

# Power Quality Issues

Deepak P. Kadam

Department of Electrical Engineering  
BKC-MET- Institute of Engineering Nashik, India  
Savitribai Phule Pune University, Maharashtra.  
dpkadam@gmail.com

**Abstract**—Increasing size of wind farm connected to grid will lead to various challenges such as power quality and reactive power control during normal operation and fault ride through capability during fault conditions. Considering the challenges to be faced related to interfacing of large wind farms using Induction generators, it is necessary to study the various power quality, stability and reactive power requirement of large-scale wind farm connected to grid and provide cost effective solution for management of power quality and reactive power. Power quality problems such as voltage sag, swell, under voltage, over voltage along with rotor stability issues are some major concern. In this paper all issues are analysed. Wind turbine connected to squirrel cage induction generator is modelled using PSCAD simulation software to analyse the said issues where STATCOM is introduced as an active voltage and reactive power supporter to increase the power system stability. STATCOM unit is developed to inject reactive power for mitigation of power quality problems and to get stable grid operation.

**Index Terms**—Squirrel Cage Induction Generator (SCIG), PSCAD, Static Synchronous Compensator (STATCOM), Power Quality issues, Reactive power Management, Wind Turbine Generator (WTG).

## I. INTRODUCTION

Wind power is currently the fastest growing energy source in the world [1], and has several distinct advantages: it causes almost no greenhouse gas emissions, yields the most electricity per megawatt (MW) of RE technologies and uses the least amount of land. However, despite such arguments in favour of wind energy, its success depends largely on its efficient and economical integration into the main power generation mix. Moreover, the operational wind farms may bring voltage stability problem since the main factor causing voltage instability is the deficiency of reactive power in the system [2]. Therefore, it is necessary to provide reactive power locally, and as close as possible to the demand levels. If the network is weak this situation will cause a voltage collapse to occur in the transmission system. The process can be dynamically supported by a STATCOM to improve voltage stability and to improve recovery from network faults and mitigate voltage flicker [3].

Reduction of voltage quality due to the connection of wind generators may impose limits to the connection of large wind parks in a given part of the electrical network. The approach used to evaluate about the feasibility of such connection involves three steps, according to IEC Electromagnetic compatibility standards, IEC 61000-3-6 and 3-7 [4]-[5]. Issue

related to fixed speed wind turbine equipped with squirrel cage induction generators is the fault ride through capability. When connected to a weak power grid and during a grid fault, the over speeding of the wind turbines can cause voltage instability. As a result, utilities typically disconnect the wind turbines immediately from the grid when such a contingency occurs. With the rapid increase in penetration of wind power in power grids, tripping of many turbines in a large wind farm during grid faults may begin to influence the overall power system stability [6].

Today India is a major player in the global wind energy and as compared to develop countries Indian grid system is very weak also having poor infrastructure. Considering the increasing share of wind generation interfaced to grid it is necessary to study an overall prospective on various types of existing wind generator systems and possible generator configuration, critical power quality issues, problems related with grid connections [7]. Use of more intelligent controller for STATCOM and its interface to large power systems addressing various issues such as security, stability, and voltage profile improvement and power quality [8]. It was found that STATCOM considerably improves the stability during and after disturbances especially when network is weak [9]. FACTS devices provide an effective means of dynamic voltage control of wind farm, dynamic power control of the transmission lines, improving power oscillations damping and transient stability [10]. In weak rural networks, where circuit impedance can be high, the voltage can be depressed by the reactive power drawn by the wind farm. In particular, when the real power produced by an induction generator exceeds its rated value, there is the possibility of voltage instability as large amounts of reactive power are absorbed [11]. The use of STATCOM shall be considered for stability improvement as well as improvement of power quality taking considering techno economic aspects [12].

In this paper a wind turbine fed squirrel cage induction generator is modelled using PSCAD and different power quality issues like short duration variations (voltage sag, swell), long duration variation (under voltage, over voltage) reactive power issues are analysed. The STATCOM used as a device for mitigate these problems and simulation results prove that STATCOM is an effective means to mitigate these problems during continuous operation of grid connected wind turbines.