INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 8, Issue 3 - V8I3-1337)
Available online at: https://www.ijariit.com

Power Loss and Voltage Profile in Distribution System by Neural Network

Sandeep Kaur
sandeepkaur005566@gmail.com
Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib, Punjab

Tejpal Singh
tejpal.singh@bbsbec.ac.in
Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib, Punjab

ABSTRACT

The objective of power system operation is to meet the demand at all the locations within the power network as economically and reliably as possible. The traditional electric power generation systems utilize the conventional energy resources, such as fossil fuels, hydro, nuclear etc. for electricity generation. The operation of such traditional generation systems is based on centralized control utility generators, delivering power through an extensive transmission and distribution system, to meet the given demands of widely dispersed users. Nowadays, the justification for the large central-station plants is weakening due to depleting conventional resources, increased transmission and distribution costs, deregulation trends, heightened environmental concerns, and technological advancements. location and size of the DGs before and after radial network reconfiguration are determined using a multi-objective particle swarm optimization technique. In an active distribution network, an ideal network layout with DG coordination eliminates power losses, elevates voltage profiles, and enhances system stability, reliability, and efficiency.

Keyword: *Power, Distribution, System, Neural Network*

1. INTRODUCTION

It is the primary goal of power system operation to fulfil demand at all points within the power network as cheaply and reliably as feasible. The conventional energy resources, such as fossil fuels, hydropower, nuclear, and so on, are used in the typical electric power production systems. There are centralised utility generators that can provide the electricity needed by a broad range of customers, over a large transmission and distribution network, in such systems. Because of decreasing traditional supplies, rising transmission and distribution costs, deregulation tendencies, greater environmental concerns, and technology developments, the case for massive central-station plants is eroding.

Final connection between high voltage transmission and consumers is provided by distribution systems. Main feeders and lateral distributors make up radial distribution. At each of these locations, there is a primary feeder that runs from the substation to the various loads of each customer. Individual loads are coupled to laterals [9]. Because of its simplicity, radial distribution methods are often used. Because of the low voltage and hence high current in a distribution system, there is a significant amount of power lost.

Today's power grids must make the significant shift from stable passive distribution networks with one-way power flow to active distribution networks with two-way power flow. When there are no RECONFIGURATION units in the distribution network, it is referred to as a "passive" distribution network. When RECONFIGURATION units are introduced to the distribution system, the networks' electricity flows in both directions [7,9]. they become operational.Due to its proximity to the load center's power generation, an active distribution network's transmission losses are lower than in a passive distribution network. Reduced line losses, voltage profile improvement, lower emissions of pollutants, enhanced overall efficiency, and better power quality are just a few of the benefits of an Active Distribution Network. As a result, utilities and distribution firms need tools to ensure that Active Distribution Networks are planned and operated correctly. Reduced line losses and improved voltage stability are two of the most significant advantages. The size and placement of the RECONFIGURATION unit in the distribution networks are critical in defining its size and location.

A great deal of progress has been made in communications and data processing during the last several decades. The distribution system is becoming more automated. The automation of the distribution system may increase reliability, efficiency, and service quality. A distribution operational centre may be installed to monitor and operate the distribution networks, as well as to reconfigure the distribution system to decrease power losses, improve voltage profile and balance loads under normal operating circumstances. [13,19]. Sectionalizing switches, which are generally closed, and tie switches, which are normally open, are both used in distribution networks [28,39,40]. Many substations and feeders ensure that any load in the system may be supplied by multiple paths. Sectionalizing and tying switches may be used to alter the distribution system. To accomplish the following, a reorganization is carried out

- Power loss reduction.
- Load balancing.
- Service restoration after fault occurrence.
- Voltage deviation minimization.

1.1.1 Distribution Systems Power Loss Minimization

Reduction in system line losses is one of the advantages of distributed generation, as already noted. Typically, utility companies are more concerned with actual power loss since it decreases the efficiency with which energy is transmitted to consumers. But the loss of reactive power is no less significant. In order to sustain a high enough voltage, the system requires a constant supply of reactive power. Reactive power, in turn, enables consumers to get actual power through transmission and distribution lines. If the decision maker is devoted to reducing losses and improving network performance (e.g., on the level of losses and/or dependability), strategically placed RECONFIGURATION along the network feeder may be highly effective [29,30,32,46]. If a distribution firm (DISCO) recovers income that is not only based on the asset value but also on network performance, this feature may be extremely valuable.

1.2 Power Distribution Systems

Only makers and researchers were concerned with power until the 1870s. Batteries were the primary source of power in a number of investigations into electrical phenomena. Scientist Zenobe Gram from Belgium invented the generator that could provide far more obvious electrical streams than a battery could provide. Small and large power plants were then shaped into power feeders to provide light and operate force machines for essential and supporting company efforts. In the meanwhile, Thomas Alva Edison and Joseph Swan were working on the idea of a fundamentally bright light, which appeared about 1880. Force has finally made it to its clients, providing interest and appropriate power for transportation systems to these customers. Force:The last step in the transmission of electric power is the use of an electric force appropriation framework. Customers are supplied with electricity through the transmission infrastructure. Transformers connect distribution substations to the transmission network.Equipment such as transformers, circuit breakers, and protective relays devices are often found in a distribution system's equipment. The term "Distribution System" refers to the electrical network that connects the transmission system's substation to the end user or customer.

Temesgen Taye, et. al. [1] determined that FUZZY NEURAL NETWORK (FNN) based capacitor placement on Bella distribution feeder resulted in a loss reduction of 37.27% and voltage profile improvement of 15% at peak load with initial capital investment cost of 3,317,328 Birr with ROI of 0.1664 year, FUZZY NEURAL NETWORK (FNN) based RECONFIGURATION placement on Bella distribution feeder resulted in a loss reduction of 50% and voltage profile improvement of 12% at peak load with initial capital investment cost of 184,114,566Birr with ROI of 6.832 year and GA based capacitor placement on Bella distribution feeder resulted in a loss reduction of 37% and voltage profile improvement of 15.7% at peak load with initial capital investment cost of 6,698,160 Birr with ROI of 0.3361 year. FUZZY NEURAL NETWORK (FNN) based capacitor placement on Bella distribution feeder solve power loss and voltage drop problem with small capital investment cost and short payback period by increasing system capacity and improving power factor of the system. So, FUZZY NEURAL NETWORK (FNN) based capacitor placement should be implemented to optimize power loss and voltage drop of distribution systems.

Reza Indra Satrio and Subiyanto [2] a distribution transformer's electric load analysis and investigation was the goal of this project. For each individual customer, real voltage and real current were measured twice at peak load times: in the morning and in the evening. ETAP Power Station Software was used to carry out the design and simulation work. Based on modelling and real-world measurements, the percentages of voltage drop and total power losses did not meet SPLN 72:1987 (Standard PLN) specifications.. Restructuring the electrical network architecture resulted in reduced drop voltage from 1.3 percent to 31.3 percent and power losses that went from 646.7 watt to 233.29. watts after the new distribution transformer was installed and restructured Reduced voltage drop and reduced power losses may be achieved by reorganising the electrical network and adding new distribution transformers, as the study's findings demonstrate

Eshete Habtamu [3] improve the performance of the distribution network using network reconfiguration. Electric distribution systems reconfiguration comprises tie and sectionalizing switches. Tie switches are normally open, and sectionalizing switches are normally closed. By opening and closing these switches, the distribution network can be reconfigured. This reconfiguration can be done for the objective of loss minimization. In order to get feasible results (loss minimization), the reconfiguration must meet some constraints, like Kirchhoff"s voltage and current laws, other equality and inequality constraints. The method used for this optimization problem is a genetic algorithm optimization method. The genetic algorithm has been described in detail and then applied specifically to the network reconfiguration problem. In the optimization process, load flow of the distribution system was computed. Then, computer simulation was performed by using DIgSILENT PowerFactory software for analyzing the distribution network reconfiguration.

Antonio Gómez-Expósito, et. al. [4] provides an analysis of electric generation and transmission systems that addresses diverse regulatory issues. It includes fundamental background topics, such as load flow, short circuit analysis, and economic dispatch, as well as advanced topics, such as harmonic load flow, state estimation, voltage and frequency control, electromagnetic transients, etc.

Andreas, et. al. [5] discuss the reduction of distribution losses representing a specific issue for each DSO, due to heterogeneous levels of both technical (TL) and non-technical (NTL) losses, but also due to differences on definition, measurement or regulation of losses. This reveals a real concern in proposing a global framework, which would be general enough to include all DSO situations about losses and specific enough to bring adapted answers to losses management. In order to tackle these questions, CIRED has engaged a Working Group on the reduction of distribution losses, which proposes a three steps approach for 1. Measuring, 2. Managing and 3. Mitigating distribution losses.

Ola Badran, et. al. [6] discuss the Network Reconfiguration technique is a method which helps mitigate power losses from distribution systems. However, the reconfiguration technique can only do this up to a certain point. Further power loss reduction may be realized via the application of Distributed Generation (RECONFIGURATION). However, the integration of RECONFIGURATION into the distribution system at a non-optimal location may result in increased power losses and voltage fluctuations. Therefore, a strategy for the selection of optimal placement and sizing of the RECONFIGURATION needs to be developed and at the same time ensure optimal configuration. Many heuristic and artificial intelligence methods have been proposed in the literature for optimal distribution network reconfiguration, RECONFIGURATIONs sizing, and location.

Joel Jose and Anupama Kohli [7] presents a path-based mixed integer quadratic programming (MIQP) formulation of distribution feeder reconfiguration (DFR) for loss minimization and reliability enhancement. Analytical expressions for standard reliability indices like SAIFI and EDNS are obtained by adopting standard assumptions regarding component failures. A path-based modeling framework is adopted to allow for easy evaluation of the reliability indices. The proposed path-to-branch incidence matrix results in linear expressions for the reliability indices and power flow equations. These linear models are suitably deployed in a flexible DFR optimization framework wherein reliability can feature in either via objectives or constraints. The proposed MIQP formulations are applied to different test systems to optimize network losses or reliability or both. Numerical results showcase the wide range of capabilities of the proposed formulations.

T.S.R. Prasanti et. al [8] presents a new approach in order to determine the optimal placement of capacitor in radial distribution system. The power loss is significantly high in distribution systems because of lower voltages and higher currents. Optimal capacitor placement results in system loss reduction, power factor correction, voltage profile improvement and additional feeder capacity can be released. The capacitor placement is done by considering parameters like Loss sensitivity factor and better Voltage profile. FUZZY NEURAL NETWORK (FNN) algorithm is used for determination of the location system capacitor placement. In the proposed algorithm depending upon loss sensitivity factor, number of iterations required for deriving better volage profile is possible to reduce. For, 25-bus three phase unbalanced and balanced system is considered for capacitive compensation. Three phase load flow solution is obtained by using topology-based load flow program in MATLAB environment and time required, accuracy has been found satisfying.

Julius Kilonzi Charles [9] aimed at solving this problem by proposing a hybrid of GA and IFUZZY NEURAL NETWORK (FNN) to optimize RECONFIGURATION location and size while considering both real and reactive power losses. Both real and reactive power flow and power loss sensitivity factors were utilized in identifying the candidate buses for RECONFIGURATION allocation. This reduced the search space for the algorithm and thus increased its rate of convergence. The suggested method was programmed under MATLAB 2011 software and tested using IEEE 30-bus test system, IEEE 33-bus test system and IEEE 57-bus test system by considering three types of RECONFIGURATIONs. The results obtained were compared to those obtained by other researchers. It was observed that GA-IFUZZY NEURAL NETWORK (FNN) method performed better in terms of reducing both real and reactive power losses as compared to Heuristic, GA, FUZZY NEURAL NETWORK (FNN) and IFUZZY NEURAL NETWORK (FNN) methods. For the IEEE 30-bus test system, the percentage reduction in real power loss was 35.46%, 35.82% and 35.21% while the percentage reduction in reactive power loss was 36.01%, 35.95% and 35.88% for type 1, type 2 and type 3 RECONFIGURATIONs respectively. The voltage profile of the networks after optimizing RECONFIGURATION locations and sizes using GA-IFUZZY NEURAL NETWORK (FNN) method were also found to be much improved with the lowest bus voltage improved to 1.01pu and 0.959pu for the IEEE 30-bus and 33-bus test systems respectively.

MM. Aman, et. al [10] present a very detailed overview of optimum SCB placement techniques. Six different approaches of optimum SCB placement based on minimization of power losses, weakest voltage bus approach and maximization of system load ability will be applied on four different radial distribution test systems. The results have been compared on the basis of power loss reduction, voltage profile improvement, system load ability maximization and the line limit constraint.

Mohsin Mahmood, et. al [11] presents a study on technical losses in distribution system and analysis of the impact of losses in power sector. The technical losses caused by material properties and its resistance to the flow of electrical current in distribution system will be analysed and simulated through electrical transient analysis program. Moreover, the impact of different types of transformer and other equipment's connections to the substation and feeder will also be investigated.

The Fuzzy rules calculation fundamentally gained from creature's movement or conduct to take care of advancement issues. In fuzzy, every individual from the rules is known as a molecule and the rules are known as a threshold. Beginning with a haphazardly introduced populace and moving in arbitrarily picked bearings, every molecule experiences the looking space and recollects the best past positions of itself and its neighbors. Fuzzy rules convey great positions to one another and in addition powerfully alter their own position and speed got from the best position of all rules. The following step starts when the sum total of what particles have been moved. At last, all rules have a tendency to fly towards better and better positions over the looking procedure until the swarm move to near an ideal of the wellness capacity. The fuzzy-NN technique is turning out to be exceptionally main stream in view of its straightforwardness of execution and capacity to quickly unite to a decent arrangement. It doesn't require any angle data of the capacity to be enhanced and utilizes just primitive scientific administrators. As contrasted and other improvement techniques, it is quicker, less expensive and more productive.

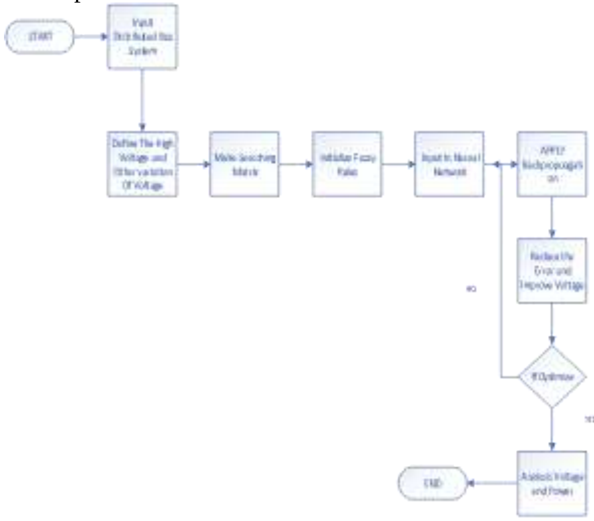

Fig.4.1 Proposed Flowchart

Likewise, there is couple of parameters to alter in fuzzy-NN. That is the reason fuzzy-NN is a perfect advancement issue solver in streamlining issues. Fuzzy-NN is appropriate to explain the non-direct, non-raised, consistent, discrete, whole number variable sort issues. For the better optimization results, the proposed work uses the genetic algorithm (GA) and the Particle Swarm Optimization (FUZZY NEURAL NETWORK (FNN)) algorithm. A genetic algorithm is a meta-heuristic algorithm based on the gene and its purpose. In the genetic algorithm, the discovery, crossover and mutation procedure are the basis of the entire process for the best results. The optimization is based on the genes' fitness value. This algorithm supports the method of local optimization that is inadequate to achieve successful results. To address this dilemma, the present work proposes a hybrid approach. The Particle Swarm Algorithm for Optimization is a meta-heuristic algorithm based on swarm behaviour. This algorithm is used to solve the complex problem in order to obtain the best results. FUZZY NEURAL NETWORK (FNN) promotes the Global Optimization function and offers the best solution to the problem worldwide. In this work, FUZZY NEURAL NETWORK (FNN) and G.A work parallel to a better and optimal solution, as they are both optimized. In the section below, we clarify with the algorithm and flow map, the Genetic Algorithm (GA) and the Particle Swarm Optimization (FUZZY NEURAL NETWORK (FNN). The flow diagram illustrates the technical execution of the algorithms in the step by step working an algorithm.

Steps for the approach suggested are shown as follows:

Phase 1: Load / Power initialization.

Stage 2: Initialize the Load Power generator.

Phase 3: Assign and measure the cost of generators.

Phase 4: Use the FUZZY NEURAL NETWORK (FNN) to optimize.

Phase 5: If FUZZY NEURAL NETWORK (FNN) performance is optimized, the convergence check otherwise begins with the following steps.

(a) Chromosome initialization.

(b) The junction of chromosomes.

(c) Add set of roulettes.

(d) Optimization check. If optimized, the convergence check otherwise runs until the target type is not obtained.

(e) Step 6: Convergence search. If converge then check the costs, restart the particles and repeat phase 5.

(f) Step 7: If costs are lower than C then stop.

3. RESULTS OF PROPOSED WORK

In this paper, analysis of different approaches of congestion and loss reduction with or without Distributed generator has been considered. In table 1 and other experiment we have used IEEE30 bus system. Table 5.1 represents the PI sensitivity base congestion in 3-Φ, 6 lines of distributed system.

Table 5.1. Congestion Lines

FROM BUS	TO BUS	PI SENESTIVITY
5	7	-14.853
9	11	0
19	20	-6.457
24	25	-1.142
25	27	-4.694
8	28	-0.613

Figure 5.1, figure 5.2 and figure 5.3 represents the IEEE30 bus system on current, power and Voltage using the concept of Newton Raphson. It presents variation in every bus. Table 2 shows the real and reactive power losses using RECONFIGURATION and without RECONFIGURATION with different power factors. Figure below shows the comparison of real and reactive power loss. Both losses reduce when RECONFIGURATION is different.

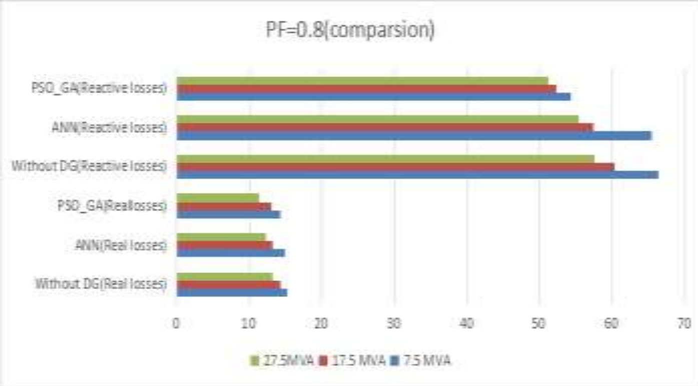

Fig.5.1 Comparison of different power factor =0.8

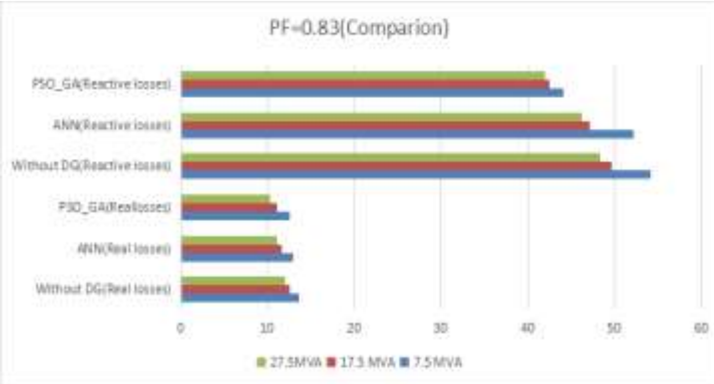

Fig.5.2 Comparison of different power factor=0.83

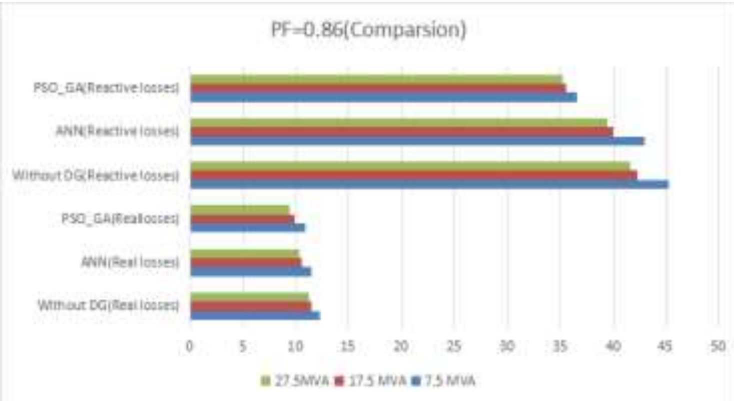

Fig.5.3 Comparison of different power factor=0.86

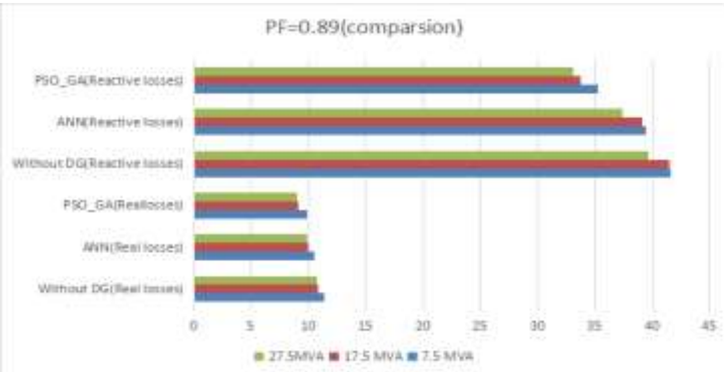

Fig.5.4 Comparison of different power factor=0.89

In fig 5.4 have been show the Power factor impact on Reactive losses and active of real losses with and without Distributed generator replacement. Losses Reduced when RECONFIGURATION replace in both cases. Its show optimal replacement of RECONFIGURATION effect on Losses.

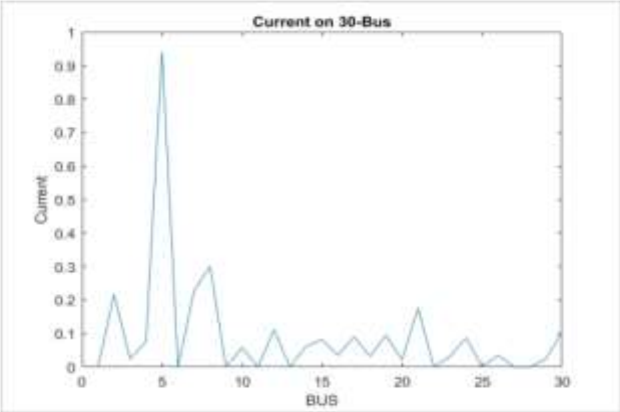

Fig.5.5 Current Distribution on 30-BUS

In fig 5.5 have been show the current distribution without RECONFIGURATION use in 30 BUS system. Its show current quality reduce because of losses Increases active and reactive.

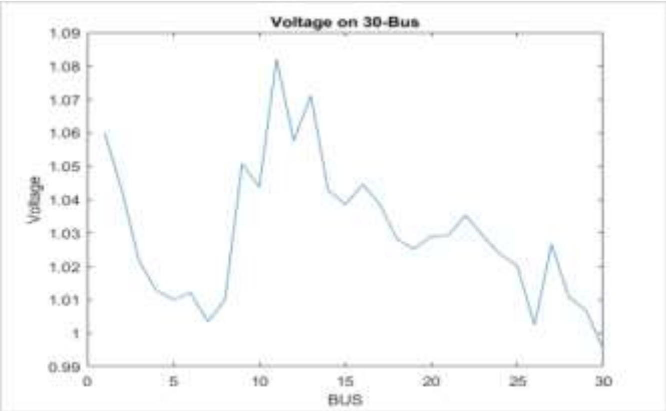

Fig.5.6 Voltage Distribution on 30-BUS

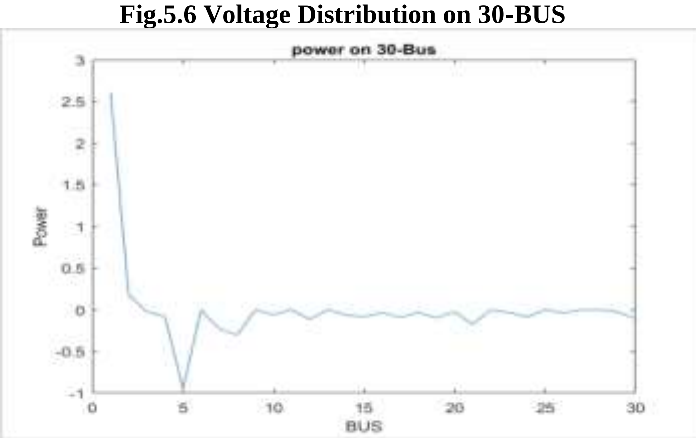

Fig.5.7 Power on a 30 bus

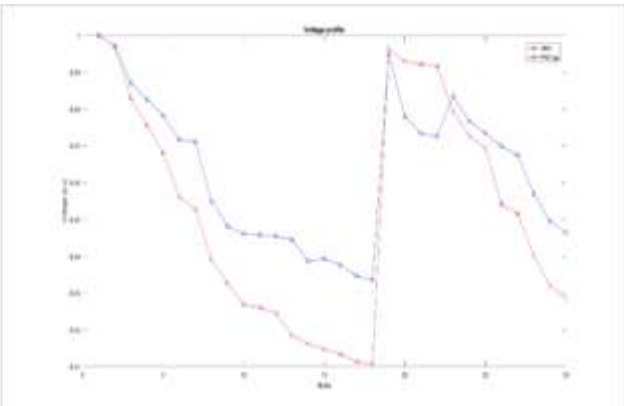

Fig.5.8 Voltage profile comparison

4. CONCLUSION

RECONFIGURATION is optimally positioned in the distribution system that provides numerous advantages such as loss of power and harmonic minimization, enhanced voltage profile and stability, environmental friendliness and reliability improvement. In this paper, the Newton Raphon's power flow method with particle swarm optimization (PSO) algorithm hybrid with genetic algorithm is used for optimal placement of RECONFIGURATION in a distribution system. The method proposed is tested and validated in various bus test systems. The proposed optimal positioning of RECONFIGURATION units has proven resilient and provides improved efficiency for loss and THD minimization and voltage profile improvement. The research proposed aims to minimize power and voltage losses and also to reduce costs. The network's investment expense is the limited number of RECONFIGURATIONs of several smallest RECONFIGURATION sizes. The cost of this work per kVar which varies by size because the prices of large sizes are lower and the size optimum is less expensive. The index method and size of the RECONFIGURATION is used for the optimal placement of the RECONFIGURATION which is given by the proposed method and classical method PSO. The performance evaluation of the proposed work is done by comparing RECONFIGURATIONs and voltages, losses. In PSO, power losses are higher and value of capacitive compensation is less. The values obtained by the PSO is slightly lower and they are in acceptable limits and reasonably good. PROPOSED (FUZZY NEURAL NETWORK (FNN) method gives better reduction in power loss with lesser value of capacitive compensation. It can be concluded that PROPOSED (FUZZY NEURAL NETWORK (FNN) is a superior method than PSO. In future enhance this work by hybrid optimization.

5. REFERENCES

[1] Taye, Temesgen. " Improvement of Distribution Feeder Loss and Voltage Profile (Case Study: Bella Substation Distribution Feeder) " PhD diss., Addis Ababa University, 2019.

[2] Satrio, Reza Indra, and Subiyanto. "Reduction technique of drop voltage and power losses to improve power quality using ETAP Power Station simulation model." *AIP Conference Proceedings*. Vol. 1941. No. 1. AIP Publishing LLC, 2018.

[3] E. Habtamu, "Power loss minimization for distribution network reconfiguration using Genetic Algorithm," Addis Ababa: Addis Ababa University, 2018.

[4] Gómez-Expósito, Antonio, Antonio J. Conejo, and Claudio Cañizares, eds. *Electric energy systems: analysis and operation*. CRC press, 2018.

[5] B. Andreas, C. Raphaël and J. Damien, "Reduction of Technical and Non-Technical Losses in Distribution Networks," *International Conference on Electricity*, vol. 20, 2017.

[6] Badran, Ola, Saad Mekhilef et al. "Optimal reconfiguration of distribution system connected with distributed generations: A review of different methodologies." *Renewable and Sustainable Energy Reviews* vol. 73, pp. 854-867, 2017.

[7] Joel Jose et. al, "Reliability constrained distribution feeder reconfiguration for power loss minimization", 2016 National Power Systems Conference (NPSC), IEEE Conference Publications.

[8] T.S.R. Prasanti, "Optimal Placement of Capacitor by Using FUZZY NEURAL NETWORK (FNN) with Considering Harmonics in Distribution Systems," *International Journal of Scientific & Engineering Research*, vol. 7, no. 12, 2016.

[9] Kilonzi, Charles J. "Loss reduction and voltage profile

improvement by optimal placement and sizing of distributed generation (RECONFIGURATION) using a hybrid of genetic algorithm (GA) and improved particle swarm optimization (IFUZZY NEURAL NETWORK (FNN)." PhD diss., University of Nairobi, 2014.
[10] Aman, M. M., et al. "Optimum shunt capacitor placement in distribution system—A review and comparative study." *Renewable and Sustainable Energy Reviews* vol.30, pp. 429-439, 2014.
[11] Mahmood, Mohsin, et al. "Real time study on technical losses in distribution system." *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, vol. 1, pp 1-7,2014.
[12] Cabré Ramos, Sergi. "Optimization of the operation of a Distribution Network with Distributed Generation using Genetic Algorithm." Master's thesis, Universitat Politècnica de Catalunya, 2014.
[13] Qiuyu Peng et. al, "Optimal branch exchange for Feeder reconfiguration in Distribution Networks", 52nd IEEE conference on Decision and Control, December 10-13, 2013. Florence, Italy.
[14] G. Kour, "Different Techniques of Loss Minimization in Distribution System," *International journal of enhanced research in science technology & Engineering*, vol. 2, no. 2, 2013.
[15] Chen, Tsai-Hsiang, Lung-Sheng Chiang, and Nien-Che Yang. "Examination of major factors affecting voltage variation on distribution feeders." *Energy and buildings, vol.* 55, pp. 494-499, 2012.