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Distributed Power Flow Controller (DPFC) to Improve the Power Quality

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Abstract

Recently, within the family of FACTS, the distributed power flow controller is an additional device. This paper highlights on voltage sag mitigation which is one of the burgeoning power quality issues. It deals with the working concept of distributed power flow controller for compensating unbalanced three phase line currents in the transmission system. The single phase series converters of DPFC are able to compensate. The unique control capability of the UPFC is given by the back-to-back connection between the shunt and series converters, which allows the active power to freely exchange. To ensure the DPFC has the same control capability as the UPFC, a method that allows active power exchange between converters with an eliminated DC link is required. An unsymmetrical fault (L-G fault) is considered near the load end side. A proper selection of controlling variables of DPFC relieves the load voltage sag, compensates the unbalance and diminishes the load voltage harmonics in few seconds. Furthermore the performance of DPFC is simulate using Matlab simulink and results denote an improvement in power quality.

Index Terms- -DPFC, power flow control, reduction of load voltage harmonics, voltage sag mitigation, unbalance fault condition

I. INTRODUCTION

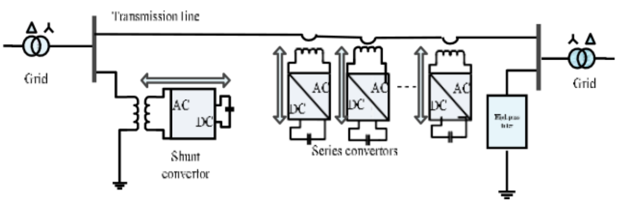
THE growing demand of electricity and increase in non linear loads need high electrical power quality. It is a well known fact that in the recent few decades, the need of electrical power has become high drastically whereas currently the enlargement of electrical power transmission as well as generation has been bounded caused by scarcity of resources and environmental limitations. As such the consequences are complexity of power system, heavy loading of transmission line and also the power system stability changes into power transfer limiting factor. For better utilization of prevailing ac transmission system and control of power flow the concept of power electronic based FACTS devices were investigated [1]. The FACTS devices which can control parameters like the bus voltages, the line impedance and the transmission angle simultaneously come under the category of most powerful FACTS devices. Among which one is unified power flow controller (UPFC),

Ideally, this injected voltage is in quadrature with the line current, such that the SSSC behaves like an inductor or a capacitor for the purpose of increasing or decreasing the overall reactive voltage drop across the line, and thereby, controlling the transmitted power. In this operating mode, the SSSC does not interchange any real power with the system in steady-state. The unified power-flow controller (UPFC) is the most versatile device of the family of FACTS devices, since it is able to control the active and the reactive power, respectively, as well as the voltage at the connection node. The Unified Power Flow Controller (UPFC) is comprised of a STATCOM and a SSSC, coupled via a common DC link to allow bi-directional flow of active power between the series output terminals of the SSSC and the shunt output terminals of the STATCOM. Each converter can independently generate (or) absorb reactive power at its own AC terminal. The two converters are operated from a DC link provided by a DC storage capacitor[5]. An unsymmetrical fault (L-G fault) is considered near the load end side. A proper selection of controlling variables of DPFC relieves the load voltage sag, compensates the unbalance and diminishes the load voltage harmonics in few seconds. Furthermore in this paper the performance of DPFC is studied and results denote an improvement in power quality as well as enhanced power flow control

II CONTROL SCHEME OF SERIES FILTER

DPFC Topology

By introducing the two approaches outlined in the previous section (elimination of the common DC link and distribution of the series converter) into the UPFC, the DPFC is achieved. Similar as the UPFC, the DPFC consists of shunt and series connected converters. The shunt converter is similar as a STATCOM, while the series converter employs the DSSC concept, which is to use multiple single -phase converters instead of one three-phase converter. Each converter within the DPFC is independent and has its own DC capacitor to provide the required DC voltage. The configuration of the DPFC is shown.



The central control unit generates reference signals for the shunt and series converters of the DPFC to regulate the bus voltage and to control power flow in transmission line. All the reference signals generated by the central control unit are corresponded to the fundamental frequency components.

CONTROL SCHEME OF SERIES FILTER

A simple algorithm is developed to control the series and shunt filters. The series filter is controlled such that it injects voltages (vca; vcb; vcc), which cancel out the distortions and/or unbalance present in the supply voltages (vsa; vsb; vsc), thus making the voltages at the PCC (vla; vlb; vlc) perfectly balanced and sinusoidal with the desired amplitude. In other words, the sum of the supply voltage and the injected series filter voltage makes the desired voltage at the load terminals.

CONTROL SCHEME OF SHUNT FILTER

The control algorithm for a shunt AF consists of the generation of 3-phase reference supply currents and it is depicted in Fig. 3. This algorithm uses supply in-phase, 120_ displaced three unit vectors computed using eqn. (1). The amplitude of the reference supply current (I_ sp) is computed as follows. A comparison of the average and the reference values of the dc bus voltage for the shunt AF results in a voltage error, which is fed to a proportional integral (PI) controller and the output of the PI controller is taken as the reference amplitude of the supply currents. The three in-phase reference supply currents are computed by multiplying their amplitude (I_ sp) and in phase unit current vectors

III. OBJECTIVES

Objectives are as follows.

1. To develop signature recognition & verification System by using artificial neural network
2. To verify an entered signature with the help of an Average signature, which is obtained from the set of, previously collected signatures
3. To accurately characterize each user's signature, thus offering good verification and recognition performance
4. To reduce the time required for Signature verification and recognition
5. To maintain the Security in various financial domain such as banking, Insurance etc.

IV. SIMULATION RESULT

Distributed Power Flow Controller (DPFC) is used to control the power flow in a 20 kV 9 Bus transmission system. The DPFC located at the middle of 9bus and Load line L2, between the 20 kV buses VB1 and VB3 and VB9 is used to control the active and reactive powers flowing through 9 bus while controlling voltage at bus B1. It consists of two 10KVA, three-level, converters, one connected in shunt and one connected in series. The shunt and series converters can exchange power through a DC bus. The series converter can inject a maximum of 10% of nominal line-to-ground voltage in series.

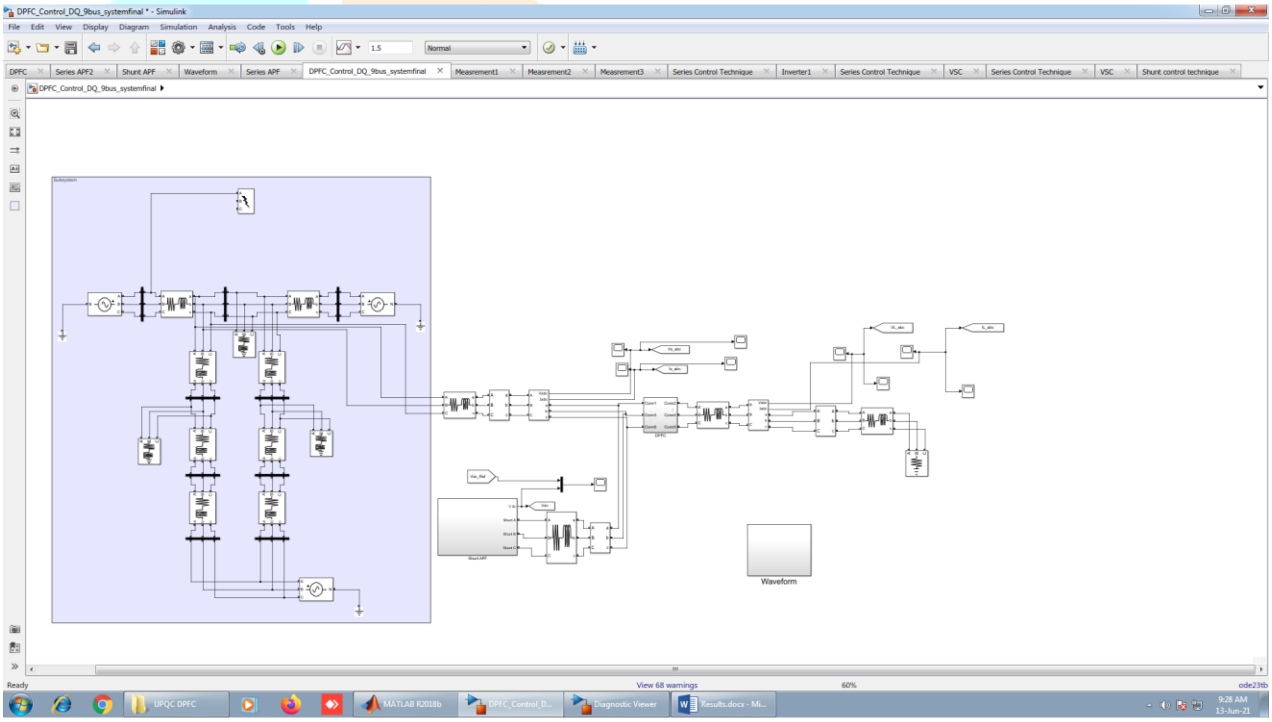
This pair of converters can be operated in three modes:

Shunt converter

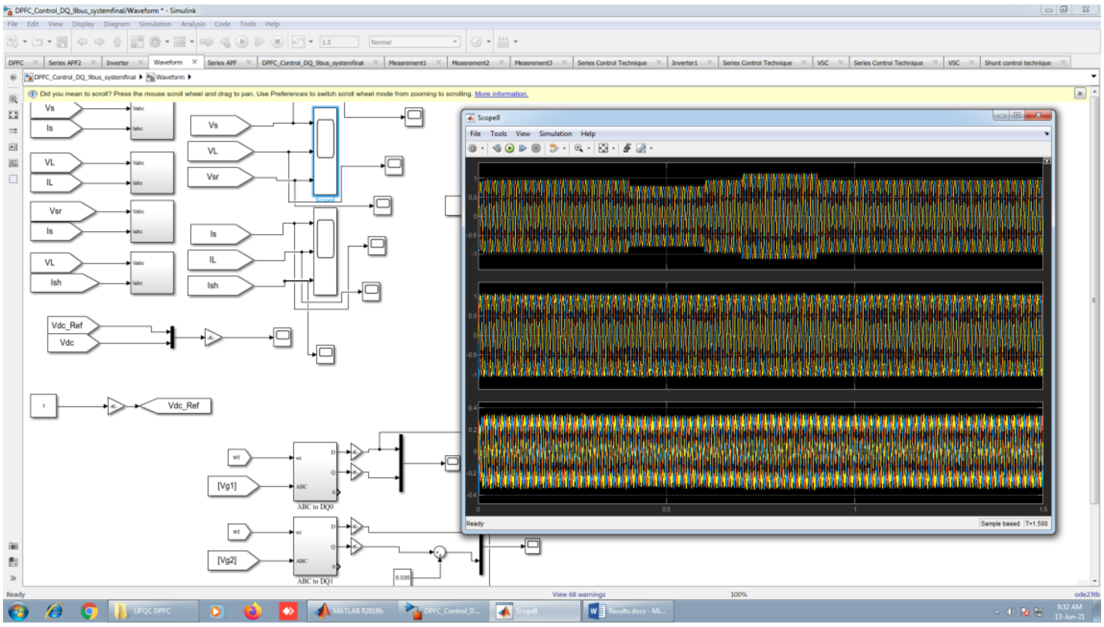
The shunt controller upholds the shunt capacitor dc voltage at constant level by taking the active power from transformer neutral at fundamental frequency. The current control and the dc voltage control are two cascaded controllers, therefore in order to deliver active power for distributed series converters a stable constant current at third harmonic frequency is injected into neutral of transformer by the shunt controller

Series Controller

There is an individual series controller for every series converters and the main purpose of the series controller is to keep the dc voltage of capacitor constant at its corresponding converters by utilizing third harmonic frequency component. Also the series controllers generate the series voltages at fundamental frequency which are as per the requirement of the central controller. The line current of corresponding phase, the reference voltage in vector form and corresponding series capacitor dc voltages are the series controller inputs. In series controller block diagram,



Outcome



To verify the performance of the DPFC, a L-G fault is taken into account near the load end side. The time duration considered for this L-G fault is from 0.4 seconds to 0.6 seconds. Fig. Shows remarkable voltage sag as the fault. Without DPFC compensation. For a single phase about 0.5 per unit voltage sag is found. As depicted in Fig. When the DPFC is tied up then the load voltage sag during L-G fault has been mitigated significantly

V. CONCLUSION

This paper introduces the unbalance compensation and the voltage sag mitigation during unbalance fault condition by utilizing a recent additional FACTS device which is distributed power flow controller (DPFC) adopting sequence analysis technique. The DPFC is designed by employing three control loops. The simulated system has two machine systems, in presence and absence of the DPFC in the system. To examine the capability of the DPFC, an unsymmetrical L-G fault is taken into account near the load end side. In this paper simulation done verifies that the adopted control is able to give unbalance compensation and mitigation of voltage sag.

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