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Reactive Power Control in a Flexible HVDC Interconnection Current Sources Multigroup

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Abstract: *The steady state solutions derived from EMTP and power flow simulations differ due to the idealized and purely fundamental frequency system representation of the latter. This paper shows, however, that a preliminary power flow assessment of the operating condition can help to reduce substantially the initialization time of the EMTP solution. The test is carried out with reference to a new concept designed to exercise independent reactive power control in a multi-level CSC-HVDC scheme used for bulk power transmission from a remote power generating station.*

Keywords: HVDC Transmission, Multilevel Conversion, Reactive Power Control.

I. INTRODUCTION

Electromagnetic Transients Programs (EMTP) and Power Flow are the two main simulation tools employed in the design and operation of ac-dc power systems. The purpose of a DC interconnection, a new control concept or a new converter configuration is to provide effective steady state power (active and reactive) transfers with acceptable voltage and current levels and waveforms. Therefore, the new project or ideas are first assessed by power flow simulation and only when the steady state objectives are met is the detailed design handed over to EMTP. The results of the power flow solution can also be used to initialize the EMTP studies. Moreover, the Power Flow and EMTP (on reaching the steady state) solutions can be used to cross validate each other. However, the transition from Power Flow to EMTP is not straight forward, because of the idealized and purely fundamental frequency representation of the power flow solution. An example of the complementary roles of Power Flow and EMTP is presented in this paper, with reference to a new concept used to provide more flexible control of the reactive power at the terminals of a long distance HVDC link connected to a remote generating plant. The reason for the proposal is the lack of independent reactive power controllability of the multi-level schemes so far considered as possible alternatives to PWM-controlled VSC Transmission. The new concept (referred to as multi-group firing-shift control) applies to self-commutating bipolar current-source Multi level HVDC transmission with two or more converter groups at each terminal. The Multi-level Current Reinjection (MLCR) configuration is used as a basis for the test.

II. FIRING-SHIFT CONTROL OF THE CONVERTER GROUPS AT THE GENERATING STATION

Fig.1 shows a simplified equivalent of a bipolar self commutating HVDC link connecting a large power station to an ac power system. The CSC converter stations consist of two twelve-pulse groups. When the operating condition of the receiving end system requires an extra injection of reactive power from the converter, the converter firing angle increases this action causes a dc voltage reduction and thus an increase of dc current. The latter, however, will be limited by a corresponding reduction of dc voltage at the sending end (implemented by an increase of firing angle) to maintain the specified power transfer. If, as is the case in conventional multi-group control, a common firing angle is used by the two groups, the extra reactive power injection at the receiving end will also result in an increase of reactive power injection at the sending end.

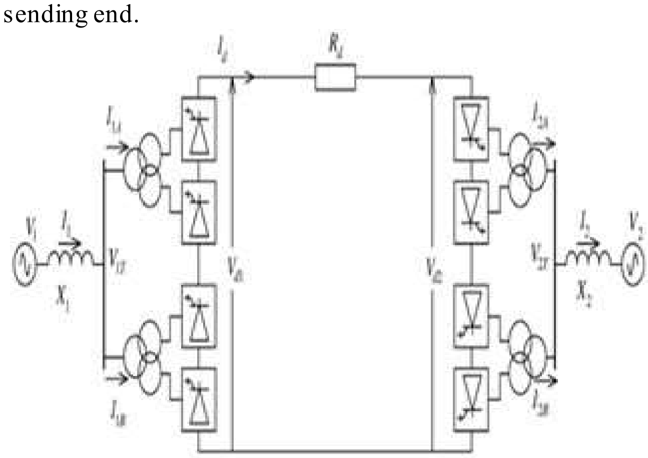

Fig.1. Simplified diagram of a DC link connecting a remote generating Station.

As the ac and dc voltages across the converter are related by the cosine of the firing angle, the sign of this angle does not affect the dc voltage level. In the proposed control, the dc

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voltage correction at the sending end in response to a reactive power increase at the receiving end is implemented by varying the firing angles of the two converter groups in opposite directions. Accordingly, one group (say group A) will advance the firing angle (i.e. inject more reactive power) and the other (say group B) delay the firing angle (i.e. absorb reactive power). This will maintain the converter operation at constant power factor. The sending end converter groups can be set to operate with minimum firing angle (say zero) when the receiving end system requires minimum reactive power injection (i.e. for the case when the Short Circuit Ratio is largest). The generating station operates at its most efficient point when the generators are controlled to provide only active power to the link.

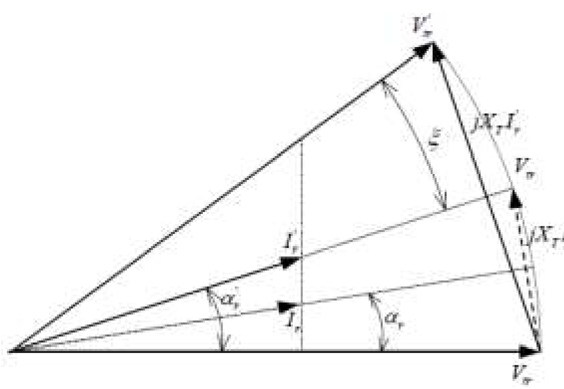


Fig.2. Effect of converter firing shift control on the relative position of the voltages and currents at the receiving end for an increased of the reactive power injection.

III. EXISTING AND PROPOSED METHODS

A. Existing Method

Multilevel VSC configurations have been presented as possible alternatives to PWM-VSC Transmission, but their structural complexity has been the main obstacle to their commercial implementation. A recent proposal, the multilevel current reinjection (MLCR) concept, simplifies the converter structure and permits the continued use of conventional thyristors for the main converter bridges.

B. Proposed Method

Using an MLCR configuration, that the use of a controllable shift between the firings of the series connected converter groups permits independent reactive power control at the two dc link terminals. This provides four quadrant power controllability to multilevel current source HVDC transmission and, thus, makes this alternative equally flexible to PWM-controlled voltage source conversion, without the latter's limitations in terms of power and voltage ratings. It has been shown theoretically and verified by Matlab/Simulink simulation and results describe its effectiveness.

1. Advantages

1. The main advantage of self over natural-commutation in HVDC transmission is the ability to control independently the reactive power at each end of the link.
2. To keep the power factor constant.
3. The new control concept gives the MLCR configuration, the flexibility until now only available to PWM–VSC transmission.

2. Applications

It can be expected that MLCR, combined with firing-shift control, should compete favorably with the conventional current source technology for very large power applications.

IV. MATLAB DESIGN OF CASE STUDY AND RESULTS

Case I:

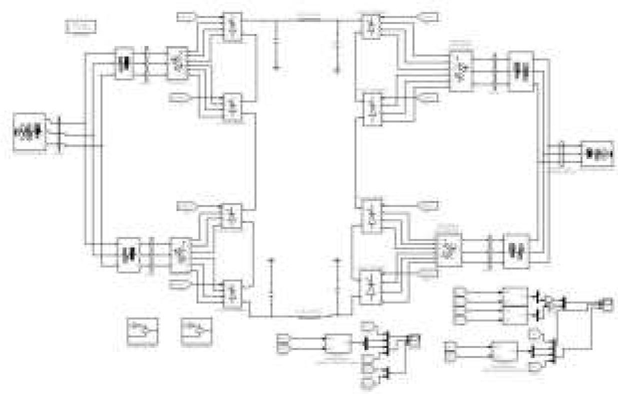


Fig.3. The design of the reactive power in case1.

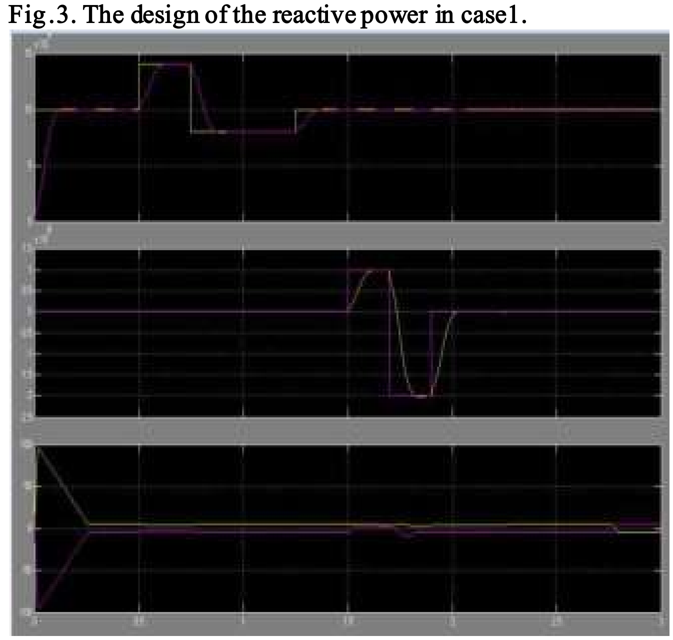
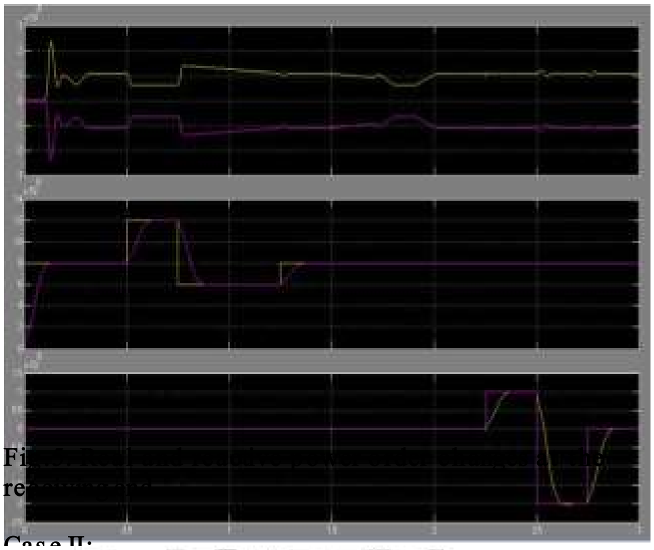


Fig.4. Real and reactive power order changes at the sending end.



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Case II:

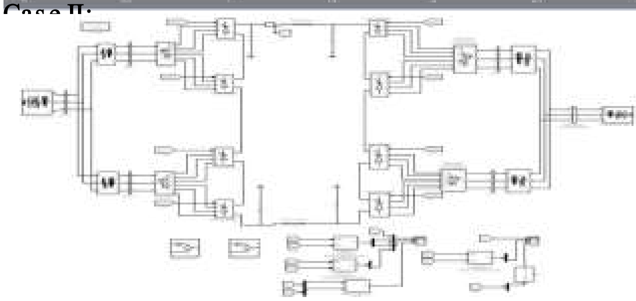

Fig.6. The design of the reactive power in case2.

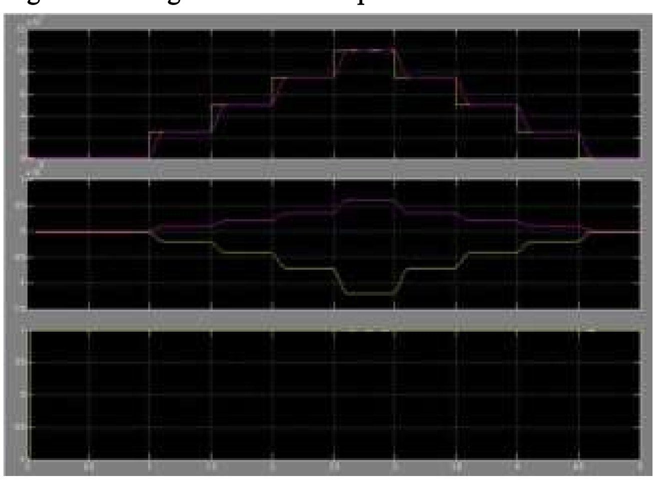

Fig.7. Reactive power responses under power factor.

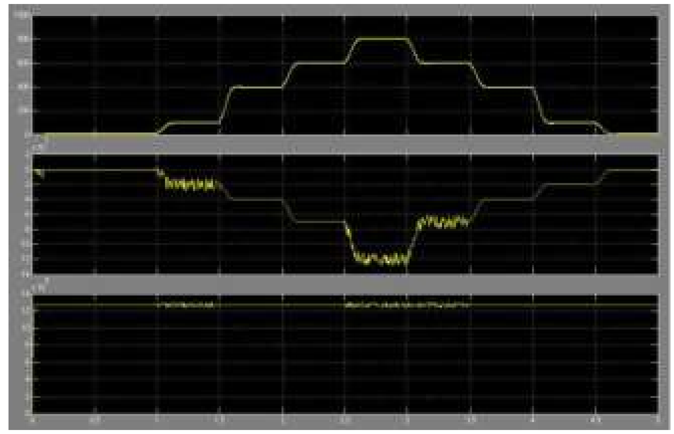

Fig.8. Reactive power responses under terminal voltage control.

Reactive power responses under power factor and terminal voltage control for a series of step changes to real power are shown in fig 6 to 8.

V. CONCLUSION

The relevance of the power flow solution as a preliminary tool to EMTP for the design of new ac-dc schemes has been the main aim of this contribution. As an example, the combination of PSCAD-EMTDC and Power Flow simulation has been used to test the ability of a new concept (referred to as double-group firing-shift control) to make current source multi-level HVDC Transmission more flexible in terms of reactive power controllability. This concept, applicable to bipolar schemes using two 12-pulse converter groups, has been shown to provide four quadrant power controllability at the two ends of the link it may, therefore, be an interesting alternative to the conventional CSC and the recent and more flexible VSC technologies for bulk power HVDC transmission The use of power flow simulation to derive approximate initial conditions for the EMTP simulation has been shown to provide realistic information and reduce the computation task by at least an order of magnitude. Also, on reaching the steady state the EMTP simulation have been shown to be sufficiently close to the Power Flow solution and thus provide cross-validation of the EMTDC and Power Flow results.

VI. REFERENCES

[1] Nick J. Murray, Member, IEEE, Jos Arrillaga, Fellow, IEEE, Yong He Liu, Member, IEEE, and Neville R. Watson, Senior Member, IEEE, "Flexible Reactive Power Control in Multi-group Current-Sourced HVDC Interconnections", IEEE Transactions on Power Delivery, Vol. 45, No. 5, April 2014.
[2] G. Asplund, K. Eriksson, and O. Tollerz, "Land and sea cable interconnections with HVDC light," presented at the CEPSI Conf., Manila, Philippines, Oct. 2000.
[3] G. Asplund, K. Eriksson, and K. Svensson, "DC transmission based on voltage source converters," presented at the CIGRE SC Colloq., Johannesburg, South Africa, 1977.

[4] Cigre SC-4 WG 37, VSC Transmission Final document. Paris, France, 2004.

[5] G. Jung et al., "A general circuit topology of multilevel inverter," in Proc. IEEE Power Electronics Specialist Conf., 1991, vol. PESC 91 Rec., pp. 96–103, Mass. Inst. Technol..

[6] L. B. Perera, N. R. Watson, Y.-H. Liu, and J. Arrillaga, "Multi-level current reinjection self-commutated HVDC converter," Proc. Inst. Elect. Eng., Gen., Transm. Distrib. vol. V152, no. 5, pp. 607–615, Sep. 2005.

[7] J. Arrillaga, Y. H. Liu, L. B. Perera, and N. R. Watson, "A current reinjection scheme that adds self-commutation and pulse multiplication to the thyristor converter," IEEE Trans. Power Del., vol. 21, no. 3, pp. 1593–1599, Jul. 2006.

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