IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Grid-Connected Wind-Photovoltaic Cogeneration Using Back-to-Back Voltage Source Converters

Mr. Chintala Sanjeev[1], E Sai Lohit[2], P Lakshmi Prasanna[3], A Supriya[4]
(Asst. Professor[1] EEE students[2,3,4])
Electrical and Electronics Engineering, St.Peter's Engineering College Opp.Forest Academy, Kompally Road, Dulapally, Maisammaguda, Medchal, Hyderabad-500100, Telangana, India.

Abstract:

With developing concerns, in renewable energy sources can improve which is an increasing amount. This paper reviews both the vitality of the wind and the photovoltaic (PV) energy conversion strategies. And their maximum-power-point tracking (MPPT) methods. Then, a new Grid tied wind–PV cogeneration generation using back to back voltage source converters system is proposed. For the wind power generation permanent-magnet synchronous machine is used to capture the maximum wind power by using optimum speed control. For the PV power generation boost converter is adopted to harness the maximum solar power by tuning 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 of the preferences of nature natural energy sources practically no pollutants, renewable energy wellsprings need pulled in broad consideration. Wind energy is a standout amongst the renewable energy guaranteeing clean energy sources on account of it might be effectively caught toward a wind generator for delivering power into electric energy. Photovoltaic (PV) control is an alternate guaranteeing clean energy wellspring a result it will be worldwide Furthermore could a chance to be utilized without utilizing a rotational generator. Clinched alongside fact, wind energy the more PV control need aid to some degree reciprocal Similarly as solid winds happen basically toward evening and shady days same time sunny days need aid frequently cool for powerless winds. To change over wind energy to electrical energy, two type of wind turbines need aid employed; altered variable velocity wind turbines introduced or Fixed velocity. Fixed speed wind turbines, the control generator is straightforwardly associated with the control grid. Therefore, the generator works during a consistent recurrence What's more pace. Those dynamic Furthermore sensitive force control from claiming these turbines may be portrayed in control. Variable pace wind turbine (VSWT) will be utilized for more excellent fascination of vitality starting with wind. VSWT, which attracts. 10–15% more energy, has lower mechanical stress and less power fluctuation in comparison with the fixed speed ones. To addition, wind turbines are separated under two significant classes: horizontal wind turbines and vertical, more Sherbious are those practically popular verticalaxis wind turbines (VAWT). Those air motion facilitating effectiveness of the VAWT will be more level over that of the level of horizontal yet the multifaceted nature Furthermore cost for these is low. A standout amongst those the greater part significant investigations in the VSWT is the requisition about Different control schemes for a few purposes in the plant. There need aid some techniques with control VSWT. These systems would use to track those greatest power, will control those voltage Also

recurrence of the load Also diminish control variance. Pitch control is a system will control concentrated starting with the VSWT. Most extreme energy fascination starting with those VSWT may be attained utilizing straight control; fuzzy logic control furthermore hill claim searching (HCS) strategy. Due to efficient and economical utilization of renewable energies, some of renewable energy resources such as wind turbine and solar array are integrated. Because of dependency on wind speed and sun irradiance in such systems, their reliability in satisfying the load demands decreases under all conditions. Hence, some studies propose the combination of a diesel generator as a backup and wind/solar power generation systems. This effectiveness expansion of the PV energy preparing system will be futile In the MPPT control does not guarantee that greatest energy may be concentrated starting with those PV array, both toward an enduring state and under fluctuating climatic states. In fact, the total efficiency of the power processing system is almost the product of the conversion efficiencies, which must be maximized by taking into account the extremely variable operating conditions throughout the day as well as the MPPT efficiency. There are multiple MPPT techniques [20] that could be compared using different criteria (Table 1). The main techniques are dP/dV or dP/dI feedback control, incremental conductance (IncCond), and hill climbing {or perturbation– observation (P&O)}.

Table 1
MPPT Comparision for Photovoltaic System

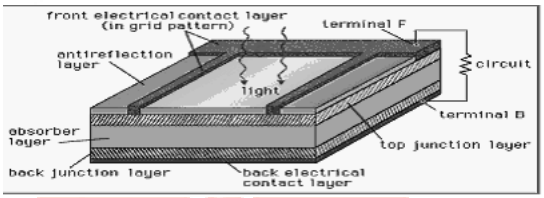
S. no	mppt technique	PV array Dependent	True mppt	Convergence Speed	implementation complexity	Sensed parameters
1	P&O	No	Yes	Varies	Low	Voltage, current
2	IncCond	No	Yes	Varies	Medium	Voltage, current
3	Fractional *Voc*	Yes	No	Medium	Low	Voltage,
4	Fractional *Isc*	Yes	No	Medium	Medium	current
5	Fuzzy logic	Yes	Yes	Fast	High	Varies
6	Neural network	Yes	Yes	Fast	High	Varies
7	*dP/dV* control	No	Yes	Fast	Medium	Voltage, current

On photovoltaic framework a front-end support converter will be by and large obliged toward the enter about inverter will match the load prerequisites. Previously, such DC-AC alternately DC-DC AC energy converters, there will be An likelihood for concurrent exchanging from claiming switches (IGBTs/MOSFETs) of the same leg(s) from claiming inverter because of EMI effect, inappropriate terminating of switches, aggravation out breaking and nonattendance of cross conduction security inside the gate-drivers itself and so on. This prompt shorting from claiming wellspring alternately dc connection capacitor through the shortedleg(s) of inverter, causing a large current flow and damage to the system. A voltage source inverter is one of the examples. Proposed system is designed for maximum energy captured from the wind turbine / solar array and deliver to utility grid.

2. Related Works:

The brief introduction of different modules used in this project is discussed below:

Solar Array:



When light falls on a solar cell, electrons in the absorber layer are excited from a lower-energy "ground state," in which they are bound to specific atoms in the solid, to a higher "excited state" in which they can move through the solid. In the absence of the junction-forming layers, these "free" electrons are in random motion and so there can be no oriented direct current. The addition of junction-forming layers, however, induces a built-in electric field that produces the photovoltaic effect. In effect, the electric field gives a collective motion to the electrons that flow past the electrical contact layers into an external circuit where they can do useful work.

Permanent Magnet Synchronous Generator:

Let's assume that the machine is running at no load and a positive torque is applied to the shaft; that is, the rotor flux angle is advanced ahead of the stator flux angle. As in the case of motor operation, the stator currents will change to create the new conditions of equilibrium shown in Figure 1, under generator. If the machine is initially underexcited, condition (a) in Figure 1 obtains. On the other hand, if the machine is overexcited, condition (b) in Figure

It is important to note that when "seen" from the terminals, with the machine operating in the underexcited mode, the power factor angle (#1) is leading (i.e., I1 leads V1). This means the machine is absorbing reactive power from the system. The opposite occurs when the machine is in the overexcited mode. As for the motor operation, an overexcited condition in the generating mode also allows for greater power deliveries. As generators are normally called to provide VARs together with watts, they are almost always operated in the overexcited condition.

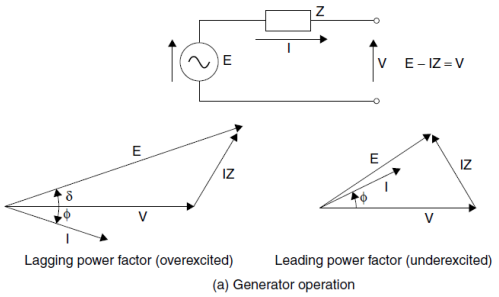


Fig:1

This generator is connected through a back-to-back converter to the grid. This provides maximum flexibility, enabling full real and reactive power control and fault ride-through capability during voltage dips. The schematic diagram and the equivalent circuit of PMSG are shown in Figures 2a and 2b, respectively. The equivalent circuit nomenclature and details can be found.

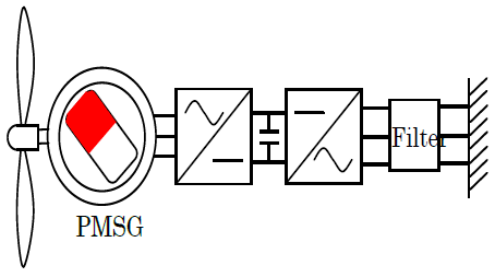


Fig: 2a

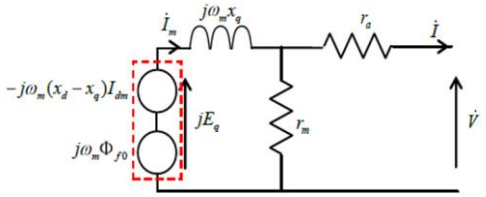


Fig:2b

WIND TURBINE AND SYSTEM OF STUDY

Wind Turbine Concept

The wind effect is very important in modeling wind turbines. Wind models describe wind fluctuations in wind speed which causes power fluctuation in generator. Four components are considered in describing a wind model as shown below:

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

Where, are the Base wind, Gust wind, Ramp wind and Noise wind components respectively in .The base component is a constant speed; wind gust component could be described as a sine or cosine wave function or combination; a simple ramp function and a triangular wave may describe the ramp and the noise components respectively. The wind speed in this study is shown in the simulation results for the dynamic analysis of the system during wind speed change.

MPPT CONTROL FOR SOLAR ENERGY CONVERSION SYSTEM

To enhancing the efficiency of the photovoltaic panel MPPT is utilized. According to the maximum power point theorem, the output power of any circuit will be maximum whenever source impedance equivalent to the load impedance, so the MPPT algorithm is utilized to the problem of impedance coordination. In this paper work, the Boost Converter is utilized as impedance coordination device between input and output by changing the duty cycle of the converter circuit. Favorable position of the Boost is that low to high voltage is acquired from the accessible voltage. Control algorithm, the PV voltage and current are sensed and then estimate the power, after that find the change in power and voltage by comparing the previous power and voltage; if change in power is zero then duty cycle will be same as previous otherwise duty cycle will change according to the followed condition

GRID CONVERTER CONTROL

Most inverters operate as current sources injecting a current that is sinusoidal and in phase with the grid voltage, with a power factor equal or very close to unity. It is required that the inverter synchronizes with the fundamental component of the grid voltage, even in the cases when the grid voltage is distorted or unbalanced or when the grid frequency varies. An example of synchronization in steady state for a three-phase system is shown in

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

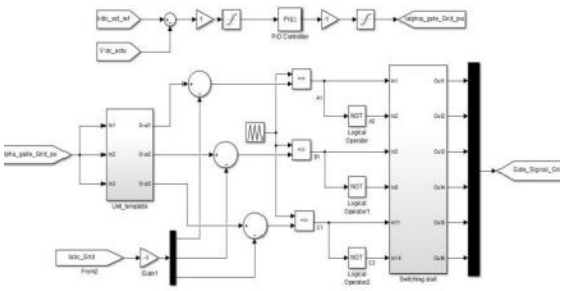


Fig. 3 Grid side converter control

3. Proposed system:

The proposed hybrid energy generation system is depicted in Fig. 1. This system consists of a horizontal axis and variable speed wind turbine, a solar array, permanent magnet synchronous generators, sinusoidal pulse width modulation (SPWM) converters, DC/DC converters, an adaptive feedback linearization controller

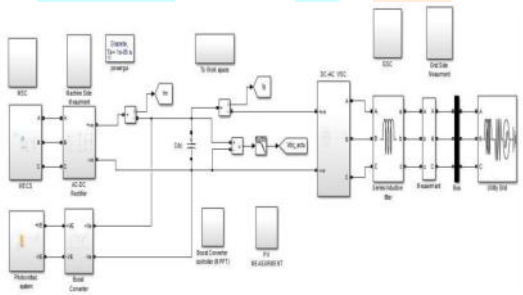


Fig. 1 Proposed System modeling

4. RESULTS:

MATLAB Simulink™ 17a is used to evaluate the performance of the proposed co-generation system and controllers. For the energy conversion system utilized in this paper, pitch angle is assumed zero and yaw control mechanism is not considered. It consists of an aerodynamic system based on wind speed model, wind power versus wind speed model and etc., permanent magnet synchronous generator (PMSG), a SPWM AC/DC converter, a DC/DC boost converter, a DC/AC inverter and AC filters, PID controllers.

A. Performance of PV system

Fig. 4 shows the performance of PV system with time 0 to 10 second of 100kW rating solar irradiation increases and decreases to perform the system. This section is divided into five section in which first section represent to solar irradiation profile, second section present to PV voltage, third waveform represent to PV current which is depends on solar irradiations profile if irradiation is increases then PV current is increases and whenever irradiations decreases then current is decreases. Fourth wave shows the dc link voltage which is constant of magnitude 1400V. Fifth one represents to PV power generated.

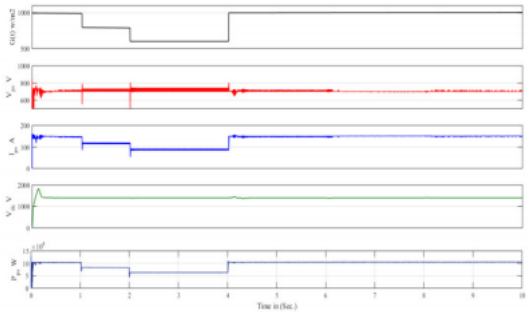


Fig. 4. Performance of PV system

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

Demonstrating the performance of proposed system under normal conditions when wind speed is fixed at 12 m / s with disturbance depicted in Fig. 5. When PMSG operated near rated speed at 2.72 rad/s, active power generated from wind turbine is 2 MW and electromagnetic torque of generator is - 0.68 MN-m (negative sign indicate that machine operated as generator). Machine side converter maintained DC link voltage at 1400V.

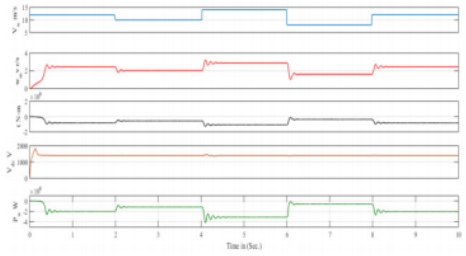


Fig 5: Performance of wind energy co-generation system

Performance of grid of proposed cogeneration unit

Fig. 6 shows the performance of grid of cogeneration unit. Here performance of proposed system analyzed, in which first wave represents to grid voltage second one to grid injected current third one is grid injected active power while fourth one reactive power wave. It is observed that whenever power generation by wind and PV increases then grid injected current is increases and therefore active power is increases.

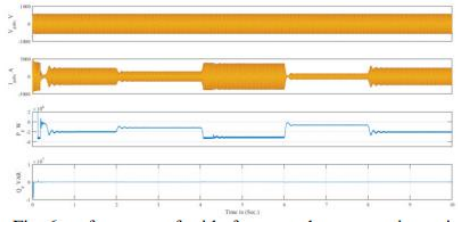


Fig 6: performance of grid of proposed co-generation unit

5. CONCLUSION:

Wind-PV Co-generation system connected to the grid are increasing both in the number of installations and also in the rated power of each plant and will cover a significant percentage of the electric generation mix. In this article, a comprehensive overview of grid-connected wind PV co-generation systems is presented. Different control techniques for proposed system such as PV MPPT, WECS MPPT control. And Inverter control and its performance is validated through the MATLAB Simulink version 2017a.Grid side converter control is done to grid synchronization with power (active and reactive) control.

REFERENCES:

[1] Y.-M. Cheng, Y.-C. Liu, S.-C. Hung, and C.-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 Europe and the US: patterns and drivers of development. 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 speed of a fixed pitch wind turbine operation in a wide speed range. IEEE Trans Energy Convers 1993;8(3):520–6.

[8] Nagai Baku M, 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.