Voltage Source Inverter based Static Synchronous Compensator

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*Abstract:*The Distribution static synchronous compensator is used to reduce the losses and improvement of voltage regulation in Multi Bus systems.The DSSC introduces a current into the system to lower the losses. The DSSC can enhance the reliability and quality in power flow of a less voltage distribution network. A DSSC is one of the new generation FACTSdevices with a promising feature of applications in power system.

This work deals with the modeling and simulation of 50 Bus systems with Distribution static synchronous compensator and the voltage sag is created by involving a heavy load. The sag is mitigated with Distribution static synchronous compensator.

Keywords: Flexible AC Transmission System,DistributionStatcom,Power Quality

I. INTRODUCTION

Generally Power distribution system requires maintaining of active and reactive power in terms of its supply and demand. The stability is not maintained and frequency is varied much if it is not properly maintained.Then power controllers are essential so as to maintain the stability. Nowadays power distribution system is facing increase in demand with improved power quality having greater reliability with low cost and environmental impact.

D-Statcom controller gives the reactive power to obtain stability, correctionofpower factor, and harmonic compensation of a specific load.

II.   PRINCIPLE OF OPERATION

The PE based shunt connected FACTS device which interchange reactive power to the specific load for improving the voltage stability of the load busses.The recent innovationsand the applications of FACTS controllers in transmission of power had paved a path toexistence of controllers in improvement of the system stability where D-STATCOM is used to regulate the voltage

There aremany economic impacts on utilities, their customers, and suppliers of load equipment. The quality of power has a direct economic effect on many industrial customers.
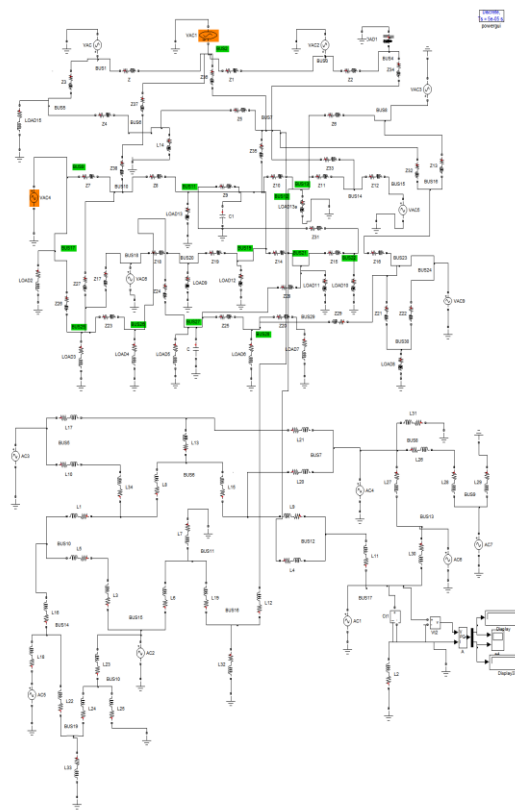
III.   RESULTS

Fig1 IEEE 50 bus system without D-STATCOM

In Power System Network, the D-STATCOM is used to regulate the voltage by exchange the reacting power, i.e., either sending or receiving. The 50 bus system network and corresponding simulation circuit as represented in the paper. The 50 bus system model is presented without D-STATCOM with simulation results. The 50 bus system model with D-STATCOM is presented and simulation results are compared. In 50 bus system multiple D-STATCOMs are used in various buses at different locations where the voltage sags are more. After adding D-STATCOMs, the voltage is improved at various bus locations. The voltage is improved after adding D-STATCOM. The comparision table is prepared at various bus locations with and without D-STATCOM. After adding D-STATCOM at various locations of the system, the power quality is improved. The D-STATCOM gives very fast deactive power compasation in order to maintain stable voltage profile. If the system voltage is less than D-STATCOM, then it supplies the reactive power to increase the voltage profile to rated value. If the system voltage is more then it absorbs the reactive power from the system, thus improving the power quality.

It minimizes the lower harmonics and eliminate the hard harmonics by less than 3% of THD.
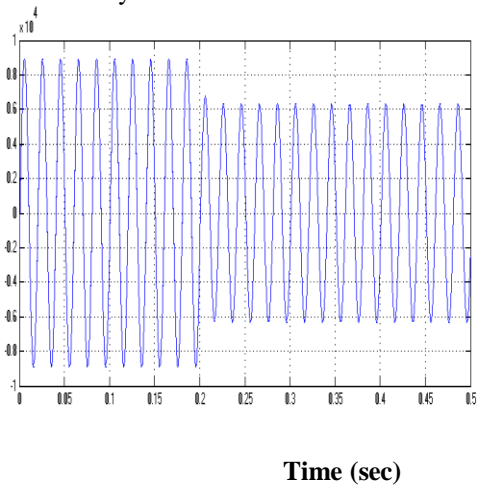

Fig3 Reactive Power at Bus-4
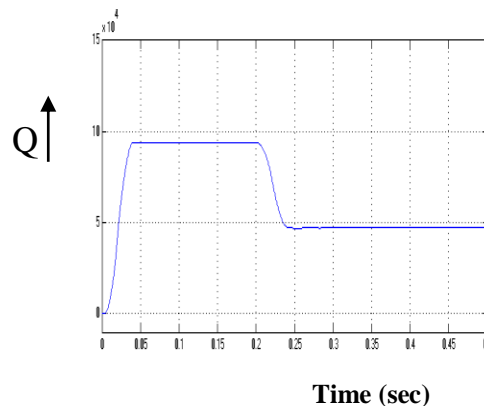

Fig4 Voltages at Bus-12
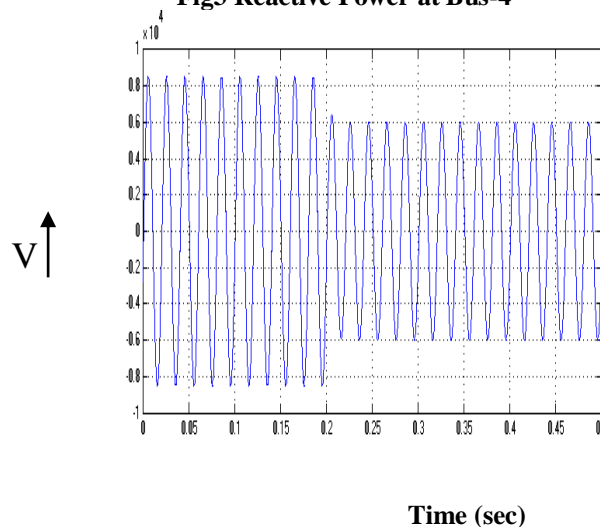

Time (sec)

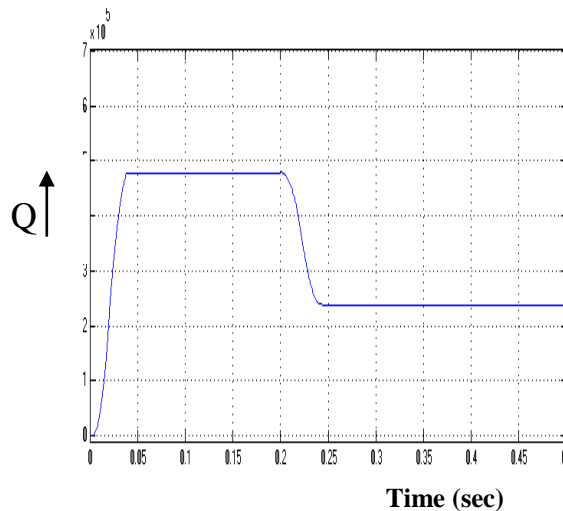Fig 2 Voltages at Bus-4

Time (sec)

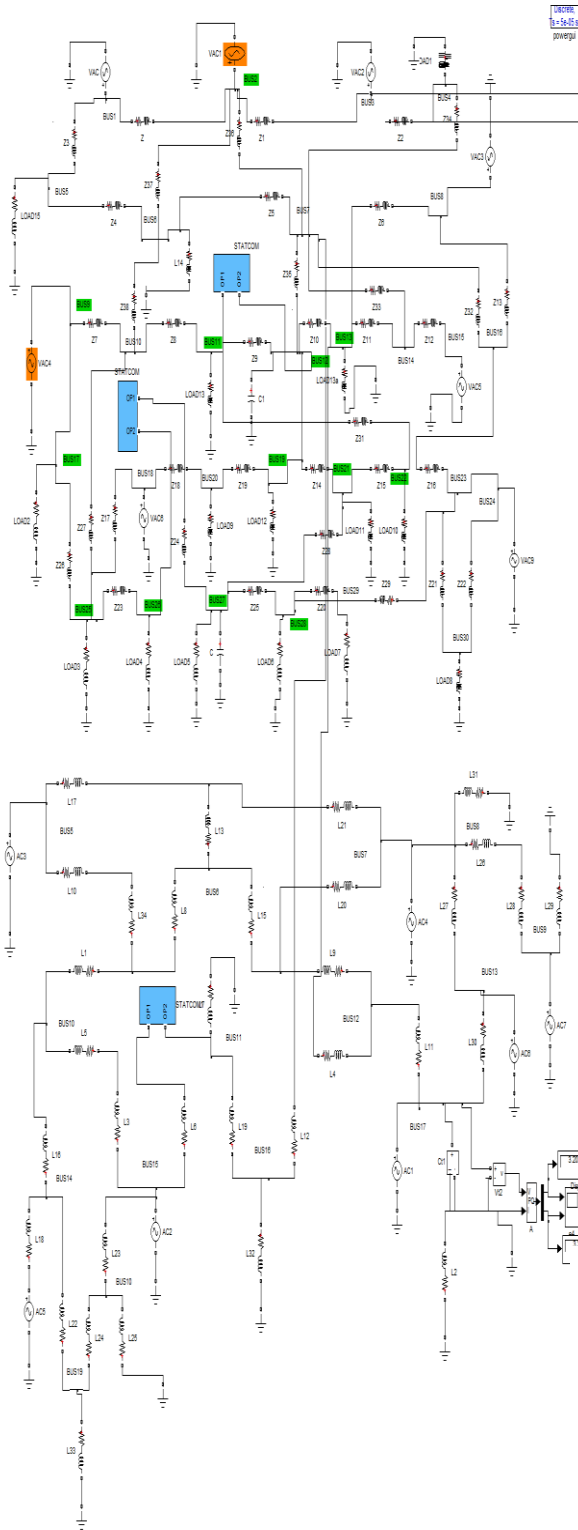Fig5.Reactive Power at bus-12

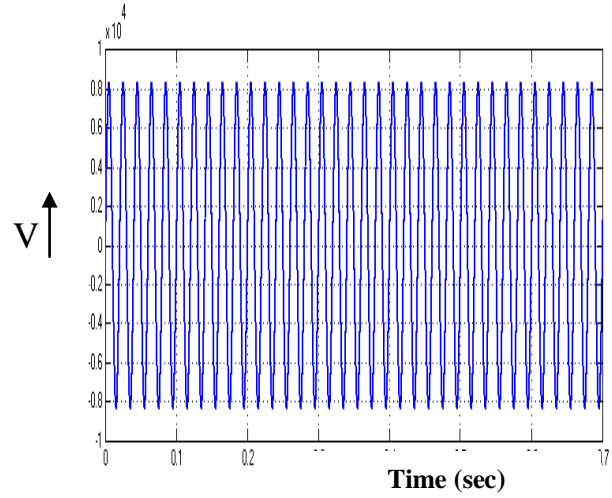**Fig6 IEEE 50 bus system with D-STATCOM**
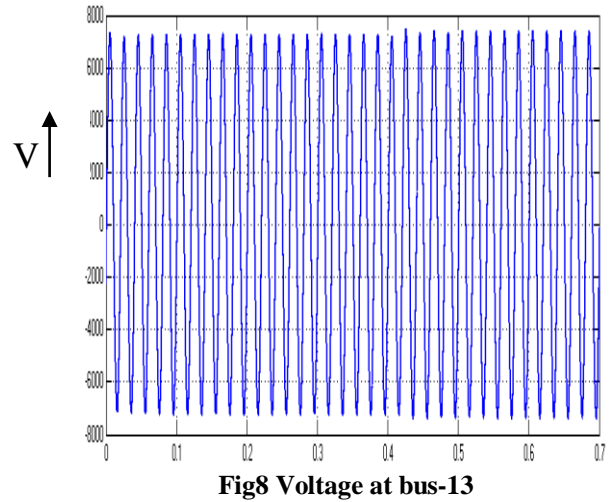

Fig7 Voltage at bus-11
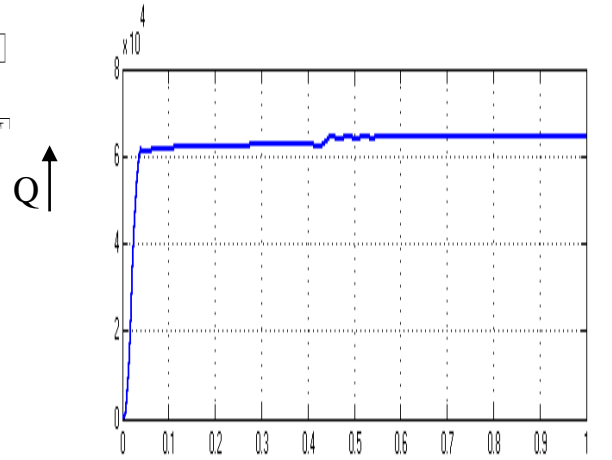

Fig8 Voltage at bus-13
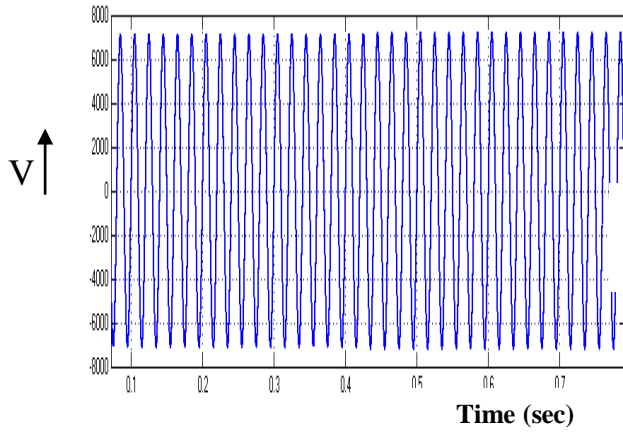

Fig9 Reactive Power at bus 13
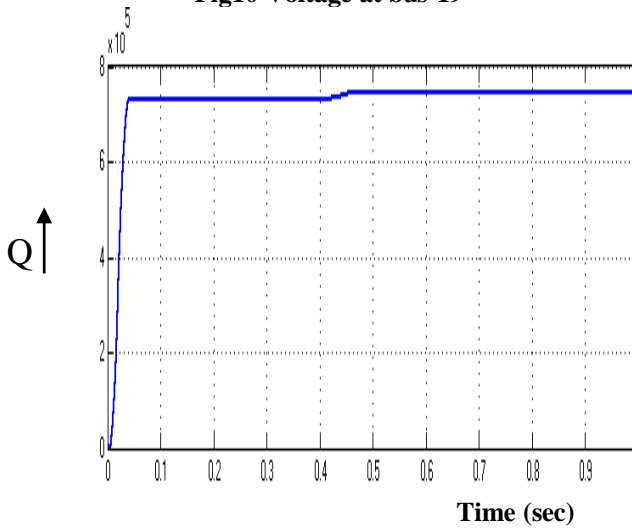
Fig10 Voltage at bus-19
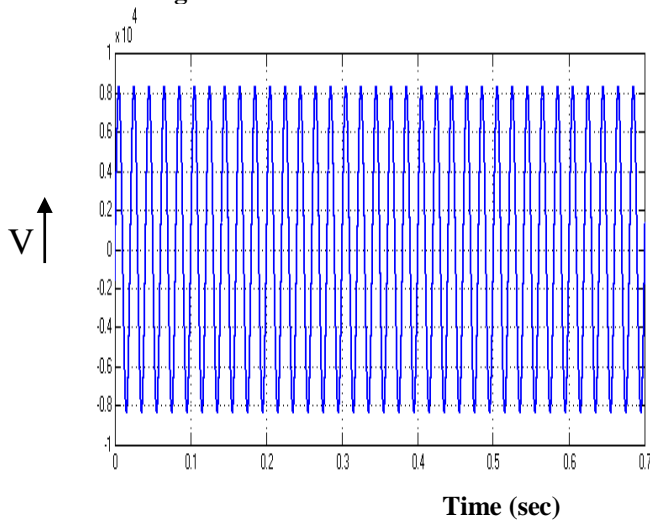

Fig11 Reactive Power at bus 19
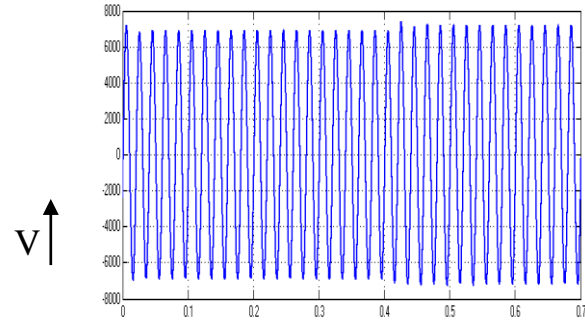

Fig12 Voltage at bus-25
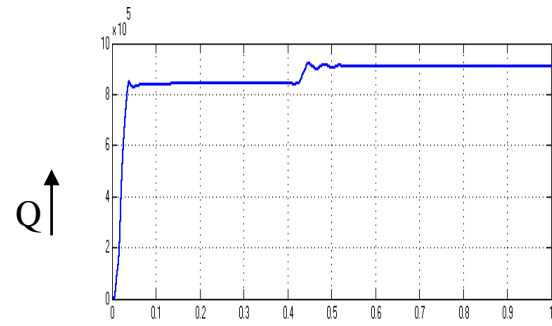

Fig 13 Voltage at bus-30
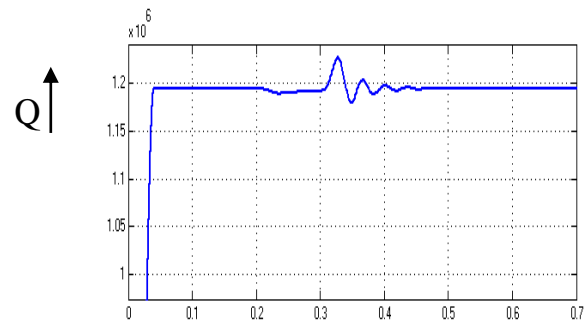

Fig14 Reactive power at bus-30
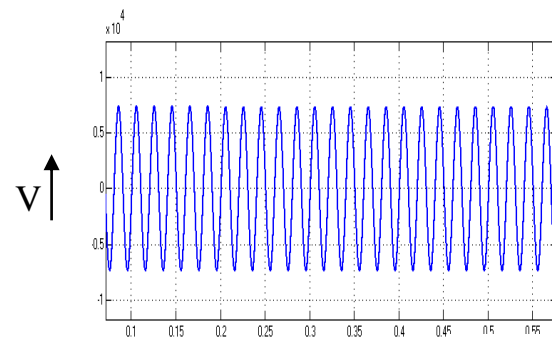

Fig15 Reactive power at bus 35
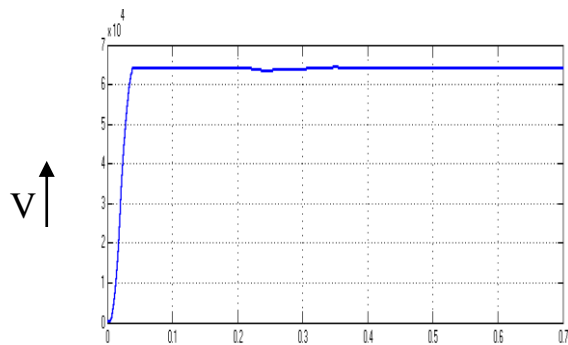

Fig 16 Voltage at bus-45

Fig 17 Reactive Power at bus 45

IV.TABLE 1

Reactive Power at different buses with and without D-STATCOM

BUS NO.	REACTIVE POWER WITHOUT D-STATCOM (MVAR)	REACTIVE POWER WITH D-STATCOM (MVAR)
1	0.312	0.342
2	0.321	0.349
3	1.22	1.811
4	2.310	2.988
5	2.28	2.891
6	2.29	2.860
7	2.29	2.892
8	2.291	2.946
9	2.298	2.892
10	2.891	2.999
11	2.89	3.39
12	3.13	3.35
13	2.28	2.32
14	1.951	1.988
15	1.48	1.59
16	1.76	1.88
17	2.779	2.975
18	2.598	2.761
19	2.316	2.478
20	2.186	2.351
21	2.510	2.988
22	3.812	3.929
23	2.679	2.98
24	1.771	1.898
25	3.021	3.251
26	2.743	2.756
27	1.52	1.70
29	3.54	3.56
30	2.510	2.988
31	2.53	2.9

BUS NO.	REACTIVE POWER WITHOUT D-STATCOM (MVAR)	REACTIVE POWER WITH D-STATCOM (MVAR)
32	2.37	2.710
33	2.46	2.642
34	2.541	2.946
35	1.771	1.898
36	1.42	1.71
37	2.47	2.710
38	2.56	2.92
39	2.41	2.96
40	2.58	2.83
41	2.71	2.889
42	3.4	3.5
43	3.4	3.5
44	2.3	2.3
45	1.8	1.85
46	1.45	1.65
47	1.78	1.98
48	2.758	2.85
49	2.57	2.87
50	2.35	2.567

V. **Comparision of Voltage & Reactive Power at different busses with and without D-STATCOM**

Bus No.	Reactive Power without D-STATCOM (MVAR)	Reactive Power with D-STATCOM (MVAR)	Line Voltage (KV)	D-STATCOM Voltage (KV)
BUS-4	2.310	2.988	3.24	4.3
BUS-11	2.98	3.25	3.21	4.5
BUS-36	1.5	1.87	3.26	4.7

VI. CONCLUSION

50 bus system is tested in MATLAB software and results are presented. The system consisting of series impedence and shunt capacitance which is similar to the line model and the results are compared by with and without using D-STATCOM in 50 bus system. After adding D-STATCOM the power quality is improved as shown in the table.

VII. SCOPE FOR FUTURE WORK

The software used throughout the work was MATLAB and SIMULINK. This work can also be done using PSCAD or PSIM.

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