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Automatic Wind Turbine Re Generative Braking System

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***Abstract*- This Project proposes a new soft-stalling control strategy for re generative braking. wind turbines operating in the high and very high wind speed conditions. A wind turbine generator regenerative braking system may be used to slow or stop a rotating shaft or wheel, wherein energy may be recovered as electricity generated by a turbine generator and stored in batteries, ultra-capacitors, or other storage systems. And High temperature superconducting wind turbine generators are expected to offer a compact and lightweight direct drive train for large offshore wind turbines.**

***Keywords* – Wind, Regenerative Braking, Magnetic Motor**

I. INTRODUCTION

Most commercial wind turbines operate at fixed speed, with an regenerative rotor driving an induction generator via a gearbox and high-speed shaft. Wind turbine brakes are used to reduce the speed of the regenerative when the wind speed exceeds the design operating envelope, for maintenance or in the event of a fault in the machine.

Wind turbine design standards require two independent brakes which must be capable of reducing the wind turbine to a safe rotational speed in all anticipated wind speeds [l, 2]. Conventional wind turbine brake systems usually combine mechanical shaft brakes and regenerative

The loads imposed by a mechanical shaft brake during a shut down from rated speed frequently determine the design of the gearbox and may have a significant impact on its cost [3]. The maintenance costs of replacing worn brake components may also be an important cost factor over the life of a wind turbine. regenerative brakes, whether tip brakes for a stall-regulated wind turbine or full-span blade control for pitch regulated machines, require complex control mechanisms which are susceptible to failure in extreme conditions

An regenerative brake can be used as part of a wind turbine brake system. Most design standards require one brake on the low-speed shaft and, since the regenerative brake would be on the high-speed side of the gearbox, a low-speed shaft brake, either regenerative or mechanical, would also be required.

Although regenerative braking of induction machines is in common use in industrial applications [4, 5], it has not been adopted by wind turbine designers to any significant degree. The technique has been implemented on a wind farm of small wind turbines in the USA and has been tested at 66kW by one US wind turbine manufacturer [6]. However, this has not yet been developed at large scale and details to enable the design of a brake are not available.

This project discusses the design and implementation of an regenerative brake for a fixed-speed wind turbine with an induction generator. The brake consists of a resistor-capacitor circuit which is switched on to the terminals of the induction generator after disconnection from the network. The induction generator self-excites and the interaction of the rotor and stator currents develops a braking torque which is dissipated in the external circuit resistance. Both single-phase and balanced three-phase brake-circuit configurations were investigated and models were developed for both cases.

Previous work in the field had indicated that a single phase configuration could achieve more effective braking than the equivalent capacitance connected as a three-phase circuit [9]. However, initial laboratory tests confirmed the single-phase model simulation predictions that the magnitude of the torque oscillations induced by a single-phase braking circuit would damage a wind turbine drive train. With a balanced network, a smooth braking torque was obtained, which can be controlled by suitable choice of resistor and capacitor values. Increasing capacitance is required to maintain excitation as the machine speed reduces. This is achieved by connecting additional capacitance in multiple stages over the braking cycle.

One important factor which has prevented the widespread exploitation of regenerative braking for wind turbines is the difficulty in accurately predicting the transient performance of an induction generator under saturated conditions.

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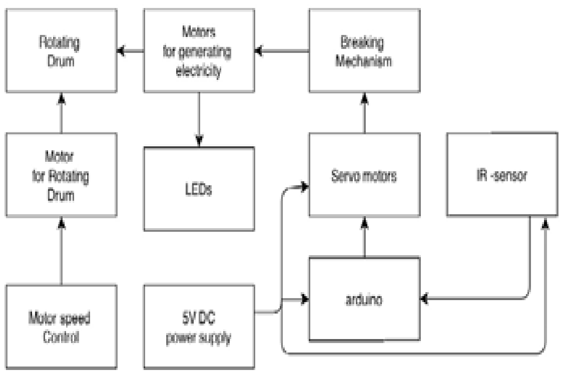
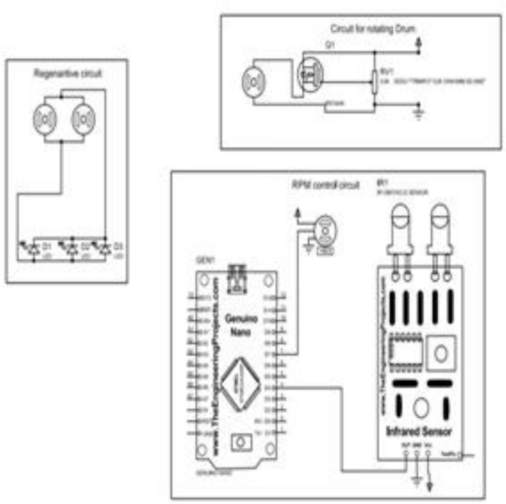
Block Diagram



Circuit Diagram



II. LITERATURE PAPERS

1. Regenerative Braking wind turbine with a Slip Power Recovery System

The paper reports the results of a digital simulation of the regenerative braking of an aero generator with a Darrieus vertical-axis wind turbine and a variable-speed drive. The drive is made up of a wound-rotor asynchronous generator and a slip power recovery system. The variable-speed drive is equipped with direct current and speed regulators in cascade.

A linear decrease in the rotational speed reference value was used to obtain the regenerative braking. As a result, the DC reference value increases as does the electrical torque which brakes the aero generator. However, the slip power recovery system cannot be operated at or near the synchronous speed.

2. Regenerative Operation of Machines for Multi mega watt Wind turbines

Modern windmills and multi mega watt turbines are nearly exclusively equipped with electrical pitch systems. The pitch system itself has to fulfill the following functions In the case of strong wind conditions during normal operation, the system is responsible to limit the generator torque. On the other hand, the feathering position of the blades is needed to brake down the turbine in stop or emergency situations. In modern wind turbines this aero dynamical brake is necessary, because the mechanical brake is designed as a holding brake and is not able to prevent over speed conditions. The last function described is safety relevant. Because of this, pitch systems are equipped with an backup energy storage. So the blade can be put into feathering position in any case. DC-machines are preferred in pitch systems because of their capability to be supplied directly by the DC-storage unit without any control or power electronics.

3. Regenerative Braking System and Anti-Lock Braking System for Under Emergency Braking Conditions

The economy of electrified vehicles can be improved by using the motor to recover the energy released during braking. However, the vehicle's regenerative braking system (RBS) and anti-lock braking system (ABS) are not compatible, so the energy dissipated during braking cannot be recovered under emergency braking conditions.

This paper employs the method of logic threshold control combined with phase plane theory to analyze the relationship between the slip rate and the braking torque during the ABS braking process and to obtain the composition rule of the braking torque required for ABS braking. Based on this rule, a control strategy to coordinate RBS and ABS when triggering ABS is proposed to improve the efficiency of braking energy

III. OVER-SPEED CONTROL INTEGRATION

High rotor speed in the wind turbine can be harmful, as both the turbine and the electronic components can be damaged or destroyed due to mechanical failure or excessive high back-emf voltages.

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A very high wind speed may produce a torque that could not be counteracted by the generator, eventually resulting in an excessive rotor speed. Some type of protection against high wind speeds is therefore mandatory. A method to allow the wind turbine to operate safely with high wind speed is proposed in this section. The protection is integrated along with the MPPT control. It is assumed that neither wind speed sensor nor shaft speed sensor are available.

The rectifier output voltage will be used to indirectly control the turbine speed according to the curves shown in section.

comparative analysis

Sr no	**Para meters**	**Topo Logy1**	**Topo Logt2**	**Topo Logy3**	**Topo Logy4**
1	efficiency	low	low	low	high
2	Friction loss	more	more	Inter mideat	less
3	Power storage	Not possible	Not possible	Not possible	possible
4	Speed control	Im possible	Im possible	Im possible	possible
5	cost	more	more	more	less
6	Regenerativ e braking	Not possible	Not possible	Not possible	possible

IV. CONCLUSION

This paper showed that this modified multilevel inverter topology with reduced number of switches can be implemented for industrial drive applications. This multilevel inverter structure and its basic operations have been analyzed. A detailed procedure for calculating required voltage level on each stage has been analyzed. As conventional five-level inverter involves eight switches, it increases switching losses; cost and circuit complexity. This 5-level inverter engages only eight switches which reduces switching losses, cost and circuit complexity. Moreover it effectively reduces lower order harmonics. Therefore effective reduction of total harmonics distortion is achieved.

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