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Impacts of Distributed Generation in Power System

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Abstract:

A distributed generation (DG) system is comparable to a conventional power plant. It makes use of renewable energy sources (hydropower generation, solar power, wind, etc.). Reactive power imbalances in the power system are being addressed by the current study as a means of enabling DG integration. The technique focusses on determining the best place to connect a compensating device and obtains simulation results with DG interfaced under typical power system operating conditions. The network parameters were set and the results were tested in accordance with IEEE-14 bus standards.

Keywords: Renewable energy, reactive power, distributed generation, power system etc.

I. INTRODUCTION

The ability of India's traditional power systems to behave radially permits power to move from a source station capable of producing thousands of Mega Watts (MW) to customer ends, such as homes, businesses, and government agencies. There was a lot of power waste during transmission, and the power plant's remote location had an adverse effect on the environment. There was a lot of power waste during transmission, and the power plant's remote location had an adverse effect on the environment. The need for electricity is growing all the time these days, and such losses will not be affordable. Researchers and academicians have already put in a lot of effort to reduce these losses in the past.

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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.

A novel method for installing small generation units known as distributed generation was created during the current investigation. With a capacity ranging from KW (Kilo Watt) to MW (Mega Watt), the DG unit facilitates the use of renewable energy sources.

. The primary benefit of employing distributed generation is the ability to station at locations close to customers, which minimises transmission losses. In addition, the other benefit of DG units is that they are inexpensive to operate and can be readily mounted on roofs to generate income through grid connection (i.e. solar panel generation unit).

In a single-ended system, DG is a very useful technological advancement. On the other hand, DG units that are connected to grid networks cause issues with the power system, such as imbalanced current flow and voltage fluctuations. Consequently, anomalies in the distribution of active and reactive power could be observed, potentially leading to the malfunction of associated apparatus and gadgets.

. The study's methodology included identifying the bus that has the most reactive power disturbance and recommending the best location for a compensating device installation. An IEEE-14 bus network with and without DG was designed for the current study, and STATCOM was used as a compensating device.

II. METHODOLOGY

The IEEE-14 bus standard was followed in the design of the network under study, and parameter values were selected accordingly (Fig. 1 and Fig.2). Power System Analysis Tool (PSAT) software and base software MATLAB were used to simulate the networks.

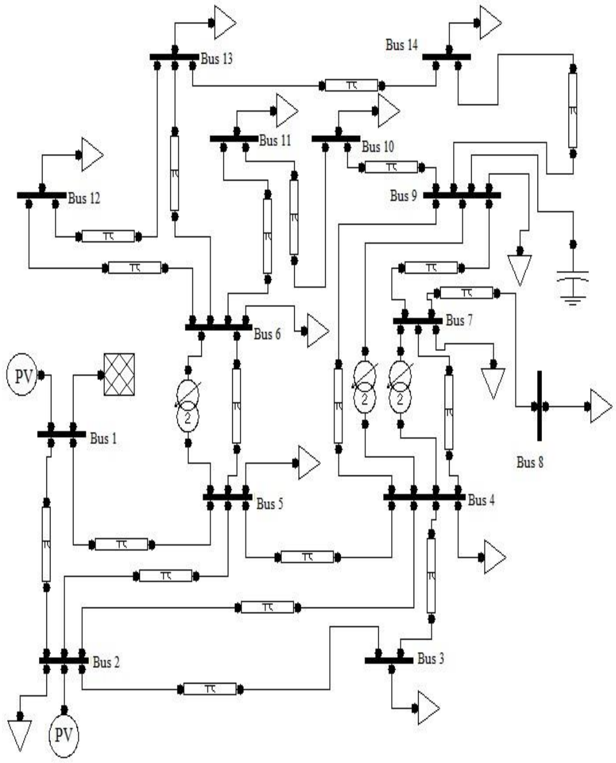

Fig.1: IEEE-14 bus network

Given that bus 14 is the weakest bus with the greatest amount of power drop and represents an increasing trend in the power utility, wind-based distributed generation of 50 MVA and 11 kV is connected to it under the test network. Reactive power imbalance was noticed following the DG connection; to address this, a 100MVA, 11kV STATCOM device is connected to bus 9 (Fig. 2).

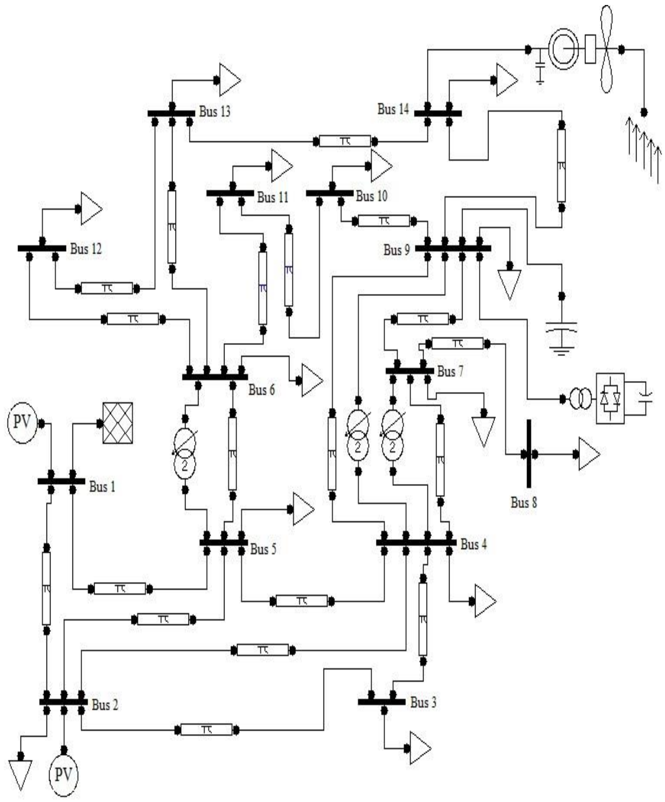

Fig.2: IEEE-14 bus network with DG and STATCOM

III. RESULT AND DISCUSSION

Using PSAT 2.1.7 simulation software, which uses the Newton Raphson Iterative method to solve the complex power flow equations, the IEEE-14 bus network as designed in Fig. 1 was simulated. It was discovered that the reactive power at the load and generation ends was 1.570 p.u. and 6.9471 p.u., respectively. A total of 5.3766 p.u. were lost (Figs. 3 and 4).

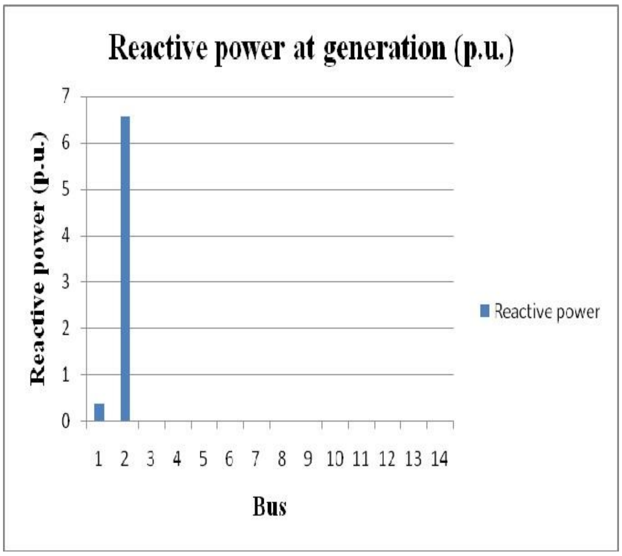

Fig.3: Reactive power at generation

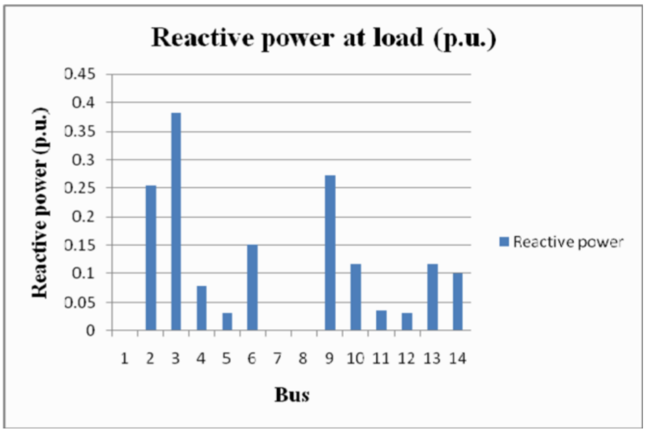

Fig.4: Reactive power at load

Following the acquisition of the IEEE-14 bus network power flow simulation results, DG had to be connected in accordance with the power requirement at each bus, and STATCOM had to be connected in order to make up for the reactive power imbalance in the test network. According to the simulation results, the reactive power at the load and generation ends was enhanced to 1.0725 and 0.95224 p.u., respectively, and the overall loss was reduced to 0.12023 p.u.

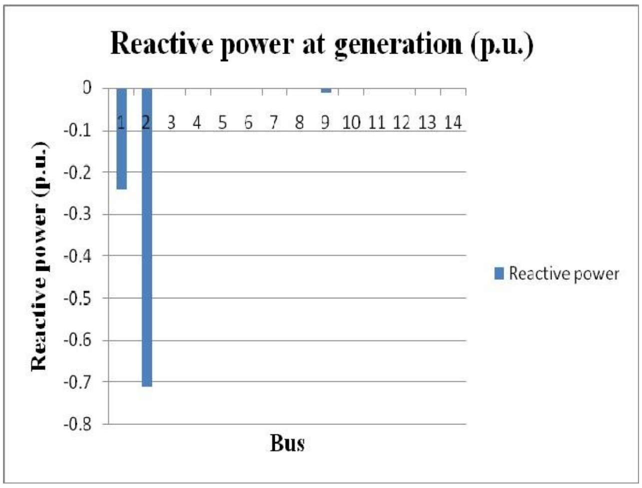

Fig.5: Reactive power at generation with DG and STATCOM

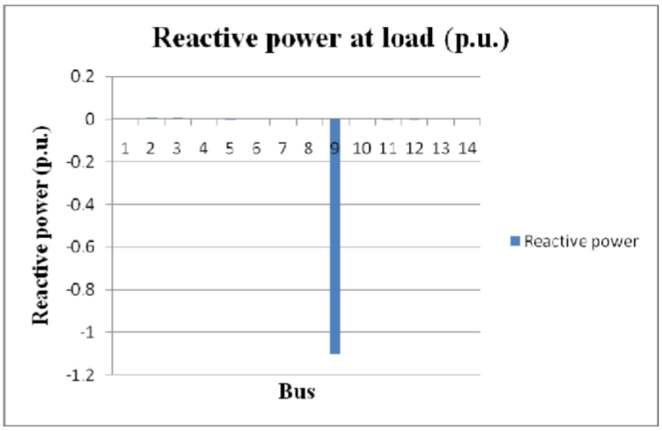

Fig.6: Reactive power at load with DG and STATCOM

IV. CONCLUSION

Based on current research, it is determined that distributed generation is a useful technology that can be used close to customers' locations to meet their power consumption needs. DG can be installed reasonably priced and makes use of renewable energy. Still, using it as a standalone utility has advantages. On the other hand, interfaced to a grid network may result in a number of losses, including active power, reactive power, and disruptions in the flow of voltage and current. The integration of STATCOM was investigated in order to offset these losses (Fig. 6).

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