

Title: Dynamic Study of 69 Bus Radial Network with Distributed Generation Using OpenModelica and OpenIPSL

Name of the Contributor: Aritra Banerjee

Institution/Organization: MeghnadSaha Institute of Technology, Kolkata

Email: aritrabanerjee343@gmail.com

Abstract:

This simulation represents modeling and load flow analysis of a radial distribution network of 69 buses system. In this test case, an interconnected distribution system with 1 generator and 69 buses are reconnected in a radial distribution network. There are 2 separate cases developed in this modelling.

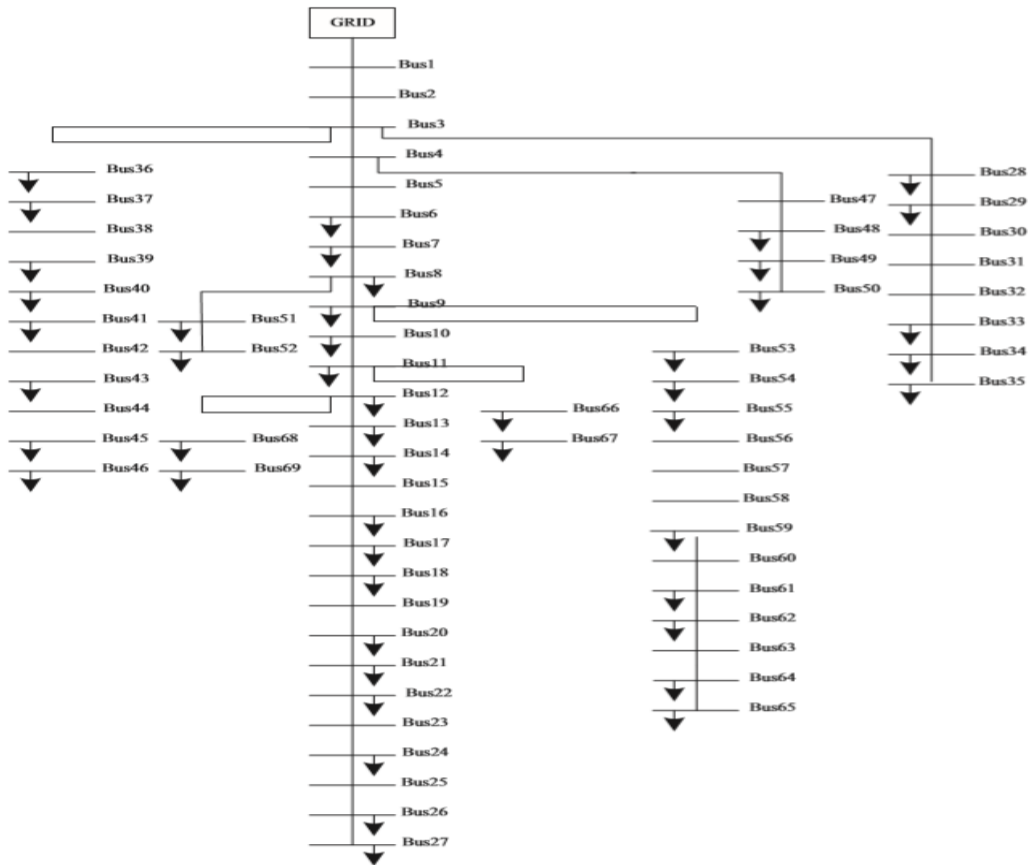


Fig 1: Line Diagram of 69 bus radial distribution system

Explanation:

This model uses the following components:

Component Name	Class Path	Number
Genrou	OpenIPSL.Electrical.PSSE.GENROU	1
WT3G	OpenIPSL.Electrical.Wind.PSSE.WT3G	1
Bus	OpenIPSL.Electrical.Buses.Bus	69
Transmission Line	OpenIPSL.Electrical.Branches.PwLine	68
Load	OpenIPSL.Electrical.Loads.PSAT.LOADPQ	48
Systm Block	OpenIPSL.Electrical.SystemBase	1
Three Phase Fault	OpenIPSL.Electrical.Events.PwFault	1

Case 1: Figure 1 shows the configuration that total system is connected with Genrou of rating 12.7 kV and Base power of Machine is 10 MVA. Total Model is constructed by OpenModelica using OpenIPSL. The Simulation Results of 69 bus is shown in figure 3.

Case 2: In case 2 WT3G (Wind Turbine) is connected with radial distribution network, shown in figure 2. Model WT3G is created by using OpenIpsl. In both cases we will study the variance of dynamics of simulation results. For case 2 Dynamic results of simulation is shown in figure 4.

By modelling and simulation, here we can observe in 1-generator 69-bus, continuous changing of the load demand for active and reactive power. The model submitted is implemented in Modelica language using OpenIPSL package. The fault applied is a bolted symmetrical three-phase applied 0.886 second after the start of the simulation in bus 35. The Fault is applied with duration of 0.4 sec. the simulated voltage profiles of 69 bus system at various buses. The lower voltage magnitude limits at all buses are 0.844 p.u, and upper limits are 1.000 p.u, Simulation obtained shows voltage profiles at various buses.

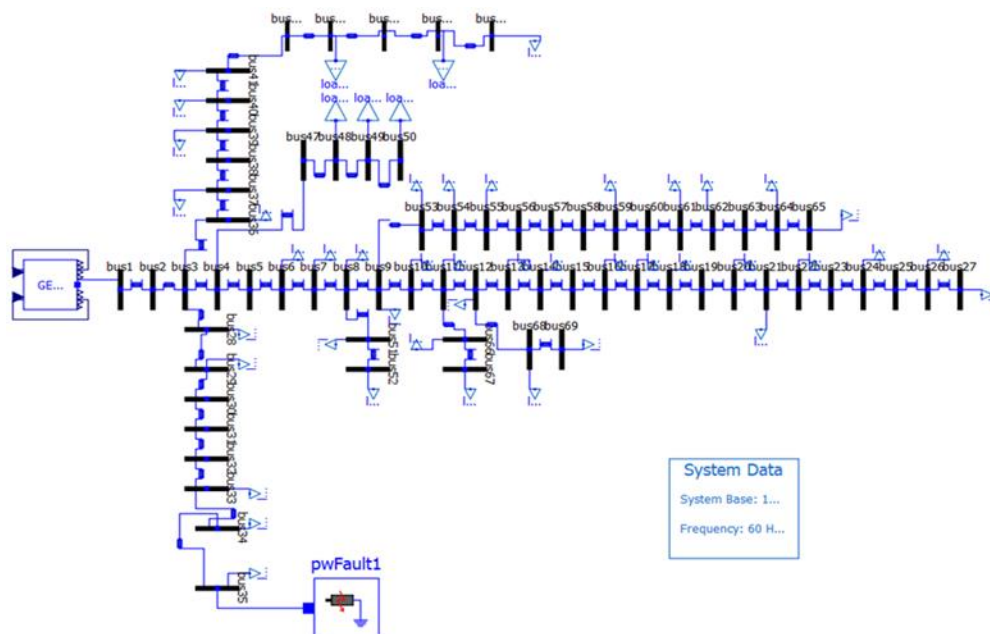


Fig: 69 Radial Distribution network with Genrouby using OpenModelica (Case 1)

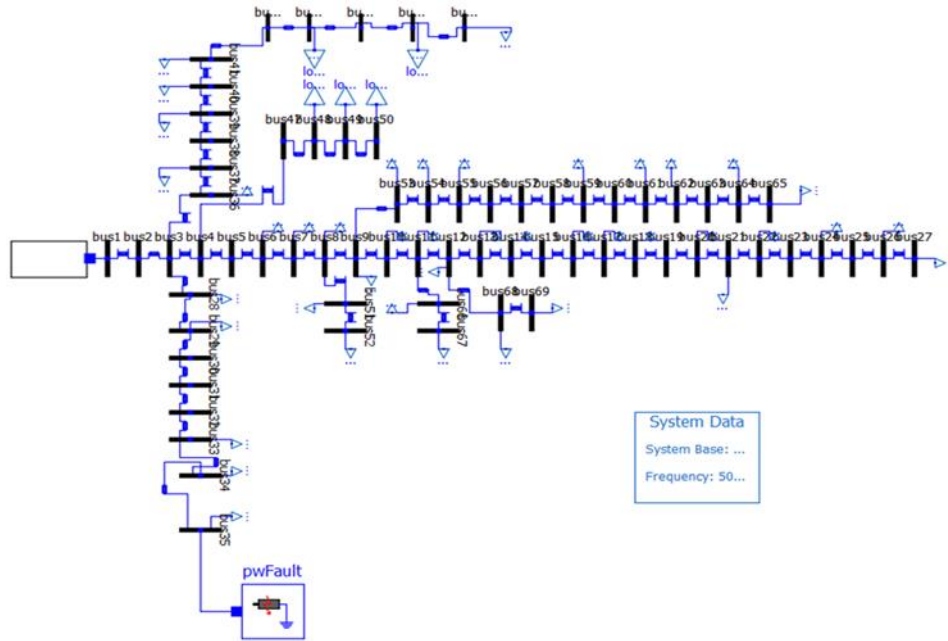


Fig 3: 69 Radial Distribution network with WT3G by using OpenModelica (Case 2)

Model is characterised by 2 cases, in first case total system is connected with Genrou of rating 12.7kv and Base power of Machine is 10 MVA and in case 2 WT3G (Wind Turbine) is connected with radial distribution network. The power generated by Genrou will be transmitted through the entire system shown in figure 1. Genrou recognize variation of the inductance coefficients of the machine implicitly and handle saturation by developing a term to be added on to the field current that is calculated on the basis of the unsaturated inductance coefficients, and in figure 2 we can observe that entire system is connected with WT3G. A Fault is connected (PW Fault) with bus number 35 for both cases which is considered as line to line fault. Each and Every load is considered as Constant PQ Load.

The simulation result of all 69 Bus voltages with Genrou shown below:



Fig 4: Dynamic Result of 69 bus for case 1

The simulation result of all 69 Bus voltages with Genrou shown below:

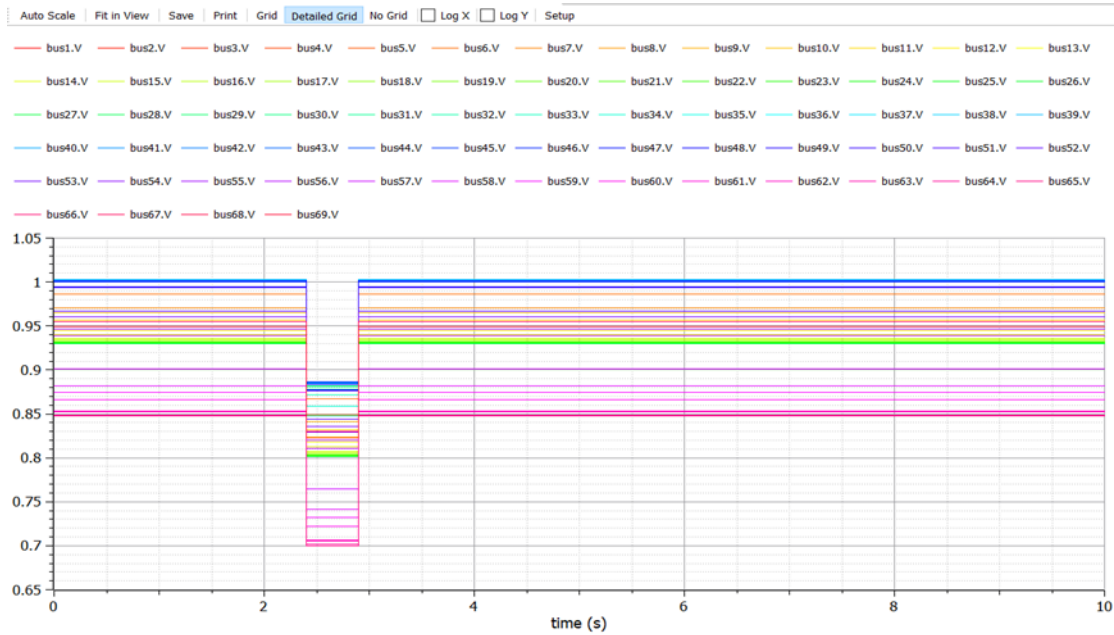


Figure 5: Steady State analysis of 69 bus with WT3G

BUS NUMBER	BUS VOLTAGE MAGNITUDE (p.u)
1.	1.000
2.	1.000
3.	1.000
4.	1.000
5.	0.998
6.	0.983
7.	0.967
8.	0.964
9.	0.962
10.	0.954
11.	0.952
12.	0.947
13.	0.942
14.	0.937
15.	0.932
16.	0.931
17.	0.930
18.	0.930
19.	0.929
20.	0.929
21.	0.928
22.	0.928
23.	0.928
24.	0.927
25.	0.927
26.	0.927
27.	0.927
28.	1.000

29.	1.000
30.	1.000
31.	1.000
32.	0.999
33.	0.999
34.	0.998
35.	0.998
36.	1.000
37.	1.000
38.	0.999
39.	0.999
40.	0.999
41.	0.998
42.	0.998
43.	0.998
44.	0.998
45.	0.997
46.	0.997
47.	1.000
48.	0.998
49.	0.991
50.	0.991
51.	0.964
52.	0.964
53.	0.957
54.	0.951
55.	0.944
56.	0.936
57.	0.897
58.	0.878
59.	0.871
60.	0.862
61.	0.850
62.	0.849
63.	0.848
64.	0.845
65.	0.844
66.	0.952
67.	0.952
68.	0.946
69.	0.946

Conclusion:

The implemented 69 bus radial network model in Modelica represents the system behaviour before and after the fault occurs at bus 35 in both cases, case1 and case2. Bus voltage magnitude (p.u.) of all 69 buses obtained are found to be between 0.844 p.u and 1.000 p.u. Genrou recognize variation of the inductance coefficients of the machine implicitly and handle saturation by developing a term to be added on to the field current that is calculated on the basis of the unsaturated inductance coefficients. The radial type of distribution system is used extensively to serve the light- and medium-density load areas where the primary and secondary circuits are usually carried overhead on poles.