ABSTRACT

Doubly fed induction generator (DFIG) is now the most used type of generator in wind energy system due to its main advantage of controllability of active as well as reactive power. The thesis presents a detail study for the steady-state performance and transient performance of DFIG driven by wind turbine.

A simple algorithm is presented to determine the steady-state values of the rotor active and reactive current components in order to follow a predefined tracking characteristic at a reference power factor. The P-Q capability chart of the DFIG considering a predefined tracking characteristic is deduced which consider the operation limit of the wind power generation system.

A mathematical model of the system including turbines, drive train, generator and grid system is presented and used to deduce the performance of the system under normal and abnormal operating conditions. Random variation of wind speed, grid voltage sag and sudden three phase short circuit in the grid are considered.

In order to simplify the study of the impact of a wind farm on the power system, the behavior of wind farm at the point of common coupling with the grid is represented by an equivalent model derived from the aggregation of wind turbines in the farm. A new equivalent model of wind farm is presented in this thesis. The presented model can be applied in the practical case which involve aggregated wind turbines receive different winds. The errors in the calculation of active power and reactive power delivered to the grid at the point of common coupling are deduced by considering a

simple wind farm. Much reduced errors are observed by using the presented model comparing to the error if average wind speed is used.

A case study of Zafarana has been studied and optimal capacitor placement has been proposed using (ETAP) program, also the effect of using synchronous generator has been investigated.