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ESTIMATION OF TOTAL HARMONIC DISTORTION (THD) OF A BATTERY SUPPORTED DYNAMIC VOLTAGE RESTORER (DVR) CONNECTED TO AN SECONDARY DISTRIBUTION NETWORK WITH A NON-LINEAR LOAD

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ABSTRACT

In This paper describes about major power quality problems-voltage quality and harmonics[2], in power systems, enormously effects on sensitive loads[10], these loads can be protect by introducing custom power device[14] called Dynamic Voltage restorer (DVR), this is connected in series[9] with the line, it can inject/absorb voltage [8][9]with the help of self supported capacitor[12] -inject voltage in quadrature with the line current during sag[2] by adding a Battery energy storage system-inject voltage in phase with Vs. So that voltage source converter rating is reduced, gate pulses should be generated based on synchronous reference frame theory(SRF) and by applying FFT analysis to find the THD.

Keywods:- *DVR, abc to dqo transformattion ,voltage sag, voltage swell, FFT*

I. INTRODUCTION

In recent years, there has been an increased emphasis on the quality of power delivered to factories, commercial establishments, and residences. This is due in part to the prevalence of harmonic-creating systems in use. Such harmonic-generating equipment contributes to the harmonic[7] burden the system must accommodate. In addition, utility switching and fault clearing produce disturbances that affect the quality of delivered power. One of the biggest problems in power quality aspects is the harmonics content in the electrical system. Generally, harmonics may be divided into two types: voltage harmonics and current harmonics. Current harmonics is usually generated by harmonics contained in voltage supply and depends on the type of load such as resistive load, capacitive load, and inductive load. Both harmonics can be generated by either the source or the load side. Harmonics generated by load are caused by nonlinear operation of devices, including power converters, arc-furnaces, gas discharge lighting devices, etc. Load harmonics can cause the overheating of the magnetic cores of transformer and motors. On the other hand, source harmonics are mainly generated by power supply with non-sinusoidal voltage waveform. Voltage and current source harmonics imply power losses, electromagnetic interference and pulsating torque in AC motor drives. Much of the equipment in use today is susceptible to damage or service interruption during poor power-quality events. Everyone with a computer has experienced a computer shutdown and reboot with a loss of work resulting. Often this is caused by poor power quality on the power line. Poor power quality also affects the efficiency and operation of electric devices and other equipment in factories and offices. IEEE has done significant work on the definition, detection, and mitigation of power quality events.

IEEE Standard 1100 (IEEE 1999) defines :-

power quality as the concept of powering and grounding sensitive electronic equipment in a manner suitable for the equipment.

Electrical equipment susceptible to power quality or more appropriately to lack of power quality would fall within a seemingly boundless domain. All electrical devices are prone to failure or malfunction when exposed to one or more power quality problems. The electrical device might be an electric motor, a transformer, a generator, a computer, a printer, communication equipment, or a household appliance. All of these devices and others react adversely to power quality issues, depending on the severity of problems.

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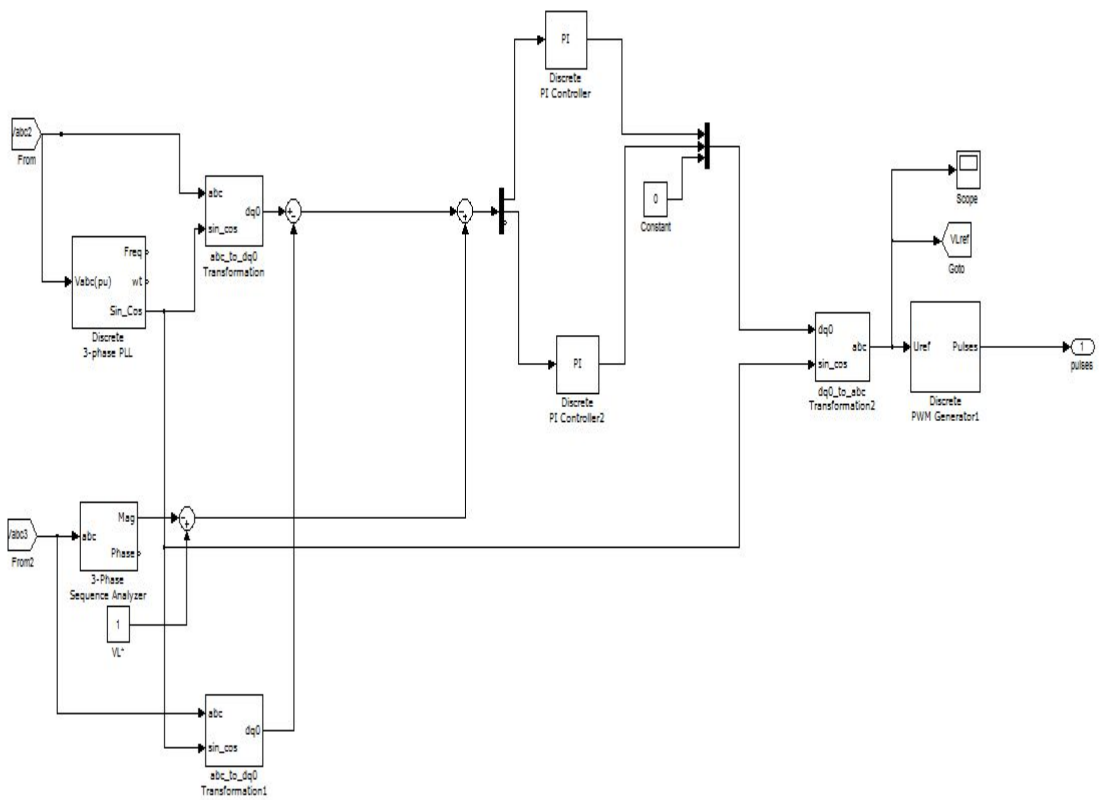
II. OBJECTIVES OF THE WORK

For an economic operation of power system power quality should be maintained properly. Voltage sag/swell and harmonics has been concerned as major power quality issue[2].

The Main Objectives Of This Paper Are:-

1. Detection of voltage sag/swell and estimation of THD in the power system network .
2. To mitigate the power quality issue using Battery support DVR
3. To control the device in order to obtain desired performance

A. Synchronous reference frame theory - control loop for Battery support DVR



B. Simulation Model For battery support DVR During Sag & swell

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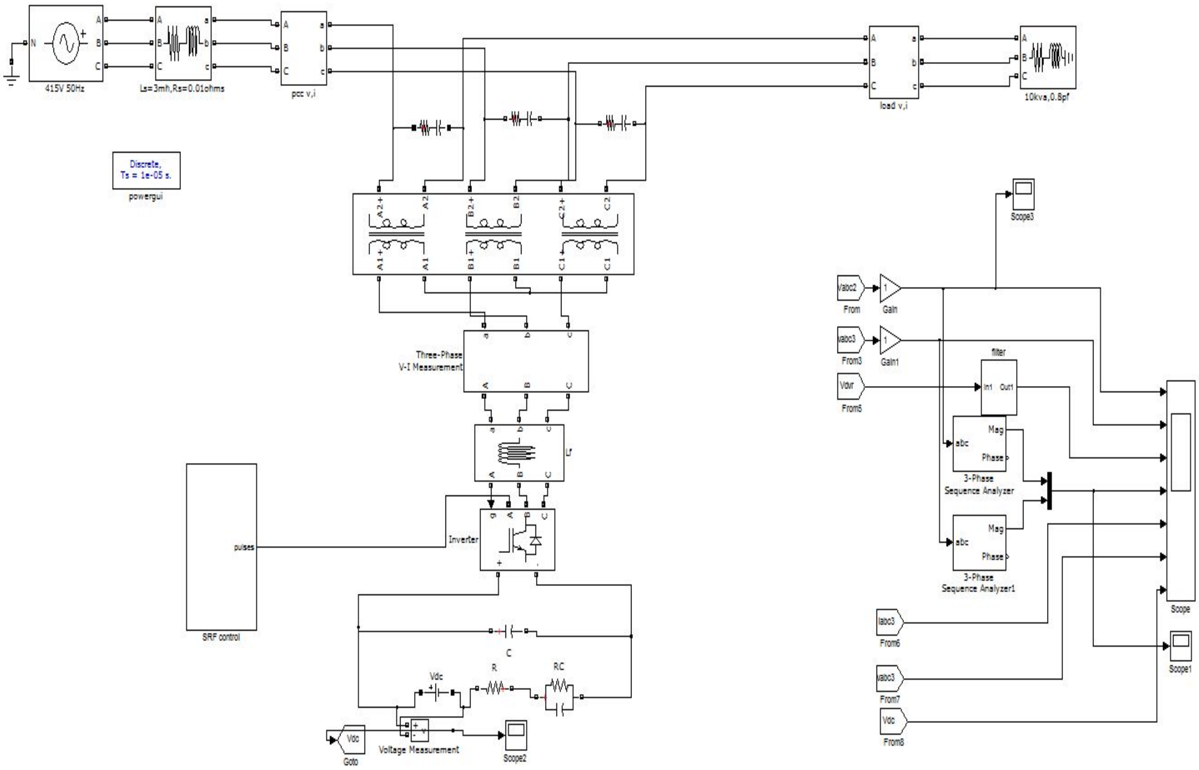
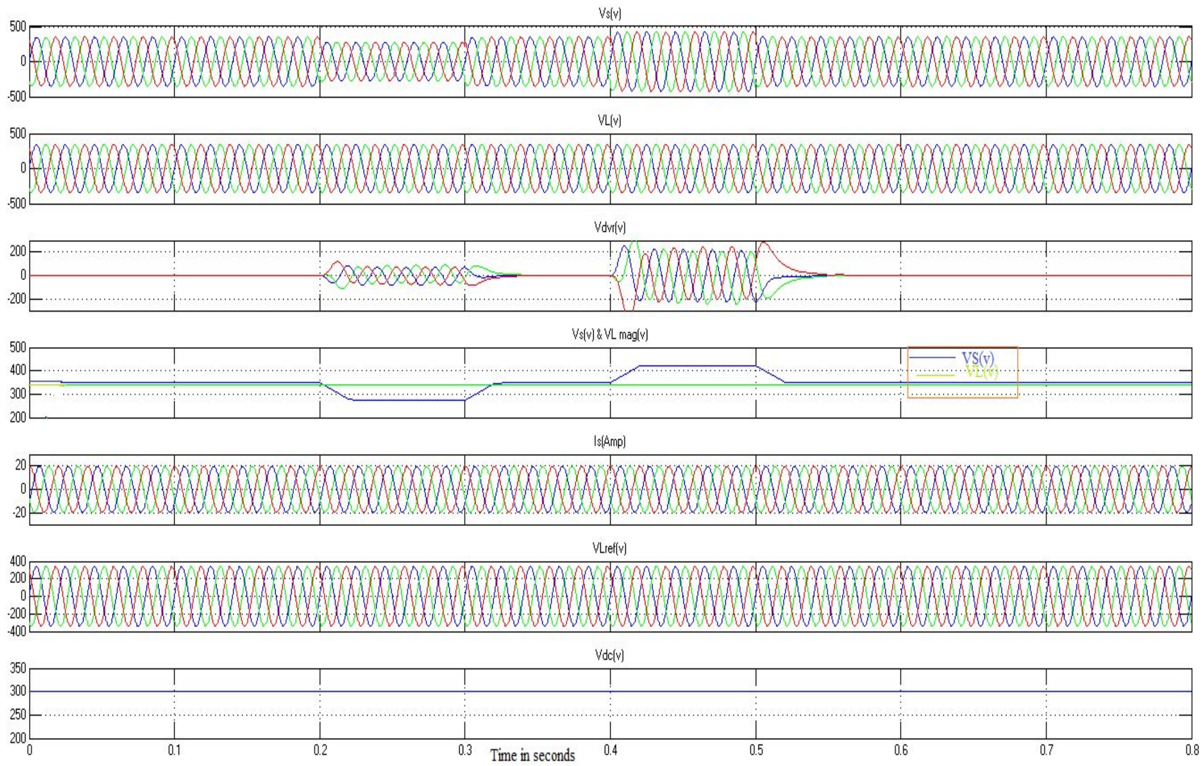


C. Battery support DVR connected system during sag &swell



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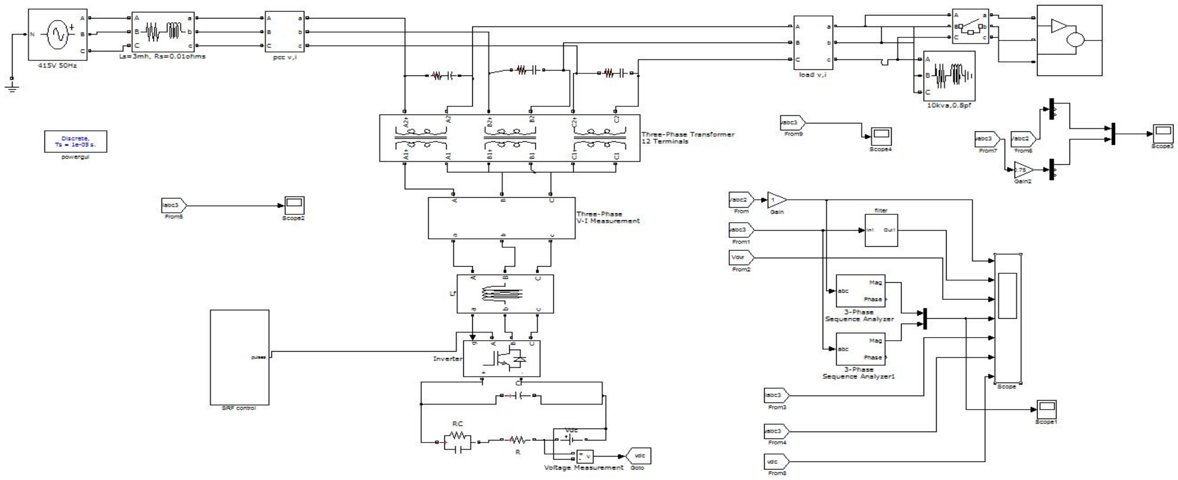
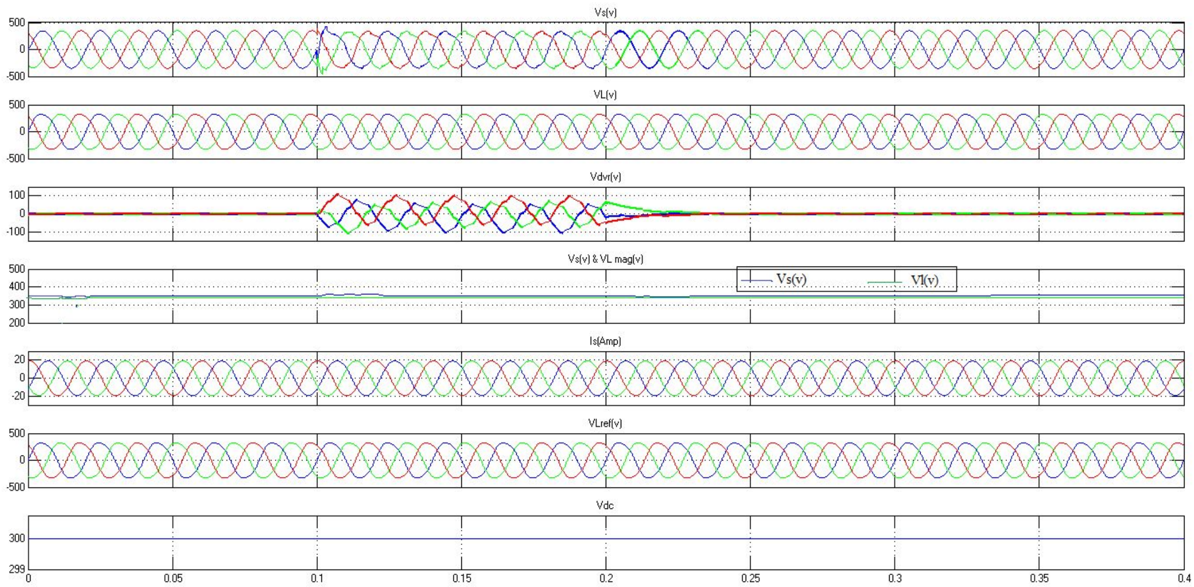
D. Simulation model during Disturbance



E) Results Of Battery Support DVR at The Time of Disturbance



Advantages of Fast Fourier Transformation(FFT)

I) Faster capture of waveform

II)Greater flexibility

III)Able to capture non-repetitive events

IV)Wave forms can be stored

Total Harmonic Ddistortion(THD):-

THD is a measure of how much harmonic content is there in a waveform.This is calculated from the expression

THD = $\sqrt{\Sigma}$ $(Un)2$ and expressed as a percentage of the fundamental component.

The Total Demand Distortion (TDD):-

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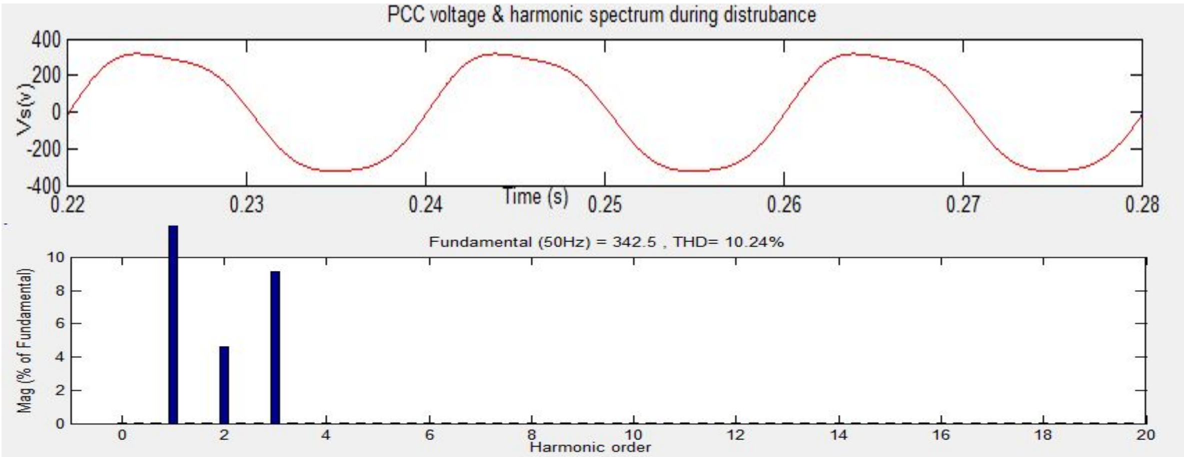
It is useful to measure and limit harmonics in electric power systems in order to avoid operational problems and equipment deterioration

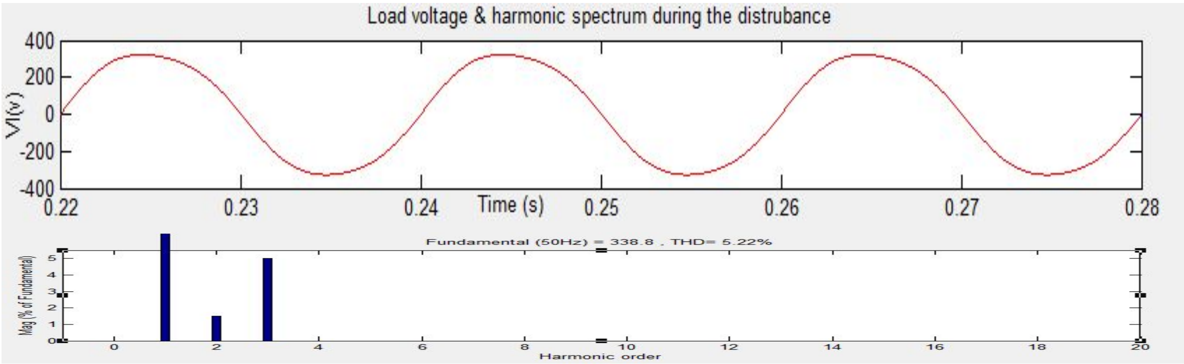
TDD was introduced in IEEE Standard 519 (IEEE 1993) to measure the Current Distortion level

F) FFT Analysis During The Disturbance

I) PCC voltage and harmonic spectrum



II) load voltage and harmonic spectrum



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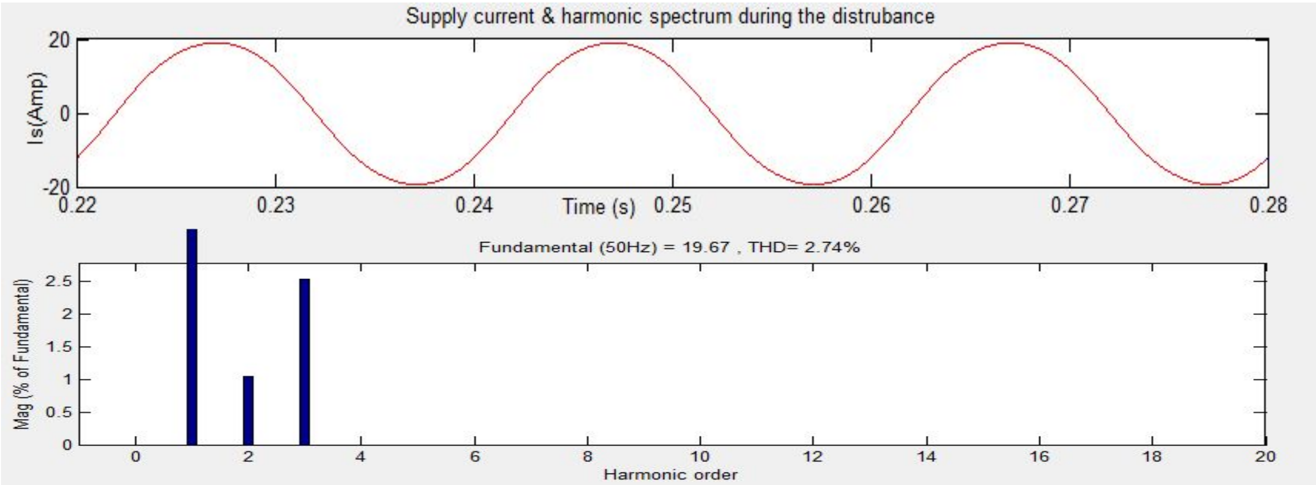
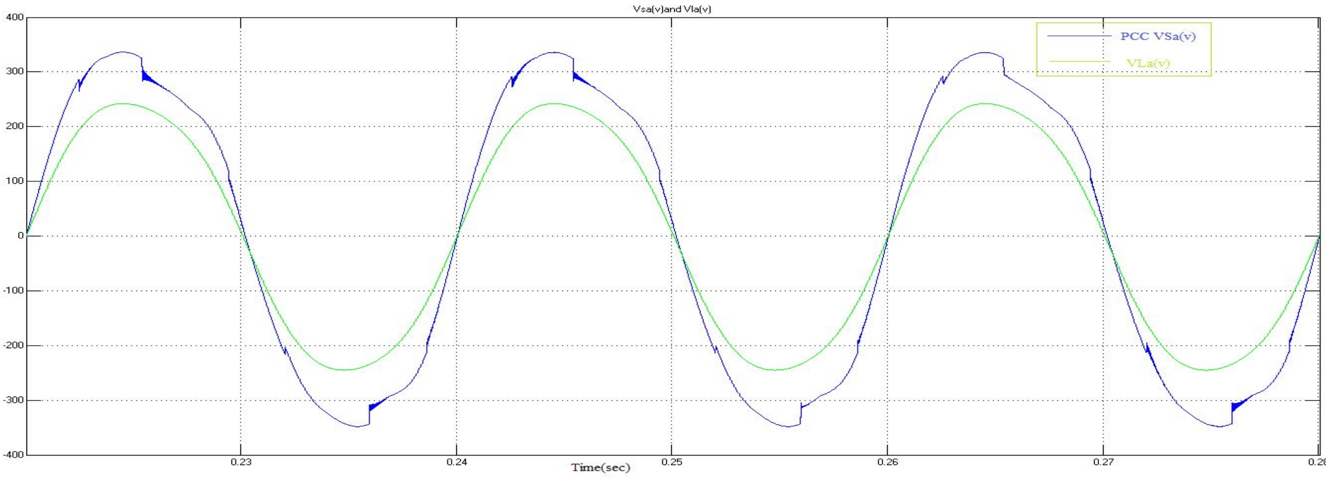
III) supply current and harmonic spectrum



IV) PCC Voltage and Load Voltage During Disturbance



V) Comparison table

Parameters	With Out DVR	%THD	With DVR	%THD
Source voltage at at PCC	338	12.1	342	10.24
Source current	27	12.94	19.67	2.74
Load voltage	289.7	27.9	338	5.22

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III. CONCLUSION

With self supported DVR during sag condition dvr can inject 150vol , in quadrature with the line current , by adding Battery to DVR, for the same loading condition 100vol, is enough compensate the dip i.e inject in series with supply voltage, any series connected devices size[9] is depends on injecting voltage[9][10],if injecting voltage is less automatically rating is reduced so With BESS supported DVR rating of the converter is reduced and when ever we switched on nonlinear load harmonics are introduced in the system . by applying FFT analysis and finding the Total Harmonic Distortion in the source voltage at point of common coupling , source current and load voltage. From above table after placing the DVR into the system the THD distortion is Reduced

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