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The Modeling of a Wind Driven Induction Generator to Provide a DC Small Grid

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Abstract

Isolated renewable energy systems supported Wind sources are thought of as possible and reliable options instead of typical systems in order to satisfy the forthcoming demand and also to produce a distributed generation in places that are diversified from generating source with token losses and high potency this model is intended. It comprises of turbine model in which dynamic behaviour of rotary engine is analysed to scale back the oscillations of drive train when there is speed fluctuations, diode bridge rectifier, buck converter and closed loop circuit to maintain voltage consistency In this project, a straightforward simulation model of turbine for wind speed rangeof8m/s to 10m/s and a circuit model of closed loop is designed and analysed in order to obtain a constant voltage of 120v DC . Finally, theoretical analysis is done to verify the Simulink results

Keywords: DC-Microgrid, induction generators, maximum power point tracking(MPPT) , power converter , wing power generation.

Introduction

Renewable energy is presently wide used. one amongst these resources is wind energy. With a read to satisfy out the continuing and increasing energy demand, several countries have started the method of liberalisation of their electrical systems, gap access to transmission and distribution grids for connecting tiny or medium scale generators. This method driven the event of forming the small grids using Distributed Generators (DGs). These distributed generation systems cut back the energy loss and infrastructure value for transmission systems, since DGs are connected terribly near the load centers. Additionally, renewable energy sources, like wind and star are extensively deployed in distributed generation systems that further assists for the pollution free atmosphere.

It is noted that the electrical output from DGs using renewable energy sources is of variable voltage DC or AC quantities. within the gift day state of affairs majority of the masses, such as, light-emitting diode lighting, pc hundreds and variable speed drives demand DC because the supply. So, to attach differing types of distributed generation systems, a DC bus is often used with appropriate power electronic controllers, that forms DC small grid. Absence of reactive power, less power conversion stages and simple to attach energy storage devices, particularly battery, plug-in electrical vehicles and super capacitors are engaging choices for DC small grid with DGs. magnet Alternators(PMAs) and Self-Excited Induction Generators (SEIGs) are the acceptable decisions for such tiny scale wind generators used in DC small grids. Rugged rotor construction, absence of slip rings, brushes and a separate DC supply for excitation and easy maintenance are the most reasons for preferring induction machines, with renewable energy systems.

Proposed Block Diagram

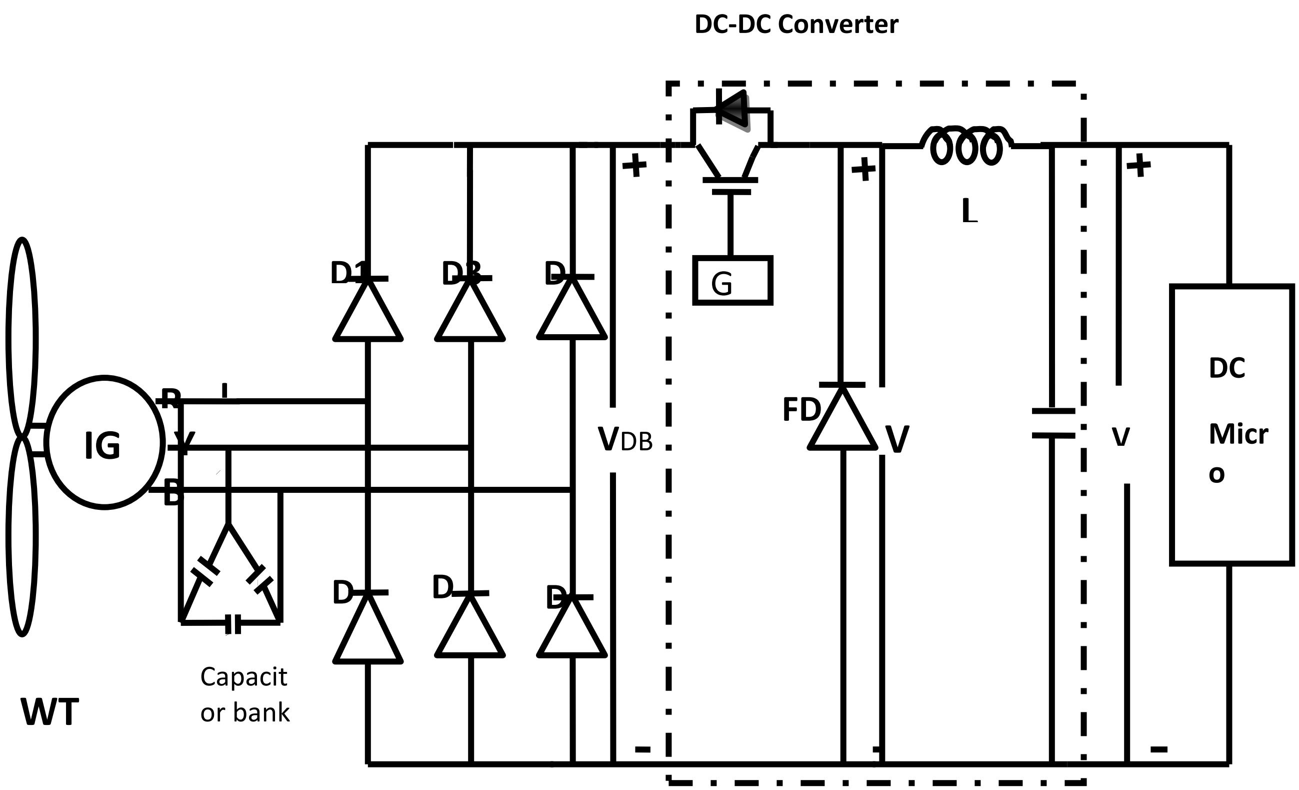

Fig: Schematic diagram of the proposed wind-driven SEIG for DC Microgrid application.

PARTS:

1. Horizontal Wind Turbine
2. Self Excited Induction Generator
3. Diode Bridge Rectifier
4. Buck converter

1. Horizontal Axis Wind Turbines

Horizontal-axis wind turbines (HAWT) have the most axis and electrical generator at the highest of a tower, and should be pointed into or out of the wind. Tiny turbines are pointed by a straightforward vane, whereas giant turbines typically use a wind device as well as a servo motor. Most have a case that turns the slow rotation of the blades into a faster rotation that's a lot of appropriate to drive associate electrical generator.

2. Self-Excited or Isolated Induction Generator

Capacitor bank is connected across the mechanical device terminals of a 3 part induction machine.

This type of induction generator doesn't need associate existing AC offer system for getting its magnetizing reactive power. Within the Self excited induction generator, a electrical condenser bank is connected across the mechanical device terminals.

3. Diode Bridge Rectifiers

In the diode bridge rectifier diodes are organized in 3 legs. every leg has 2 series-connected diodes. higher diodes decilitre, D3, D5 constitute the positive cluster of diodes. The lower diodes D2, D4, D6 type the negative cluster of diodes. This rectifier is additionally known as 3-phase 6-pulse diode rectifier, 3-phase full-wave diode rectifier, or three-phase B-6 diode rectifier. Positive group of diodes conduct once these have the foremost positive anode. Similarly, negative cluster of diodes would conduct if these have the foremost negative anode. In alternative words, diodes D1, D3, D5, forming positive cluster, would conduct once these expertise the best positive voltage. Likewise, diodes D2, D4, D6 would conduct once these are subjected to the foremost negative voltage.

From ωt= 30° to 1500 voltage Vr is a lot of positive than the voltages Vy, Vb. Therefore, diode D1 connected to line R' conducts throughout the interval ωt= 30° to 150°. Likewise, from ωt= 150° to270°, voltage Vy is a lot of positive as compared to Vr, Vb, Therefore, diode D3 connected to line Y conducts throughout this interval. Similarly, diode D5 from the positive cluster conducts from ωt=2700to 3900 then on. Note conjointly that from 00to30°,Vbis the foremost positive, therefore, diode D5 from the positive cluster conducts for this interval. Voltage Vb is the foremost negative from ωt=90 0to 2100 • so, negative cluster diode D2connected to line 'e' conducts throughout this interval. Similarly, diodeD4 conducts from2100 to 3300and diode D6 from 3300to 450 zero then on. Note conjointly that from ωt= 00 to 900 Vy is the most negative, so diode D6 conducts throughout this interval.

4. Buck Converter

Buck Converter is a DC-to-DC power device steps down voltage (while stepping down current) from its input (supply) to its output (load). it's a category of switched-mode power offer (SMPS) containing a minimum of two semiconductors (a diode and a transistor) and a minimum of one energy storage part

Simulink Results

Speed as Input To The Wind Driven Induction Generator

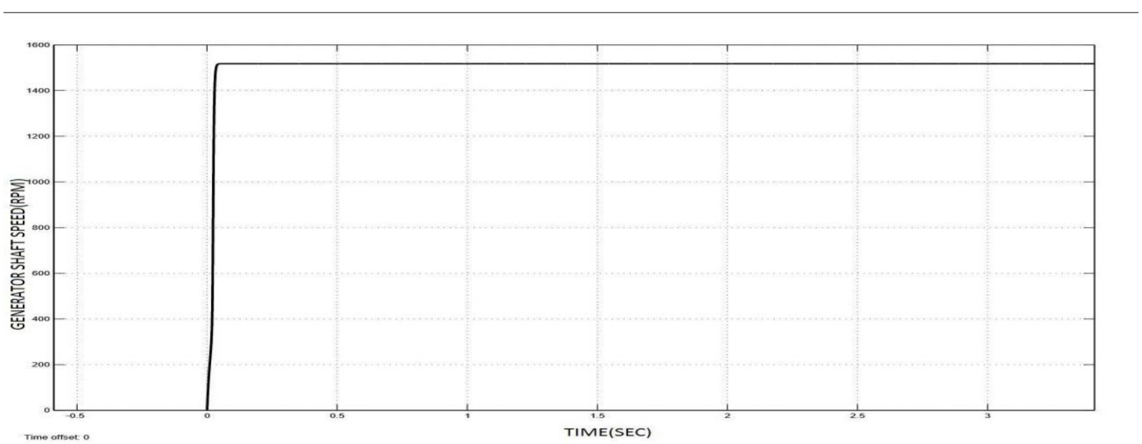

Fig: Current Generated By Wind Driven Induction Generator

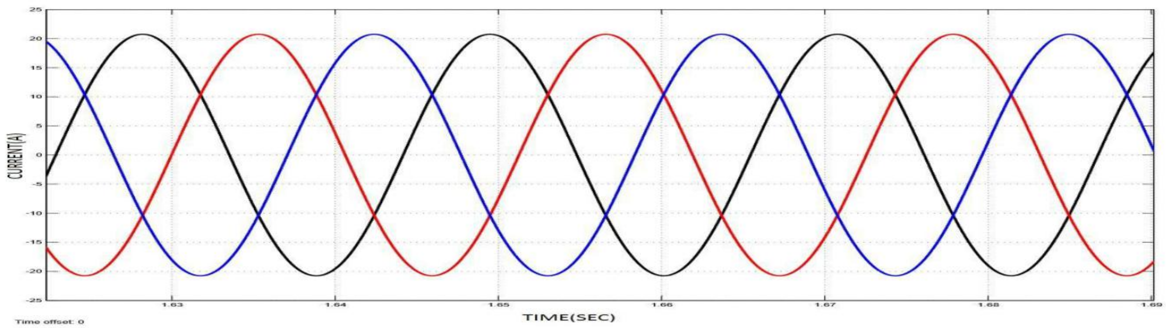

Fig: Voltage Generated By Wind Driven Induction Generator

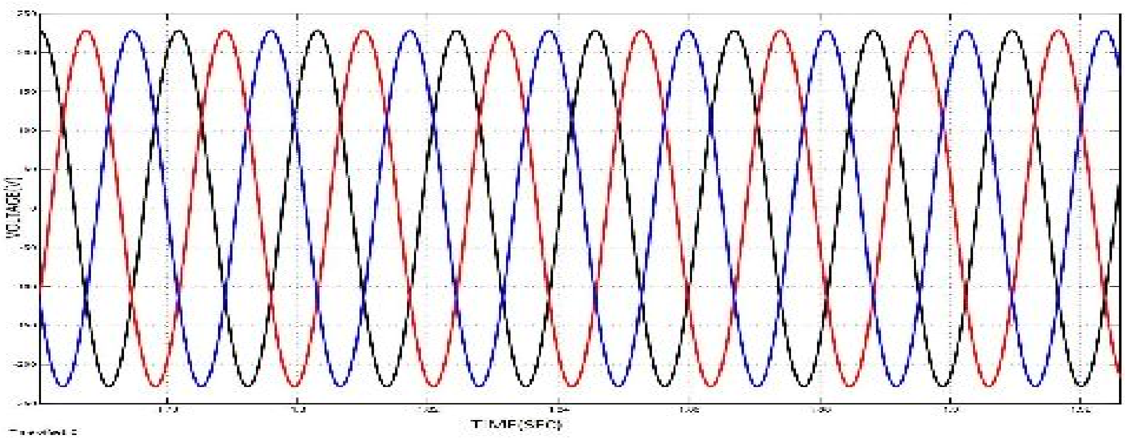

Fig: Power Generated By Wind Driven Induction Generator

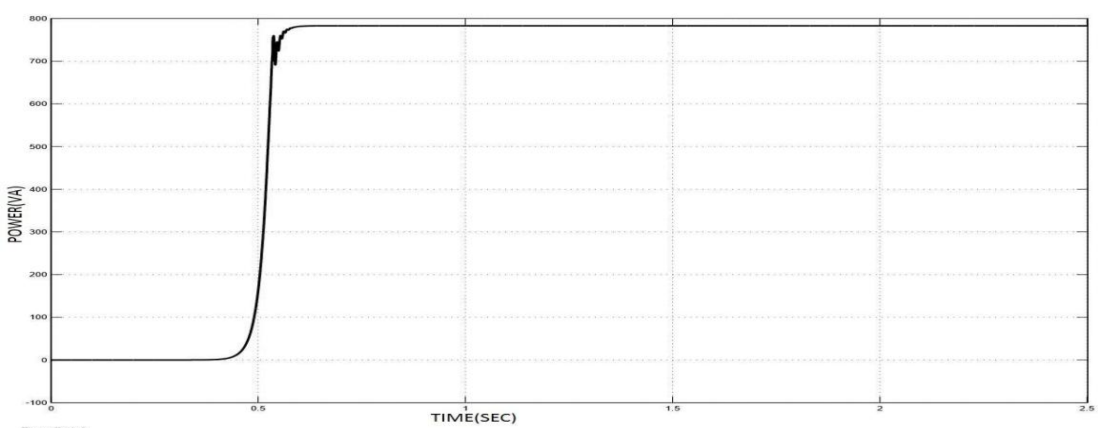

Fig: Voltage Obtained At Uncontrolled Rectifier

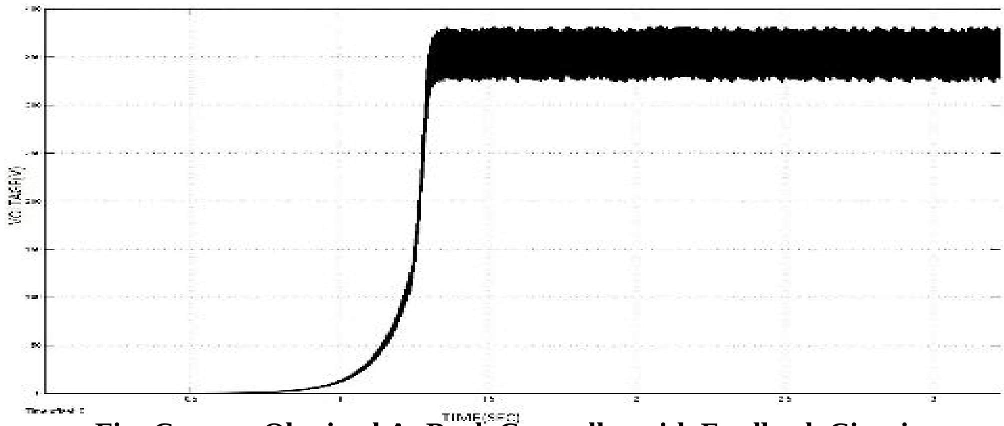

Fig: Current Obtained At Buck Controller with Feedback Circuit

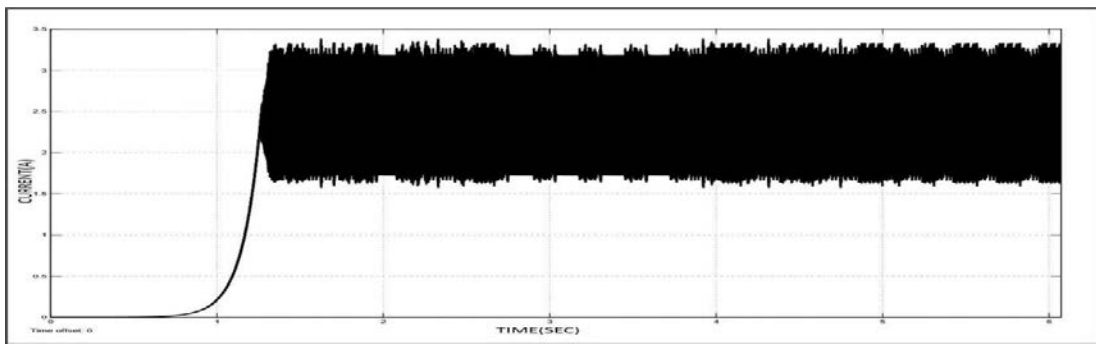

Fig: Voltage Obtained At Buck Controller with Feedback Circuit

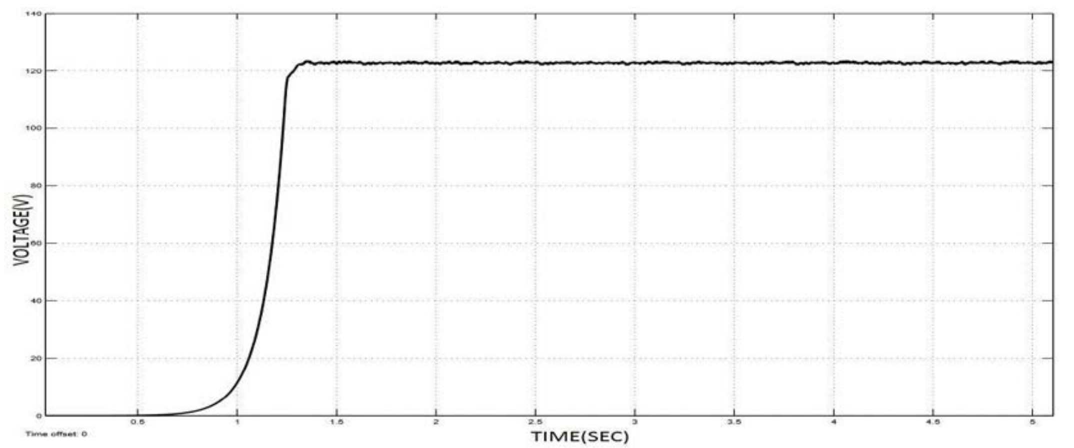

Fig: Duty Cycle Provided To IGBT by Feedback Circuit

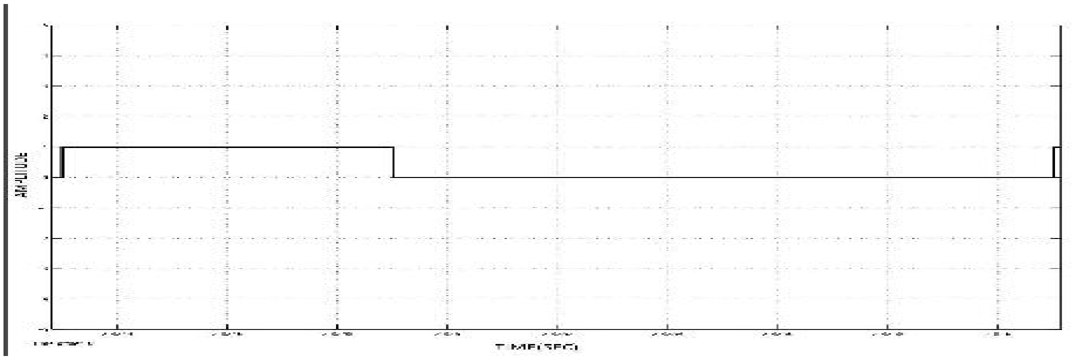

Fig: Duty Cycle Wave Provided To IGBT by Feedback Circuit

Conclusion

Here circuit is designed in such a way so as to obtain constant voltage in order to do this is various components are designed it can be explained as follows: Force of linearly flowing wind is input to wind turbine if the force is sufficient enough to rotate the wind turbine at required speed then self excited induction generator which is coupled to turbine shaft generates AC power as output and capacitor bank will supply the reactive power and also provides residual flux if the generator looses residual magnetism due to ageing or any other factors. This AC power output of induction generator is converted to pulsating DC by Diode bridge Rectifier and DC power which is obtained is very high but we need 120V of dc voltage so the voltage have level has to be reduced this is done by a semiconductor switching device called as buck converter, but we know speed of wind is not constant in order to over come this problem and to maintain constant voltage irrespective of wind speed the output of buck converter is compared with reference voltage of 120V and pulse width of buck converter (duty cycle ratio) is modified to obtain required voltage.

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