Title: Voltage Stability Enhancemet in IEEE 57 Bus Test System Using STATCOM

Name of the Contributor : Alvin Paul P, Ajin Raj D, Anskar Nishanth A, Sujin Akash M

Institution/Organization: St. Xavier's Catholic College of Engineering

Abstract: The IEEE 57-bus test system shall be used to study the voltage stability Enhancement at different buses. The power system model consists of 7 generators, 57 buses, 42 loads, 80 lines, 17 transformers. The system is on a 100 MVA base. The model submitted is implemented in Modelica language using OpenIPSL package shown in Figure 1.In Case:1 STATCOM is connected at Bus 31&56 the simulated voltage profiles of IEEE 57 bus system at various buses shown in Figure 2 . In Case:2 the system is subjected to disturbance by making outage in line between bus38&48 for 1 sec (4.2-4.3) the simulated voltage profiles of IEEE 57 bus system at various buses shown in Figure 4. For all analysis of this system, the lower voltage magnitude limits at all buses are 0.9 p.u and upper limits are 1.05 p.u. Simulation obtained shows voltage profiles at various buses.

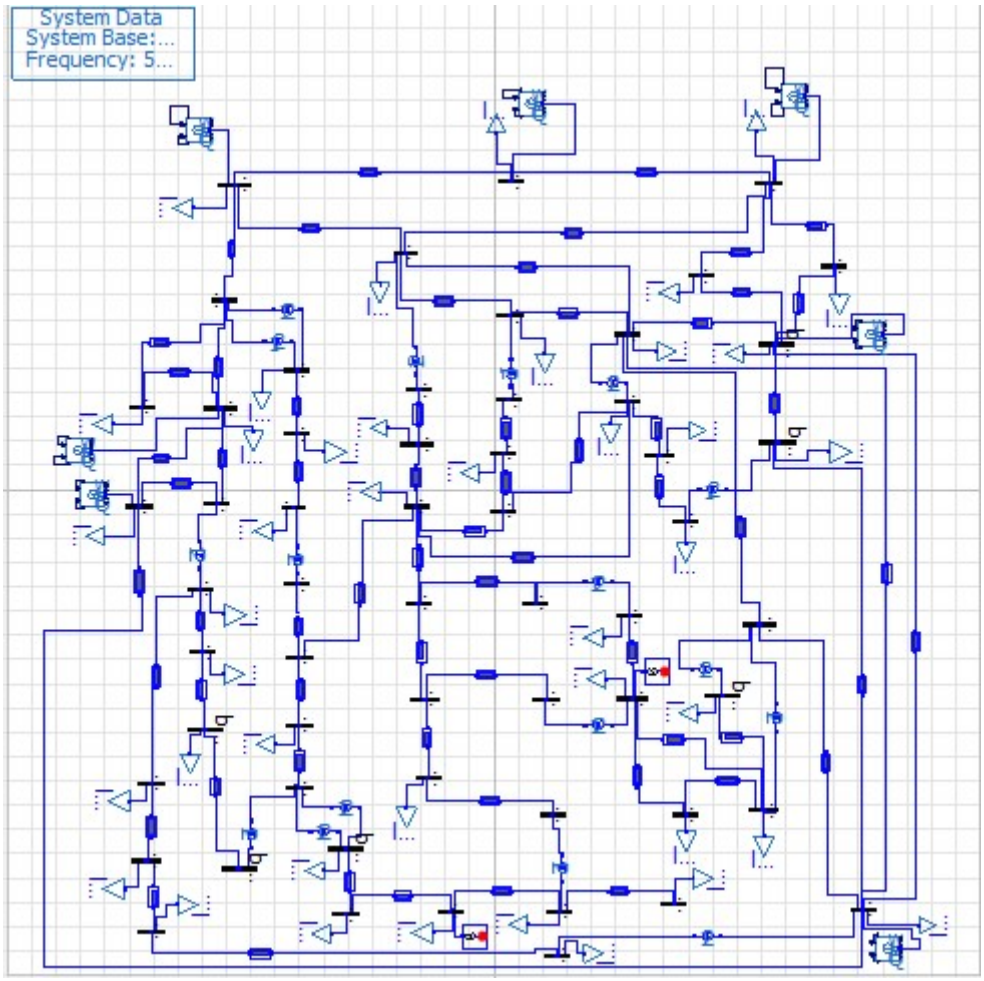

Figure 1: Implementation of IEEE 57 bus system using Modelica and OpenIPSL.

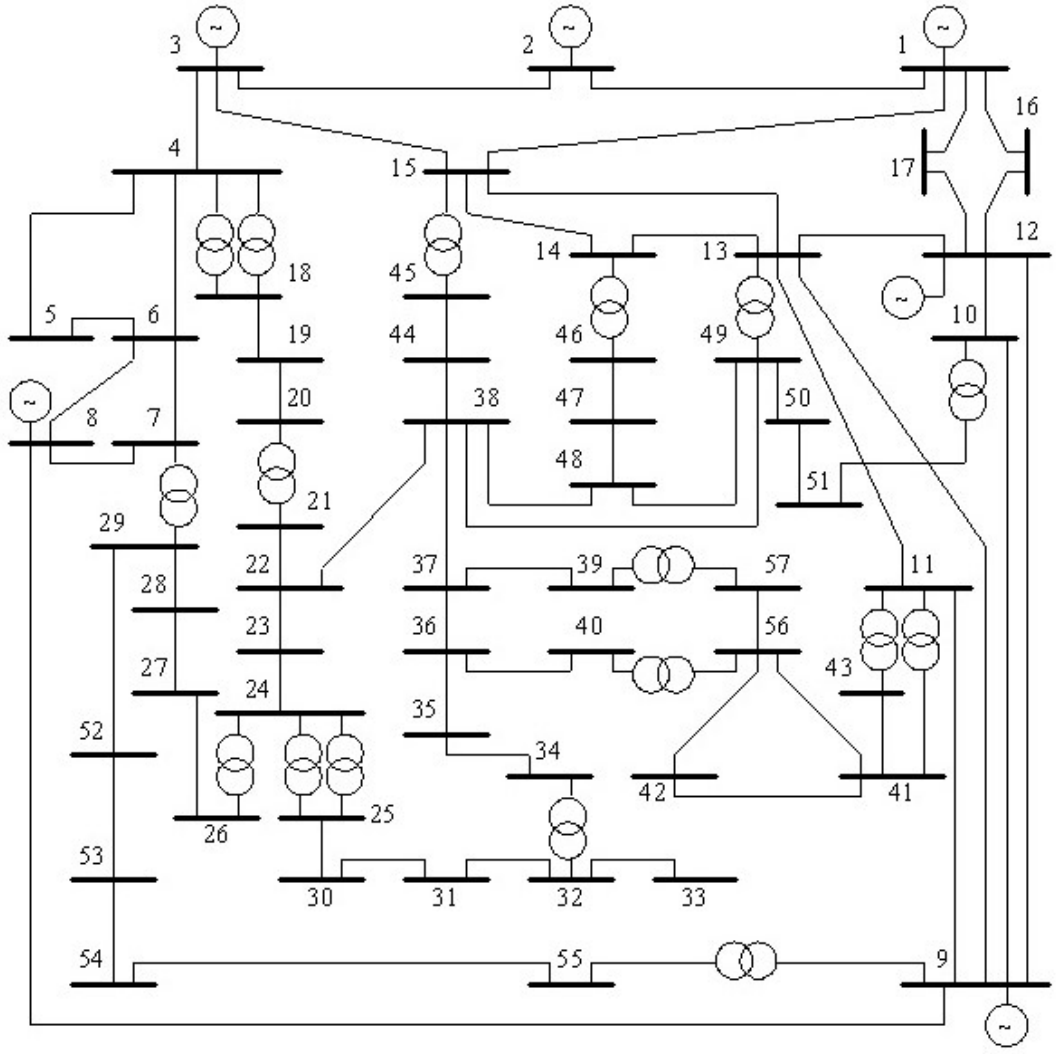

Figure 2:Single line diagram of IEEE 57 bus system.

Explanation:

This model uses the following components:

Component Name	Class Path	Number
Generators	OpenIPSL.Electrical.Machines.PSAT.Order2	7
Buses	OpenIPSL.Electrical.Machines.PSAT.Order6	57
PwLine	OpenIPSL.Electrical.Branches.PwLine	80
Two Winding Transformer	OpenIPSL.Electrical.Branches.PSAT.TwoWindingTransformer	12
Constant PQ Load	OpenIPSL.Electrical.Loads.PSAT.LOADPQ	42
Sysdata block	OpenIPSL.Electrical.SystemBase	1
STATCOM	OpenIPSL.Electrical.FACTS.PSAT.STATCOM	2

Table 1: Components used in system

The IEEE 57 bus model implemented in Modelica language using OpenIPSL package, is used to study the voltage stability at different buses. The system is on a 100 MVA base. For all analysis of this system, the lower voltage magnitude limits at all buses are 0.9 P.u. and upper limits are 1.05 P.u. The type of generator used is a synchronous generator of order2. A STATCOM is connected at 31^{st} bus &56^{th} bus. During this voltage stability will improve, we can observe from the bus voltage profiles. Simulation obtained shows profiles at various buses and waveforms obtained are observed. The system is subjected to disturbance by making outage

in line between bus38&48 for 1 sec (4.2-4.3) the simulated voltage profiles of IEEE 57 bus system at various buses and waveforms obtained are observed.

The simulation result of all 57 Bus voltages shown below.

Case:1

STATCOM is connected at Bus 31&56 the simulated voltage profiles of IEEE 57 bus system at various buses.

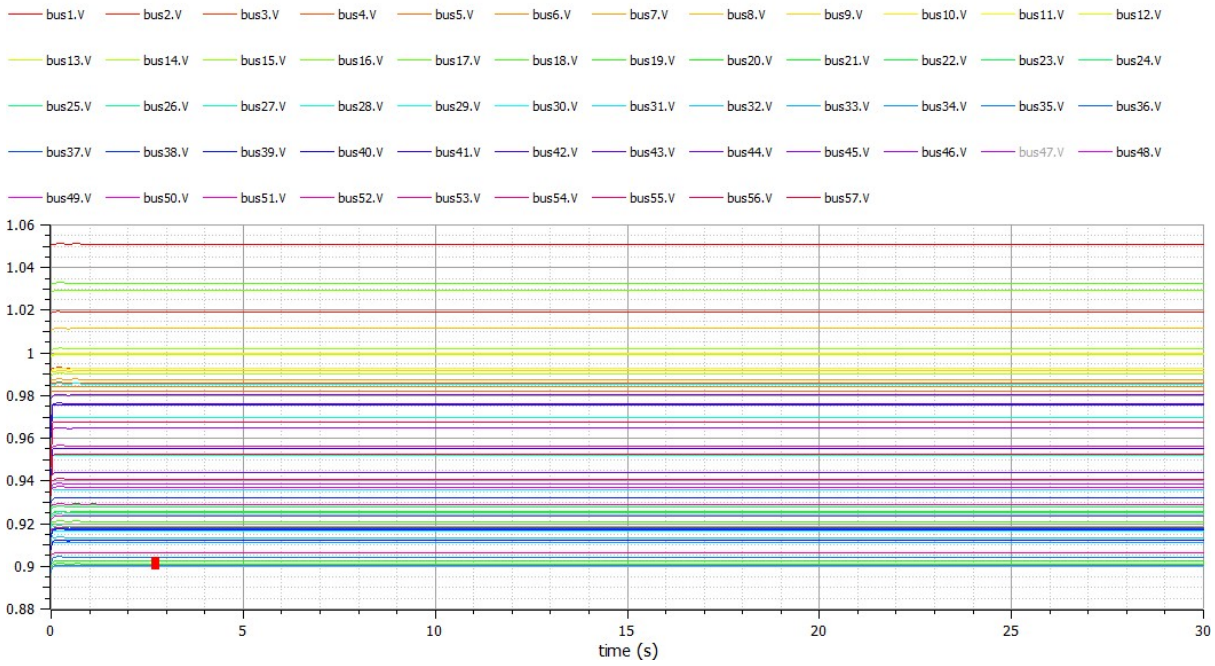

Figure 3: The voltage profiles of simulated IEEE 57 bus.

Bus no.	Bus Voltage magnitude (p.u.)
1.	1.05113
2.	1.01923
3.	0.992967
4.	0.986009
5.	0.981978
6.	0.984389
7.	0.98768
8.	1.01145
9.	0.991525
10.	0.999841
11.	0.992653
12.	1.02924
13.	0.999297
14.	0.990336
15.	1.00204
16.	1.02934
17.	1.03281
18.	0.921076
19.	0.901196
20.	0.902407

21.	0.925497
22.	0.929668
23.	0.928009
24.	0.925344
25.	0.918915
26.	0.924185
27.	0.952017
28.	0.969833
29.	0.98551
30.	0.916766
31.	0.936103
32.	0.913554
33.	0.911169
34.	0.900246
35.	0.904328
36.	0.912176
37.	0.917769
38.	0.932038
39.	0.917256
40.	0.912056
41.	0.975664
42.	0.955398
43.	0.976354
44.	0.943851
45.	0.980257
46.	0.964668
47.	0.94265
48.	0.938682
49.	0.937163
50.	0.923414
51.	0.956436
52.	0.929153
53.	0.966286
54.	0.918039
55.	0.940749
56.	0.967424
57.	0.952281

Table 2: Bus voltage magnitude (p.u.) of all buses obtained by connecting STATCOM.

Case:2

The system is subjected to disturbance by making outage in line between bus38&48 for 1 sec (4.2-4.3) the simulated voltage profiles of IEEE 57 bus system at various buses.

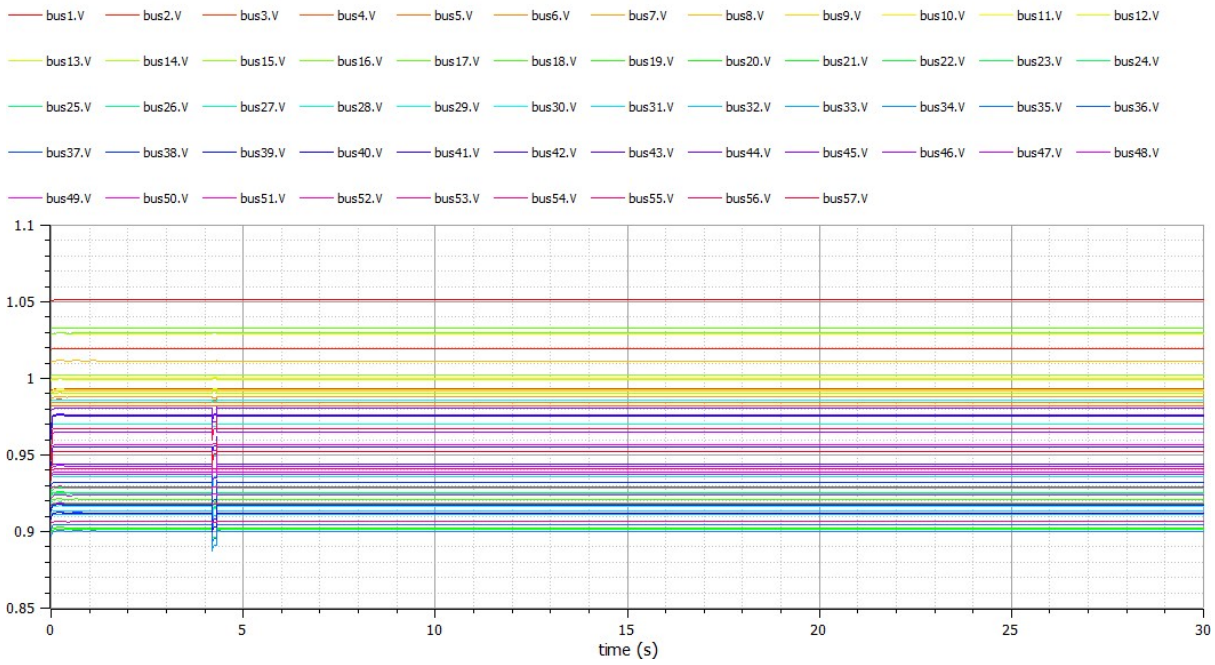

Figure4 : The voltage profiles of simulated IEEE 57 bus after outage of line between bus 38&48.

Bus no.	**Bus Voltage magnitude (p.u.)**
1.	1.05127
2.	1.01942
3.	0.993089
4.	0.986123
5.	0.982076
6.	0.984479
7.	0.987787
8.	1.01156
9.	0.9911663
10.	0.999997
11.	0.992793
12.	1.0294
13.	0.999445
14.	0.990481
15.	1.00218
16.	1.0295
17.	1.03297
18.	0.921204
19.	0.90133
20.	0.902542
21.	0.925633
22.	0.929204
23.	0.928144
24.	0.925465
25.	0.918964
26.	0.924205
27.	0.952185
28.	0.969943
29.	0.985658
30.	0.916742
31.	0.936105
32.	0.913593

33.	0.911207
34.	0.900367
35.	0.904451
36.	0.912301
37.	0.917896
38.	0.932175
39.	0.917382
40.	0.912181
41.	0.97571
42.	0.955424
43.	0.976439
44.	0.94399
45.	0.980395
46.	0.964811
47.	0.942792
48.	0.938823
49.	0.937308
50.	0.923566
51.	0.956591
52.	0.929274
53.	0.906412
54.	0.91817
55.	0.940884
56.	0.967429
57.	0.952298

Table 3: Bus voltage magnitude (p.u.) of all buses after outage of line between bus 38&48.

Conclusion:

The implemented IEEE 57 bus model in Modelica represents the system behaviour before and after outage of line between bus 38&48 while connecting STATCOM in bus 31^{st} &56^{th} . Bus voltage magnitudes (p.u.) of all 57 buses obtained are found to be between 0.9 p.u and 1.05 p.u.