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Enhancement of Power Quality in the Grid-Connected Wind Energy System for Reducing Harmonics by using DSTATCOM

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ABSTRACT: Distribution system, as the name suggest, is the medium through which power is distributed among the end consumers. Distribution systems are comparatively not as stiff as grid systems, so objectionable voltage drop due to the increase of RL load could be critical for the entire system. Thus DSTATCOM is an effective solution for power systems facing such power quality problems. This report deals with one of the potential applications of distribution static compensator (DSTATCOM) to industrial systems for mitigation of voltage sag problem. The model of DSTATCOM connected in shunt configuration to a three phase source feeding RL loads is developed using Simulink of MATLAB software. Simulated results demonstrate that DSTATCOM can be considered as a viable solution for solving such voltage dip problems. This thesis work aims at developing a DSTATCOM for inductive and resistive loads with reduced voltage sag.

KEYWORDS: Distribution System, DSTATCOM, Power System, Power Quality, Voltage Swell, Voltage Sag.

I. INTRODUCTION

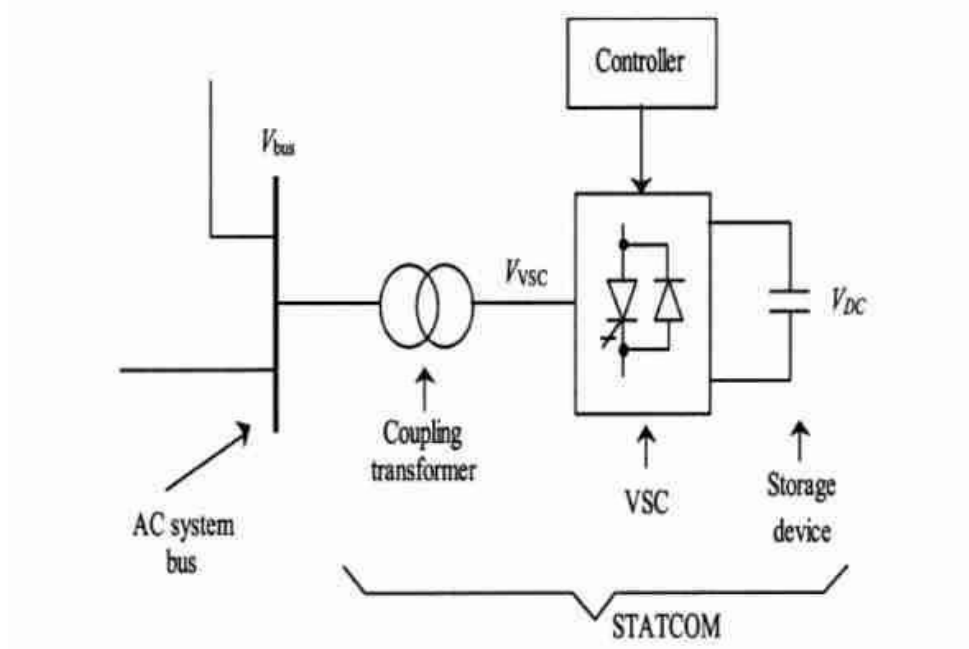
One of the most common power quality problems today is voltage fall/dip at load terminals. A voltage dip is an event which occurs when the operating voltage is less than its actual rating due to excess reactive power consumption by the load. Voltage fall will affect the working of sensitive loads there by decreasing the system performance. In a three-phase system, voltage dip by nature is a three-phase phenomenon, which affects both the phase-to-ground and phase-to-phase voltages. A voltage dip is also caused by a fault in the utility system, a fault within the customer's facility or a large increase of the load current, like starting a motor or transformer energizing. Improved power quality is the driving force for today's modern industry. Consumer awareness regarding reliable power supply has increased enormously in the last decade. This has led to an additional bump to the development of small distributed generation (DG). Small isolated DG sets have the capability to feed local loads and thus leads to improvement in reliability of power with low capital investment. These systems are also gaining increased importance in isolated areas where transmission using overhead conductors or cables is unrealistic or prohibitive due to excessive cost and other circumstances. Small generation systems in rural areas, islands, hilly terrains, off shore plants, aircrafts etc. can be efficiently utilizing even in developing countries. However, these DG sets may have to be de-rated if induction motor loads are simultaneously started. One useful choice is to use DSTATCOM in shunt configuration with the main system so that the full capacity of generating sets is efficiently utilized. DSTATCOM consists of a voltage source converter (VSC) and its internally generates the required capacitive and inductive reactive power. Its control is very fast and has the capability to provide adequate reactive power compensation to the system to which it is connected. However, due to disadvantages of passive devices such as fixed compensation, large size, possibility of resonance etc., the use of new compensators such as DSTATCOM is growing to solve these power quality problems. The use of DSTATCOM for solving power quality problems due to voltage fall/dip, flickers, swell etc, has been suggested. The purpose of DSTATCOM is to provide efficient voltage regulation at point of common coupling (PCC) and thus prevent large voltage dips.

II. METHODOLOGY

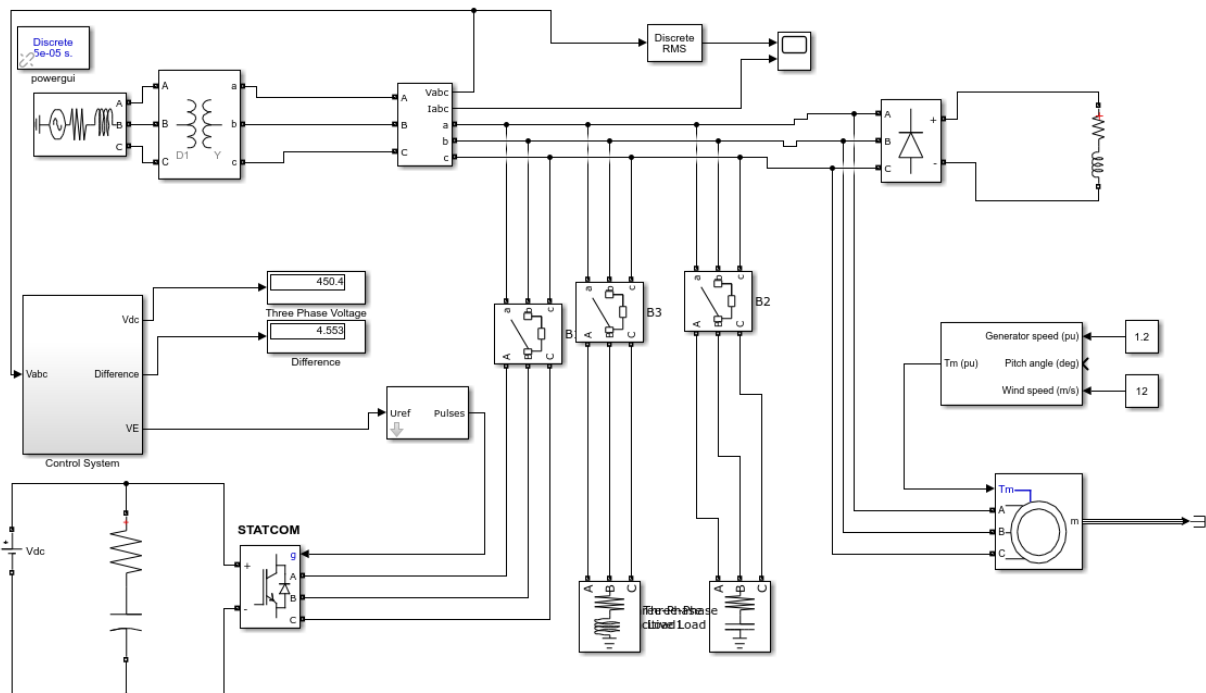
The DSTATCOM is a three-phase and shunt connected power electronic devices. It is connected near the load of the distribution systems. DSTATCOM consists of a dc capacitor, three-phase inverter (IGBT, thyristor) module, ac filter, coupling transformer and a control technique. The basic electronic block of the DSTATCOM is the voltage-sourced

converter that converts an input dc voltage into a three-phase ac output voltage at fundamental frequency in capacitive mode and it converts three phase ac voltage to dc voltage in inductive mode. DSTATCOM uses an inverter to convert the DC link voltage V_{DC} on the capacitor to a voltage source of amendable magnitude and phase. Therefore the DSTATCOM can be treated as a voltage-controlled source. The DSTATCOM can also be seen as a current-controlled source.

III. BLOCK DIAGRAM



IV. CIRCUIT DIAGRAM





V. EXPERIMENTAL RESULTS

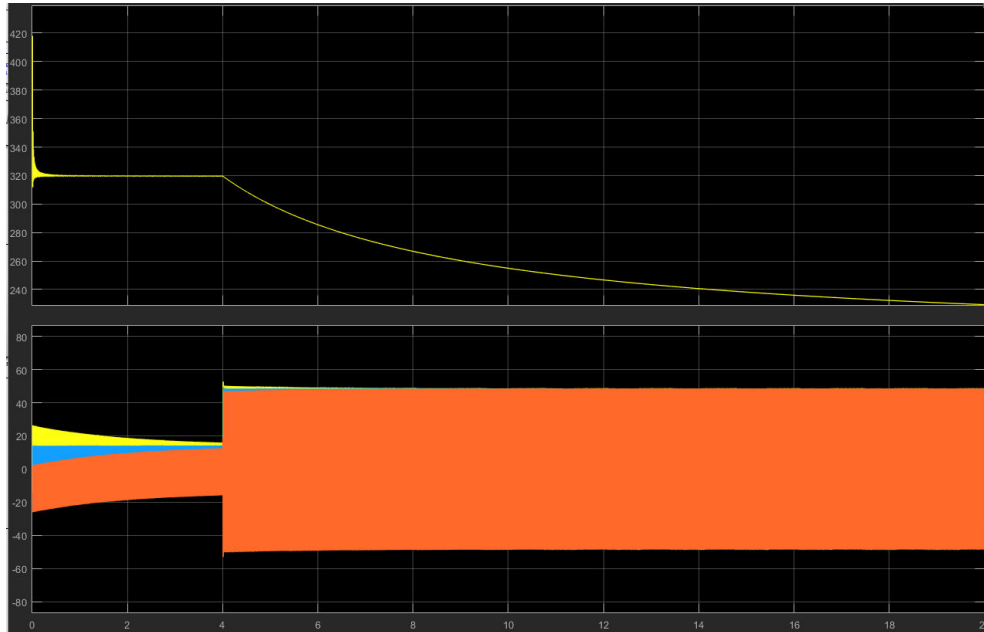


Fig 1. Voltage Sag due to Load connected without STATCOM

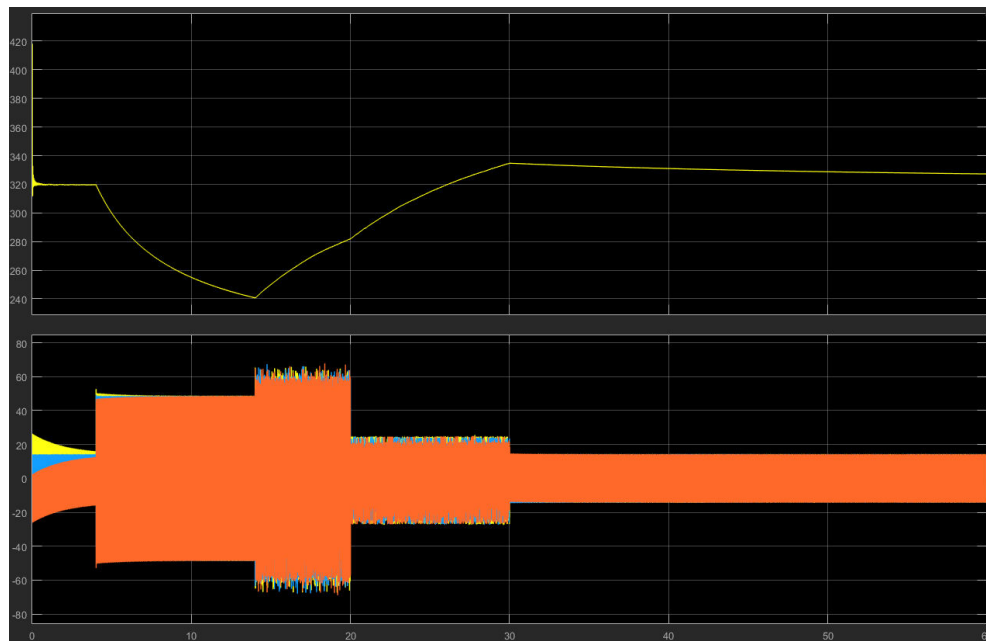


Fig 2. DSTATCOM Connected at 14 Second to Compensate Voltage Sag



VI. CONCLUSION

- Conclusions In this work, DSTATCOM has been modelled and simulated in MATLAB/SIMULINK environment.
- Simulation shows the effectiveness of DSTATCOM in a distribution network with FOC induction motor drive as non-linear load and wind turbine coupled with asynchronous generator as active load.
- PI controller has been used to generate the switching signals. It is clear from comparison of THD analysis that DSTATCOM effectively removes the harmonic content from the source current under normal working condition and effectively able to balance the source current under load perturbation condition.
- Hence, it is concluded that DSTATCOM has a large scope in improving power quality levels in distribution systems.

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