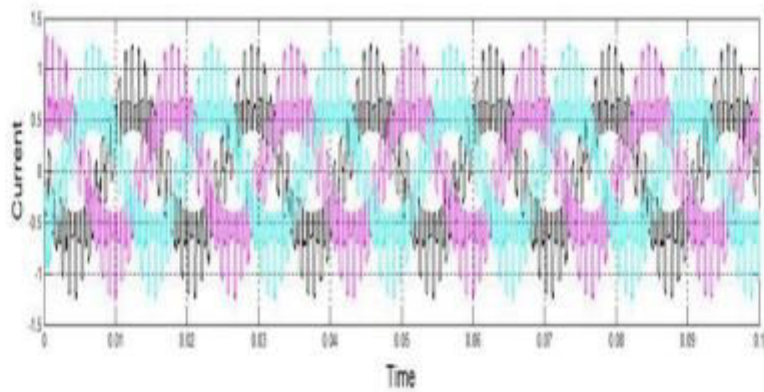
**SIMULATION RESULTS**



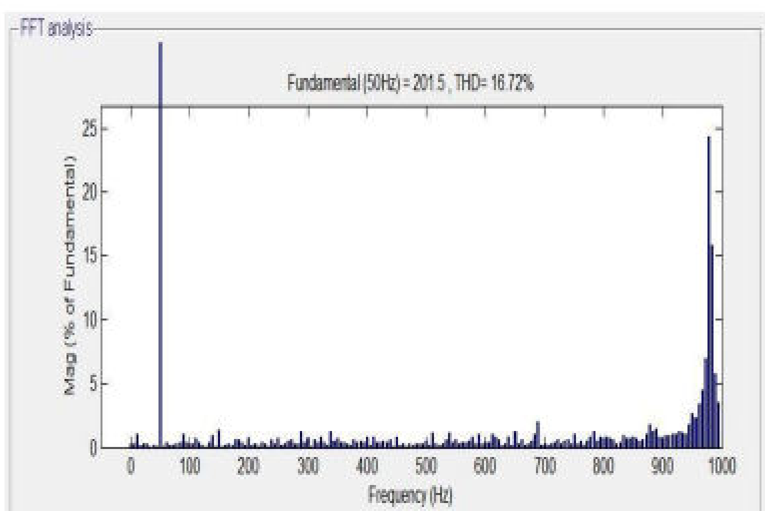
*Proposed circuit configuration without STATCOM/UPQC*




***PCC VOLTAGE WITHOUT D-STATCOM/UPQC***




**PCC CURRENT WITHOUT STATCOM/UPQC**




***THD without STATCOM/UPQC***

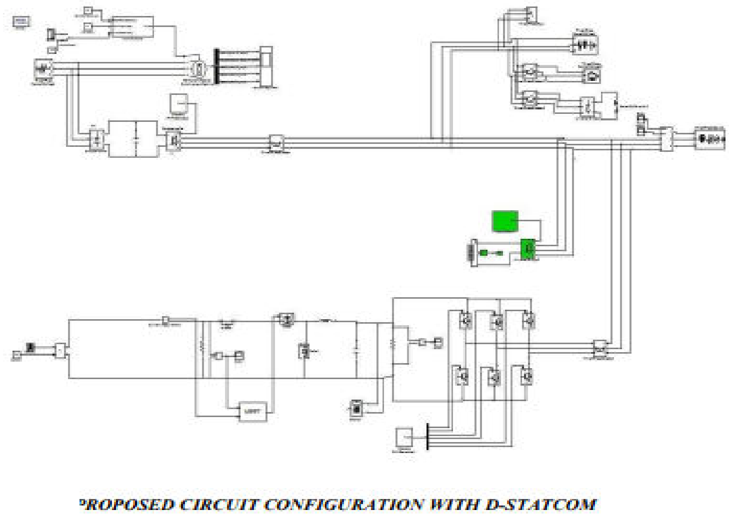



Fig.2: PROPOSED CIRCUIT CONFIGURATION WITH D-STATCOM

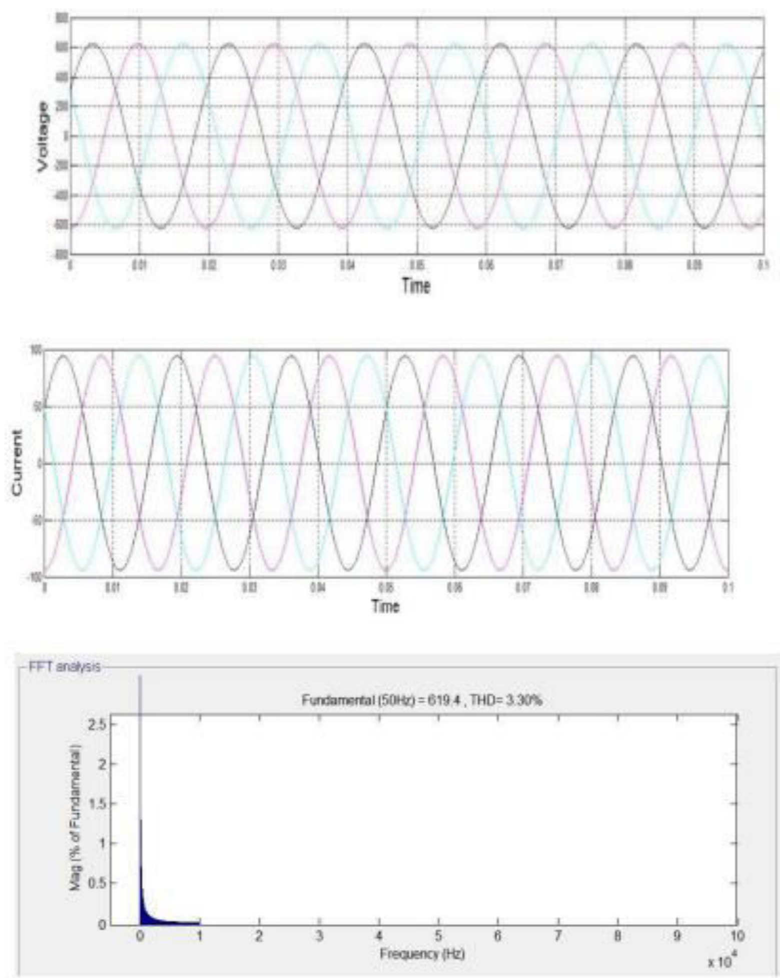



Fig.3: With STATCOM THD at PCC

## CONCLUSION

In this work, the objective of the power quality improvement of proposed hybrid PVwind system has been achieved. The improved THD in presence of D-STATCOM/UPQC is found by the FFT analysis, is shown in figure 7. Asimulation model of hybrid power system with the D-STATCOM is used. The result shows that the total harmonic distortion (THD) is within the limitof 5% set by IEEE. This indicates the satisfactory operation of the proposed wind-PV hybrid generation model.

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