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DYNAMIC VOLTAGE RESTORER AS A SOLUTION FOR VOLTAGE SAG COMPENSATION

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ABSTRACT: The design and simulation of a dynamic voltage restorer are shown in this study. This device helps keep voltage changes in energy distribution networks to a minimum. There are many dynamic options with the dynamic voltage converter. When placed between the power source and a vital load feeder, it can quickly restore line voltage by quickly rectifying voltage drops or rises. This keeps the load from losing power. This paper looks at whether it is technically possible to add dynamic voltage restorers (DVRs) to regular DC storage systems. During the voltage change, the DC voltage across the DC link would stay the same. In MATLAB, the dynamic voltage restorer is modeled piece by piece, and the function of each piece is tested. According to the models, the control method might be able to lower power loss.

Keywords:PowerQuality,DynamicVoltageRestorer(DVR),OperatingStates.

1. INTRODUCTION

When voltage changes during load changes, reactive power imbalances have happened in the past and stopped energy flow in power transmission systems. In modern power systems, a lot of companies and areas with high demand are linked by complicated networks of transmission and distribution lines. Customers of load centers care most about how reliable and good their power source is. Despite the fact that most modern countries have very reliable energy production methods, the energy supply is not as steady and reliable as it should be. In an ideal world, power distribution networks would send sinusoidal energy to users at the right frequency and amplitude.

A lot of irregular loads, especially in the distribution system, have a big effect on the quality of the power supply. In this way, the original waveform's purity was lost. The level of quality of power is going down significantly. In order to make it bigger, certain power sources are needed. In 1995, Hingorani put in place specific power. Specialized power management methods that are built into power system networks make electronic devices work better. Some of the most important power tools are surge arresters (SA), uninterruptible power supplies (UPS), active power filters, superconducting fault current limiters (SSFCL), battery energy storage systems (BES), distribution series capacitors (DSC), and static transfer automatic controllers (STAC). Even if the power source changes, the electric demand can keep the dynamic voltage restoration going. To keep the power quality stable, other specialty equipment is used, like digital video recorders (DVRs). Managing voltage changes can be done well with the solid-state switch voltage boost method.

2. POWER CIRCUITS OF DVR

In Figure 1, the four parts of the DVR power source are shown. Three single-phase injection transformers, an energy storage unit, and a voltage source inverter (VSR) are all built into the gadget.

Voltage Source Inverter(VSR)

Either a 4-wire or 3-phase arrangement can be used for a 3-phase VSI. Step-up injection transformers can handle both high current and low voltage. With the Flex AC Transmission System (FACTS), you don't have to build huge, multistory buildings like you did with other options. Three-level Graetz bridge inverters are often connected to inverters.

Injection Transformers

One of two winding patterns—delta/open star or star/open star—can be used to connect three single-phase transformers to the power grid. It is only possible for positive and negative sequence voltages to flow through a star or open star winding structure. Sequence voltages that are positive or negative can only be sent through the delta/open wire. There is less DC link voltage used by star-open windings than by delta/open star windings.

It depends on how the power transfer system and the 132kV to 11kV step-down transformer are connected to choose which windings to use for the injection transformer. When the neutral ends of the A-Y transformers are grounded, they can't send out 11kV/O.415kV harmonics or zero-sequence voltages. The power is spread out evenly across the whole high voltage network. Because of this, there is no need to change the voltage of the zero series. This finding doesn't apply to Y-Y transformers that are connected to a neutral ground. The injection transformer is wrapped and controlled in line with the step-down transformer design of the distribution system. To keep the engine from getting too hot, the injection transformer needs to make a steady-state flux that is at least twice the highest root mean square (rms) voltage when unsaturated fuel is injected. What a digital video camera is and how it works. The high-voltage inverter side of the series injection transformer could be the screening part of the dynamic voltage restorer.

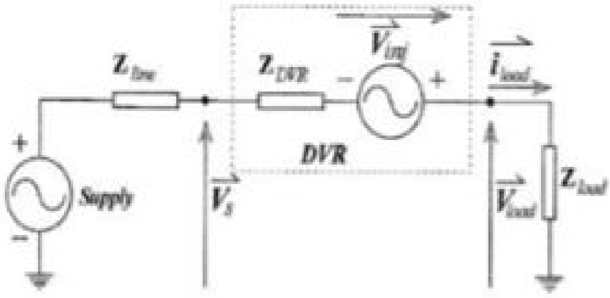

Fig.1:a) A diagram of a comparable DVR

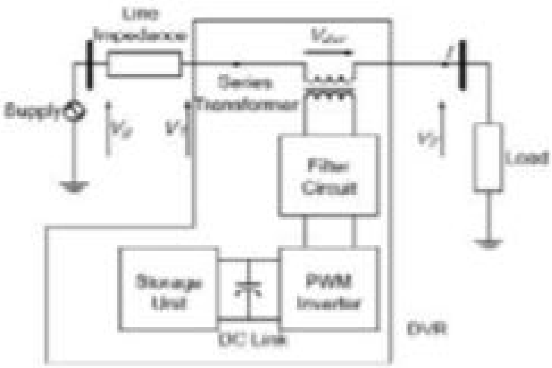

Fig.1:b)general DVR description

Passive Filters

The low-voltage side of the series transformer, which is close to the harmonic source, is where the inverter filter works best. Because of this, the series transformer can't handle high-order harmonic currents. It will take less energy to run the transformer. Change the value of filter inductor L to lower the DVR's output voltage and phase angle when it is the source. The DVR's management method might change because of this. Because it is on the stronger side of the series transformer, the filter can pick up high-order harmonics. Because of this, a transformer with a higher power is needed. Filtration could be made easier by leaks in the reactance of the generator. The filter capacitor raises the inverter's highest value, which means that neither method works.

Energy Storage

Energy storage is needed to meet demand when there isn't enough electricity available. Many types of technology, like flywheels, SMES, and lead-acid batteries, can store energy. Lead acid batteries gave this thing its power. Cells that store electrochemical energy make ions that are electrically charged. Chemical reactions mean that batteries can only be charged or discharged at set rates. This means that the rate of release affects the amount of energy that is available. Aside from that, lead-acid batteries are made using old methods.

3. CONTROL OF THE DVR

A DVR's control system is in charge of several important tasks, including keeping the system safe, figuring out when the sag starts and ends, giving a voltage reference, and making sure that the injected voltage changes quickly and reliably. The DVR was

told by the computer system to use a certain sampling and switching frequency. There are four different ways to measure parameters.
You can change the output voltage by connecting the DVR to up to three phase voltages and looking for voltage drops. It is possible to control the voltage at the output after the DVR by using three-phase voltage feedback. Three currents in the link protect the DVR from both too much and too little current. Three things are done by the dc-link voltage: it saves energy, keeps the CPU from talking to other devices, and sets the dc voltage.
The DVR is set to "null" so that it doesn't lose too much power, even when the grid is working fine. If there is a drop in energy, the DVR sends power to the grid.

Table1: a table that stores data and system configurations.

S.No	System Quantities	Standards
1.	Inverter Specification	IGBT based, 3 arms, 6 Pulse, Carrier frequency =1080 Hz, Sample Time= 5 µs
2.	Transmission Line Parameter	R=0.001 ohms, L=0.005H
3.	PI Controller	KP=0.5, Ki=50, Sample time=50 µs

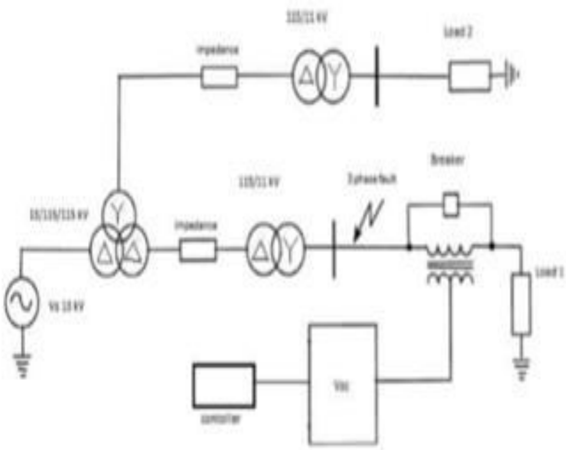

Fig.2:A diagram of the DVR testing setup.

4. SIMULATION RESULTS

To keep the voltage from dropping, the system's capacity is tested by using a number of separate DC storage levels to get the highest voltage at a load. This makes it possible to figure out how well the system stops power drops. A lot of different pressures and situations are being used to test how direct current (DC) storage affects sag correction.
Due to a resistance value of 0.66, the first scenario causes a 17.02% drop in voltage at point X, which eventually causes all three phases to fail. When energy storage devices are linked in parallel with capacitors rated at 75 microfarads (F) and 3.1 kilovolt-based (KV), the digital video recorder (DVR) works best. It's likely that the fault shift will last between 0.4 and 0.6 seconds.

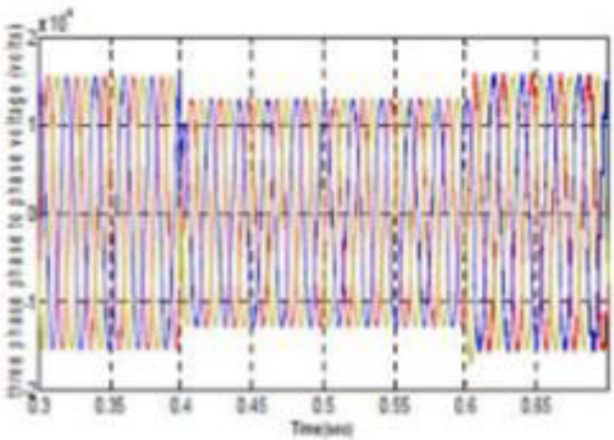

Fig. 3: a) Without When there is no DVR energy storage, the phase-to-phase voltage changes three times

Case2: If there is a three-phase failure at spot X, the 0.60 resistance causes the voltage to drop by 19%. The fault transfer should take somewhere between 0.4 and 0.6 seconds to finish. You can store 3.3 kilovolts (kV) of energy in the Digital Video Recorder (DVR) and store 750 microfarads (10-6 F) of energy in capacitors.

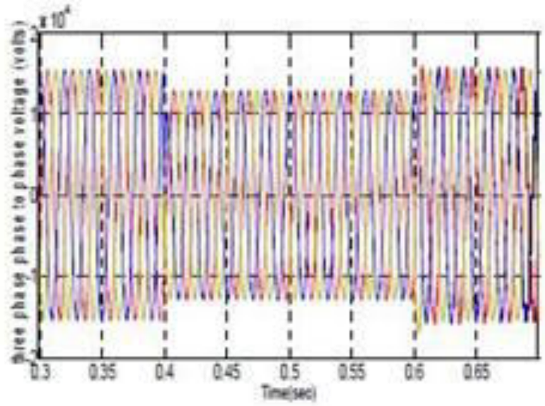

Fig.4:a) When there is no DVR energy storage, the phase-to-phase voltage changes three times.

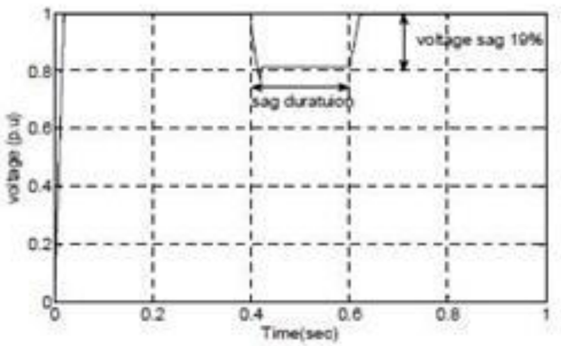

Fig. 4: b) the power at the load before the DVR.

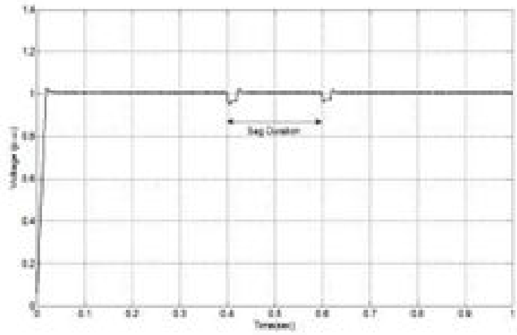

Fig.4:c) It has a load point voltage of 3.3 kV and stores DC power.

Case3: It's 23% less power at point X because of a 0.50 three-phase defect. The fault shift is likely to happen in the next 0.4 to 0.6 seconds. VRT can work at 3.5 kV because it stores energy at that voltage.

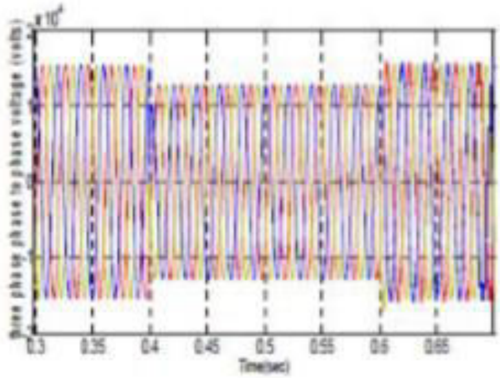

Fig. 5: a) Three stages, one after the other, without a straight video recorder.

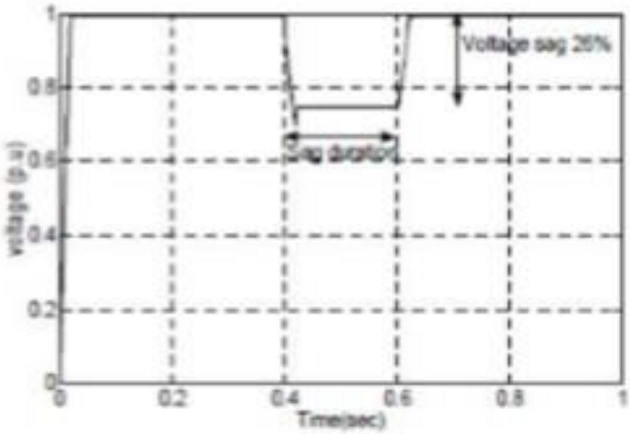

Fig. 5: b) the power at the load before the DVR.

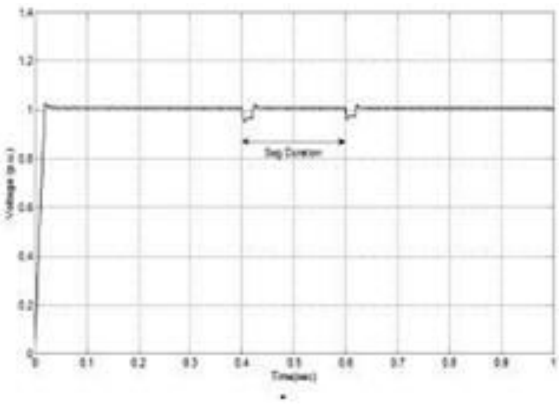

Fig.5:c) 3.5 kV DC point of release and storage voltage

Case4: Point X's voltage drops by 26% because of a three-phase failure caused by 0.45 resistance. It's likely that the fault shift will take between 0.4 and 0.6 seconds. Battery packs for DVRs have a voltage of 3.7 KV, and capacitors have a voltage of 75010–6 F

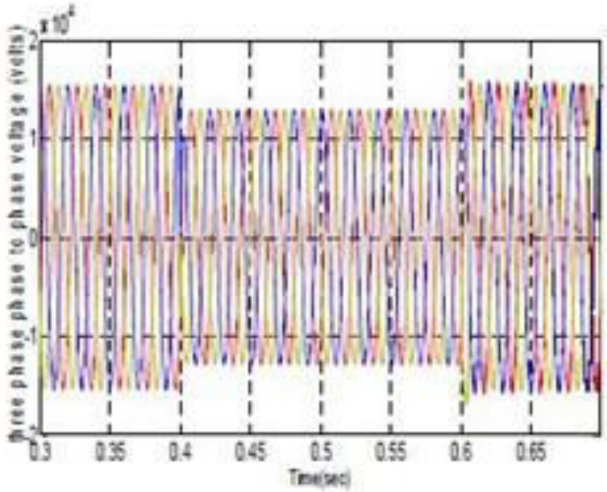

Fig. 6: a) There are three steps, with no direct video filming in between.

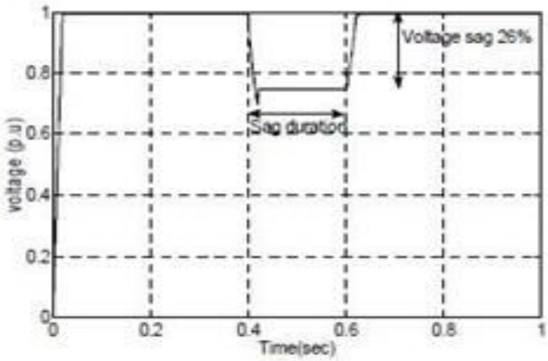

Fig. 6: b) the power at the load before the DVR.

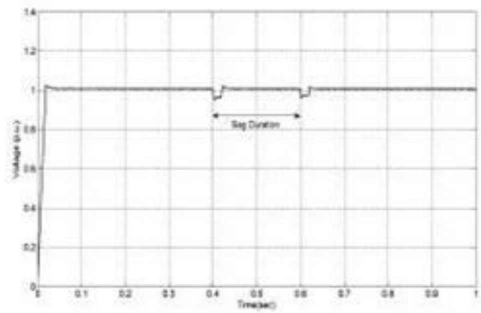

Fig.6:c) It has a load point voltage of 3.7 kV and stores DC power.

Case5: Site X loses 29% of its power because of the 0.40 resistance, which is caused by a damage in three phases. It is thought that the fault shift will happen in 0.4 to 0.6 seconds. It is possible for some DVR energy storage parts to have voltages higher than 3.7 KV and capacitances higher than 75010-6 F.

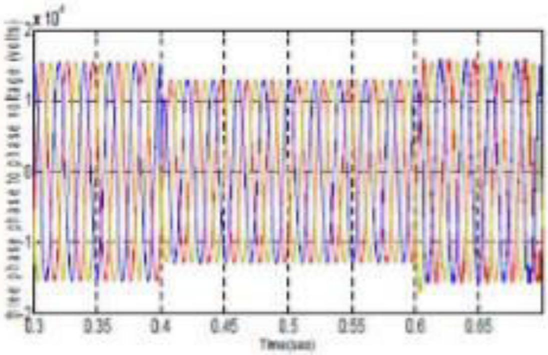

Fig.7:a) When there is no DVR energy storage, the phase-to-phase voltage changes three times.

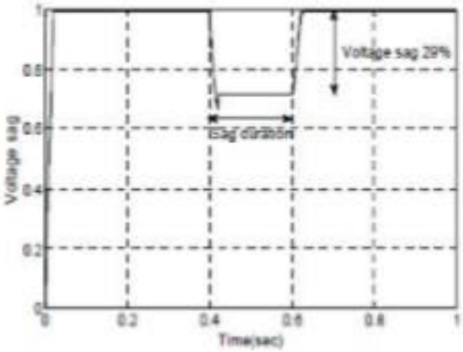

Fig. 7: b) the power at the load before the DVR.

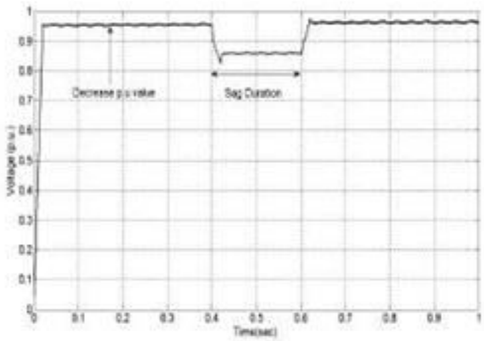

Fig.7:c) The load point voltage (p.u.) increases with 4.3 kV DC

S. No.	% Voltage Sag	Required DC Voltage (KV)
1.	17.02	3.1
2.	19	3.3
3.	23	3.5
4.	26	3.7
5.	29	Above 3.7

Table2: Significant reduction in DC power as compared to the source

See the table below for a full picture of the different types of voltage drop that require different DC storage. DC energy savings go up in direct relation to the voltage drop on 11 KV lines when the load stays the same. It happens when there is a loss of more than 28% in the power flow. When the voltage per unit drops below one, the problem gets worse as the voltage loss % of the 11 kV feeder rises.

5. CONCLUSION

As shown in Figure 8, the voltage drop rises, which causes the DC stored voltage to change. To find out how much the DC storage is worth, use the following formula:

$$Y = 0.0012X^3 - 0.008X^2 + 1.8X - 10$$

Where Y= DC Voltage (kV) and X=% Voltage sag

For DC storage calculations, you need to know the voltage sag numbers. The DC storage rate and the % voltage loss are the two most important parts of a DVR device. When a certain voltage drop happens, the load port voltage of the test equipment goes down too.

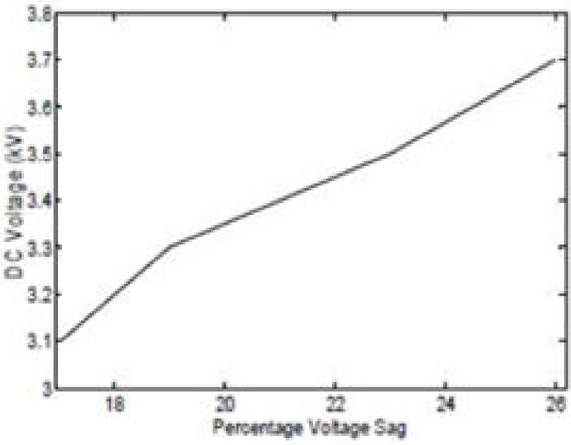

Fig.8:%voltages agverses DC storage(KV)

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