International Journal for Innovative Engineering and Management Research

A Peer Revieved Open Access International Journal

www.ijiemr.org

IJIEMR Transactions, online available on 14th Dec2017. Link :http://www.ijiemr.org/downloads.php?vol=Volume-6&issue=ISSUE-12

Title: **POWER QUALITY IMPROVEMENT OF GRID CONNECTED DUAL VSI**

Volume 06, Issue 12, Pages: 443–450.

Paper Authors

B PRAVEEN,S.V.SIVA NAGARAJU,G.N.S. VAIBHAV

PVKK Institute of Technology, Anantapuramu.

USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

POWER QUALITY IMPROVEMENT OF GRID CONNECTED DUAL VSI

[1]B PRAVEEN,[2]S.V.SIVA NAGARAJU,[3]G.N.S. VAIBHAV
[1]M.Tech Student, PVKK Institute of Technology, Anantapuramu
[2]Associate Professor, PVKK Institute of Technology, Anantapuramu
[3]HOD, PVKK Institute of Technology, Anantapuramu

Abstract: This paper uncovers a double voltage source inverter (DVSI) outline to upgrade the vitality quality and reliability of the smaller scale lattice framework. The proposed conspire is comprised of two inverters, which allows the smaller scale network to switch control made by the conveyed vitality assets (DERs) and to repay the area unequal and nonlinear weight. The control calculations are created predicated on immediate symmetrical perspective hypothesis (ISCT) to utilize DVSI in network posting and framework infusing settings. The proposed design has expanded constancy, bring down data transfer capacity reliance on the key inverter, more affordable because of diminishing in filtration size, and better utilization of miniaturized scale framework capacity when utilizing lessened dc-connect voltage score for the key inverter. The DVSI is fabricated by these highlights outline a promising choice for miniaturized scale matrix giving overly sensitive parts. The control and topology calculation are approved through far reaching reproduction and test comes about.

Keywords:DVSI, Instantaneous Symmetrical Aspect Theory (ISCT), DERs.

I. INTRODUCTION

Innovative advance and natural concerns drive the power framework to a change in perspective with more sustainable power sources coordinated to the system by methods for disseminated age (DG). These DG units with composed control of nearby age and storerooms frame a small scale framework. In a smaller scale framework, control from various sustainable power sources, for example, energy components, photovoltaic (PV) frameworks, and wind vitality frameworks are interfaced to lattice and burdens utilizing power electronic converters. A framework intelligent inverter assumes an essential part in trading power from the smaller scale network to the lattice and the associated stack. This small scale network inverter can either work in a matrix sharing mode while providing a piece of nearby load or in framework infusing mode, by infusing energy to the principle lattice. Keeping up control quality is another imperative viewpoint which must be tended to while the miniaturized scale lattice framework is associated with the fundamental network. The multiplication of energy gadgets and electrical burdens with lopsided nonlinear streams has debased the power quality in the power conveyance organize. Besides, if there is a lot of feeder impedance in the appropriation frameworks, the proliferation of these consonant streams twists the voltage at the purpose of basic coupling (PCC). At a similar moment, industry robotization has come to an abnormal state of modernity, where plants like car producing units, compound processing plants, and semiconductor enterprises require clean power. For these applications, it is fundamental to repay nonlinear and unequal load streams. In, a voltage direction and power stream control conspire for a breeze vitality framework (WES) is proposed. A dispersion static compensator (DSTATCOM) is used for voltage control and furthermore for dynamic power infusion. The control conspire keeps up the power adjust at the framework terminal amid the breeze varieties utilizing sliding mode control. A multifunctional control electronic converter for the DG control framework is portrayed in. This plan has the capacity to infuse control produced by WES and furthermore to execute as a symphonious compensator. The greater part of the revealed writing around there talk about the topologies and control calculations to give stack pay ability in a similar inverter notwithstanding their dynamic power infusion. At the point when a lattice associated inverter is utilized for dynamic power infusion and in addition for stack remuneration, the inverter limit that can be used for accomplishing the second goal is chosen by the accessible prompt small scale network genuine power. Considering the instance of a framework associated PV inverter, the accessible limit of the inverter to supply the receptive power turns out to be less amid the most extreme sunlight based insolation periods. At a similar moment, the receptive energy to manage the PCC voltage is particularly required amid this period. It demonstrates that giving multi functionalities in a solitary inverter corrupts either the genuine power infusion or the heap remuneration capacities.

II.ELECTRIC POWER QUALITY

Electric power quality (EPQ), or simply Power quality, refers to "maintaining the near sinusoidal waveform of power distribution bus voltages and currents at rated magnitude and frequency.",[1] determining the fitness of electric power to consumer devices. Synchronization of the voltage frequency and phase allows electrical systems to function in their intended manner without significant loss of performance or life. The term is used to describe electric power that drives an electrical load and the load's ability to function properly. Without the proper power, an electrical device (or load) may malfunction, fail prematurely or not operate at all. There are many ways in which electric power can be of poor quality and many more causes of such poor quality power. The electric power industry comprises electricity generation (AC power), electric power transmission and ultimately electric power distribution to an electricity meter located at the premises of the end user of the electric power. The electricity then moves through the wiring system of the end user until it reaches the load. The complexity of the system to move electric energy from the point of production to the point of consumption combined with variations in weather, generation, demand and other factors provide many opportunities for the quality of supply to be compromised. While "power quality" is a convenient term for many, it is the quality of the voltage rather than power or electric current that is actually

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

described by the term. Power is simply the flow of energy and the current demanded by a load is largely uncontrollable.

III.DUAL VOLTAGE SOURCE INVERTER

A. System Topology

The proposed DVSI topology is appeared in Fig. 1. It comprises of a nonpartisan point clipped (NPC) inverter to acknowledge AVSI and a three-leg inverter for MVSI. These are associated with lattice at the PCC and providing a nonlinear and unequal load. The capacity of the AVSI is to remunerate the responsive, music, and unbalance segments in stack streams. Here, stack streams in three stages are spoken to by ila, ilb, and ilc, separately. Additionally, ig(abc), iμgm(abc), and iμgx(abc) indicate matrix streams, MVSI ebbs and flows, and AVSI ebbs and flows in three stages, separately. The dc connection of the AVSI uses a split capacitor topology, with two capacitors C1 and C2. The MVSI conveys the accessible power at disseminated vitality asset (DER) to lattice. The DER can be a dc source or an air conditioner source with rectifier coupled to dc connect. Generally, sustainable power sources like energy unit and PV create control at variable low dc voltage, while the variable speed wind turbines produce control at variable air conditioning voltage. In this way, the power produced from these sources utilize a power molding stage before it is associated with the contribution of MVSI.

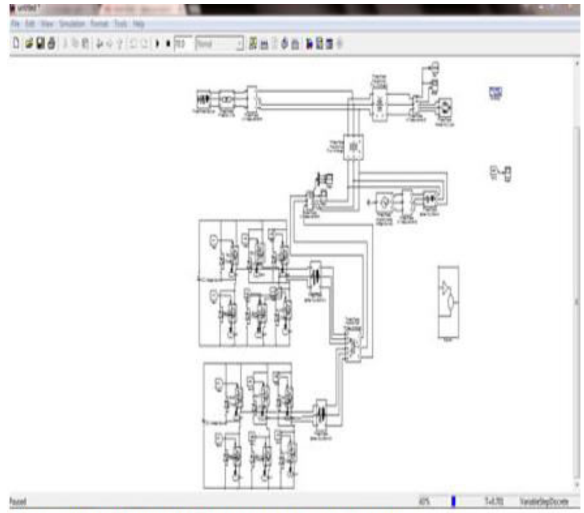

Fig1. Topology of proposed DVSI scheme.

In this study, DER is being represented as a dc source. An inductor filter is used to eliminate the high-frequency switching components generated due to the switching of power electronic switches in the inverters. The system considered in this study is assumed to have some amount of feeder resistance Rg and inductance Lg. Due to the presence of this feeder impedance, PCC voltage is affected with harmonics. Section III describes the extraction of fundamental positive sequence of PCC voltages and control strategy for the reference current generation of two inverters in DVSI scheme.

B. Design of DVSI Parameters AVSI:

The important parameters of AVSI like dc-link voltage (Vdc), dc storage capacitors (C1 and C2), interfacing inductance (Lfx), and hysteresis band (±hx) are selected based on the design method of split capacitor DSTATCOM topology. The dc-link voltage across each capacitor is taken as 1.6 times the peak of phase voltage. The total dc-link voltage reference (Vdcref) is found to be 1040 V. Values of dc capacitors of AVSI are chosen based on the change in dc-link voltage during transients. Let total load rating is S kVA. In the worst case, the load power may vary from minimum to maximum, i.e., from 0 to S kVA. AVSI needs to exchange real power during transient to maintain the load power demand. This transfer of real power during the transient will result in deviation of capacitor voltage from its reference value. Assume that the voltage controller takes n cycles, i.e., nT seconds to act, where T is the system time period. Hence, maximum energy exchange by AVSI during transient will be nST. This energy will be equal to change in the capacitor stored energy. Therefore

$$\frac{1}{2}C_1(V_{\mathrm{dcr}}^2 - V_{\mathrm{dc1}}^2) = nST \quad (1)$$

where Vdcr and Vdc1 are the reference dc voltage and maximum permissible dc voltage across C1 during transient, respectively. Here, S =5 kVA, Vdcr = 520 V, Vdc1 = 0.8 Vdcr or 1.2 Vdcr, n = 1, and T = 0.02 s. Substituting these values in (1), the dclink capacitance (C1) is calculated to be 2000 μF. Same value of capacitance is selected for C2. The interfacing inductance is given by

$$L_{fx} = \frac{1.6\,V_m}{4\,h_x f_{\max}}. \quad (2)$$

Accepting a most extreme exchanging recurrence (fmax) of 10 kHz and hysteresis band (hx) as 5%of load current (0.5 A), the estimation of Lfx is figured to be 26 mH. 2) MVSI: The MVSI utilizes a three-leg inverter topology. Its dc-interface voltage is acquired as 1.15 Vml, where Vml is the pinnacle estimation of line voltage. This is figured to be 648 V. Also,MVSI supplies an adjusted sinusoidal current at solidarity control factor. In this way, zero arrangement exchanging sounds will be missing in the yield current of MVSI. This diminishes the channel necessity for MVSI when contrasted with AVSI. In this investigation, a channel inductance (Lfm) of 5 mH is utilized.

C. Advantages of the DVSI Scheme

The various advantages of the proposed DVSI scheme over a single inverter scheme with multifunctional capabilities are discussed here as follows:

1. Increased Reliability: DVSI scheme has increased reliability, due to the reduction in failure rate of components and the decrease in system down time cost. In this scheme, the total load current is shared between AVSI and MVSI and hence reduces the failure rate of inverter switches. Moreover, if one inverter fails, the other can continue its operation. This reduces the lost energy and hence the down time cost. The reduction in system down time cost improves the reliability.

2. Reduction in Filter Size: In DVSI scheme, the current supplied by each inverter is reduced and hence the current rating of individual filter inductor reduces. This reduction in current rating reduces the filter size. Also, in this scheme, hysteresis current control is used to track the inverter reference currents. As given in (2), the filter inductance is decided by the inverter switching frequency. Since the lower current rated semiconductor device can be switched at higher switching frequency, the inductance of the filter can be lowered. This decrease in inductance further reduces the filter size.

3. Improved Flexibility: Both the inverters are fed from separate dc links which allow them to operate independently, thus increasing the flexibility of the system. For instance, if the dc link of the main inverter is disconnected from the system, the load compensation capability of the auxiliary inverter can still be utilized.

4. Better Utilization of Microgrid Power: DVSI scheme helps to utilize full capacity of MVSI to transfer the entire power generated by DG units as real power to ac bus, as there is AVSI for harmonic and reactive power compensation. This increases the active power injection capability of DGs in micro grid.

5. Reduced DC-Link Voltage Rating: Since, MVSI is not delivering zero sequence load current components, a single capacitor three-leg VSI topology can be used. Therefore, the dclink voltage rating of MVSI is reduced approximately by 38%, as compared to a single inverter system with split capacitor VSI topology

D. GRID-TIE Inverter

A grid-tie inverter is a power inverter that converts direct current (DC) electricity into alternating current (AC) with an ability to synchronize to interface with a utility line. Its applications are converting DC sources such as solar panels or small wind turbines into AC for tying with the grid. Residences and businesses that have a grid-tied electrical system are permitted in many countries to sell their energy to the utility grid. Electricity delivered to the grid can be compensated in several ways. "Net metering" is where the entity that owns the renewable energy power source receives compensation from the utility for its net outflow of power. So for example, if during a given month a power system feeds 500 kilowatt-hours into the grid and uses 100 kilowatt-hours from the grid, it would receive compensation for 400 kilowatt-hours. In the US, net metering policies vary by jurisdiction. Another policy is a feed-in tariff, where the producer is paid for every kilowatt hour delivered to the grid by a special tariff based on a contract with distribution company or other power authority. In the United States, grid-interactive power systems are covered by specific provisions in the National Electric Code, which also mandates certain requirements for grid-interactive inverters.

E. Typical Operation

Inverters take DC power and invert it to AC power so it can be fed into the electric utility company grid. The grid tie inverter (GTI) must synchronize its frequency with that of the grid (e.g. 50 or 60 Hz) using a local oscillator and limit the voltage to no higher than the grid voltage. A high-quality modern GTI has a fixed unity power factor, which means its output voltage and current are perfectly lined up, and its phase angle is within 1 degree of the AC power grid. The inverter has an on-board computer which senses the current AC grid waveform, and outputs a voltage to correspond with the grid. However, supplying reactive power to the grid might be necessary to keep the voltage in the local grid inside allowed limitations. Otherwise, in a grid segment with considerable power from renewable sources, voltage levels might rise too much at times of high production, i.e. around noon. Grid-tie inverters are also designed to quickly disconnect from the grid if the utility grid goes down. This is an NEC requirement that ensures that in the event of a blackout, the grid tie inverter will shut

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

down to prevent the energy it transfers from harming any line workers who are sent to fix the power grid. Properly configured, a grid tie inverter enables a home owner to use an alternative power generation system like solar or wind power without extensive rewiring and without batteries. If the alternative power being produced is insufficient, the deficit will be sourced from the electricity grid.

F. Technology

Technologies available to grid-tie inverters include newer high-frequency transformers, conventional low-frequency transformers, or they may operate without transformers altogether. Instead of converting direct current directly to 120 or 240 volts AC, high-frequency transformers employ a computerized multi-step process that involves converting the power to high-frequency AC and then back to DC and then to the final AC output voltage. Transformer less inverters, lighter are more efficient than their counterparts with transformers, are popular in Europe. However, transformer less inverters have been slow to enter the US market over concerns that transformer less electrical systems could feed into the public utility grid without galvanic isolation between the DC and AC circuits that could allow the passage of dangerous DC faults to be transmitted to the AC side.[4] However, since 2005, the NFPA's NEC allows transformer less (or non-galvanically) inverters by removing the requirement that all solar electric systems be negative grounded and specifying new safety requirements. The VDE 0126-1-1 and IEC 6210 also have been amended to allow and define the safety mechanisms needed for such systems. Primarily, residual or ground current detection is used to detect possible fault conditions. Also isolation tests are performed to ensure DC to AC separation.

Fig2. Inside of a SWEA 250W Transformer-based grid-tie inverter.

IV. EXPERMETAL RESULT

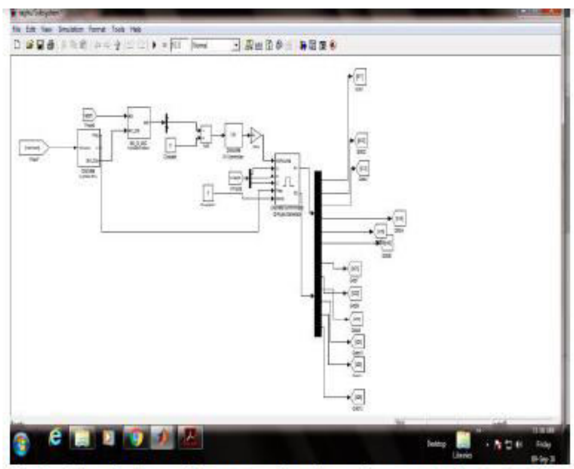

Fig3. Simulation diagram showing the control strategy of proposed D VSI scheme.

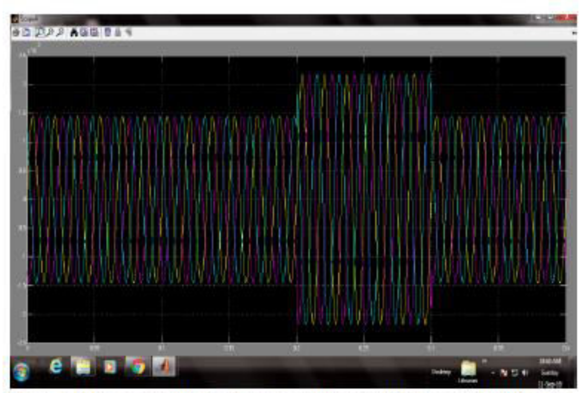

Fig4. Voltage swell during non linear load parallel to the dual inverter connected load.

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

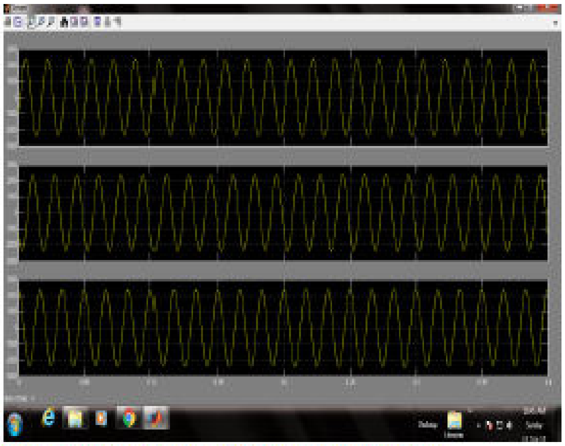
Fig5. 3-phase voltages of dual inverter fed line.

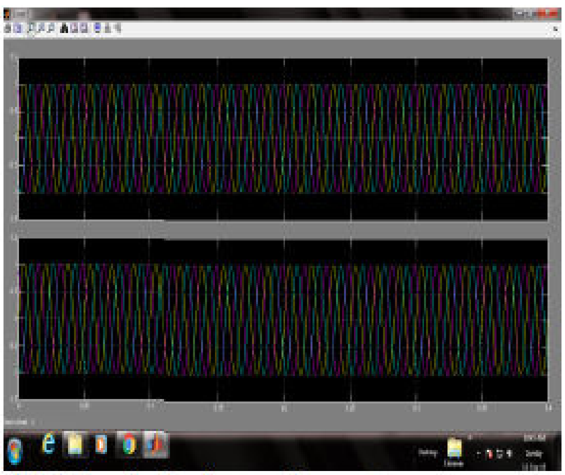
Fig6. 3-phase load voltages and currents.


Fig7. 3-phase currents of dual fed line.

V. CONCLUSION

A DVSI conspire is proposed for miniaturized scale network frameworks with upgraded control quality. Control calculations are produced to create reference streams for DVSI utilizing ISCT. The proposed plot has the ability to trade control from dispersed generators (DGs) and furthermore to remunerate the neighborhood uneven and nonlinear load. The execution of the proposed plot has been approved through reenactment and trial thinks about. When contrasted with a solitary inverter with multifunctional abilities, a DVSI has many focal points, for example, expanded unwavering quality, bring down cost because of the lessening in channel size, and more usage of inverter ability to infuse genuine power from DGs to miniaturized scale lattice. Besides, the utilization of three-stage, three wire topology for the fundamental inverter decreases the dc-connect voltage prerequisite. In this way, a DVSI conspire is a reasonable interfacing choice for small scale network providing touchy burdens.

VI. REFERENCES

[1]A.Kahrobaeian and Y.-R.Mohamed,―Interactive distributed generation interface for flexible micro-grid operation in smart distribution systems,‖ IEEE Trans. Sustain. Energy, vol. 3, no. 2, pp. 295–305, Apr. 2012.

[2] N. R. Tummuru, M. K. Mishra, and S. Srinivas, ―Multifunctional VSC controlled microgrid using instantaneous symmetrical components theory,‖ IEEE Trans. Sustain. Energy, vol. 5, no. 1, pp. 313–322, Jan. 2014.

[3] Y. Zhang, N. Gatsis, and G. Giannakis, ―Robust energy management for microgrids with high-penetration renewables,‖ IEEE Trans. Sustain. Energy, vol. 4, no. 4, pp. 944–953, Oct. 2013.

[4] R. Majumder, A. Ghosh, G. Ledwich, and F. Zare, ―Load sharing and power quality enhanced operation of a distributed

microgrid,‖ IET Renewable Power Gener., vol. 3, no. 2, pp. 109–119, Jun. 2009.

[5] J. Guerrero, P. C. Loh, T.-L. Lee, and M. Chandorkar, ―Advanced control architectures for intelligent microgrids—Part II: Power quality, energy storage, and ac/dc microgrids,‖ IEEE Trans. Ind. Electron., vol. 60, no. 4, pp. 1263–1270, Dec. 2013.

[6] Y. Li, D. Vilathgamuwa, and P. C. Loh, ―Microgrid power quality enhancement using a three-phase four-wire grid-interfacing compensator,‖ IEEE Trans. Ind. Appl., vol. 41, no. 6, pp. 1707–1719, Nov. 2005.

[7] M. Schonardie, R. Coelho, R. Schweitzer, and D. Martins, ―Control of the active and reactive power using dq0 transformation in a three-phase grid-connected PV system,‖ in Proc. IEEE Int. Symp. Ind. Electron., May 2012, pp. 264–269.

[8] R. S. Bajpai and R. Gupta, ―Voltage and power flow control of grid connected wind generation system using DSTATCOM,‖ in Proc. IEEE Power Energy Soc. Gen. Meeting—Convers. Del. Elect. Energy 21st Century, Jul. 2008, pp. 1–6.

[9] M. Singh, V. Khadkikar, A. Chandra, and R. Varma, ―Grid interconnection of renewable energy sources at the distribution level with power-quality improvement features,‖ IEEE Trans. Power Del., vol. 26, no. 1, pp. 307–315, Jan. 2011.

[10] H.-G. Yeh, D. Gayme, and S. Low, ―Adaptive VAR control for distribution circuits with photovoltaic generators,‖ IEEE Trans. Power Syst., vol. 27, no. 3, pp. 1656–1663, Aug. 2012.

[11] C. Demoulias, ―A new simple analytical method for calculating the optimum inverter size in grid-connected PV plants,‖ Electr. Power Syst. Res., vol. 80, no. 10, pp. 1197–1204, 2010.

[12] R. Tonkoski, D. Turcotte, and T. H. M. EL-Fouly, ―Impact of high PV penetration on voltage profiles in residential neighborhoods,‖ IEEE Trans. Sustain. Energy, vol. 3, no. 3, pp. 518–527, Jul. 2012.