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Coordinated design of supplementary controllers in VSC-HVDC multi-terminal systems to damp electromechanical oscillations

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Abstract-

High Voltage Direct Current Transmission (HVDC) systems are called to play an important role in modern electric power systems. Among the many aspects of HVDC currently under active research, this paper presents a proposal to design supplementary controllers in multi-terminal HVDC systems based on Voltage Source Converters (VSC-MTDC, for short) to damp electromechanical oscillations (Power Oscillation Damping or POD). In the proposed POD controllers (PODC), each VSC station compares the average of the frequencies measured at the AC connection points of the VSC stations of the MTDC system (frequency set point) with its own AC output frequency. This difference is then used to manipulate the active- (P) and reactive-power (Q) injections of each one of the VSC stations. The proposed PODCs are designed systematically by using a coordinated-design method using the concept of eigenvalue sensitivity, in order to achieve the required damping ratio of a set of electromechanical modes of interest in the power system where the VSC-MTDC is connected. The proposed designed methodology has been tested in the Cigré Nordic32A system with an embedded VSC-MTDC system. Results show that the proposed PODCs are effective damping successfully the electromechanical modes of interest and they are robust against communication latencies.

Index Terms- Active and reactive power control, power oscillation damping, VSC-HVDC, multi-terminal.

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