International Journal of Engineering, Science and Mathematics
Vol. 6 Issue 8, December 2017 (Special Issue)
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijesm.co.in, Email: ijesmj@gmail.com Double-Blind
Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

DVR Applications on Distribution Systems for Power Factor Improvement

E. Anil Kumar*
K.Venkateswararao**
M. Sai Ganesh***
M.V.S. PremSagar****

Abstract

The dynamic voltage restorer (DVR) is a custom power gadget utilized for voltage remuneration of delicate burdens against voltage aggravations in control dispersion lines. The DVR can manage the heap voltage from the issues, for example, list, swell, and sounds in the supply voltages. Subsequently, it can shield the basic shopper loads from stumbling and ensuing misfortunes. Diverse voltage infusion plans for dynamic voltage restorers (DVRs) are broke down with specific concentrate on another technique used to limit the rating of the voltage source converter (VSC) utilized as a part of DVR. Another control system is proposed to control the capacitor-bolstered DVR. The control of a DVR is exhibited with a lessened rating VSC. The reference stack voltage is evaluated utilizing the unit vectors. The synchronous reference outline hypothesis is utilized for the transformation of voltages from pivoting vectors to the stationary edge. The outcomes are displayed by utilizing Matlab/simulink programming.

Keywords:

Dynamiv Voltage Restorer;
Power Quality;
Unit vector;
Voltage harmonics;
Voltage swell;
Voltage sag.

Author correspondence:

E.Anil Kumar,
Asst.prof, BABA Institute of Technology and sciences
P.M.Palem, Visakhapatnam-530048.

1. Introduction

Power Quality issues in the present-day dissemination frameworks are tended to in the writing [1]– [6] because of the expanded utilization of delicate and basic hardware pieces, for example, correspondence arrange, process ventures, and exact assembling forms. Power quality issues, for example, homeless people, lists, swells, and different mutilations to the sinusoidal waveform of the supply voltage influence the execution of these hardware pieces. Advances, for example, custom power gadgets are risen to give security against control quality issues [2]. Custom power gadgets are principally of three classes, for example, arrangement associated compensators known as unique voltage restorers (DVRs), shunt-associated compensators, for example, circulation static compensators, and a mix of arrangement and shunt-associated compensators known as brought together power quality conditioner [2]– [6]. The DVR can direct the heap voltage from the issues,

* Doctorate Program, Linguistics Program Studies, Udayana University Denpasar, Bali-Indonesia (9 pt)
** STIMIK STIKOM-Bali, Renon, Depasar, Bali-Indonesia
*** English Language Specialist, Oller Center, Carriage House, 2nd Floor, California, USA
**** Head, Dept. of Political Science, Faculty of Arts & Culture, South Eastern University of Sri Lanka, Oluvil, Sri Lanka

for example, droop, swell, and sounds in the supply voltages. Subsequently, it can shield the basic shopper loads from stumbling and ensuing misfortunes [2]. The custom power gadgets are produced and introduced at shopper point to meet the power quality principles, for example, IEEE-519 [7].

Voltage droops in an electrical framework are not generally conceivable to maintain a strategic distance from due to the limited clearing time of the shortcomings that reason the voltage hangs and the proliferation of lists from the transmission and appropriation frameworks to the low-voltage loads. Voltage droops are the normal purposes behind intrusion underway plants and for end-client hardware breakdowns all in all. Specifically, stumbling of hardware in a generation line can cause creation intrusion and critical expenses because of loss of creation. One answer for this issue is to make the hardware itself more tolerant to lists, either by smart control or by putting away ride through‖ vitality in the gear. An option arrangement, rather than adjusting every segment in a plant to be tolerant against voltage droops, is to introduce a plant wide uninterruptible power supply framework for longer power intrusions or a DVR on the approaching supply to alleviate voltage lists for shorter periods [8]– [23].

DVRs can wipe out the vast majority of the lists and limit the danger of load stumbling for profound lists, yet their fundamental downsides are their standby misfortunes, the hardware cost, and furthermore the security plot required for downstream shortcircuits. Numerous arrangements and their issues utilizing DVRs are accounted for, for example, the voltages in a three-stage framework are adjusted [8] and a vitality enhanced control of DVR is talked about in [10]. Mechanical cases of DVRs are given in [11], and diverse control techniques are investigated for various sorts of voltage droops in [12] – [18]. An examination of various topologies and control techniques is exhibited for a DVR in [19]. The plan of a capacitor-upheld DVR that secures list, swell, mutilation, or unbalance in the supply voltages is talked about in [17]. The execution of a DVR with the high-recurrence connect transformer is talked about in [24]. In this paper, the control and execution of a DVR are shown with a diminished rating voltage source converter (VSC). The synchronous reference outline (SRF) hypothesis is utilized for the control of the DVR.

2. Operation of DVR

The schematic of a DVR-associated framework is appeared in Fig. 1(a). The voltage Vinj is embedded with the end goal that the heap voltage V is steady in size and is undistorted, despite the fact that the supply voltage Vs isn't consistent in greatness or is contorted. Fig. 1(b) demonstrates the phasor chart of various voltage infusion plans of the DVR.

V_L (pre−sag) is a voltage over the basic load preceding the voltage droop condition. Amid the voltage droop, the voltage is decreased to Vs with a stage slack point of θ. presently, the DVR infuses a voltage with the end goal that the heap voltage size is kept up at the pre-hang condition. As per the stage point of the heap voltage, the infusion of voltages can be acknowledged in four ways [19]. V_{inj1} speaks to the voltage infused in-stage with the supply voltage. With the infusion of V_{inj2}, the heap voltage size stays same however it drives Vs by a little edge. In V_{inj3}, the heap voltage holds an indistinguishable stage from that of the pre-hang condition, which might be an ideal edge considering the vitality source [10]. V_{inj4} is where the infused voltage is in quadrature with the current, and this case is reasonable for a capacitor-upheld DVR as this infusion includes no dynamic power [17]. Be that as it may, a base conceivable rating of the converter is accomplished by V_{inj1}. The DVR is worked in this plan with a battery vitality stockpiling framework (BESS).

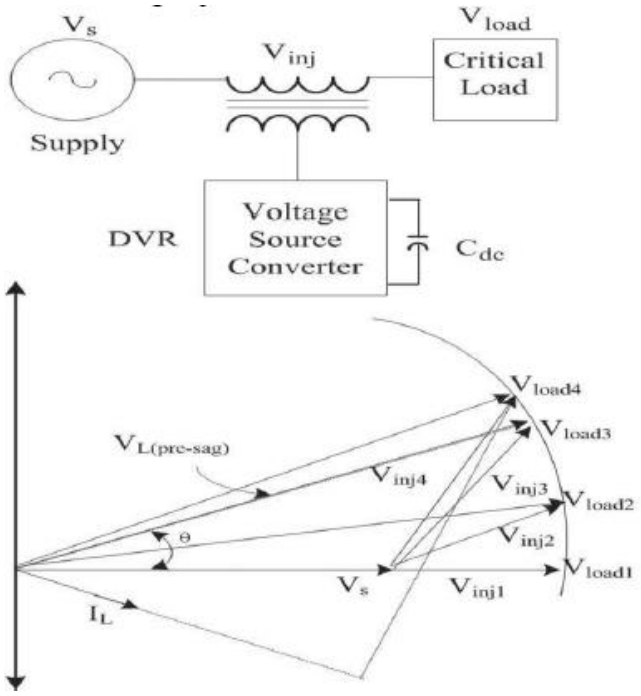

Figure 1 (a) *Basic ciucuit of DVR (b) Phasor diagram of DVR voltage Injection schemes*

Fig.2 demonstrates a schematic of a three-stage DVR associated with reestablish the voltage of a three-stage basic load. A three-stage supply is associated with a basic and touchy load through a three-stage arrangement infusion transformer. The proportional voltage of the supply of stage A V_{Ma} is associated with the purpose of basic coupling (PCC) vSa through short out impedance Z. The voltage infused by the DVR in stage A,V is with the end goal that the heap voltage V is of appraised extent and undistorted. A three-stage DVR is associated with the line to infuse a voltage in arrangement utilizing three single-stage transformers T. L and Crepresent the channel segments used to channel the swells in the infused voltage. A three-leg VSC with protected entryway bipolar transistors (IGBTs) is utilized as a DVR, and a BESS is associated with its dc transport.

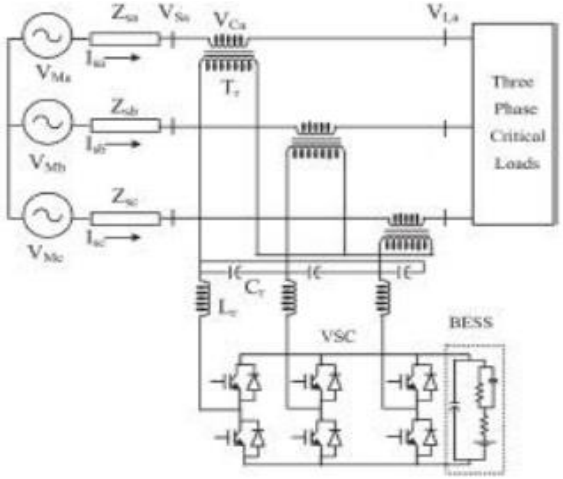

Figure 2Schematic *diagram of the DVR connected system*

3. Control of DVR

The pay for voltage hangs utilizing a DVR can be performed by infusing or engrossing the responsive power or the genuine power [17]. At the point when the infused voltage is in quadrature with the current at the crucial recurrence, the pay is made by infusing responsive power and the DVR is with a self-bolstered dc transport. In any case, if the infused voltage is in stage with the current, DVR infuses genuine power, and subsequently, a battery is required at the dc transport of

the VSC. The control system received ought to consider the confinements, for example, the voltage infusion capacity (converter and transformer rating) and enhancement of the span of vitality stockpiling.

3.1. Control of DVR with BESS for Voltage Sag, Swell and Harmonic Compensation:

Fig.3 demonstrates a control piece of the DVR in which the SRF hypothesis is utilized for reference flag estimation. The voltages at the PCC V_S and at the heap terminal V_L are detected for determining the IGBTs' door signals. The reference stack voltage V*L is separated utilizing the inferred unit vector [23].

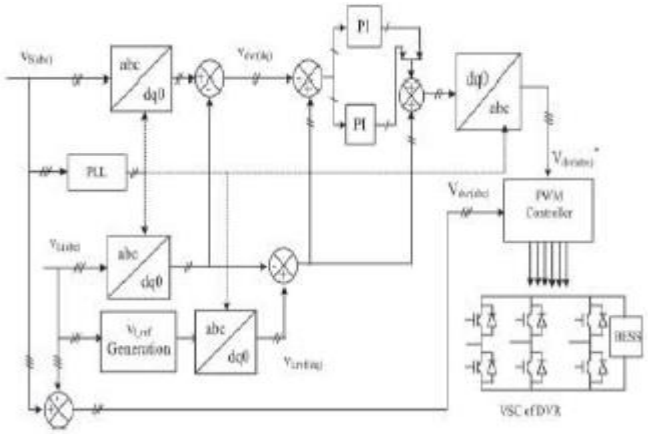

Figure 3Control block *of DVR that uses the SRF method of control*

4. Hysteresis Voltage control Technique

The control of dynamic voltage restorer is relates with the identification of voltage droop/plunge, voltage swell, and the age of the reference voltages for infusion reason. The hang, swell recognition procedure is critical errand for the proper working of dynamic voltage restorer. There are different procedures for the discovery of voltage list, swell. Some are given beneath.

- Measuring peak values of input supply.
- Measuring of voltage components in dq frame in a Vector controller.
- Applying phase locked loop to each phase.
- Applying the Fourier transform to every phase.
- Applying the wavelet transform to every phase

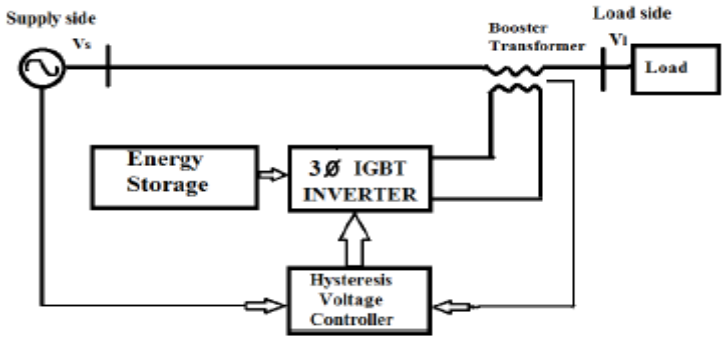

Figure 4*Structure of DVR with Hysteresis voltage control*

The control procedure connected in this paper depends on voltage mistake and is non straight control strategy as appeared in Fig.4. It comprises of an examination between the yield

voltage and as far as possible (V_H, V_L) around the reference voltage, While the yield voltage is between maximum breaking point and lower restrict , no exchanging happens and when the yield voltage increments to as far as possible (bring down band) the yield voltage is diminished (expanded).

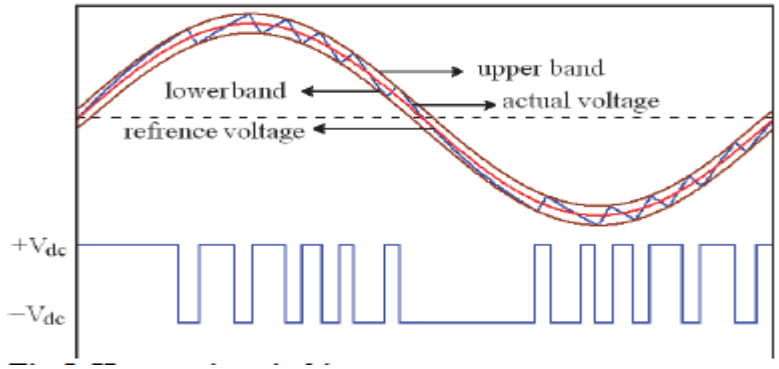

Figure 5*Hysteresis switching pattern*

Following figure clarifies the fundamental control graph of dynamic voltage restorer with hysteresis voltage controller. It essentially comprises of three stage IGBT inverter, Energy stockpiling, supporter transformer and the hysteresis voltage controller. The hysteresis controller basically requires two voltage signals, one is from supply side voltage flag and another is from sponsor transformer which is voltage infused by unique voltage restorer. The controller thinks about these two flags and as indicated by these signs exchanging design is built up. The hysteresis exchanging strategy is very much clarified in fig.5.

5. Simlation Results

Simulation results of this paper are as shown in Figs.6 to 15.

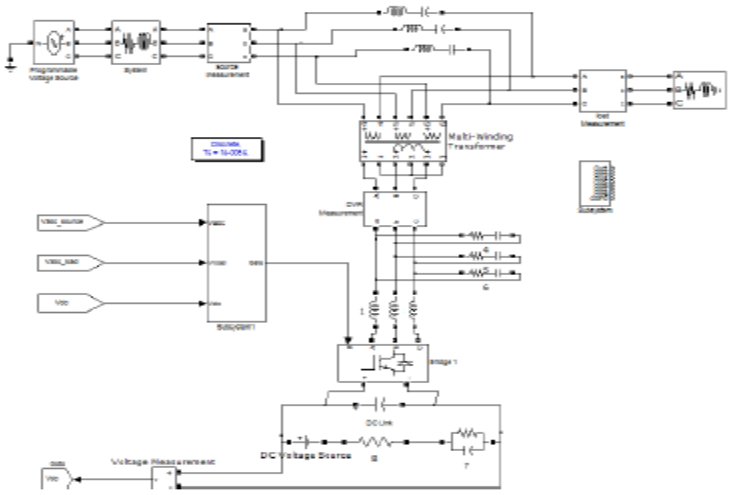

Figure 6*MATLAB-based models of the BESS- supported DVR Connected system*

Figure 7*Simulation waveforms of source voltage, DVR voltage, load voltage, source current using PI controller*

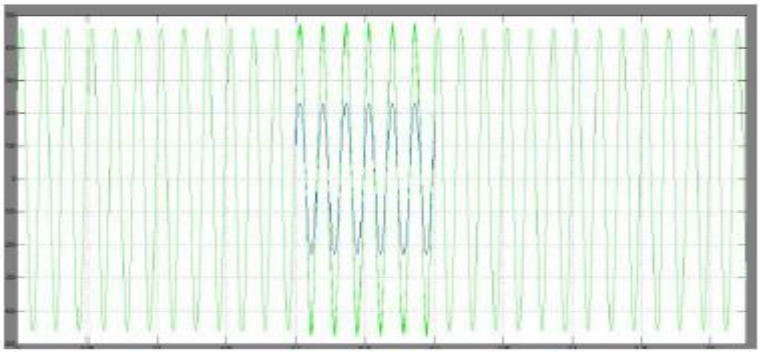

Figure 8*shows the variation of source voltage and load voltage using PI controller*

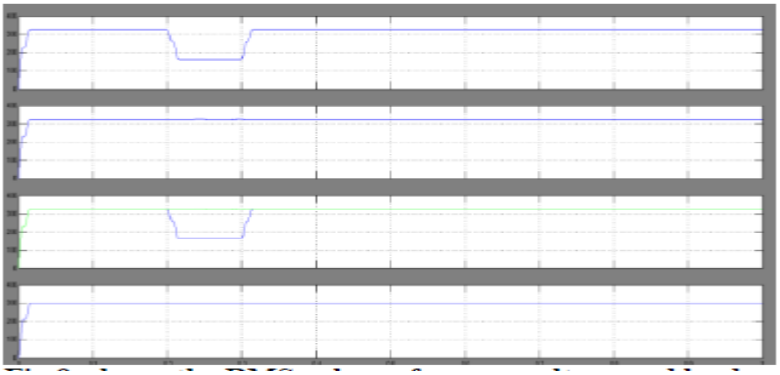

Figure 9*shows the RMS values of source voltage and load voltage using PI controller*

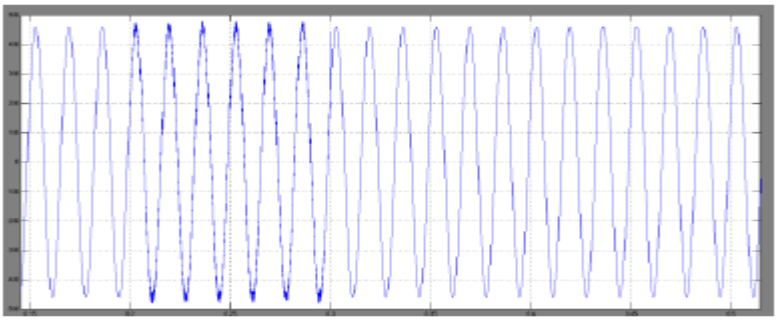

Figure 10*shows the load voltage response using PI controller*

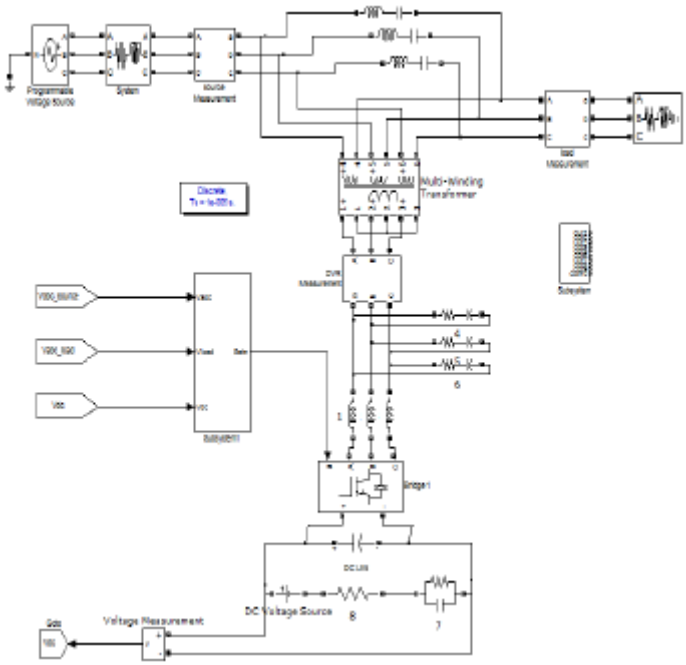

Figure 11*MATLAB based model of the BESS supported DVR connected system using hysteresis voltage controller*

Figure 12*Simulation waveforms of source voltage, DVR voltage, load voltage, source current using hysteresis voltage controller.*

Figure 13*shows the variation of source voltage and load voltage using hysteresis voltage controller*

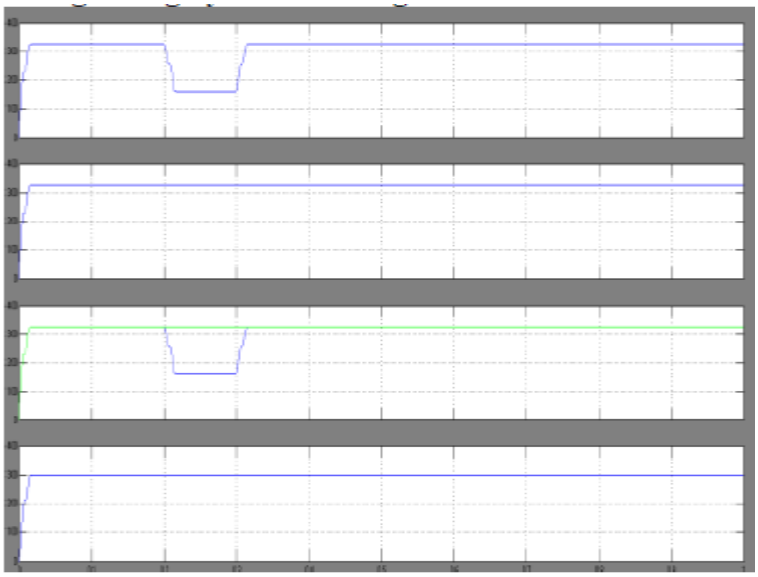

Figure 14*shows theRMS value of source voltage and load voltage using fuzzy hysteresis voltage controller*

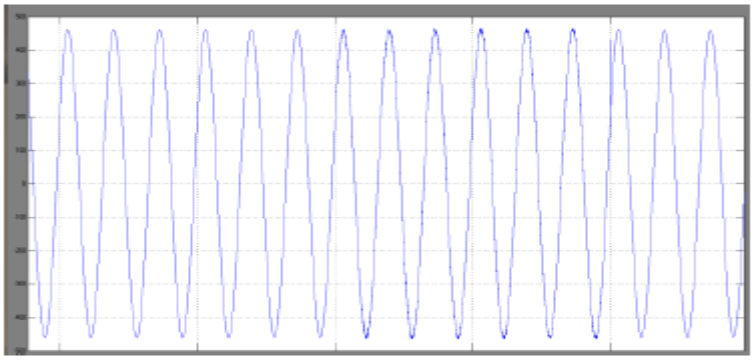

Figure 15*shows the load voltage response using hysteresis voltage controller*

6. Conclusion

This paper has introduced the power quality issues, for example, voltage plunges, swells, contortions. Remuneration methods of custom power electronic devices DVR were exhibited. The plan and uses of DVR for voltage droops and thorough outcomes were introduced the compelling calculation has been Developed keeping in mind the end goal to get a quick reaction of the device. The examination of DVR under hysteresis voltage controller is completed utilizing MATLAB Power System Block set. The aftereffects of reproduction are displayed and talked about. The THD and the measure of unbalance in stack voltage are diminished with the use of DVR. The proposed framework performs superior to anything the customary strategies in alleviating music and voltage droops.

References

[1] M. H. J. Bollen, Understanding Power Quality Problems—Voltage Sags and Interruptions. New York, NY, USA: IEEE Press, 2000.

[2] A. Ghosh and G. Ledwich, Power Quality Enhancement Using Custom Power Devices. London, U.K.: Kluwer, 2002.

[3] M. H. J. Bollen and I. Gu, Signal Processing of Power Quality Disturbances. Hoboken, NJ, USA: Wiley-IEEE Press, 2006.

[4] R. C. Dugan, M. F. McGranaghan, and H. W. Beaty, Electric Power Systems Quality, 2nd ed. New York, NY, USA: McGraw-Hill, 2006.

[5] A. Moreno-Munoz, Power Quality: Mitigation Technologies in a Distributed Environment. London, U.K.: Springer-Verlag, 2007.
[6] K. R. Padiyar, FACTS Controllers in Transmission and Distribution. New Delhi, India: New Age Int., 2007.
[7] IEEE Recommended Practices and Recommendations for Harmonics Control in Electric Power Systems, IEEE Std. 519, 1992.
[8] V. B. Bhavraju and P. N. Enjeti, —An active line conditioner to balance voltages in a three phase system,‖ IEEE Trans. Ind. Appl., vol. 32, no. 2, pp. 287–292, Mar./Apr. 1996.
[9] S. Middlekauff and E. Collins, —System and customer impact,‖ IEEE Trans. Power Del., vol. 13, no. 1, pp. 278– 282, Jan. 1998.
[10] M. Vilathgamuwa, R. Perera, S. Choi, and K. Tseng,
[11] —Control of energy optimized dynamic voltage restorer,‖ in Proc. IEEE IECON, 1999, vol. 2, pp. 873–878.
[12] J. G. Nielsen, F. Blaabjerg, and N.Mohan, —Control strategies for dynamic voltage restorer compensating voltage sags with phase jump,‖ in Proc. IEEE APEC, 2001, vol. 2, pp. 1267–1273.
[13] A. Ghosh and G. Ledwich, —Compensation of distribution system voltage using DVR,‖ IEEE Trans. Power Del., vol. 17, no. 4, pp. 1030–1036, Oct. 2002.
[14] A. Ghosh and A. Joshi, —A new algorithm for the generation of reference voltages of a DVR using the method of instantaneous symmetrical components,‖ IEEE Power Eng. Rev., vol. 22, no. 1, pp. 63–65, Jan. 2002.