JOURNAL OF INFORMATION, KNOWLEDGE AND RESEARCH IN
ELECTRICAL ENGINEERING (ISSN 0975 – 6736 , GIF: 01.1419 , SIF: 02.798)

IMPROVING RIDE- THROUGH CAPABILITY OF DC-LINK VOLTAGE IN MULTILEVEL UNIFIED POWER FLOW CONTROLLERS

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ABSTRACT *- The three-level neutral-point-clamped (NPC) converter allows back-to-back connection as the UPFC shunt and series converters. As well the pulse width-modulated (PWM) multilevel control plans, UPFCs need constant dc-link voltage and balanced voltages in the NPC multilevel dc capacitors. This paper proposes three main contributions to increase the dc-link voltage steadiness of multilevel UPFCs under line faults: 1) decoupled active and reactive linear power controllers; 2) real-time PWM generation; and 3) double balancing of dc capacitor voltages. The results show the effectiveness of the real-time PWM generation and dc-link capacitor voltages balancing included in NPC series and shunt converters to stay the dc-link voltage steadiness under line faults, generally enhancing the UPFC ride-through capability*
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Index Terms – Decoupled Power Controller, Flexible Ac Transmission System (FACTS), Power Flow Control, Uniffed Powerflow Controller.

I INTRODUCTION

Environmental and economical constraints affect the building of electric power stations and transmission lines, While power demand continues to grow. Thus, increasing power controllability and optimize existing power system capacities by suitable control of the power flow (PF) during steady state as well as in transient conditions is needed. The flexible ac transmission systems (FACTS) concept namely, the unified power-flow controller.

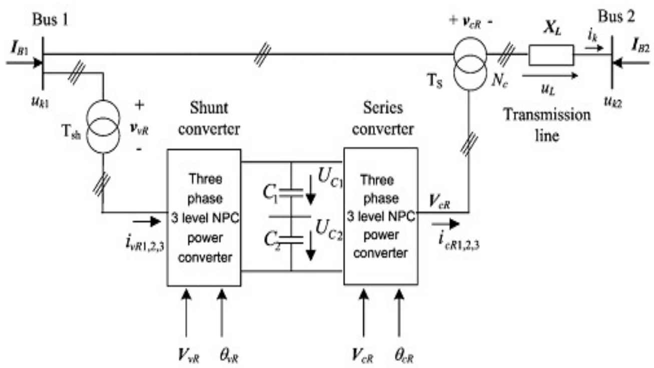

Fig. 1 Typical diagram configuration of the UPFC

(UPFC), can provide the necessary PF optimization in transmission lines while improving power oscillation damping

and, thus, is able to enforce active and reactive powers in a transmission line. Multilevel converters present attractive features, such as high-voltage (HV) capability and low harmonic content voltage waveforms, with the NPC multilevel converter

being advantageous for UPFCs, since it needs capacitor bank on the dc bus to produce voltage levels. Fig. 1 shows the typical diagram configuration of the UPFC two high-power back-to-back NPC multilevel voltage-source inverters connected through a smoothing capacitor bank dc-link voltage. oscillation damping [2]–[4].The UPFC can control line parameters, such as bus voltage, voltage angle, and line impedance, and, thus, is able to enforce active and reactive powers in a transmission line [5]–[7]. Multilevel converters present attractive features, such as high-voltage (HV) capability and low harmonic content voltage waveforms, with the NPC multilevel converter being advantageous for UPFCs [8], [9], since it needs capacitor banks on the dc bus to produce voltage levels. Fig. 1 shows the typical diagram configuration of the UPFC two high-power back-to-back NPC multilevel voltage-source inverters connected through a smoothing capacitor bank dc-link voltage. Oscillation damping control uses UPFC nonlinear control schemes [10] although a simplified power injection model was employed to obtain the UPFC behavior and the UPFC dc-link ride-through capability was not investigated. In [11], dynamic control and performance evaluation of a UPFC is presented.

UPFC with multilevel converters has been partially addressed in [15] studying the frequency-response characteristics of the UPFC and in [16], the balancing of the voltage capacitors has been proposed using an extra chopper converter and, therefore, requires extra converters. Proportional-integral (PI) power-controlled UPFCs [16] show strong cross-coupling between active and reactive power responses. Decoupled cascaded PI voltage and current controllers

II. LITERATURE REVIEW

B.Fardanesh (2004) proposed method for optimal dimensioning of multiconverter converter-based FACTS controllers. This general method allows comparisons of the steady-state performance and effectiveness of all single, two, and three-converter controllers in achieving specific power system operating objectives. The effects of various shunt and series converter size modularizations in multiconverter FACTS controllers are demonstrated. Realistic constraints representing various converter limits have been implemented. MATLAB optimization routines are utilized.

N.G Hingorani, L.Gyugyi (2000) proposed various aspects of unified power flow controller (UPFC) control modes have been discussed and it describes its settings and evaluates their impacts on the power system reliability.

UPFC is the most versatile flexible ac transmission system device ever applied to improve the power system operation and delivery. It can control various power system parameters, such as bus voltages and line flows. A power injection model is used to represent UPFC and a comprehensive method is proposed to select the optimal UPFC control mode and settings. The proposed method applies the results of a contingency screening study to estimate the remedial action cost (RAC) associated with control modes and settings and finds the optimal control for improving the system reliability by solving a mixed-integer nonlinear optimization problem. The proposed method is applied to a test system in this paper and the UPFC performance is analyzed in detail.

S.JIANG, U.D.Annakage, A.M.Gole(2006) proposed a platform system for the incorporation of flexible ac transmission systems (FACTS) devices has been presented. The platform permits detailed electromagnetic transients simulation as it is of manageable size. It manifests some of the common problems for which FACTS devices are used such as congestion management, stability improvement, and voltage support. D. E. Soto-Sanchez, T. C. Green (2001) proposed a UPFC using three converters is proposed. Two phase-shifted converters are required to provide a full range of voltage control of the series connection while ensuring low distortion and a balanced DC link. A single shunt converter is used. S. Mehraeen, S. Jagannathan, M. L. Crow (2010) proposed the determination of most unstable bus of system using P-V curve and Eigen value analysis and the critical line using the stability indices has been presented. Voltage collapse indicators indices give exact information about the stability condition of a system and also determine the most in secure bus of the system. The line indices are evaluated for IEEE 14 bus system and critical line is found where the index reaches its maximum value. PSAT (power System Analysis Toolbox) software is used for Continuation Power Flow (CPF)) and the results shows that optimal placement of Unified Power Flow Controller (UPFC) significantly increase the load ability margin and stability of system.

J Guo, M. L, Crow,J. Sarangapani (2009) proposed the DVR multilevel topology is suitable for medium-voltage applications and operated by the control scheme developed in this paper. It is able to mitigate power-quality disturbances, such as voltage sags, harmonic voltages, and voltage imbalances simultaneously within a bandwidth.

H. Fujita, H. Akagi, Y. Watanabe (2006) proposed a control scheme and comprehensive analysis for a unified power flow controller (UPFC) on the basis of theory, computer simulation and experiment has been presented. This developed theoretical analysis reveals that conventional power feedback control scheme makes the UPFC induce power fluctuation in transient states. This paper proposes an advanced control scheme which has the function of successfully damping out the power fluctuation. Experimental results agree well with both analytical and simulated results and show viability and effectiveness of the proposed

.

III. UPFC DECOUPLED POWER CONTROL

In this work decoupled linear UPFC power controllers are to be introduced to obtain the reference ac voltages (VcRref) and currents (IvRref) for the two back-to-back-connected three phase three-level converters that enforce active and reactive power in the transmission line, with cross-coupling suppression. The converters share common dc-link capacitors C1, C2 and rely on real-time PWM generators to enforce the shunt converter ac input currents (IvR = IvRref) and series converter line-to-neutral voltages (VcR=VcRref). The dc-link voltage will be regulated by the shunt converter, while shunt and series converters will balance the dc voltages of the dc-link capacitors. Real-time PWM generation and the double balance of the two dc capacitor dc voltages are intended to show that it enhances the voltage ride-through capability. Simulation results will be presented to show the ride-through performance under line faults. The effectiveness of the proposed methods will be compared to controllers without real-time PWM generation and decoupled active and reactive power control.

IV. NPC MULTILEVEL CONVERTER

The power electronics device which converts DC power to AC power at required output voltage and frequency level is known as inverter.

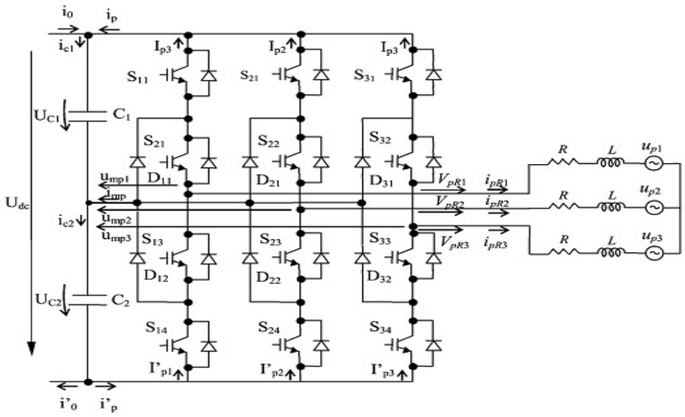

Fig.4.Three-phase three level NPC power converter

In this work it is expected that Active and reactive PF control in the transmission line is accomplished by using a decoupled power controller, nearly enabling cross-coupling suppression. It is expected that PWM generation helps in eliminating errors due to dc capacitor voltage variations. The dc-link capacitor voltages, which are usually balanced using only one of the multilevel converters, will be balanced using both series and shunt multilevel converters. It is expected that the decoupled active and reactive power controllers remain insensitive to the non modeled dynamics and parameter variation, since active and reactive powers are to be enforced, despite network configuration being changed due to fault clearing.

VI. CONCLUSION

It will concludes that a voltage ride-through enhancement strategy for multilevel UPFCs can be realized and the proposed UPFC control strategy will include A) Decoupled active and reactive linear power control. B) Real-time PWM generation in both UPFC multilevel converters, dc-link voltage gains With low sensitivity to dc link current C) The balancing of the dc-link capacitor voltages using both multilevel converters. It will concluded that the decoupled active and reactive power controllers remain insensitive to the no modeled dynamics and parameter variation, since active and reactive powers are to be enforced, despite network configuration being changed due to fault clearing

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