

# Case study of power quality survey in wind farms

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## Abstract

Wind power generation is increasing rapidly in India and wind integration with the grid is considered as a promising source of energy, Double Fed Induction Generator (DFIG) being the most commonly used wind turbine generator, when integrated with the grid show challenges during grid faults. This paper focuses on the challenges faced by DFIG during the occurrence of voltage sags and the Low Voltage Ride through (LVRT) methods to overcome it. The crowbar protection method is used to ride through voltage sags and FACTS device STATCOM is used to quickly sense the voltage sag and overcome it. Furthermore, simulation has done using MATLAB/SIMULINK; analysis of the performance of combined crowbar protection and STATCOM on DFIG during voltage sags. The results show that crowbar protection method is a reliable method to ride through the fault and STATCOM helps to sense and overcome voltage sags quickly. Moreover, the grid code requirements are met, the utilisation of renewable energy resources like the wind, solar, biomass, etc., are increasing to meet the energy demand and to have sustainable growth. In sustainable energy system, energy conservation and the use of renewable energy resource are the key paradigm. The need to integrate the renewable energy like wind energy into the power system is to reduce the environment impact produced due to the conventional plant and to meet the required energy demands. However, the integration of wind energy into the existing power system presents technical challenges like voltage regulation, stability, power quality problems. The issue of power quality is of great importance to wind turbine. Thus, power system operators have created grid codes which determine how WT's should operate during grid disturbances.

## Introduction

The aim of electrical grid is to provide and deliver to the consumer's electric energy of outlined parameters, wherever the most quantities describing the electrical energy square measure the voltage and frequency. Throughout traditional operation of system the frequency varies as a results of the variation of the \$64000 power generated and absorb. At an equivalent time, as a result of voltage drops within the transmission lines and transformers it's not possible to stay the voltage at the nominal level altogether the nodes of the ability system. it's additionally not possible to stay a perfect curved form of the voltage or current wave form because of the nonlinearities in several devices use for electrical energy generation, transmission and at finish users. that's why the electrical grid need to stay the quantities close to the value. Recently, the deregulated electricity market has additionally opened the door for patrons own distributed generation because of economic and technical profit. The liberalisation of the grid ends up in new management structures, within which the commercialism of energy is very important. the requirement to integrate the renewable energy like wind energy into grid is to reduce the environmental impact on typical plant of generation. the traditional plant uses fossil fuels like coal & oil product to run the steam turbines and generate the thermal power. The fuel consumption has associate degree adverse result on the atmosphere and it's necessary to reduce the polluting and exhausting fuel. The flowing of renewable energy particularly wind has been increasing quick throughout the past few years and it's expected to rise additional in close to future. Several countries round the world square measure probably to expertise similar penetration level. Throughout the last decade of the 20th century, worldwide wind energy capability is doubled some each 3 years.

The essential power quality problems associated with assimilation of wind farms are known by team of Riso National Laboratory and Danish Utility analysis Institute, Scandinavian country and Electronic analysis and Development Centre, Republic of India in November.1998 .The power quality in reference to a turbine describe the electrical conduct of wind energy generating system. It reflects the generation of grid interference and therefore the influence of a turbine on power and voltage quality of grid. the difficulty of power quality is of nice importance to the wind turbines. There has been an in depth growth and fast development within the exploitation of wind energy in recent years [6]-[7]. The individual units are often of enormous capability up to five MW, feeding into distribution network, significantly with customers connected in shut proximity. But with apace varied voltage fluctuations because of the character of wind, it's tough to enhance the ability quality with easy compensator. Advance reactive power compensators with quick management and power electronic have emerged to follow the traditional reactive compensator

It has been urged that today's industrial development square measure connected with generalized use of computers, adjustable speed drives and different electronics hundreds. It additionally becomes associate degree increasing concern with power quality to the tip client. The presence of harmonic and reactive power within the grid is harmful; as a result of it'll cause further power losses and malfunction of grid element. the huge penetration of electronically controlled devices and equipment's in low voltage distribution network is accountable for more worsening of power-quality downside

The problems square measure associated with the load instrumentation and devices utilized in electrical energy generation. Currently a days the transmission and distribution system become additional sensitive to power quality variation than those utilized in the past. several new devices contain chip based mostly controls and physics power components that square measure sensitive to several sorts of

disturbances. The turbine generating systems square measure the extremely variable supplies of energy and turbine square measure happiness to the source of such downside.

The wind generation within the electrical grid system affects the voltage quality. To assess this result, the information of regarding the electrical characteristic of turbine is required. The electrical characteristics of turbine square measure manufacturer's specification and not website specification. This suggests that by having the particular parameter values for a selected turbine the expected impact of the turbine on voltage quality is very important. The requirement for consistent and replicable documentation of the ability quality characteristics of wind turbines, the International Electro-technical Commission (IEC) started work to facilitate for power quality in 1996. As a result, IEC 61400-21 was developed and these days most wind turbines makers give power quality characteristic information consequently. Wind turbines and their power quality are certified on the idea of measurements in step with national or international tips. These certifications square measure a very important basis for utilities to judge the grid affiliation of wind turbines and wind farms.

The power quality is outlined as set of parameters process the properties of the ability provide as delivered to user in traditional operative condition in terms of continuity of provide and characteristics of voltage, frequency.

With the advancement in quick switch power devices there's a trend for power provide size reduction. The present harmonics because of switch converters makes provide current distorted. The rise of electronic controllers in drives, furnaces, ménage equipment's and SMPS square measure increasing the harmonic content and reactive power in electrical provide. The distribution transformers aside from reactive hundreds draw reactive current from the provision to satisfy the magnetizing current. The ever-increasing demand for power isn't consummated by increase in generation and significantly in distribution for varied reasons like environmental problems, increasing price of

natural fuel, opposition to atomic power plants, etc. This puts excessive burden on the electrical provides leading to poor power quality. The term power quality here refers to the variation in provide voltage, current and frequency. The excessive load demand tries to retard the turbines at generation plant. This ends up in reduction in voltage and additional severely reduction within the provide frequency. The authority's square measure operating for power quality improvement by victimisation reactive compensators and active filters on provide aspect and penalizing shoppers for polluting the ability grid.