

Mitigation of Voltage SAG for Power Quality Improvement Using DPFC System

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Abstract— A new control scheme to improve and maintain the power quality of an electrical power system by design of distributed power flow controller. Generally, In case of modern power utilities have problems like challenges in growth of electricity in case of non-linear loads in grid connected systems. In this paper, we introduced a new FACTS method i.e. distributed power flow controller which is similar to other series-shunt controller types. This DPFC method is also used like UPFC to mitigate voltage sag and swell as a power quality issue. In DPFC, we eliminate the common dc link capacitor and instead of single three phase series converter it has three individual single phase converters. In this paper the control circuit is designed by using series referral voltages, branch currents. The evaluated values are obtained by using MATLAB/SIMULINK.

Keywords— DPFC, Voltage Sag and Swell, Power Quality.

1. Introduction

Because of power demand grows dramatically, and extension in transmission and generation is restricted with the rigid environmental constraints and the limited availability of resource. But in case of transfer of power from the generation units to the utility customers, the term power quality is a measure of how the elements affect the system as a whole. From consumer point of view, the power quality issue is concentrated about current, voltage or frequency deviation which causes the failure of power. For solving such type of power quality problem a new method based on the power electronic based equipment's such as flexible alternating current transmission system (FACTS) and custom power devices (DVR) which are used in both transmission and distribution control, respectively, should be developed. But, the majority of problems transmission lines are such as sag (voltage dip), swell (over voltage) and interruption. To mitigate this type of power quality problems, the utilization of FACTS devices such as unified power flow controller (UPFC) and static synchronous compensator (STATCOM) can be helpful. In this paper we introduce a new method like distributed power flow controller (DPFC) which has similar configuration to UPFC structure. The DPFC has a combination of parallel converter and multiple series converters which is used to balance the transmission line parameters, such as bus voltage, line impedance, and transmission angle.

2. WORKING OF DPFC

The DPFC consists of parallel and series connected converters. The parallel converter is similar as a STATCOM, while the series converters employ the D-FACTS concept such as DVR. Each converter within the DPFC is independent

and has a separate DC link capacitor to provide the required DC voltage. Illustration. 1 shows the structure of single machine system with DPFC. The control capability of the Unified power flow controller is given by the back-to-back connection between the shunt and the series converters with DC link, which allows the active power to exchange freely. To ensure that the DPFC has the same control capability as the UPFC device, a method that allows the exchange of active power between converters without DC link is the prerequisite. Therefore, it is allows to exchange the active power through the AC terminals of the converters.

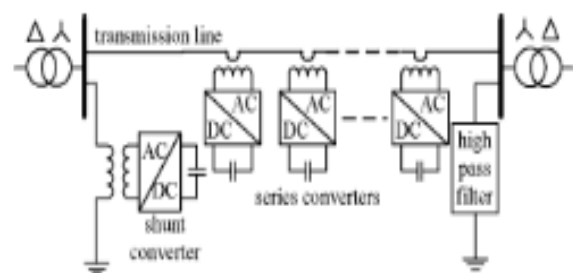


Fig 1: Basic Configuration of DPFC

A. Advantages of DPFC:

The Distributed Power Flow Controller has the following advantages in comparison with UPFC, such as:

1) More capability to control.

The DPFC can control all parameters of transmission line such as, impedance, load angle and voltage magnitude.

2) High efficiency.

The series converters redundancy increases the DPFC reliability during converters operation [10]. It means, if one of series converters fails, the others can continue to work.

After creating the fault the load current swell around 0.2 per unit. The simulation results of load current in case of swell condition and mitigation of current are shown in figure 8 and figure 9.

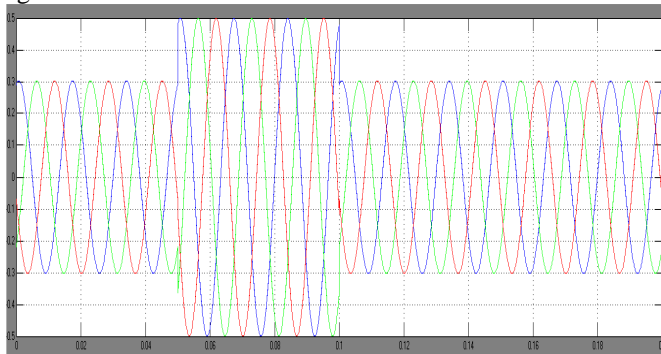


Fig 8: Simulation results for current swell condition

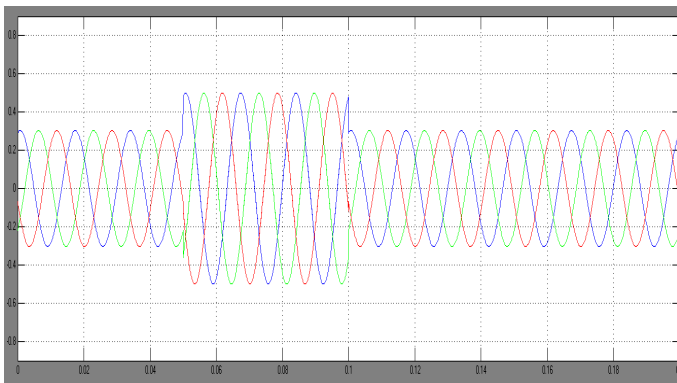


Fig 9: Simulation results for mitigation of current swell with DPFC system

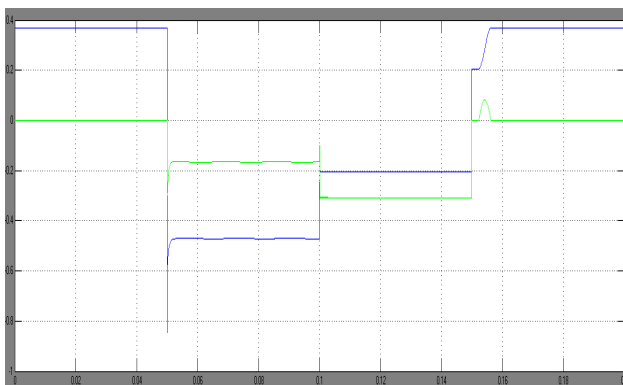


Fig 10: simulation results for active and reactive powers

6. CONCLUSION

In this paper we implemented a new concept for controlling power quality problems by Distributed Power Flow Controller device. The proposed concept of the DPFC approach is mathematically formulated and analyzed for voltage dips and their mitigations for a three phase source with linear load. The experimental results of DPFC show the effectiveness of DPFC in power quality enhancement as compared to all other FACTS devices.

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