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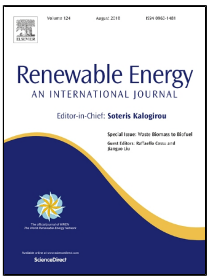

Coordinated Control of a Hybrid Wind Farm with DFIG-based and PMSG-based Wind Power Generation Systems under Asymmetrical Grid Faults

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Coordinated Control of a Hybrid Wind Farm with DFIG-based and PMSG-based Wind Power Generation Systems under Asymmetrical Grid Faults

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ABSTRACT: A non-communication-based coordinated control strategy for a hybrid wind farm with doubly fed induction generator (DFIG)-based and direct-driven permanent magnet synchronous generator (PMSG)-based wind farms under severe asymmetrical grid faults is proposed in this paper. Firstly, the in-depth research of the severe asymmetrical fault and its impact on the operation characteristics of the DFIG and PMSG systems are investigated. Secondly, based on the operation characteristics analysis, the control objectives and priorities of the hybrid DFIG and PMSG systems are described first time during severe asymmetrical fault, respectively. In addition, the current allocation principles of each control unit in the DFIG and PMSG systems are investigated in detail according to the converter capacity and the system operation conditions. Furthermore, a coordinated control strategy for the hybrid wind farm is proposed. This strategy make full use of each wind farm's current capability, both the operation performance of the entire hybrid wind farm and the voltage quality of the power grid was greatly improved collectively. Finally, the correctness of the theoretical analysis and the effectiveness of the proposed control strategy for the hybrid wind farm with DFIG and PMSG are validated by the simulation and experimental results.

Keywords: Wind power generation, hybrid wind farm, asymmetrical grid fault, coordinated control, current allocation principle

Nomenclature

$\boldsymbol{u}$, $\boldsymbol{i}$	Voltage and current vectors.
P, Q	Active and reactive power.
U_{dc}	Common dc-link voltage.
E_r	Rotor induced electromotive force of DFIG.
U_T	Terminal voltage of wind turbine.
I_N	Rated current of wind turbine.
P_e	Electromagnetic power.
P_X	Active power across the coupling inductor.
ω_W	Rotate speed of wind turbine blade.
ω_e	Synchronous rotate speed.
ω_r	Rotor speed of DFIG.
δ	Voltage unbalance factor.
s	Slip of DFIG.
L_m, L_s, L_r	Mutual, stator and rotor inductance of DFIG.