Dissertation title : The M.Sc. thesis tilted **"Utility Grid Compliance of Distributed Generation Incorporating Variable Speed Wind Turbines"**

Abstract

Wind power generators represent a prominent facility for generating renewable and clean bulk power to utility grids. . Basically, there are many good reasons for using more wind energy on electricity systems. For instance, wind generation is supported by not only being clean and renewable but also having minimal running cost requirements. With the increasing penetration of wind energy into the grid, the influence of wind turbines on the grid power quality has drawn more and more attention. Due to the stochastic nature of wind, power and voltage generated by a wind turbine are more variable than that produced by conventional generators. One of the most important wind-power quality considerations is the effect of voltage fluctuation. The lighting flicker level is generally used to measure voltage fluctuation. Voltage fluctuation disturbs the sensitive electric and electronic equipment. This may lead to a great reduction in the life span of most equipment; flicker has widely been considered as a serious drawback and may limit the maximum amount of wind power generation that can be connected to the grid. Moreover, recent standards and grid codes, for example IEC6100-3-3, require certain limits for voltage fluctuation (flicker emission) of generating units. The main objectives of this thesis are addressing and reducing the challenges obstacle the continuous increase of wind power generation. Higher potential is given to the flicker emission caused by PMSG – based wind turbines and its compliance with grid codes. Furthermore, to get the full benefits of the bulk wind power produced by the interesting PMSG scheme, a Maximum Power Point Tracking (MPPT) strategy has been implemented. The dynamics of the system, comprehensive model of flickermeter and control actions are simulated with detailed model using MATLAB/SIMULINK environment.
Based on the simulation results, PMSG – based wind turbine gives reduced flicker emission when the grid side control scheme is equipped with a voltage regulator loop. Further, the PMSG based wind turbine is capable to achieve MPPT.

Published paper in 2012

1- Title : Ali H. Kasem Alaboudy, Ahmed A. Daoud, Sobhy S. Desouky, and **Ahmed A. Salem,** "Converter Controls and Flicker Study of PMSG-Based Grid Connected Wind Turbines", ***Ain Shams Engineering Journal, Elsiever***, 11 June 2012.

Abstract: Max (150 wards)
With the increased penetration of wind power, the influence of wind turbine generators on the grid power quality stipulates careful investigation and analysis. Direct driven permanent magnet synchronous generator (PMSG) with a back-to-back converter set is one of the promising technologies in wind power generation schemes. In this paper, comprehensive models of wind turbine are used to analyze power and voltage fluctuations. The short time flicker index is used to assess the voltage fluctuation emitted. The control scheme of the grid-side converter is supported with a voltage regulation loop to reduce flicker emission. The effects of grid and site parameters on voltage fluctuation are investigated. Simulation results show that reduced flicker emissions are given when the developed voltage regulation loop is activated. Reasonable values of grid and site parameters contribute in the minimization of voltage fluctuation and flicker emission levels.

2- Title : Ali H. Kasem Alaboudy, Ahmed A. Daoud, Sobhy S. Desouky, and **Ahmed A. Salem** "Minimizing Flicker Emission Caused by Grid Connected PMSG-Based Wind Turbines", ***MEPCON'12 Conf., Alexandria, Egypt***, Dec 2012.

Abstract: Max (150 wards)
The influence of wind turbine generators on the grid power quality stipulates careful investigation and analysis especially with the rapid increased of wind power penetration in power network. Direct driven permanent magnet synchronous generator (PMSG) with a back-to-back converter set is one of the promising technologies in wind power generation schemes. In this paper, comprehensive models of wind turbine are used to analyze power and voltage fluctuations. The short time flicker index is used to assess the voltage fluctuation emitted. The control scheme of the grid-side converter is supported with a voltage regulation loop to reduce flicker emission. The effects of grid and site parameters on voltage fluctuation are investigated. Simulation results show that reduced flicker emissions are given when the developed voltage regulation loop is activated. Reasonable values of grid and site parameters contribute in the minimization of voltage fluctuation and flicker emission levels.