

Conflicts in the Power System Due to Incorporation of Distributed Generation

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Abstract: - Power requirement is the most necessary requirement of the modern high power advanced technology. To fulfil this increased demand of power requirement, a new technology has been developed which is known as the Distributed Generation (DG). It uses renewable energy sources for the generation of electric power with little impact on the environment of the surrounding area at its site of construction, economical production, less exclusion of toxic sea wastes etc. however it also has some disadvantages. Under the study network of IEEE-5bus network, the impact of connecting DG to the Distribution Network (DN) was studied. The simulation results shown indicate disturbances in the DN with the integration of DG.

Keywords: Distributed Generation, Distribution network, non-renewable energy sources, renewable energy sources etc.

1. INTRODUCTION

A Distributed Generation is a new technology which is becoming an important area of research and study nowadays. A Distributed Generation can be defined as a technology which is based on the use of renewable energy sources viz. solar energy, biomass energy, geothermal energy, tidal energy etc. A Distributed Generation as compared to the traditional method of power generation has several advantages like – it occupies less area of installation, economical, flexible and environment friendly technology. Various authors defined distributed generation (DG) as follows:

1. The *Electric Power Research Institute* defines distributed generation as generation from 'a few kilowatts up to 50 MW' [7].
2. According to the *Gas Research Institute*, distributed generation is 'typically between 2 and 25 MW' [7].
3. *Cardell* defines distributed generation as generation 'between 500 kW and 1MW' [1].
4. The *International Conference on Large High Voltage Electric Systems* (CIGRE) defines DG as 'smaller than 50-100 MW' [7].

Besides having several advantages, a DG can also cause disturbances in the network if the connected DG is not of optimal size location. A DG can disturb the voltages profile of the network thereby disturbing the reactive power balance in the network which results in more losses and hence reduces the stability of the connected grid network. Therefore, it is necessary to find out the optimal size and location of DG in order to minimize the losses. The work presented shows the disturbances caused by the DG when it is interfaced with the DN. The study has been done on an IEEE-5 bus test network. The test network under study was simulated using

PSAT 2.1.7 simulation software. The result showed that with the integration of DG the voltage profile of the network gets disturbed.

Section II discusses the implementation of the proposed methodology with and without DG connection and the optimal location of DG connection was found. Section III list the results obtained after simulation.

2. METHODOLOGY

The proposed methodology was implemented using PSAT 2.1.7 simulation software. An IEEE-5 bus network with and without DG connection was shown (Fig-1 and Fig-2) respectively.

2.1 Size and Location of Distributed Generation:

The placement of distributed generation in a distribution system improved the voltage profile with reduced losses. However, placing DG only at optimal location is not sufficient wherein the size of the DG should also be determined for its efficient working. Wind based distributed generation of 50 MVA and 11kV had been connected under the study. Authors of [3] suggested the method for finding the weakest node for the optimal location of DG in any grid connected network. The weakest node may be traced out by searching of the maximum voltage drop i.e. the bus with the smallest voltage magnitude is the weakest bus. The weakest bus was observed in the bus no. 4 and 3 whereas bus no. 3 being the weakest bus and the most suited location for the installation of DG. The engineers may also advise to install the DGs' at bus 3 as and when required.

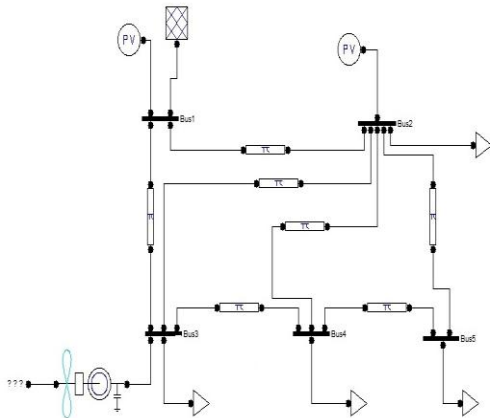


Fig-1: IEEE- bus network with DG connection

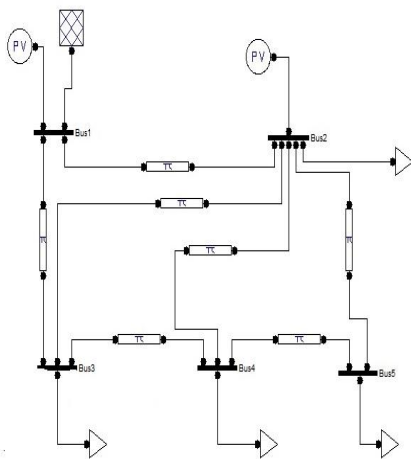


Fig-2: IEEE-5 bus network without DG connection

3. RESULT AND DISCUSSION

Comparison of the simulation results obtained with and without DG connection shows an improvement. If the DG was connected at the optimal location (Table-1 and Table-2) respectively. The variation in the voltage profile of the network with and without DG connection was shown (Fig-3 and Fig-4) respectively.

Table-1: Reactive power at electricity generation and load with DG connection

Bus	Q. gen (p. u)	Q. load (p. u)
Bus 1	9.1976	0
Bus 2	0.98332	0.49166
Bus 3	0	0.73749
Bus 4	0	0.24583
Bus 5	0	0.49166

Table-2: Reactive power at electricity generation and load without DG connection

Bus	Q. gen (p. u)	Q. load (p. u)
Bus 1	1.0231	0
Bus 2	12.8637	0.47111
Bus 3	0	0.70666
Bus 4	0	0.23555
Bus 5	0	0.47111

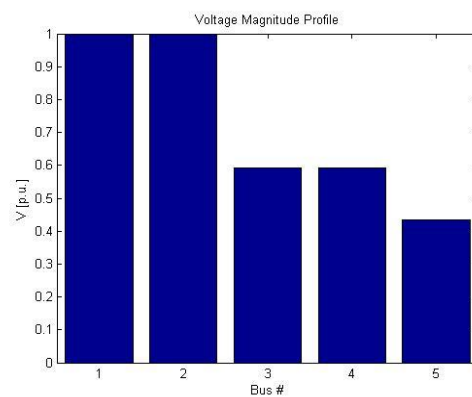


Fig: 3 Voltage Profile with DG

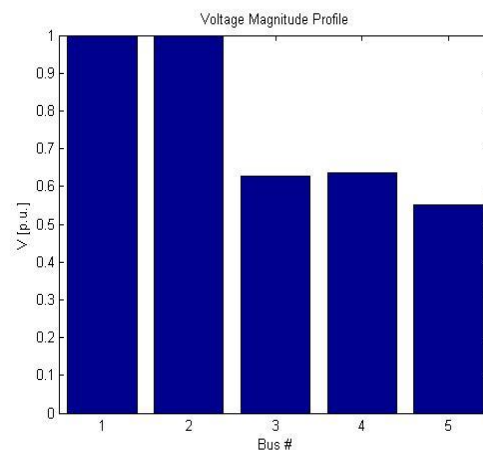


Fig: 4 Voltage Profile Without DG

4. CONCLUSION

From the above study, it has been concluded that the distributed generation has several advantages like - it is eco-friendly, economical, uses renewable sources of energy, no toxic by-products etc. However, it also disturbs the voltage profile of the network if not connected at the optimal location. Under the study, the optimal location of the DG has been found by the study of the weakest bus and bus no. 3 was found to be the weakest. Integrating DG into the DN also decreases the

stability of the connected grid network and thereby increasing the reactive power loss.

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