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Impacts of the Distributed Generation on Voltage Profile in Modern Power System

Manoj Kumar Nigam [1], Dr. V.K. Sethi[2]
[1]*Research Scholar,* [2]*Vice Chancellor, RKDF University, Bhopal, MP,* INDIA
Email: nigam74_123@yahoo.com , vksethi1949@gmail.com

Abstract- The role of distributed generation of (DG) in the present scenario is very important for power and energy requirement. With the improvement in the technology and increasing demands of the customer, the researcher and engineers are concentrating the research on an alternate resource for power generation which may be cheap and not harmful. The have been used in our study is the PSAT 2.1.7. MATLAB based software. The result obtained showed a DG can affect the technology is based on the renewable sources as solar energy, wind energy, tidal energy etc. This paper is based on the effect of distributed generation on voltage profile as well as reactive power in transmission system for this IEEE-30 bus test network is used. The software stability and reliability of the overall network.

Index Terms- Distributed generation, power quality, impact, solar energy, etc.

1. INTRODUCTION

The distributed generation in the recent scenario becomes one of the major field of interest of the engineers as well as the researchers because of its advantages and the use of conventional sources of energy destroy the ecological balance and also harmful to the health of human beings by their products such as fly ash and other waste material. There is a need for conducting research on these non-renewable limited resources to overcome the availability of ill effects in the nature through using the distributed generation technology with the following advantages:

1. Voltage support and improved power quality Produces very less pollution.
2. Can be installed at any desired location.
3. Does not affect the ecological balance.
4. Improved utility system reliability.
5. May be installed as per the requirement of production capability.
6. **Loss** reduction

Apart from several advantages, DG possess following limitations on the distribution network:

1. Disturbs the stability.
2. Affects the performance of the system.
3. Decreases the life of the connected devices.
4. Increase trend of power losses.

These effects are raised at the point of connection of DG with the distribution network. A radial distribution network is mostly a power plant consisting a station of main power generation, supply power energy to the substation located at far off places and at the last to customers with a main drawback of highly unreliable and susceptible to the noise interferences.

The integration of relatively large capacity DG into weak distribution network may cause a voltage rise especially during low demand periods [2]

Presently, the impact of DG on the electric utility is normally assessed in planning studies by running traditional power flow computations, which seemingly is a reasonable action, since the penetration ratios of the DG are still relatively small However, as the installed capacity of DG increases, its impact on the power system behavior will become more expressed and will eventually require full-scale detailed dynamic analysis and simulations to ensure a proper and reliable operation for of the power system with large amounts of DG.

More research on this area has been done in this context for its advancement particularly compensating the effects caused by DG. Authors used several Methods such as optimal power flow method, particle swarm optimization, ant colony optimization, genetic algorithm, monte-carlo simulation methods have been discussed in [8] [18] [03 [07] [06]. In this paper the simulation of the IEEE 30 bus test network is done using Power System Analysis Tool (PSAT) of MATLAB.

The study is focused under the network of 11kV 100MVA radial distribution network. A wind distributed generation of 68 MVA 11kV and 50 MVA 11kv has been connected to bus no. 29 and 30 respectively because these buses are more sensitive.

This section provides the brief introduction of the distributed generation and the detailed overview of the work done. The methodology section explains the implementation of the suggested method for the analysis of an IEEE-30 bus network. The result section showed the comparative performance of the network and the location of DG.

2. METHODOLOGY

PSAT 2.1.7 software used for the simulation of an IEEE-30 bus network without DG connected (Fig. 1) and IEEE-30 bus network with DG connected (Fig. 2). PSAT includes the following analysis tools:

1. Continuation power flow.
2. Optimal power flow.
3. Time domain analysis.
4. Small signal stability analysis.

For performing the power flow analysis PSAT library contains various static and dynamic components such as transmission line, buses, transformers, wind distributed generation, FACT devices etc.

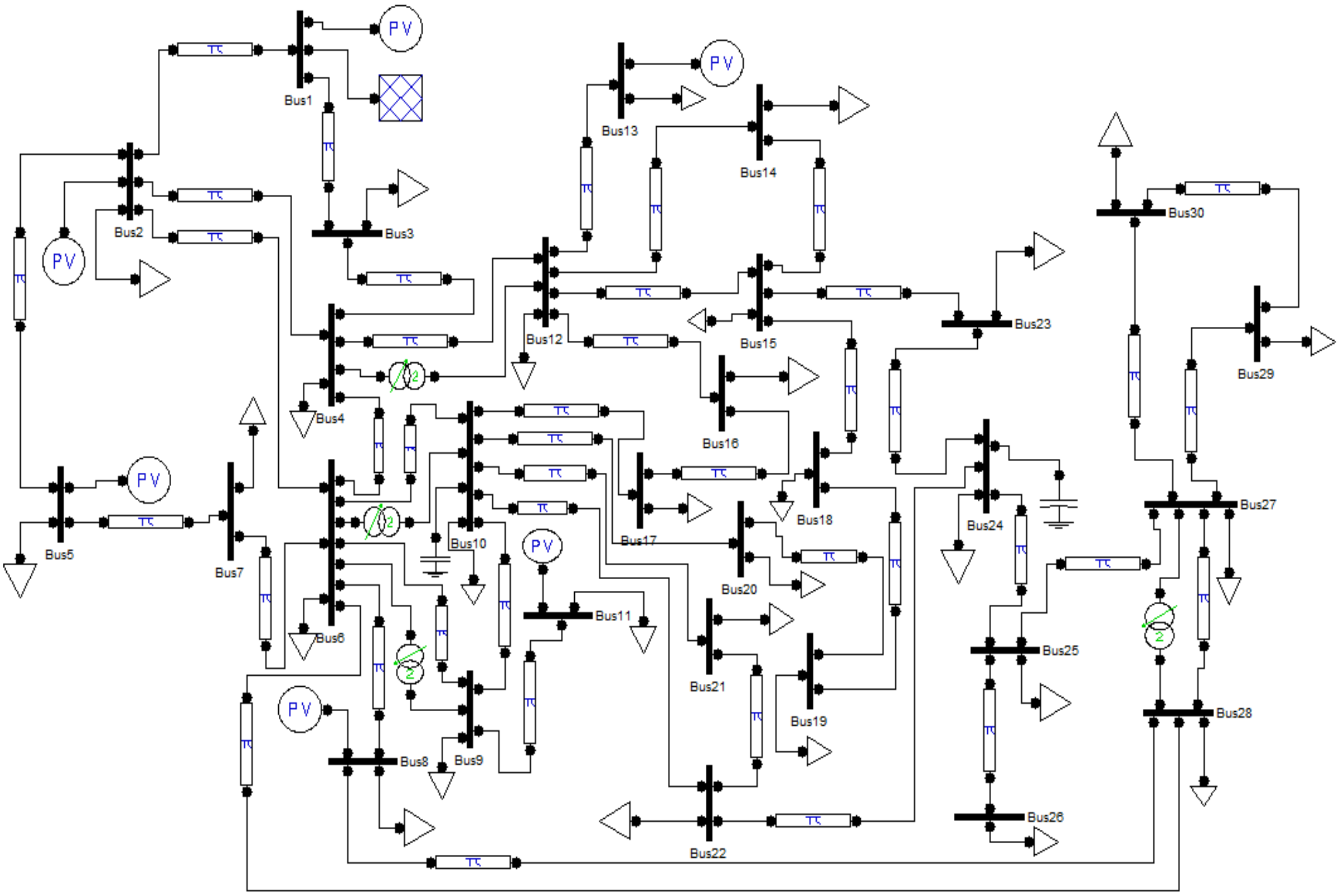

Figure 1: . IEEE-30 bus network without DG connected

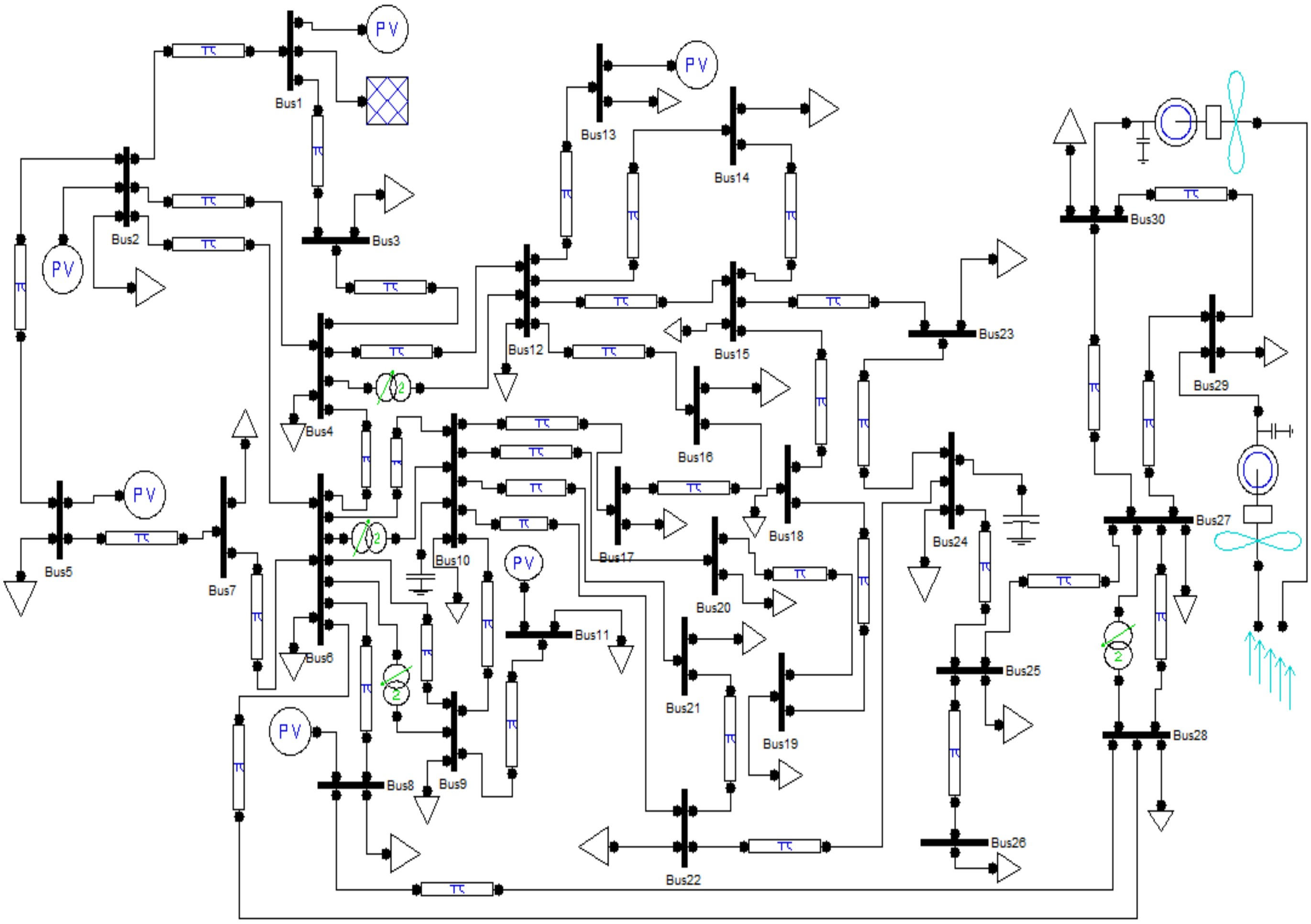

Figure 2: IEEE-30 bus network with DG connected

To determine the location of distributed generation

Distributed generation will also impact losses on the feeder. DG units may be placed at optimal locations where they can provide the best reduction in feeder losses. Siting of DG units to minimize losses is like siting capacitor banks for loss reduction. The difference is only that the DG units will impact on both ***real and reactive power flow.*** Capacitors only impact the reactive power flow. Most generators will be operated between 0.85 Lagging and 1.0 power factor, but some inverter technologies can provide reactive compensation. [19]

Authors of [1] reported that the optimal location of connecting DG is the weakest node at which the maximum voltage drop occurs. It was noticed that the weakest bus in our work is the bus 30 whereas the authors can also connect the DG at bus no. 26 and 29 respectively if required.

3. RESULT

The result obtained from continuation power flow of an IEEE-30 bus network (Table I) and IEEE-30 bus network with DG connected (Table II) are listed respectively. Comparison of the reactive power loss when DG is not connected and when DG connected is showed in (Fig. 3).

TABLE I. POWER FLOW RESULT WITHOUT DG CONNECTED

Bus	**Q load [p.u]**
Bus 1	0
Bus 2	0.41728
Bus 3	0.03943
Bus 4	0.05257
Bus 5	0.62428
Bus 6	0
Bus 7	0.35814
Bus 8	0.98571
Bus 9	0
Bus 10	-0.04854
Bus 11	0
Bus 12	0.24643
Bus 13	0
Bus 14	0.05257
Bus 15	0.08214
Bus 16	0.05914
Bus 17	0.19057
Bus 18	0.02957
Bus 19	0.11171
Bus 20	0.023
Bus 21	0.368
Bus 22	0
Bus 23	0.05257
Bus 24	0.20274
Bus 25	0
Bus 26	0.07557
Bus 27	0
Bus 28	0
Bus 29	0.02957
Bus 30	0.06243

TABLE II. POWER FLOW RESULT WITH DG CONNECTED

Bus	**Q load [p.u]**
Bus 1	0
Bus 2	0.41718
Bus 3	0.03942
Bus 4	0.05256
Bus 5	0.62412
Bus 6	0
Bus 7	0.35805
Bus 8	0.98546
Bus 9	0
Bus 10	-0.0485
Bus 11	0
Bus 12	0.24636
Bus 13	0
Bus 14	0.05256
Bus 15	0.08212
Bus 16	0.05913
Bus 17	0.19052
Bus 18	0.02956
Bus 19	0.11169
Bus 20	0.02299
Bus 21	0.3679
Bus 22	0
Bus 23	0.05256
Bus 24	0.20271
Bus 25	0
Bus 26	0.07555
Bus 27	0
Bus 28	0
Bus 29	0.02956
Bus 30	0.06241

The results obtained for load flow without DG is as follows:

Total Generation

Real power [p.u.]	13.9588
Reactive power [p.u.]	20.138

Total Load

Real power [p.u.]	9.3117
Reactive power [p.u.]	4.0149

Total Losses

Real power [p.u.]	4.6471
Reactive power [p.u.]	16.1231

The result of load flow with DG connected is as follows:

Total Generation

Real power [p.u.]	13.9605
Reactive power [p.u.]	20.1497

Total Load

Real power [p.u.]	9.3093
Reactive power [p.u.]	4.0139

Total Losses

Real power [p.u.]	4.6512
Reactive power [p.u.]	16.1358

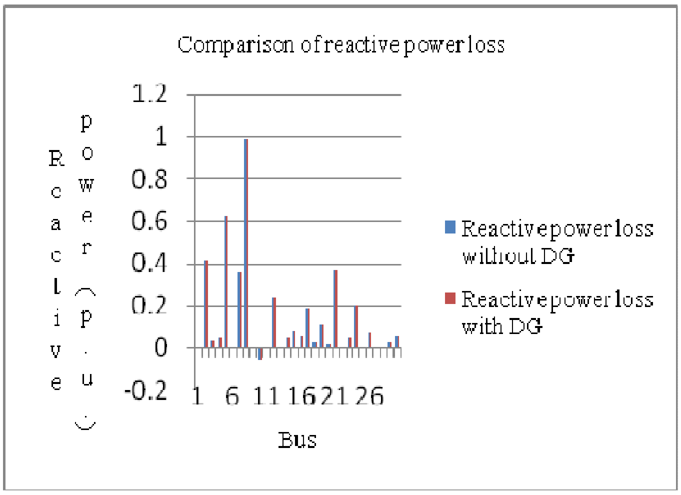

Figure 3: Comparison of reactive power loss

4. CONCLUSION

The impact of distributed generation on an IEEE-30 bus network has been analyzed on a radial distribution network. The system under study was 11kV 100 MVA network and the DG connected was of 50 MVA 11kV and 68 MVA and 11kv to bus no. 30 and 29 respectively. It can be seen from Fig. 3 that the integration of DG disturbs the reactive power balance of the network. The optimal location for connecting DG into the network had also been suggested by determining the weakest node from the result of Table. 1. Thus the integration of DG onto the affects the network stability and overall reliability of network.

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AUTHORS PROFILE

AUTHOR 1

Manoj Kumar Nigam received the B.E. and ME degree in Electrical Engineering from MITS Gwalior, M.P., India. He has more than 12 years of experience in teaching and research and is a Ph.D Scholar in Electrical Engineering in R.K.D.F University, Bhopal, M.P., India.

His current research focuses on the "Distributed generation and power quality Issues in the Power System".

AUTHOR 2

Dr. V.K. Sethi received the BE (Hons.) from IIT Roorkee, PG from UK and Ph. D from IIT Delhi, He was Scientist 'C' Department of Atomic Energy, BARC, Bombay, Asst.Director, Deputy Director (Faculty) Ministry of Power, Deputy Director (Site), Director Ministry of Power, Central Electricity Authority and Ex. Director MOP/CEA, EX-Rector & Director, RGPV, Bhopal and is now a Vice Chancellor RKDF University, Bhopal (MP), India.

He has published 115 research papers in reputated national, international journals and conferences he is an authors of 12 books. His research interests are power plant engineering, Renewable Energy, Green Power Technologies & CDM Opportunities.