Faculty of Engineering and Technology

Electrical and Computer Engineering Department

Power System ENEE (4403)

Power Word Simulator Project

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Sec#: 1

1) The system was built at PWS as the specific data, the system show in the Figure 1 bellow:

The Value of Z1 was Choosed as a BZU ID number which is equal ➔ X=0.1+0.2, so Z1= 0.08+J0.3. And Z0 = 0.6 + j1.5

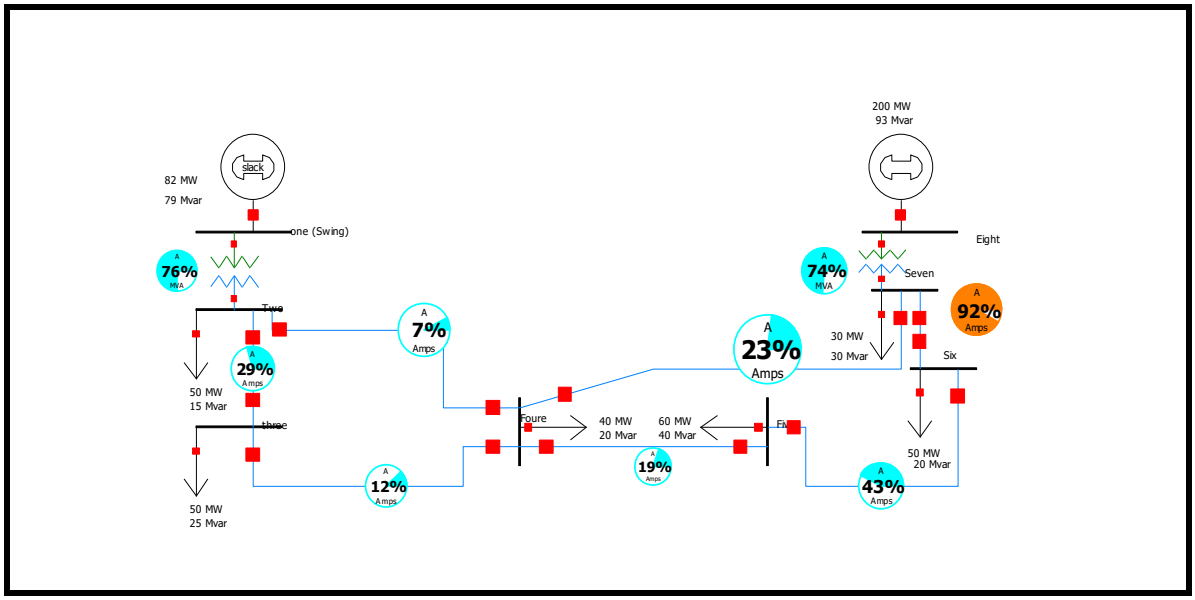


Figure 1: The system Block

The Per Unit Impedances were found, and it is show in the Figure 2:

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	R	X	B	Lim MVA A	Lim MVA B	Lim MVA C
1	3	three	2	Two	1	Closed	Line	NO	0.00302	0.01134	0.03492	200.0	200.0	200.0
2	7	Seven	6	Six	1	Closed	Line	NO	0.00302	0.01134	0.03492	200.0	200.0	200.0
3	5	Five	4	Foure	1	Closed	Line	NO	0.00378	0.01418	0.04364	200.0	200.0	200.0
4	6	Six	5	Five	1	Closed	Line	NO	0.00831	0.03118	0.09604	200.0	200.0	200.0
5	3	three	4	Foure	1	Closed	Line	NO	0.00907	0.03403	0.00000	200.0	200.0	200.0
6	2	Two	4	Foure	1	Closed	Line	NO	0.01282	0.04815	0.14847	200.0	200.0	200.0
7	6	Six	4	Foure	1	Closed	Line	NO	0.01806	0.06790	0.20973	200.0	200.0	200.0
8	8	Eight	7	Seven	1	Closed	Transformer	YES	0.00000	0.10000	0.00000	300.0	300.0	300.0
9	1	one (Swing)	2	Two	1	Closed	Transformer	YES	0.00000	0.10000	0.00000	150.0	150.0	150.0

Figure 2: The Per Unit Impedances

2)

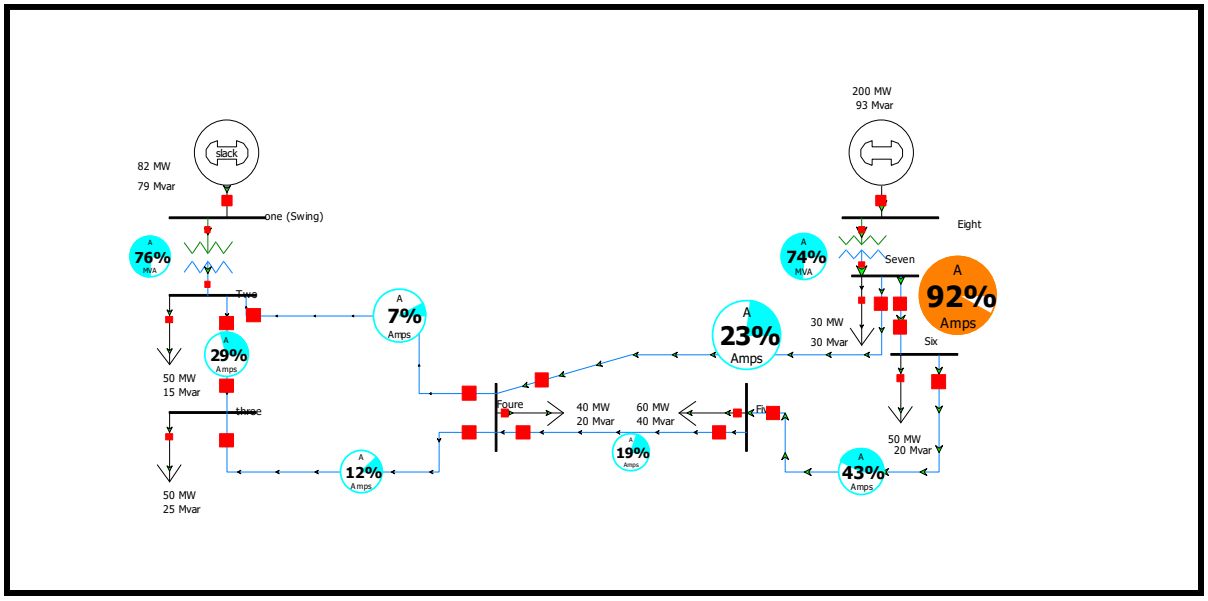


Figure 3: The run of the system show all the parameter

The voltage and the angle of each bus and loss of the transformer and transition Line is show in the Figure 4:

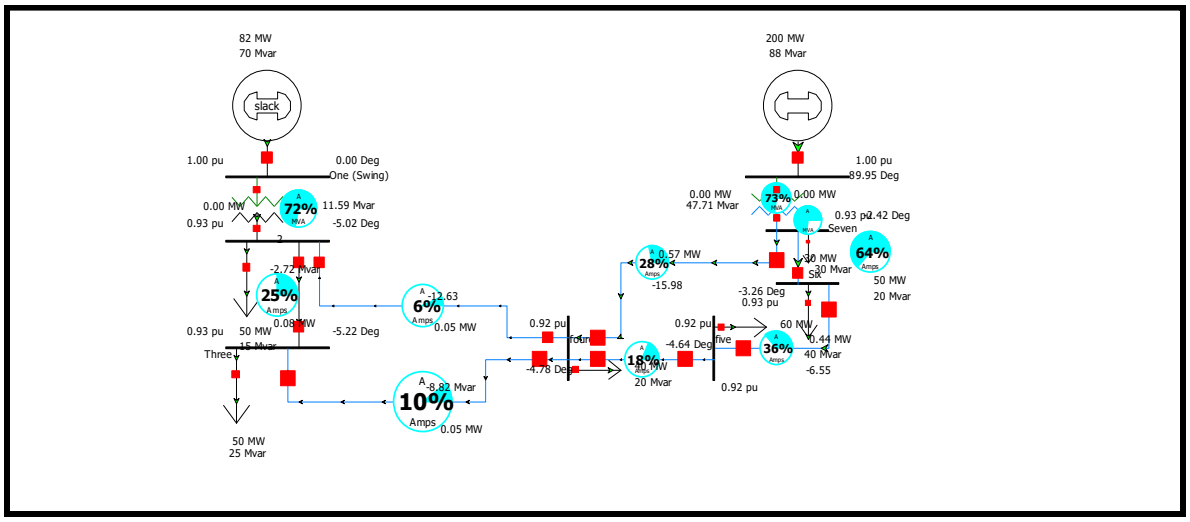


Figure 4: The angle and the Per Unit Voltage of each Bus

The loss and the MVA, MW generation is shown in the Figure 5:

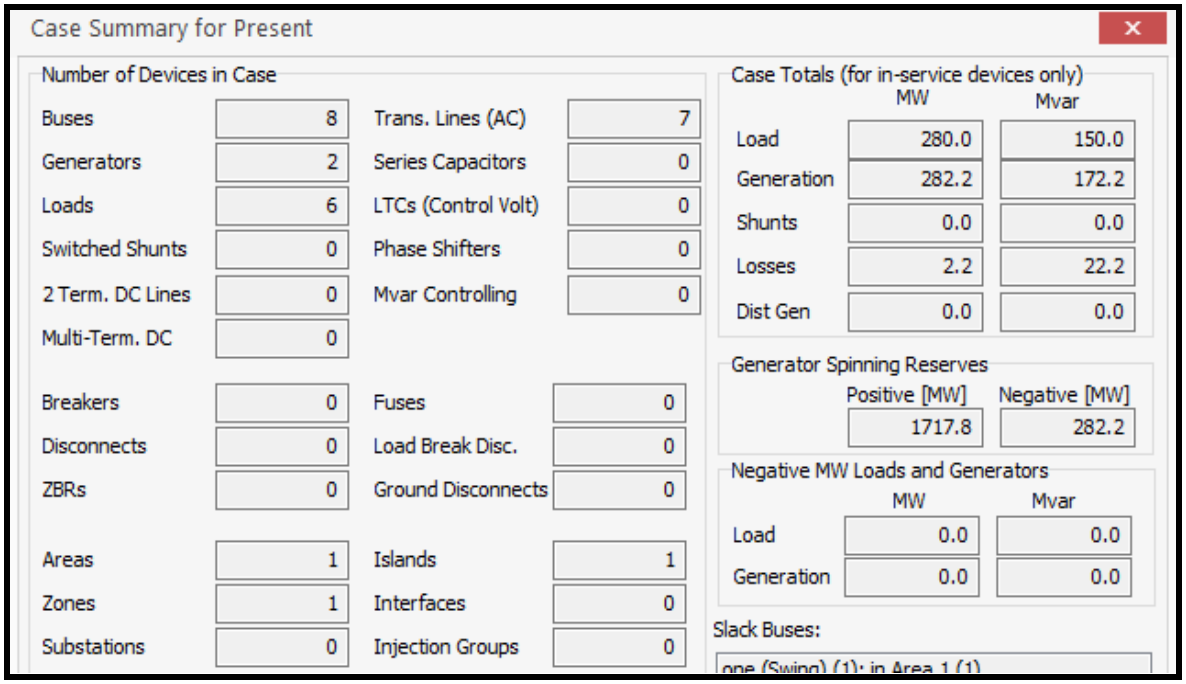


Figure 5: The Case Summary

The program gave the YBus Matrix; it is show in the Figure 6:

	Number	Name	Bus 1	Bus 2	Bus 3	Bus 4	Bus 5	Bus 6	Bus 7	Bus 8
1	1	one (Swing)	0.00 - j10.00	-0.00 + j10.00						
2	2	Two	-0.00 + j10.00	27.12 - j111.62	-21.95 + j82.32	-5.16 + j19.39				
3	3	three		-21.95 + j82.32	29.27 - j109.74	-7.32 + j27.44				
4	4	Foure		-5.16 + j19.39	-7.32 + j27.44	33.70 - j126.24	-17.56 + j65.86	-3.66 + j13.75		
5	5	Five				-17.56 + j65.86	25.54 - j95.74	-7.98 + j29.95		
6	6	Six				-3.66 + j13.75	-7.98 + j29.95	33.59 - j125.85	-21.95 + j82.32	
7	7	Seven						-21.95 + j82.32	21.95 - j92.31	-0.00 + j10.00
8	8	Eight							-0.00 + j10.00	0.00 - j10.00

Figure 6: The Y_{BUS} Matrix

The Table of the Bus voltages Per Unit and angle and load values were found and it is show in the Figure 7:

	Number	Name	Area Name	Nom kV	PU Volt	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar	Switched Shunts Mvar	Act G Shunt MW	Act B Shunt Mvar	Area Num
1	1	one (Swing)	1	13.80	1.00000	13.800	0.00			82.25	78.74		0.00	0.00	
2	2	Two	1	230.00	0.92492	212.732	-5.10	50.00	15.00				0.00	0.00	
3	3	three	1	230.00	0.91902	211.375	-5.29	50.00	25.00				0.00	0.00	
4	4	Foure	1	230.00	0.91501	210.452	-4.84	40.00	20.00				0.00	0.00	
5	5	Five	1	230.00	0.91142	209.626	-4.59	60.00	40.00				0.00	0.00	
6	6	Six	1	230.00	0.92108	211.848	-2.97	50.00	20.00				0.00	0.00	
7	7	Seven	1	230.00	0.92837	213.526	-1.71	30.00	30.00				0.00	0.00	
8	8	Eight	1	15.00	1.00002	15.000	10.73			200.00	93.44		0.00	0.00	

Figure 7: the Bus Voltage, angle, and load

The state table of the branches were found and it is show in the Figure 8:

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	MW From	Mvar From	MVA From	Lim MVA	% of MVA Limit (Max)	MW Loss	Mvar Loss
1	1	one (Swing)	2	Two	1	Closed	Transformer	YES	82.2	78.7	113.9	150.0	75.9	0.00	12.96
2	3	three	2	Two	1	Closed	Line	NO	-34.8	-40.0	53.0	200.0	26.5	0.10	-2.61
3	2	Two	4	Foure	1	Closed	Line	NO	-2.6	13.4	13.7	200.0	12.9	0.06	-12.34
4	3	three	4	Foure	1	Closed	Line	NO	-15.2	15.0	21.3	200.0	10.7	0.05	0.18
5	5	Five	4	Foure	1	Closed	Line	NO	18.2	-29.7	34.8	200.0	17.4	0.05	-3.45
6	6	Six	4	Foure	1	Closed	Line	NO	40.2	-10.7	41.6	200.0	20.8	0.35	-16.38
7	6	Six	5	Five	1	Closed	Line	NO	78.8	4.6	78.9	200.0	39.5	0.62	-5.75
8	7	Seven	6	Six	1	Closed	Line	NO	170.0	14.7	170.6	200.0	85.3	1.02	0.85
9	8	Eight	7	Seven	1	Closed	Transformer	YES	200.0	93.4	220.7	300.0	73.6	0.00	48.73

Figure 8: The state Table of all Branches

From the figure 8: note that the Mvar loss is high at the voltage-controlled bus which is number (8), and at the swing bus which is number1 the loss is Maximum .

The Value of the real Power (MW) was increased in the Bus 3 and the transformer 1 become full loaded, the Value of new MW is 95 MW. The new Power Flow direction show in the Figure 9:

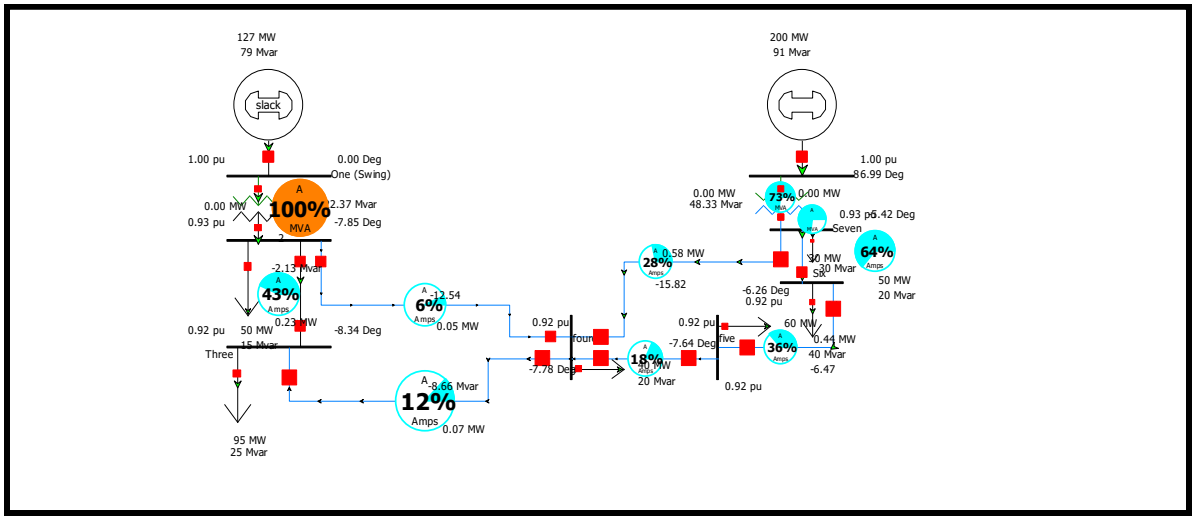


Figure 9: The New Power flow direction, Per Unit Voltage, and Angle and power losses

The loss and the MVA, MW generation is shown in the Figure 10:

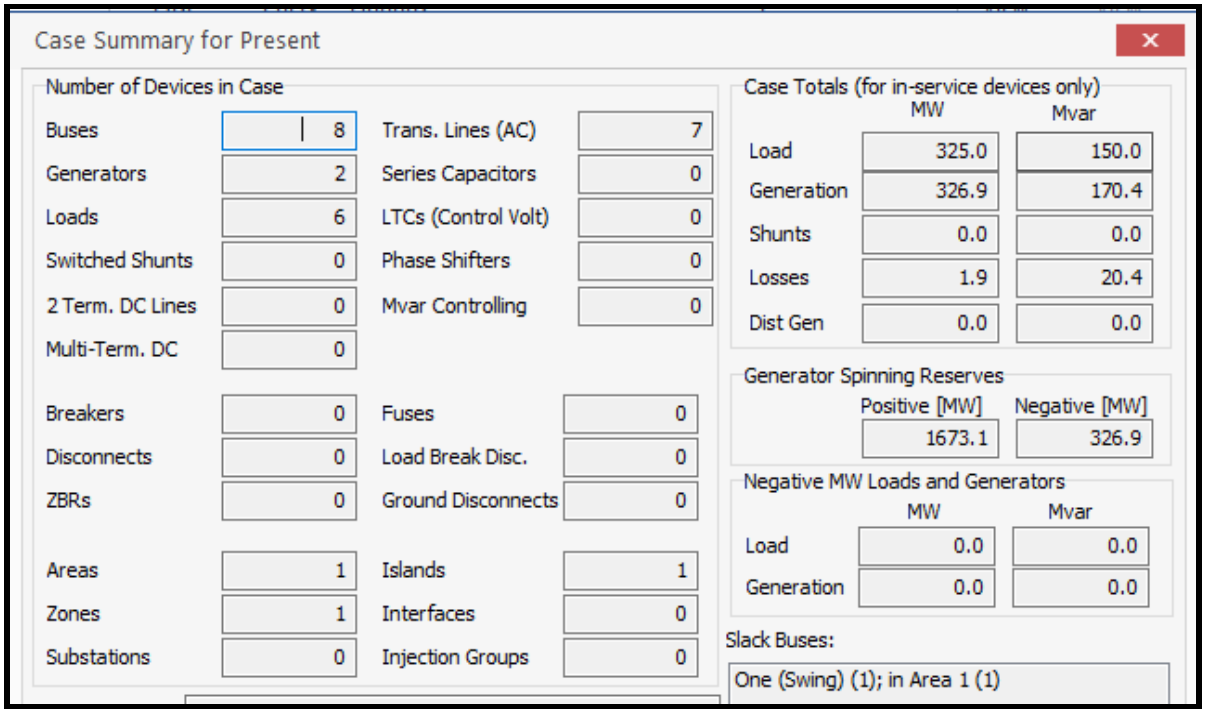


Figure 10: The Case Summary

The Shun Capacitor was added to the Bus 5 in the system to get the Per Unit Voltage at the Bus to Unity, the Capacitor insert is 110 MVAR, and the new system is show in the Figure 11: the value of the Capacitor given by $c = \frac{Mvar}{2\pi f(Vrms)^2} = \frac{110*10^6}{2*3.14*50*230Kv} = 6.6F$

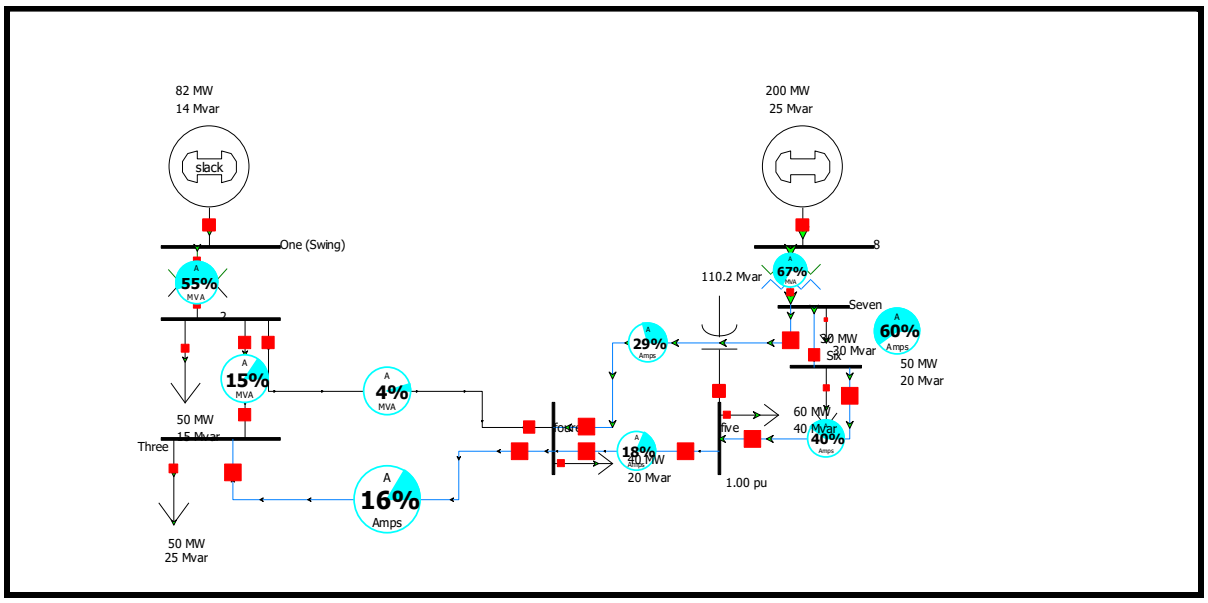


Figure 11: system with Shunt Capacitor

The power Flow direction, the PU voltage and Angle of each bus and power loss pf transformer and transmission line is show in the Figure 12:

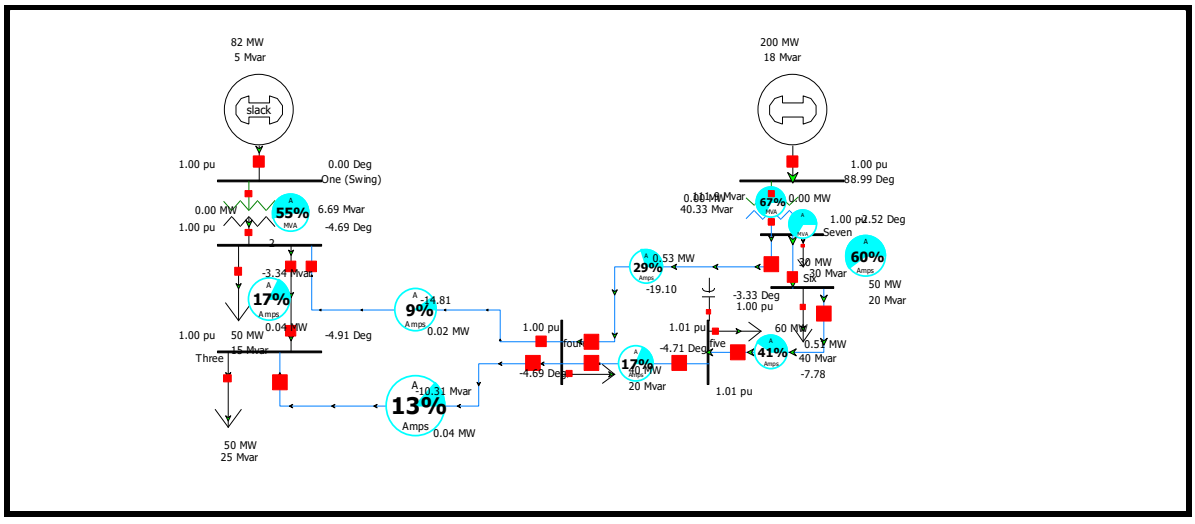


Figure 12: The PU voltage, angle and Power flow direction of the system with shun compensator

The Case summary of the system with capacitor is show in the Figure 13:

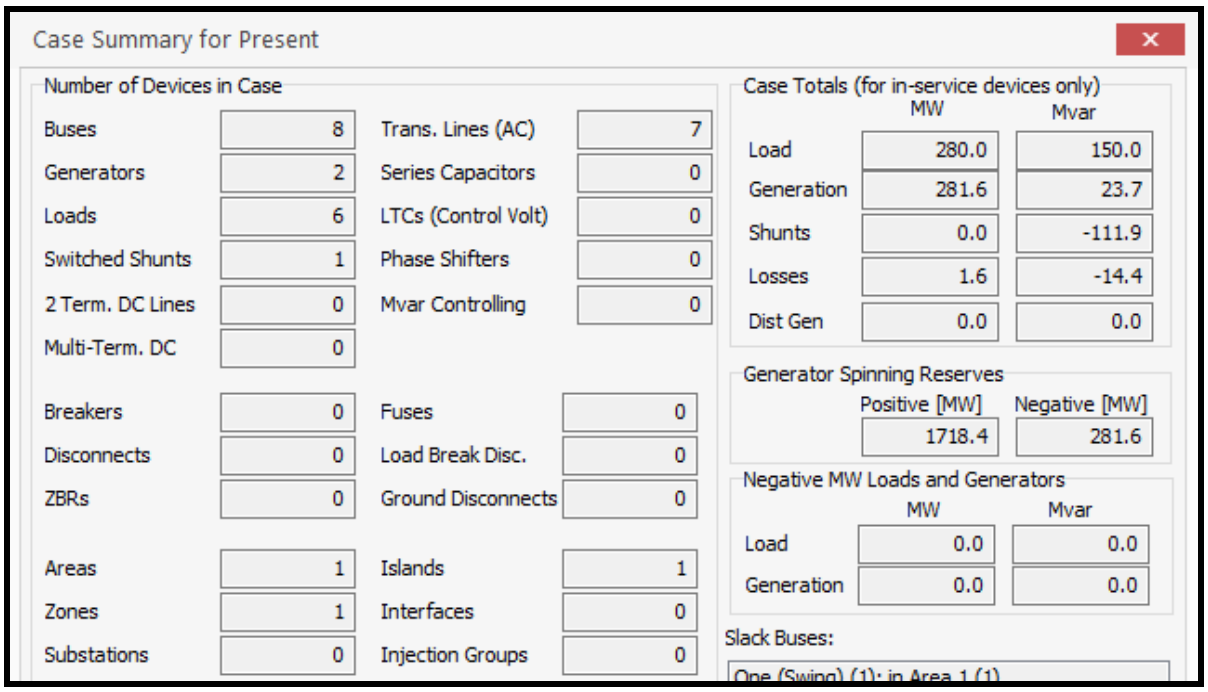


Figure 13: The Case summary of the system with capacitor

When the Value of the Capacitor is greater than 110 Mvar the same steps were done:

The Value of the Capacitor Choosed 130 Mvar: the system is show in the Figure 14:

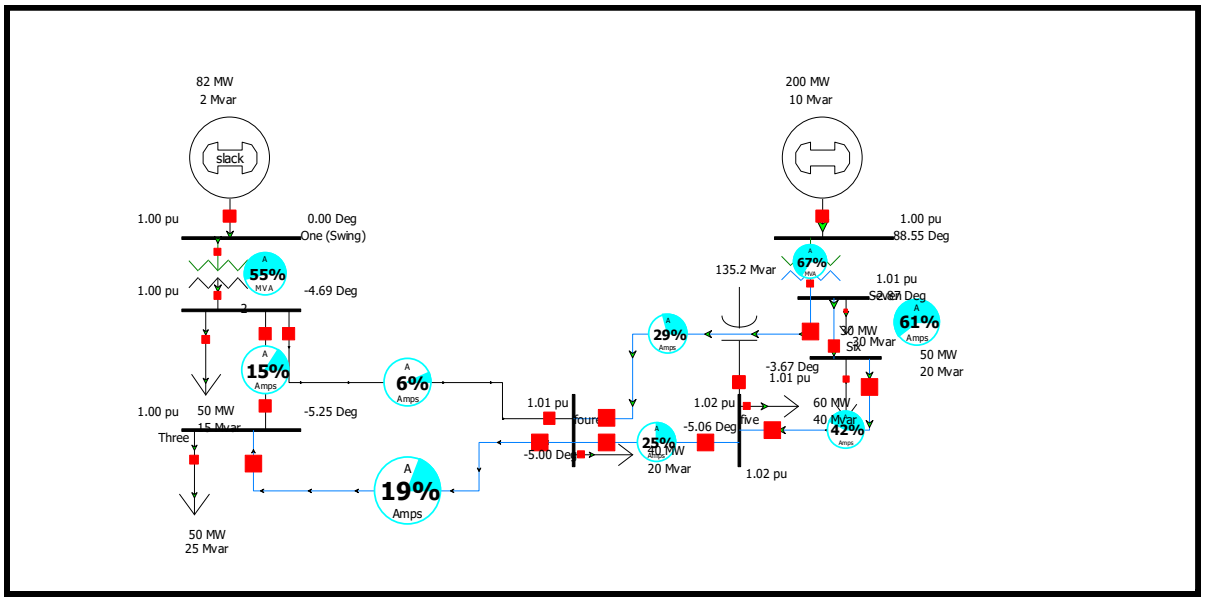


Figure 14: The new run when the capacitor is greater than 110

The Case summary of the new system is show in the Figure 15:

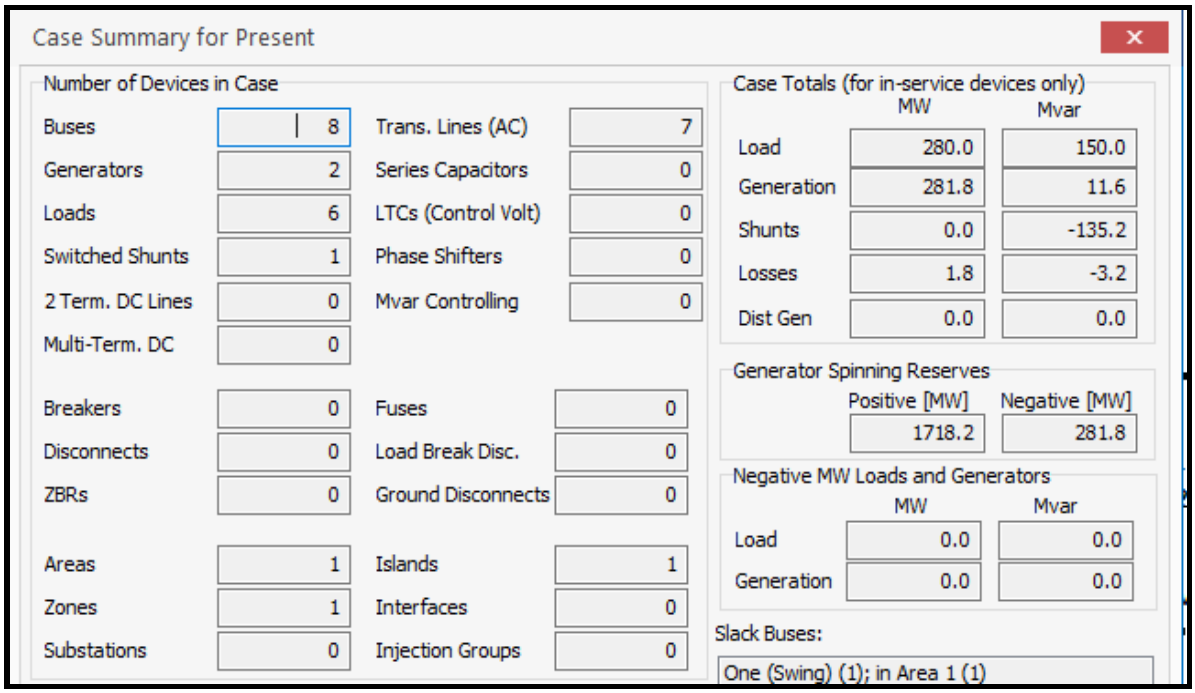


Figure 15: The New Case Summary of the System

Here, the value of the Capacitor is Choosed less than 110 Mvar:

The Value Choosed 90 Mvar, the new simulation of the system is show in the Figure 16:

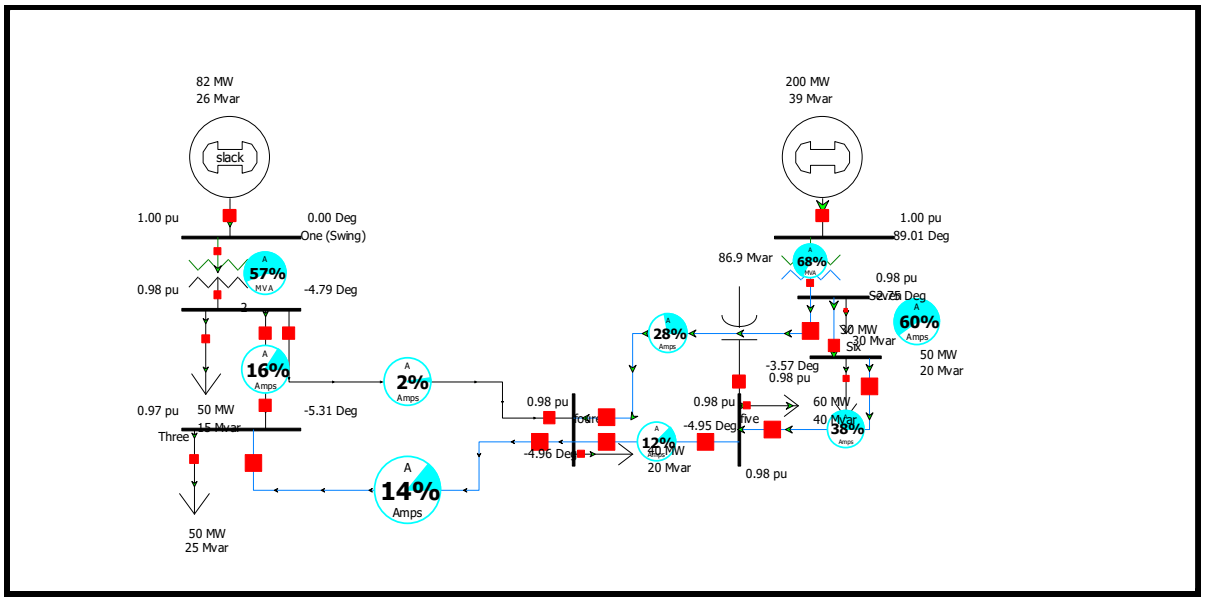


Figure 16: The Run when the Capacitor is less than 110 Mvar

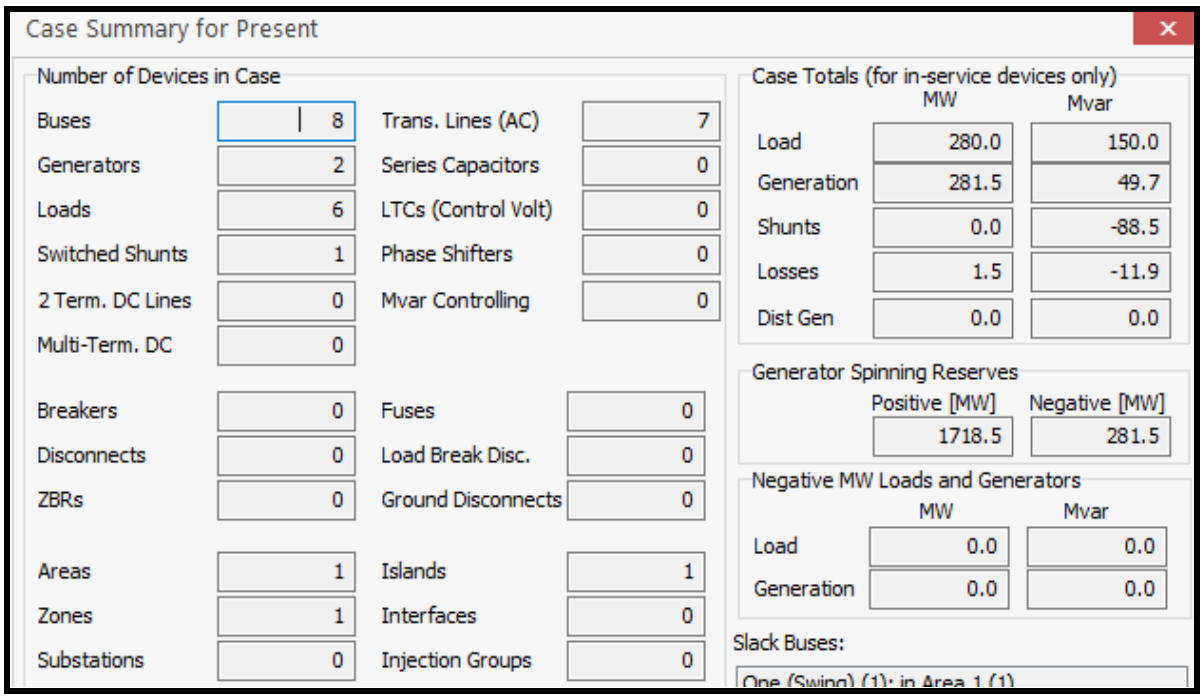


Figure 17: Case Summary when the capacitor is less than 110

From the Previse Cases when the Capacitor is chose 110 Mvar, the value of losses in (Mvar) is high and the power at the bus is unity, but when changed the value of the capacitor greater than 110 Mvar, the losses in Mvar is small, but when the capacitor is changed to less than 110, the value of the loss high but the power at the bus is not unity.

The faults information was inserted into the Program, and the 3-phase symmetrical faults were found, the results are show in the Figure 17:

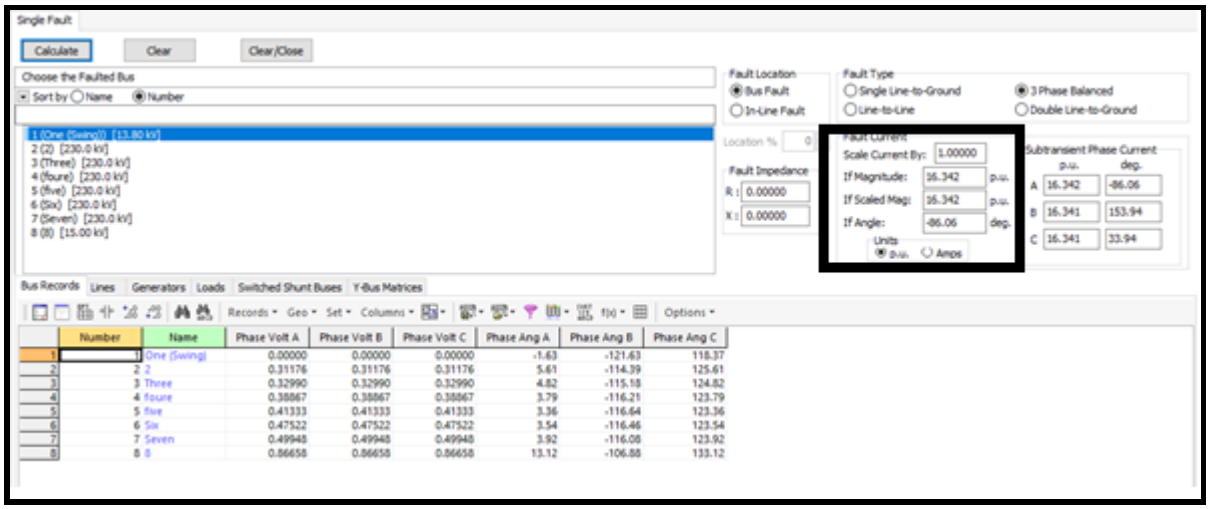
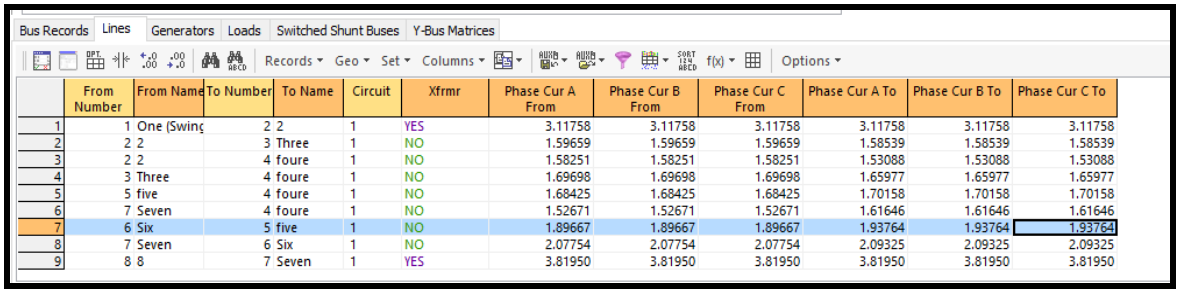


Figure 18: 3-Phase Symmetrical faults

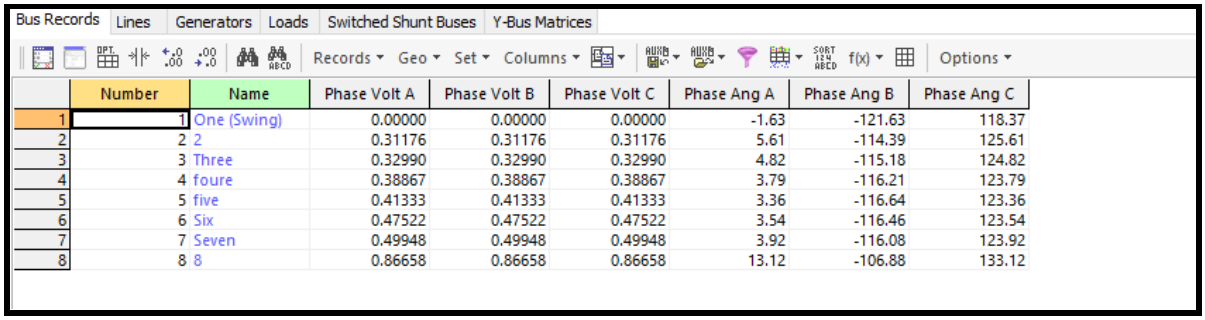


Bus Records | Lines | Generators | Loads | Switched Shunt Buses | Y-Bus Matrices

Records | Geo | Set | Columns | f(x) | Options

	From Number	From Name	To Number	To Name	Circuit	Xfrmr	Phase Cur A From	Phase Cur B From	Phase Cur C From	Phase Cur A To	Phase Cur B To	Phase Cur C To
1	1	One (Swing	2	2	1	YES	3.11758	3.11758	3.11758	3.11758	3.11758	3.11758
2	2	2	3	Three	1	NO	1.59659	1.59659	1.59659	1.58539	1.58539	1.58539
3	2	2	4	foure	1	NO	1.58251	1.58251	1.58251	1.53088	1.53088	1.53088
4	3	Three	4	foure	1	NO	1.69698	1.69698	1.69698	1.65977	1.65977	1.65977
5	5	five	4	foure	1	NO	1.68425	1.68425	1.68425	1.70158	1.70158	1.70158
6	7	Seven	4	foure	1	NO	1.52671	1.52671	1.52671	1.61646	1.61646	1.61646
7	6	Six	5	five	1	NO	1.89667	1.89667	1.89667	1.93764	1.93764	1.93764
8	7	Seven	6	Six	1	NO	2.07754	2.07754	2.07754	2.09325	2.09325	2.09325
9	8	8	7	Seven	1	YES	3.81950	3.81950	3.81950	3.81950	3.81950	3.81950

Figure 19: The Value of current in transition line during fault



Bus Records | Lines | Generators | Loads | Switched Shunt Buses | Y-Bus Matrices

Records | Geo | Set | Columns | f(x) | Options

	Number	Name	Phase Volt A	Phase Volt B	Phase Volt C	Phase Ang A	Phase Ang B	Phase Ang C
1	1	One (Swing)	0.00000	0.00000	0.00000	-1.63	-121.63	118.37
2	2	2	0.31176	0.31176	0.31176	5.61	-114.39	125.61
3	3	Three	0.32990	0.32990	0.32990	4.82	-115.18	124.82
4	4	foure	0.38867	0.38867	0.38867	3.79	-116.21	123.79
5	5	five	0.41333	0.41333	0.41333	3.36	-116.64	123.36
6	6	Six	0.47522	0.47522	0.47522	3.54	-116.46	123.54
7	7	Seven	0.49948	0.49948	0.49948	3.92	-116.08	123.92
8	8	8	0.86658	0.86658	0.86658	13.12	-106.88	133.12

Figure 20: The Bus Voltage during the fault