

Addressing the Concerns of Grid Integration of Large Wind Farms

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Abstract

In the past, the total installed wind power capacity was a small fraction of the power system and continuous connection of the wind farm to the grid was not a major concern.

At the present time, wind power enjoys the status of the second fastest growing generation source for power grid application – second only to natural gas. The total wind power installation in the US stood at more than 21,000 MW at the end of 2008, having doubled the wind power capacity in just two years. With this increasing share of electrical energy derived from wind power, connection of wind farms to the system has come under scrutiny particularly under system disturbances. Maintaining system stability and efficient fault ride through capability are the basic requirements for higher penetration. Wind turbines have to be able to continue uninterrupted operation under transient voltage conditions to be in accordance with the grid codes. Grid codes are certain standards set by regulating agencies. Wind power systems should meet these requirements for interconnection to the grid.

Two of the major issues concerning a wind farm interconnection to a power grid are related to its contribution to frequency and voltage stability. Low voltage problems occur in a power system that is not able to meet the reactive power demand during heavy loading conditions and also during certain faults. Frequency problems occur when adequate regulating capacity is not available to withstand the variable nature of the wind resource. This paper investigates the possibility of enabling wind farms to provide both voltage and frequency support for the purpose of stabilizing the grid voltage and frequency after a load change or a grid disturbance. This enhanced operation requires the use of power electronic converters and specialized controllers that include pitch angle and rotor speed control. An inertia controller, a pitch angle controller and a rotor speed controller (RSC) are introduced for wind plant output active power adjustment for frequency control. A static synchronous compensator is used at the wind collector bus for voltage control. The controllers are tested in a 4-bus test system for verification of the grid frequency and voltage performance under varying system dynamic conditions.