Electric Power Components and Systems

Volume 42, 2014, Pages 1727-1742

Contribution to the Fault Diagnosis of a Doubly Fed Induction Generator for a Closed-loop Controlled Wind Turbine System Associated with a Two-level Energy Storage System

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Abstract: In this article, a contribution to the fault diagnosis of adoubly fed induction generator for a closed-loop controlled wind turbinesystem associated with a two-level energy storage system usingan on-line fault diagnostic technique is proposed. This technique isproposed to detect the rotor fault in the doubly fed induction generatorunder non-stationary conditions based on the spectral analysis of statorcurrents of the doubly fed induction generator by an adaptive fastFourier transform algorithm. Furthermore, to prevent system deterioration,a fractional-order controller with a simple design method isused for the control of the whole wind turbine system. The fractionalordercontroller ensures that the system is stable in both healthy andfaulty conditions. Additionally, to improve the production capacityunder wind speed fluctuations and grid demand changes, a two-levelenergy storage system consisting of a supercapacitor bank and leadacidbatteries is proposed. The obtained simulation results show thatthe objectives of the fault diagnosis procedure and control strategyare reached.

Keywords : Wind energy conversion systems, adaptive Fast Fourier transform, doubly fed induction generator, fault detection and diagnosis, fractional-order control, two-level energy storage system