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Active-power control strategies in grid-forming power converters to improve transient stability in power systems with 100% converter-based generation

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Abstract-

Grid-forming voltage source converters (GFM-VSC) play a crucial role in the stability of power systems with large amounts of converter-based generation. Transient stability (angle stability under large disturbances) is a critical limiting factor in stressed power systems. Previous studies have proposed control strategies for GFM-VSCs to improve transient stability. These approaches typically rely on suitable current-limiting algorithms, voltage/reactive-power and active-power supplementary control strategies. This paper investigates and compares the effectiveness of three active-power control strategies in GFM-VSCs to enhance transient stability in power systems with 100% converter-based generation: (i) a wide-area control strategy (TSP-WACS) using the centre of inertia (COI) frequency, (ii) a local transient damping method (TSP-TDM), and (iii) a novel local control strategy (TSP-L) proposed in this work. All strategies were implemented and assessed using short-circuit simulations on Kundur´s two-area test system with 100% GFM-VSC generators, demonstrating critical clearing time (CCT) improvement. The TSP-WACS strategy achieves the best performance but requires a communication infrastructure, while TSP-L strategy offers a simple, robust alternative using only local measurements.

Index Terms- Grid-forming power converters; VSC; Transient stability; Active-power control strategies; WACS; Center of inertia (COI); Transient damping method (TDM); TSP-L

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