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# Acceleration of Interfaced Distributed Generation Power System through Reactive Power Compensation

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***Abstract:-*** *A distributed generation (DG) is of similarity to a traditional power generation station. It utilizes renewable energy sources (like wind, solar, hydropower generation etc.). Present study is an approach to handle the reactive power imbalances in the power system for the DG integration. The method deals with the finding of optimal location for connecting a compensating device and obtained the results of simulation with an interfacing of DG under normal operating condition of power system. The results were tested as per the IEEE-14 bus standards with the network parameters set.*

***Keywords—Renewable energy, reactive power, distributed generation, power system etc.***

## Introduction

The radial behavior of the traditional power systems in India allows the power flow from the source station with the capacity of generating several thousand of Mega Watts (MW) to the customer ends (like household applications, industry, private and govt. firms etc.). A great deal of power wastage faced during transmission as well as the environmental impacts due to the far off places location of power station. Nowadays, the demand for power requirement is increasing continuously and it will not be possible to afford such losses. A good deal of work to minimize these losses has already been done in the past by various researchers and academicians. The DG unit possessed the capacity varying from KW (Kilo Watt) to MW (Mega Watt) which helps to deploy renewable energy sources. The main advantage of using DG is to be stationed at adjacent places to customers and thereby receiving the benefits of reducing the transmission losses. Besides, the other advantage of DG unit provides the users in low budget and may easily be installed on their top of roof for generating their income by connection to the grid (i.e. solar panel generation unit). DG is a very helpful technology in the single ended system. However, DG unit connected to grid network, create disturbances in the power system like voltage disturbance and flow of current balance. As a result, imbalances in the active and reactive power flow may be noticed and may cause the failure of connected equipments and devices. The research under study, proposed a method to identify the bus with great deal of reactive power disturbance and also suggest the optimal position for installing compensating device. In the present study, an IEEE-14 bus network has been designed with and without DG and as a compensating device STATCOM was utilized.

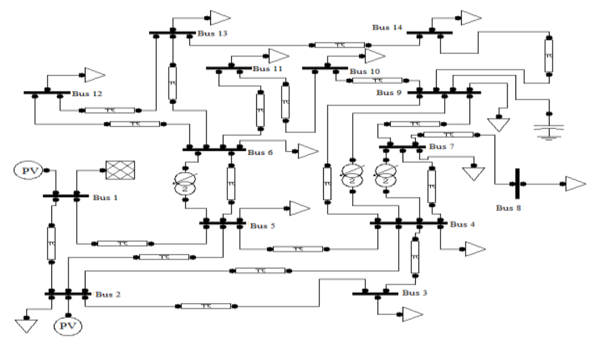


Figure 1: IEEE-14 bus network

## Methodology

An IEEE-14 bus network under study was designed and parameter values were chosen as per the IEEE-14 bus standard (Figure1 and Figure2). The networks were simulated with the help of Power System Analysis Tool (PSAT) software along with base software MATLAB. Under the test network, wind based distributed generation of 50 MVA and 11kV is connected at bus 14, since it is the weakest bus having maximum amount of power drop, indicating the increasing trend in the power utility. After connecting DG an imbalance was observed in reactive power and to overcome it, a STATCOM device of 100MVA and 11kV is connected at bus 9 (Figure2).

## Result and Discussion

The IEEE-14 bus network as designed in Figure1 was simulated using PSAT 2.1.7 simulation software which employs Newton Raphson Iterative method to solve the complex power flow equations. Reactive power at generation and load end was found to be 6.9471 p.u. and 1.570 p.u respectively. There was total loss of 5.3766 p.u. (Figure3 and Figure4).

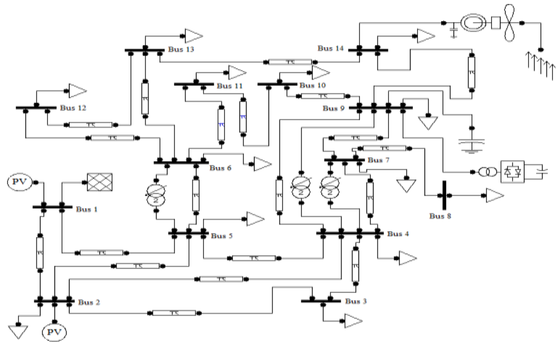

Figure 2: IEEE-14 bus network with DG and STATCOM

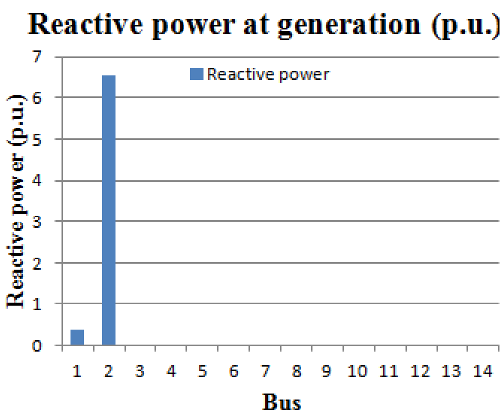


Figure 3: Reactive power at generation

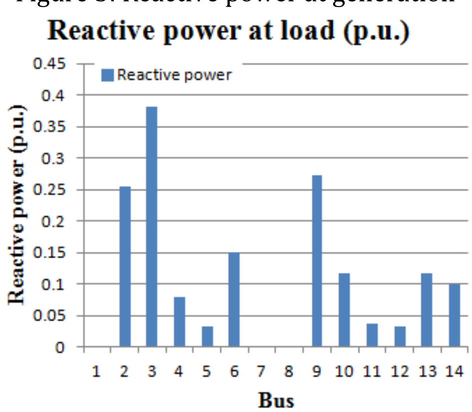


Figure 4: Reactive power at load

After obtaining the power flow simulation results of IEEE-14 bus network, there was a need to connect DG as per the power requirement at particular bus and STATCOM was connected to compensate for the reactive power imbalance within the test network. The simulation results showed the reactive power at generation and load end was improved to 0.95224 p.u. and 1.0725 p.u. and the total loss also is saved to 0.12023 p.u. (Figure5 and Figure6).

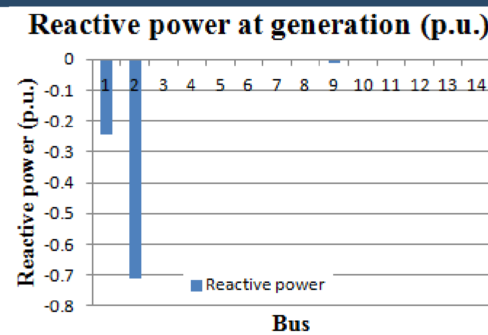


Figure 5: Reactive power at generation with DG and STATCOM

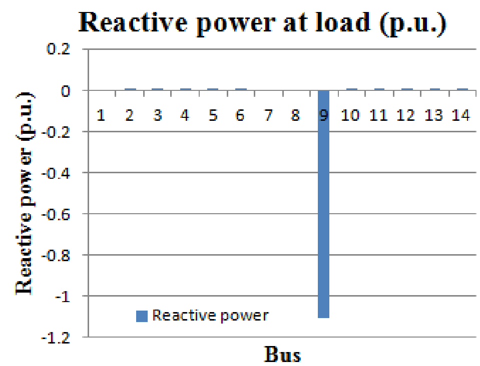


Figure 6: Reactive power at load with DG and STATCOM

## Conclusion

On the basis of present findings, it is concluded that a distributed generation is a helpful technology near to the location of costumers to fulfill their need of power utilization. DG utilizes renewable energy and may be installed at reasonable cost. Although, it is beneficial if operated as a single utility. However, if interfaced to grid network may lead to various losses like disturbances in the voltage and current flow, reactive power, active power etc. These losses were studied and compensated by the integration of STATCOM.

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