ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

A Voltage-Controlled DSTATCOM for Power-Quality Improvement

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ABSTRACT:

This project proposes a new algorithm to generate reference voltage for a distribution static compensator (DSTATCOM) operating in voltage-control mode. The proposed scheme exhibits several advantages compared to traditional voltage-controlled DSTATCOM where the reference voltage is arbitrarily taken as1.0 p.u. The proposed scheme ensures that unity power factor (UPF) is achieved at the load terminal during nominal operation,which is not possible in the traditional method. Also, the compensator injects lower currents and, therefore, reduces losses in the feeder and voltage-source inverter. Further, a saving in the rating of DSTATCOM is achieved which increases its capacity to mitigate voltage sag. Nearly UPF is maintained, while regulating voltage at the load terminal, during load change. The state-space model of DSTATCOM is incorporated with the deadbeat predictive controller for fast load voltage regulation during voltage disturbances. With these features, this scheme allows DSTATCOM to tackle power-quality issues by providing power factor correction, harmonic elimination, load balancing, and voltage regulation based on the load requirement. Simulation and experimental results are presented to demonstrate the efficacy of the proposed algorithm.

INTRODUCTION:

Power excellence matter are gaining significant notice due to the enhance in the integer of responsive loads. Many of these loads use apparatus that is responsive to deformation or dips in make available voltages. Approximately all power quality problems initiate from conflict in the allocation networks. Instruction pertains in many places, which limit the deformation and concern that a customer can carry in to a distribution system. These conventions may require the installation of filters on customer premises. It is also predictable that usefulness will make available a low deformation impartial voltage to its customers, particularly individuals with responsive loads. When a DSTATCOM is connected with a exacting load, it can insert recompense current so that the total require meets the requirement for efficacy connection. Otherwise, it can also clean up the voltage of a utility bus from any disturb and harmonic deformation. The aim of this project is to examine a DSTATCOM that can execute both these tasks.

In power distribution networks, reactive power is the main cause of growing allocation system losses excellence problems. Predictably, Static Var Compensators (SVCs) have been used in combination with inactive filters at the allocation level for reactive power return and mitigation of power quality problems. Though SVCs very effective system controllers used to make available reactive power come back at the transmission level, their limited bandwidth, superior inactive element count that enlarge size and losses and slower reaction make them inapt for the recent day circulation condition. A further compensating system has been planned by employing a grouping of SVC and active power filter which can recompense three phase loads in a least of two cycles.

AUTOMATIC VOLTAGE CONTROL MODE:

The shunt inverter reactive current is automatically regulated to maintain the transmission line voltage at the point of connection to a reference value. For this implementation of deliver, voltage retaliation signals are obtained from the sending end bus feeding the shunt coupling transformer.

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The confine inverter engagement the develop into and position of the voltage injected in series with the line to influence the power flow on the line. The physical relation of the injected voltage can be obtained in several ways. Direct Voltage Injection Mode. The reference inputs are directly the magnitude and phase angle of the series voltage.

PHASE ANGLE SHIFTER EMULATION MODE :

The reference input is phase displacement between the sending end voltage and the receiving end voltage.

LINE IMPEDANCE EMULATION MODE:

The reference input is an impedance value to insert in series with the line impedance.

AUTOMATIC POWER FLOW CONTROL MODE:

The reference inputs are values of P and Q to maintain on the transmission line despite system changes.

RUNNING SIMULATION:

You now can run the simulation of the simple system above by clicking on the play button (alternatively, you may use key sequence CTRL+T, or choose Start submenu under Simulation menu).

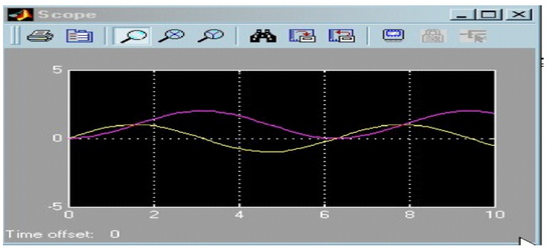

Fig 1 Sample running simulation

The Role of Simulation in Design:

Electrical power systems are combinations of electrical circuits and electromechanical devices like motors and generators. Engineers working in this discipline are constantly improving the performance of the systems. Requirements for drastically increased efficiency have forced power system designers to use power electronic devices and sophisticated control system concepts that tax traditional analysis tools and techniques. Further complicating the analyst's role is the fact that the system is often so nonlinear that the only way to understand it is through simulation.Land-based power generation from hydroelectric, steam, or other devices is not the only use of power systems. A common attribute of these systems is their use of power electronics and control systems to achieve their performance objectives.

SIMULATION RESULTS:

The control scheme is implemented using MATLAB software. Simulation parameters are given in Table I. Terminal voltages and source currents before compensation are plotted in Fig. 6.1 Distorted and unbalanced source currents flowing through the feeder make terminal voltages unbalanced and distorted. Three conditions, namely, nominal operation, operation during sag, and operation during load change are compared between the traditional and proposed method. In the traditional method, the reference voltage is 1.0 p.u., whereas in the proposed method, (32) is used to find the reference voltage.

BEFORE COMPENSATION SIMULATION:

The control scheme is implemented using matlab software. Simulation parameters .

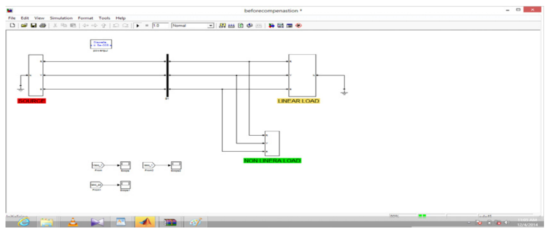

Fig 2 Before Compensation Simulation

Distorted and unbalanced source currents flowing through the feeder make terminal voltages unbalanced and distorted. Three conditions, namely, nominal operation, operation during sag,and operation during load change are compared between the traditionaland proposed method.

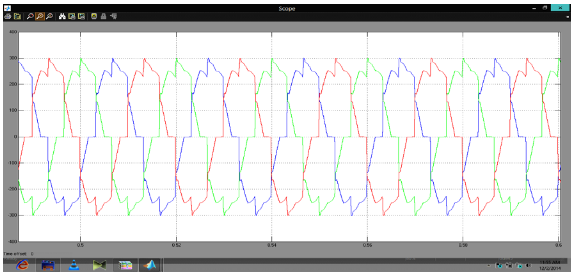

Fig 3 Before compensation (a)Terminal voltages

Under normal operation conditions with out Dstatcom terminal voltages unbalanced conditions,

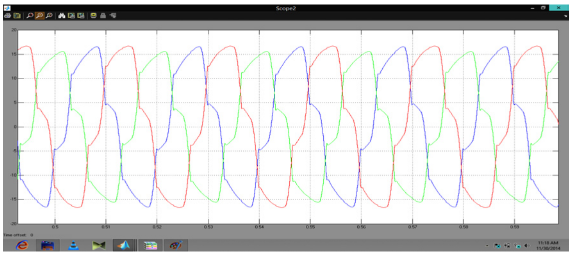

Fig 4 Before compensation (b) Source currents.

Under normal operation condition with out Dstatcom source current unbalanced condition,

NOMINAL OPERATION:

These waveforms are balanced and sinusoidal. However, source currents lead respective terminal voltages which show that the compensator supplies reactive current to the source to overcome feeder drop, in addition to supplying load reactive and harmonic currents.

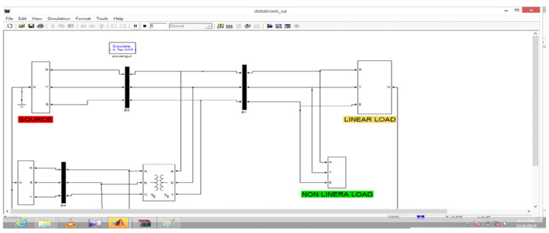

Fig 5 nominal operations

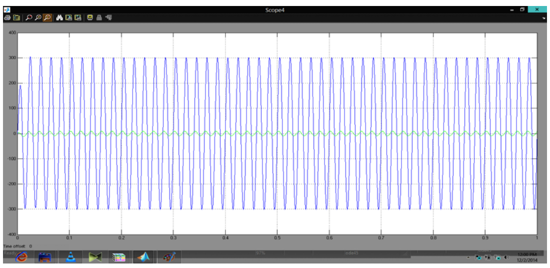

Fig 6 Terminal voltages and source currents using the proposed method phase(a)

The compensator rms currents in phase- for the traditional methods, respectively. The current has decreased from 8.4 to 5.2 A in Using and VSI losses are reduced by 61.68% and only 61.9% VSI rating is utilized in the Proposed method.

OPERATION DURING LOAD CHANGE:

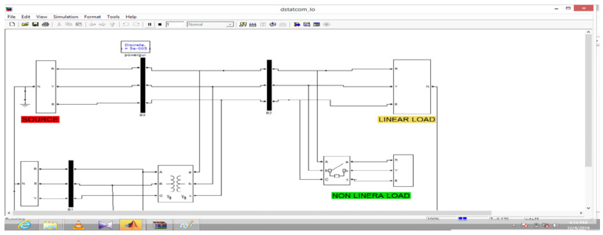

Fig 7 operation during load change

The impact of load changes on system performance, load is increased to 140%of its nominal value. Under this condition, the traditional method gives less power factor as the compensator will supply more reactive current to maintain the referencevoltage. The voltage and current waveforms.

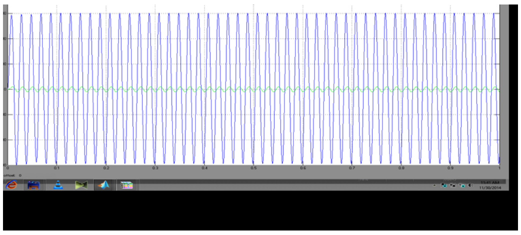

Fig 8 Terminal voltages and source currents using load change in proposed method

The proposed method is considered. Fig. 6.11 shows the regulated terminal voltages and corresponding source currents in phases and respectively.

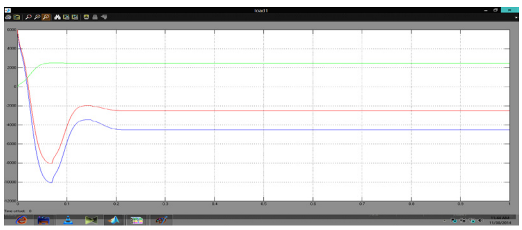

Fig 9 Load reactive power (Qload), compensator reactive power (Qvsi), and reactive power at PCC (QpccS). proposed method.

Methods are given in Fig. 11 respectively. In the proposed method, the compensator needs to overcome voltage drop across the feeder by supplying reactive power into the source. As shown in Fig 6.12 proposed method

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OPERATION DURING SAG:

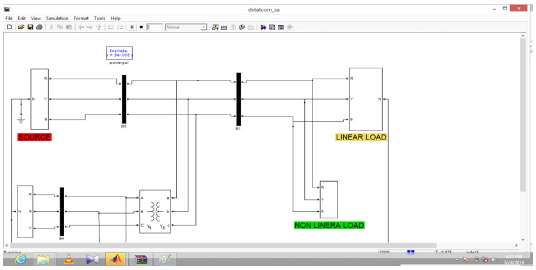

Fig 10 operation during load change

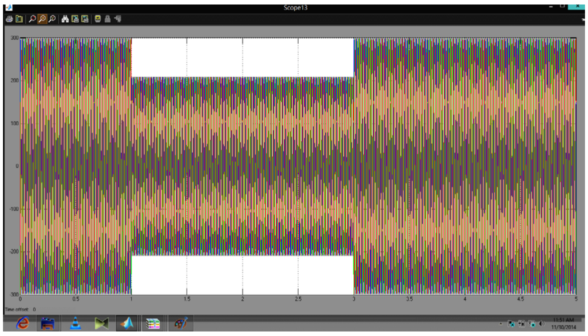

Fig 11 SOURCE VOLTAGES.

To show the capability of DSTATCOM to mitigate deep sag for a longer time, the source voltage is decreased to 60% of the nominal value for 1 to 3 s duration as show inFig.6.14.

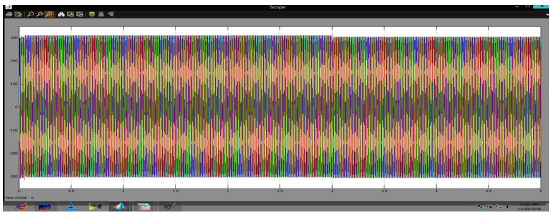

Fig 12 Terminal voltage

The terminal voltages, maintained at the reference value, are shown in Fig.6.14

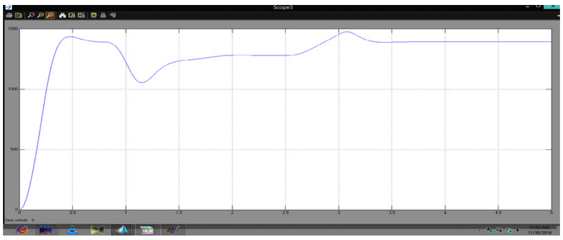

Fig 13 voltage at the dc bus

The voltage across the dc bus is shown in Fig. 6.15 under balanced condition with sag compensation

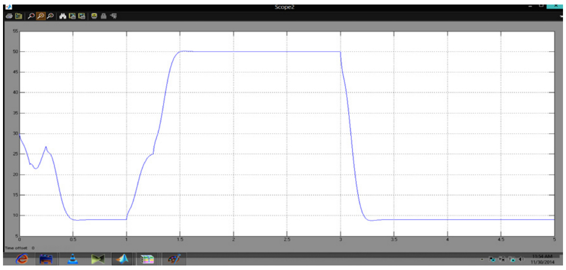

Fig 14 compensator rms current in the proposed method

During transients, this voltage deviates from its reference voltage. However, it is brought back to the reference value once steady state is reached. Fig.6.17.

TRADITIONAL METHODS OPERATION DURING LOAD TRADITIONAL METHOD:

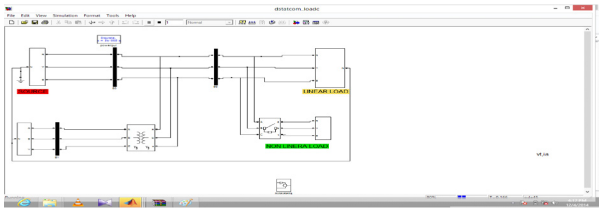

Fig 15 operation during load changes traditional method

To show the capability of DSTATCOM to mitigate deep sag for a longer time, the source voltage is decreased to 60% of the nominal value for 1 to 3 s duration as shown in The traditional method is considered. Fig.6.22 shows the regulated terminal voltages and corresponding source currents in phases , and , respectively.

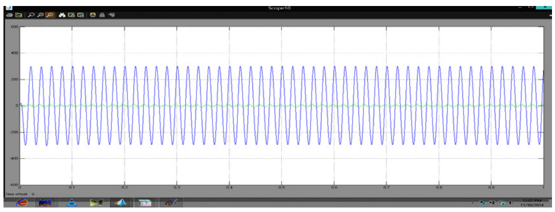

Fig 16 Terminal voltages and source currents using the traditional method (c) Phase

Methods are given in Fig.6.27 respectively. In the traditional method, the compensator needs to overcome voltage drop across the feeder by supplying reactive power into the source.

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OPERATION DURING SAG TRADITIONAL METHOD:

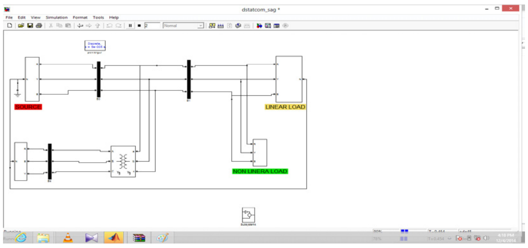

Fig 17 operation during to sag traditional method

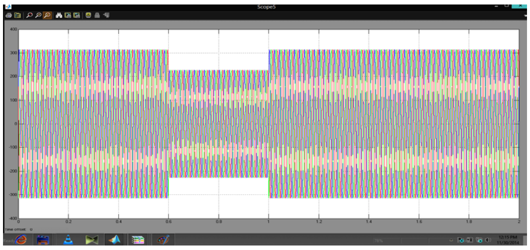

Fig 18 Source voltages during normal to sag and Source voltages during sag to normal.

To create sag, source voltage is lowered by 20% from its nominal value at 0.

•Sag is removed at 1.0 s as shown in Fig6.29

•Since voltage regulation capability does not depend upon reference voltage, it is not shown separately for the traditional method.

•Terminal voltages during normal to sag. (d) Terminal voltageduring sag to normal.

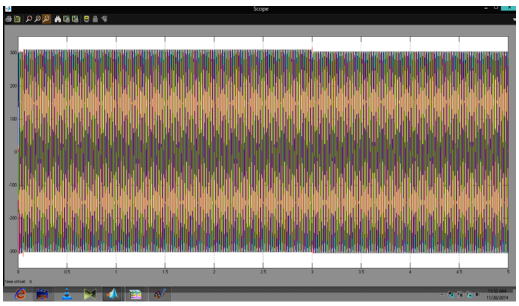

Fig 19 Terminal voltages during normal to sag. and Terminal voltages during sag to normal.

CONCLUSION:

In this project, a control algorithm has been planned for the production of situation load voltage for a voltage-controlled DSTATCOM.

The presentation of the proposed scheme is compared with the traditional voltage-controlled DSTATCOM. The proposed method make availables the subsequent advantages: 1) at nominal load, the compensator injects immediate and harmonic components of load currents, resulting in UPF; 2) nearly UPF is maintain for a load change; 3) fast voltage regulation has been accomplish during voltage disturbances; and 4) losses in the VSI and feeder are condensed significantly and have higher sag underneath potential with the same VSI rating evaluate to the traditional scheme. The reproduction and investigational results show that the planned scheme make accessible DSTATCOM, a capability to improve several PQ problems (related to voltage and current

FUTURE SCOPE:

The following points are recommended for future extension of work:

» Other types of controllers like fuzzy controller and adaptive PI fuzzy controller can be employed in the DVR compensation scheme.
» Investigation of the effectiveness of multi-level DVR can be investigated.
» The effectiveness of DVR can be established for active loads like PV source and Wind turbine.

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