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IMPROVEMENT OF POWER QUALITY AND DISPLACEMENT FACTOR BY USING IVDFC

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ABSTRACT

Power quality plays an important role in the present era. It has become importance, especially, with the introduction of sophisticated devices, whose performance is very sensitive to the quality of power supply. Power quality problem is an occurrence manifested as a nonstandard voltage, current or frequency that results in a failure of end use equipment's. One of the major problems dealt here is the power sag. To solve this problem, custom power devices are used. One of those devices is the Dynamic Voltage Restorer (DVR), which is the most efficient and effective modern custom power device. In this project, a prototype of interline dynamic voltage restorer (IDVR) is designed for reducing the disturbances due to voltage sag under abnormal conditions. Under normal conditions the displacement factor of the feeders also is improved. DF improvement can be achieved viaactive and reactive power exchange (PQ sharing) between different feeders. In this prototype controller is used to operate converters, these converters are used to boost voltage sag in the feeders.

Keywords: Power Quality, Dynamic Voltage Restorer(DVR), Interline Dynamic Voltage Restorer(IDVR),etc.

I. INTRODUCTION

An interline dynamic voltage restorer (IDVR) is invariably employed in distribution systems to mitigate voltagesag/swell problems. An IDVR merely consists of several dynamicvoltage restorers (DVRs) sharing a common dc link connecting independent feeders to secure electric power to critical loads. Whileone of the DVRs compensates for the local voltage sag in its feeder,the other DVRs replenish the common dc-link voltage. For normalvoltage levels, the DVRs should be bypassed. Instead of bypassing the DVRs in normal conditions, this paper proposes operatingthe DVRs, if needed, to improve the displacement factor (DF) ofone of the involved feeders. DF improvement can be achieved viaactive and reactive power exchange (*PQ* sharing) between different feeders. The IDVR system employs two or more DVRs connected to a common DC link. When one of the DVRs compensates the voltage sag, the other DVR in the IDVR system operates in the power flow control mode to replenish the DC link energy storage, which is depleted due to the real power taken by the DVR working in the voltage sag compensation mode.

II. CIRCUIT CONFIGURATION ANDANALYS

The Figure 1 represents the proposed topology for voltage sag/swell compensation and displacement factor improvement using IVDFC in distribution network. For normal voltage levels, achieving active power exchange Pex between feeders requires controlled voltage injection in each feeder by the corresponding converter. This injected voltage should not perturb the load voltage magnitude of both feeders; therefore, both converters are operating under

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power control (PC) mode. When applying the proposed PQ sharing mode, the sourcing feeder DF will be improved, while the receiving feeder DF decreases.

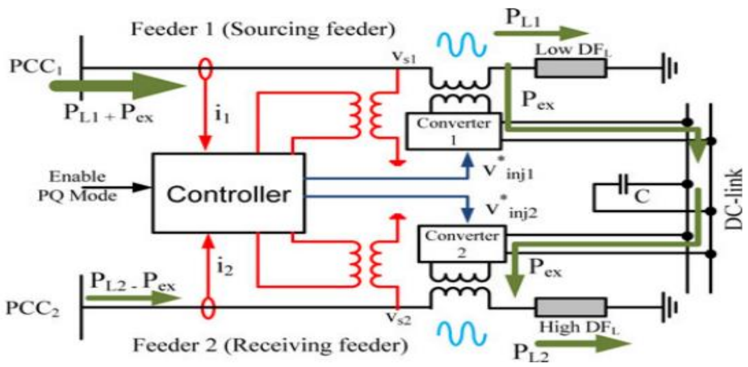

Figure 1: Operation of IDVR with DF improvement during normal condition.

III. TWO-LINE IDVR WITH DF IMPROVEMENT SYSTEM DURING NORMAL OPERATION

The main differences between an IPFC, IDVR, and the proposed system are summarized in Table1. In this table, the IPFC, which is used in transmission applications, is compared with an IDVR and IDVR with DF improvement, which is considered for distribution systems. The IDVR consists of several back-to-back voltage source converters with common dc link connecting independent feeders as shown in Figure 1. Each converter can be operated in either power control (PC) or voltage control (VC) modes. If one of the feeders is subjected to voltage sag, its converter will operate in VC mode and the required power for voltage restoration will be absorbed from the dc link. In this state, the other converters connected to the healthy feeders should be switched to PC mode to replenish the dc-link voltage; a power-sharing scheme to determine the reference power of each healthy feeder is presented.

FEATURES	IPFC	IDVR	IDVR with DF improvement.
main fuction	It is used in transmission system to control power flow of parallel transmission lines.	It is used in distribution network to compensate voltage sag and swells.	It is used in power distribution network to compensate sag swells also improvement of displacement factor of lines.
Operation	Employed in normal operation or condition.	Employed in abnormal operation or condition.	Employed in normal condition as well as abnormal conditions..
In phase voltage injection.	Active power control.	Active power control at abnormal condition.	Active power control when it is switched to power control mode or displacement factor mode.
Quadrature voltage injection.	Reactive power control.	Reactive power control at abnormal condition.	Reactive power control when it is switched to power control mode or displacement factor control mode.

Table 1:Basic comparative features of IPFC, IDVR and IDVR with DF improvement

During normal operating conditions (i.e., all feeders are healthy), the DVRs are typically bypassed via bypass switches, or they can be alternatively used for load sharing purposes. Instead of bypassing the IDVR in normal operation, this paper proposes a new operational mode, namely *PQ* sharing mode, to improve the DF of one of the involved feeders by sharing active and reactive power among different system feeders through the buffering stage (the common dc link). To apply this concept, several constraints are observed throughout the paper.

The IDVR with improvement of DF (two feeders are included, feeder x and feeder y), are managing the power transfer through a dc link in normal and abnormal condition. The proposed controller of the same is shown in Figure 1.

Logic unit decision / Cases	Converter *x*				Converter *y*			
	VC	PC	PQ	off	VC	PC	PQ	off
v_{sx} is normal and sag/swell at v_{sy}	0	1	0	0	1	0	0	0
v_{sy} is normal and sag/swell at v_{sx}	1	0	0	0	0	1	0	0
Normal condition, *PQ* is enabled	0	0	1	0	0	0	1	0
Normal condition, *PQ* is disabled	0	0	0	1	0	0	0	1

Generally the voltage sag, voltage swell and DF improvement problems are handled in only one control unit. Out of 4 modes (off mode, VC mode, PC mode, or PQ mode) the converter will be switched to one of the mode. In this controller the different modes of operation are handled individually. The main cases are shown in Table 2 and in the subsections (where hyphenated condition describes the state of one of the feeders to the left of hyphen and other feeder to the right of hyphen). The converters can be switched to off position, for all other cases.

IV. MATLAB SIMULATION

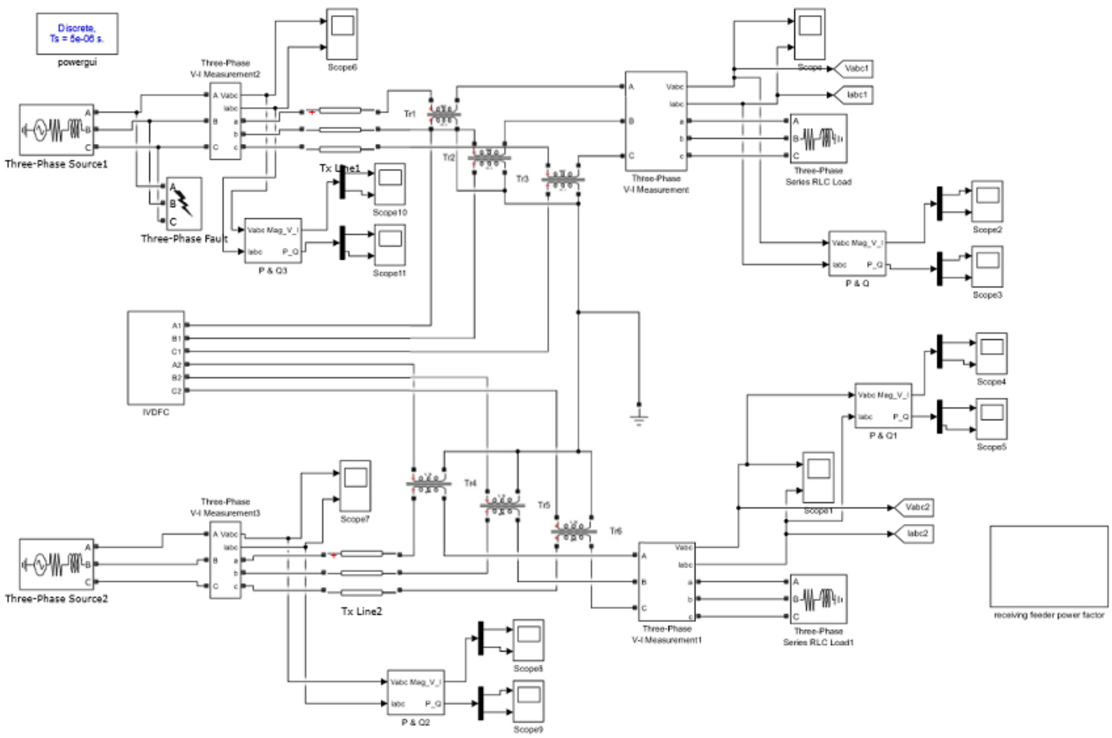

Figure4(a): Simulink model of IVDFC

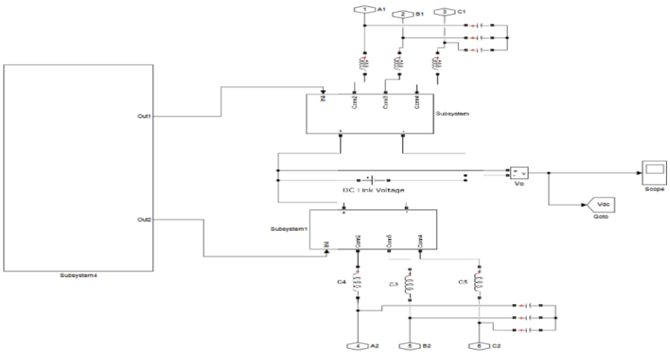

Figure4(b): IVDFC subsystem

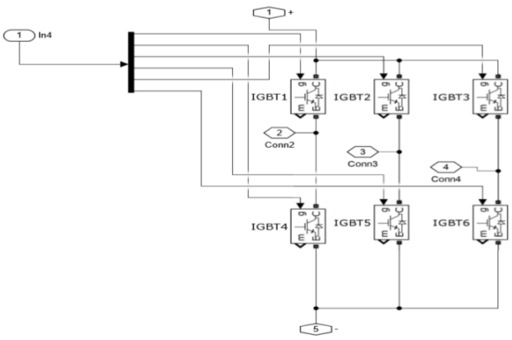

Figure 4(c): Converter subsystem.

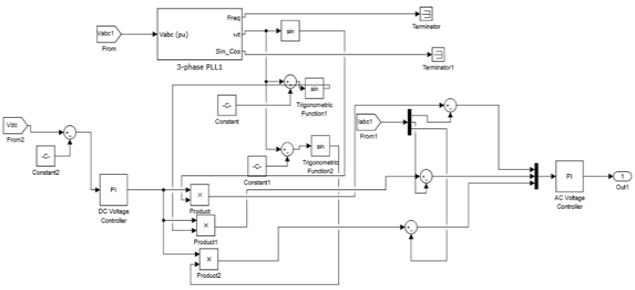

Figure 4(d): Control technique of IVDFC

V. SIMULATION RESULTS

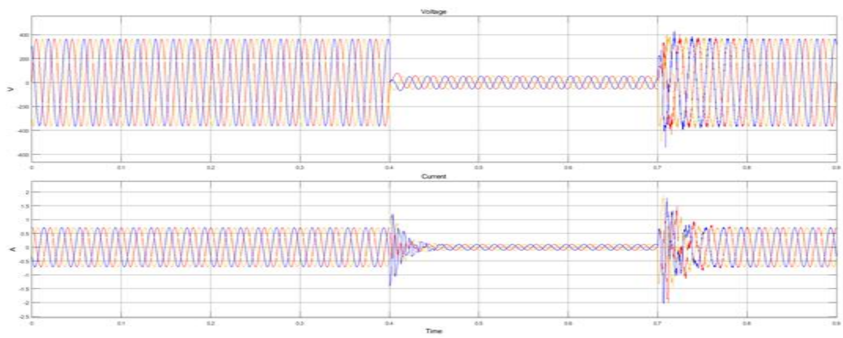

Figure 5(a): Feeder-1 Output Voltage and Current Waveform during voltage sag.

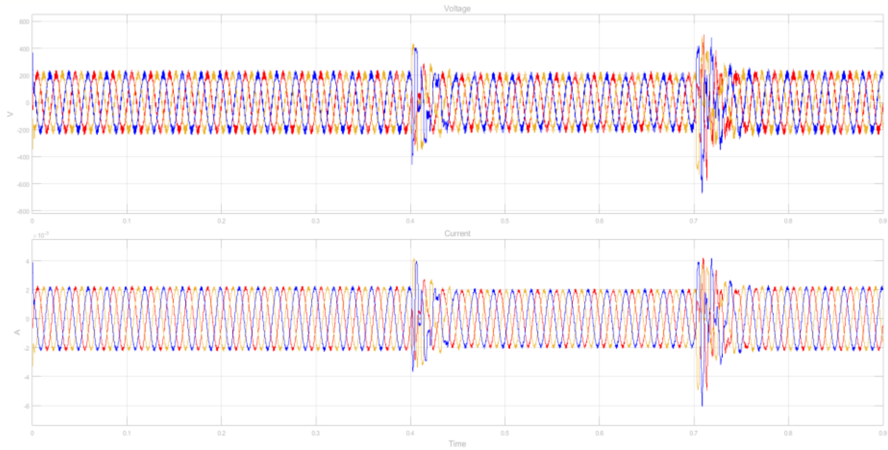

Figure 5(b): Feeder-1 Output Voltage and Current Waveform after compensation

VI. CONCLUSION

This paper presents the power quality problems such as voltage dips, swells, distortions and harmonics. Compensation techniques of custom power electronic devices DVR is used in order to reduce the voltage sag in the network. In this paper, an interline dynamic voltage restorer (IDVR) is used for reducing the disturbances due to voltage sag under abnormal conditions and under normal conditions the displacement factor is improved of the feeders connected to the system. The voltage sag reduction and improvement of displacement factor helps to improve the power quality of overall system.

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