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RESEARCH ARTICLE

ENHANCEMENT AND IMPROVEMENT OF WIND POWER SYSTEM BY USING SMES AND SFCL

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Abstract: This paper proposes an exhaustive study about the performance analysis of Doubly Fed Induction (DFIG) under abnormal condition. Now a day, majority of power network countenance the problem of over current and grid connectivity issues. SFCL (Superconducting Fault Current Limiter), which have the competence to limit the fault current and protect the equipments from damage. SMES (Superconducting Magnetic Energy Storage) is mainly used to compensate both real and reactive power variations, thus power quality can be enhanced. propose the application of a superconducting fault current limiter to improve the voltage unbalance in a transmission system linked to a Scott transformer. In addition, we analyzed the effects of the proposed method using transient simulations.

Index Terms— Electric railway, superconducting fault current limiter (SFCL), thyristor controlled series capacitor (TCSC), transmission line, voltage unbalance

I. INTRODUCTION

In recent years more attention has been given to induction machines because they are used for low and medium power application. Attractive advantages over conventional generators are lower unit cost, less maintenance and robust construction etc. Doubly-Fed Induction Generators (DFIG) is particularly suitable for isolated operation like hydro and wind developments [1]. Doubly fed induction generators (DFIGs) are currently dominating the renewable energy market. Over the last decades, DFIG-based wind turbines have been most preferred option for the high capacity wind farms because it has the ability to control the active and reactive power exchange within the network. DFIGs have the capability to operate in variable speed regions so we have to achieve a smoothened and twice the power than any other conventional generator will produce. In the development of wind turbine techniques, DFIG is becoming more popular because of its unique characteristics such as high efficiency, low cost and flexible control [2]. Most of the wind turbines face a problem of LVRT. One common LVRT solution is to install a crowbar circuit across the rotor terminals. When the rotor over current is detected, the crowbar circuit short circuits the rotor terminals and isolates the converters from the rotor. And thus Rotor Side Converter triggering is blocked. This provides conservative protection to the rotor circuit and the RSC changes the DFIG to a squirrel cage induction machine, which absorbs reactive power from the grid. As a result dynamic VAR compensators, such as static VAR compensators or static synchronous compensators are sometimes installed at the DFIG terminals to provide reactive power support during a grid fault [3]. Unbalanced grid faults degrade the performance of DFIG-based wind turbines. In fact, if voltage unbalance is not taken into account the stator and rotor currents will be highly unbalanced even with a small unbalanced stator voltage. The unbalanced currents will create unequal heating on stator and rotor windings which will produce a complete change in torque and power pulsations of the generator which is twice the line frequency [4]. Several control approaches have been presented for DFIG systems operating with unbalanced grid faults. The rotor-side system is decomposed in two separate models which are represented with positive and negative-sequence components respectively. Two parallel controllers which are expressed in the positive and negative-synchronous reference frame are also presented. The goal of the positive-sequence controller is to regulate the rotor side converter as in the case of normal operating conditions

II. DFIG BASED WIND POWER GENERATION

The majority of wind turbines are equipped with Doubly Fed Induction Generators (DFIGs). The wound rotor induction generator has stator which is directly connected to the grid and rotor mains are done by a Variable Frequency AC/DC/AC Converter (VFC). This has the ability to handle a fraction (25%-30%) of the total power to achieve full control of the generator. The Variable Frequency Controller consists of a Rotor side Converter (RSC) and a Grid-Side Converter (GSC) connected back-to-back by a dc-link capacitor in order to meet power factor requirement (e.g. −0.95 to 0.95) at the point of connection.

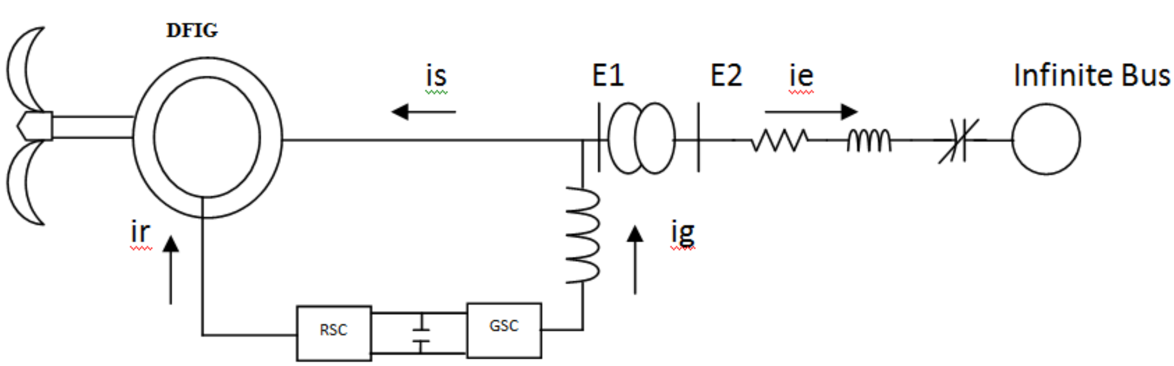


Figure 1. Wind turbine model

2.1. Controller Circuit of Rotor Side Converter (RSC)

The Rotor-Side Converter (RSC) applies the voltage to the rotor windings of the Doubly-Fed Induction Generator. The purpose of the rotor-side converter is to control the rotor currents such that the rotor flux position is optimally oriented with respect to the stator flux in order that the desired torque is developed at the shaft of the machine. The rotor-side converter uses a torque controller to regulate the wind turbine power output and measured the voltage or reactive power at the machine stator terminals. The power is measured in order to follow a pre-defined turbine power-speed characteristic to obtain the maximum power point.

2.2. Controller circuit of Grid-Side Converter (GSC)

The grid-side converter aims to regulate the voltage of the dc capacitor link. Moreover, it is allowed to generate or absorb reactive power for voltage support requirements. The function is realized with two internal control loops as well an outer regulation loop. The reference current measured at the output of voltage regulator is '*icdref*' for the current regulator. The inner current regulator loop consists of a current regulator to control the magnitude and phase of the generated voltage of converter. The '*icdref*' is produced by the dc voltage regulator and specified *q*-axis '*icqref*' reference is shown in Figure

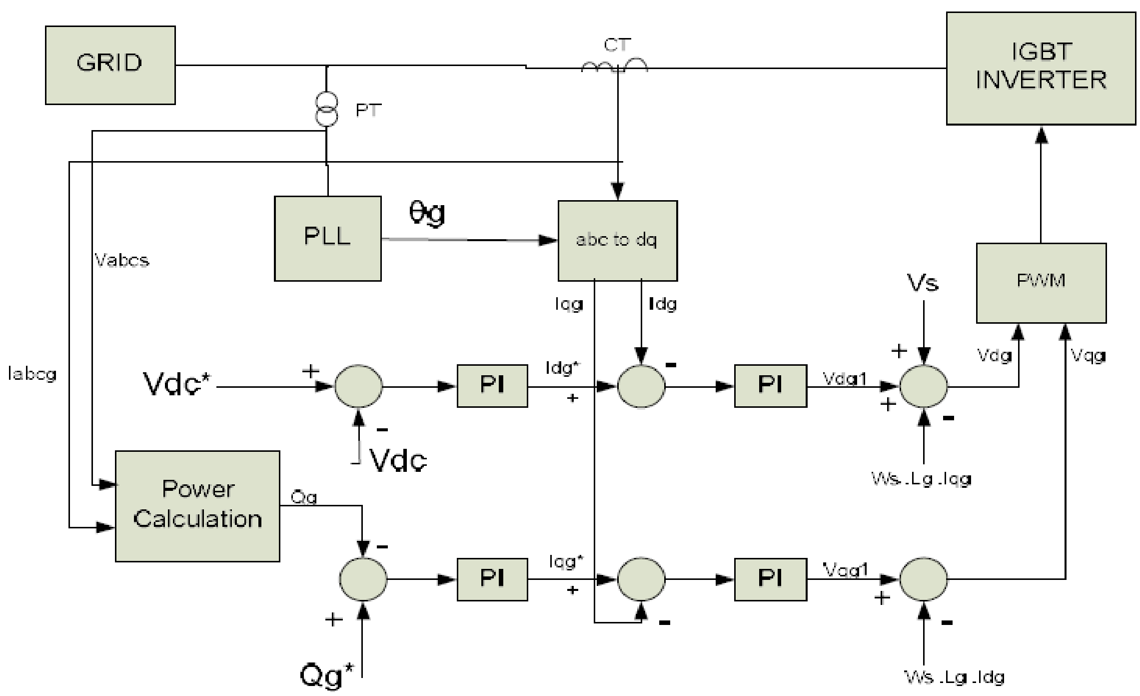


Figure 2. The Grid-Side Converter (GSC)

III. SUPERCONDUCTING FAULT CURRENT LIMITER (SFCL)

SFCLs utilize superconducting materials to limit the current directly or to supply a DC bias current that affects the level of magnetization of a saturable iron core. While many FCL design concepts are being evaluated for commercial use and improvements in superconducting materials over the last 3 years have driven the technology to the forefront. This improvement is due to the ability of HTS materials to operate at temperatures around 70K instead of near 4K which is required by conventional superconductors. The advantage is that the refrigeration overhead associated with operating at the higher temperature is about 20 times less costly than the initial capital cost. SFCLs use the transition of superconductors from zero to finite resistance to limit the fault currents that result from short circuits in electric power systems. Such short circuits can be caused by aged or accidentally damaged insulation by lightning striking an overhead line or by other unforeseen faults. If not deliberately checked, the subsequent fault current is limited only by the impedance of the system between the location of the fault and the power sources.

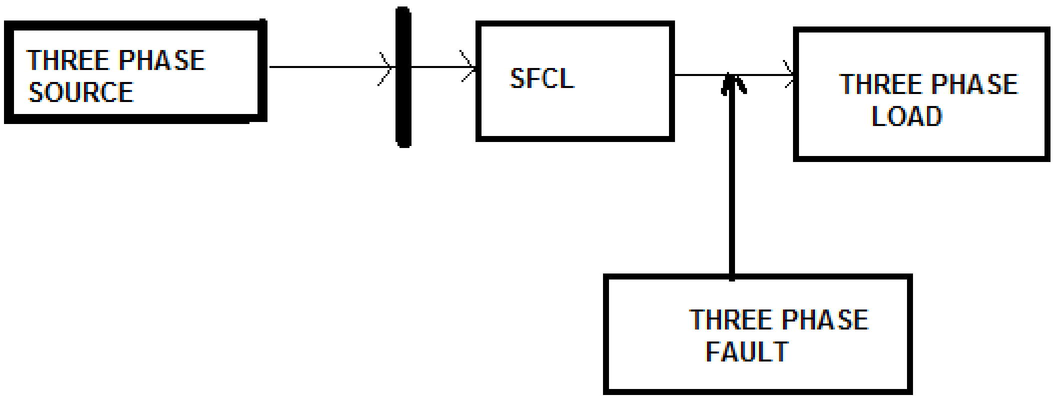


Fig 3.0 Superconducting Fault Current Limiter connected in series transmission line

IV. RESULTS AND DISCUSSSION

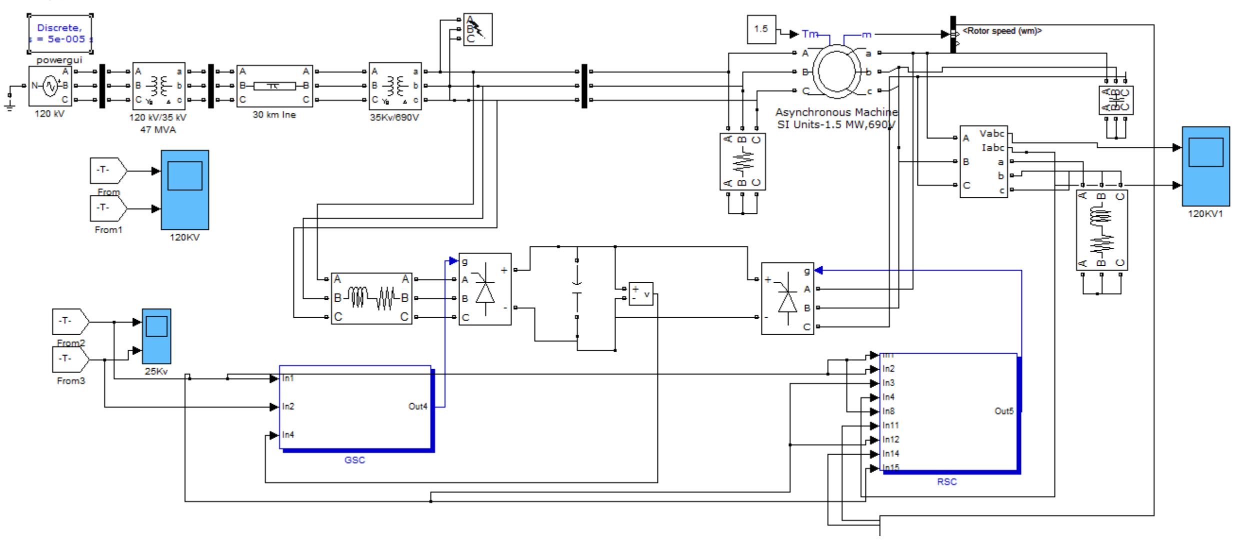
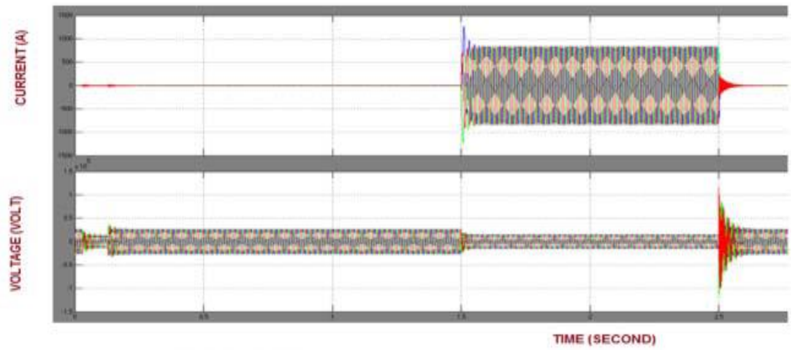
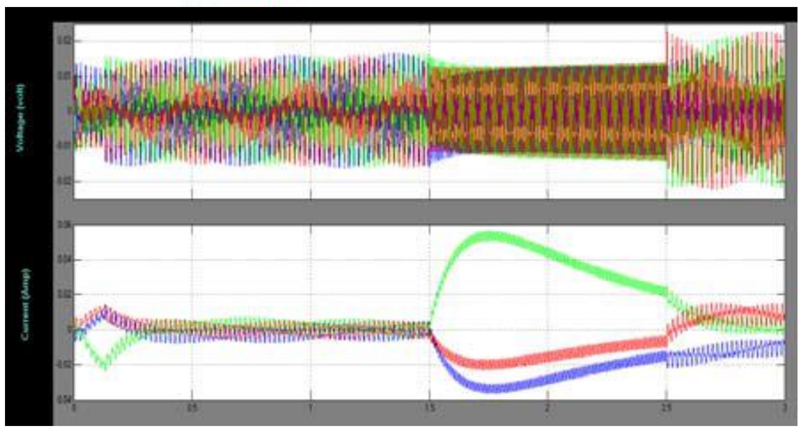


Fig 4.0 Modelling of DFIG based wind power generation under fault

Under Fault Condition



Fault Time:1.5-2.5



V. CONCLUSION

In this paper a new topology has been proposed for grid connection during symmetrical fault condition to enhance the variable speed driven DFIG fed AC-DC-AC system fault ride-through capability. The proposed technology is simulated in MATLAB using powers im toolbox. Simulation results prove that the proposed control strategy is able to provide full ride through to the generator and power system capability can be improved. An SFCL-MES circuit is very intensive to enhance the LVRT capability and smoothed the power output of a DFIG based wind turbine. The SFCL-MES has no influence on the power generation of the DFIG based wind turbine. Co-ordinated operation of SMES with SFCL is used to improve the overall performance.

REFERENCES

[1] M Anju and R Rajasekaran. “Co-Ordination Of SMES With STATCOM For Mitigating SSR And Damping Power System Oscillations In A Series Compensated Wind Power System”. *IEEE 2013 International Conference on Computer Communication and Informatics (ICCCI -2013)*. 2013.
[2] J Morren and SWH de Haan. “Ride through of wind turbines with doubly-fed induction generator during a voltage dip”. *IEEE Transaction. Energy Converters.* 2005; 20(2): 707–710.
[3] L Peng, B Francois, and Y Li. “*Improved crowbar control strategy of DFIG based wind turbines for grid fault ridethrough*”. in Proc. IEEE Appl. Power Electronic. Conf. 2009: 1932–1938.
[4] X Yan, G Venkataramanan, Y Wang, Q Dong, and B Zhang. “Grid-fault tolerant operation of DFIG wind turbine generator using a passive resistance network”. *IEEE Transaction. Power Electron.* 2011; 26(10): 2896– 2905.
[5] C Abbey, W Li, L Owatta, and G Joos. “*Power electronic converter control techniques for improved low voltage ride through performance in WTGs*”. in Proc. IEEE Power Electronics. Spec. Conf. 2006: 1–6.

[6] C Abbey and G Joos, "*Short-term energy storage for wind energy applications*". in Proc. IEEE Ind. Appl. Conf., 2005: 2035–2042.
[7] C Abbey and G Joos. "Supercapacitor energy storage for wind energy applications". *IEEE Transaction. Ind. Appl.* 2007; 43(3): 763–776.
[8] D Xiang, L Ran, P Tavner, and S Yang. "Control of a doubly fed induction generator in a wind turbine during grid fault rid through". *IEEE Trans. Energy Convers.* 2006; 21(3) 652–662.

