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Simulation of Voltage Flicker Mitigation by Electric Spring in Wind Generations

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Abstract:

Day to day population is increasing in world there by power demand also increasing in order to meet power demand need to depend on renewable energy sources like wind, solar, tidal etc. But these are not constant throughout the time, constant power or voltage is not possible by renewable energy sources. In order to meet power demand and maintain the constant voltage or power in the grid some of the controllers are already being used. To get more reliable power, Electric springs are used in this project. Electric spring is a combination of IIGBT based self commutated voltage source converter with inductor and capacitor. Electric springs are connected to smart loads. Power generated by wind energy system is connected to grid, these smart loads are connected with the help of electric springs, so that voltage flickers are mitigated. The proposed PMSGG and DFIG based wind generation system is simulated using MATLAB/simulink model.

Index Terms—**Distribution feeder, permanent magnet synchronous generator, smart loads, voltage flicker, voltage regulation, wind energy.**

I. Introduction

The government has set a target is to reduce 20% greenhouse gas emission by the year 2020 bearing in mind baseline of the year 2006. Most of these targets are predictable to meet through renewable power generations (RPGs) in such provoked, powerful, financial and constructive policy driven environment. The proposed infiltration of RPGs offers many advantages along with positive challenges to the reliability of operation of mass power system. These RPGs generally do not associate with customer load demand in time scales due to its towering intermittency. Therefore, it leads to one of the main causes of destabilizing the power system. The fossil fuel and hydro based power plants play important role in modifiable voltage and frequency of network and consequently in stabilizing the operation using automatic generation control. The situation convenient with less infiltration of RPGs i.e. 10–15%. However in light of improved penetrations of such RPGs (50–60%), it will be trickier even for conventional power plants to participate efficiently in maintaining immovability of the network. Under such conditions, it is a real confront for policy makers to develop strategies in actual time to meet load demand with such extremely variable and fewer predictable power generation. It leads to the operation of upcoming grid much more consciously controlled on the basis of RPGs rather than consumer loads such that power industry is sustainable and environmentally protected. Among the other troubles that happen due to high penetrations of RPGs,

Voltage regulation, decreasing voltage distortions due to flickers, swell, sag and frequency control are considered as main control objectives. To resolve such troubles, solutions are presented in the this project, such as, enlarged rating of a stand-by DG unit and adopted storage systems for supplying lack real time load Demand. And frequency of arrangement, consequently in stabilizing the operation using routine generation control. The condition is controllable with less infiltration of RPGs i.e. 10–15%. However in light of enlarged penetrations of such RPGs (50–60%), it will be additional complicated even for conservative power plants to contribute successfully in maintaining steadiness of the network. Under such circumstances, it is a genuine challenge for rule makers to enlarge strategies in actual time to meet up load demand with such extremely variable and less predictable power generation. It leads to the operation of upcoming grid much additional purposely controlled on the origin of RPGs rather than consumer loads such that power industry is sustainable and environmentally sheltered. Among the former problems that happen due to high penetrations of RPGs, voltage regulation, reduce voltage distortions due to swell, flickers, sag and frequency manage are painstaking as major control objectives. To explain such trouble, solutions are obtainable in the literature, such as, improved rating of a reserve DG unit and employing storage space systems for supplying shortage actual time load demand. Among these solutions, augmented rating of a reserve unit and elevated rating of the storage systems are against the movement of authoritarian authorities to boost reliable infiltration of RPGs in enjoin to decrease fossil fuel utilization and carbon foot print to protect environment. Enlarge in the rating of stand-by DG unit increases principal and operational cost of the power system and reduces the advantages of rising more units of RPGs. Several types of storage systems have been advised and are in process with power system based on their little term, average term and extended term storage capacity. However, their around trip effectiveness, assets

Investment and space requirements are always controversial. Moreover, trends are to install RPGs near to the load centres in order to diminish line losses and to diminish accumulation reinforcements of transmission networks. In view of all above, a lot more infiltration of RPGs with distribution system is likely in coming years. The planned research work is enthused to explore alternative methods of voltage regulation and its excellence improvements under lofty penetrations of RPGs at the delivery level. Voltage variations are painstaking as one of the mainly severe topic under elevated penetrations of wind energy at supply level. Most of the alleviation methods reported in the creative writing for reducing flash emissions are engaged at generation end with suitable control on converters of variable speed wind energy Conversion systems (VSWECS), such as reactive power reparation, active power control, and Energetic volt-var control. However, the load demand reaction has never been explored with the greatest information available from literature for addressing Voltage variation problems.

This project presents stipulate response organization using SLs under elevated penetration of VSWECS at distribution level. The forceful torque and power variations of wind turbine are obtained considering stochastic and episodic effects.

The involvement of this work are shortened as follows,

1) The voltage difference alleviation method employing load insists reaction based on SLs is obtainable first time.
2) The disciplined design of SLs is existing.
3) The arrangement of SLs is investigated and explored under Lofty Infiltration of wind power.

II. ENERAL CONCEPTS OF THE PROPOSED STUDY

Smart loads have been discussed in the literature as a novel technology for load stipulate management to follow power generation under ac power generation. These Smart Loads are mainly reactive power (Q) controllers which adjust input voltage fairly than output voltage. It can be installed at diverse locations to support grid voltage. Voltage Flicker is an occurrence which originated from RPGs stations and propagates in to the distribution line. It is distinct as low frequency voltage fluctuation naturally in the range of 0.05–40 Hz and causes exasperation in human eyes. In this sense, although these voltage flickers are emitted from Regenerative Power Generations stations but considered more in tolerable at load terminals. This study explores the usefulness of Smart Loads in explanatory voltage flickers so that voltage quality at load terminals improves.

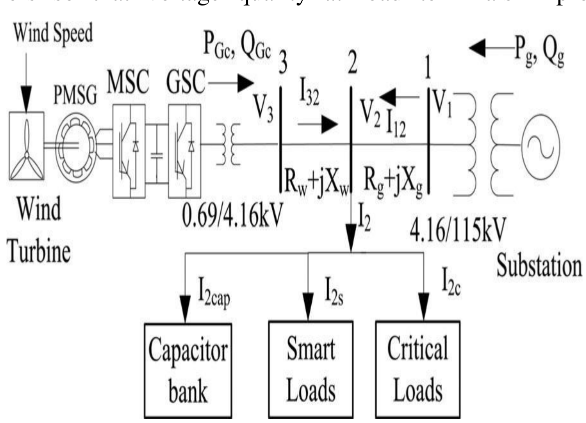

Fig. 1. Schematic diagram of proposed distribution network with PMSG based wind energy conversion system and SLs.

Fig. 1 shows the proposed diagram of distribution complex measured for the imminent study. The distribution network is supplied from the grid at bus 1 and 40 connected to the PMSG based VSWECS at the bus 3. The bus 2 is considered as load bus. The grid supply is considered with short circuit ratio (SCR) of 10 and X/R ratio equal to 0.5 to treat it as a weak distribution network. The rated capacity of VSWECS is 2 MW. To present practical wind power belongings on distribution network, wind speed model is developed, and used as an input for uneven speed wind turbine. The erratic speed operation of the PMSG generates power variable voltage and variabl frequency. It is transferred to the constant voltage constant frequency supply distribution feeder using back-back connected converters topology. The load bus provisions loads, which are classified as critical loads (CLs) and SLs. These CLs are those, which need regulated voltages at its terminal so that their load expenditure remains constant. On the other hand, SLs are non-critical in nature in which power flow can be altered under change in the applied voltage.

According to World Health Organization (WHO) statement, the urban population is rising rapidly and it will be almost double by the middle of 21st century .In Europe, buildings consume almost 40% of total electricity. In several large cities of Asia, residential, commercial and industrial buildings devour over 80–90% of total order. In Canada and United States of America, important portion of electricity demand (50–60%) is required for residential, commercial and industrial buildings.

The electricity demand of such buildings can be stylishly controller without sacrificing much on their output performances. Table I presents the list of loads potentially usedas SLs. The power demand of SLs can be distorted or staggered in real time to comeup with RPGs. Considering the above facts, it is pertinent to consider that 50–60% of loads may be transformed to use as SLs. Keeping in mind these facts, 1.5MWload are used as CLs and 2 MW loads as SLs in this project. In practice, these SLs are distributed around the network, and installed in every residential, commercial or industrial consumer building. However, in this study, for the sake of better sympathetic in presenting the cases, these loads are considered on per phase basis and shown in Fig. 2(a). With these specifications of distribution network, the penetration of wind power is obtained equal to 57%. The distribution lines are used in between various buses, which are modelled using standard parameters for particular line lengths.

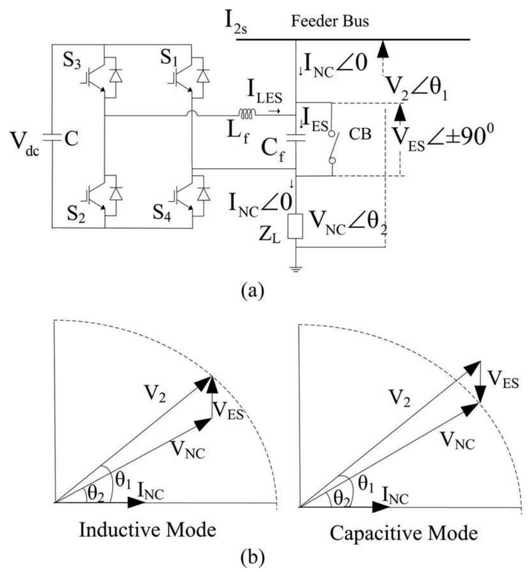

Fig. 2. (a) Circuit diagram of SLs arrangement for each phase.
(b) Phasor diagram for inductive and capacitive mode of operation of SLs.

Fig. 2(a) shows the schematic diagram of SLs arrangement used in each phase. The ZL is considered as load impedance. An ES is connected in series with ZL. The ES is a converter based system with dc bus which injects controlled magnitude of voltage (VES) in quadrature of load current presumptuous lossless converter system. The basic principle of operation of an ES and its various operating modes are described carefully. However, it is also presented briefly in this section. A single-phase self commutated switches based full bridge voltage sourced converter (VSC) with a low pass filter (Lf ,Cf) at its ac terminals and a capacitor at its dc bus is known as an ES in this work. The mid-point of each half-bridge of VSC is connected to the terminals of ac capacitor Cf through an interface inductor Lf. The capacitors were connected in back to back between deliver and load terminals, voltage crosswise its terminals are measured VES.

III.MATLAB SIMULATION

The proposed system is developed n MATLAB simulink model. In MATLAB for constructing electrical circuit's sim power system tool box can be used. In simpower system all power electronics switches, electrical sources, electrical elements, machines, converters and measuring instruments are available. The proposed system wind unit developed for required values of output. Based on the wind unit, the PMSG is developed. For voltage conversions rectifier and inverters are designed. Linear transformers also designed for voltage changes. Smart loads are connected at load centres with the help of electric springs for mitigate the voltage flickering. One of the braker is connected to each phase of the electric spring to compare results with and without electric springs.

Electric springs are connected to each of the phase by taking the ground support.

SIMULATION MODEL OF PMSG

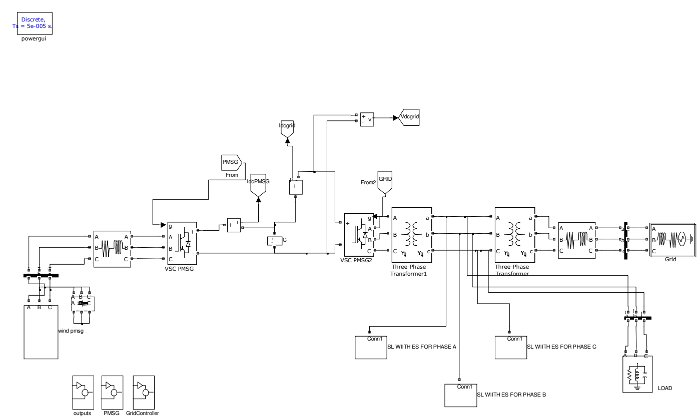

Fig.3.Simulation model of proposed system.

Fig.3 shows the simulation diagram of distribution network considered for the proposed model. The distribution network is abounding from the grid at bus 1 and connected to the PMSG based VSWECS at the load bus 3. The bus 2 is measured as load bus. To present sensible wind power belongings on distribution network, wind speed replica is developed, and used as an input to variable speed wind turbine. The variable speed process of PMSG generates power at changeable frequency and voltage. It is transferred to the steady voltage constant frequency supply distribution feeder using back-back connected converters topology. The load bus supplies loads, which are classified as critical loads (CLs) and SLs. The electric springs are connected with smart loads for each phase.

V.SIMULATION RESULTS

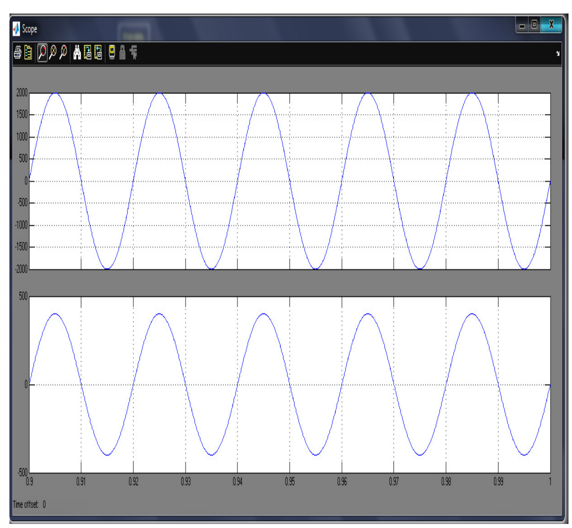

Fig.4 Simulation waveform of Voltage and current.

Fig.4 Shows the phase A voltage,urrent at load bus.from this result obbserved that by connecting electric spring volttage and currents are regulaated.So the effect of electric sspring is seen here.

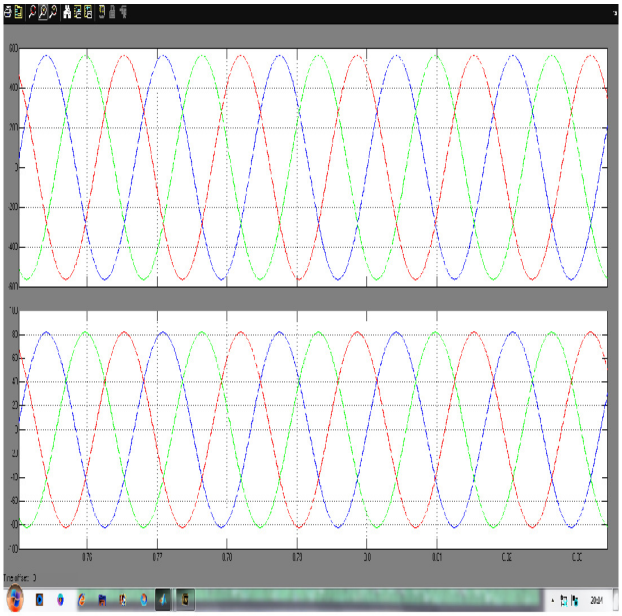

Fig.5 Wind voltage and current waveform across wind generator.

Fig.5 Shows Wind voltage and current waveform across wind generator. This voltage also known as Grid side converter (GNC) voltage, This waveform represents that regulated voltage being applied to load by ES..Voltage and current waveforms are pure sinusoidal by using smart loads with Electric springs.

SIMULATION MODEL OF WIND DFIG

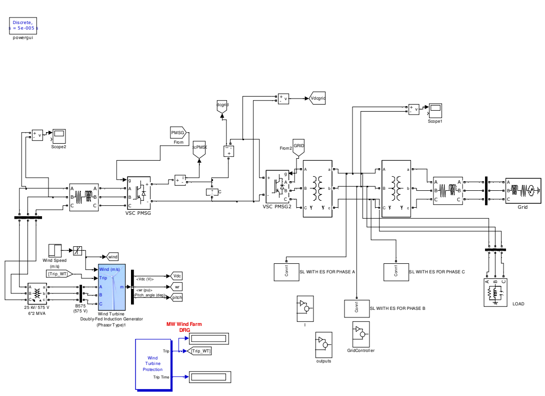

Fig.6. Simulation model for wind DFIG

Fig.6. shows Simulation model for wind DFIG it is an extension work for proposed system. Here doubly fed induction generator is considered instead of PMSG and verified voltage and current wave forms.

VOLTAGE AND CURRENT ACROSS DFIG

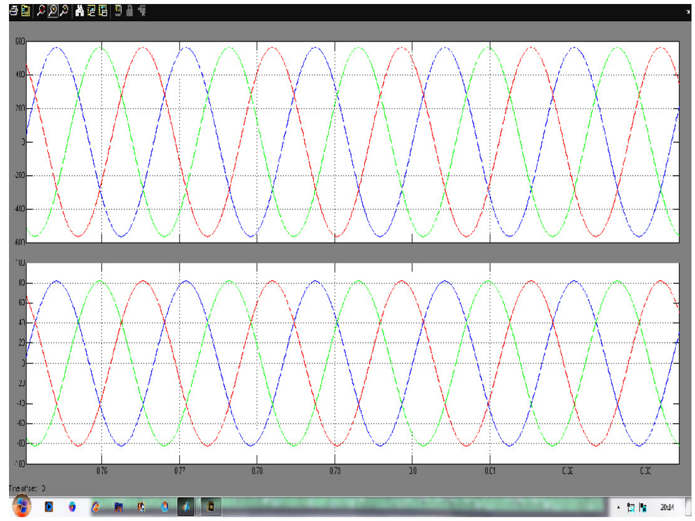

Fig.7 Wind voltage and current waveform across wind generator.

Fig.7 Shows Wind voltage and current waveform across wind doubly fed induction generator. This voltage also known as Grid side converter (GNC) voltage, This waveform represents that regulated voltage being applied to load by ES.Voltage and current waveforms are pure sinusoidal by using smart loads with Electric springs.

VI.CONCLUSION

Wind turbine output is connected to PMSG and DFIG, power generation is variable voltage, because air flow is not constant. If this supply is connected to grid total voltage gets disturbs. In this proposed work wind energy is connected to gird through back to back converters and with linear transformers. With the help of linear transformers grid voltage is synchronised with generation voltage. Smart loads are very sensitive at load terminals, so in order to maintain the constant voltage, Electric springs are designed to compensate active and reactive powers. Electric spring takes more power when power generation is more from wind generating station and vice versa. The proposed system is designed in MAATLAB/SIMULINK software.Vltage, power at load cementers are verified in matlab/simulink model. All the results are shown that Electric springs are mitigated voltage flickering in distribution system. The proposed load demand response management using SLs have been fruitfully employed for voltage control under lofty wind energy penetrations in the distribution feeder.

REFERENCES

[1] "Particular report on accommodating high level of changeable generation," North American Electric Reliability Commission, Atlanta, GA, USA, 2009.

[2] Z. Yunqian, H. Weihao, C. Zhe, C. Ming, and H. Yanting, "Flicker mitigation strategy for a doubly fed indution generator by torque conrol," IET Renewable Power Generattion.

[3] J. P. Barton and D. G. Infield, "Energy storage of its use with intermittent renewable energy," IEEE Trans. Energy Convers.,

[4] T. Brekken, Yokochi, A. von Jouanne, Yen, H. M. Hapk, and D. A. Halamay, "Optimal enrgy storage in sizing and manage for wind power aplications.

[5] C. Premier, J. Guwy, . M. Dinsdale, and Maddy, "Energy storge for active network managemnt on electricity in distr0bution networks with wind power," IET Renewable Power Gener.,

[6] D. Bian, M. Pipattanasmporn, and S. Rahman, "A human expert-based aproach to electrical peak command management.

[7] F. A. Rahiman, , V. Khadkkar, . Kennedy, and Pandi, "Demad response mismatch (DRM): Concept, impact analysis, and solution," IEEE ..

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