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A New Control Technique To Control The Capacitor-Supported DVR

K Harisha[1], Dr D Srinivas[2]
[1]*(EEE, KITS,DIVILI/JNTUK,AP,INDIA)*
[2]*(EEE, KITS,DIVILI/JNTUK,AP,INDIA)*

Abstract: *In this paper, distinctive voltage infusion plans for dynamic voltage restorers (DVRs) are broke down with specific concentrate on another strategy used to limit the rating of the voltage source converter (VSC) utilized as a part of DVR. Another control strategy is proposed to control the capacitor-upheld DVR. The control of a DVR is shown with a diminished rating VSC. The reference stack voltage is assessed utilizing the unit vectors. The synchronous reference outline hypothesis is utilized for the transformation of voltages from turning vectors to the stationary edge. The remuneration of the voltage list, swell, and music is shown utilizing a lessened rating DVR*

Keywords -*Dynamic voltage restorer (DVR), power quality, unit vector, voltage harmonics, voltage sag, voltage swell*

I. INTRODUCTION

Power Quality problems in the present-day distribution systems are addressed in the literature [1]–[6] due to the increased use of sensitive and critical equipment pieces such as communication network, process industries, and precise manufacturing processes. Power quality problems such as transients, sags, swells, and other distortions to the sinusoidal waveform of the supply voltage affect the performance of these equipment pieces. Technologies such as custom power devices are emerged to provide protection against power quality problems [2]. Custom power devices are mainly of three categories such as series-connected compensators known as dynamic voltage restorers (DVRs), shunt-connected compensators such as distribution static compensators, and a combination of seriesand shunt-connected compensators known as unified power quality conditioner [2]–[6]. The DVR can regulate the load. voltage from the problems such as sag, swell, and harmonics in the supply voltages. Hence, it can protect the critical consumer loads from tripping and consequent losses [2]. The custom power devices are developed and installed at consumer point to meet the power quality standards such as IEEE-519 [7].Voltage sags in an electrical grid are not always possible to avoid because of the finite clearing time of the faults that cause the voltage sags and the propagation of sags from the transmission and distribution systems to the low-voltage loads. Voltage sags are the common reasons for interruption in production plants and for end-user equipment malfunctions in general. In particular, tripping of equipment in a production line can cause production interruption and significant costs due to loss of production. One solution to this problem is to make the equipment itself more tolerant to sags, either by intelligent control or by storing "ride-through" energy in the equipment. An alternative solution, instead of modifying each component in a plant to be tolerant against voltage sags, is to install a plantwide uninterruptible power supply system for longer power interruptions or a DVR on the incoming supply to mitigate voltage sags for shorter periods [8]–[23]. DVRs can eliminate most of the sags and minimize the risk of load tripping for very deep sags, but their main drawbacks are their standby losses, the equipment cost, and also the protection scheme required for downstream short circuits.

Many solutions and their problems using DVRs are reported, such as the voltages in a three-phase system are balanced [8] and an energy-optimized control of DVR is discussed in [10]. Industrial examples of DVRs are given in [11], and different control methods are analyzed for different types of voltage sags in [12]–[18]. A comparison of different topologies and control methods is presented for a DVR in [19]. The design of a capacitor-supported DVR that protects sag, swell, distortion, or unbalance in the supply voltages is discussed in [17]. The performance of a DVR with the high-frequency-link transformer is discussed in [24]. In this paper, the control and performance of a DVR are demonstrated with a reduced-rating voltage source converter (VSC). The synchronous reference frame (SRF) theory is used for the control of the DVR.

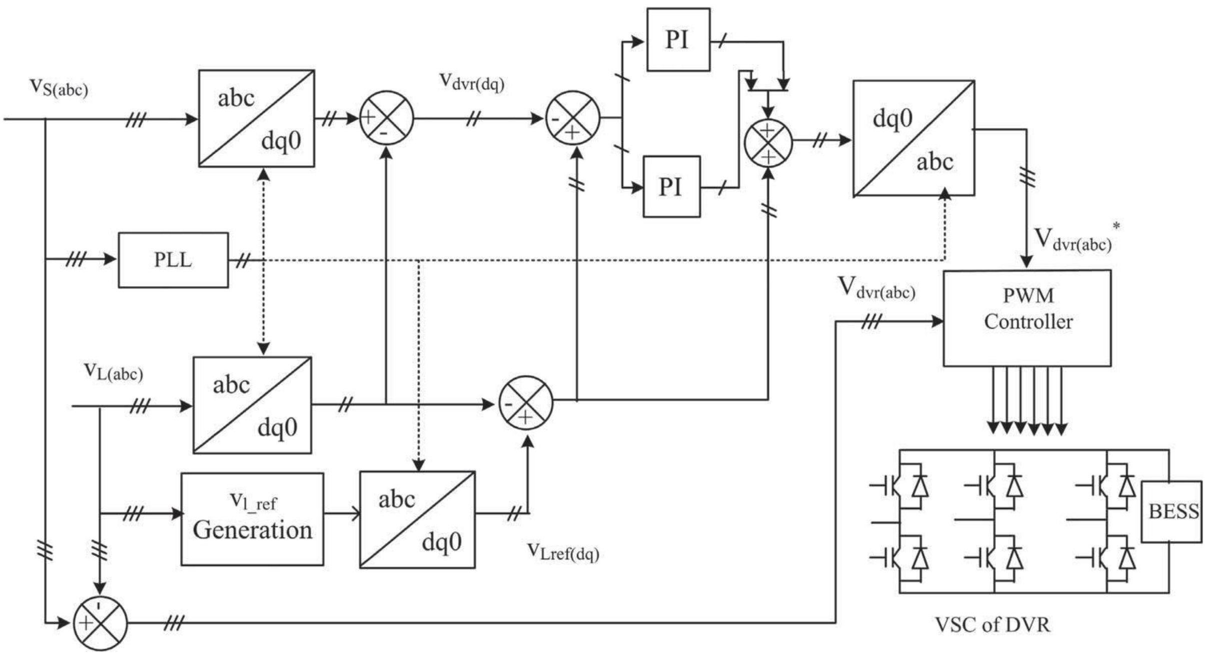
II. OPERATION OF DVR

The schematic of a DVR-associated framework is appeared inFig. 1(a). The voltage Vinj is embedded with the end goal that the heap voltage V load is steady in size and is undistorted, in spite of the fact that the supply voltage Vs is not steady in size or is misshaped.Fig. 1(b) demonstrates the phasor graph of various voltage infusion plans of the DVR. VL(pre−sag) is a voltage over the basic load before the voltage hang condition. Amid the voltage list, the voltage is lessened to Vs with a stage slack edge of θ. Presently, the DVR infuses a voltage with the end goal that the heap voltage greatness is kept up at the pre-list condition. As indicated bythe stage point of the heap voltage, the infusion of voltages can be acknowledged in four ways [19]. Vinj1 speaks to the voltage injected in-stage with the supply voltage. With the infusion of Vinj2, the heap voltage greatness stays same however it leads Versus by a little point. In Vinj3, the heap voltage holds the same stage as that of the pre-list condition, which might be an ideal point considering the vitality source [10]. Vinj4 is the condition where the infused voltage is in quadrature with the current, and this case is reasonable for a capacitor-bolstered DVR as this infusion includes no dynamic power [17]. Be that as it may,a base conceivable rating of the converter is accomplished by Vinj1.The DVR is worked in this plan with a battery vitality capacity framework (BESS).

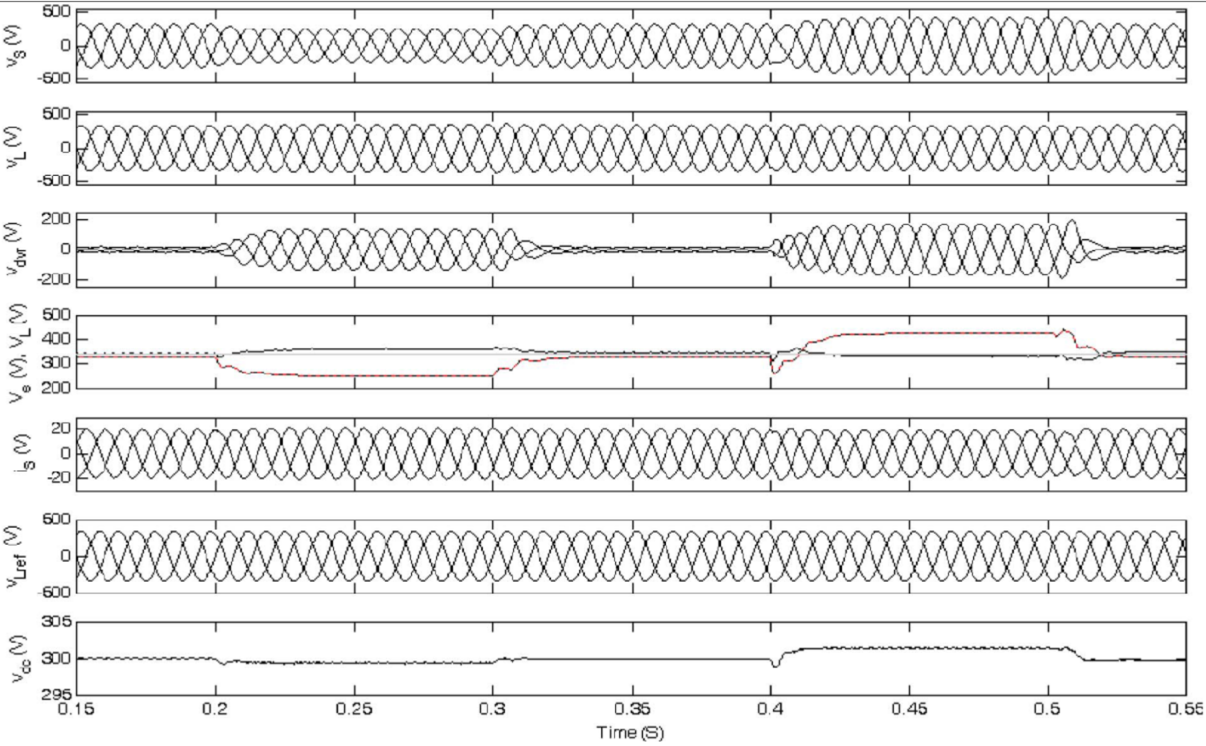
III. CONTROL OF DVR

The remuneration for voltage droops utilizing a DVR can be performed by infusing or engrossing the responsive power or the genuine power [17].When the infused voltage is in quadrature with the current at the key recurrence, the pay is made by infusing receptive power and the DVR is with a self-upheld dc transport. Be that as it may, if the infused voltage is inphase with the current, DVR infuses genuine power, and henceforth,a battery is required at the dc transport of the VSC. The control method embraced ought to consider the constraints, for example, the voltage infusion ability (converter and transformer rating) also, advancement of the extent of vitality stockpiling.

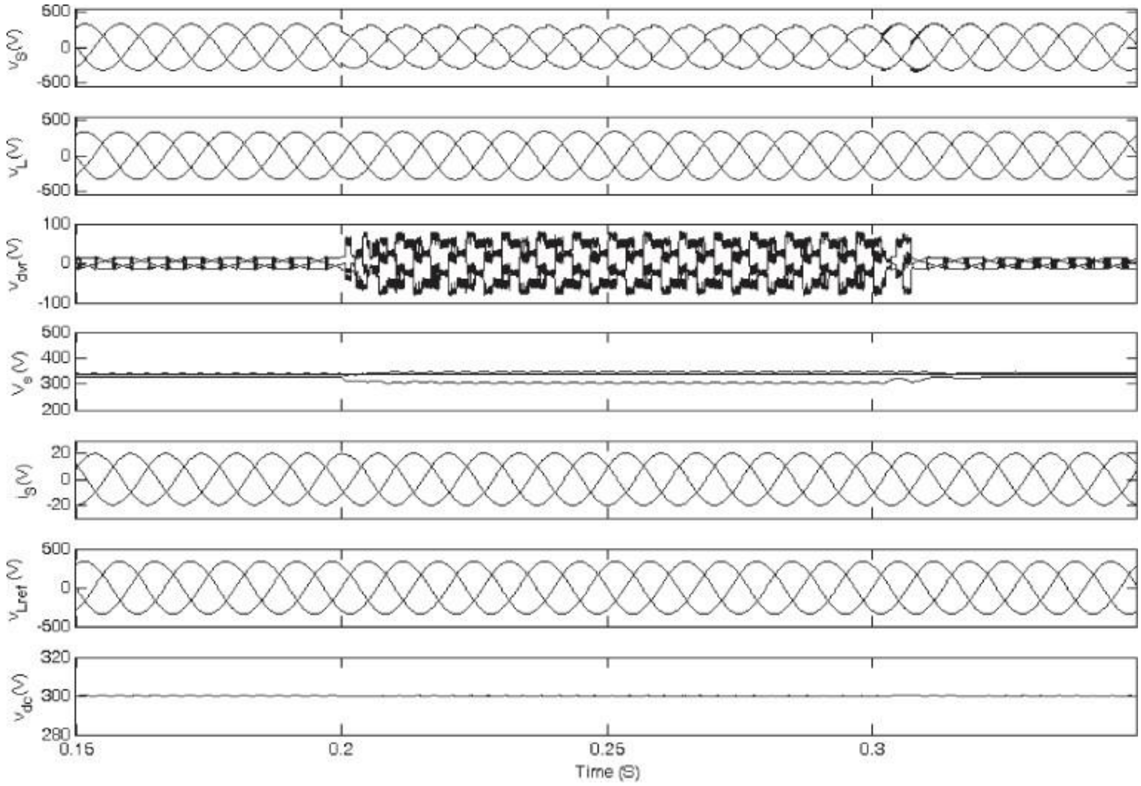
IV. FIGURES AND TABLES



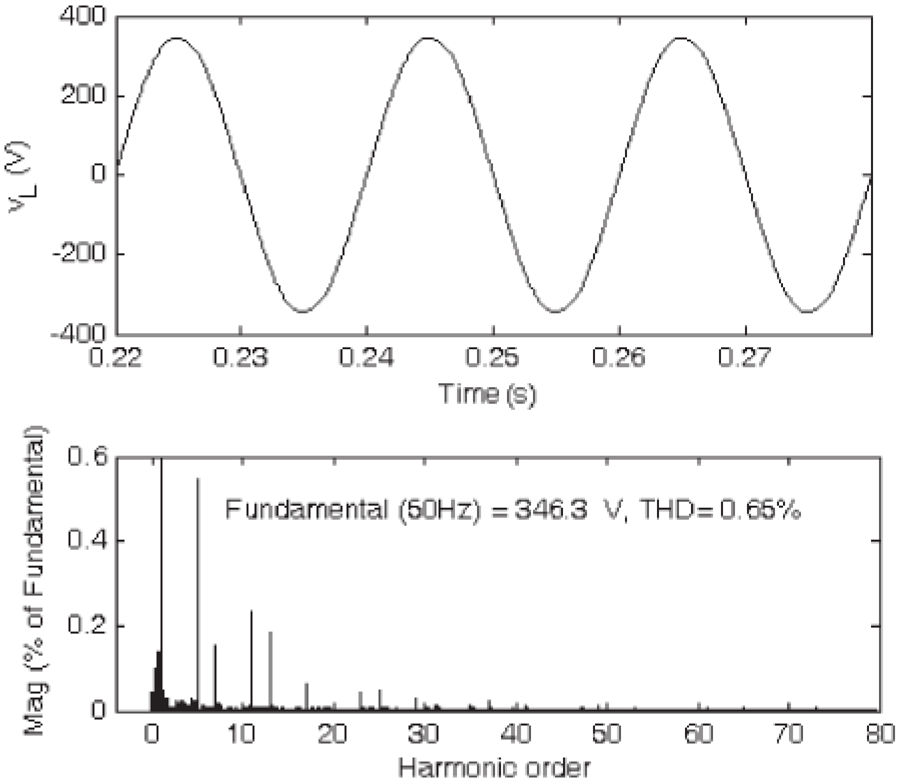
Basic circuit of DVR. (b) Phasor diagram of the DVR voltage injection schemes.



Dynamic performance of DVR with in-phase injection during voltage sag and swell applied to critical load.



Dynamic performance of DVR during harmonics in supply voltage applied to critical load.



Load voltage and harmonic spectrum during the disturbance.

V. CONCLUSION

The operation of a DVR has been exhibited with another control procedure utilizing different voltage infusion plans. A correlation of the execution of the DVR with various plans has been performed with a decreased rating VSC, including a capacitor-upheld DVR. The reference stack voltage has been evaluated utilizing the technique for unit vectors, and the control of DVR has been accomplished, which limits the blunder of voltage infusion. The SRF hypothesis has been utilized for evaluating the reference DVR voltages. It is inferred that the voltage infusion in-stage with the PCC voltage brings about least evaluating of DVR yet at the cost of a vitality source at its dc bus

APPENDIX

AC line voltage: 415 V, 50 Hz
Line impedance: L_s = 3.0 mH, R_s = 0.01 Ω
Linear loads: 10-kVA 0.80-pf lag
Ripple filter: C_f = 10 μF, R_f = 4.8 Ω
DVR with BESS
DC voltage of DVR: 300 V
AC inductor: 2.0 mH
Gains of the *d*-axis PI controller: K_{p1} = 0.5, K_{i1} = 0.35
Gains of the *q*-axis PI controller: K_{p2} = 0.5, K_{i2} = 0.35
PWM switching frequency: 10 kHz
DVR with dc bus capacitor supported
DC voltage of DVR: 300 V.
AC inductor: 2.0 mH
DC bus voltage PI controller: K_{p1} = 0.5, K_{i1} = 0.35
AC load voltage PI controller: K_{p2} = 0.1, K_{i2} = 0.5
PWM switching frequency: 10 kHz
Series transformer: three-phase transformer of rating
10 kVA, 200 V/300 V.

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