MODELING AND SIMULATION OF DSTATCOM BY IMPROVING POWER QUALITY PROBLEMS

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Abstract - Even a few years back, the main concern of consumers in power system was the reliability of supply which is defined as the continuity of electricity. It is however not only the reliability that consumers want these days, quality of electricity supply is also very important for consumers. The term, electric power quality, broadly refers to maintaining a nearly sinusoidal bus voltage at rated magnitude and frequency in an uninterrupted manner from the reliability point of view. For a well-designed generating plant which generates voltages almost perfectly sinusoidal at rated magnitude and frequency, power quality problems start with transmission system and stay valid until end users in distribution system.

Keywords - DSTATCOM, PWM inverter, MATLAB simulation, Voltage Source Inverter.

I. INTRODUCTION

The majority of power consumption has been drawn in reactive loads such as pumps, electric motors, electric welding etc. These loads draw lagging power-factor currents and therefore give rise to reactive power burden in the distribution system. The excessive reactive power demand increases feeder losses and reduces the active power flow capability of system where as unbalancing affects the operation of transformers and generators..The effect of D-STATCOM on the performance of a power system with RL load is studied under MATLAB environment. The real and reactive power with voltage magnitude in the line as well as in the load are observed without D-STATCOM. The variable power flow after the introduction of the D-STATCOM is noted. A PI-based controller is designed for the D-STATCOM and then its performance is studied using MATLAB.
The magnitude of voltage withD-STATCOM is compared with model without connecting D-STATCOM and thus its performance is evaluated. The modeling of STATCOM with power system is done by using the sim power systems toolboxes in MATLAB /SIMULINK. The modeling is done by connecting a single phase source and RL load through a transmission line. The AC voltage at source is stepped down by using step down transformer of 230/12V and the frequency is 50Hz. The load voltage and line voltage are observed. Using thevoltage measurement blocks available in Simpower system..The MATLAB diagram of the power system.

II. PROJECT WORK

We are showing without D-STATCOM and with D-STATCOM in simulation at 12V supply is given.

Following tools are the used for the simulation,

A. Tools Used In Simulation:

i. Voltage Source Inverter
ii. PWM Generator
iii. PI Controller
iv. Single Phase PLL
v. PI Section Line

i. Voltage Source Inverter:

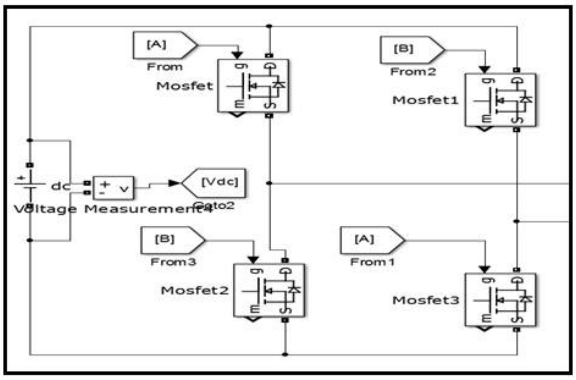


Fig. 1 Voltage Source Inverter

The converters are built with the IGBT/Diode block which is the basic building block of all VSCs. The IGBT/Diode block is a simplified model of an IGBT (or GTO or MOSFET)/Diode pair where the forward voltages of the forced-commutated device and diode are ignored. You may replace these blocks by individual IGBT and diode blocks for a more detailed representation. VSCs are controlled in open loop with the Discrete PWM Generator block available in the Extras/Discrete Control Blocks library [5].

i.

ii. PWM Generator:

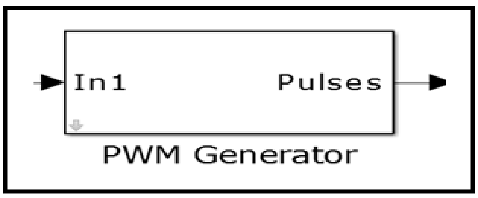


Fig.2 PWM Generator

The PWM generator is used to generate the gate pulses for the MOSFET's of the VSI. Here, the sine and the triangular waveforms are generated.The sine wave which is of 50Hz is compared with the triangular wave of 20kHz. According to the comparison, the PWM pulses are produced. Thesepulses are given to gates of theMOSFET's. By varying the modulation index, themagnitude of the converter output will vary and as well as by varying thephase angle of the modulating wave, the converter output voltage phase anglewill also vary [5].

iii. PI Controller:

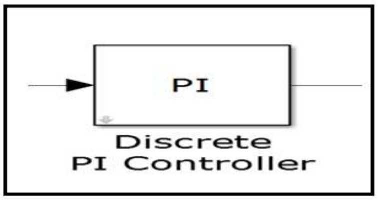


Fig.3 PI Controller

PI controller gains are tunable either manually or automatically. The PI Controller block output is a weighted sum of the input signal, the integral of the input signal, and the derivative of the input signal. The weights are the proportional, integral, and derivative gain parameters. A first-order pole filters the derivative action.

Configurable options in the PI Controller block include:

- Controller type and form
- Time domain (continuous or discrete)
- Initial conditions and reset trigger
- Output saturation limits and built-in anti-windup mechanism.

iv. Single Phase PLL (Phase Locked Loop):

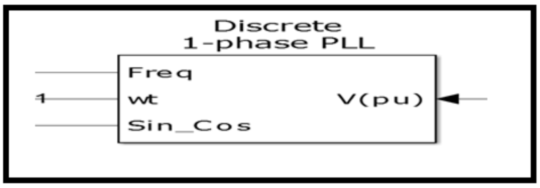


Fig.4 Single Phase PLL

The Discrete 3-Phase PLL block measures the frequency and generates a signal (wt output) locked on the variable frequency system voltage. The PLL drives two measurement blocks taking into account the variable frequency: one block computing the fundamental value of the positive-sequence load voltage and another one computing the load active and reactive powers. These two blocks and the PLL are initialized in order to start in steady state. The PLL and the two measurement blocks are available respectively in the Extras/Discrete Control Blocks and Extras/Discrete Measurements libraries.

v. PI (Proportional Integrator) Section Line:

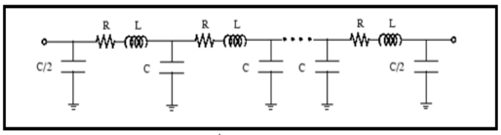


Fig.5. PI Section Line

The PI Section Line blocks implements a single-phase transmission line with parameters lumped in PI sections. For a transmission line, the resistance, inductance, and capacitance are uniformly distributed along the line. An approximate model of the distributed parameter line is obtained by cascading several identical PI sections, as shown in the following figure.

III. SIMULATION MODULATION

A. Without D-STATCOM:

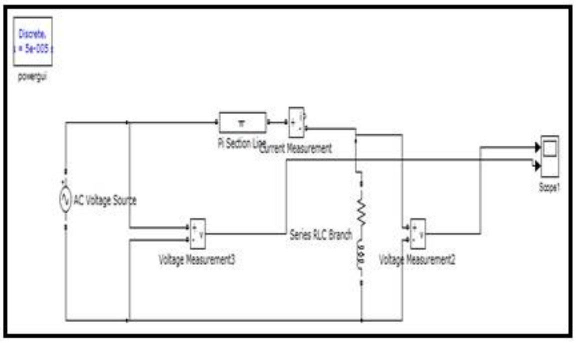


Fig.6 Simulation without DSTATCOM

Above Simulation consists of RL load, the load will consume the voltage. As shown in above figure the input is given 12V, at load side we are getting 4.3V. So the RL load is consuming the voltage. D-STATCOM will compensate the voltage drop caused by RL load after connecting in system.

B. With D-STATCOM:

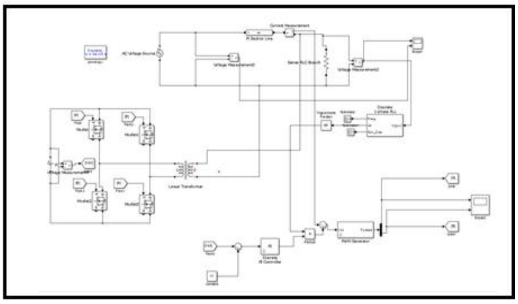


Fig. 7 Simulation with D-STATCOM

As shown in above fig, after connecting the D-STATCOM in the system it will compensate the the voltage drop caused by RL load by comparing the reference input voltage and actual output voltage across the load. The reference input voltge is 12V same as system voltage. The actual output voltage is compared with the reference voltage. The error signal will produce & given to PI controller. The PI controller will try to set the error signal at zero, it will pass the output signal of PI controller to PWM generator, depending signal of PI contoller PWM generator will produce the set of pulses for the Voltage Source Converter. After receiving the pulses from PWM generator Voltage.Source Converter will produce alternating voltage in phase with the system voltage. This generated voltage will be injected in the system by using coupling transformer.The output of system without D-STATCOM is 4.3V, after connecting the D-STATCOM in the system output is 11.3V. So we can said that D-STATCOM compensate the voltage sag caused RL load.

IV. SIMULATION RESULT

B. Without D-STATCOM:

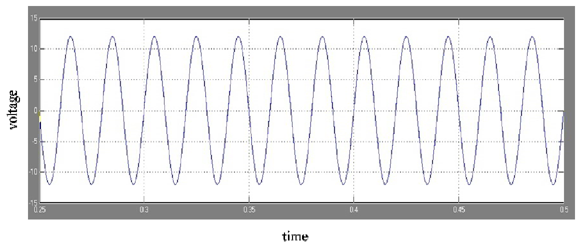


Fig.8 Input Voltage

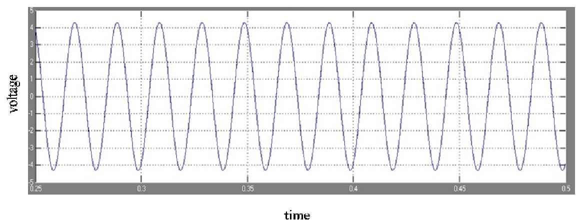


Fig.9 Output Voltage

B. With D-STATCOM:

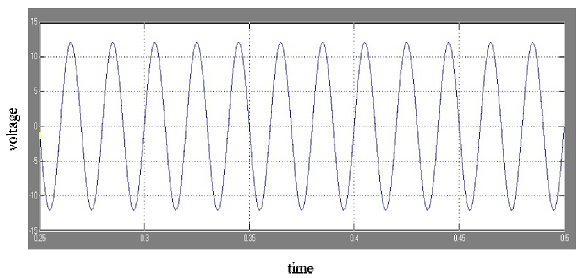


Fig.10 Input Voltage

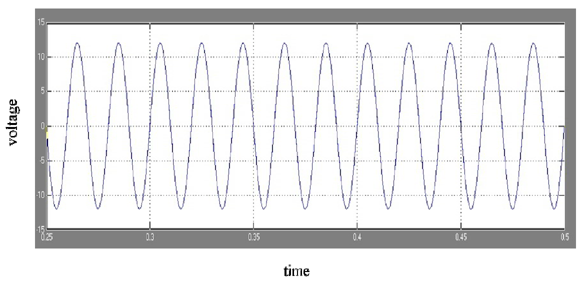
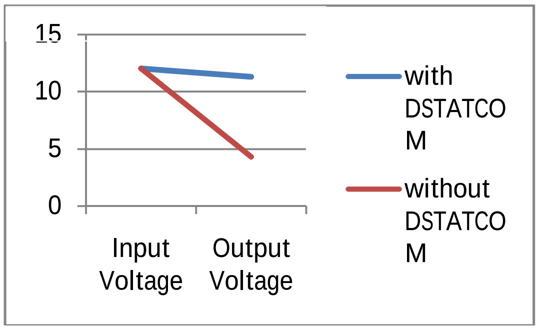


Fig.11 Output Voltage

V. RESULT ANALYSIS

Parameter	Input Voltage	Output voltage
Without DSTATCOM	12v	4.3v
With DSTATCOM	12v	11.3v



The result shows the opera0tion of the D-STATCOM in which stability in voltage is achieved with D-STATCOM unit.

CONCLUSION

The D-STATCOM is connected between Source and Load. The results are taken in the power system model with and without the D-STATCOM for loads. For each type, the readings are taken for with and without the D-STATCOM and are compared. In the simulation, the output of system without D-STATCOM is 4.3V due to RL load, after connecting D-STATCOM in the system output is 11.3V. From the results of simulation we can conclude that D-STATCOM is able to compensate the voltage.

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