Result Analysis of Authority to Control of Variable Pitch and Variable Speed of Wind Turbines in Fragile Grid Structure With Active Power Balance

[1] Shikha Chaturvedi, [2] Nisheet Soni,
[1] M.tech. Scholar, [2]Head of Department,
[1,2] Electrical Engineering Department,
[1,2] Shri Ram Institute of Technology, Jabalpur, India

***Abstract*— In the case of operating in a very weak grid system, when wind generation becomes a significant portion of the power system or maybe the only energy supply, the wind power generators and converters are expected to help maintain the grid voltage. The terminal (grid) region convertor desires to vocation as an electrical energy source to assist control the terminal (grid) voltage amplitude and rate of recurrence by regulate the reactive control and active power flow, severally. For a direct-drive magnet synchronous generator through a full power convertor, the active power must be provided by the captured wind generation. The active power flow between the supply (captured wind power) and therefore the grid (load) should be balanced by actively controlling the generator speed and turbine pitch angle. In the study, the coordinated control of generator speed and blade pitch angle is planned along with a dc-link voltage controller. A model of the grid-side tool prepared as a voltage give for design and also the strategy relating to voltage and frequency regulation is given. Simulation is administered with totally different wind and cargo profile. The results show the wind energy will facilitate support the weak grid and power the native grid in complete mode still.**

***IndexTerms*—SCIG (squirrel cage induction generator), PCC (point of common coupling), DFIG (doubly-fed induction generator).**

I. Introduction

In the present day, for the most part distributed generation (DG) from wind property in medium voltage (MV) and low voltage (LV) distribution networks accounts for a comparatively little share of the power provided by the networks. The grid is typically perceived as a perfect voltage supply (strong grid) and also the generator and power device operates as a current supply, wherever the most wind generation is transferred to the robust grid, following MPPT (maximum electrical outlet tracking) mode. This case is probably going to vary within the close to future, as an outsized installation of wind generation is inspired in several countries due to the distinct advantages they will offer: property, emission-free. The space between the power station and cargo centre is typically terribly long; the drop due to the state of the conductor can vary for various wind generation and cargo conditions. Similarly, the grid frequency additionally varies with power; within the case wherever the bus isn't infinite (e.g. the generators connected to the grid are droop controlled). Therefore, the power station is after all facing a weak grid, wherever the voltage of the purpose of common coupling (PCC) isn't a perfect voltage supply. During this case, once wind generation becomes a big portion of the facility system or maybe the only real energy supply, the wind generation generator and its device are expected to assist maintain the grid voltage and frequency, operational sort of a standard giant synchronous generator (SG). The weak grid condition may be a result of intended disjointing or is landing from the grid or grid faults (unintentional islanding). It applies still to the complete operational mode. The structure of a typical weak grid system with wind turbines and native load still because the transmission network. The bus that the system is connected to is assumed to own restricted capability with frequency droop characteristics. Every turbine adopts the topology of a full power device and a direct-drive permanent magnet generator (PMG).

Several papers have studied the device complete mode operation and power sharing between the load-side converters exploitation droop management, forward the device dc-link voltage is constant with active power balance, while not considering the supply (wind) characteristics. The authors mentioned the turbine active power management by dynamic the generator speed and don't embrace pitch management for adjusting the input power. In adopt the auxiliary load (damping resistor) to dissipate the excessive wind energy for power equalization purpose that isn't sensible for big wind turbines.

II. Method

Active Power Control

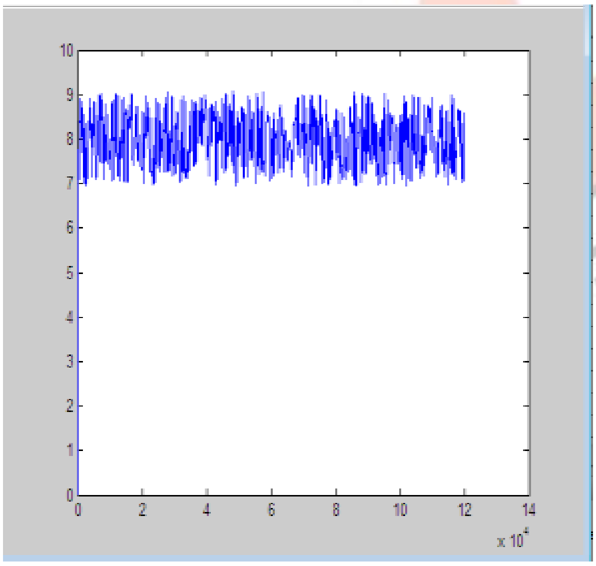
Active power control helps balance load with generation at numerous times, avoiding inaccurate power flows, involuntary load shedding, machine injury, and therefore the risk of potential blackouts. Active Power Controls from Wind Power: finds that wind generation will support the facility system by adjusting its power output to reinforce system responsibleness. In addition, the study finds that it typically can be economically useful to supply active power control, and probably damaging hundreds on turbines from providing this control is negligible. The wind generation response has to improve facility reliability; not impair it. Active power management shouldn't have negative impacts on the rotary engine loading or induce structural injury that would scale back the lifetime of the rotary engine. if the grid may be treated as a perfect voltage supply (strong grid), then the generator and power device is operated as a current supply. Therefore, the generator-side convertor the PMG torque, so adjusting the PMG speeds to attain MPPT in conjunction with the pitch system. The grid-side converter managements the convertor dc-link voltage, transferring all the ability generated from the PMG to the grid. This is the control strategy presently adopted by most of the massive variable speed wind turbines. However, within the case of a weak grid, the grid has restricted capability and afterward the voltage amplitude or frequency at the PCC could exceed the allowable limit if the quantity of wind generation isn't well regulated. Additionally, poor voltage quality at the PCC means no stiff voltage reference may be provided for correct converter control. Similarly, in complete mode, the local grid (load) will solely consume specific amount of wind power. Under these conditions, the turbine system should support the grid with appropriate amount of active power (frequency control) and reactive power (voltage amplitude control), in keeping with the grid and load conditions.

MPPT Technique

Maximum Power Point track, commonly referred to as MPPT, is associate electronic system that operates the electrical phenomenon (PV) module in a very manner that permits the modules to get all the ability they're capable of. MPPT isn't a mechanical following technique that “physically moves” the module to construct them purpose additional directly at the sun. MPPT is totally electronic systems that change the electrical operating purpose of the modules so the modules are able to deliver most accessible power. Additional power harvested from the modules is then created offered as increased battery charge current. MPPT may be used at the same time with a automatic following system, however the 2 systems are fully completely different. to acknowledge however MPPT works, let’s initial decide the operation of a standard (non MPPT) charge controller. Once a standard controller is charge a discharged battery, it essentially connects the modules on to the battery. This forces the modules to control at battery voltage, sometimes not the perfect operating voltage at that the modules are able to manufacture their most offered power output. MPPT or most electric receptacle following is algorithmic rule that enclosed responsible controllers used for extracting most offered power from wind module below bound conditions. The voltage at that wind module will generate most power is termed ‘maximum power point’ (or peak power voltage). Most power varies with wind module produces power with most power voltage. A MPPT or maximum electric receptacle hunter is associate electronic DC to DC device that optimizes the equivalent between the star vary (PV panels), and also the battery bank or utility grid. to place it merely, they modify a better voltage DC output beginning star panels (and some wind generators) right down to the lower voltage required to charge batteries.

III. Simulation Results

A simulation model has been built in MATLAB/Simulink with the basic structure. The simulation results shown in below figure.



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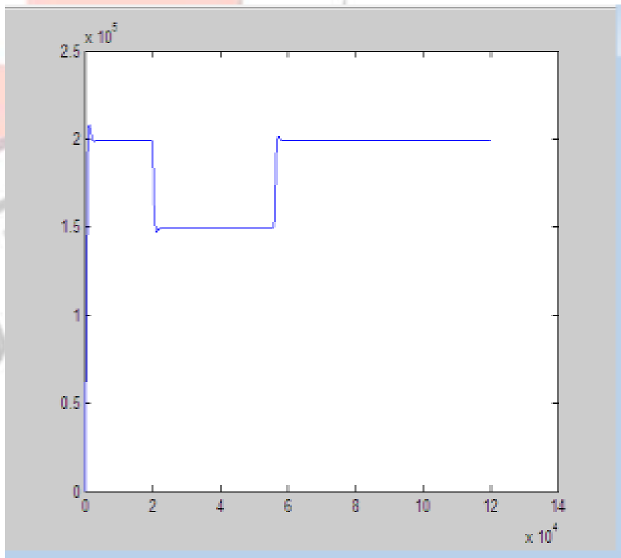

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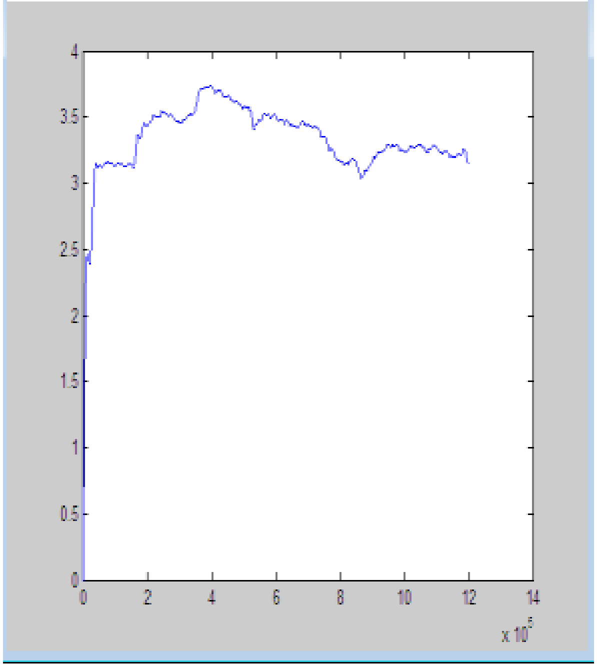
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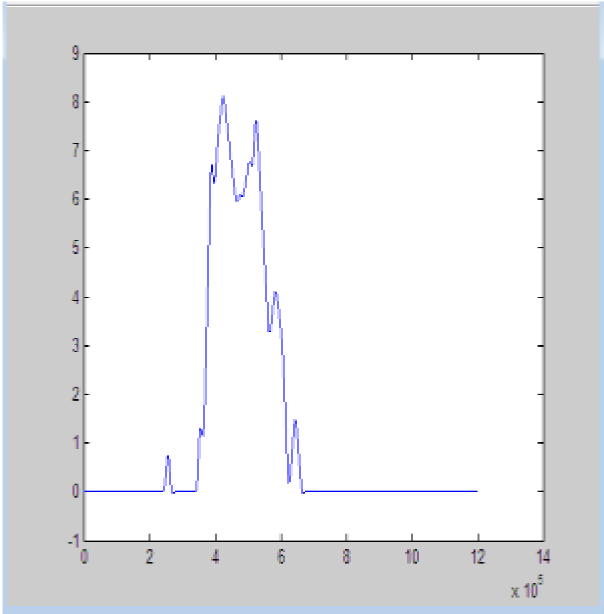
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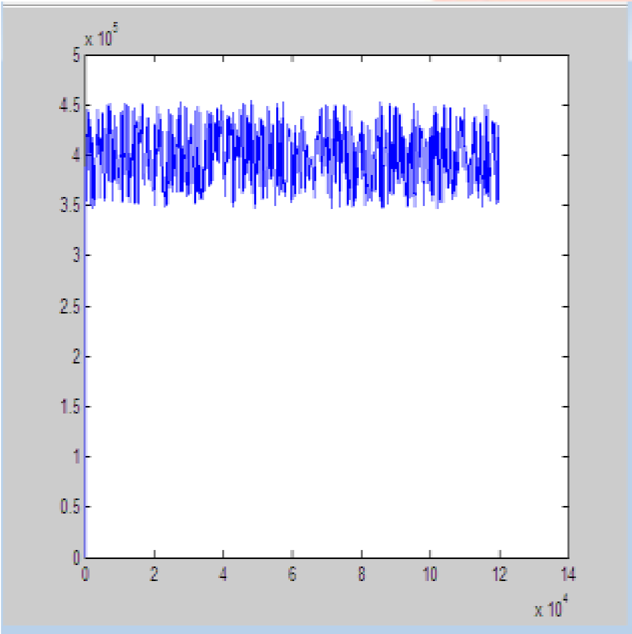
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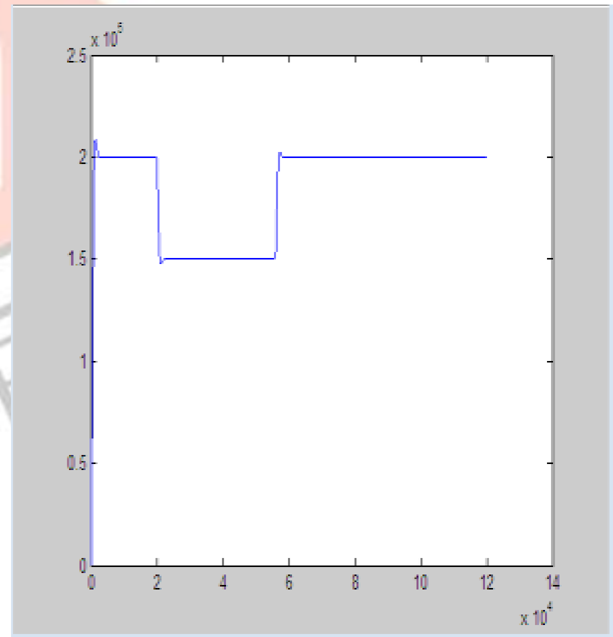
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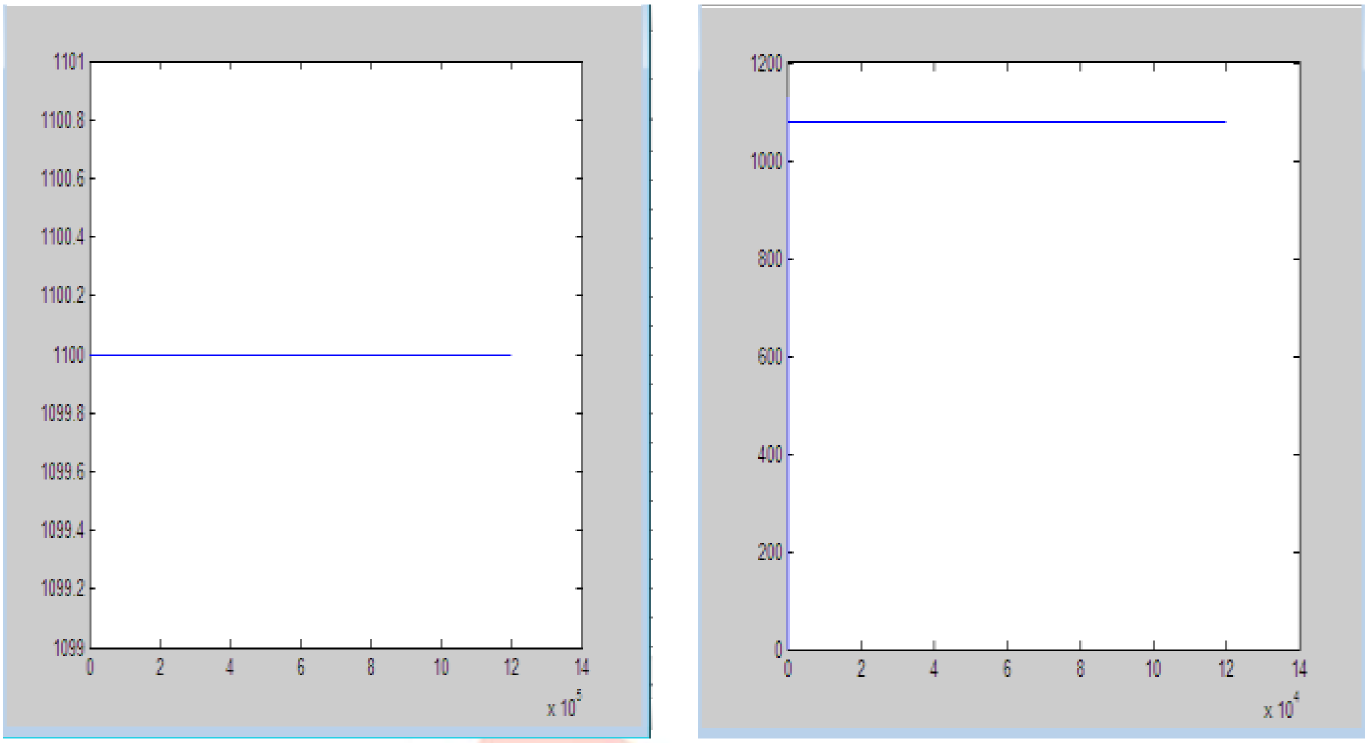
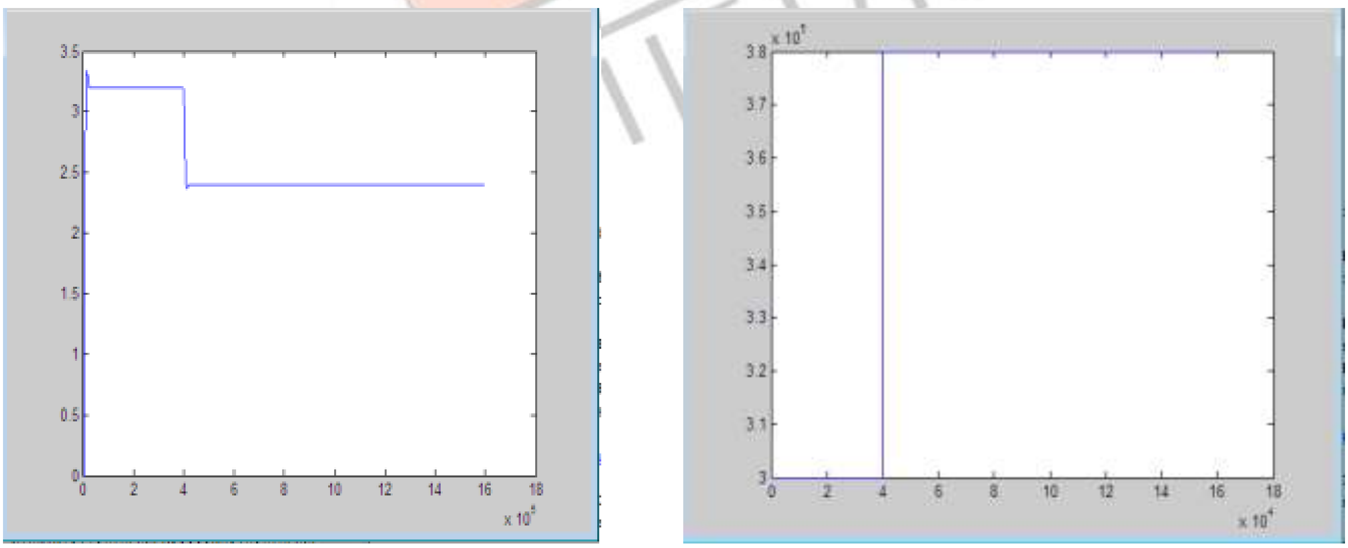


(g) (h)

Fig .1 Simulation results for active power balancing

(a)Wind speed profile
(b) Load power
(c) Wind turbine pitch angle
(d) PMG speed
(e) PMG output power
(f) PMG output power
(g)Dc-link voltage



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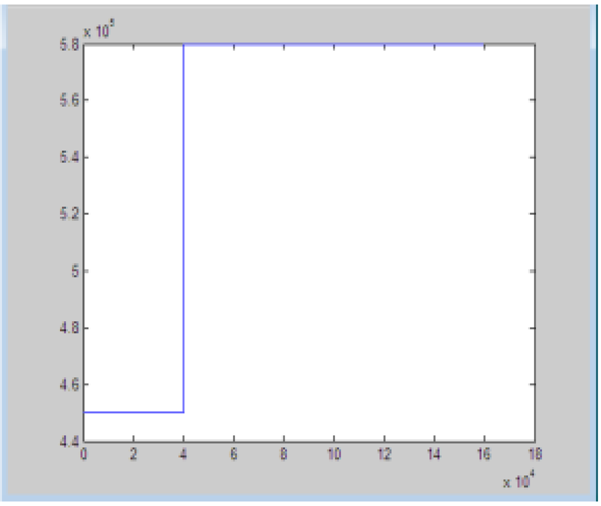

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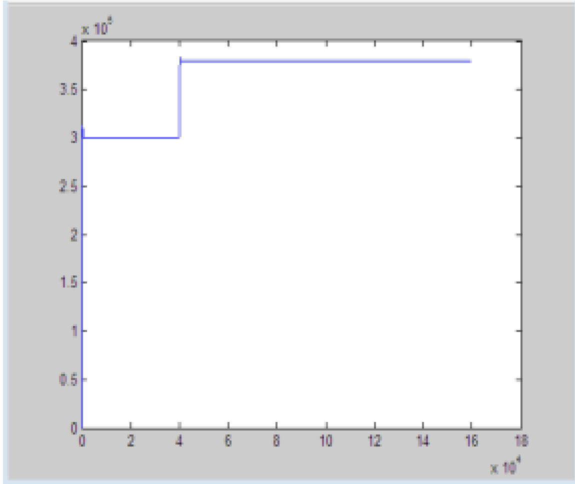

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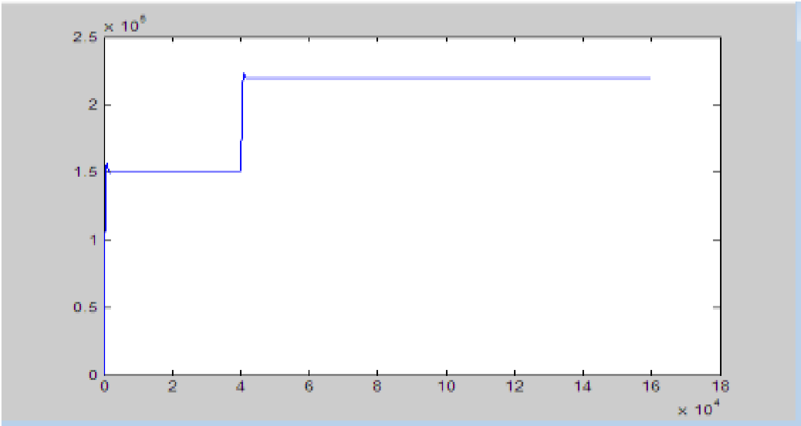

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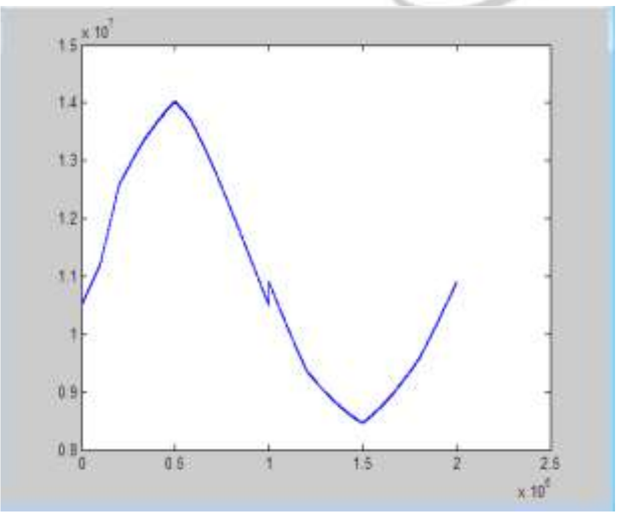
Fig. 2 System performance during load increase

(a) Generator speed
(b) Wind generator power reference
(c) Load power, wind generator output power and grid power



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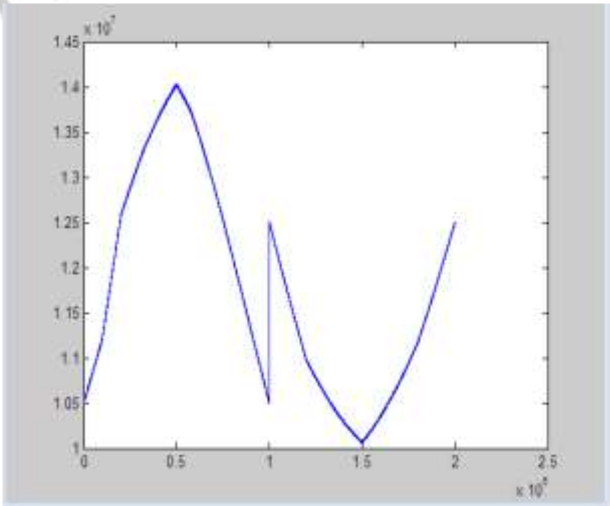

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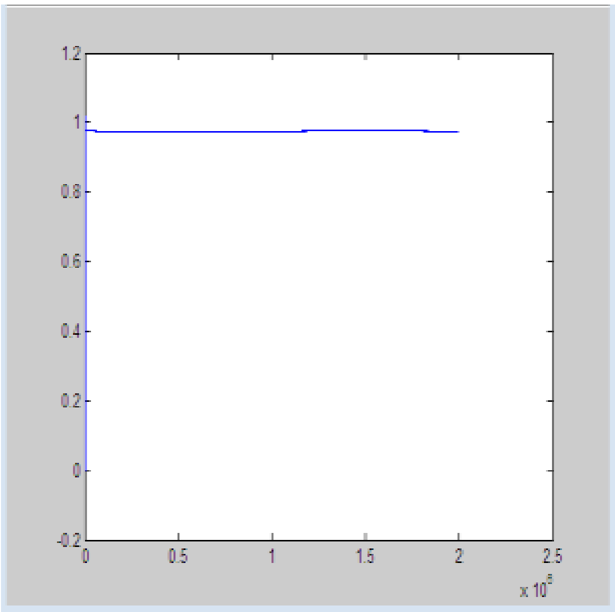

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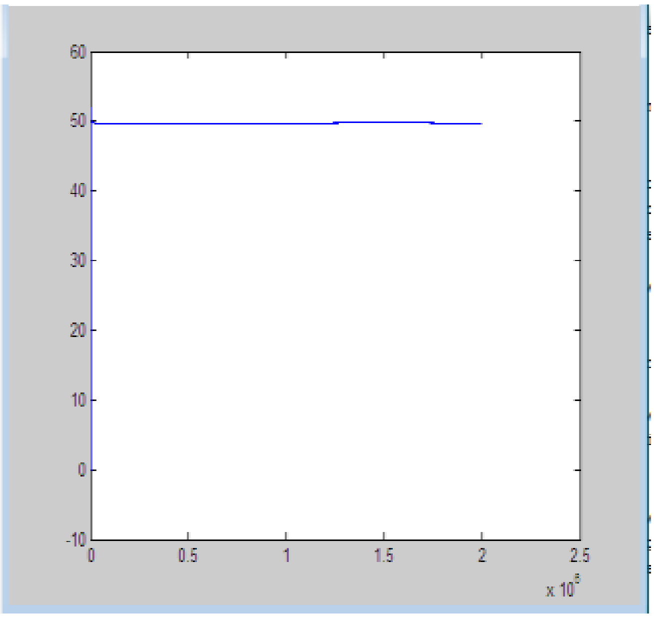
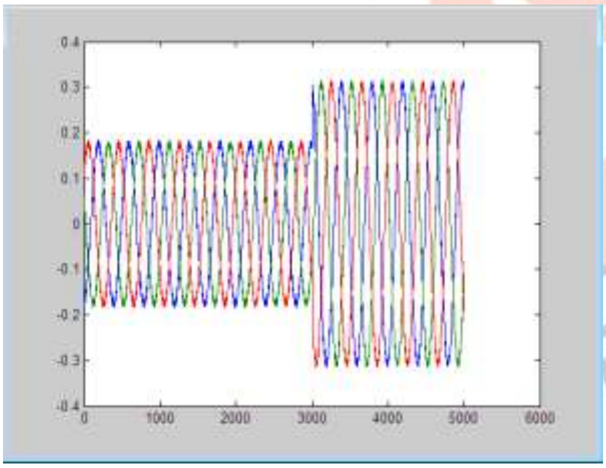


(d)

Fig. 3 Simulation results with a wind farm connected to a weak grid system

(a) Reference load power and real load power with/without wind power support
(b) Voltage amplitude and frequency at PCC point with/without wind power support
(c) Grid power and wind power



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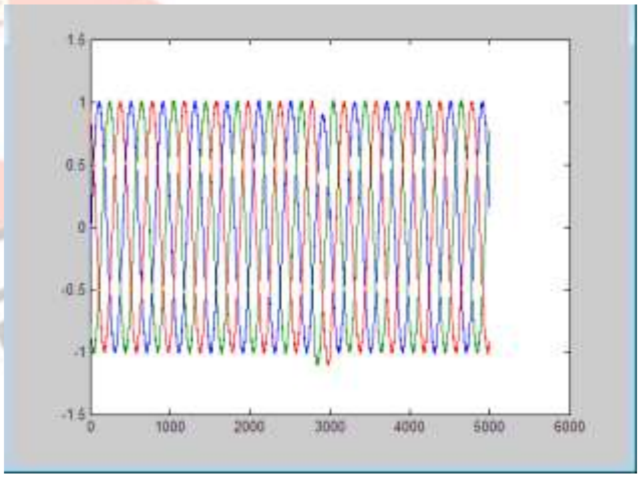

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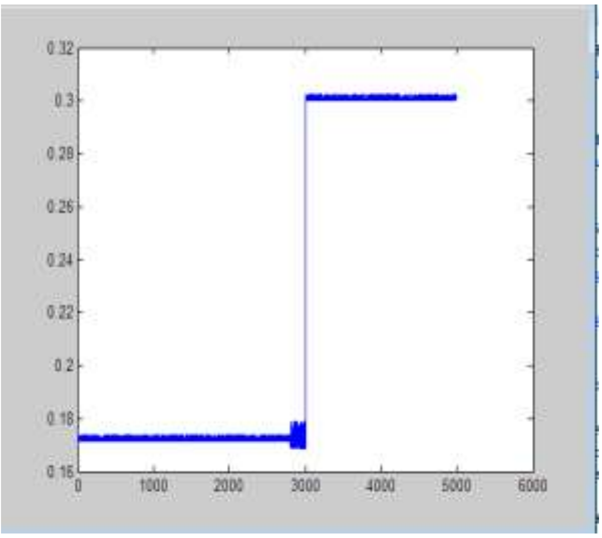

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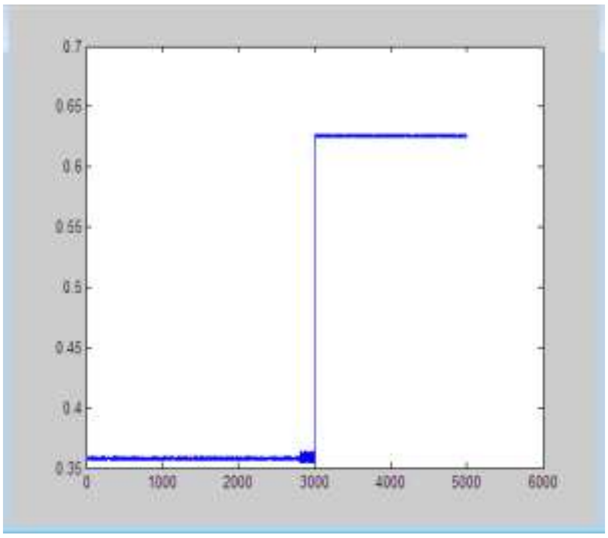

(b)

Fig.3 Simulation results for two wind turbines in a stand-alone system

(a) Voltage at the PCC and converter output current during load change
(b) Active power output of converter I and converter II

IV. Conclusion

In this paper in a very weak-grid system or complete system, the captured alternative energy ought to be balanced with the load power, which may be achieved by the generator speed and rotary engine pitch management. By dynamic the generator speed, the captured wind generation will be adjusted and therefore the K.E. is keep or free consequently, that is useful for damping the load power modification. The pitch management is coordinated with the generator speed management and is employed for limiting the generator speed varies. A well-designed dc-link voltage controller will maintain the active power flow balance between the supply and cargo. The droop management is adopted for power sharing between multiple winds converters and additionally for control the grid voltage amplitude and frequency via reactive power and active power management. Simulations results have shown that the planned system will facilitate maintain the weak grid voltage and additionally power the native grid in complete mode operation. The planned theme with active power management can even be used for wind generation smoothing and different active power management applications.

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