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Coordinated control in VSC-HVDC Multi- terminal systems to improve transient stability: the impact of communication latency

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Abstract-

Power transmission is the main purpose of high voltage direct current systems based on voltage source converters (VSC-HVDC). Nevertheless, this type of system can also help to improve transient stability by implementing suitable supplementary controllers. Previous work proposed active- (P) and reactive-power (Q) control strategies in VSC-HVDC multi-terminal systems (VSC-MTDC, for short) to improve transient stability, producing significant improvements. In those strategies, each VSC station of the MTDC system compares its frequency measurement with the average of the frequencies measured by all converter stations of the MTDC system (weighted-average frequency, WAF) in order to modulate its own P and Q injections. Hence, a communication system is required. This paper presents a detailed analysis of the impact of communication latency on the performance of those control strategies. The communication delays have been modelled using a Padé’s approximation and their impact on the performance of the control strategies have been assessed by means of time-domain simulation in PSS/E. The effect of the control strategies on transient stability has been quantified with the critical clearing time (CCT) of a set of faults. Results show that the control strategies analysed present good results for realistic values of communication delays.

Index Terms- power systems; high voltage direct current (HVDC) transmission; HVDC systems based on voltage source converters (VSC-HVDC); multi-terminal; transient stability; control strategies; communication latency

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