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Primary frequency support through North American continental HVDC interconnections with VSC-MTDC systems

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Abstract-

This paper proposes a frequency control strategy for voltage source converter based multi-terminal HVDC systems (VSC-MTDC) to facilitate the exchange of primary frequency reserves among asynchronous AC systems, thus providing frequency support from each AC system to the others. The proposed frequency control utilizes a reference signal calculated from global measurements which reflects the overall frequency dynamics of all connected asynchronous AC systems. The proposed control outperforms the traditional frequency droop scheme by reducing impact on the DC voltage profile and improving frequency nadir. The performance of the designed frequency control with different DC voltage droop controls is evaluated. The adaptation of the proposed frequency control for converter outages is analyzed. The robustness of the proposed control to communication latency and the sensitivity of frequency support to power limits are also investigated. The VSCMTDC model and the proposed control are implemented in the commercial grade software PSS/E and thus is suitable to study large-scale realistic systems and can be incorporated into the power system planning process at utilities and ISOs. The effectiveness of the proposed control is illustrated on a developed AC-MTDC test system and also on a large-scale realistic model combining the North American Western Interconnection (WI) and Eastern Interconnection (EI) with continental HVDC interconnections.

Index Terms- VSC-MTDC, frequency support, droop control, PSS/E

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