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Conceptual Design and Performance Evaluation of a 35 kV / 500 A Flux-Coupling-Type SFCL for Protection of a DFIG-Based Wind Farm

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For the flux-coupling-type superconducting fault current limiter (SFCL) which is composed of coupling transformer (CT), superconducting component (SC) and controlled switch, it can be regarded as a typical application of magnet technology. As the flux-coupling-type SFCL offers many technical advantages, such as higher flexibility, better controllability and lower operation loss, this paper conducts its utilization in improving the transient performance of a 15 MW class doubly fed induction generator (DFIG)-based wind farm. In normal condition, the SFCL shows the non-inductive coupling and does not affect the wind farm. In case of a fault, the electromagnetic properties of the SFCL will be changed, and the current-limiting impedance will be activated and connected in series with the main circuit. In light of the wind power parameters, the conceptual design, electromagnetic analysis and performance evaluation of a 35 kV / 500 A class SFCL are carried out. From the results, the CT achieves the maximum magnetic field in the event of that the fault current reaches to its peak value, and the AC loss of the SC is controlled to a lower level. The demonstrated electromagnetic properties of the SFCL meet the requirements, and using the SFCL in the wind farm enables to limit the fault current, compensate the voltage sag and mitigate the power fluctuation. Consequently, the robustness of the DFIG-based wind farm against the short-circuit fault is well enhanced, and the applicability of the conceptual design of the SFCL is verified.

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