ANALYSIS OF THE WORKING MODES OF DYNAMIC VOLTAGE RESTORER

Bui Thi Hai Linh[1]

[1] *Thai Nguyen University of Technology, Vietnam*

ABSTRACT

The voltage sag phenomenon is a change in voltage in a short time. Still, it can cause the machine to stop at some essential loads, affecting the regular operation of the entire electric power system. The voltage sag can be overcome by applying a Dynamic Voltage Restorer (DVR) built on a power electronic converter with advanced features such as immediate impact and very high accuracy.

Keyword: *Voltage sag phenomenon, Dynamic Voltage Restorer, PWM controller.*

1. INTRODUCTION

Voltage sag is a phenomenon of reducing, unbalancing of voltage, phase angle jump or transient voltage, interrupting power supply in the short term [1-11]. This short-term interval usually ranges from 0.5 to 30 cycles. The causes of the voltage sag are short-circuited failures in the electric power system, the voltage sag due to the starting of the large-capacity motors, or the impacts of switching on or off of transformers or the compensate capacitor system and may be due to slight operating errors, etc. The phenomenon of voltage sag affecting each device in the system is different and depends on the sensitivity of the device in the system [12-17].

2. OPERATION OF THE DYNAMIC VOLTAGE RESTORER

The DVR will add the voltage V_{DVR} and compensate the voltage so that the load voltage is equal to the voltage value before the incident. The instantaneous magnitude of pumped 3-phase voltage is controlled by eliminating any adverse effects of breakdown on the V_L load voltage.

The DVR set works independently with the types of incidents or any event on the system. It provides voltage to the rest of the system connected to the reserve.

DVR has two operation modes as follows: standby mode and boost mode.

When the standby mode (V_{DVR} = 0) is used, the low voltage winding of the transformer is short-circuited via a voltage source converter (VSC). There is no switching when operating in this mode. DVR will work mainly in this mode.

When the boost mode (V_{DVR}> 0) is used, the DVR will pump the compensation voltage through the transformer. When it detects unbalanced source voltage, the DVR will add the voltage as V_{DVR} so that the load voltage is equal to the voltage value before the incidents. The instantaneous magnitude of 3-phase voltage is controlled by eliminating any adverse effects of breakdown on the V_L load voltage.

Such an incident is handled by a controller whose output is the(, providing to the PWM signal generator. The controller inputs are the error signals obtained from the reference voltage and the RMS value of the voltage at the pole to be measured. important to concern that

$V_{control}$ consists of 3 sinusoidal control signals which are calculated by the following formula:

$$\begin{cases} V_R = \sin(\omega t + \delta) \\ V_Y = \sin\left(\omega t + \delta - \dfrac{2\pi}{3}\right) \\ V_B = \sin\left(\omega t + \delta + \dfrac{2\pi}{3}\right) \end{cases} \quad (1)$$

PI controller controler:

$$PI(s) = K_p + \frac{K_i}{s} \quad (2)$$

The transfer function of the controller for the DVR system is given by $G_R(z)$:

$$G_R(z) = \frac{K_P + K_I z^{-1}}{1 + z^{-1}} \quad (3)$$

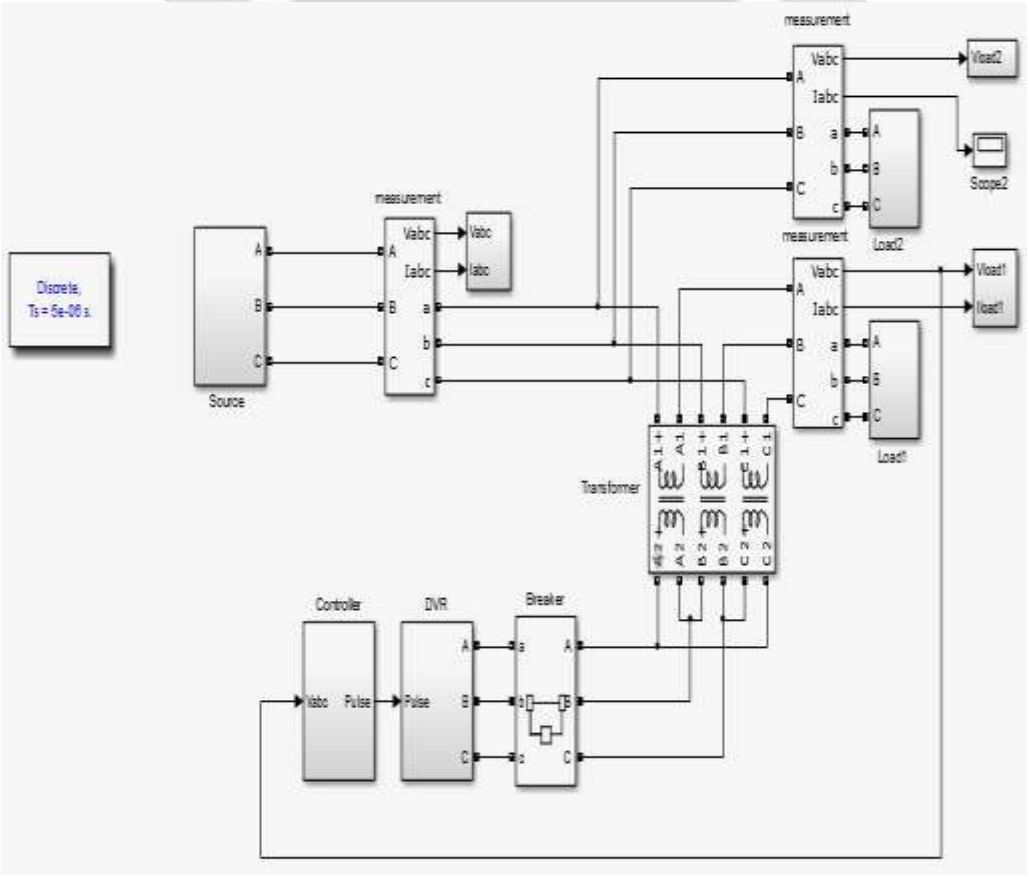

Fig -1 *Simulation model of the DVR system*

The results of the DVR system simulation in the Matlab Simulink are shown in Fig -2 and Fig -3.
When a short-circuit problem occurs, the phenomenon of voltage sag is almost entirely reduced, and the AC load voltage remains at 96% as shown in Fig -3. However, at the time of 400ms still causes the transient phenomenon within 4.5ms due to the control process of the DVR system. This period is relatively short, ensuring fast restoration for a medium voltage grid.

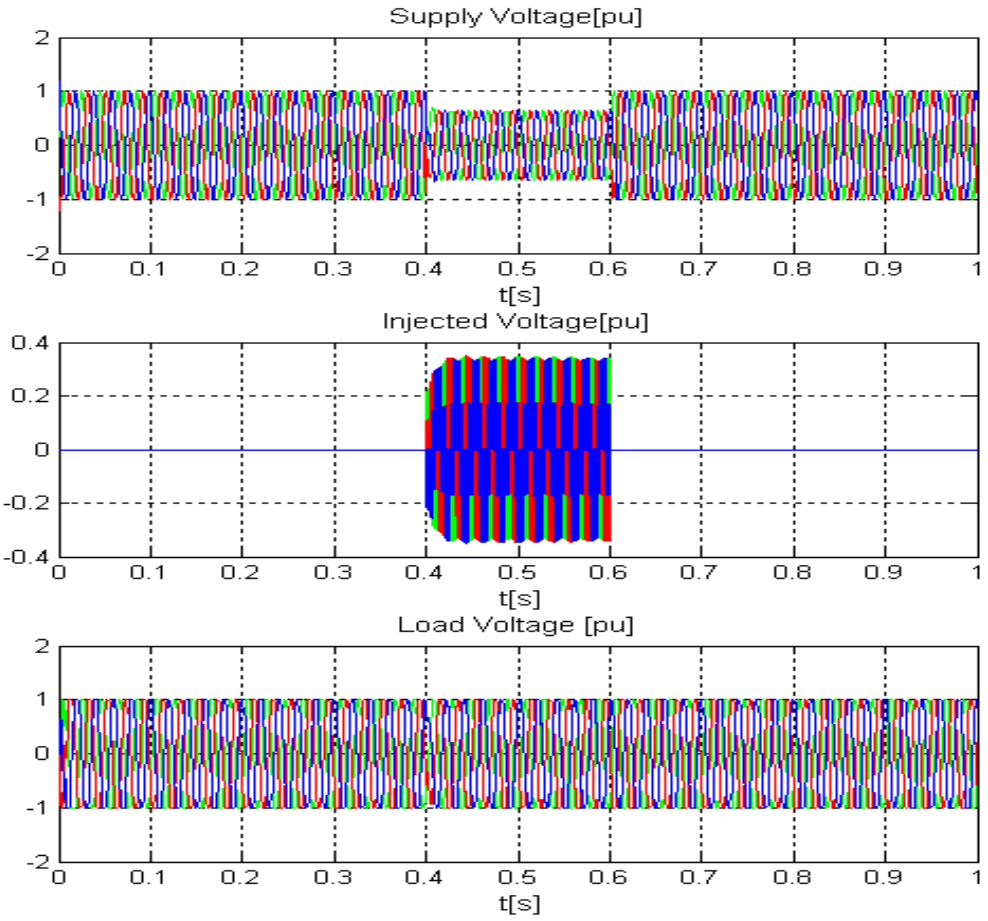

Fig -2 *Voltage, current of the supply source, load when using the DVR system during a three-phase voltage sag*

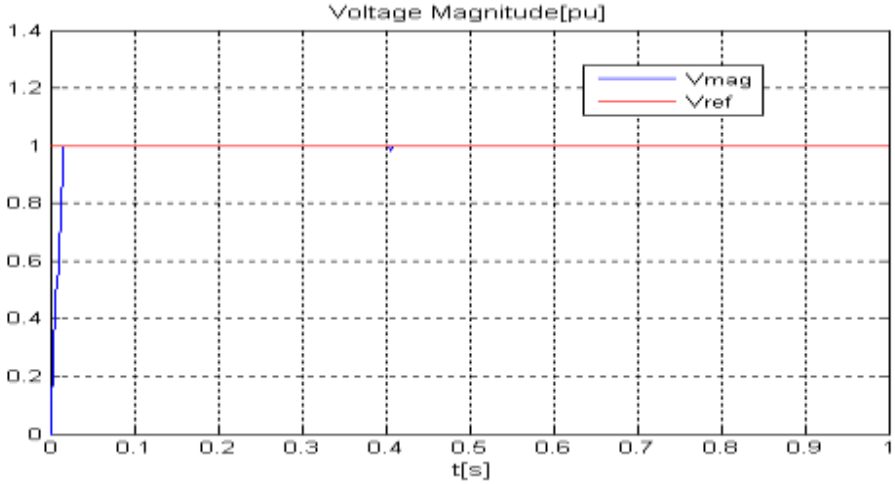

Fig -3 *Load voltage magnitude when using the DVR system during a three-phase voltage sag*

3. CONCLUSIONS

With the design and simulation results for the DVR system model, the voltage sag on the medium voltage line has been maintained. When using the PI controller in the DVR system, the load voltage magnitude closely follows the setting values. This helps DVR ensure the supply of voltage to compensate for the voltage sag of the grid, improving electric power quality, ensuring quick restorer for the grid.

4. ACKNOWLEDGEMENT

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5. REFERENCES

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