March - April 2020
ISSN: 0193-4120 Page No. 8999 - 9004

Comparative Study of Placement of Multiple DG's in an Integrated Distributed System

K.C.Archana[1], Dr.Y.V.Siva Reddy[2], Dr.V.Sankar [3]

[1]Research Scholar,JNTUA,Ananthapuramu,[2] GPREC,Kurnool, [3] JNTUA,Anantapuramu

Article Info
Volume 83
Page Number: 8999 - 9004
Publication Issue:
March - April 2020

Article History
Article Received: 24 July 2019
Revised: 12 September 2019
Accepted: 15 February 2020
Publication: 09 April 2020

Abstract

Distributed generation units are mostly used to meet the Electricity demand. Integrated power distributed system (IPDS) is a hybrid combination of distributed generation (DG) units like Solar and Wind Energy, Diesel Generator and Battery storage .Different (DG)s are combined to satisfy the demand curve based on their availability at a specific time. Improper positioning of the DGs may affect the performance of the system. The accuracy in the placement of the DG would increase the overall performance of the system. In this paper the comparative study of placement of DGs in integrated distributed system is analyzed using 6 Bus and 14 Bus system.

Index Terms: Optimal Placement of DGs, PSAT, IEEE 14 bus system

I. INTRODUCTION

Renewable energy sources (RES) are mostly used for power generation now a day. Distributed generation (DG) is power generation at the customer side. The development of smaller energy generation such as solar, wind, fuel cell, micro turbines have opened new opportunities for the distributed power generation [2]. Demand for distributed generation (DG) is increased because of the Environmental effects; technological advances. Distributed energy systems solve the difficulty of long distance transmission of the electric power. Distributed energy system increases the reliability and continuity of power supply to critical loads when the grid collapses [1]. The methodology suggested in paper [2] uses the 6 bus system with one DG to locate the optimal position. Here in this paper comparative study is performed on both 6 bus and 14 bus system. Power flow studies are performed on 6 bus system with one DG and Two DGs both for 6 bus and 14 bus system.

PSAT software is used for the simulation process. Power System Analysis Toolbox (PSAT) is a Matlabtoolbox for electric power system analysis and control. Graphical user interface is used for the design of the IEE14 bus system with the help of Simulink-based library which is a user friendly toolbox. Static and/or dynamic analysis can be performed using PSAT [4].

II. IPDS

Electric power has become a fundamental part of the infrastructure of contemporary society. IPDS is the combination of Solar, Wind energy, Diesel generator and Battery storage [1]. System is more reliable when the generation units are distributed. Solar, Wind, Diesel and Battery storage energies are integrated into a Power distributed system Fig 1. Integrated Power distribution system is not much reliable when any one unit is removed for service or maintenance. In this type of system, generator units are accountable for nearby loads and however for normal operation dependent on outside sources [2].

Renewable energy sources are extensively used all throughout the world where there is no electric power or places where diesel generators are used to meet the power demand [1]. The thought of using

Renewable Energy Sources is mostly increasing nowadays. Battery storage is used to store the excess energy from solar wind. Diesel generators are used in commercial and industrial applications as a backup or emergency source of energy. Advantages of using multiple DGs include improving the reliability, reducing the losses and increasing the voltage stability of the system. Placement of DG in a power system is very important as the improper placement of DG in a power system can raise the total power losses and thus increasing the network costs.

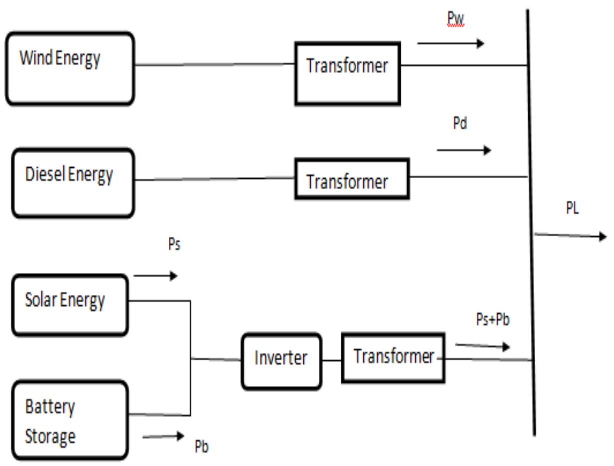

Fig 1. IPDS

III. DISTRIBUTION GENERATION LIMITS

Integration of distributed generation (DG) in distribution systems has increased to high penetration levels. Integrating DG units can have an impact on distribution systems, such as the voltage profile, power-flow, power quality, stability, reliability, and protection. So the constrain or the limit of adding DG in the system is very important [2]. Critical problems are to be considered when integrating DGs to distribution systems:

(1) Voltage profile/voltage rise problems

(2) Impacts on power flow directions, and protection coordination

(3) Thermal limits of cables/line

(4) Power quality disturbances causes by the presence of electronically coupled DGs such as solar-PV generators.

IV. METHEDOLOGY

There are different methods for the placement of DGs like analytical Approach, Numerical Approach and Heuristic Methods. In these methods Heuristic approach is followed with the proposed flow chart. Optimal placement with one DG and with Multiple DGs is carried out in this paper.

Numerical approach correctly determines the optimal location. It is not, however ideal for huge networks. Meta-heuristic is a powerful technique that determines almost perfect optimal position of DG results even for the big and complicated network.[2]

The power balance equation for the system is

P_{Diesel}=Total Demand-(P_{Solar}+P_{wind}) (1)

$P_{Solar} <= P_{SolarMax}$ (2)

$P_{Wind} <= P_{WindMax}$ (3)

A. Optimal Placement of One DG.

Fig.2 shows the process of load flow analysis. Load flow is executed by connecting the Single DG (Wind/Solar) to each individual bus. The result is losses are tabulated in Table 1.

The best location for DG is decided by the losses in the system. Where the losses are less that position is best suited for the placement of DG.

Published by: The Mattingley Publishing Co., Inc.

March - April 2020
ISSN: 0193-4120 Page No. 8999 - 9004

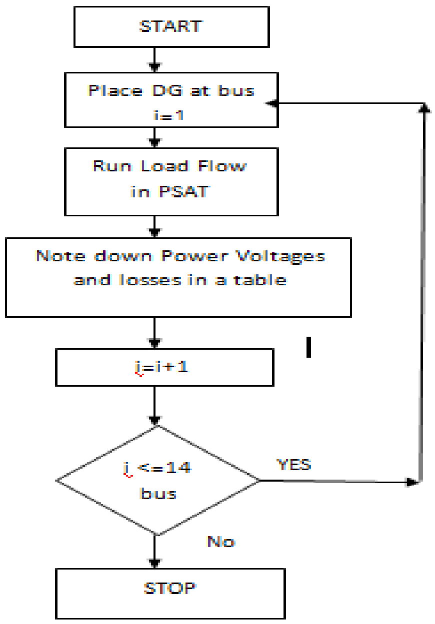

Fig 2. Optimal placement of one DG

Table 1.Load Flow Results for Optimal placement of one DG

B. Optimal Placement of two DGs (Solar/Wind):

From the above analysis performance indices like Active power loss indices, Voltage deviation indices will be calculated. Optimal placement of twp DGs is carried out using the flow chat given in Fig 3.The best location for DG is decided by the losses in the system

For 6 bus system using the flow chart the different positions of DGs are (1,3),(1,4),(1,5),(1,6),(3,4),(3,5)(3,6)(4,5)(4,6)

(5,6)

For IEEE 14 bus system DG1 is fixed at bus 1 and DG2 position is changed from bus 2 to bus 14 i.e. positions of DG1,DG2are as below given (1,2)(1,3)(1,4)(1,5)(1,6)(1,7)(1,8)(1,9)(1,10)(1,11)(1,12)(1,13)(1,14).For this one iteration results are shown in the Table 2.Now DG1 is changed to bus 2 and DG2 position is changed from bus3 to bus14 i.e. (2,3)(2,4)(2,5)(2,6)(2,7)(2,8)(2,9)(2,3)(2,4)(2,5)(2,6)(2,7)(2,8)(2,9)(2,10)(2,11)(2,12)(2,13)(2,14).Same procedure is performed for 13 times.

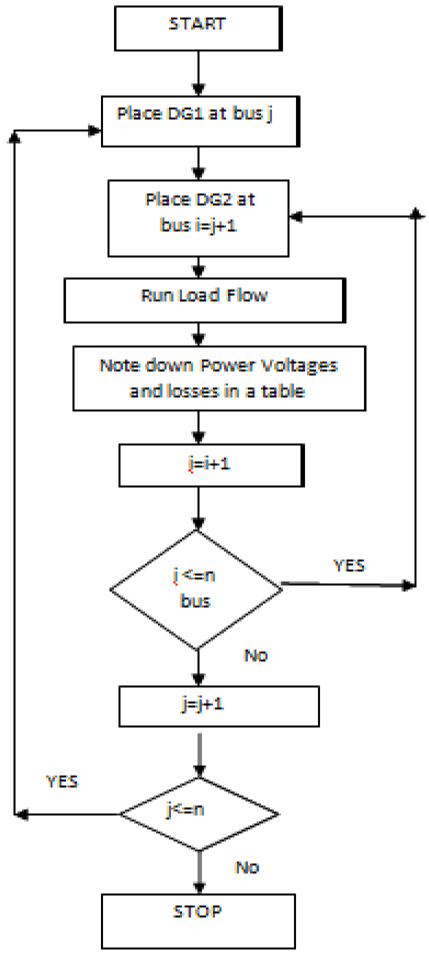

Fig 3. Optimal placement of two DGs

V. SIMULATION AND RESULTS

PSAT software used for the power flow analysis which uses Newton Raphson Method. Power flow is run on 6 bus system and IEEE 14 bus system with one DG for the load 28MW.Real power losses are noted and tabulated in Table 1 and Table 3.

Power flow is performed with two DGs(Wind/Solar) as per the flow chart on both 6 bus system and IEEE 14 bus system. The load is equally divided for the DGs i.e for Solar 14 Mw and for Wind 14 MW and results are tabulated in Table 2 and Table 4.

Published by: The Mattingley Publishing Co., Inc.

March - April 2020
ISSN: 0193-4120 Page No. 8999 - 9004

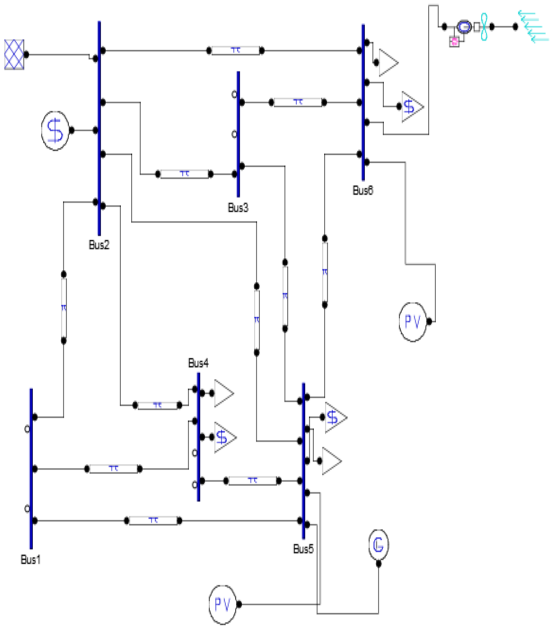

Fig. Simulation diagram of 6 Bus System

Table.1 Load Flow results of 6 Bus system with one DG

Bus Position	Real Power Losses [MW]
1	0.14666
3	0.14325
4	0.15745
5	0.08027
6	0.13922

Table.2 Load Flow results of 6 Bus system with two DG

Bus Position	Real Power Losses [MW]
1,3	0.08962
1,4	0.15184
1,5	0.07703
1,6	0.08338
3,4	0.08594
3,5	0.06243
3,6	0.14399
4,5	0.05051
4,6	0.08096
5,6	0.05331

Fig 2 Load Flow Simulation diagram in PSAT

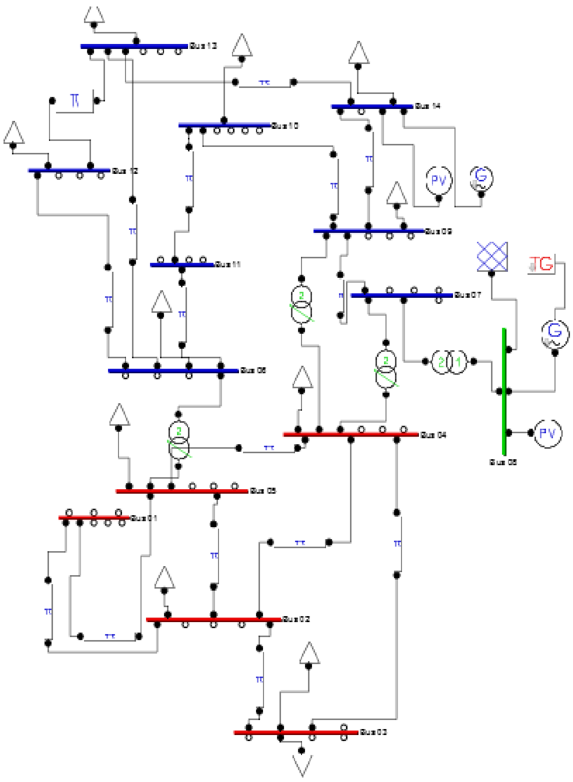

Fig. Simulation diagram of IEEE 14 Bus System

Table.3 Power losses in IEEE 14 bus system with one DG

Bus Position	Real Power Losses [MW]
1	0.5660
2	0.3646
3	0.61109
4	0.14635
5	0.14472
6	0.32787
7	0.26242
9	0.43226
10	0.86658
11	1.3743
12	2.1928
13	0.59804
14	1.7107

Table 4. Power losses in IEEE 14 bus system with two DGs

S.No	(DG1,DG2)	Real Power Losses
1	(1,2)	0.37259
2	(1,3)	0.32011
3	(1,4)	0.20452
4	(1,5)	0.21193
5	(1,6)	0.24032
6	(1,7)	0.249
7	(1,9)	0.31429
8	(1,10)	0.40896
9	(1,11)	0.56622
10	(1,12)	0.73296
11	(1,13)	0.30392
12	(1,14)	0.58586

Table 3.Summary table of all Iteration with two DGs

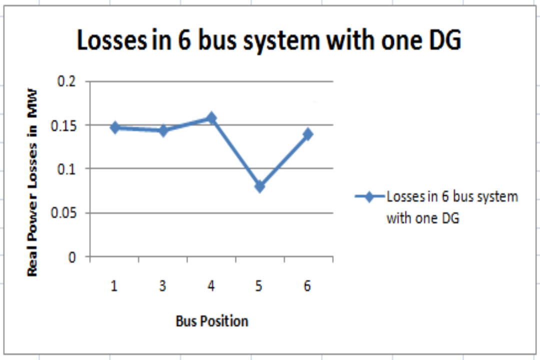

Fig.2 Results of power losses in 6 bus system with Solar DG

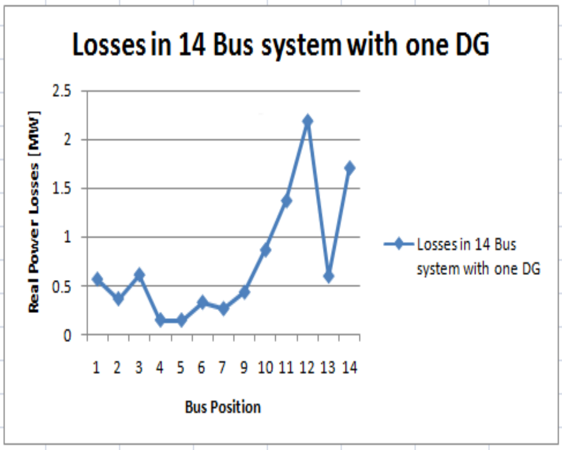

Fig.3 Results of power losses in IEEE14 bus system with Solar DG

Fig.4 Results of power losses in 6 bus system with Two DGs

VI.CONCLUSIONS

In this paper comparative study of optimal placement of the one DG and Two DGS with IEEE 14 Bus system and 6 bus system is analyzed. 1.Optimal location for the solar DG in 6 bus system and 14 bus systems is at bus 5.

2. Optimal location for the two DGs is at buses(4,5) for 6 bus system

3. Minimum losses are reduced in 6 bus systems with two DGs compare to one DG.

4. Similarly minimum losses are reduced in 14 bus system with two DGs compare to one DG.

REFERENCES

[1] Ravi Kumar, D., Archana, K.C., Raju, G.S.,” Optimal operation of an integrated power distribution system fed with renewable energy sources, diesel generation and battery storage (Conference Paper)”, ICECIT 2015; Anantapur ;India., Lecture Notes in Electrical Engineering, pp. 425-432 Volume 394, 2017

[2] M. A. Bakar, T. Logenthiran, A. Sharma and V. Phan, "Optimal placement of DGs in a distributed power system with power system studies," 2017 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), Bangalore, 2017, pp. 1-6.

[3] M. A. Bakar, T. Logenthiran, A. Sharma and V. Phan, "Optimal placement of DGs in a distributed power system with power system studies," 2017 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), Bangalore, 2017, pp. 1-6.

[4] A.G. Bakirtzis and P.S. Dokopulos, "Short Term Generation Scheduling in a Small Autonomous System with Unconventional Energy Sources“, IEEE Trans. on Power Systems, Vol. 3, No. 3, 1988, pp.1230-1236.

[5] Ying-Yi Hong, Ching-Sheng chiu,chang-Ting Li ,”KW Scheduling in an Autonomous

System", Conference Publications, Pages 1730 - 1735

[6] Warsono,D.J.King,C.S.Ozeveren and D.A. Bradely, "Economic Load Dispatch Optimization of Renewable Energy in Power System using Genetic Algorithm", IEEE Trans. on power systems, 2007 , PP. 2174 - 2179

[7] O.Erdinc∗,M.Uzunoglu,"Optimum design of hybrid renewable energy systems: Overview of different", Renewable and Sustainable Energy Reviews 16 (2012) 1412– 1425