PHOTO-VOLTAIC POWER INJECTION IN LV ELECTRICAL SYSTEM USING DVR AND RENEWABLE RESORCES

1.CHANDAN KUMAR 2.PIO REBELLO
(1,2) UG STUDENT
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

Abstract : Generally, a Dynamic Voltage Restorer (DVR) displayed in a framework related breeze ranch, is used for coordinating hang/increase in system potential and consequently remains ideal under clear cross area potential. To update the use of such a DVR, this examination implement to show a sun controlled plant in the DVR so that in spite of tending to hang/increase in grid potential, hugeness can be obtained and infused into the structure from the PV plant utilizing the proportionate DVR. Particular procedures for development of the proposed PVDVR are outlined, underlining the dependably set needs. Serious consistent and graphical examinations are made to explore the purposes of repression of working zone of every strategy for PVDVR thinking about dangers in matrix voltage and accessible PV control. Examinations are done in a 50MW breeze ranch and a 0.75kW research office enlistment machine (both system related) each with an appropriate DVR. Deferred outcomes of reenactments in PSCAD/EMTDC and research office tests show improved utilization of DVR when bolstered from PV plant..

Index Terms - **DVR, Harmonics , sag, swell, control strategy**

I. INTRODUCTION

Because of the expansion in worldwide ecological concerns and exhaustion of traditional vitality assets, sustainable power sources are the almost all looked for power age. (WECS) has seen noteworthy development lately . The sunlight based Photo Voltaic (PV) framework has made quick walks in sending because of the decrease in expense of PV boards and headways in power semiconductor advances . Attributable to the reciprocal nature, a breeze PV cross breed control age framework offers higher unwavering quality to get improved power yield than a sole sustainable power age framework . Further through the wind– PV half breed control age framework, the space accessible in wind ranches can be successfully used for introducing sun based PV exhibits. With expanding entrance of WECS, thorough framework codes are implemented for the function of wind ranches for guaranting matrix strength. The matrix program likewise demand breeze ranches to be prepared to get (FRT) or (LVRT) to anticipate age misfortune and to guarantee prompt blame leeway to stay away from framework insecurity

Among the (PQ) issues, asymmetrical voltage drop , swell cruelly influence the WEC. Along lopsided framework potential, -ve succession flows stream in stator. The +ve grouping flows alongside the negative succession flows cause throbs in power and torque in this way prompting mechanical worry in components of the turbine generator framework. To defeat the PQ problems, for example, droop/ increase , to guarantee FRT and the fuse of DVR in the WECS has been examined . In spite of the fact that non constant speed wind-generator is turning into favored machine in as of late introduced breeze cultivates, a few establishments still utilize fixed speed wind generators (FSWG). Adapting to unsafe network unsettling influences, (for example, hang/swell) alongside the requirement for consistence according to framework program advocates the utilization for arrangement , shunt compensators for assurance for these generators . Through the conceivable cures, DVR for arrangement remuneration also STATCOM for shunt pay are viewed as dependable alternatives for constant and variable speed wind ranches . DVR encourages control for receptive load amid list/increase empowering the fast recuperation from instantaneous change in matrix voltage in this manner keeping up the security of the breeze ranch. The job of a DVR in a breeze ranch being principally to ensure the generator against lattice voltage influences, it remains inert amid typical matrix terms. Such as situations, a DVR coincides along with a WECS, it is valuable for incorporate the sun based PV plant to encourage the DVR so that notwithstanding tending to list/swell in framework voltage, vitality can be gathered and infused into the network from the PV plant utilizing the equivalent DVR amid the daytime. The degree of genuine and receptive power traded under different states of network voltage and PV control with an arrangement associated inverter is broke down for a steady burden and an arrangement associated inverter fueled by sustainable power source is utilized for microgrid application

II. CONTROL STRATEGY

The game-plan of the PVDVR with a framework related breeze age structure is appeared in Fig. 3a. The control rationality of the proposed framework is appeared in Fig. 3b. 3.1 DC-interface voltage control The DC-partner voltage must be made sense of how to help control trade between the DC-interface and the framework. Continuously end, the DC-interface voltage is controlled to accomplish dynamic power balance through control of the stage motivation behind generator voltage concerning compose voltage [24-25]. In a comparative system, the demand or reference estimation of the stage edge of generator voltage relating to the real capacity to be embedded (from the PV plant) can be enrolled from the DC-interface voltage control. The examination of different MPPT following frameworks is shown in [26] from which the execution of the developed P&O procedure is watched flawless to be gotten in the proposed structure. 3.3 PVDVR (Inverter) control A twofold circle control is executed for the three single stage inverters autonomously to encourage earth shattering control of the PVDVR. The inner circle controls the yield current of inverter and the outside circle controls the infused voltage.

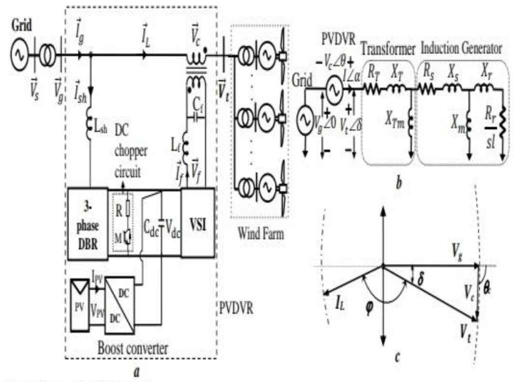


Fig. 1 a Proposed PVDVR in wind farm
b Equivalent circuit
c Phasor diagram

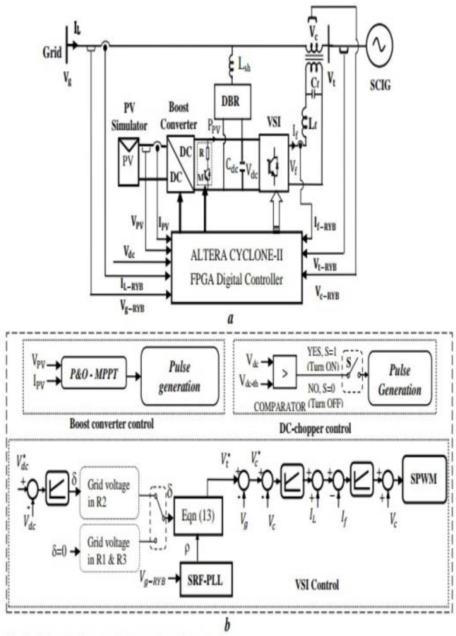


Fig. 3 a Schematic diagram of the experimental setup
b Control Strategy of the PVDVR in wind farm

III. POWER QUALITY ISSUES

Various power quality issues that normally occur in a power system are listed below a**)Voltage Sag** : A decrease of the normal voltage level between 10 and 90% of the nominal rms voltage at the power frequency, for durations of 0,5 cycle to 1 minute. Faults on the transmission or distribution network (most of the times on parallel feeders). Faults in consumer's installation. Connection of heavy loads and start-up of large motors. Malfunction of information technology equipment, namely microprocessor-based control systems (PCs, PLCs, ASDs, etc) that may lead to a process stoppage. **b)Very Short Interruptions** Total interruption of electrical supply for duration from few milliseconds to one or two seconds. Mainly due to the opening and automatic reclosure of protection devices to decommission a faulty section of the network. The main fault causes are insulation failure, lightning and insulator flashover. Tripping of protection devices, loss of information and malfunction of data processing equipment **c) Long Interruptions** Total interruption of electrical supply for duration greater than 1 to 2 seconds. Equipment failure in the power system network, storms and objects (trees, cars, etc) striking lines or poles, fire, human error, bad coordination or failure of protection devices. Stoppage of all equipment. **d) Voltage Spike** Very fast variation of the voltage value for durations from a several microseconds to few milliseconds. These variations may reach thousands of volts, even in low voltage. Lightning, switching of lines or power factor correction capacitors, disconnection of heavy loads. **e)Voltage** Swell Momentary increase of the voltage, at the power frequency, outside the normal tolerances, with duration of more than one cycle and typically less than a few seconds. Start/stop of heavy loads, badly dimensioned power sources, badly
regulated transformers (mainly during off-peak hours). Data loss, flickering of lighting and screens, stoppage or damage of sensitive equipment, if the voltage values are too high**. f)Harmonic** Distortion Voltage or current waveforms assume non-sinusoidal shape. The waveform corresponds to the sum of different sine-waves with different magnitude and phase, having frequencies that are multiples of power-system frequency. Classic sources: electric machines working above the knee of the magnetization curve (magnetic saturation), arc furnaces, welding machines, rectifiers, and DC brush motors. Modern sources: all non-linear loads, such as power electronics equipment including ASDs, switched mode power supplies, data processing equipment, high efficiency lighting. **g)Voltage** Fluctuation Oscillation of voltage value, amplitude modulated by a signal with frequency of 0 to 30 Hz. Arc furnaces, frequent start/stop of electric motors (for instance elevators), oscillating loads. Most consequences are common to under voltages.

The most perceptible consequence is the flickering of lighting and screens, giving the impression of unsteadiness of visual perception. **h)Noise** Superimposing of high frequency signals on the waveform of the power-system frequency. Electromagnetic interferences provoked by Hertzian waves such as microwaves, television diffusion, and radiation due to welding machines, arc furnaces, and electronic equipment. Improper grounding may also be a cause**.. i) Voltage Unbalance** A voltage variation in a three-phase system in which the three voltage magnitudes or the phaseangle differences between them are not equal. Large single-phase loads (induction furnaces, traction loads), incorrect distribution of all single-phase loads by the three phases of the system (this may be also due to a fault). Unbalanced systems imply the existence of a negative sequence that is harmful to all three phase loads

IV. OUTCOMES AND DISCLOSURE

The adequacy of the proposed framework is checked under different working states of framework voltage and PV control through PSCAD/EMTDC proliferations and examinations. The framework parameters are given in Table A-1 in instructive improvement. 4.1 Simulation results The test structure 1 incorporates 25 fixed speed choice generators all of 2MW rating related with the framework through a transformer, and 6 MW (0.12 p.u.) surveyed PV plant. This framework is imitated in PSCAD/EMTDC. The 6MW PV control plant is perceived with an arrangement of 775 strings with 31 sheets each. The rating of each PV board is 250W with an open circuit voltage of 37.8V and a short out current of 8.7A at 1000W/m2 lighting up and 25°C temperature. The PV show is connected with a solitary stage reinforce converter with an information and yield DC voltage of 976V and 1500V freely, which gives the subtleties of genuine and responsive power balance at different framework voltage and PV control combinations. The authentic and open power are settled and are changed over to per unit views with the base attributes as given in the Table-3. The running with cases are considered for examination.

works in Mode-1 and infuses 0.06 p.u. besides, 0.13 p.u. of authentic and open power independently (relates to 'B' in Fig. 2b). For a 5% hang (Fig. 4a), the working point shifts from 'B' to 'B1' (Mode-1 to Mode-2) whereby authentic intensity of 0.06 p.u. furthermore, responsive intensity of 0.45 p.u. are blended to repay the hang and to keep up the open power need of wind ranch since the responsive power given by system reduces amidst once-over additionally, holds the wealth responsive influence from structure to keep up the generator voltage at 1.0 p.u.. 4.1.2 Case 2: Symmetrical hang/swell in structure voltage with zero PV control (Night time) The LVRT limit of the proposed framework is had a go at as demonstrated by system code [27] and a 85% of symmetrical hang is presented in matrix voltage at t=0.45s (Fig. 4b) wherein the PVDVR inserts 0.85 p.u. voltage (in-organize) to the framework voltage and ingests a touch of genuine power since the veritable power eaten up by the cross area diminishes under hang. Unsymmetrical hang in structure voltage if there should develop an occasion of an unsymmetrical hang in cross segment voltage with an accessible PV power of 0.06 p.u., a half of once-over is displayed at t=0.35s in two stages (Y and B) of framework voltage (Fig.5a). Since the inclination is to relieve the hang, the PVDVR works in Mode-3 to facilitate the unsymmetrical hang and accordingly PV control isn't blended and is dissipated.

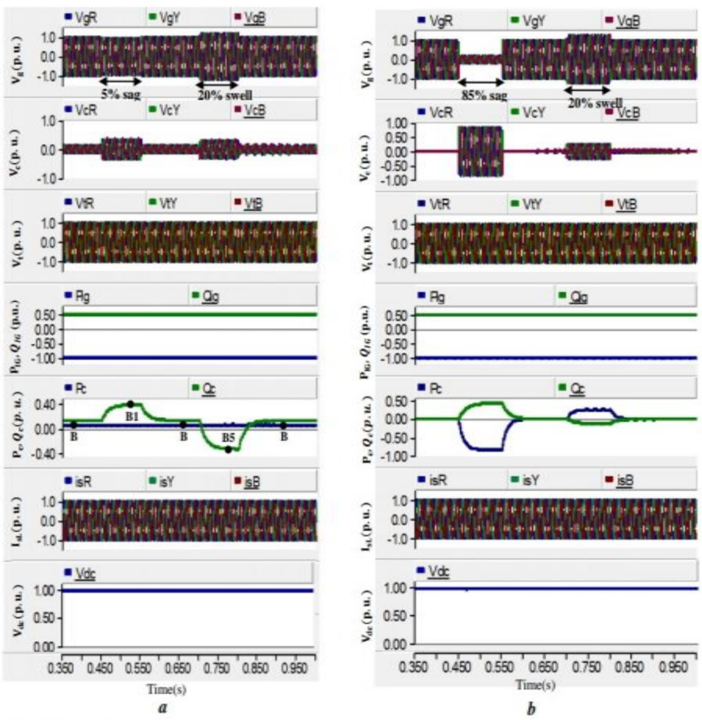
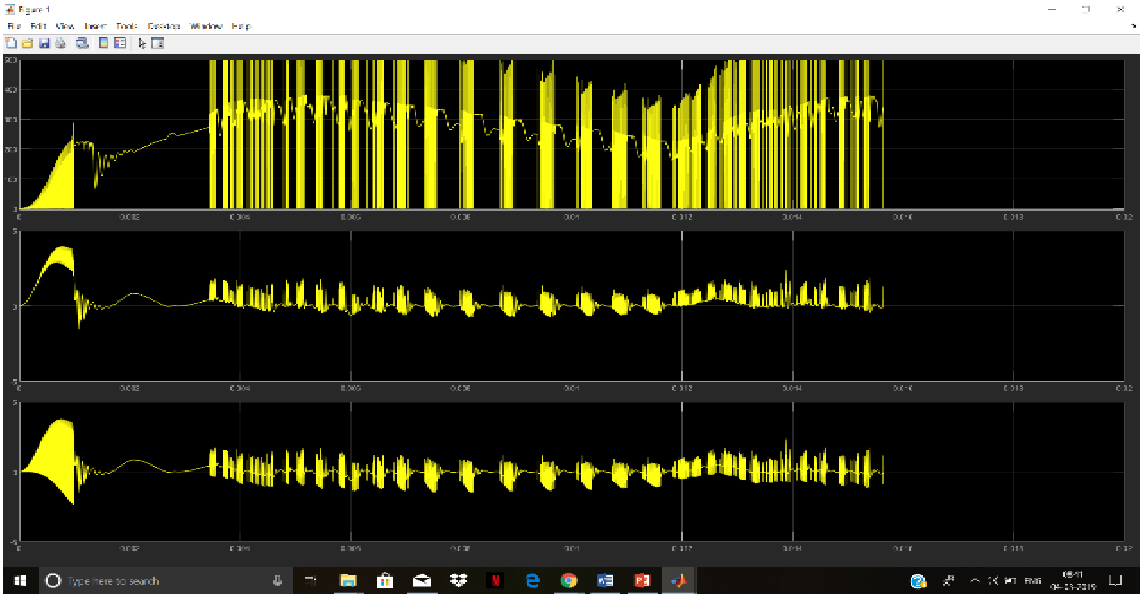
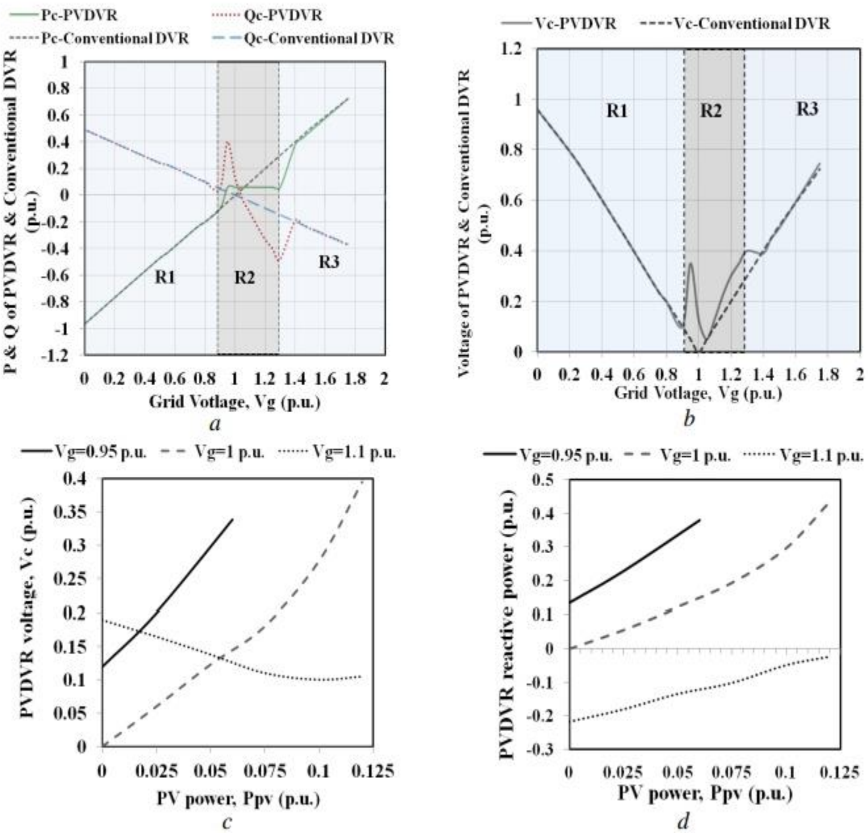


Fig. 4 System response under
a Case 1: Symmetrical sag(5%) and swell(20%) in grid voltage with simultaneous PV power injection
b Case 2: Symmetrical sag(85%) and swell(20%) in grid voltage with zero PV power

V. RESULTS AND DISCUSSION

The precedents in veritable and open intensity of the PVDVR and ordinary DVR with differentiating framework voltage (areas R1, R2 and R3) and PV control are appeared in Fig.6a. In a framework related breeze ranch with a standard DVR, the confirmed intensity of DVR is immediate in regard to the deviation of system voltage from clear respect (1.0 p.u.). The PVDVR demonstrates a for all intents and purposes indistinguishable precedent in locales R1 and R3 where grid voltage has noteworthy hang or swell. Regardless, in domain R2, the veritable power of PVDVR is suffering (0.06 p.u.) seeming consistent genuine power imbuement from PV. In like way, a standard DVR supplies responsive capacity to arrange under structure voltage rundown and holds.. This is in light of the way that, in region R2, because of the open gateway for synchronous hang/increase easing and PV control blend, the controller deals with to pervade the accessible PV control into framework while additionally comprehending how to coordinate the minor hang/swell of system voltage. Thusly, the open power traded is facilitated by the accessible PV control and the affirmed grid potential at the present time.





REFERENCES

[1] The Global Wind Energy Council, "GWEC's Global Wind Report",2014.

[2] International Energy Agency Photovoltaic Power Systems, IEA PVPS(2015). "Trends in photovoltaic applications. Survey report of selected IEA countries between 1992 and 2014". Int. Energy Agency Photovoltaic Power Syst. (IEA PVPS).

[3] S. Sarkar, V. Ajjarapu, "MW Resource Assessment Model for a Hybrid Energy Conversion System With Wind and Solar Resources", IEEE Trans. Sustain. Energy, 2016,2(4), pp. 383-39.

[4] Lin Xu, Xinbo Ruan, Chengxiong Mao, Buhan Zhang, and Yi Luo, "An Improved Optimal Sizing Method for Wind-Solar-Battery Hybrid Power System", IEEE Trans. Sustain. Energy, 2017, 4(3), pp-774-785

[5] Adikanda Parida Debashis Chatterjee, "Model-based loss minimisation scheme for wind solar hybrid generation system using (grid-connected) doubly fed induction generator", IET Electric Power Applications, 2016, 10(6), pp. 548–559.

[6] Li Wand, Quang Son Va, Anton V. Prokhorov, "Stability Improvement of a Multimachine Power System Connected with a LargeScale Hybrid Wind-Photovoltaic Farm Using a Super capacitor", IEEE Trans. Ind. Appl, 2017,54(1), pp-50- 60.

[7] M. Tsili and S. Papathanassiou, "A review of grid code technical requirements for wind farms," Renewable Power Generat., IET, 2015, 3(3), pp. 308–332.

[8] E. Leon, M. F. Farias, P. E. Battaiotto, J. A. Solsona, M. I. Valla, "Control Strategy of a DVR to Improve Stability in Wind Farms Using Squirrel-Cage Induction Generators" IEEE Trans. Power Syst, 2011, 26(3), pp. 1609-1617.

[9] Abdul Mannan Rauf and Vinod Khadkikar, "An Enhanced Voltage Sag Compensation Scheme for Dynamic Voltage Restorer", IEEE Trans. Ind. Electron, 2015, 62(5), pp-2683-2692.