

POWER QUALITY IMPROVEMENT OF DISTRIBUTION SYSTEM WITH PV SYSTEM BASED USING STATCOM

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ABSTRACT : This paper presents power quality improvement for effective power transfer throughout a grid-integrated star photovoltaic-wind energy hybrid system. The hybrid system constitutes a renewable energy farm, supported electrical phenomenon energy generation system and wind energy conversion system. The system occurrences continued interference in AC masses and power output from the property farm. This produces reactive power incompatible and will increase voltage unpredictability and power quality problems. This gap is sometimes eliminated exploitation associate adjustable reactive power supply i.e., static synchronous compensator. 3 case eventualities of the hybrid system, i.e., Hybrid system in (I) standalone mode, (II) grid-integrated mode and (III) grid-integrated mode with STATCOM, area unit tested to match their dynamic and transient performances. Results show that scenario-III best fulfilled the dynamic compensation demand among all cases. below this state of affairs, load bus voltage is regulated at around one.0 p.u. and total harmonic distortion in voltages/currents unit of measurement maintained at around one p.c. moreover, this situation incontestable superior transient response towards a step modification in reactive power load, considerably reducing most peak deviation by seventy-three.4% and sinking time by seventy fifth in receiving voltage compared to the critical case of scenario-I.

Keyword: Solar photovoltaic, Wind energy, Hybrid PV-Wind system, STATCOM, Voltage stability.

INTRODUCTION

With the urbanization, industrial enterprise and rise in living standards, the utilities area unit burdened with the escalating pace in demand for electricity. The ability provide from mere typical sources is unable to cater to trendy power demand and therefore raising the difficulty of power reliablenss and security whereas the massive quantity of pollutants poses serious environmental problems. In last twenty years, renewable and distributed energy sources have emerged as a supplement to standard energy sources and area unit predicted by utility engineers as a potent resolution in fulfillment of load demand in with success overcoming the ability problems. Hybrid Renewable Energy Systems (HRES) based mostly Distributed Generation (DG) is that the recent trend within the renewable energy system because it has shown to enhance the performance and liableness. Varied opportunities are argued for effectively exploiting many renewable energy sources for electricity generation. Among all the trending renewable energy resources, wind and alternative energy sources combined along are used expeditiously in various hybrid systems. Recently, star PV-Wind hybrid systems received vital attention from the utilities worldwide. The work conferred during this paper involves the elaborated modelling, technique and comprehensive performance analysis of Wind electrical phenomenon hybrid energy system inter-connected to the grid via power-electronic interfacing. To get an additional sensible state of affairs, variable AC load is utilized within the system in conjunction with intermittent power sources of star PV and WEC system in a trial to introduce severe dynamics into the hybrid system. This primarily drives a necessity for a supply of variable reactive power thus on maintain a voltage profile at the load bus. In these circumstances, STATCOM is envisaged to be a alternative of the device because the same has been verified to enhance the voltage regulation in isolated hybrid systems as steered by many studies. System modelling further because the simulation is finished mistreatment MATLAB/Simulink 2019. Results area unit obtained to assess the performance and verify the practicability of the grid-connected hybrid system over isolated systems and to prove the suitability of STATCOM within the increase the voltage characteristics of the load bus.

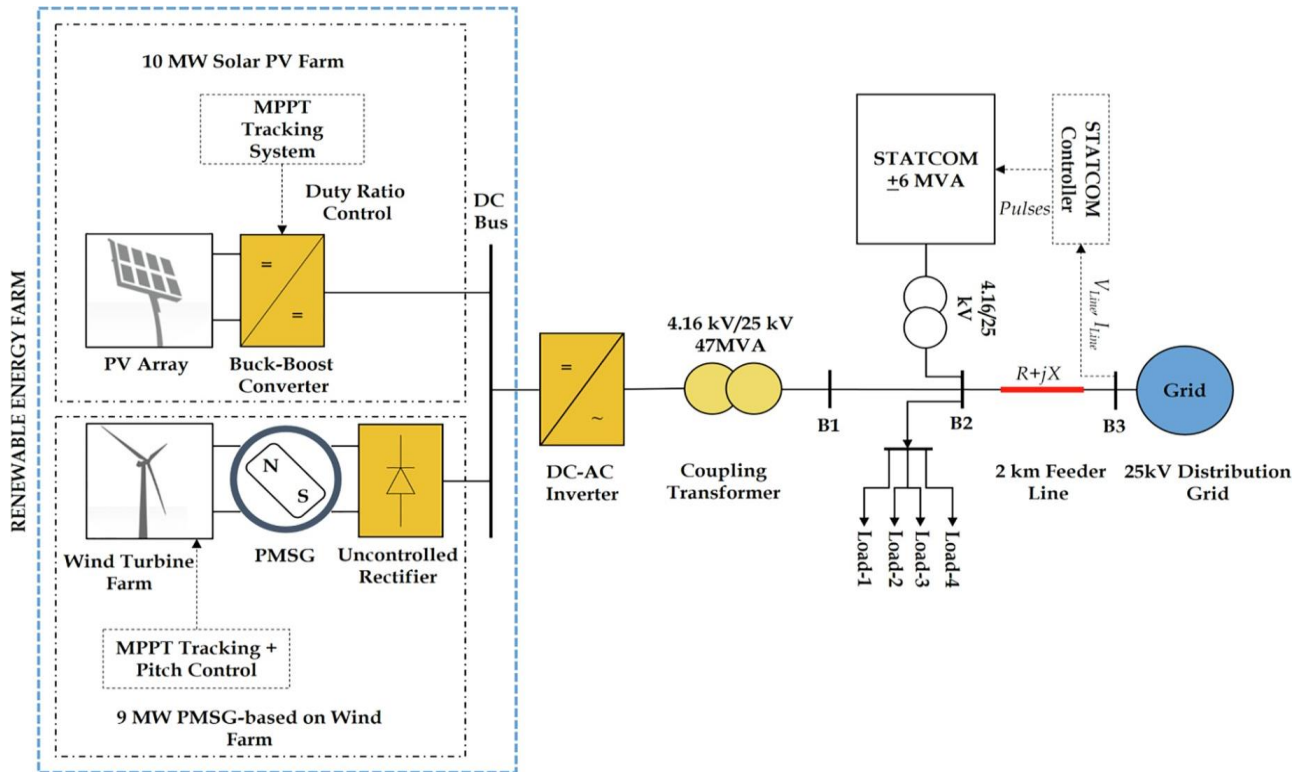


Fig. 1. Configuration of the PV-Wind hybrid renewable energy system interconnected with a distribution grid compensated using STATCOM.

Utilities are increasingly burdened with electricity demand. The facility supply from mere conventional sources is unable to cater to modern power demand and thus raising the difficulty of power reliability and security while the large number of pollutants pose serious environmental issues [1,2]. In last 20 years, renewable and distributed energy sources have emerged as a supplement to standard energy sources and are foreseen by utility engineers as a potent solution in fulfillment of load demand in successfully overcoming the facility issues [3,4]. Hybrid Renewable Energy Systems (HRES) based Distributed Generation (DG) is that the recent trend within the renewable energy system because it has shown to enhance the general performance and reliability [5]. Numerous opportunities are suggesting for effectively exploiting several renewable energy sources for electricity generation [6]. Among all the trending renewable energy resources, wind and solar power sources combined together are used efficiently in diverse hybrid systems. Recently, Solar PV-Wind hybrid systems received significant attention from the utilities worldwide [7,8] Wind and solar power systems complement one another during each day cycle. Solar power, having a possible of even providing as high as fourfold the entire global energy demand during a certain region of North Africa [9], is present throughout the day while strong winds mostly occur during nocturnal period. Usually, strong winds are observed within the course of the already dark also as cloudy days in contrast to weak winds occur during bright days [10]. Regardless of their intermittent behavior and inherent drawbacks, Wind-PV hybrid energy systems are wont to supply energy to load with greater reliability and continuity of supply [11,12]. Despite having the ability to provide power with improved continuity and reliability, the volatile nature of such intermittent energy sources which directly affects the critical stability between the renewable energy sources' power supply and therefore the connected load [13]. As a consequence, deviations in bus voltage and system frequency, oscillations at intervals the system, and supernumerary reactive power generation are determined in turn moving the system's stability and power quality [14]. With the arrival of power physical science technology and associated versatile A.C. transmission (FACTS) devices [15], the devices notice its potential applications in such Renewable Energy Sources (RES) in mitigating power quality problems arising from their integration. Varied devices on the market are being utilised and researched, providing satisfactory results [16].

Out of many devices, SVC and STATCOM are reportedly best fitted to reactive power compensation and voltage maintenance support [24]. SVCs are wont to increase the ability quality downside in isolated hybrid systems [25,26] supported reactive power management. However, STATCOM, being a VSC primarily based device exhibits higher performance compared to SVC, considering the identical vary and ratings [27,28]. Mohanty et al. [29] conferred the advantages of Genetic Algorithm (GA) AND Particle Swarm optimization (PSO) optimized STATCOM implementation in an off-shore wind-diesel-tidal rotary engine hybrid system. The hybrid system was established by adopting the tiny signal model. Simulation results verified reactive power compensation is accomplished by the combination of the STATCOM controller. Shanthi et al. [30], incontestable AN economical power transfer structure for hybrid Wind-PV, created doable with a minimum variety of converters, wherever grid aspect device for WEC is employed as STATCOM for rising grid dynamics. Mohanty et al. [31] have outlined numerous problems related to poor transient stability in AN autonomous Wind/ Diesel/PV hybrid system and conferred the impact of UPFC, SVC and STATCOM in suppressing the hybrid system dynamics. The careful comparison unconcealed that STATCOM possessed superior characteristics over typical PI controller-based SVC. The simulation study administered by Bhatti et al. [32] investigated the impact of STATCOM to manage bus voltage in AN autonomous Wind-Diesel hybrid, by compensating reactive power demand of immune globulin and variable load, thereby maintaining system stability once a step modification is administered in reactive load and wind speed. in reactive load and wind speed.

SOLAR PV MPPT MANAGEMENT TECHNIQUE

To facilitate most power from a PV system, associate influence electronic DC device is required to need care of the bus voltage at the output to such a gaggle purpose where most power unit of measurement sometimes discovered. This electrical device is nothing but associate MPPT controller introduced between the PV system and payload. A buck-boost power device as given in Fig. 4(a) is one all told the often-used MPPT topologies. A voltage device is employed aboard to induce shift pulses supported variable duty magnitude relation management at a seamless carrier frequency thus on maintain mounted periodic pulses, as shown in Fig. 4(b) Reference voltage $V_o(\text{reference})$ may even be a significant signal needed to be computable pattern one all told the numerous MPPT management techniques offered up to now [40]. a seamless voltage technique [41] is reportable to be the foremost convenient to use. though this system demonstrates restricted accuracy compared to completely different advanced techniques, it's still hottest where speed and straightforward calculations unit of measurement priorities. this system is fast due to the particular undeniable fact that reference voltage value is quickly calculated by setting the magnitude relation of most purpose voltage to circuit voltage (V_{amp}/V_{oc}) at intervals the vary from zero.72 to 0.78 for varied insolation as given in (2). This magnitude relation holds true for many of the PV cells commercially offered once constant or dazed temperature variations occur. Thus, the right choice for this work since the temperature is unbroken constant at twenty-five °C.

$$V_o(\text{reference}) = 0.72 \times V_{oc}$$

Comparison of this signal with output voltage signal $V_o(\text{sensed})$ and generation of switch signals unit administered by normal PI controller (with gains set to $k_P = \text{one}$ and $k_I = 5$), dominant the output voltage at around V_{mpp} . rotary engine farm wind farms have some place in turbines to provide one purpose to collect the energy related to process winds and convert it into a usable form of energy, i.e. electricity through electrical generators. The mechanical power P_w created by a rotary engine may even be a perform of air density $\rho(\text{kg}/\text{m}^3)$, the radius of blade R (m), wind speed V_w (m/s) and power constant C_P which might be a perform of tip speed magnitude relation magnitude relation and so the pitch angle of blade β (degrees). Mechanical power generated as a result of interaction between process winds and rotary engine unit generally made public by the subsequent mathematical equation.

FUTURE WORK

In this paper the frilly modelling, possibility and comprehensive performance analysis of Wind physical phenomenon hybrid energy system inter-connected to the grid via power-electronic interfacing. to urge a ton of smart state of affairs, variable AC load is employed at intervals the system beside intermittent power sources of star PV and WEC system during a shot to introduce severe dynamics into the hybrid system. This primarily drives a necessity for a provider of variable reactive power so on maintain a voltage profile at the load bus. In these circumstances, STATCOM is envisaged to be a range of the device as a result of an equivalent has been verified to boost the voltage regulation in isolated hybrid systems as prompt by several studies.

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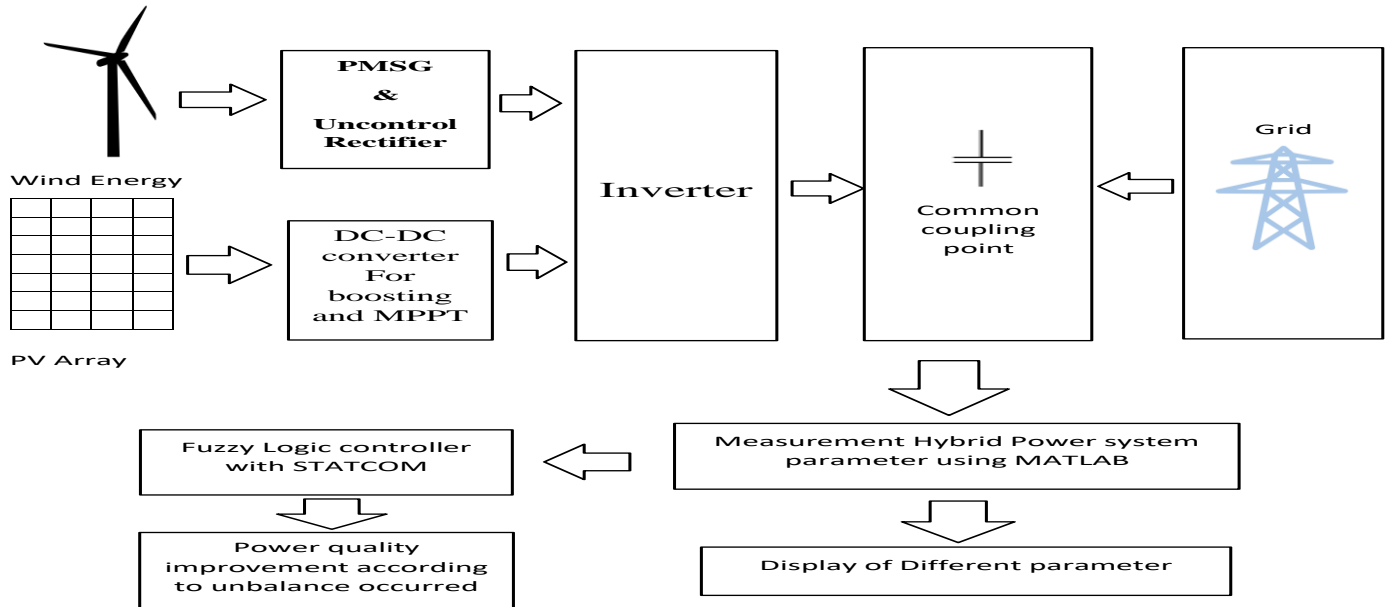


Fig.2 proposed block diagram

CONCLUSION

This paper explored the potential influence of STATCOM in associate surroundings of Grid-Tied Hybrid star PV-Wind system in presence of variable loading conditions. 3 whole whole totally different case eventualities were developed to assess the effectiveness of the STATCOM to strengthen the voltage regulation so, the responsibility of such systems. The effectiveness of each case state of affairs is evaluated grounded on dynamic place along as transient responses. Measure is to boot performed for transient responses obtained for each case. Results obtained showed that the voltage profile is with success maintained in presence of STATCOM, that effectively counters the presence of further reactive power flow on the road and suppress its undesirable effects. Therefore, STATCOM is verified to be a necessity just merely simply just in case the hybrid system is functioning in grid integrated mode to any elevate the system performance. Therefore, a conclusion unit generally drawn from the simulation results obtained that the STATCOM possesses the ability to stabilize the voltage at the connecting bus by compensating reactive power and might provide a shocking answer to the utilities for the event of performance and responsibility of these systems. This work thought of solely linear heaps, either strictly resistive or inductive in nature, for simple simulation. However, these heaps rarely exist in power systems. Wise heaps largely embrace non-linear and inductive motor heaps, adding any system disturbances in terms of current unbalance and harmonic injections. In future, this work would possibly even be extended by implementing such wise heaps in grid-integrated hybrid RES surroundings to review their effects on the system dynamics and explore the potential varied various of assorted} FACTS controller to accomplish various functions against harmonics and unbalance in system current.

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