Impact Factor (SJIF): 3.632

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 3, Issue 4, April -2016

PLACEMENT OF DISTRIBUTION GENERATOR IN DISTRIBUTION SYSTEM FOR DIFFERENT LOADING CONDITION

Khushbu A. Patel[1], Urvish Mewada[2], Yamin Bhati[3], Harshal B. Patel[4]

[1]Electrical Engineering, AI T
[2]Electrical Engineering, AI T
[3]Electrical Engineering, AI T
[4]BioMedical Engineering, Government Polytechnic, Gandhinagar

Abstract*- Nowadays as use of DG is increasing significantly in power distribution industries but the proper placement of DG is necessary to reduce system losses. Here IEEE 14 bus radial distribution system is used to calculate losses after DG placement. DG placement is considered here for different loading of system like peak load, 75% and 50% loading conditions. IA method and LSF methods are used to find optimal location and size of DG at different loads and are compared.

Keywords*- Distribution generator; IEEE 14 bus radial system; optimal location; optimal size; different loads of system; loss sensitivity factor method; improved analytical method.

I. INTRODUCTION

Electrical power system is playing a vital role in human civilization. The requirements are growing continuously and so its increase in demand is achieved by maximum utilization of renewable energy sources like photovoltaic cells, wind turbines etc. The integration of renewable energy into the power system can potentially cause severe challenges for the control and protection of large central generators in the distribution system. Nowadays smart grid technologies have come to meet the customer demand more efficiently and economically. Distributed generation is an important part of this technology. This modification has considered high penetration of distributed generation. However, with the high penetration of such resources, along with demand variations has introduced many challenges to distribution networks like power fluctuations, high losses, voltage rise and low voltage stability etc. So it is necessary to considered optimal placement and optimal size of DG at various loading of system.

II. OBJECTIVE

Main objective is to find the optimal location and size of DG for different loading condition of the system such that the total system losses are minimized. DG under consideration is delivering active power.

III. SIMULATION AND RESULTS

Numerical results are computed using two methods:

1. Loss Sensitivity Method (LSF)
2. Improved Analytical Method (IA)

The proposed methodology is tested on IEEE 14 bus system with total load of 259 MW and 73.5 Mvar using MATLAB software tool for load flow, calculate losses and identify the optimal location and size of DG. NR method is used for load flow. Results of DG (injecting active power) by IA method and its comparison with LSF are computed for peak load, 75% and 50% of loading on system.

3.1 For Peak Loading Condition of System

3.1.1 LSF Method

Table 1: LSF factor at each Bus

Bus no	LSF factor	DG size (MW)
2	1.3916	14.697
3	-1.8030	27.694
4	-4.3510	11.351
5	-4.5875	11.913
6	0.3485	18.057
7	7.5623	10.813
8	7.0975	11.165
9	-5.9293	6.991
10	-7.2057	6.226
11	-3.2997	2.795
12	-1.3320	6.936
13	-2.9700	2.804
14	-9.8319	4.802

Table 2: Bus arranged in descending order as per LSF

Bus no	LSF factor	Loss (MW)	%Loss Reduction
7	**7.5623**	**5.673**	**58%**
8	**7.0975**		
2	**1.3916**		
6	**0.3485**		
12	**-1.3320**		
3	**-1.8030**		
13	**-2.9700**		
11	**-3.2997**		
4	**-4.3510**		
5	**-4.5875**		
9	**-5.9293**		
10	**-7.2057**		
14	**-9.8319**		

Table 3: Optimum location and size of DG as per LSF Method

Optimum bus	with optimum DG size	Base case losses	Total losses with DG	% loss reduction
7	**10.813**	**13.593**	**5.673**	**58%**

3.1.2 IA Method

Table 4: DG size at each bus as per IA method

Bus no	value of DG (MW)
2	**14.697**
3	**27.694**
4	**11.351**

5	11.913
6	18.057
7	10.813
8	11.165
9	6.991
10	6.226
11	2.795
12	6.936
13	2.804
14	4.802

Table 5: Total losses at each bus after DG placement

Bus no	Cal. value of DG from Eq. (MW)	Total losses (MW)	Optimum placement @ bus 4
2	14.697	12.803	
3	2.769	10.177	
4	11.351	5.012	Loss reduction is 63.1%
5	11.913	6.239	
6	18.057	11.989	
7	10.813	5.673	
8	11.165	5.750	
9	6.991	7.746	
10	6.226	8.734	
11	2.795	11.114	
12	6.936	12.8	
13	2.804	10.855	
14	4.802	9.52	

Table 6: Optimum location and size of DG as per IA Method

Optimum bus	with optimum DG size	Base case losses	Total losses with DG	% loss reduction
4	11.4	13.593	4.992	63.3%

3.2 For 75 % Loading Condition of System

Base case load flow for 75 % loading on system gives total real loss of 7.013 MW.

3.2.1 LSF Method

Table 7: Bus arranged in descending order as per LSF 75 % load

Bus no	LSF factor	Size(MW)	Loss (MW)	%Loss Reduction
8	2.4202	10.1	2.740	59.8%
5	1.3420			
6	0.6575			

4	-0.0434			
10	-0.1879			
9	-0.2319			
11	-0.5234			
14	-0.9766			
12	-1.6747			
13	-1.7008			
2	-2.0935			
7	-2.4235			
3	-4.683			

Table 8: Optimum location and size of DG as per LSF Method 75 % load

Optimum bus	with optimum DG size	Base case losses	Total losses with DG	% loss reduction
8	10.1	7.013	2.740	59.8%

3.2.2 IA METHOD

Table 9: DG size at each bus for 75 % load

Bus no	value of DG (MW)
2	12.23
3	7.19
4	1.14
5	3.40
6	3.37
7	3.65
8	3.87
9	2.57
10	1.58
11	4.27
12	9.28
13	16.32
14	4.951

Table 10: Total losses at each bus after DG placement for 75 % load

Bus no	Cal. value of DG from Eq. (MW)	Total losses (MW)	Optimum placement @ bus 4
2	12.23	5.032	
3	**7.19**	**2.653**	loss reduction is **62.17 %**
4	1.14	6.92	
5	3.40	5.114	
6	3.37	5.239	
7	3.65	4.659	
8	3.87	4.544	

9	2.57	6.818	
10	1.58	6.889	
11	4.27	6.705	
12	9.28	6.390	
13	16.32	5.874	
14	4.951	6.569	

Table 11: Optimum location and size of DG as per IA Method 75 % load

Optimum bus	with optimum DG size	Base case losses	Total losses with DG	% loss reduction
3	7.50	7.013	2.581	63.2%

3.3 For 50 % Loading Condition of System

Base case load flow results in total real loss of 2.786 MW.

3.3.1 LSF Method

Table 12: Bus arranged in descending order as per LSF 50 % load

Bus no	LSF factor	DG size (MW)	Loss (MW)	%Loss Reduction
9	1.7480	6.4	1.320	52.58%
10	1.2778			
2	1.2476			
14	-0.0894			
8	-0.1298			
11	0.1299			
7	-0.1587			
6	-0.6912			
5	-0.8415			
4	-1.0629			
13	-1.2536			
12	-1.5330			
3	-3.0461			

Table 13: Optimum location and size of DG as per LSF Method 50 % load

Optimum bus	with optimum DG size	Base case losses	Total losses with DG	% loss reduction
9	6.4	2.786	1.320	52.58%

3.3.2 IA method

Table 14: DG size at each bus 50 % load

Bus no	value of DG (MW)
2	9.03
3	4.80
4	2.86
5	2.16
6	3.58
7	2.42
8	2.07
9	19.84
10	10.99
11	1.07
12	8.56
13	12.17
14	0.46

Table 15: Total losses at each bus after DG placement for 75 % load

Bus no	Cal. value of DG from Eq. (MW)	Total losses (MW)	Optimum placement @ bus 3
2	9.03	2.635	
3	**4.80**	**1.110**	**6.2 MW gives loss of 1.019 MW 63.42 % loss reduction**
4	2.86	1.720	
5	2.16	2.079	
6	3.58	1.854	
7	2.42	2.687	
8	2.07	2.696	
9	19.84	2.029	
10	10.99	2.335	
11	1.07	2.783	
12	8.5660	2.473	
13	12.1710	2.296	
14	0.4651	2.760	

Table 16: Optimum location and size of DG as per IA Method 50 % load

Optimum bus	with optimum DG size	Base case losses	Total losses with DG	% loss reduction
3	6.2	2.786	1.019	63.42%

IV. CONCLUSION

Above results are computed on same system by two different methods. For DG: Injecting real power only on peak, 75% and 50% loading conditions of the system.

Table 17: Comparison of LSF & IA methods results @ Peak load

Method	Size (MW)	Bus	Total Ploss without DG	Total Ploss with DG	% reduction
LSF	10.8	7	13.593 MW	5.793 MW	58%
IA	11.4	4	13.593 MW	4.992 MW	63.3%

Table 18: Comparison of LSF & IA methods @ 75% load

Method	Size (MW)	Bus	Total Ploss without DG	Total Ploss with DG	% reduction
LSF	10.1	8	7.013 MW	2.743 MW	59.8%
IA	7.50	3	7.013 MW	2.581 MW	63.2%

Table 19: Comparison of LSF & IA methods @ 50% load

Method	Size (MW)	Bus	Total Ploss without DG	Total Ploss with DG	% reduction
LSF	6.4	9	2.786	1.320	52.58%
IA	6.2	3	2.786	1.019	63.42%

From the results we conclude that IA method is more accurate than LSF method. Loss reduction is more in IA than LSF. From the results we conclude that IA method is more accurate than LSF method. Loss reduction is more in IA than LSF. Thus IA method is more efficient than LSF method.

REFERENCES

[1] Khushbu A. Patel, 'Integration of Distribution Generation in Primary Distribution System', IJAREST vol.03 Issue 02,Feb.2016.

[2] Thomas Ackermann, G.Andersson and Lennart, 'Distributed generation: a definition'- Elsevier, 05th December 2000.

[3] Duong Quoc Hung, Nadarajah Mithulananthan, Member- IEEE, and R. C. Bansal, Senior Member- IEEE, 'Analytical Expressions for DG Allocation in Primary Distribution Networks', IEEE transactions on energy conversion, Vol.25, no.3, September 2010.

[4] Philip P. Barker and Robert W. de Mello, 'Determining the Impact of Distributed Generation on Power Systems: Part 1 - Radial Distribution Systems', IEEE pg.1645 - 1656 vol. 3, July 2000

[5] Duong Quoc Hung, Nadarajah Mithulananthan,'Multiple Distributed Generators Placement in Primary Distribution Networks for Loss Reduction', IEEE transactions on industrial electronics, April 2013.

[6] NareshAcharya, PukarMahat and M. Nadarajah , 'An Analytical approach for DG allocation in primary distribution network' , Elsevier- 24thFebruary, 2006.

[7] H.Hdayati, S.A.Nabaviniaki, A.Akbarimsjd,'A Method for Placement of DG Units in Distribution System',IEEE –Transaction on power delivery, Vol.23, no.3, July-2008.

[8] RashmiPriya, Surya Prakash, 'Optimal location and sizing of generator in distributed generator system', IJREE- March 2014.

[9] M.Amon, G.Jasmon, A.Bakar, H.Mokhlis, 'A new approach for optimum DG placement and sizing based on voltage stability maximization and minimization of power loss', Elsevier- 19th February-2013.