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MAXIMIZING RENEWABLE ENERGY INTEGRATION GRID-CONNECTED WIND-PHOTOVOLTAIC COGENERATION WITH BACK-TO-BACK VOLTAGE SOURCE CONVERTERS

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ABSTRACT: As people's concerns grow, renewable energy technologies may advance even further. This study investigates various approaches to changing photovoltaic (PV) energy, how wind power is currently performing, and how their maximum power point tracking (MPPT) methods work. Following that, a completely new grid-connected cogeneration system for wind and photovoltaics with back-to-back voltage source converters is proposed. In wind power generation, a permanent-magnet synchronous machine is used to achieve the highest speed and output. In photovoltaic power generation, boost converters are used to extract the most power from the sun by varying the duty cycle.

KEYWORDS: AC-DC power converters, DC-AC power converters, maximum power point trackers, permanent magnet machines, solar power generation, wind power generation.

1.INTRODUCTION

Because natural energy sources emit almost no pollution, renewable energy sources must be carefully planned. Wind energy differs from other clean energy sources in that it can be directed toward a wind generator and converted into electricity. Photovoltaic (PV) control is an alternative method that ensures both good spring results and clean energy generation. It can also operate without a rotating generator. Without a doubt, PV control assistance increases wind energy production, though the results are not entirely opposite. Strong winds are more common in the evening and on cloudy days, so you may need to use cooling aids.

If you want to convert wind energy into electricity, you'll need either modified variable velocity or constant speed wind turbines. When wind turbines operate at a constant speed, there is a direct connection between the control generator and the control grid. As a result, the generator has a consistent behavior. Which is faster? These turbines are performing well, as evidenced by their dynamic and sensitive force control systems. Putting in variable speed wind turbines (VSWT) will pique people's interest in energy, beginning with wind.

Drawing VSWTs have ten to fifteen percent more energy, are less prone to failure, and experience fewer power changes than VSWTs with fixed speeds. Additionally, wind turbines can be divided into two categories: horizontal wind turbines (VAWT) and vertical wind turbines. The latter group is less clear-cut than the first. Even though the airflow that powers the VAWT will be more vertical than horizontal, it remains a complex system. Aside from that, these are inexpensive. One of the most important investigations the VSW conducted was to gather information on the various control systems used in the facility to achieve various objectives.

To control VSWT, you must use specific methods. In addition, these systems would monitor the maximum power output, manage voltage changes, and reduce control variation while the load was restored. Starting with the VSWT, pitch control is used to regulate concentration. Fuzzy logic control, the hill claim searching (HCS) technique, and straight control can all be combined to achieve maximum energy fascination, beginning with VSWT.

Some renewable energy sources, such as solar panels and wind turbines, are built in because they are effective and inexpensive. Because they rely on solar irradiance and wind speed, these systems are never completely dependable in terms of meeting load demands. As a result, some research suggests that a diesel generator be used as a backup power source alongside wind and solar power systems. Such an addition to the system for producing PV energy would be ineffective.

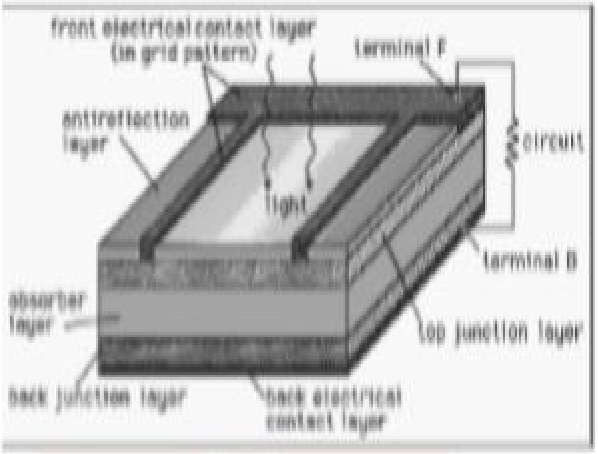
It is possible that the initial concentration of maximum energy does not always occur for MPPT-controlled PV arrays, both when in a steady state and when weather conditions change. In contrast to MPPT efficiency, the overall efficiency of the power processing system is primarily based on conversion efficiencies, which must be optimized while taking into account how operating conditions change throughout the day. Different MPPT methods can be evaluated using specific standards, as shown in Table 1. The most common methods are dP/dV or dP/dI feedback control and incremental conductance measurement.

S. no	mppt techni que	PV array Depend ent	True mppt	Converg ence Speed	impleme ntation complexi ty	Sensed paramet ers
1	P&O	No	Yes	Varies	Low	Voltage, current
2	IncCo nd	No	Yes	Varies	Medium	Voltage, current
3	Fracti onal *Voc*	Yes	No	Medium	Low	Voltage,
4	Fracti onal *Isc*	Yes	No	Medium	Medium	current
5	Fuzzy logic	Yes	Yes	Fast	High	Varies
6	Neura l netwo rk	Yes	Yes	Fast	High	Varies
7	*dP/dV* contro l	No	Yes	Fast	Medium	Voltage, current

Most photovoltaic systems require a front-end support converter to ensure that the inverter can handle the load. Previously, these DC-AC and DC-DC energy converters could exchange switches (IGBTs/MOSFETs) from the same leg as the inverter simultaneously. This could have happened for a variety of reasons, including EMI effects, poor switch termination, worsened out-of-phase breaking, insufficient cross-conduction security in gate-drivers, or something similar. A shorting occurs when the wellspring switches between connecting to the dc connection capacitor and the inverter's shorted legs. This causes a large amount of current to flow and damages the system. A voltage source inverter is one method for accomplishing this. The proposed system aims to transfer as much energy as possible from solar panels or wind turbines to the power grid.

2.RELATED WORKS

Solar Array:



Light excites electrons in a solar cell's absorber layer, causing them to transition from their lower-energy "ground state," where they are bound to specific atoms in the solid, to their higher-energy "excited state," where they can move freely within the solid. Because there are no junction-forming layers, these "free" electrons move randomly, making it impossible to have a direct current that flows in a straight line.

The photovoltaic effect, on the other hand, is produced by the addition of junction-forming layers, which generates an electric field inherent in the material. The electric field essentially gives the electrons collective motion, which they use to move through the electrical contact layers and into an outside circuit, where they initiate beneficial processes for the system.

Permanent Magnet Synchronous Generator:

Assume the machine is running with no load and has a positive torque on the shaft. This indicates that the rotor flux angle is moving faster than the stator flux angle. Stator currents will change in a manner similar to how a motor works to create the new equilibrium conditions depicted in Figure 1. If the machine is not sufficiently excited at the start, condition (a) of Figure 1 applies. However, condition (b) in Figure is important if the apparatus becomes overly excited. When the machine is in the underexcited mode, the power factor angle (#1) leads, as "seen" from the terminals.

This indicates that I1 is ahead of V1. This means that the device is utilizing the system's reactive power. If the machine is overexcited, the opposite will occur. When the motor is overexcited in the generating mode, it may also be able to deliver higher power. Generators frequently have to deliver VARs in addition to watts, which means that they operate almost continuously when overexcited.

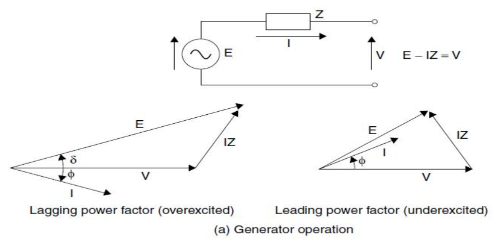


Fig:1

This generator is connected to the power grid via a back-to-back converter. This product is extremely versatile because it can handle faults when the voltage drops and provides complete control over both real and reactive power. Figure 2a shows the schematic diagram of the PMSG, while Figure 2b shows its equivalent circuit. The details and terms for the relevant circuits are available.

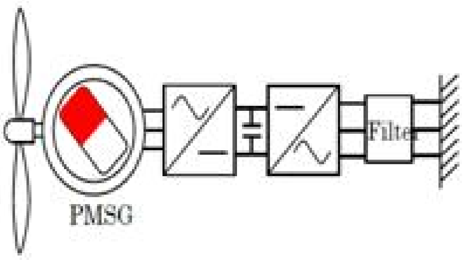


Fig:2a

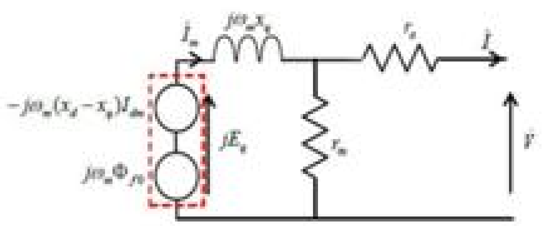


Fig:2b

WIND TURBINE AND SYSTEM OF STUDY

Wind Turbine Concept

The wind effect is extremely important when simulating wind turbines. Wind models take into account the changes in generator power that occur as wind speed changes. The four components that comprise the wind model are as follows:

$$V_{wind} = V_{bw} + V_{gw} + V_{rm} + V_{nm}$$

Where do the Base, Gust, Ramp, and Noise winds live right now?The base component is a constant speed. The wind gust component can be represented by a sine or cosine wave function, either alone or in combination. The noise and ramp components can be represented by a simple ramp function and a triangular wave, respectively. As part of this study, the wind speed is displayed in the simulation results, allowing the system to be dynamically analyzed as the wind speed changes..

MPPT CONTROL FOR SOLAR ENERGY CONVERSION SYSTEM

The MPPT method is used to improve photovoltaic panel performance. The peak power point theorem states that a circuit's output power is greatest when the impedances of its source and load are equal. So, the MPPT algorithm is used to solve the impedance coordination problem. In this study, the Boost Converter functions as an impedance coordination device between the input and output by varying the duty cycle of the converter circuit. The Boost's advantage is that it can convert the available voltage into a range of voltages, from low to high. A power estimate is made by measuring the PV voltage and current with a control algorithm. The duty cycle is calculated by comparing the current power and voltage to those from the previous period. If the power has not changed, it will remain constant; if it has, it will change according to the conditions listed below.

GRID CONVERTER CONTROL

A large number of inverters function as current sources, producing sinusoidal current that is parallel to the grid voltage and has a power factor of one or close to one. In situations where the grid voltage changes, is imbalanced, or has frequency fluctuations, it is critical that the inverter remain in sync with the important portion of the grid voltage. An example of steady-state synchronization for a three-phase system in

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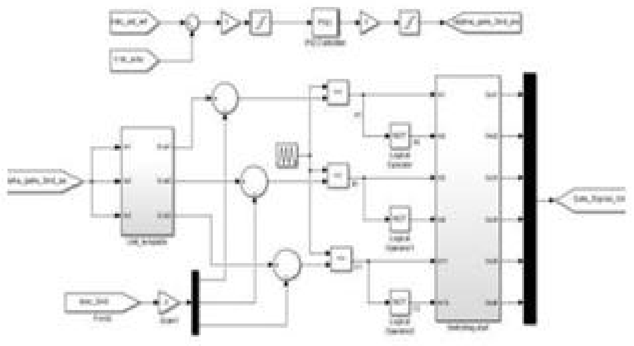
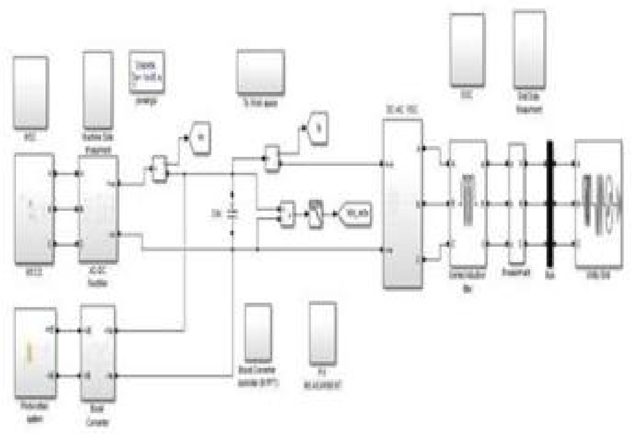


Fig. 3 Grid side converter control

Fig.3, in which three phase wind photovoltaic co-generation system with load.

3.PROPOSED SYSTEM

Figure 1 depicts the proposed hybrid energy generation system. This system's components include an adaptive feedback linearization controller, a solar array, permanent magnet synchronous generators, sinusoidal pulse width modulation (SPWM) converters, and a horizontal axis wind turbine.



4.RESULTS

MATLAB SimulinkTM 17a is used to evaluate the performance of the proposed co-generation system and controllers. The article discusses an energy conversion system that assumes the pitch angle is zero and ignores the yaw control mechanism. The package includes a permanent magnet synchronous generator (PMSG), SPWM AC/DC converter, DC/DC boost converter, and DC/AC inverter. The aerodynamic system consists of several models, some of which compare wind speed and power.

Performance of PVsystem

This image (Figure 4) depicts how well a 100kW photovoltaic (PV) system performs as solar irradiance changes over 10 seconds. This section is divided into five parts. The first graph depicts the profile of solar radiation, the second the PV voltage, and the third the PV current flow. The PV current flows upward as the amount of irradiation increases, and downward as the amount of irradiation decreases. The fourth wave displays a constant dc link voltage of 1400V. The fifth number indicates how much PV energy was produced.

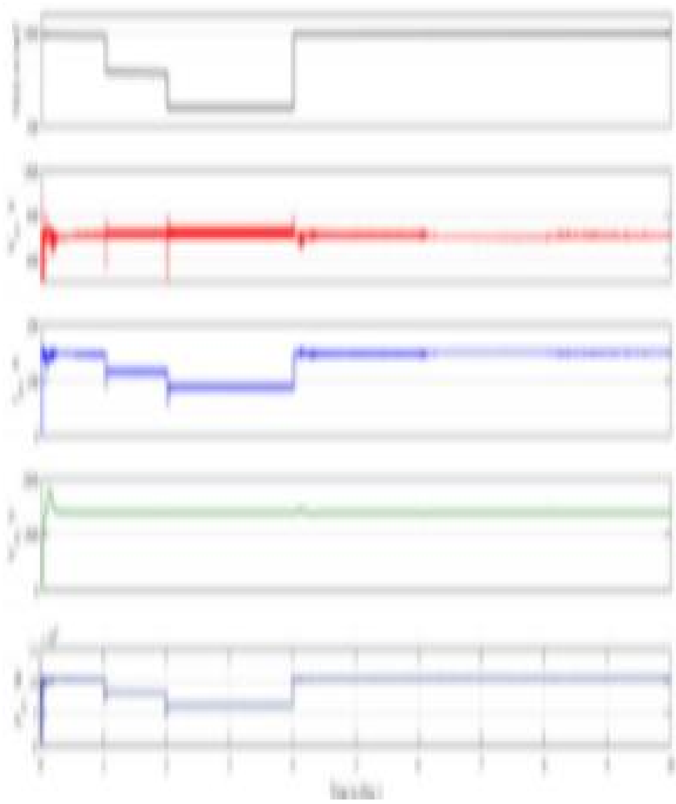


Fig.4.Performance of PV system

A .Performance of wind energy conversion system of co-generation unit

Figure 5 depicts how well the proposed system performs in normal conditions, with the wind speed remaining constant at 12 m/s even when there are disturbances. When the PMSG is operating at close to its rated speed of 2.72 rad/s, the wind turbine generates 2 MW of active power. The generator's electromagnetic torque is -0.68 MN-m, with a negative sign indicating that it is working. The machine side converter maintained a constant DC link voltage of 1400V.

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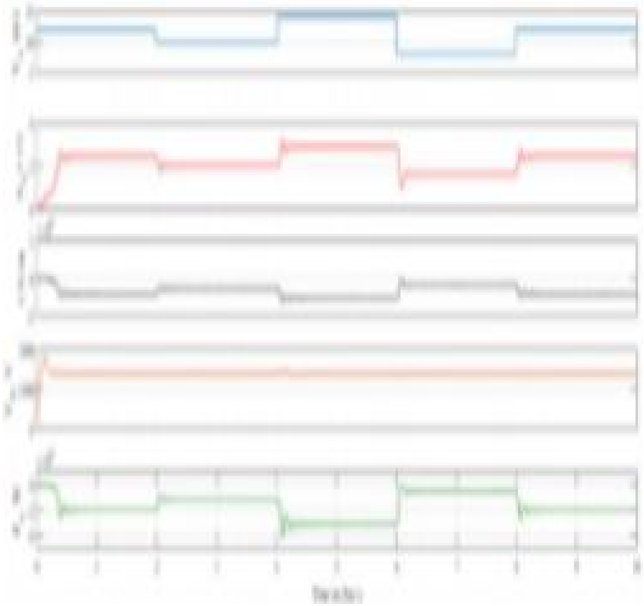

Fig5: Performance of wind energy co- generation system

Performance of grid of proposed cogeneration unit

Figure 6 depicts how effectively the cogeneration unit integrates with the power grid.This analysis focuses on the performance of the proposed system. The first wave shows the grid's voltage, the second wave shows the current entering the grid, the third wave shows the active power entering the grid, and the fourth wave shows the reactive power. As the amount of power generated by wind and solar panels increases, so do the amounts of grid-injected current and active power.

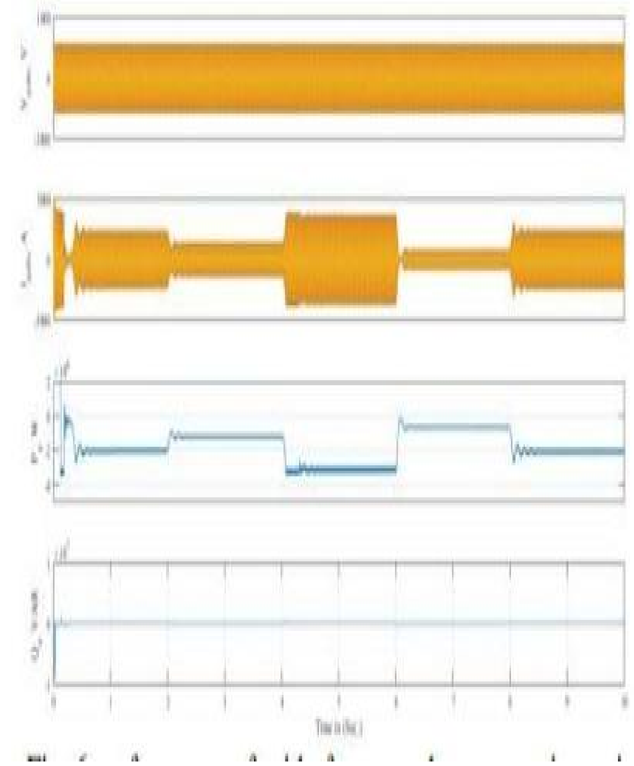

Fig6: performance of grid of proposed co-generation unit

5.CONCLUSION

When more wind-powered photovoltaic cogeneration systems are connected to the grid, each plant's rated power increases. These systems are expected to contribute significantly to the overall mix of electricity generation. This article takes a comprehensive look at wind PV cogeneration systems that are connected to the power grid. Several control strategies for the system are proposed, including PV MPPT control and WECS MPPT control. Additionally, version 2017a of MATLAB Simulink is used to ensure that the inverter control works.When grid side converter control is used, power control (active and reactive) synchronizes with the grid.

REFERENCES:

1. Y.-M.Cheng, Y.-C. Liu,S.-C. Hung,andC.- S. Cheng, “Multi-input inverter for grid-connected hybrid PV/wind power system,”IEEE Trans. Power Electron., vol. 22, no. 3, pp. 1070–1076, May 2007.
2. Snyder Brian, Kaiser Mark J. A comparison of offshore wind power development in Europeand the US: patterns and drivers ofdevelopment. Appl Energy 2009:1845–56.
3. KrichenLotfi, Francois Bruno,OualiAbderrazak. A fuzzy logic supervisory for active and reactive power control of a fixed speed wind energy conversion system. Electric Power Syst Res 2007.
4. Kamoji MA, Kedare SB, Prabhu SV. Experimental investigations on single stage modified Savonius rotor. Appl Energy 2009:1064– 73.
5. De Almeida Rogerio G, Castronuovo Edgardo D, Lopes JA. Optimum generation control in wind parks when carrying out system operator request. IEEE Trans Power Syst 2006.
6. Tapia A, Tapia G, Ostolaza JX. Reactive power control of wind farms for voltage control applications. Renew Energy 2004.
7. ThirigerTorbojorn, Linders J. Control by variable rotor speedof afixedpitchwindturbine

operationin a wide speed range. IEEE Trans Energy Convers 1993;8(3):520–6.
8. NagaiBakuM,AmekuKazumasa,Roy JitendroNath. Performance of a 3 kW wind turbine generator with variable pitch control system. Appl Energy 2009:1774–82.
9. Simoes Marcelo Godoy, Bose Bimal K, Spiegel Roland J. Fuzzy logic based intelligent control of a variable speed cage machine wind generation system. IEEE Trans Power Electron 1997;12(1).
10. Hilloowala Robin M. Rule based fuzzy logic control for a PWM inverter in a stand-alone wind energy conversion scheme. IEEE Trans IndAppl 1996:57–65.