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Unbalanced Load Flow Study Using PSS Sincal

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ABSTRACT

The unbalanced load flow calculates the flow of power from the generators, over head lines and transformers to the power consumers. PSS Sincal performs the results of the unbalanced load flow calculations (currents, voltages) for individual phases and results for each nodes and terminal shown below.

Keywords: Distribution system, PSS Sincal, Newton raphson method.

I. INTRODUCTION

Power system planning and contingency analysis are being determined from load flow analysis. Load flow analysis of a system decides the interconnection and size of a system. For Load flow, various software's are used pertaining to optimization and automation like Smart Grid. Therefore, it's become mandatory to solve load flow solution efficiently to keep system healthy [1-6]. Every component in power system needs to be reliable and efficient enough to be operated in complex manner. In existing power system, accuracy is not met with limited bus size and operational features, thus with futuristic view, a tool is required to adapt and follow the different system configuration with speed and accuracy. It is observed that a system leads to unbalanced network, whenever sudden element is added or deletion occurs, so for those special cases where failure is frequent, special consideration is required [11-13]. Thus we use PSS Sincal software for the analysis of unbalanced load flow. In this paper, we proposed experimental set up with n number of buses with and without fault analysis along with their stability and contingency analysis.

II. PSS®E AND ITS FEATURES

In PSS Sincal different kinds of algorithms are available to solve the load flow problems [5-9] (current iteration, newton raphson, admittance matrix).

Advantages of working with PSS®E

- Load flow calculations are necessary for all electrical networks.PSS Sincal can simulate distribution and transmission network as well as industrial networks.
- It can manage more than one isolated network at the same time.
- Number of infeeders and generators are supported.
- Optimal tap position can calculated by voltage controllers while automatically taking into account voltage ranges
- Improved work processes and efficiency
- Calculates the area exchanges in the planning network model.

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- PSS®E produces the fastest and most accurate results of any competitor.
- Most comprehensive model library in industry
- Users can automate their workflows via scripting

III. EXPERIMENTAL RESULTS

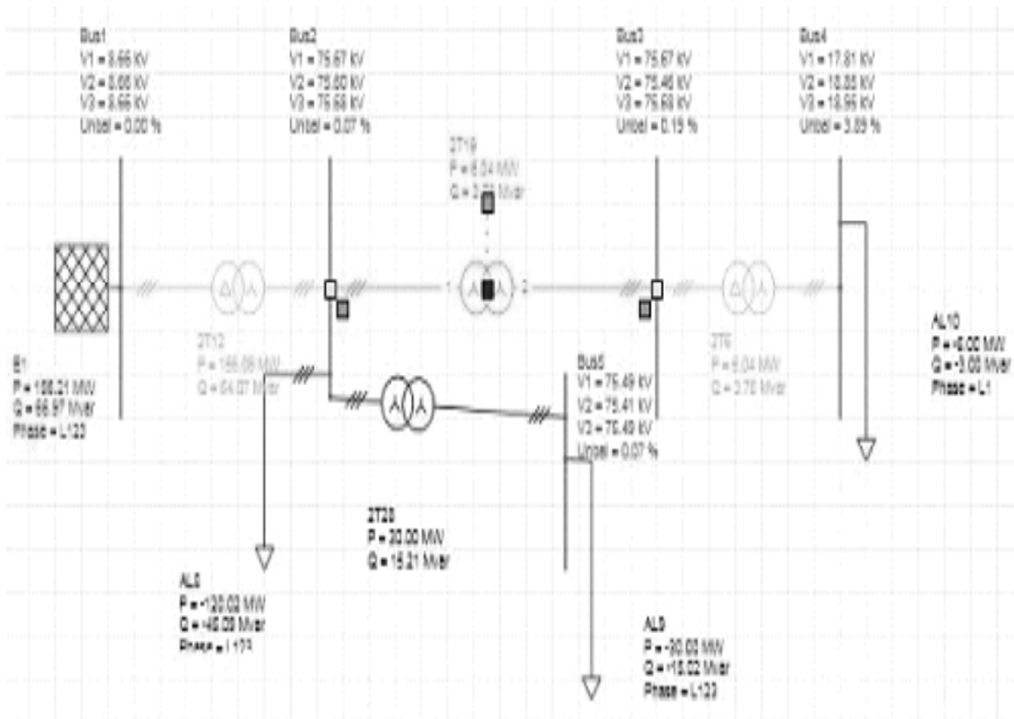
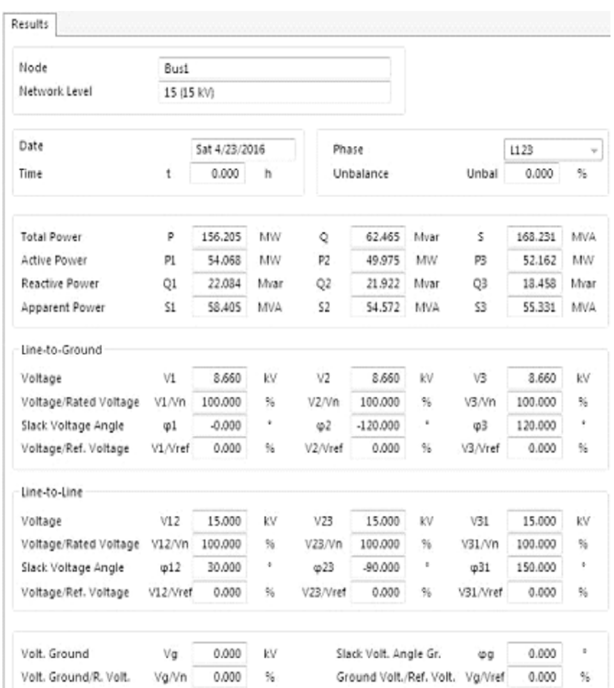


Figure 1: Basic load flow diagram.



Results

Node	Bus1
Network Level	15 (15 kV)

Date		Sat 4/23/2016		Phase		L123	
Time	t	0.000	h	Unbalance	Unbal	0.000	%

Total Power	P	156.205	MW	Q	62.465	Mvar	S	168.231	MVA
Active Power	P1	54.068	MW	P2	49.975	MW	P3	52.162	MW
Reactive Power	Q1	22.084	Mvar	Q2	21.922	Mvar	Q3	18.458	Mvar
Apparent Power	S1	58.405	MVA	S2	54.572	MVA	S3	55.331	MVA

Line-to-Ground

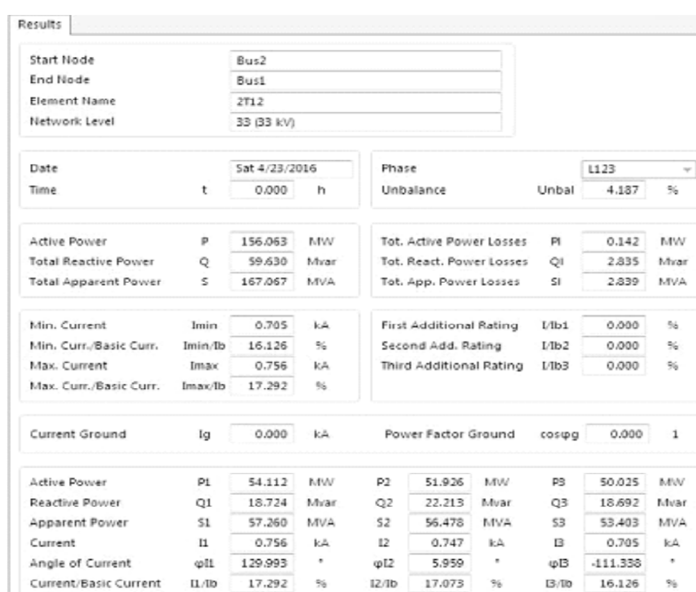
Voltage	V1	8.660	kV	V2	8.660	kV	V3	8.660	kV
Voltage/Rated Voltage	V1/Vn	100.000	%	V2/Vn	100.000	%	V3/Vn	100.000	%
Slack Voltage Angle	φ1	-0.000	°	φ2	-120.000	°	φ3	120.000	°
Voltage/Ref. Voltage	V1/Vref	0.000	%	V2/Vref	0.000	%	V3/Vref	0.000	%

Line-to-Line

Voltage	V12	15.000	kV	V23	15.000	kV	V31	15.000	kV
Voltage/Rated Voltage	V12/Vn	100.000	%	V23/Vn	100.000	%	V31/Vn	100.000	%
Slack Voltage Angle	φ12	30.000	°	φ23	-90.000	°	φ31	150.000	°
Voltage/Ref. Voltage	V12/Vref	0.000	%	V23/Vref	0.000	%	V31/Vref	0.000	%

Volt. Ground	Vg	0.000	kV	Slack Volt. Angle Gr.	φg	0.000	°
Volt. Ground/R. Volt.	Vg/Vn	0.000	%	Ground Volt./Ref. Volt.	Vg/Vref	0.000	%

Figure 2: Represents different values of bus 1(15kv)



Results

Start Node	Bus2
End Node	Bus1
Element Name	2T12
Network Level	33 (33 kV)

Date		Sat 4/23/2016		Phase		L123	
Time	t	0.000	h	Unbalance	Unbal	4.187	%

Active Power	P	156.063	MW	Tot. Active Power Losses	Pl	0.142	MW
Total Reactive Power	Q	59.630	Mvar	Tot. React. Power Losses	Ql	2.835	Mvar
Total Apparent Power	S	167.067	MVA	Tot. App. Power Losses	Sl	2.839	MVA

Min. Current	Imin	0.705	kA	First Additional Rating	I/Ib1	0.000	%
Min. Curr./Basic Curr.	Imin/Ib	16.126	%	Second Add. Rating	I/Ib2	0.000	%
Max. Current	Imax	0.756	kA	Third Additional Rating	I/Ib3	0.000	%
Max. Curr./Basic Curr.	Imax/Ib	17.292	%				

Current Ground	Ig	0.000	kA	Power Factor Ground	cosφg	0.000	1

Active Power	P1	54.112	MW	P2	51.926	MW	P3	50.025	MW
Reactive Power	Q1	18.724	Mvar	Q2	22.213	Mvar	Q3	18.692	Mvar
Apparent Power	S1	57.260	MVA	S2	56.478	MVA	S3	53.403	MVA
Current	I1	0.756	kA	I2	0.747	kA	I3	0.705	kA
Angle of Current	φI1	129.993	°	φI2	5.959	°	φI3	-111.338	°
Current/Basic Current	I1/Ib	17.292	%	I2/Ib	17.073	%	I3/Ib	16.126	%

Figure 3: Shows the different values at bus1 and bus 2(33kv)

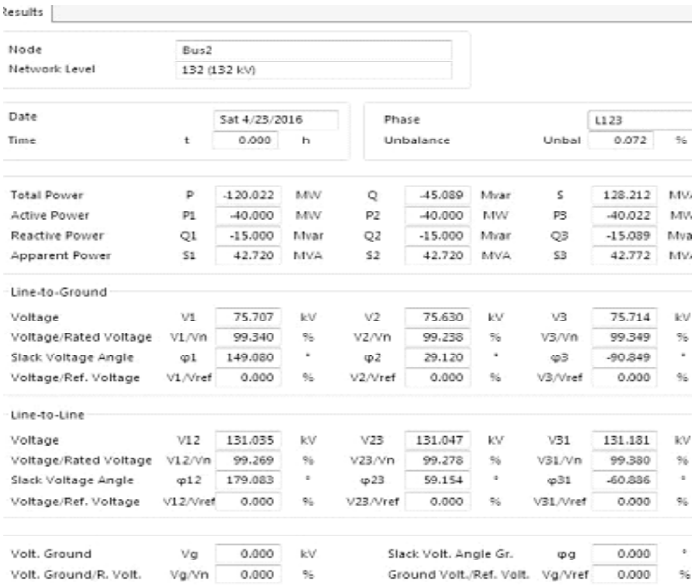


Figure 4: Represents the different values of bus 2(132kv)

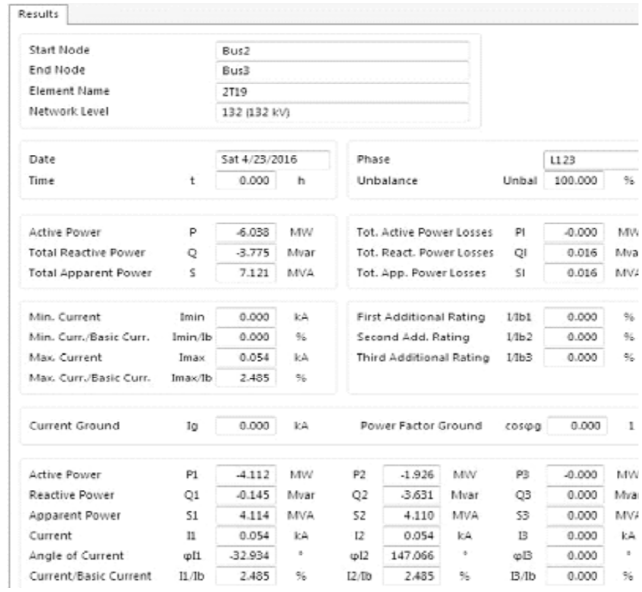


Figure 5: Represents different values between bus 2 and bus 3

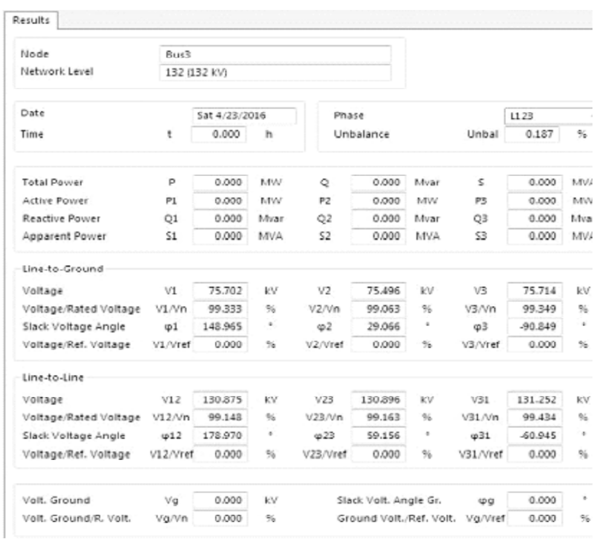


Figure 6: Represents different values at bus 3

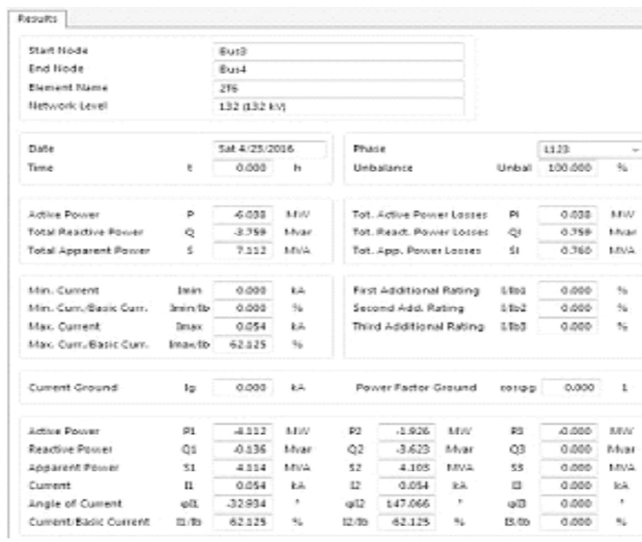
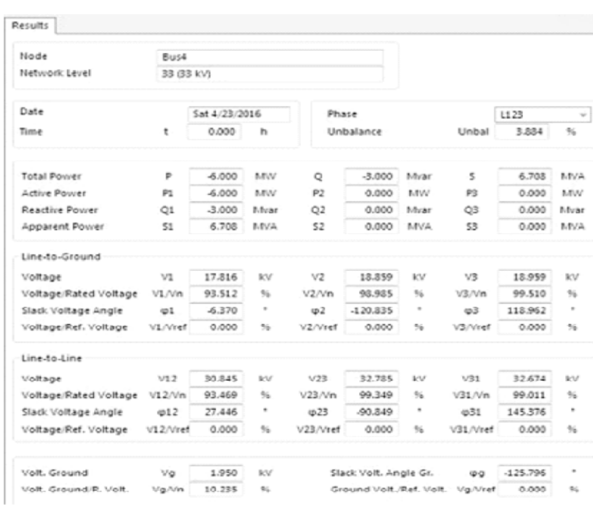


Figure 7: Represents different values at bus 3 and bus 4



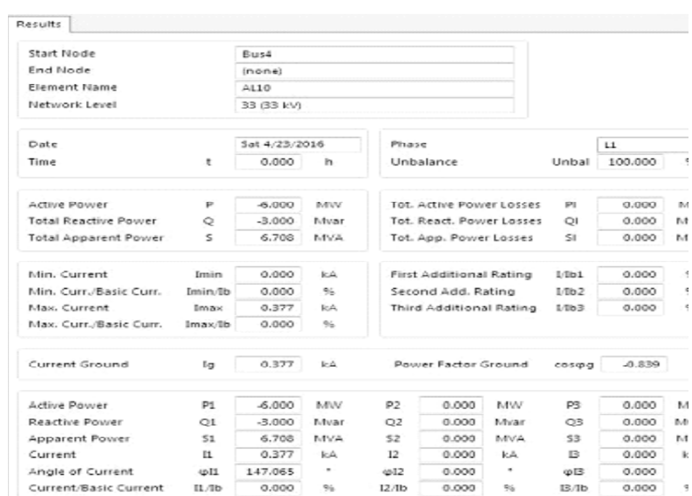


Figure 8: Represents the different values at bus 4

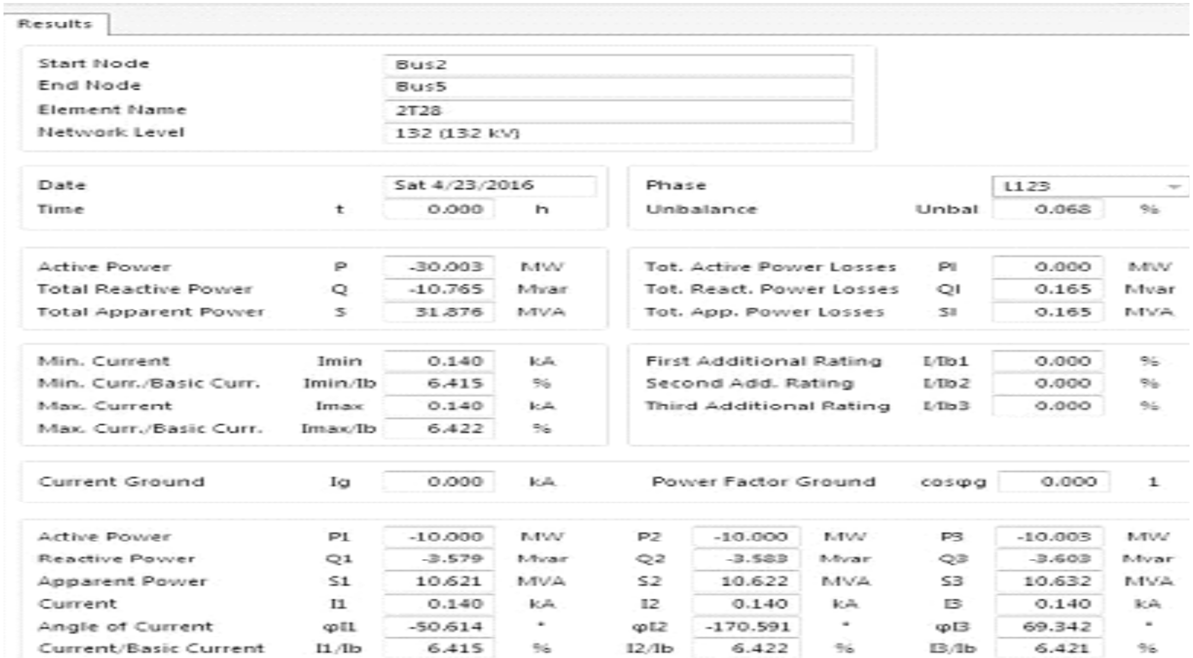


Figure 9: Represents different values between bus 2 and bus 5

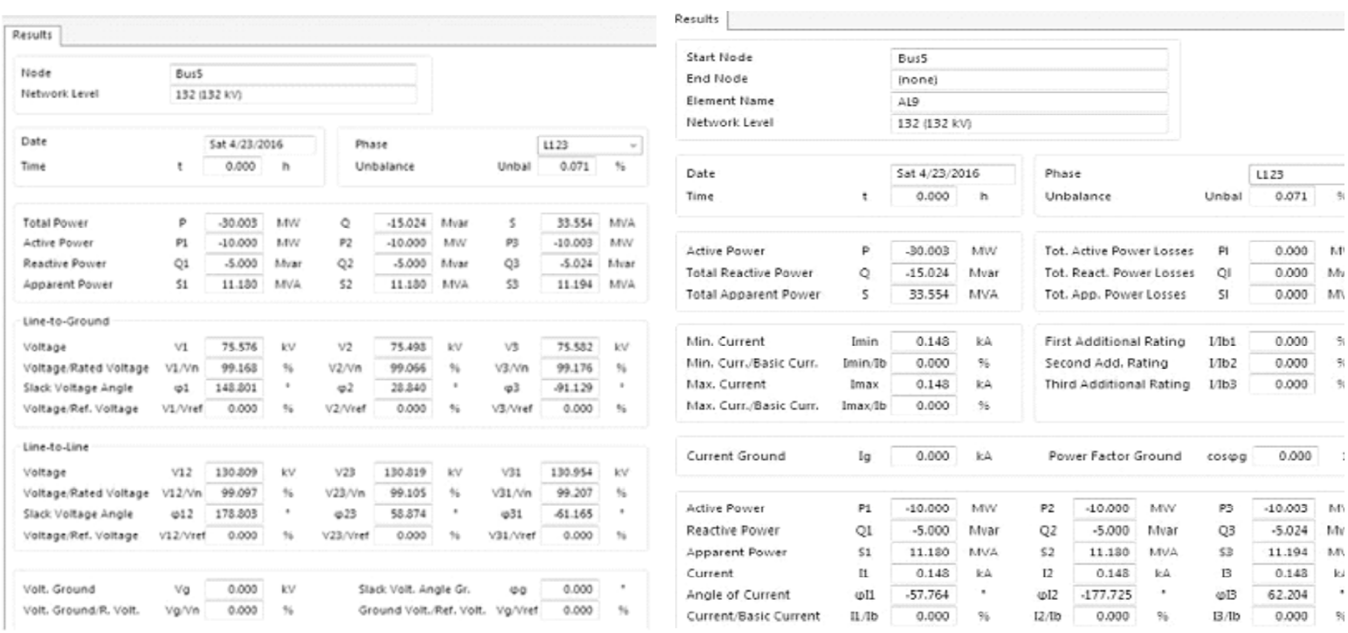


Figure 10: Represents different values of bus 5

IV. CONCLUSION

This paper shows the basic load flow study using PSS Sincal software .It shows the reduction in manual data filing pertaining to stability with optimum use of manpower and resources along with minimal errors.PSS Sincal prepares the result of unbalanced load calculations(current and voltages) for individual phases.

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