Research article Available online www.ijsrr.org ISSN: 2279–0543

International Journal of Scientific Research and Reviews

Load Flow Analysis Using MI Power Softwa

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ABSTRACT

The paper helps to know the basic of Optimal Load Flow Analysis of power system. Load Flow Analysis are used to validate that the power transfer from generators to consumers through the grid system is stable, reliable and economical. Load flow analysis is very useful for stabilityanalysis, future expansion planning and in determining the best economical operation for existing systems. Load flow analysis also helpful for now the proper setting of the protection devices. Power system analysis also help to ensure to know that the safe operation of cables, transformer, transmission lines and other components of power system. Various data of power system like active power, reactive power,load angle, power factor, thermal limit are has to be known.

KEYWORDS: Load flow analysis, contingency analysis, line loading, power system operation.

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1.INTRDUCTION

A well-designed system saves on cost in implementing and maintenance. The primary tools for analysis for steady state operation is so called power flow analysis or Load flow studies where the voltage and power flow through the system is determined[1]. Another very popular steady state analysis tool is the short circuit analysis for determining the fault current through system. Load flow analysis helps us to determine flows of power in system during normal and emergency conditions and study the transient behaviour of the system resulting from fault conditions and switching operations.A power system is "secure" when it can withstand the loss of one or more elements and still continue operation without major problems.

OBJECTIVES OF POWER SYSTEM STUDY

- Power flow analysis is very important in planning stages of new networks or addition to existing ones like adding new generator sites, meeting increase load demand and locating new transmission sites.
- It is helpful in determining the best location as well as optimal capacity of proposed generating station, substation and new lines.
- The line status should be known. The line should be not overvoltage it means it should not operate near the thermal limit or closed to stability.

2. LOAD FLOW ANALYSIS

Power flow analysis is the backbone of power system analysis and design. The most important information is known from the load flow is the voltage profile in the system If voltage variesin the system, large reactive power due to which there is increase in real power loss and in some extreme cases voltage collapse[2].If due to demand increase additional lines is to be required a load flow analysis is help how it will relieve overload adjacent lines. With the help of load flow analysis one can also know the study performance of the Transformer, Transmission line, and Generator at steady state[3]. For load flow analysis there are various methods like N-R METHOD, GAUSS-SIEDEL METHOD, FAST ECOUPLE LOAD FLOW METHOD, among this we are using the N-R METHOD which has the below benefits among the other methods.

LOAD FLOW TECHNIQUES		
Gauss-Siedel Method	Newton-Raphson Method	Fast Decoupled Load Flow

Advantages of N-R METHOD

- One of the fastest method convergences to the root
- Easy to convert to multiple dimensions
- More accurate and not sensitive to the factors such like slack bus selection, regulation transformers etc. and the number of iterations required in this method is almost independent of system size

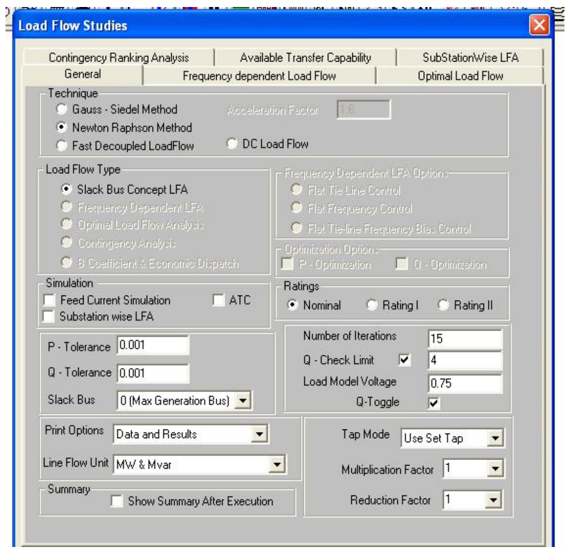

Figure:1 Load flow studies method

3. MI POWER SOFTWARE

Mi Power is a highly interactive, user friendly windows-based Power System Analysis package. It includes a set of modules for performing a wide range of power system design and analysis study[4]. By using the MI-power software we can able to do VARIOUS ANALYSIS FOR POWER SYSTEM like fault analysis,Contingency analysis,Power flow analysis/load flow analysis, Frequency analysis, Protection coordination and others.

4.SYSTEM UNDER SYUDY

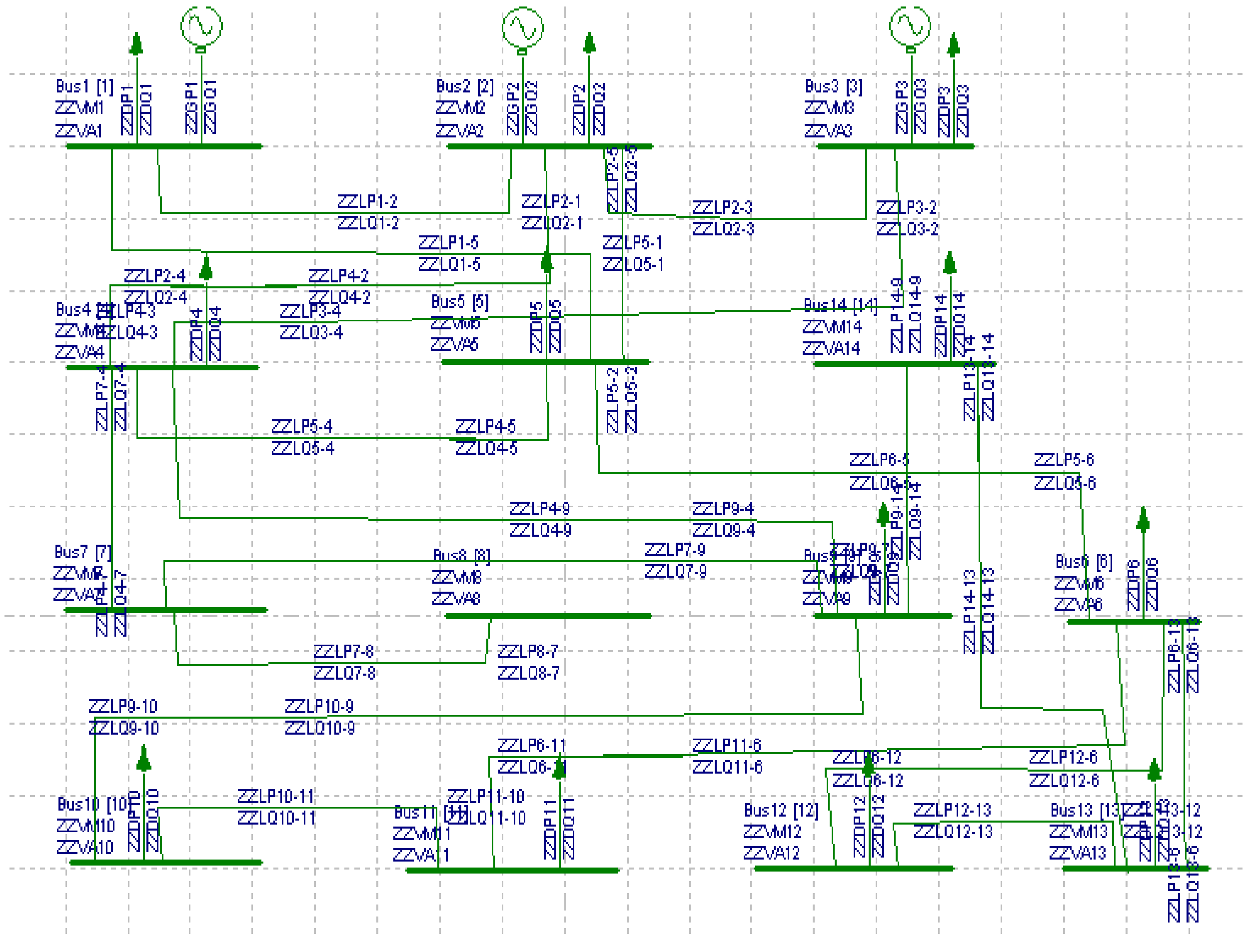

Figure:2 shows the single line diagram of the system under study in MI Power software.

Table:1 Load Details

LOAD DETAILS		
BUS NO	MW	MVAR
BUS 2	21.7	12.7
BUS 3	94.2	19.00
BUS 4	47.8	3.9
BUS 5	7.6	1.6
BUS 6	11.2	7.5
BUS 9	29.5	16.6
BUS 10	9.0	5.8
BUS 11	3.5	1.8
BUS 12	6.1	1.6
BUS 13	13.5	5.8
BUS 14	14.9	5.0

Numbers of components		
Sr no	**DESCRIPTION**	**No**
1	**Bus Number Used**	**14**
2	**Transmission Lines**	**20**
3	**Generator**	**3**
4	**Loads**	**12**

Table: 2 components details

BUS NO.	KV	BUS NO.	KV
1	**220**	**10**	**220**
2	**220**	**11**	**220**
3	**220**	**12**	**220**
4	**220**	**13**	**220**
5	**220**	**14**	**220**
6	**220**		
7	**220**		
8	**220**		
9	**220**		

Table: 3 Bus voltage details

The effective and most reliable amongst the three load flow methods is the Newton-Raphson method because it converges fast and is more accurate. In the load flow analysis methods simulated, the tolerance values used for simulation are 0.001 and 0.1.

5. RESULT FILE

Table: 4 BUS VOLTAGE AND POWER WITHOUT ANY CONTIGENCY

BUS VOLTAGE AND POWER WITHOUT ANY CONTIGENCY						
Bus No.	**Bus Voltage**		**Generation**		**Load**	
	Magnitude Per Unit	**Phase Angle Degrees**	**Real MW**	**Reactive MVAR**	**Real MW**	**Reactive MVAR**
1	1	0	303.126	200.285	0	0
2	0.6338	-915.24	40	977.19	28.544	16.705
3	0.1027	228.51	0	22.826	9.549	1.926
4	-0.0256	-3309.17	0	0	2.539	-0.207
5	-0.0011	-311.55	0	0	-0.12	-0.025
6	-0.0125	-1388.17	0	0	-0.241	0.161
7	-0.0029	-1280.25	0	0	0	0
8	-0.0029	-1280.25	0	0	0	0
9	-0.0584	-1735.4	0	0	-3.136	1.765
10	0	-1823.22	0	0	0	0
11	-0.0062	163.31	0	0	-0.029	-0.015
12	0.0019	-869.6	0	0	0.006	0.002
13	0.0002	-1794.86	0	0	-0.006	-0.003
14	0.0089	-943.23	0	0	0.619	0.208

Table: 5 BUS VOLTAGE AND POWER WITH CONTIGENCY WHEN GENERATOR 1 IS OPEN

BUS VOLTAGE AND POWER WITH CONTIGENCY WHEN GENERATOR 1 IS OPEN						
Bus No.	Bus Voltage		Generation		Load	
	Magnitude Per Unit	Phase Angle Degrees	Real MW	Reactive MVAR	Real MW	Reactive MVAR
1	0.8052	-2.48	0	0	0	0
2	1	0	278.444	262.546	21.7	12.7
3	0.5977	-26.28	0	24.94	89.573	18.067
4	0.518	-17.73	0	0	41.539	3.389
5	0.6129	-6.47	0	0	7.023	1.478
6	0.1754	-14.55	0	0	3.659	2.45
7	0.3714	-21.1	0	0	0	0
8	0.3714	-21.1	0	0	0	0
9	0.2246	-25.88	0	0	15.21	8.559
10	0.1794	-22.39	0	0	4.393	2.831
11	0.17	-22.73	0	0	1.44	0.741
12	0	-64.88	0	0	0	0
13	-0.0001	-55.18	0	0	-0.002	-0.001
14	0	-70.41	0	0	0.002	0.001

Table: 6 BUS VOLTAGE AND POWER WITH ANY CONTIGENCY WHEN LINE 1-2 OPEN

BUS VOLTAGE AND POWER WITH ANY CONTIGENCY WHEN LINE 1-2 OPEN						
Bus No.	Bus Voltage		Generation		Load	
	Magnitude Per Unit	Phase Angle Degrees	Real MW	Reactive MVAR	Real MW	Reactive MVAR
1	1	0	114.073	234.035	0	0
2	2.902	107138.6	40	340.47	55.812	32.664
3	3.0994	105526.6	0	3098.696	2385.045	481.06
4	2.7022	133386.8	0	0	11.454	0.935
5	1.0354	45045.91	0	0	-0.1	-0.021
6	-1.233	129871.3	0	0	9.799	6.562
7	-3.9145	6415.1	0	0	0	0
8	-0.9141	6145.11	0	0	0	0
9	0.6095	12059.45	0	0	29.5	16.6
10	3.2485	716.46	0	0	9	5.8
11	0.5582	-5308.6	0	0	3.5	1.8
12	1.1745	130531.4	0	0	1.439	0.377
13	-0.0165	24671	0	0	-0.254	-0.109
14	0.0961	14066.71	0	0	5.124	1.719

Table: 7 LINE FLOW AND LINE LOSSES WITH CONTIGENCY LINE1-2 OPEN

LINE FLOW AND LINE LOSSES WITH CONTIGENCY LINE1-2 OPEN						
SR No.			FORWARD		**Loss**	
	FROM NODE	TO NODE	**Real MW**	**Reactive MVAR**	**Real MW**	**Reactive MVAR**
1	BUS 1	BUS 2	LINE IS OPEN			
2	BUS 2	BUS 3	2260.177	3869.126	4075.205	8297.273
3	BUS 2	BUS 4	1154.827	-63.267	271.4895	552.763
4	BUS 1	BUS 5	-140.365	149.284	71.7703	146.1271
5	BUS 2	BUS 5	1385.428	2595.702	1757.069	3577.459
6	BUS 3	BUS 4	584.258	4323.327	3386.545	6895.136
7	BUS 4	BUS 5	1485.64	1992.248	1445.766	2943.635
8	BUS 5	BUS 6	-190.502	144.128	90.9881	185.2552
9	BUS 4	BUS 7	-1080.48	-256.872	288.7302	587.8657
10	BUS 7	BUS 8	-0.253	0.58	0	0.001
11	BUS 4	BUS 9	396.3	1288.293	501.0.334	1020.123
12	BUS7	BUS 9	1736.786	2931.942	1295.407	2637.497
13	BUS 9	BUS 10	243.186	555.429	1691.728	3444.422
14	BUS 6	BUS 11	94.406	192.715	51.7759	105.4177
15	BUS 6	BUS 12	-34.588	662.56	494.8986	1007.632
16	BUS 6	BUS 13	177.199	348.873	172.1127	350.428
17	BUS 9	BUS 14	54.367	94.995	55.126	112.2386
18	BUS 10	BUS 11	799.417	2684.56	1270.823	2587.444
19	BUS12	BUS 13	157.355	324.346	161.0.222	327.8473
20	BUS 13	BUS 14	-0.242	-0.242	0.7338	1.4939

Table: 8**LINE FLOW AND LINE LOSSES WITHOUT CONTIGENCY**

LINE FLOW AND LINE LOSSES WITHOUT CONTIGENCY						
SR No.			FORWARD		**Loss**	
	FROM NODE	TO NODE	**Real MW**	**Reactive MVAR**	**Real MW**	**Reactive MVAR**
1	BUS 1	BUS 2	82.744	70.98	20.3143	41.3608
2	BUS 2	BUS 3	62.463	93.03	53.4213	108.7677
3	BUS 2	BUS 4	43.728	96.711	47.9284	97.5841
4	BUS 1	BUS 5	113.966	231.57	113.8615	231.8264
5	BUS 2	BUS 5	45.855	93.005	45.7479	93.1455
6	BUS 3	BUS 4	1.877	2.458	1.5509	3.1577
7	BUS 4	BUS 5	0.07	0.158	0.0777	0.1581
8	BUS 5	BUS 6	-0.002	-0.003	0.0148	0.0302
9	BUS 4	BUS 7	0.093	0.157	0.0867	0.1765
10	BUS 7	BUS 8	0	0	0	0
11	BUS 4	BUS 9	-0.058	0.515	0.6985	1.4221
12	BUS7	BUS 9	0.042	-0.014	0.3927	0.7906
13	BUS 9	BUS 10	0.388	0.791	0.3883	0.7906
14	BUS 6	BUS 11	0.004	0.051	0.0287	0.0584
15	BUS 6	BUS 12	0.017	0.03	0.013	0.0266
16	BUS 6	BUS 13	0.018	0.037	0.0181	0.0369
17	BUS 9	BUS 14	0.52	0.771	0.4333	0.8822
18	BUS 10	BUS 11	0	0	0.0044	0.009
19	BUS12	BUS 13	0	0.001	0.0005	0.001
20	BUS 13	BUS 14	0	0	0.0092	0.0187

LINE FLOW AND LINE LOSSES WITH CONTIGENCY GENERATOR 1						
SR No.			FORWARD		Loss	
	FROM NODE	TO NODE	Real MW	Reactive MVAR	Real MW	Reactive MVAR
1	BUS 1	BUS 2	-25.06	-32.172	4.484	9.1296
2	BUS 2	BUS 3	114.022	77.331	32.444	66.058
3	BUS 2	BUS 4	94.127	99.348	32.015	65.1837
4	BUS 1	BUS 5	25.709	32.232	4.481	9.1235
5	BUS 2	BUS 5	60.456	82.672	17.9299	36.506
6	BUS 3	BUS 4	-4.837	17.066	1.5052	3.0646
7	BUS 4	BUS 5	-19.243	-2.915	2.4132	4.9134
8	BUS 5	BUS 6	34.099	60.587	21.9971	44.877
9	BUS 4	BUS 7	11.284	16.362	2.5169	5.1244
10	BUS 7	BUS 8	0	0	0	0
11	BUS 4	BUS 9	21.23	33.58	10.0559	20.4742
12	BUS7	BUS 9	7.846	11.907	2.5196	5.129
13	BUS 9	BUS 10	0.591	2.641	0.2484	0.5057
14	BUS 6	BUS 11	1.125	-0.191	0.0723	0.1473
15	BUS 6	BUS 12	3.499	7.125	3.4994	7.1249
16	BUS 6	BUS 13	3.499	7.128	3.5014	7.129
17	BUS 9	BUS 14	5.734	11.67	5.7314	11.6695
18	BUS 10	BUS 11	0.236	0.373	0.0103	0.021
19	BUS12	BUS 13	0	0	0	0
20	BUS 13	BUS 14	0	0	0	0

Table: 9 **LINE FLOW AND LINE LOSSES WIH CONTIGENCY GENERATOR 1**

Table :10 LINES LOADING DETAILS

LINES LOADING DETAILS			
LINE %	WITHOUT ANY CONTINGENCY	WITH CONTIGENCY WHEN LINE 1-2 OPEN	WITH CONTIGENCY WHEN GENERATR 1 OPEN
NUMBER OF LINE LOADED BEYOND 125%	1	11	2
NUMBER OF LINE LOADED BETWEEN 100% AND 125%	1	0	1
NUMBER OF LINE LOADED BETWEEN 75% AND 100%	8	4	4
NUMBER OF LINE LOADED BETWEEN 50% AND 75%	4	3	3
NUMBER OF LINE LOADED BETWEEN 25% AND 50%	2	1	6
NUMBER OF LINE LOADED BETWEEN 1% AND 25%	3	1	3
NUMBER OF LINE LOADED BETWEEN 0% AND 1%	1	0	1

CONCLUSION

This paper represents the load flow analysis by Newton Raphson flow techniques using MI power software which reduced the number of iterations. The software helps to analyse power system operation in an efficient manner and leads the system to effective utilization of power and voltage. Simulation analysis of diagram gives details of system parameters which is highly influence stability and reliability. From the results file we can observe that due to contingency the line loading are changes and power flow also change. Hence this study is very important for power system and analysis.

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