Control and Stability Improvement of Combined Wind-battery System with a Permanent Magnet Synchronous Generator Supplying Active Load

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Extended Abstract

Introduction: This paper deals with the control and stability enhancement of a wind-power generation system feeding active load with constant power characteristic. The under-study system is a combined wind-battery generation system with a permanent magnet synchronous generator (PMSG) supplying active load by using interfaced power electronics converters. The employed active load is indeed an active rectifier behaving like a constant power load (CPL). Since CPLs from the small-signal point of view behave like negative resistances, they result in stability margin reduction and even in system instability at higher load power penetration. In this paper, as the novelty, a control approach was presented which results in system stability at the presence of active loads. In other words, by using the proposed control method, the output impedance of the load-side converter at low frequencies converged to zero; this, in turn, resulted in the improvement of system stability margin under the presence of active loads. At the end, the performance of the study system with active loads was examined by time domain simulations and with/without the proposed control method.

Materials and Methods: The system under study in this paper is a wind power generation system supplying a stand-alone load. The subject of this paper considersthe control and stabiliziation of the study system at the presence of active load with constant power characteristics. In this paper, a control method based on feedback linearzing approach has been implemented to enhance the system stability margin.

Results: The proposed control method successfully stabilizes the system under the high penetration of active load.

Discussion and Conclusion: The employed active load in this study is an active rectifier behaving like a constant power load (CPL). Since CPLs from the small-signal point of view behave like negative resistances, they result in stability margin reduction and even in system instability at higher load power penetration. By using the proposed control method, the output impedance of the load-side converter at low frequencies converges to zero; this, in turn, results in the improvement of system stability margin under the presence of active loads. Simulation results have shown that at the presence of an active load, the load-side converter with the proposed control approach can provide a fixed stable voltage at the dc-side of an active rectifier. On

the other hand, the study system without the proposed control approach is unable to provide the desired voltage at the dc-side of the active rectifier.

Keywords: Wind turbine, combined wind-battery power generation system, active load, stability investigation, load-side converter

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