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Power Flow Analysis of 30 Bus System Using Different Methods

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Abstract: *Voltage stability is foremost in heavily loaded systems with massive disturbances. This is stereotypically the case in the deregulated environment where in the transmission systems are operating underneath more stressed condition. This is due to increased transaction level associated with open access. Abnormal voltage instability has occurred in several countries in recent years. More attention is required to address voltage instability problems to keep voltage profile under control. Generator reactive power limit is a vital factor in voltage instability. In this paper simple load flow analysis is carried out for a multi-bus power system (30 Bus System).*

***Keywords**:* Voltage Instability, Voltage collapse, PV and QV curve, Load flow analysis, Newton-Raphson, Gauss-Siedel and Fast Decouple method.

1. INTRODUCTION:

The continuous increase in the demand of active and reactive power within the facility network has limits as scope for network growth much another time poses serious issues. In power system theres must be able to maintain acceptable voltage at all nodes in the system at a normal operating condition as well as post disturbance periods. Voltage instability may be a serious issue within the system because of progressive and uncontrollable fall in voltage level. Due to heavier loadings the voltage stability has gained more importance in highly developed network and the end result of voltage instability is power system collapse. Voltage stability is the ability of a power system to maintain balance voltages at all buses in the system even after being subjected to a disturbance from a certain initial operating condition. Voltage collapse is that the condition by that voltage instability ends up in loss of voltage in an exceedingly vital part of the system. When a power system is subjected to a sudden increase of reactive power reserves supplied from generators and compensation devices. Most of the time this can be achieved since there are sufficient reserves. Sometimes, it's out of the question to fulfill this fast increase in demand because of combination of events and system conditions. Thus, voltage collapse and a serious breakdown of half or all of the system could occur.

Power system usually operates under more stressed condition especially in deregulated environment. Heavily loaded systems are frequently subjected to voltage instability and maximum loadability of the system is critically affected. In recent years, abnormal voltage instability has occurred in several countries like France, Japan, USA. In order to keep the voltage profile and voltage stability under control more attention has to be paid. In voltage instability generator reactive power limit is a main factor. The generator reactive power limit becomes voltage dependent, when the field or armature current limit becomes active. Sometimes, there is a need for generators to operate in the overexcited region to support stable operation and also sometimes the operation beyond the overexcited limit is also required. In this respect, the maximization of effective reactive power reserve is planned exploitation centralized and decentralized implementations. Some of the methods are proposed for the purpose of reactive power and voltage control.

Appreciations to most mechanical device current, maximum and minimum rotor (field) current as well as maximum rotor angle (under excitation) limiters. The strategic generator model for static voltage stability studies is encircled in a standard power flow program. In present paper simple voltage stability analysis is carried out for a multi-bus power system (30 Bus System) and also the effect of generator reactive power limits on voltage stability and system loadability is established.

1.1 P-V CURVE AND Q-V CURVE ANALYSIS:

The curves which relate voltage to active or reactive power are commonly considered. Those curves are stated as P-V and Q-V curves. The variation of voltage as a function of total active power load at a bus in a power system consisting of many voltage sources and load buses are shown in Fig.1. The voltage drops rapidly with an increase in load demand, saddle node bifurcation point (SNB), at the Knee of the curve. Beyond this limit, the power flow solution fails to converge, which is an indicative of instability.

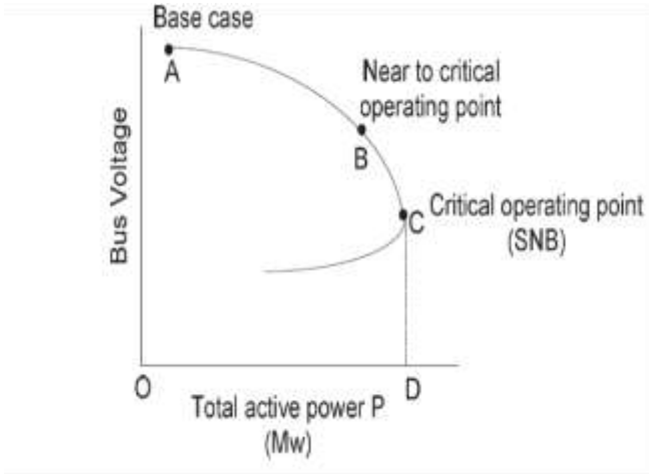


Fig.1. V-P curve

2. METHODOLOGY:

2.1 Algorithm steps for load flow analysis:

1. Enter the input data (IEEE 30 bus system).

2. Enter the number of parameters i.e. (acc factor, Base MVA, No. of iterations, accuracy etc).

3. Perform the load flow analysis using different methods (N-R, G-S and F-D methods) and check the total loss and line loss.

4. Now plot the results.

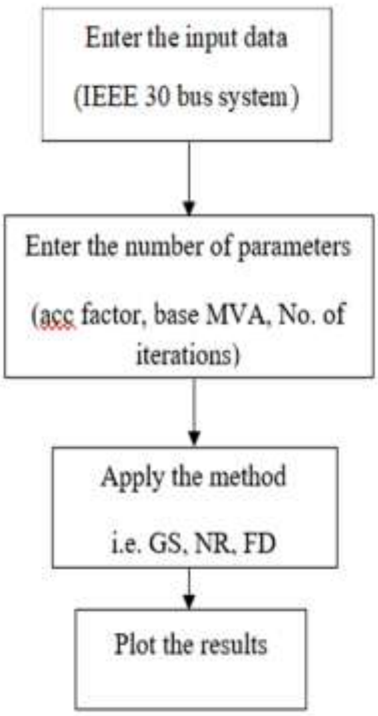


Fig.2. Load flow analysis of 30 bus system

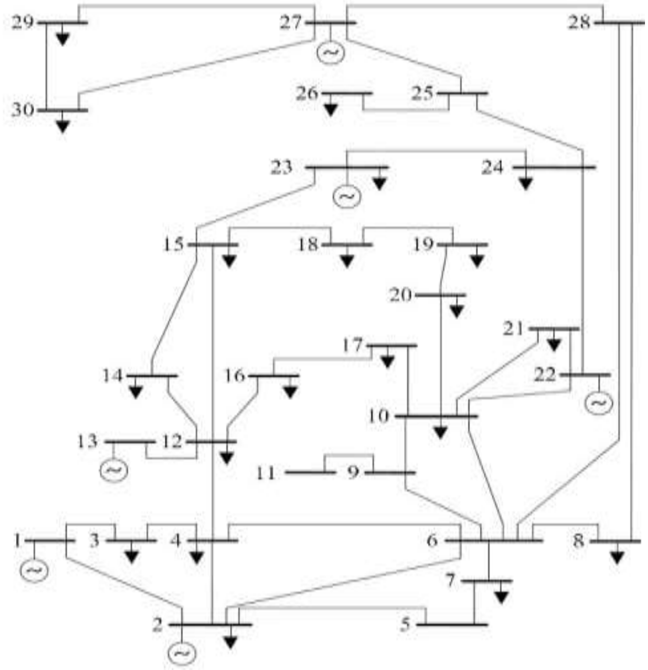
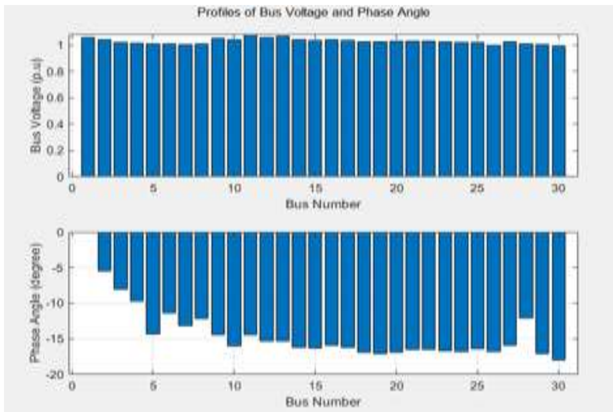
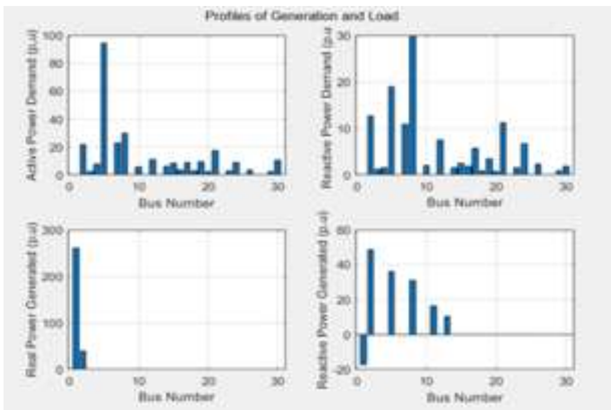


Fig.3. 30 Bus system

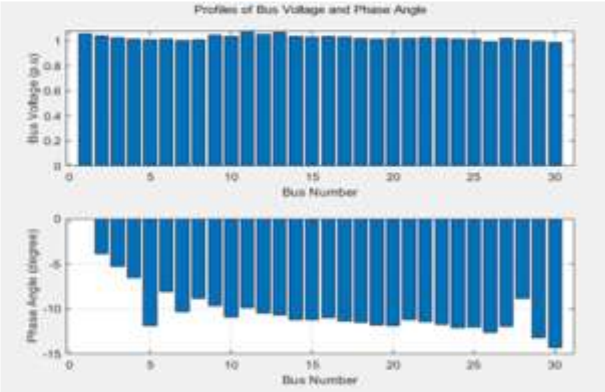
3. RESULTS AND DISCUSSION:

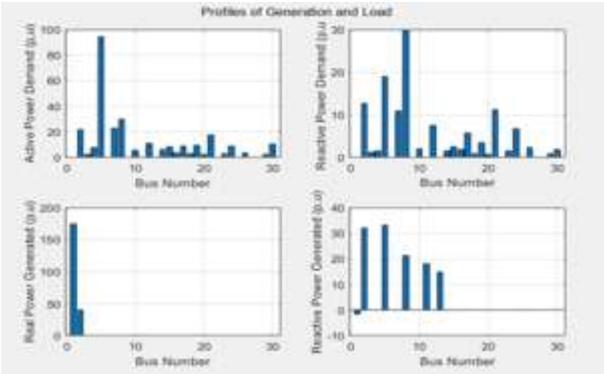
1. Gauss-Siedel: Base MVA=100, Acc. Factor=1.6, Accuracy=0.0001, N0. Of iterations=10.



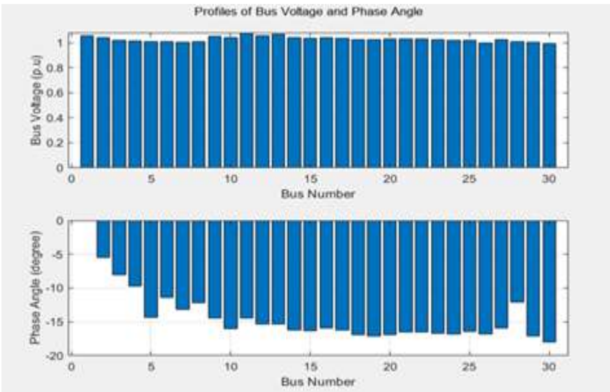


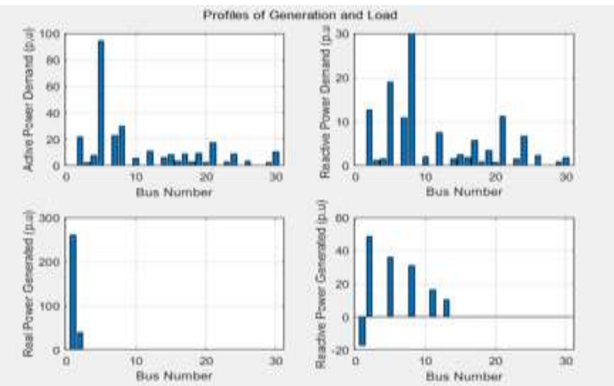
2. Newton-Raphson: Base MVA=100, Acc. Factor=1.6, Accuracy=0.0001, No. of iterations= 10.





3. Fast-Decouple: Base MVA=100, Acc. Factor=1.6, Accuracy=0.0001, No. of iterations= 10.





All the simulations were carried out using Matlab and implemented for IEEE 30-bus test cases for Gauss-Seidel, Newton-Raphson and Fast Decouple. The tolerance values used for simulation are 0.001 and 0.1 for all the simulation that are carried out, in load flow analysis methods simulated. The computational time for Gauss-Seidel is low compared to the Newton-Raphson and fast decouple. Newton-Raphson have more computational time compared to other two methods due to the complexity of the Jacobian matrix for each iteration but still converges fast since less number of iterations are carried out and required.

4. CONCLUSION:

Voltage collapse might occur when load dynamics effort to restore power consumption beyond the capability of transmission network and the connected generation. Voltage stability is exposed when a disturbance rises the reactive power demand beyond the sustainable capacity of the existing reactive power resource. Generator reactive power limit is a crucial factor in voltage instability. The generator reactive power limits are enforced, owing to operation of overexcited limiter, the bus voltages are preserved within limit. Consequently, an operating point is more voltage stable on the P-V curve lacking the operation of overexcited limiters of the generator. The outcomes of this paper advise that the planning of a power system can be carried out by using Gauss-Seidel method for a small system with less computational difficulty due to the virtuous computational characteristics is revealed. The actual and most reliable among the three load flow methods is the Newton-Raphson method since it converges fast and is more accurate.

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