Harmonic Mitigation, Maximum Power Point Tracking, and Dynamic Performance of Variable-speed Grid-connected Wind Turbine

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Abstract:

This article presents a method for harmonic mitigation and maximum power point tracking for a variable-speed grid-connected 20-kW wind turbine. The wind energy conversion system consists of a permanentmagnet synchronous generator driven by variable-speed 20-kW wind turbine. The output of the permanent magnet synchronous generator is connected to a single-switch three-phase boost rectifier to generate DC voltage, which feeds a current-controlled inverter to interface the system with the electric utility. The single-switch three-phase boost rectifier is an active power factor correction technique to maintain the power factor at the permanent magnet synchronous generator side to nearly unity and mitigate the permanent mag- net synchronous generator current harmonics. To mitigate inverter output current and voltage harmonics, an LCL filter has been used. A complete analysis of the harmonic content has been done everywhere in the system. The results show that the proposed maximum power point tracking control strategy succeeded to track the maximum wind power irrespective of the wind speed. This strategy in presence of an LCL filter achieved harmonic mitigation at the permanent magnet synchronous generator and inverter output sides. The dynamic response of the wind energy con- version system is tested under a three-phase fault condition. For comparison pur- poses, an active power filter is designed and checked against the single-switch three-phase boost rectifier for harmonic mitigation at the permanent magnet synchronous generator side.

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