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Coordinated reactive power compensation strategy for doubly-fed induction generation wind turbines

Kamila Nieradzinska[1,*], David Campos-Gaona[1], Olimpo Anaya-Lara[1], Douglas Bertram[2], William Leithead[1]

[1]Department of Electronic & Electrical Engineering, [2]Department of Civil &Environmental Engineering University of Strathclyde, Glasgow, UK; [*]corresponding author email: kamila.nieradzinska@strath.ac.uk

Abstract

Wind energy sector has gained the highest attention among all other renewable energy resources. The UK government has a target of 15% of its energy to be produced from renewable sources [1]. In 2016 wind energy contributed up to 10% to the UK's total electricity supply [2].

Over the last 30 years wind technology has improved, and various wind turbine concepts and generators have been developed and enhanced. The increasing use of wind energy in the UK grid imposed the requirements for wind farms to comply with current Grid Codes as conventional power plants and contribute to the network support and operation. The future of the large scale wind farms may lay offshore and comprehensive studies in terms of controllability and reliability are required [3, 4].

Nowadays the leading generator technologies in large wind turbine development are the double-fed induction generators (DFIG) and the fully rated converter (FRC) [5]. From the controlled development point of view, both technologies share the same mechanical system dynamics, and similar controllers can be applied to each technology to attain control over the speed of the turbine. However, during AC faults, the dynamics of each wind turbine technology are different due to the distinct fault response nature of each machine as well as the different type of power conversion interface to the ac grid.

During a fault condition the power electronics of the DFIG wind turbine are disconnected in order to protect partially-rated converter and control over the machine is lost. The DFIG also acts as an induction generator and consumes reactive power which does not comply with fault ride through capabilities.

This work analyses the behavior of the DFIG and FRC under voltage dip. The two technologies are combined into a hybrid wind plant and a control method is proposed to support DFIG wind turbine during voltage dip by providing reactive power via FRC wind turbine. Fig. **1** shows simplified power system configuration of hybrid wind farm.

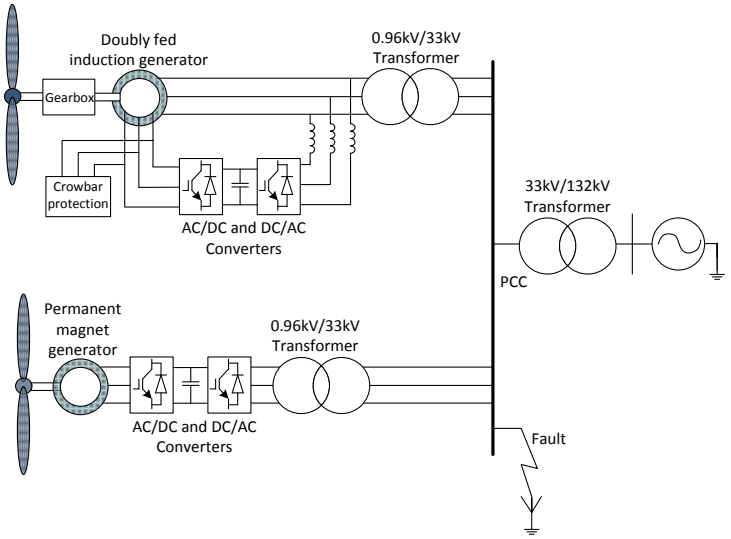

Fig. 1. Schematic of a hybrid wind farm system.

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Keywords

hybrid network; reactive power compensation; wind farm; voltage control

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