 ISBN 978-979-17047-5-5

THE OPTIMIZATION OF POWER CONVERSION FROM WIND ENERGY

Norhana Binti Safee, Ida hariyanti Binti Hassan@Talib, Fadilah Binti Mohamad Najuri
Computer System and Support Engineering Unit,
Kolej Komuniti Jasin,
77300 Merlimau, Melaka
Phone/Fax : +606 2631515 / +606 2631616
Email: a_800831@yahoo.com; ida2712@yahoo.com; hadilaf14@yahoo.com;

Abstract

The electrical power generated by using the power in the wind to drive a wind turbine to produce mechanical power. This mechanical power can be converted into electrical power by using electrical induction generators. Output voltage of the generators is influenced by the changes in the rotor blades load, capacitor or rotor speed of the machine. In this project, computer program have been used to obtain the performance of the generator under different conditions. Matlab has been utilized to get the maximum capacitance required for self-excited induction generator, minimum frequency under variable load resistance, load reactance and speed. Finally resul to show component needed to improve performance wind turbine system. The component is the dynamo. It has a few mechanical properties that are functional for wind turbines. So, the induction dynamo is the most public dynamo in wind power arrangement requests due to its simplicity and ruggedness. The utilized formula to compute the maximum capacitance needed for self-excited induction dynamo is easy and it doesn't demand numerical iteration. For this reason, this formula helps to ascertain the maximum capacitance needed for self-excited induction dynamo on line.

Key word: wind turbine, induction generators, generator, matlab

1. INTRODUCTION

The working principle of wind energy system is a combination of rotor, generator or the alternator, the tower and tail. Wind turbines operate on some simple principles. The energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. Wind turbines are mounted on a tower to capture the most energy. At 100 feet (30 meters) or more above ground, they can take advantage of faster and less turbulent wind. Wind turbines can be used to produce electricity for a single home or building, or they can be connected to an electricity grid for more widespread electricity distribution. Home wind energy systems generally comprise a rotor, a generator or alternator mounted on a frame, a tail (usually), a tower, wiring, and the "balance of system" components: controllers, inverters, and/or batteries. Through the spinning blades, the rotor captures the kinetic energy of the wind and converts it into rotary motion to drive the generator. The project is to study suitable techniques to optimize the power conversion of wind energy.

The advantages of wind energy:

1. Wind energy is fueled by the wind, so it's a clean fuel source. Wind energy doesn't pollute the air like power plants that rely on combustion of fossil fuels, such as coal or natural gas. Wind turbines don't produce atmospheric emissions that cause acid rain or greenhouse gasses.
2. Wind energy relies on the renewable power of the wind, which can't get exhausted or used up. Wind is actually a form of solar energy source. Wind is caused by the heating of the atmosphere by the sun, the rotation of the earth and the earth's surface irregularities.
3. Wind energy is one of the lowest-priced renewable energy technologies available today, costing between 4 and 6 cents per kilowatt-hour, depending upon the wind resource and project financing of the particular project.

2. PROBLEM STATEMENT

As the energy source is limited, this project explores the optimization of power conversion from wind energy. The general maturing of wind power has mounting pressure converter suppliers to offer readily available standardize converters that are prequalified, hence low technical risk, and flexible enough to be used in a range of power ratings.

The objectives of this project are to study the suitable circuitry to optimize the power conversion of wind energy and to produce performance analysis of the circuit studied earlier

3. METHODOLOGY

Induction dynamo has a extensively agreement in employing alongside wind power conversion arrangements for countless reasons. Induction dynamo is extremely easy, extremely rugged, reliable, inexpensive, handy, long lifetime, produces elevated manipulation each fuse mass of materials and needs extremely slight maintenance. All above gains are extremely vital exceptionally in wind power conversion arrangements whereas the dynamo is in the top of the tower whereas the heaviness, maintenance and existence period are extremely vital aspects. Induction dynamo can be utilized alongside stand alone as well as grid related wind power conversion systems. Also, induction dynamo works alongside steady speed steady frequency arrangements as well as variable speed steady frequency systems.[1]

The main drawback of induction dynamo in wind power conversion arrangements requests is its demand for managing reactive manipulation to craft up the terminal voltage and to produce mechanical power. Employing terminal capacitor across dynamo terminals can produce this managing reactive power. The capacitance worth of the terminal capacitor is not steady but it is fluctuating alongside countless arrangement parameters like shaft speed, burden manipulation and its manipulation factor. If the proper worth of capacitance is selected, the dynamo will work in self-excited mode. The capacitance of the excitation capacitor can be modified by countless methods like switching capacitor bank [2], thyristor manipulated activator [3] and thyristor manipulated DC voltage watchdog [4]. In last decade countless researches uses PWM method to furnish the wanted excitation by manipulating the modulation index and the stay slant of the manipulation waveform [5].

4. ANALYSIS

4.1 The equivalent route parameters test

The equivalent route parameters of the squirrel pen induction contraption are computed from terminal measurements of DC, no-load and locked-rotor examination as delineated in the pursuing subsections.[6]

This examination was requested to substitute the parameters utilized in the MATLAB plan of the 1st portion of the graduate undertaking by the others discovered in this examination due to notice the variance amid the hypothetical and useful results.[6]

4.1.1 D.C Test

D.C Voltage is requested across two periods of the contraption and countless readings of the present and voltage are taken. The stator confrontation (RS) is next computed by seizing the hill of the line associating the voltage across the present across the motor winding.[6]

4.1.2 No-Load Test

By using a synchronous motor as a driver of the test motor with speed of 1800 r.p.m. A variable sinusoidal voltage source at 50 Hz, is connected to the stator. Figure 4.1 shows test requirements. In this test, the slip is zero, which means that the branch corresponding to the rotor in the equivalent circuit can be considered as open.[6]

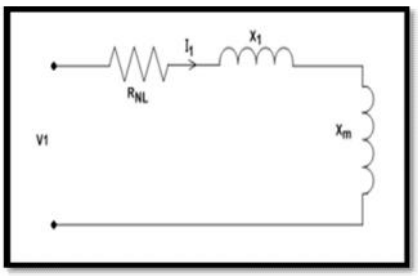

Figure 4.1 The no-load test equivalent circuit

4.1.3 Locked-rotor test

In this examination, the rotor and the stator is related to a low voltage and the equivalent route of this examination is shown in Figure 4.2, from

that we can find the denoted parameters i.e. (Rr and Xr) pursuing the subsequent steps and equations:[6]

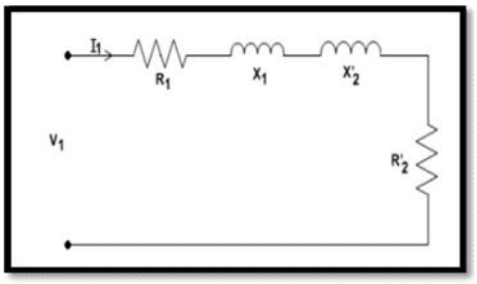

Figure 4.2 The locked-rotor test equivalent circuit

Under rated line voltage, after the rotor of an induction motor is locked, the stator present IS is nearly six periods its rated value. Furthermore, the slip s is equal to one. This way that Rr / s is equal to Rr. This leaves the equivalent route shown in Figure 4.2 lacking the magnetizing branch.[7]

4.2 Min. and Max.Capacitance Needed for Self-Excited Induction dynamo Test

The nodal way was requested on the induction dynamo to attain the min. and max. capacitance needed for the accumulation voltage employing a multimedia plan for computing the needed values.

In useful, the examination has been completed in the lab to find the higher and lower worth of the capacitor that the accumulation voltage appears and make a analogy amid the hypothetical and useful results.[6]

In fact, the merely setback discovering the maximum worth of the capacitor in the lab, is that the induction motor reaches its rated present worth lacking a voltage downfall happens, so to deal alongside this setback, the capacitance worth at the rated present has been select as the maximum capacitance needed for self-excited induction dynamo, and that's for stopping each damage could transpire to the machine.[8]

To find the needed capacitance benefits, the pursuing steps have been done:

1. First, the route shown in Figure 4.3 has been related and the vital steps to work the induction contraption has been applied.
2. Without switching ON the burden switch, the speed has been set at 800 rpm, and next the capacitor bank switch is switched ON.
3. The worth of capacitance has been increased till the accumulation voltage appears in the induction contraption, next in softly steps the worth of capacitance has been cut till the accumulation voltage vanish, and this worth has been recorded as the minimum capacitance needed for the self-excited induction dynamo at 800 r.p.m.

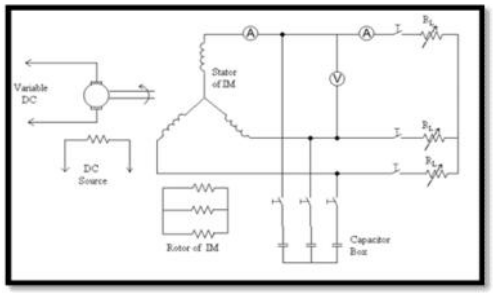

Fig. 4.3 The circuit used for testing in the lab

4. The speed has been increased in steps of 100 rpm and the pace (c) has been recapped at every single speed worth alongside recording the capacitance worth at every single speed, and this will be the no burden test.
5. The burden has been set at 1 p.u and the steps from (b) to (d) has been recapped alongside switching ON the burden switch.
6. The burden benefits has been modified from 1 p.u to 1.5 p.u and 2 p.u and the preceding steps has been recapped and in the end, the aftermath has been plot for every single burden utilized in this test.

And to find the maximum capacitance worth, the pursuing steps has been taken:

1. With the route shown above, the alike vital steps has been requested to work this machine.
2. without switching ON the burden switch, the speed has been set at 800 r.p.m and the capacitor bank switch has been ON.
3. The worth of capacitance has been increased till the accumulation voltage happens, next in softly steps the worth of the capacitance is increased till the rated present of the induction contraption has been grasped, and this worth will be record as the maximum worth of capacitance at 800 r.p.m.
4. The speed has been increased in steps of 100 r.p.m till the rated speed of the contraption, and the pace (c) has been recapped for every

single speed worth, and alongside recording every single worth of capacitance at every single speed, this will be the no-load test.

5. The burden has been at 1 p.u. and the steps from (b) to (d) has been recapped, alongside switching ON the burden switch.
6. The burden benefits has been modified from 1 p.u. to 1.5 p.u. and 2 p.u. and the preceding steps has been recapped and in the end.

5. CONCLUSION

The main gains of renewable are obtainable, clean, low price and constant energy. The reasons for selecting induction dynamo in wind power arrangement are that it is extremely reliable inclines to be moderately inexpensive, light heaviness, and low maintenance. The dynamo additionally has a few mechanical properties that are functional for wind turbines. So, the induction dynamo is the most public dynamo in wind power arrangement requests due to its simplicity and ruggedness. The utilized formula to compute the maximum capacitance needed for self-excited induction dynamo is easy and it doesn't demand numerical iteration. For this reason, this formula helps to ascertain the maximum capacitance needed for self-excited induction dynamo on line. The formula gives normal aftermath as the aftermath obtained from iterative method lacking each iteration or divergence problem.[6]

Acknowledgement

We would like to thank the paper reviewers for their valuable comments. Also, our deepest gratitude to Associate Professor Tan Kim See for his guidance in completing this research. This research was done using facilities in Faculty of Electronics and Computer Engineering, Universiti Teknikal Malaysia Melaka.

REFERENCES

[1] S. K. Baik, M. H. Sohn, E. Y. Lee, Y. K. Kwon, T. S. Moon, H. J. Park, and Y. C. Kim, "Effect of synchronous reactance and power factor on hts synchronous machine design and performance," IEEE Transactions on Applied Superconductivity, vol. 16, no. 2, pp. 1489–1492, June 2006.

[2] Young & Freedman, University Physics with Modern Physics, eleventh ed. Pearson Education Inc., Addison Wesley, 2004.

[3] A. E. Fitzgerald, C. K. Jr., and S. D. Umans, Electric Machinery, 6th ed. McGraw-Hill, 2003.

[4] P. M. Anderson and A. A. Fouad, Power System Control and Stability, 2nd ed. John Wiley & Sons, Inc., 2003.

[5] "Energy efficiency factsheet, reducing power factor cost," Washington State University Cooperative Extension Energy Program, Factsheet, 2002.

[6] N. W. Miller, J. J. Sanchez- Gasca, W. W. Price, and R. W. Delmerico, "Dynamic modeling of GE 1.5 and 3.6 MW wind turbine- generators for stability simulations," in Proc. 2003 IEEE Power Engineering Society General Meeting, pp. 1977–1983, June 2003,

[7] J. O. G. Tande, E. Muljadi, O. Carlson, J. Pierik, A. Estanqueiro, P. Sørensen, M.O'Malley, A. Mullane, O. Anaya- Lara, and B. Lemstrom. Dynamic models of wind farms for power system studies–status by IEA Wind R&D Annex 21," European Wind Energy Conference & Exhibition (EWEC), London, U.K., Nov. 22−25, 2004.

[8] T. Petru and T. Thiringer, "Modeling of wind turbines for power system studies," IEEE Transactions on Power Systems, Volume 17, Issue 4, Nov. 2002, pp. 1132 – 1139.

[9] Petri Lampola, Directly driven alternating current generators for wind power applications, ISBN 951-222826-2

[10] A. Larsson, T. Thiringer, Measurements on and Modelling of Capacitor-Connecting

[11] L. Drbal, K. Westra, P. Boston et al., Power Plant Engineering. Chapman Hall, 1996.

[12] "Power factor - the basics," PowerStudies.com, Article, 2007.