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Dynamic Voltage Stability of an Electric Power Network with Double Fed Induction Wind Power Generators

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Abstract. In recent years, the large penetration of wind power poses new challenges for the voltage stability analysis of an electric power network. In this paper is studied the effect of large scale integration of wind power in the dynamic voltage stability of a power network under a fault condition. The automatic voltage regulators of the generating units, the turbine speed governors and the double fed induction generator were modeled. Different load models were used and the under load tap changers were also taken into account. The simulation results were obtained using the EUROSTAG software package. Finally, some conclusions that provide a better understanding of the dynamic voltage stability in a system with a large amount of wind power generation are pointed out.

Key words

Double fed induction generator, Electric power network, Voltage stability, Wind farm, Wind generator.

1. Introduction

In the past, the wind power generation was only of a few kW and mostly connected to the distribution networks. The operational security rule was to disconnect the wind farms as fast as possible when a disturbance occurred, in particular short-circuits.

Currently, wind farms produce a large amount of power and is no longer possible to disconnect them from the grid due to voltage dips caused by short-circuits. Turn off a modern wind farm of hundreds or even thousands of MW might seriously endanger the security and stability of the entire power network and has very important economic and social consequences. Moreover, the new grid codes specify that wind farms should contribute to the power system control as much as the conventional power stations.

Nowadays, Portugal has installed a capacity of 3571 MW of wind power, what means, near 22% of the total installed capacity. Integrating large-scale wind power into an electric power network has a great impact on the voltage stability of the system, in particular, when a large amount of wind power generation is tripped due to a fault [1]. To ensure the electric power system stability it is required that the wind power generators have a great capability to withstand voltage dips. This can be accomplished by the implementation of the Fault Ride Through Capacity (FRTC) function [2], [3].

2. Double Fed Induction Generator

The Double Fed Induction Generator (DFIG) is an induction generator where the rotor windings are not short circuited, and are connected through a back to back power electronics converter to the machine terminals or, in other words, to the network [4]. As it is shown in fig.1, the converter controls the rotor speed and the reactive power injected on the network.

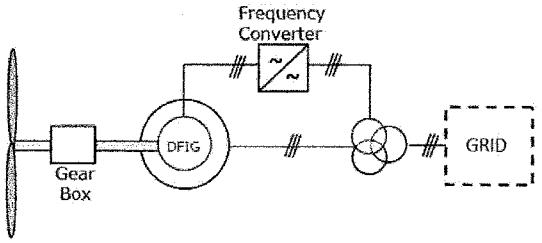

Fig. 1. Wind Turbine with DFIG.

The behavior of the machine in case of voltage dips and system short-circuits depends on its design. The more simple ones are disconnected from the grid and resynchronized later on, at a predetermined speed, for instance the synchronous speed. In this case, the