ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 7, July 2017

Voltage Stability Analysis of Radial Distribution Network under Critical Loading Condition

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ABSTRACT: Voltage stability has become an important issue of power system stability. This work is concentrated on finding weak busses with voltage stability index analysis for Radial Distribution System (RDS). In this work Optimization of Multiple Distribution Generating Unit using Voltage Stability Index and Analytical Approach with Forward, Backward Sweep method (FBS). In this work a novel approach has been implemented to reduce the losses in the radial distribution system. This work has been done in two phases. From the first phase of work identification of weak nodes with voltage stability index, which are most sensitive to voltage collapse using the Branch Injection and Branch Current (BIBC) and Branch Current and Branch Voltage (BCBV) matrix have been analyzed. This feature enables us to set an index threshold to monitor and envisage system test case stability, so that a proper action can be taken to prevent the system from collapse. From second phase, optimal allocation of Multiple DG with the objective as minimizing the distribution line losses with cost attributes. . It is vitally essential to characterize the size and location of multiple DGs' to be placed and the cost of DG's, with the cost of line loss when the DG is active. By virtue of some intrinsically characteristics of distribution systems, as the structure is radial in nature, immensely colossal number of nodes, with an extensive range of R/X ratios, the conservative techniques diverges in the distribution system for the determination of optimum size and location of these multiple Distributed Generations (DG). The projected approach and results are validated on IEEE 33,69 bus standard test systems.

KEY WORDS*:* .Weak bus, load modelling, voltage stability, voltage collapse

I.INTRODUCTION

A centralized power generation is followed by a typical power system. The transmission and distribution system acts like a barrier between this centrally generated power and the consumer. A continuity of delivering to the load is more important for transmission and distribution companies to maintain their reliability in the system. Reliability according to consumer can be defined as the continuous supply to the consumer end or the ability of the power system components to deliver electricity to all points of consumption. Reliability is often measured by outage indices defined by the Institute of Electrical and Electronics Engineers (IEEE) Standard 1366. According to supremacy in load increment, these concentrated generations will not satisfy the needs of consumer, so that this DG has come into picture with new difficulties and advantages. Depending upon this increase in load the generation should increases instantly, but concentrated generation did not satisfy the load demand in optimal concern.

II. VOLTAGE STABILITY INDEX

Voltage instability results from the inability of the case to provide the power requested by loads. The driving force for voltage instability is increased load. The voltage stability margin is a parameter that identifies the near collapse nodes. The node with small stability indices are called weak nodes and then should be reinforced by injecting reactive power. In the present analysis, voltage stability margin is calculated for time variant realistic ZIP load model. The impact Of DG on voltage stability improvement has also determined. The node at which minimum voltage stability index

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is occurred is taken as weak bus .DG is placed at that node. Voltage stability margin is determined for each bus using Eq. (2.31) and the bus with minimum VSM is determined. VSM of each bus is a number between 0 and 1. The method is based on the BIBC matrix and helps us to develop a computerized algorithm for the calculation of each bus index value of any distribution system.

III. LOAD MODELING

Depending on nature of publication lodes are modelled as
1. constant power load
2. constant impedance load
3. constant current load
4. composite load

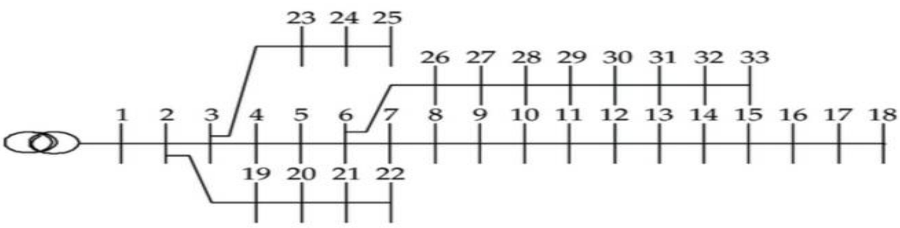

Fig 1. IEEE 33 bus system

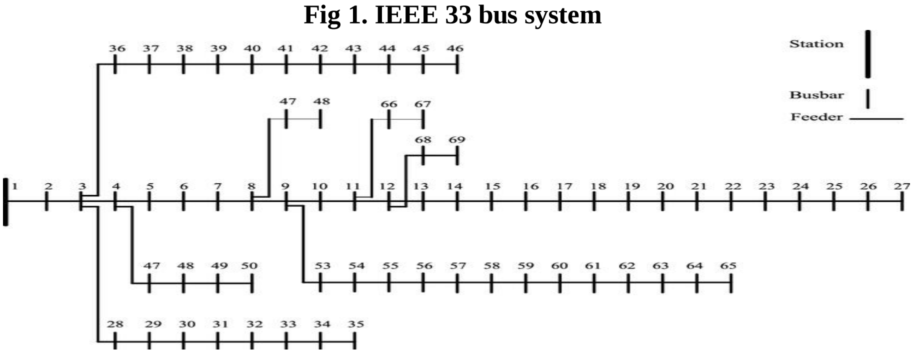

Fig 2. IEEE 69 bus system

IV. DISTRIBUTION GENERTOR

Distributed,generation,also distributedenergy, on-sitegeneration (OSG)[1] or district/decentralized energy is generated or stored by a variety of small, grid-connected devices referred to as distributed energy resources (DER) or distributed energy resource systems.[2]Conventional power stations, such as coal-fired, gas and nuclear powered plants, as well as hydroelectric dams and large-scale solar power stations, are centralized and often require electricity to be transmitted over long distances. By contrast, DER systems are decentralized, modular and more flexible technologies, that are located close to the load they serve, albeit having capacities of only 10 megawatts (MW) or less. These systems can comprise multiple generation and storage components. In this instance they are referred to as Hybrid power systems.DER systems typically use renewable energy sources, including small hydro, biomass, biogas, solar power, wind power, and improve security of supply. Micro grids are modern, localized, small-scale grids[3][4], contrary to the traditional, centralized electricity grid (macro grid). Micro grids can disconnect from the centralized grid and operate autonomously, strengthen grid resilience and help mitigate grid disturbances. They are typically low-voltage AC grids, often use diesel generators, and are installed by the community they serve. Micro grids increasingly employ a mixture of different distributed energy resources, such as solar hybrid power systems, which reduce the amount of emitted carbon significantly. The maximum number of DG and allowable capacity of DG to be placed in the system

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will depend upon three factors. Those are voltage limits of system, fault levels, thermal limits of considered lines, lines and substation. The above three technical factors affect the size and place of DG. For minimizing losses in the distribution systems, distribution companies (in India DISCOMs') operate these DGs' locally to handle at load side within above technical factors. Before introducing the DG in steady state / practical system the (DISCOM) distribution companies will make sure that if any violation in these three technical factors for secures operation. Some of the worst cases the system faces when distribution system

1. Maximum load and no generation
2. Minimum load and maximum generation
3. Minimum voltage at the load when DG size exceeds its range.

IV.MATLAB RESULTS

The MATLAB results has done on less than 5 MW DG .The Placement of DG is done based on voltage stability index. By taking IEEE33,69 bus test system we are considered. In all of these cases, by placing DG then minimum voltages and minimum voltage stability index values are improved and critical node is shifted from 65th bus to 27th bus in IEEE69 bus test system and critical node doesn't shifted in IEEE33 bus test system .18th bus will be the weak node in both cases i.e with DG and with out DG.

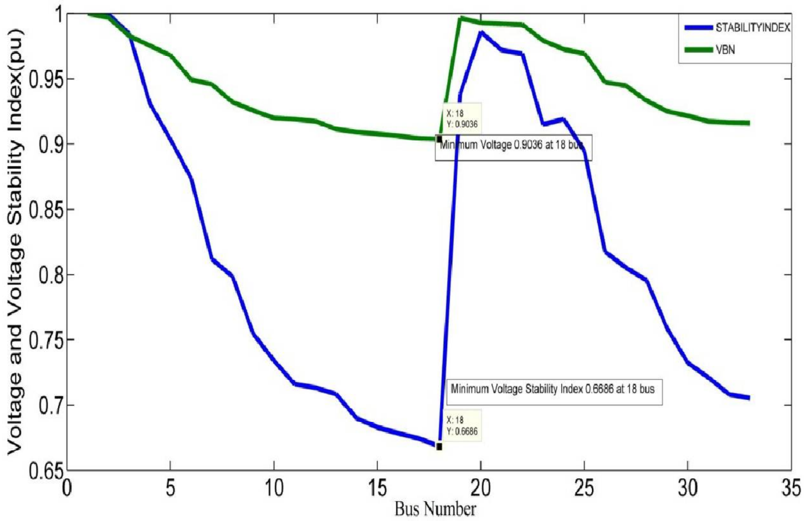

Fig 3: Bus number vs voltage and VSI without DG

From Fig:3 the minimum voltage, and voltage stability index value is occurred at 18th bus. Those values are 0.9036 and 0.6675

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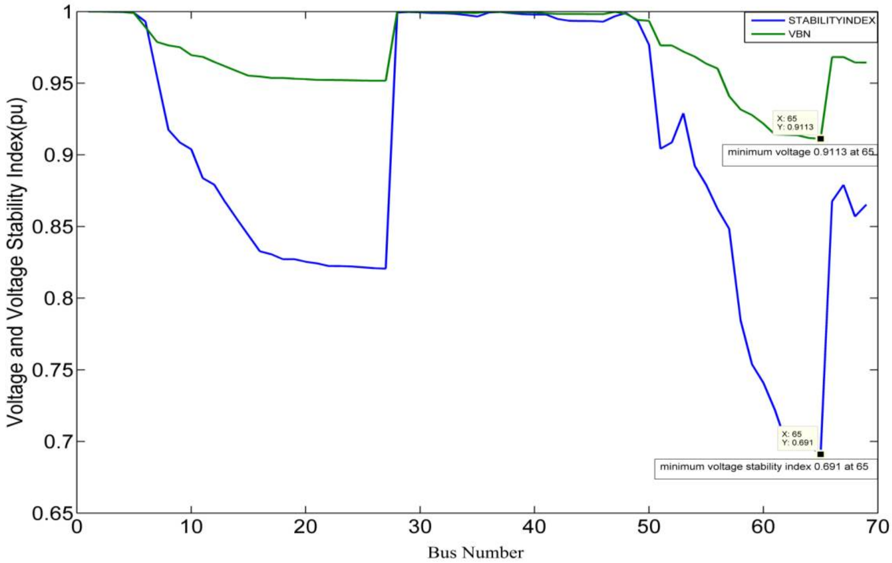

Fig 4: Bus number vs voltage and VSI Without DG

From fig:4 the minimum voltage and minimum voltage stability index is occurred at 65th bus in IEEE69 bus system .those values are 0.9113 and 0.9694..

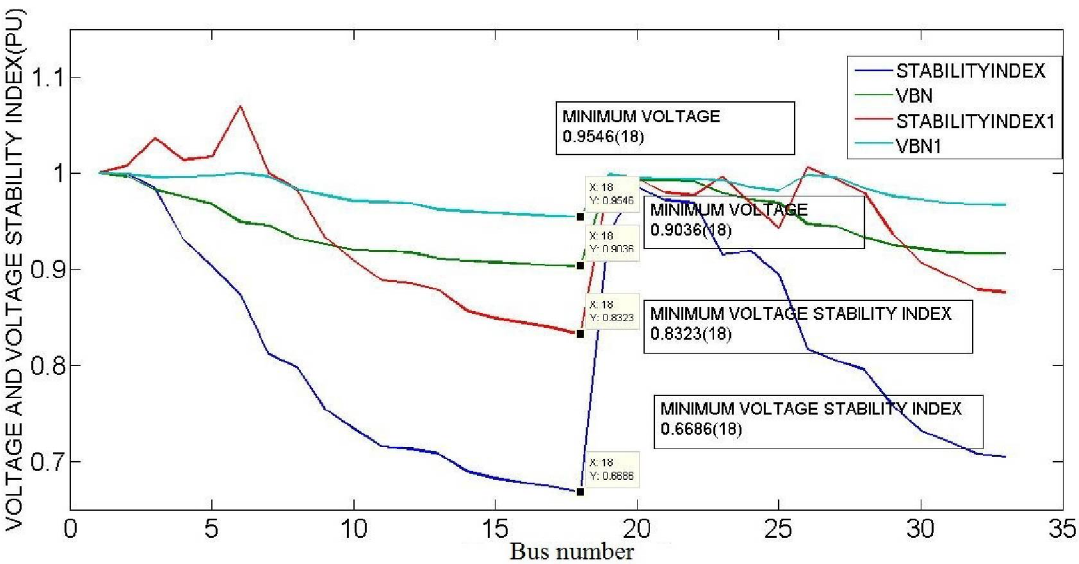

Fig 5: Bus number vs voltage and VSI with DG

From fig:5 After placing DG the variation of voltage and voltage stability index in test systems the voltage is varied from 0.9036 to 0.9546 and voltage stability index is varied from 0.6686 to 0.8636 is occurred at 18th bus in IEEE33 bus system .

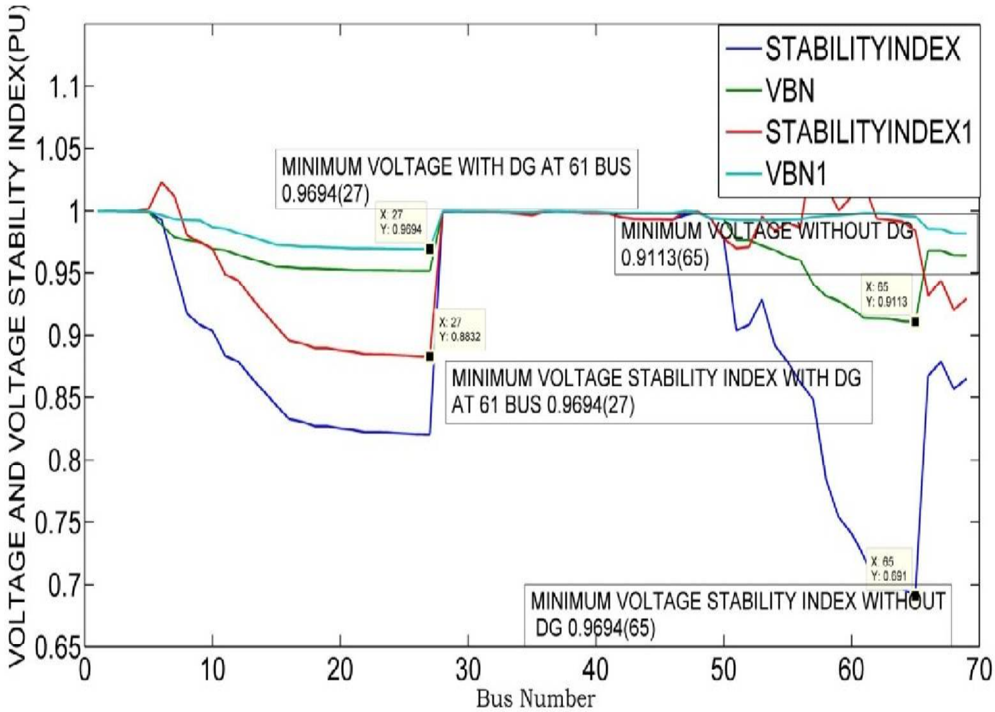

Fig 6:Bus number vs voltage and VSI with DG

From figures:6 the minimum voltage is occurred at 65th bus that value is 0.9113 and minimum voltage stability index value is 0.9694. By placing DG at 61st the minimum voltage is occurred at 27th bus that value and minimum voltage stability index is shifted from 0.9694 at 65th bus to 0.9694 at 27th bus.

V.CONCLUSIONS

A Forward, Backward Sweeping method (FBSM) has been implemented to find out the bus voltages of radial distribution network. Comparison of minimum voltage at weak nodes for constant power, constant current and constant impedance load types are done. Optimal location with DG has been found using analytical approach to improve the voltage profile. The main theme of this work is voltage profile improvement rather than voltages stability improvement.

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