# PMSG FED WIND TURBINE FOR STANDALONE APPLICATION USING FLC

**SHIVAJI BHUKYA[1], Dr. S. PRAKASH [2]**

[1,] PhD Scholar Department of EEE, BIHER.

[2,] Professor, Department Of EEE, BIHER CHENNAI

**ABSTRACT:**

With the approach of need of renewable energyresource assets, wind energy turns out to be an indispensable class of the asset. It is a splendid and productive nontraditional wellspring of vitality. It very well may be utilized as consistent and variable breeze speeds task. With proceeded with improvement in this field cutting edge innovations and supervision analyzed, which causes the wind turbine to work at its ideal position. Significant scientists have concentrated on greatest power extraction from the generator utilizing the diverse most Maximum power point Tracking (MPPT) procedures. While in this article the goal is to exhibit the examination of traditional Perturb and Observe calculation (P&O) and fluffy based Perturb and Observe calculation and investigation of intensity motions and computational time. This paper based on simulation study of proposed independent framework which is finished utilizing SIMULATION in MATLAB.

***Key words- Renewable Resource, wind energy, turbine, Maximum Power Point Tracking (MPPT)***

## I. INTRODUCTION:

We are living in the period of mechanical progress and each civilization needs vitality (energy) for advancement, so appropriate usage of our assets is basic. There are loads of non-Customary vitality sources like sun powered vitality, biomass, sea vitality, wind vitality and so on [1]. Here we will center on wind vitality as a result of the 24*7 accessibility. It is protected, clean, financially suitable and plenteous in nature [2]. This likewise be a purpose behind specialists to consider it as a most better than average and propelled energy source.

The wind (breeze) turbine can accomplish its best working point for various breeze speeds by changing the pole increasing speed according to the necessity. It can achieve out-most productivity by any stretch of the imagination wind speeds [3]. From the investigation of writing, we have discovered that, perpetual magnet synchronous generator (PMSG) is an extremely helpful gadget. Mechanically, it works at low speed, has multi-post and spares adapt boxes, that implies it has basic structure, simple support, very dependable, cost reserve funds gadget. Electrically, it works the full power converter, which is worthy for all breeze speed and controls quickly for the MPPT [3 - 6]. Taking a gander at the quick development in the breeze control framework and its gigantic achievement, we need to state that it is anything but difficult to think about in an ideological and theoretical way, which makes it significantly more straightforward and smooth.

A near investigation of two calculations has been done in this paper with variable speed PMSG based breeze turbine. Simulation results as acquired are examined for both traditional and fuzzy logic based MPPT calculation. Segment II have dialog about the demonstrating of wind turbine. This also gives a little introduction about MPPT calculation and parameters of wind turbine and PMSG has been appeared and in this segment we have dissected the power motions with traditional MPPT calculation.

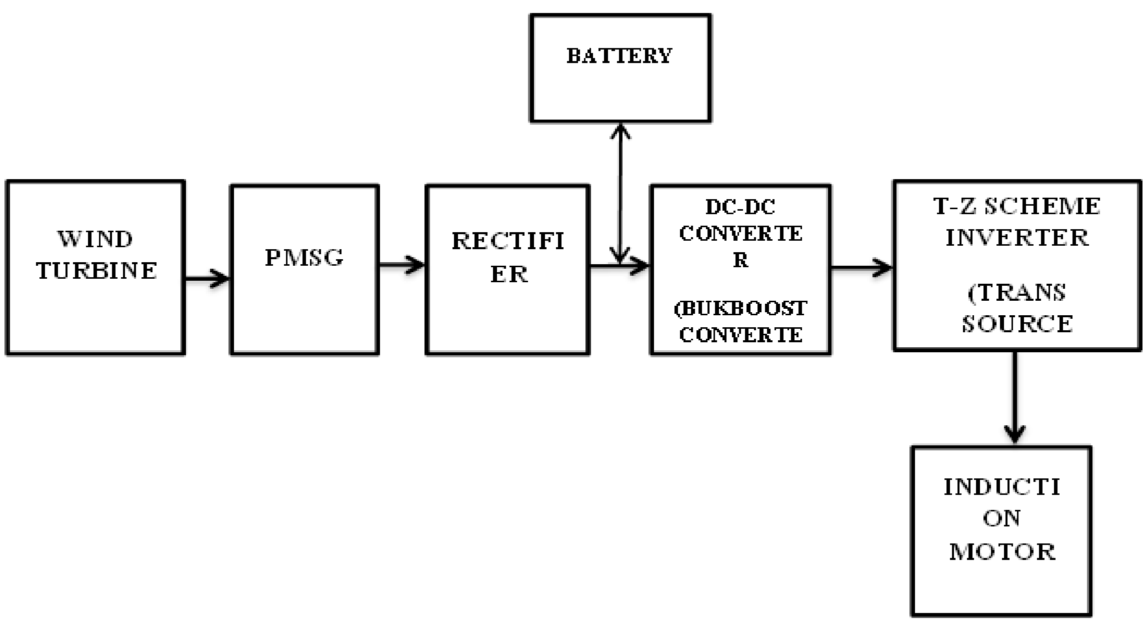


Fig.1.Block diagram representation of Proposed System

## II. Principle and Methodology of Proposed System

A PMSG fed wind turbine is simulated in this paper when connected to induction motor the characteristics are observed.

### A. BUCK BOOST CONVERTER:

A Buck-Boost converter is a type of switched mode power supply that combines the principles of the Buck Converter and the Boost converter in a single circuit. Like other SMPS designs, it provides a regulated DC output voltage from either an AC or a DC input. The Buck converter produces a DC output in a range from 0V to just less than the input voltage. The boost converter will produce an output voltage ranging from the same voltage as the input, to a level much higher than the input. There are many applications however, such as battery-powered systems, where the input voltage can vary widely, starting at full charge and gradually decreasing as the battery charge is used up. At full charge, where the battery voltage may be higher than actually needed by the circuit being powered, a buck regulator would be ideal to keep the supply voltage steady. However as the charge diminishes the input voltage falls below the level required by the circuit, and either the battery must be discarded or re-charged; at this point the ideal alternative would be the boost regulator. By combining these two regulator designs it is possible to have a regulator circuit that can cope with a wide range of input voltages both higher and lower than that needed by the circuit. Fortunately both buck and boost converters use very similar components; they just need to be re-arranged, depending on the level of the input voltage.

### B. TRANS Z SOURCE INVERTER

In the voltage-fed quasi Z-source inverter with continuous input current, two dc inductors can be Trans-Z-Source Inverters are separated or coupled. When the two inductors are coupled, the voltage across the inductor L1 is reflected to the inductor L2 through magnetic coupling. Then one of the capacitors, for instance, C2 can be removed from the circuit. It is named as the voltage-fed trans-quasi-Z-source inverter (transqZSI) to distinguish it from a later structure closer to the Z-source inverter. Furthermore, the voltage across L2 can be made proportional to the voltage across L1 by changing the turn’s ratio n2/n1. As the voltage constraint from one of the capacitors is released, the two windings behave more like a transformer, except for the stored energy. Like the Z-source inverter, the trans-quasi-Zsource inverter has extra shootthrough zero states besides the traditional six active states and two zero states.

**C. CASE STUDY:**

The PMSG based settled speed and variable speed wind turbine framework is gathered utilizing MATLAB/Simulink programming for constant recreation of the conduct of framework subjected to steady and variable breeze speed. Here we think about little size breeze turbine. The parameters of the breeze turbine and PMSG are appeared. The testing time utilized for the recreation is 10 seconds.

In this case, we take the same PMSG based turbine with variable breeze speed. For this situation we have looked at the traditional P&O and fluffy based P&O methods. Fluffy based MPPT procedure offers chance to remove most extreme power and through it appraised power can be completed at considerably lesser breeze speed. Fig. 9 demonstrates the most extreme power yield with increment in wind speed. The variety in wind is appeared. From the reproduction result it tends to be gotten that fluffy based MPPT calculation is better over the established P&O MPPT strategy. This methodology gives better outcomes independent of the quantity of cycle, measurement and rating of the turbines and computational time. Due to the adjusted advance size of obligation cycle with variable breeze speed which is helpful to WECS to get most extreme power yield we acquired better result. At the point when most extreme working point is far away, advance size of obligation cycle is sufficiently extensive and step size of obligation cycle is little as we near the MPP so the following time likewise decreases.

**D. Induction Motor**

An electric engine changes over electrical capacity to mechanical power in its rotor (pivoting part). There are a few different ways to supply capacity to the rotor. In a DC engine this control is provided to the armature specifically from a DC source, while in an enlistment engine this power is initiated in the turning gadget. An acceptance engine is at times called a turning transformer on the grounds that the stator (stationary part) is basically the essential side of the transformer and the rotor (pivoting part) is the optional side. Acceptance engines are broadly utilized, particularly polyphase acceptance engines, which are much of the time utilized in mechanical drives.

Acceptance engines are currently the favored decision for mechanical engines due to their rough development, nonattendance

Issn No : 1006-7930

of brushes (which are required in most DC engines) and the capacity to control the speed of the engine

## III. Simulation of Proposed System

The simulation of proposed system is modeled in MATLAB simulation software. The simulation model of the proposed system is as shown in the figure 2.

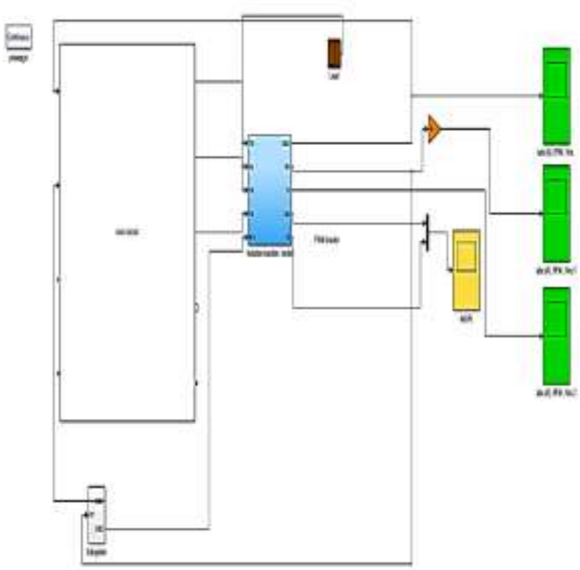

Fig.2.Simulation model of proposed system

The wind connected trans-Z-Source inverter is modeled as shown in the figure 3.

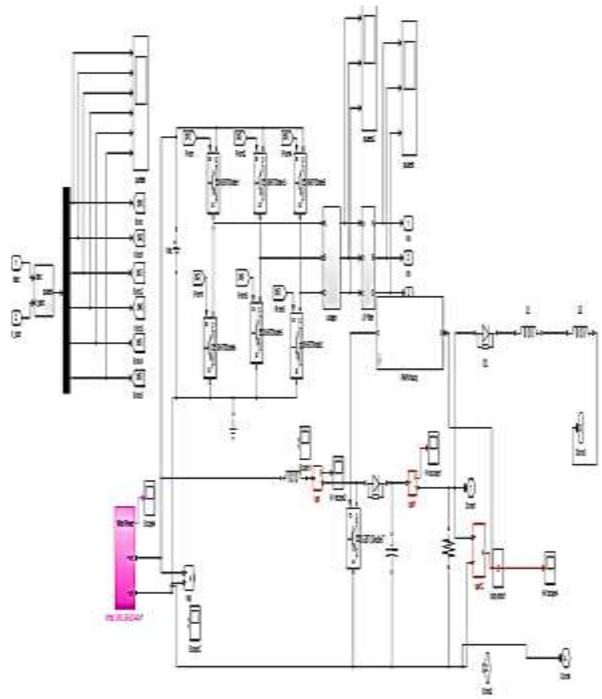

Fig.3.Simulation model of wind power connected to trans-Z-Source inverter

The simulation model of induction machine connected to the wind generated supply is as shown in the figure 4.

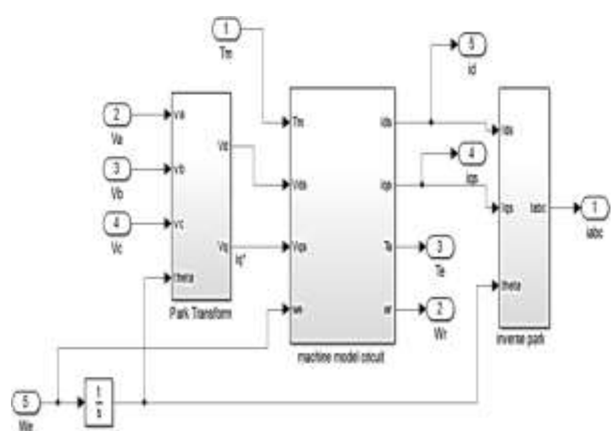


Fig.4.Simulation model of proposed induction machine

The induction machine is connected to the wind turbine generated supply. The induction machine is simulated as mathematical model as shown in the figure.

## IV. Simulation output waveform and Results

The simulation is successfully completed in MATLAB/Simulink Simulation Software. The output is taken for different cases.

### CASE 1: Results for Wind Speed 12 m/sec

The proposed system is run at a constant wind speed of 12 m/sec. The induction machine output is noted for comparison with various speeds, to get the characteristics of motor. The wind voltage output waveform is as shown in the figure 5.

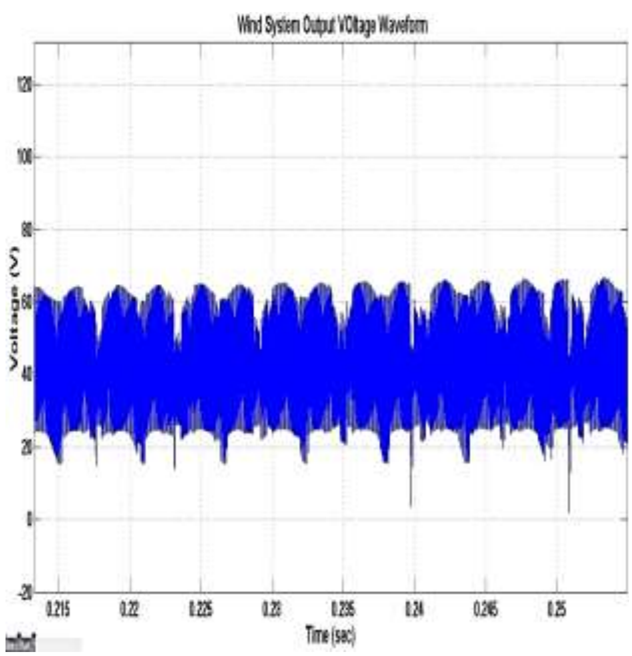


Fig.5.Output Voltage Waveform of Wind Power Generation

The boosted output voltage waveform of the wind power system is as shown in the figure 6.

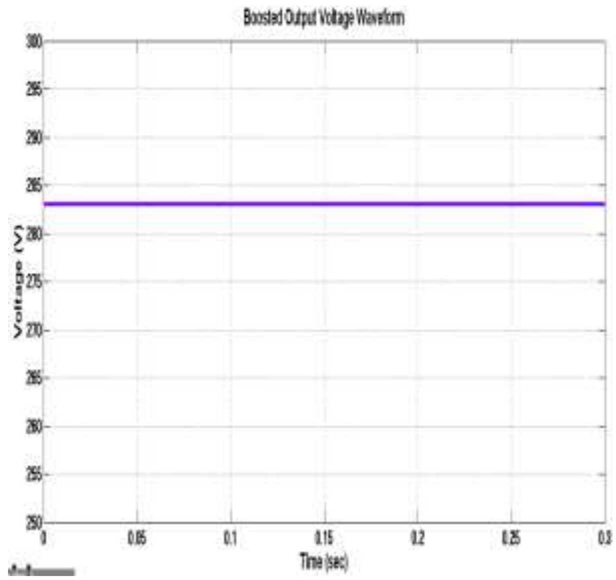


Fig.6.Output Voltage waveform from boost converter with FLC Controller

MPPT-FLC implemented pulse generation is as shown in the figure 7

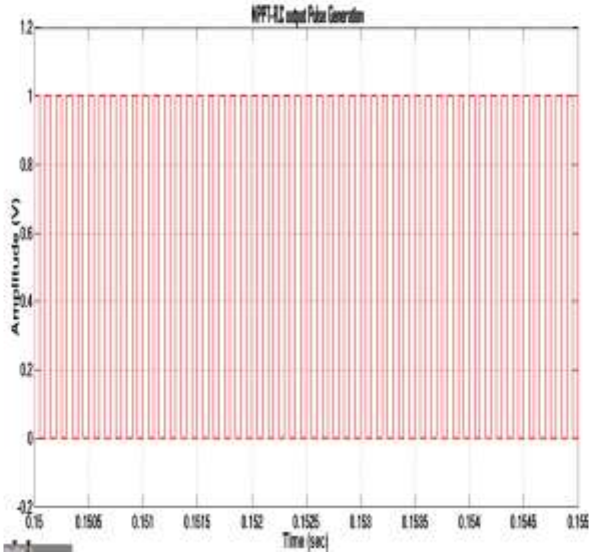


Fig.7.Three phase Output Voltage Waveform of Invert

Three phase output voltage waveform from T-Z inverter is as shown in the figure 8.

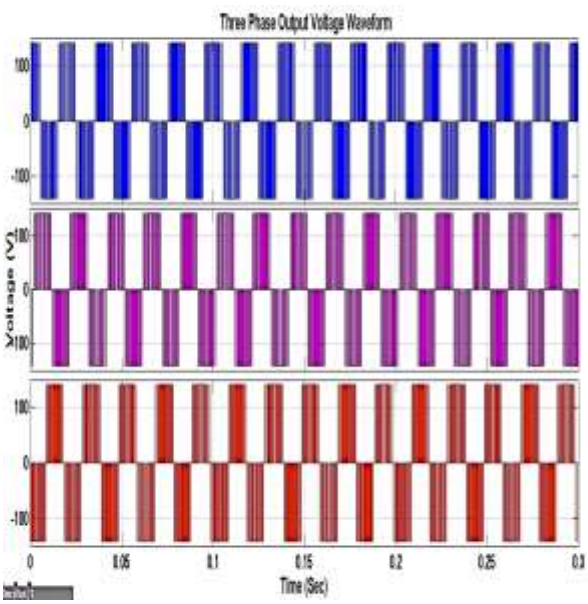


Fig.8.Three phase Output Voltage Waveform of Inverter

The current consumption of induction motor is as shown in the figure 9.

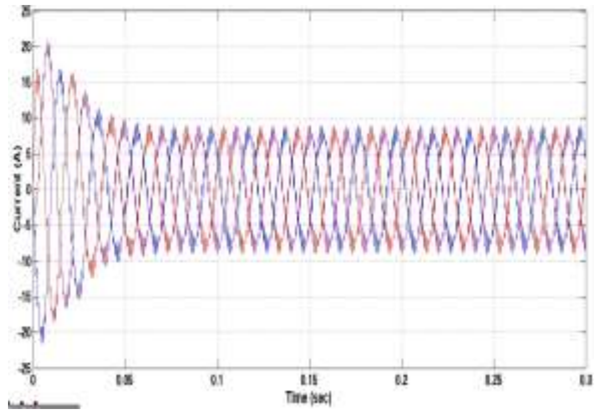


Fig.9.Output result of current waveform of Induction machine at 12m/sec

The speed in RPM is as shown in the figure 10.

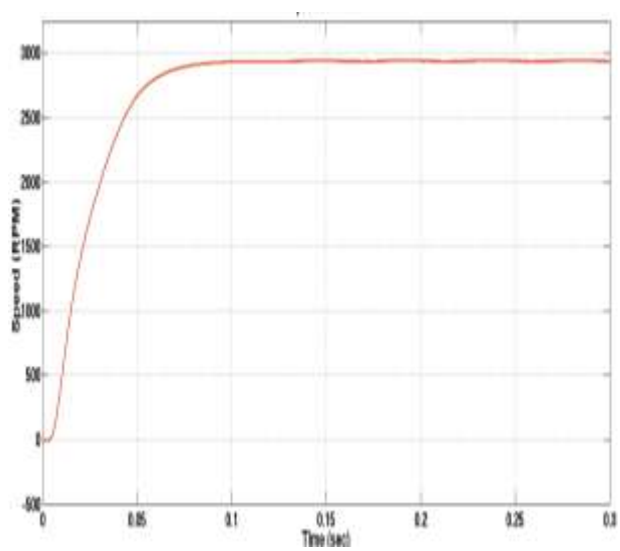


Fig.10.speed of the induction machine at 12 m/sec

The torque generated by the motor is as shown in the figure 11.

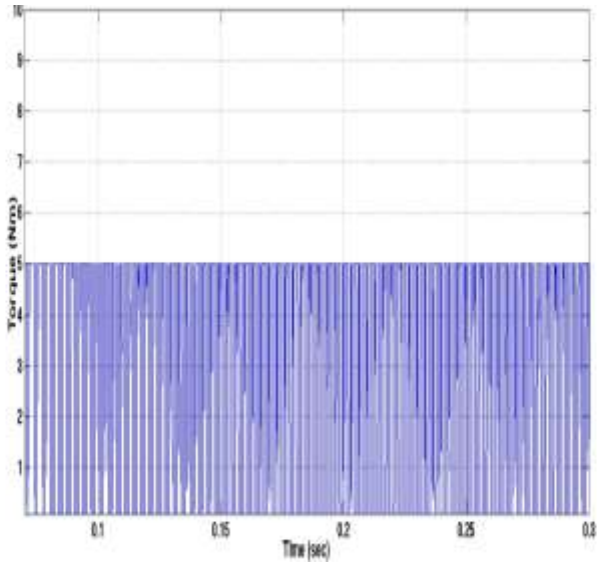


Fig.11.Torque generated at induction machine at 12 m/sec

**CASE 2: Results for wind speed at 15 m/sec**

The proposed system is run at a constant wind speed of 15 m/sec. The induction machine output is noted for comparison with various speeds, to get the characteristics of motor. The wind voltage output waveform is as shown in the figure 12.

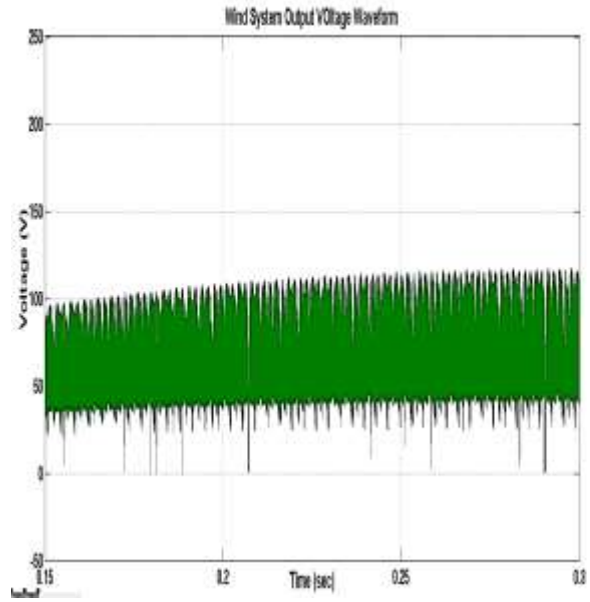


Fig.12.Output Voltage Waveform of Wind Power Generation

The boosted output voltage waveform of the wind power system is as shown in the figure 13.

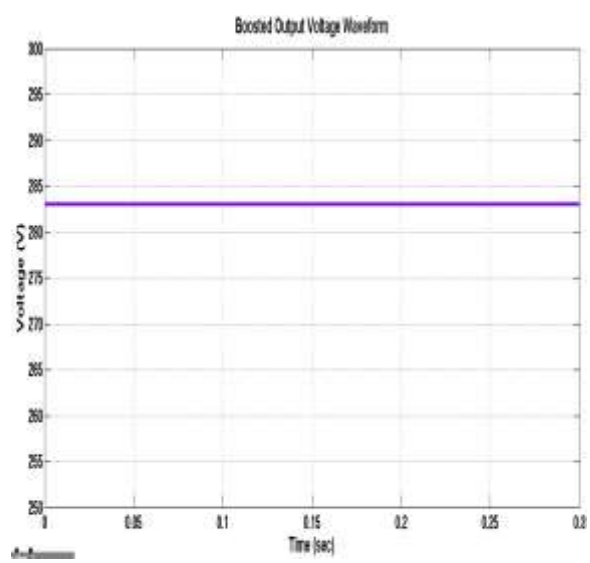


Fig.13.Output Voltage waveform from boost converter with FLC Controller

Three phase output voltage waveform from T-Z inverter is as shown in the figure 14.

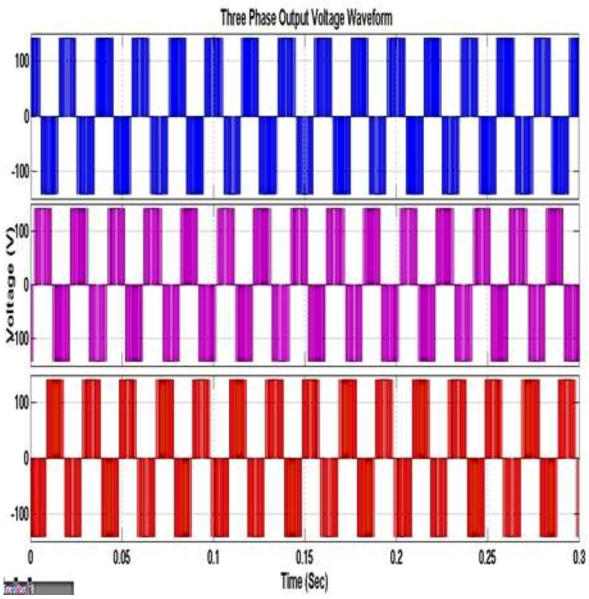


Fig.14.Three phase Output Voltage Waveform of Inverter

The current consumption of induction motor is as shown in the figure 15.

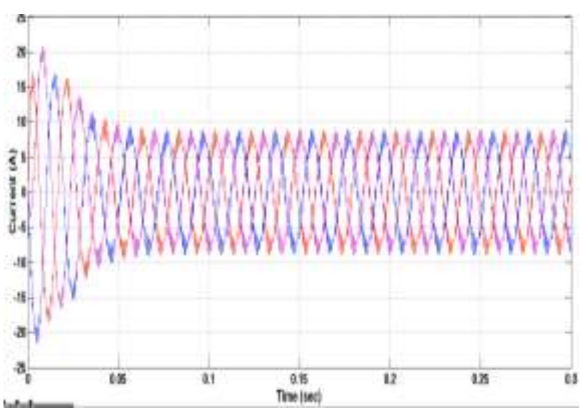


Fig.15.Output result of current waveform of Induction machine at 15m/sec

The speed in RPM is as shown in the figure 16.

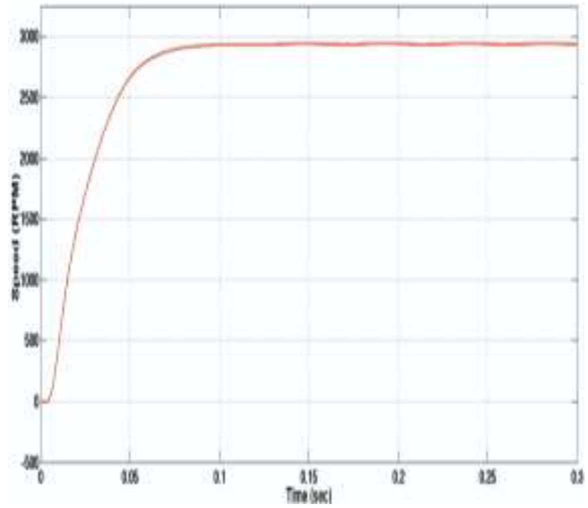


Fig.16.speed of the induction machine at 15 m/sec

The torque generated by the motor is as shown in the figure 17.

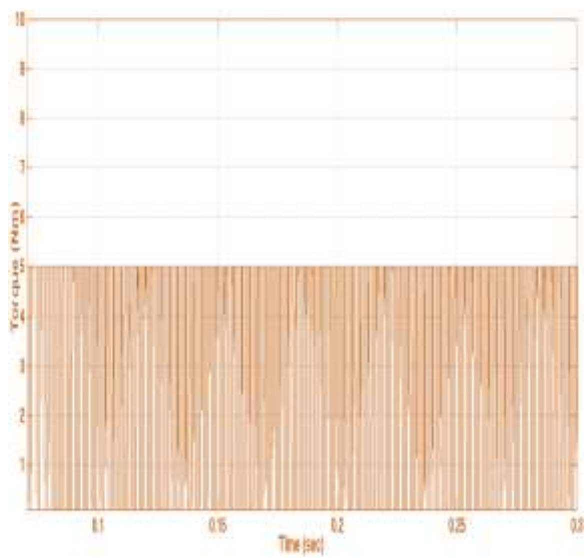


Fig.17.Torque generated at induction machine at 15 m/sec

**CASE 3: Results for Wind Speed 18 m/sec**

The proposed system is run at a constant wind speed of 18 m/sec. The induction machine output is noted for comparison with various speeds, to get the characteristics of motor. The wind voltage output waveform is as shown in the figure 18.

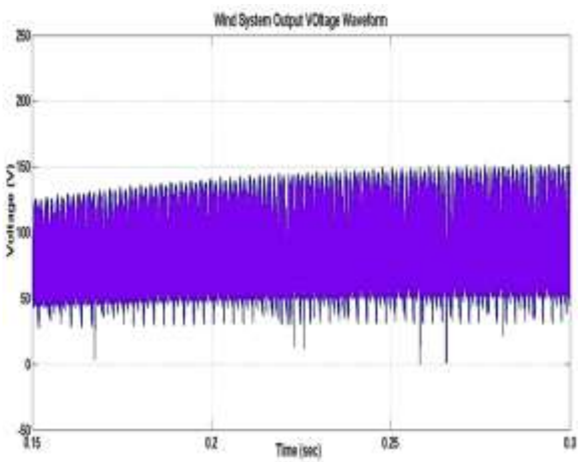


Fig.18.Output Voltage Waveform of Wind Power Generation

The boosted output voltage waveform of the wind power system is as shown in the figure 19.

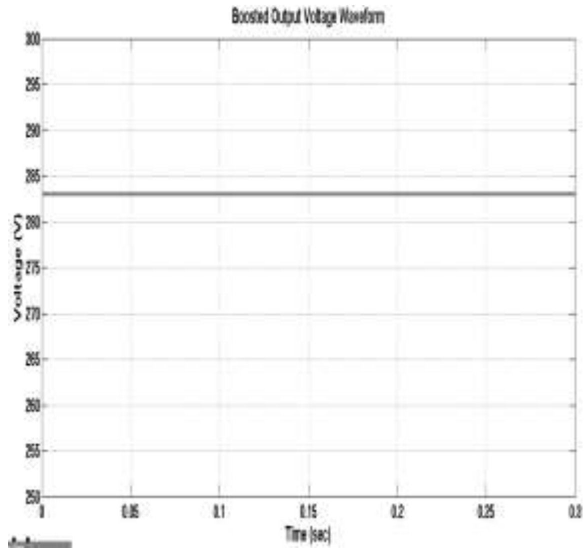


Fig.19.Output Voltage waveform from boost converter with FLC Controller

Three phase output voltage waveform from T-Z inverter is as shown in the figure 20.

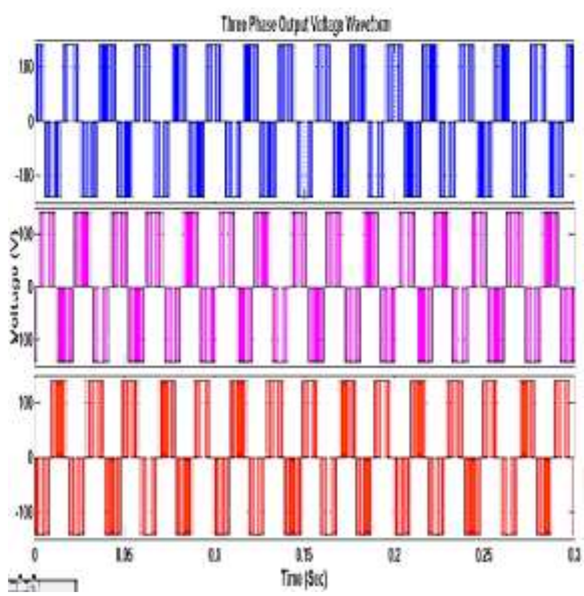


Fig.20.Three phase Output Voltage Waveform of Inverter

The current consumption of induction motor is as shown in the figure 21.

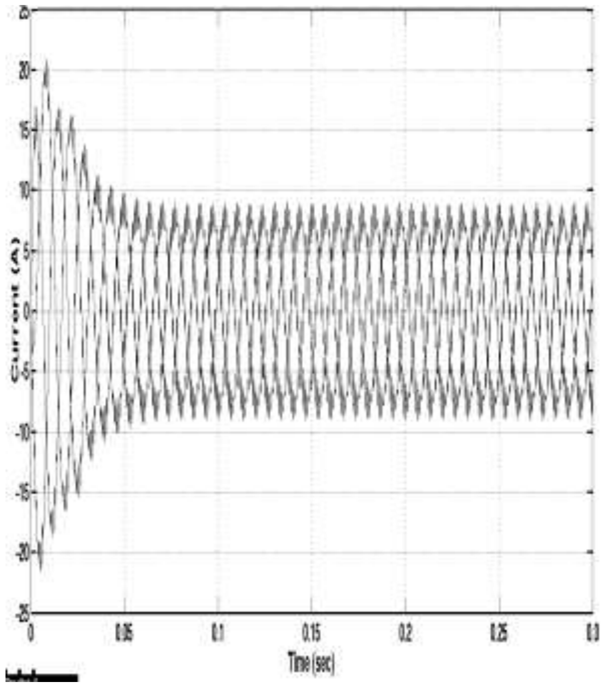


Fig.21.Output result of current waveform of Induction machine at 18m/sec

The speed in RPM is as shown in the figure 22.

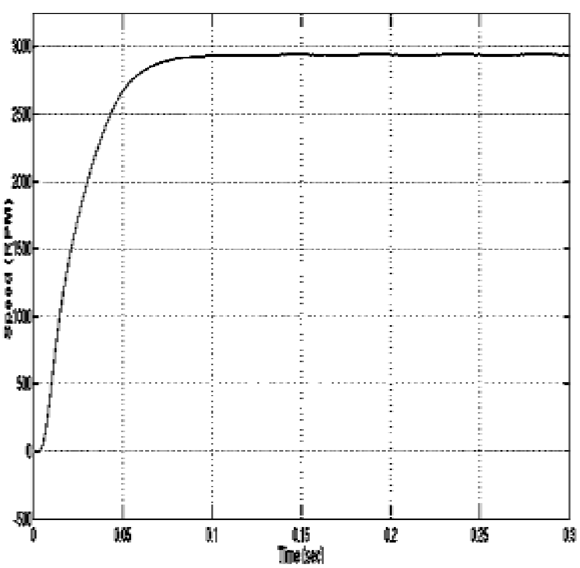


Fig.22.speed of the induction machine at 18 m/sec

The torque generated by the motor is as shown in the figure 23.

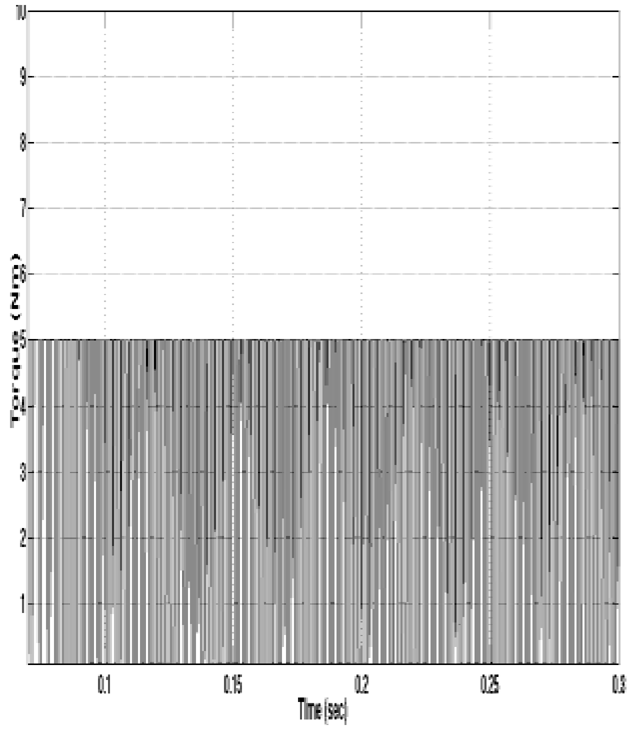


Fig.23.Torque generated at induction machine at 18 m/sec

From the above comparison of three cases with different wind speed it can be concluded that the proposed system gives constant output voltage waveform for variable wind speed.

| **Wind Speed** | 12 m/sec | 15 m/sec | 18 m/sec |
|---|---|---|---|
| Wind Generator Output Voltage (Volts) | 65 | 110 | 150 |
| Boost Converter Output Voltage (Volt) | 280 | 280 | 280 |
| T-Z Inverter (Volt) | 144 | 144 | 144 |
| Induction Motor Current (A) | 10 | 10 | 10 |
| Speed in RPM | 2800 | 2800 | 2800 |
| Torque in Nm | 5 | 5 | 5 |

## V. Conclusion

Wind integrated induction machine of speed variation is designed, simulated and characteristics is observed in this paper. From the above output waveform generated it can be concluded that proposed system is capable of run the induction machine at variable speed at very minimal ripple in current, speed, torque and flux.

In this paper simulation is done for various wind speed at 12 m/sec, 15 m/sec, and 18 m/sec. The results are observed to give less torque ripple even with the supply is generated from Wind power generation system.

## REFERENCES:

1. K.A. Corzine, J.R. Baker, Reduced parts-count multilevel rectifiers. IEEE Trans. Ind. Electron. 49, 766–774 (2002)

2. K.A. Corzine, M.W. Wielebski, F.Z. Peng, J. Wang, Control of cascaded multilevel inverters. IEEE Trans. Power Electron. 19(3), 732–738 (2004)

3. J. Rodriguez, L.G. Franquelo, S. Kouro, J.I. Leon, R.C. Portillo, M.A.M. Prats, M.A. Perez, Multilevel converters: an enabling technology for high-power applications. Proc. IEEE 97(11), 1786–1817 (2009)

4. F.Z. Peng, A generalized multilevel inverter topology with self-voltage balancing. IEEE Trans. Ind. Appl. 37, 611–618 (2004)

5. M.D. Manjrekar, P.K. Steimer, T.A. Lipo, Hybrid multilevel power conversion system: a competitive solution for high-power applications. IEEE Trans. Ind. Appl. 36, 834–841 (2000)

6. M. Malinowski, K. Gopakumar, J. Rodriguez, M.A. Pe´rez, A Survey on cascaded multilevel inverters. IEEE Trans. Ind. Electron. 57(7), 2197–2206 (2010)

7. Z. Du, L.M. Tolbert, J.N. Chiasson, B. Ozpineci, Cascade multilevel inverter using a single dc source, in Proceedings of the Applied Power Electronics Conference (APEC) (Dallas TX, 2006), pp. 426–430

8. K. Corzine, Y. Familiant, A new cascaded multilevel H bridge drive. IEEE Trans. Power Electron. 17(1), 125–131 (2002)

9. X. Yuan, I. Barbi, Fundamentals of a new diode clamping multilevel inverter.IEEE Trans. Power Electron. 15(4), 711–718 (2000)

10. G. Cerlia, V. Guzman, C. Sanchez, F. Ibanez, J. Walter, M.I. Gimenez, A new simplified multilevel inverter for DC–AC conversion.IEEE Trans. Power Electron. 21(5), 1311–1319 (2005)

11. V.G. Agelidis, D.M. Baker, W.B. Lawrance, C.V. Nayar, A multilevel inverter topology for photovoltaic applications, in IEEE International Symposium on Industrial Electronics, ISIE'97 (Vol. 2, July 1997), pp. 589–594

12. M.D. Manjrekar, T.A. Lipo, A generalized structure of multilevel power converter, in IEEE Conference on Power Electronics, Drives, and Energy Systems (Australia, 1998), pp. 62–67

13. F.Z. Peng, J.S. Lai, Multilevel cascade voltage-source inverter with separate DC source, U.S. Patent 5,642,275, 24 June 1997

14. B.-S. Shuk, Y.-H.Lee, D.-S. Hyun, T.A. Lipo, A new multilevel inverter topology with a hybrid approach, in EPE 99-AUSANNE, pp. 01–09

15. C. Cecati, F. Ciancetta, P. Siano, A multilevel inverter for photovoltaic systems with fuzzy logic control. IEEE Trans. Ind. Electron. 57(12), 4115–4125 (2010)