Voltage Sag Compensation in Fourteen Bus System Using IDVR

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Abstract - *Dynamic voltage restorer (DVR) has been used for compensation or mitigation of sudden rise/dips in voltage level under the usage of sensitive loads. To reduce VOLTAGE SAGS different FACTS devices are used in distribution system side. The DVR is fast, flexible and efficient solution for voltage sag problem. For voltage compensation process involves a injection of real power into the distribution system. For compensating long duration sags the availability of new DVR topology results in DVR energy storage capacity. This paper proposes a new device namely interline dynamic voltage restorer (IDVR) with a common DC link.* **.***The objective of this work is to improve the real and reactive powers by employing IDVR fourteen bus systems with line interruption with and without IDVR are simulated then the results of voltage sag compensation, real power and reactive power are compared and tabulated using MatLab/Simulink and the simulation results are presented.*

Key Words**: Interline dynamic voltage restorer (IDVR), Dynamic voltage restorer (DVR), Voltage sag, Power quality, Fourteen Bus**

1. INTRODUCTION

Nowadays, power electronics plays a vital role in transmission lines and industries. Because of the very sensitive and less tolerant equipment are used. Therefore for a short time, voltage sag occurs in these places. Voltage sag is created by connecting an additional load in parallel with the exiting load. Among the several novels, the dynamically voltage restorer is one of the power electronics devices which is technically advanced over economical for voltage sag mitigation in distribution system. The DVR works by injecting ac voltage in series with the incoming supply voltage, the purpose of which is used to improve voltage quality. DVR involves injection of real and reactive power to the distribution system to compensate the voltage sag problems which determines the capacity of the energy storage devices. In order to meet the real power requirement an external energy storage is required especially for mitigating long duration voltage sag compensation, the maximum amount of real power which is supplied to the load is a deciding factor of DVR, while the reactive power is generated electronically by using VSI voltage injection from the DVR is an appropriate phase advanced with respect to source side voltage can reduce energy consumption. For some phase advance technique alone, energy requirement cannot be met. Therefore for mitigating deep long duration sags, as it is merely a way of optimizing existing energy storage. By dynamically replenished the DC link of the DVR that can be capable of mitigating deep sags with long durations.

The Interline IDVR proposed in these paper provides a way to replenish the energy in the common dc link energy storage. For protecting several sensitive loads in different distribution feeders emanating from different grid substations. Then it consists of several DVRs and all that DVRs are connected to a common dc link. The control system of DVR plays a important role for the requirement of fast response in the control of voltage sags and variation of connected loads. In these controller is used to control the DVR. The novel minimal energy consumption strategy for the DVR is proposed in two different voltage distribution system are protected using two DVR's. The first is a low voltage DVR operating in voltage sag mitigation mode injecting active power from the DC link capacitor. In that time other medium voltage DVR keeps the voltage of the Dc link capacitor constant the optimum rating for two DVR's when used for IDVR system is designed.

2. Basic Operational Principles of DVR and IDVR

2.1 DVR-Dynamic Voltage Restorer

DVR is a distributed voltage DC to AC solid-state switching inverter that injects three phase ac output voltage in series with the distribution feeders using series injection transformers. When we are injecting this power DVR can restore the quality of three phase AC voltage at it load terminals. When the quality of source side terminal voltage is distorted[voltage sags] due to sensitive loads.

The DVR is series connected device by which can control the load voltage by voltage injection from the dc link. When the voltage occurs the DVR injecting the missing voltage and it avoids the load tripping. The DVR consists of

a. An Injection / series transformer
b. Harmonic filter
c. Energy storage device
d. Voltage Source Converter(VSC)
e. Control system.

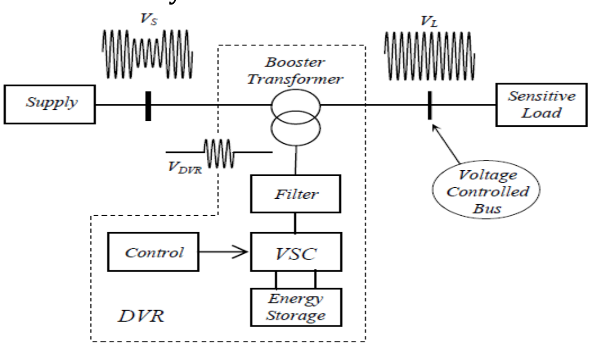

Fig -1: Dynamic Voltage Restorer.

2.2 IDVR-Interline Dynamic Voltage Restorer

The IDVR system consists of two DVR's protecting sensitive loads in diff distribution feeders emanating from different grid substation and these DVR's shares a common dc link. These controllers techniques provides a capability to transfer real power direct between the two transmission lines when the real time power is controlled within each transmission line. It shares a common dc link between different DVR's.

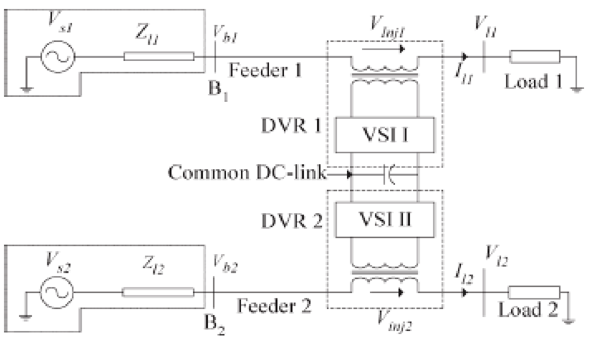

Fig -2: Interline Dynamic Voltage Restorer.

3. SIMULATION RESULTS

Fourteen bus system in normal condition is shown in Fig 3.1.The receiving end voltage is shown in Fig 3.2. The real & reactive powers are shown in Fig 3.3.

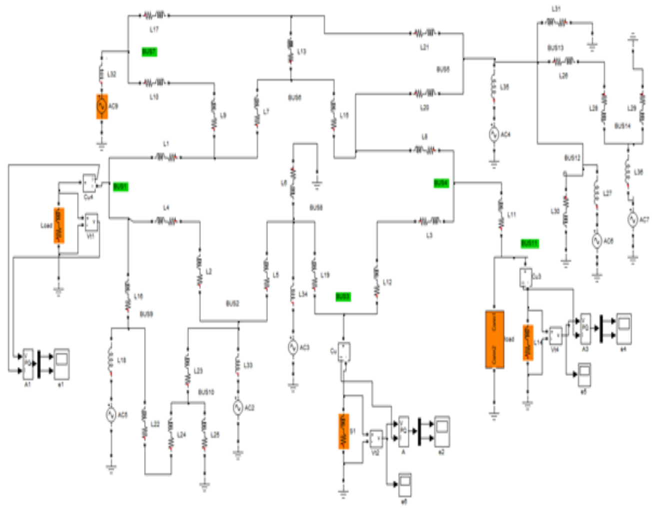

Fig -3.1: Simulink Model of 14- Bus System without IDVR

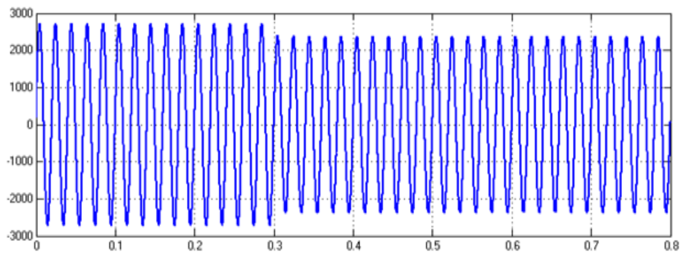

Fig-3.2: Output Voltage of 14 bus system without IDVR

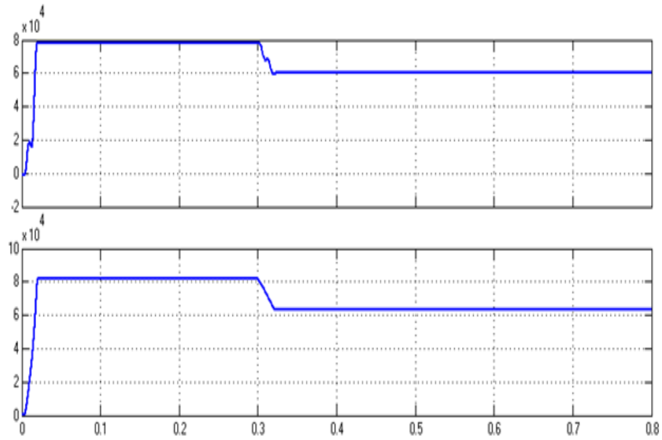

Fig-3.3: Real and Reactive Power at Bus-4

Simulink model of fourteen bus system with IDVR is shown in Fig 3.4.The receiving end voltage of fourteen bus system with IDVR is shown in Fig 3.5. The real & reactive powers of fourteen bus system with IDVR are shown in Fig 3.6.

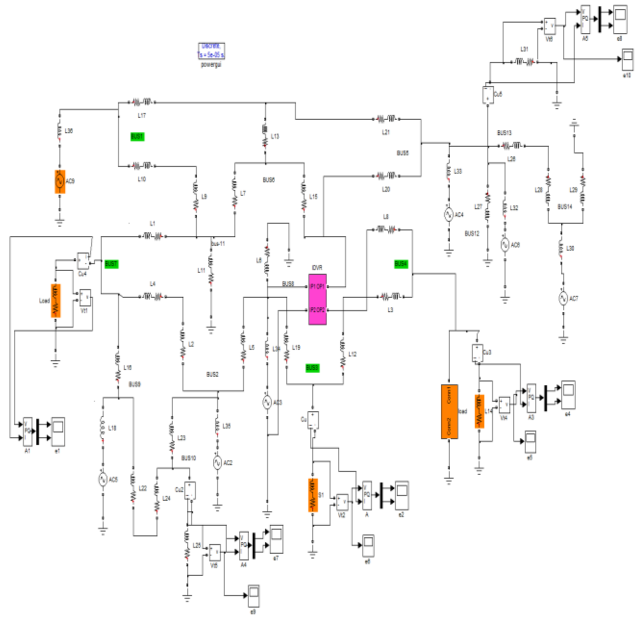

Fig -3.4: Simulink model of 14 Bus System with IDVR

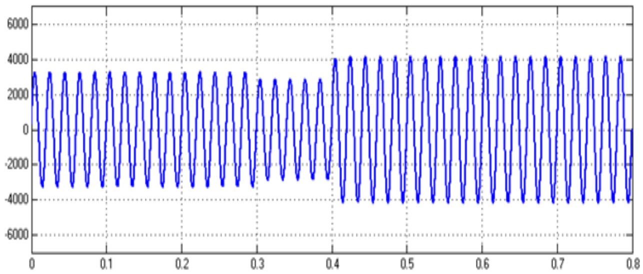

Fig-3.5: Output Voltage of 14 bus system with IDVR

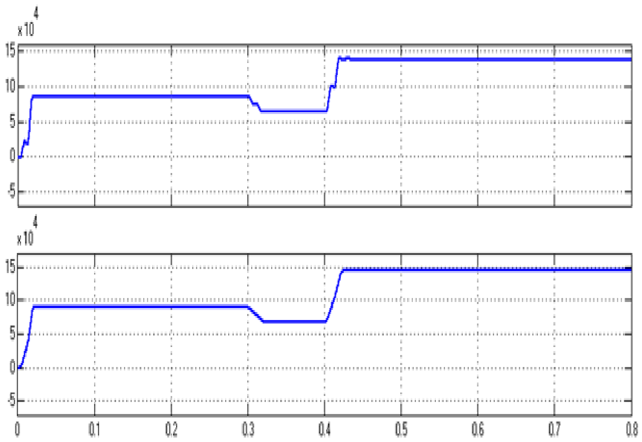

Fig-3.6: Real and Reactive Power of Bus-4 with IDVR

Table -1: Comparison of Voltage, Real & Reactive power

IDVR -14 BUS	VOLTAGE (Volts)	Real Power (MW)	Reactive Power (MVAR)
Without IDVR	2400 V	0.061	0.063
With IDVR	3800 V	0.118	0.119

4. CONCLUSIONS

The results of fourteen bus system with and without IDVR are presented. The real power increases from 0.061MW to 0.063MW by adding IDVR. The reactive power increases from 0.118 to 0.119 MVAR. That the IDVR is capable of maintaining normal real and reactive powers during contingency condition. The disadvantages of proposed system are the requirement of two converters.

The Scope of present work is voltage sag compensation in fourteen bus system using IDVR system. The contingency studies in thirty three bus system will be done in future. The studies will be extended for multiple line interruptions.

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