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STATCOM and PID Controller Based Stability Enhancement of a Grid Connected Wind Farm

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ABSTRACT: This paper proposes a lattice-connected wind energy conversion system (WECS) based on a dual-feed induction generator (DFIG) with variable speed operation. Consider that the wind itself is intermittent. Due to the limitations of conventional energy sources, wind energy, as one of renewable energy sources, is becoming increasingly important in the field of research. However, stabilizing the voltage obtained from wind vigor has become a main issue.
Various methods are used to alleviate this situation. Stability of grid-connected wind farms was improved by reducing voltage fluctuations and using static synchronous compensator (STATCOM) to achieve reactive power compensation. A current control loop with PID manager is used to controller STATCOM. The PWM method (pulse width modulation) is adopted as a management strategy for STATCOM. During the period of changes in wind speed, different methods (i.e. wind farms with capacitor banks and STATCOM or using STATCOM with proportional-integrated-derivative controllers) have been used to conduct various comparative studies of the stability of the wind farm.

I.INTRODUCTION

The electrical system network is designed to provide continuous power to end users with Safeway. The safe and stable operation of the electricity grid can ensure reduction of social and economic costs, because the instability of the electricity grid can even cause costly power outages. Gohate et al. [2011] stated that the goal requires two phases: the preparation phase, arranging the electrical system network together to achieve predictable utilization, the specific electrical energy load at a particular time, the action phase, to respond to unexpected behaviour and maintain stable power distribution real-time. The service period is the time interval for the operating phase, and its range in different power grids varies from 5 minutes to 60 minutes.The energy produced by unconventional energy is called renewable energy. The energy collected from renewable resources is called renewable energy and is usually supplemented in the human period, such as sun, wind, raindrops, tides, signal waves and heat from geothermal energy. Wind power production has established significantly. In 1999, approx. 10,000 megawatts of wind power production capacity worldwide. In recent years, the world has built more wind power generation units than nuclear power generation capability.

II.WIND TURBINE (FIXED-SPEED)

The wind turbine with fixed speed is connected directly to the grid system. Synchronous generators were used in various early models. Due to lower costs, widely improved environmental stability and greater mechanical resemblance to initiation generators with rapid wind speed changes are accepted. The gearbox and generator are located in the nacelle on top of the nacelle. The purpose of the gearbox has been demonstrated by reducing the speed of the turbine in the generator area to higher speed. The induction generator usually has a rotation speed of 1000 rpm or 1500 rpm. For example, the speed of the turbine is about 200 KW, and it depends on the rotor's diameter.50 rpm, but a 1000 KW turbine has a speed of approx. 30 rpm. The main equipment is located in a fixed speed wind turbine, as shown in figure 1.2. A fixed rapidity wind turbine is intended to achieve supreme competence at a unique wind speed, which provides the best tipping wind speed ratio for rotor air plate. To collect more energy, certain fixed-speed wind speeds have 2 dissimilar rotating speeds. To absorb more vigor, some fixed-speed wind turbines have two dissimilar rotational speeds. This can be attained with one or two producers with two windings, as explained by Von Altrock et al. [1992a] as shown in Figure 1.2.

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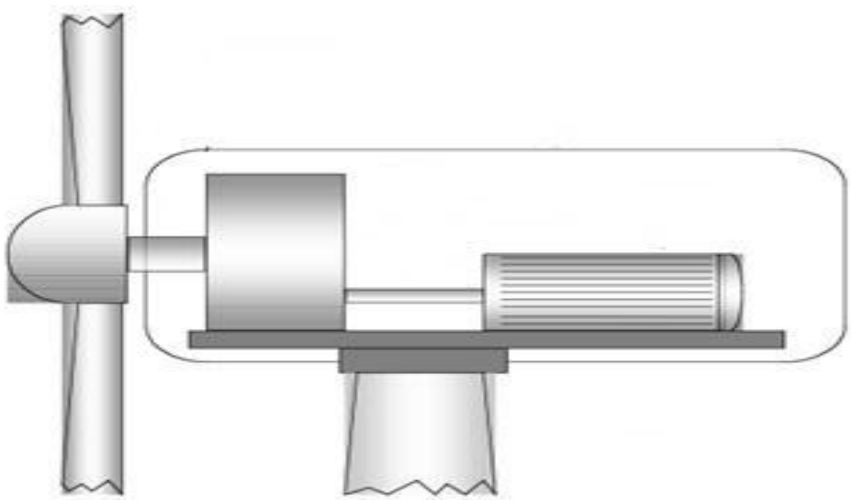

Fig. 1: Fixed-Speed Wind Turbine

Variable Speed Wind Mill Electrical System

Currently, many manufacturers use variable speed wind turbines. When action changes, it happens. Souza et al. [2001] proved that the mutable speed of wind turbines can be achieved in several dissimilar conducts, and some dissimilar electrical schemes are used for wide or tapered speed ranges.

The alteration among the wide and narrow speed range is mainly energy manufacture and noise reduction capability When a wider speed range is associated with a narrower speed range, it increases power output and reduces noise. All the different transmission structures can reduce the power variation from the tower shadow Tapered speed range DFIG with a converter related to rotor course can be used in a narrow speed range. Several major manufacturers have used this type of transmission system.

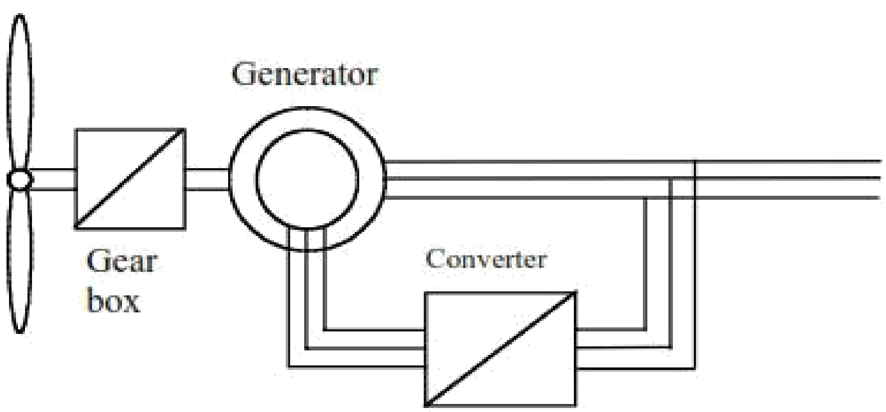

Fig. 2: Variable-Speed DFIG with a Converter Circuit

To use the controllable rotor resistance to achieve additional possible arrangements. A Danish manufacturer manufactures an IG wind turbine to rotate the rotor 1-10% by sliding. A Light-Controlled Converter can be used to change the rotor resistance of the generator. Figure 3 shows the electrical method of a wind turbine with a handy rotor battle.

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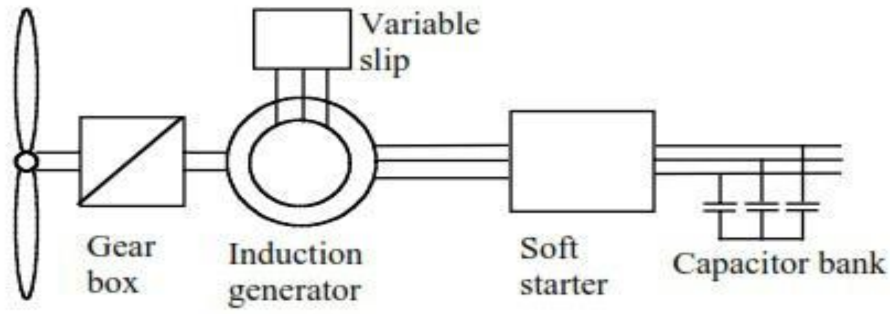

Fig. 3: Electrical System of a Wind Turbine with Controllable Rotor Resista

Objective

- The implement of DFIG wind energy conversion system with grid connected system
- The objective of this paper is design PID control methods for STATCOM smooth operation during fault

The addition of mutable speed wind turbines or DFIG has received increasing attention. Compared to SCIG and PMSG, DFIG has many benefits, such as high efficacy, flexible control, fast active or responsive power control or condensed mechanical load. The stator for DFIG is fed straight into the three-phase structure, while its rotor is fed into the UG through the modifier or back-to-back converter, as show in figure. The converter's main part is the RSC, the GSC or the DC bus condenser. The converter is also used. RSC can be used to measure vigorous strength and reactive power. The GSC controls the energy of the DC bus.In addition, it can ensure the process of the converter in units with power feature. The power converter accounts for approximately 20% to 30% of total power to achieve complete supervisor of generator. Therefore, related to a full-speed WES with a full-class converter, the cost converter is reduced and the power loss is minimized.

Advantages

- Sensitivity system
- feasibility of the proposed strategy
- The power utilization is maximum
- The excess power is seed to the grid
- During fault instead of isolation it maintains balance among machine power and the grid power under faults

Control Unit

Proportional integrated derivative (PID) manager is a control loop instrument that uses replay and has been used in manufacturing controller systems and several submissions that require unceasing inflection control. The PID controller constantly analyses the error values e (t) {displaystyle e (t)} e (t) as changes to expected time zone (SP) and measurable error rate (PV) , and adjust it accordingly. Or a differentiated expression (representing each P, I and D), that is the name. An example every day is the in-car travel control system. When constant power is used, the speed is reduced. The control PID algorithm the required measurement speed to required speed and slows down by increasing motor power. Since early 1920s, study of applications and practical applications has been first of its kind on the ship's control system. It is used for control of logical processes for production and is used in pneumatic and electronic control. In this model: the P expression corresponds to present charge of SP-PV error e (t). For example, if defect is large or good, considering getting a “K”, the discharge control will be large and good. Using proportional control alone will source an error among the set value or value of actual process, as this will result in a proportional response and will result in an error. If there is no error, there is no correction answer.

- Word I clarify the value of the previous SP-PV error and introduces it shortly after generating word I. For example, if an SP-PV error is left after the proportional control is applied; the input transmission will increase the management by incorporating the value of historical collection to remove residues. Once theerror is removed, the word recognition will not

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increase. As the error decreases, this will cause the proportional power to decrease, but this can be offset by the increase in the integrated power. Word D is best estimation of future trends based on current level of SP-PV change. This is sometimes called "expected control" because it reduces the impact of SP1-PV defects by applying the control effect caused by the change in fault rate.

•

The faster the change, the greater control or reduction effect. [1] Use continuous correction to produce the best control. It is possible to balance these results. Adjustment adjustments are shown below as "K" and must be taken at each controller suggestion as they depend on nature of the filling response outside the controller. It depends on the measurement sensor, final control element (e.g. the control valve), delay of control signal, or behavior of the procedure itself. Usually, you can first enter the value of the constant value once you know the type of application, but you can "go through" the process of this section by changing the value and viewing the results the system to correct or correct the constant. The current communication channel above uses "direct" control actions for all words, which means that the growth of positive feedback results in an growth in positive control output generated by the summary product. But if the negative correction action is to be performed, it is called the "output". For example, if the inlet of the inlet pipe is 100-0% and the control is 0-100%, it means that the role of the regulator must be reduced. Process control and limited control involve this opposite behavior. An example of this is a solution that drips cold water. In the event of a signal loss, the unsecured state will be 100% open envelope. Therefore, the development of regulator 0% must start with the opening of the valve 100%

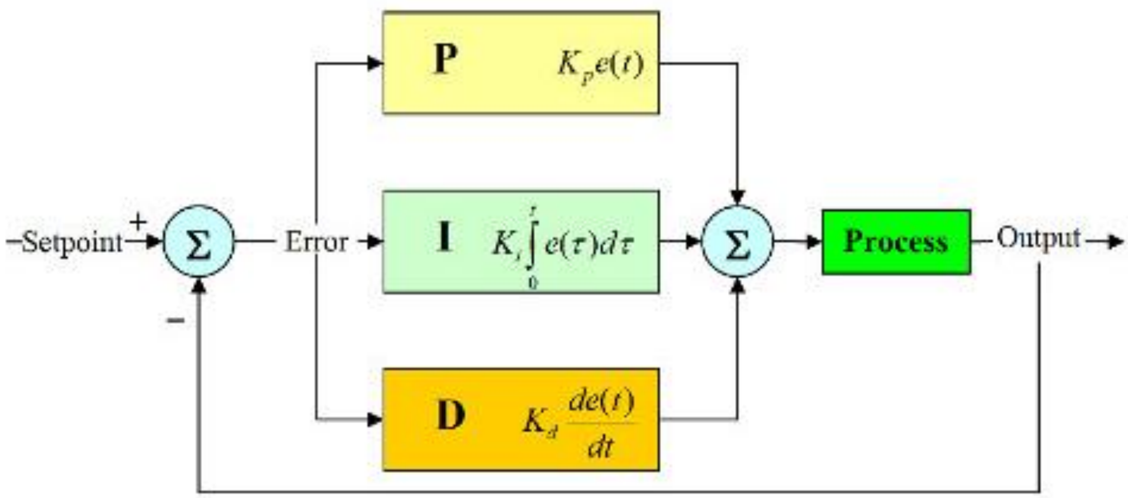

Fig. 4 : Control Unit

III.PROPOSED SYSTEM

Power generation, power transmission, and the final distribution of electricity meters are some of the steps taken in the power industry. Power quality is an important factor in determining the power status. Due to the changing behavior of the power generation in the wind power systems, the problem of high quality may arise. This article presents the simulation and analysis of the filter, the rotation and the power improvement of the synchronous static amplifiers through the control strategy. The maintenance of generating power and the fulfilment of customer needs are the main objectives of power system operation. In some of the unpredictable situations the compensation is provided by additional devices such as distribution generations integrated into the power system. The inexpensive energy sources such as wind, solar energy systems have been built into the electricity system in recent years. Among those resources the wind energy system has the increasing demand in today's environment. The reason for increasing willingness is the gratification of renewable energy systems are reduced usage of fossil fuels, reduced cost and reduction of greenhouse gases.

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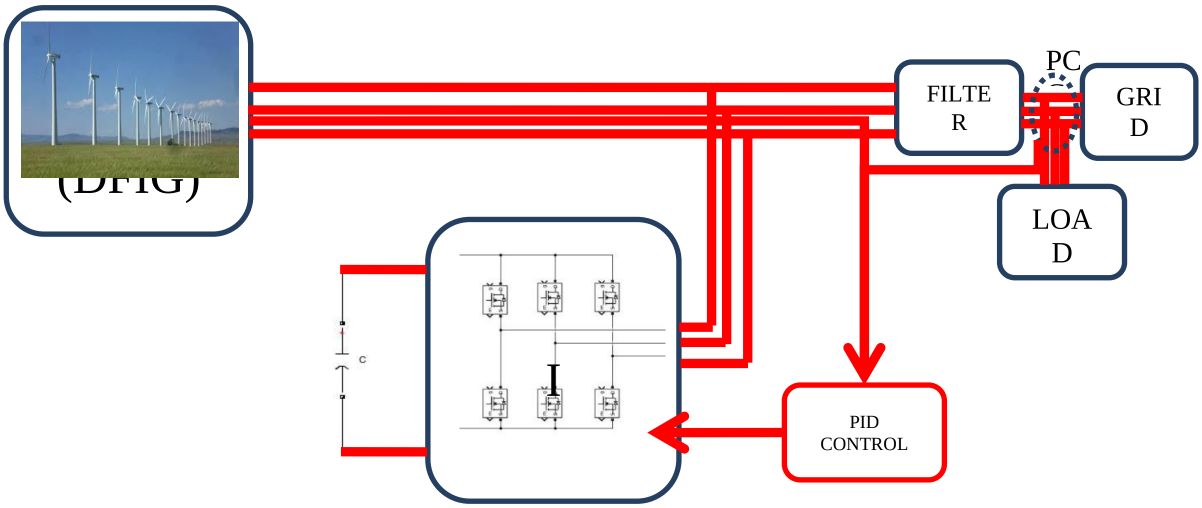

Fig 5: Proposed block diagram

The wind energy systems are integrated into the distribution power systems for the continuation of power supply. Likewise one of the promising distribution systems is the wind power distribution system. While the integration of wind systems provides betterment in supplying system power supply at the same time it generates a new problem that is power quality reduction. In the same way the generation of wind energy is oscillating one because of the wind blows.

IV.SIMULATION RESULTS AND DISCUSSION

The control system is designed to imitate the power system blocks using SIMULINK. The mark of the given system structure is shown in the table. The operation of the proposed system in active situations is also provided. The three STATCOM enclosed components in the box will reduce the spread of non-electrical and airborne loads. The IGBT-based three-step inverter connects to the grid via a converter. The process of generating reverse signal from the current software was adjusted in the hysteresis group of 0.08. Selecting a rotating hysteresis band in the system can improve the quality of the current and provide frequent belt monitoring signals to the moving wire.

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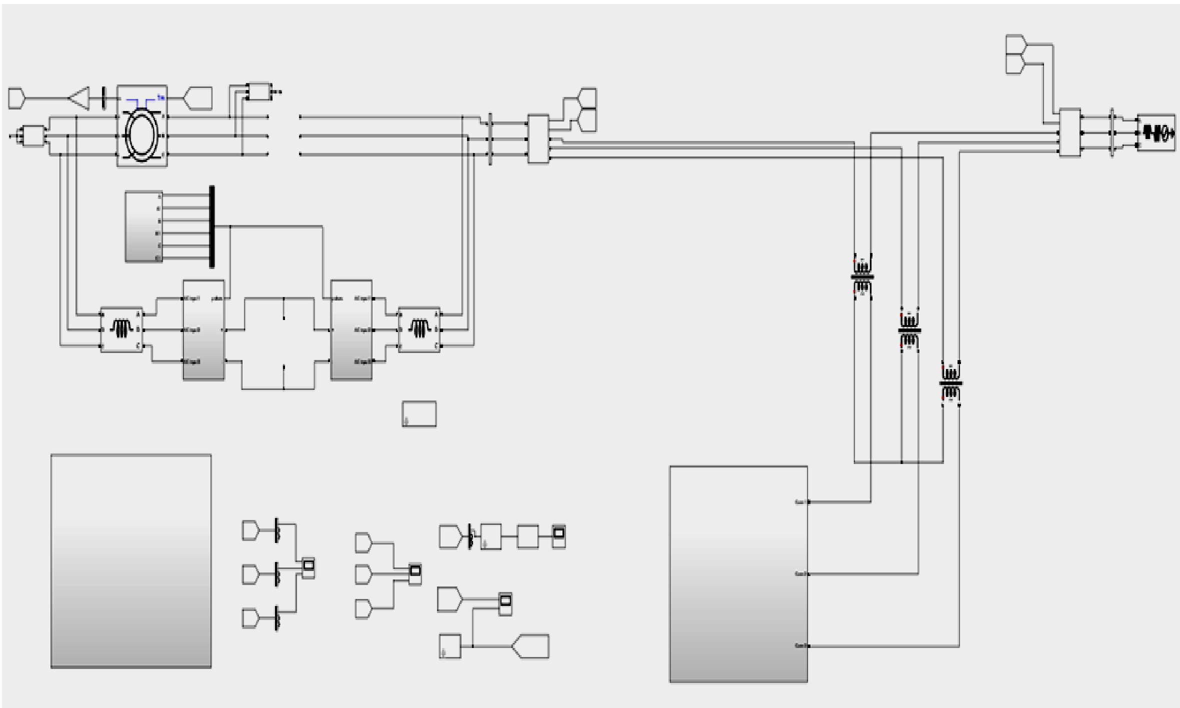

Fig. 6. Proposed System Model

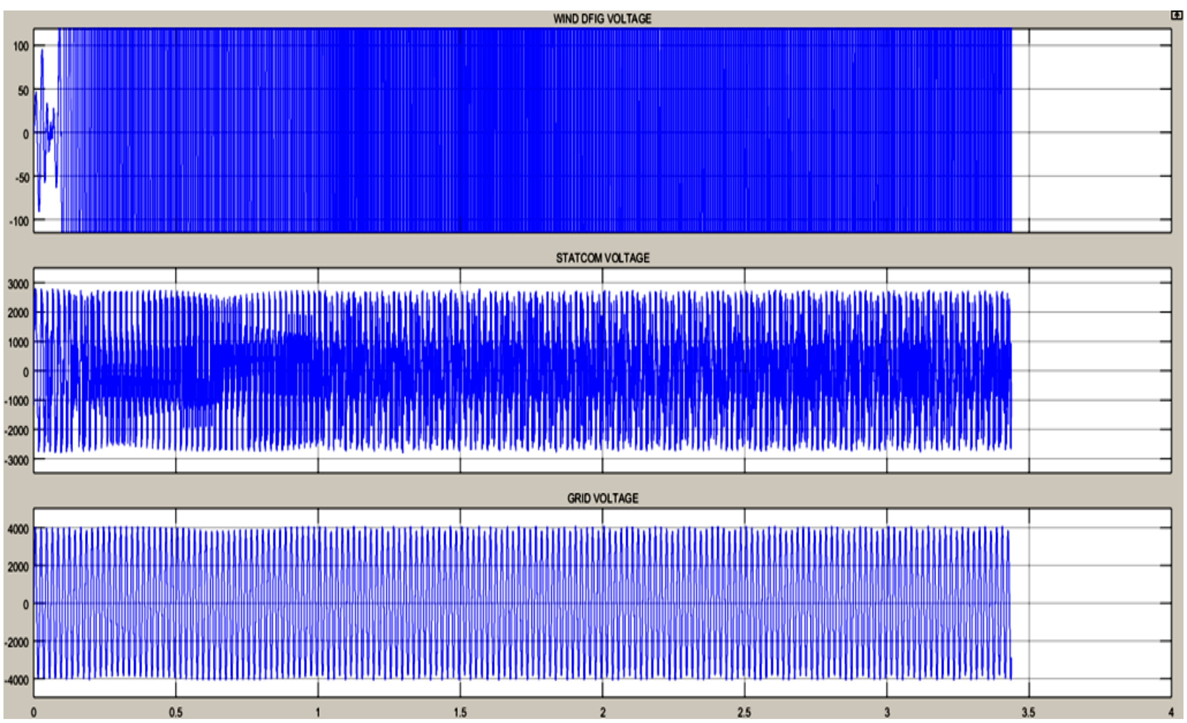

Fig 7 : Without PID

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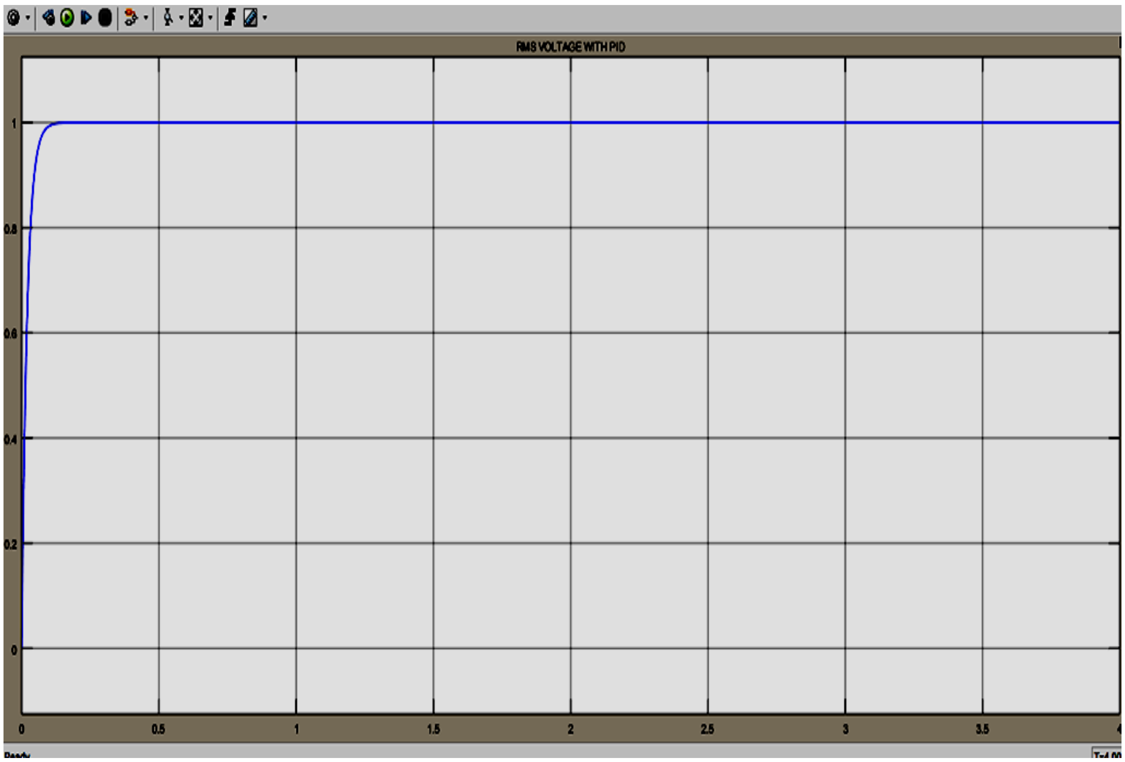

Fig 8: RMS voltage with PID

By providing sufficient reactive power to the wind farm, the voltage of the wind farm can be stabilized more stably than the capacitor bank. Therefore, the STATCOM system is more efficient. Finally, by using STATCOM and PID controllers to reduce voltage fluctuations and achieve reactive power compensation, the stability of grid-connected wind farms can be improved.

V.CONCLUSION

This paper studies the properties that can solve the power quality problem in the wind energy adaptation system and adopt an appropriate regulation program to improve the power quality of the mains-connected wind energy conversion system. Use MATLAB / SIMULINK to simulate the control plan for power generation system to recover power worth proposed .The control scheme has the ability to cancel the harmonic part of load current . It can keep the power supply voltage and current in phase or provision responsive power requirement of wind turbine and the load of PCC in the grid system, providing an occasion to improve application rate of the transmission line. The results show that STATCOM is more efficient for stabilizing RMS voltage and terminal voltage on the capacitor bank. STATCOM along with PID controller can successfully This article educations the constancy examination of STATCOM. A voltage control loop with PID controller or pulse width modulation (PWM) has been used to control STATCOM.

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