SCIG In Wind Farm System

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Abstract- *Large number of wind turbines are being installed and connected to power systems. In some of the countries the penetration of wind power is significant high so as to affect the power quality, system operation and control and power system stability. This paper studies the dynamic behaviour of system parameters with wind variation and three phases to ground fault condition in the wind farm having SCIG as wind turbine generator (WTG). The results were obtained from simulation in PSCAD/EMTDC environment.*

Keywords- Squirrel Cage Induction Generator (SCIG), PSCAD, Wind Turbine Generator (WTG)

I. INTRODUCTION

With the development of wind turbine technology, large scale wind farms of hundreds of MW level being developed in many countries. These modern wind farms are usually connected to the power grid. The global annual installation capacity is increased with the rate of 30 % in recent years (1). One of the major concerns related to high level wind power penetration is the impact on power system stability.

A. Wind Variation

Grid connected wind turbines often produce active power with significant fluctuations due to wind speed variations, the wind gradient and the tower shadow effect. The output power variations can cause fluctuations of the voltage (also called flicker, which is a measure of voltage fluctuations) at the connection point. Because of the power quality requirements from the utilities, flicker emission may become a major limiting factor for integrating wind turbines, especially the fixed-speed wind turbines (FSWTs), into weak power grids where the wind power penetration levels are high (2).

B. Fault Condition

Another important issue related to the FSWTs equipped with squirrel-cage induction generators (SCIGs) is the fault ride-through (FRT) 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 wind turbines in a large wind farm during grid faults may begin to influence the overall power system stability (2).

II. SQUIRREL CAGE INDUCTION GENERATOR

Although there is a growing interest in the usage of doubly fed induction generators, squirrel-cage rotor type induction generators are still in use due to their simplicity, robustness, low cost and low maintenance, which can be very advantageous for small and medium size wind farms Moreover, in Europe there are large wind power plants composed by squirrel-cage rotor (3).

A Squirrel cage induction generator may be directly connected to grid. The frequency of grid determines the air gap flux speed ωs, the synchronous speed. The rotor speed ωr of induction machine is made slightly higher synchronous speed to operate the machine as induction generator. The features SCIG driven wind farms are simple, cheap and no synchronization required.

The SCIG in this WTG concept can only operate within a narrow range of the rotational speed slightly above the synchronous speed. Because of these very small rotational speed variations, this type of WTG is considered to operate at fixed speed.

Grid connected wind turbine generator based on SCIG gave the following results for active power (P), reactive power requirement (Q) and reactive power supplied by grid (O) when simulated using PSCAD/EMTDC environment. Simulated results are obtained for mean wind speed (*Wms*) variations.