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33Bus System DG Size Location Optimization using Artificial Intelligence

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Abstract:- *A review article overcome the problem of voltage profile and Power losses in radial distribution system (RDS) is a task that must be solved through different optimization technique. IEEE-33 bus system is taking for sensitivity analysis some buses sensitivity is drastic changed so need of real power support it is calculated by LSO. Real power support is providing through required distributed generation on bus it is calculated by LSO. In this IEEE-33 bus reduced active and reactive power loss in RDS through Distributed Generation (DG). In this paper active and reactive power loss minimize of IEEE-33 bus by placement of DG through LSO in RDS. Power utilities are expected to meet increasing power demands considering environmental concerns and financial restrictions and power loss minimization is an attractive solution. Operating current and power losses in distribution systems are higher than in transmission systems, so finding feasible methods to reduce power loss in distribution systems is important. Among the existing power loss reduction methods in distribution systems, distributed generation (DG) integration is the most effective. Generating power using renewable energy DG sources will also help environmental concerns. The increasing cost of fossil fuels and technological developments have made renewable energy sources financially viable.*

Index Terms- Network Reconfiguration, Distributed Generator Installation, Power Loss Reduction, Voltage Stability Improvement, Adaptive Shuffled Frog Leaping Algorithm.

I. INTRODUCTION

Electric energy that is distributed to the grid from many decentralized locations, such as from wind farms and solar panel installations is known as Distributed Generation [1]. Distributed Generation resources have increased dramatically in India due to the policies related to interconnection e.g. new energy metering schemes, as well as due to the programs related to advancing the integration of green & clean energy [2].

India is on right track to pursue development of Distributed Generation with the unbundling of power sector utilizing captive and co-generation, besides putting all-out effort in harnessing various forms of new and renewable energy [3]. In fact two Ministries of Government of India are involved in the overall progress of Distributed Generation. While Ministry of Power is interested for rural electrification, Ministry of New and Renewable Energy (MNRE) is dedicated for the development of DG, these both ministries are fulfilling the needs of each other. Liberalization of Government policy, support as well as regulatory mechanism in place is helping to create conducive atmosphere to achieve target set in this direction. However, there are challenges that are being attended with utmost sincerity with Distributed Generation [4].

The structure of modern day industries is changing and power grid is becoming more networked to fulfill the growing demand of power with acceptable quality and costs [4, 5]. This restructuring of power grid has uncertainties in system operation resulting in various vital issues like uneven line loading, lack of power flow control, voltage stability, and increase in short circuit current etc. In the meshed network, the occurrence of contingency can result the sudden increase/decrease in the power flow [6]. This can result overloading of the line and increase the risk of cascading outages due to sudden increase in load or sudden decrease in load there can be over voltages, frequency higher than the rated frequency [7]. Electricity demand is continuously on the rise due to population growth and technological developments. Power utilities are expected to meet this increasing demand. This demand could be met by constructing new power plants or by expanding existing power systems. However, these approaches require significant financial investment and can create environmental concerns. Moreover, many existing systems cannot be expanded because they are located in densely populated areas. As a result, alternative methods to support extra demand with minimal additional investment are preferred by utilities [1]. Worldwide transmission and distribution power loss in 2014 was 8.12% of the total generated power of 2.72 terawatts (TW) [2], [3]. This loss is more than twice the global electricity demand increase in 2018 [3]. Further, because of higher operation currents, power loss in distribution systems is approximately twice that of transmission systems, as shown in Figure 1 [4]. Minimizing power loss in distribution systems increases the loading capacity of the lines and minimizes the heating effect in power system cables. Thus, utilities can meet increasing power demands without investing in new generation or transmission infrastructure by reducing power losses especially in distribution system [5].

II. DEFINITIONS OF DISTRIBUTED GENERATION

- Distributed Generation is, in general, not power or voltage dependent.
- The Distributed Generation technologies can be categorized as renewable and non-renewable. Distributed Generation is not synonym for Renewable source.
- Geographical location is not a relevant parameter to distinguish Distributed Generation from central generation. Distributed Generation can be both stand-alone or grid connected.
- Distributed Generation is connected to the grid either directly or using transformers or power electronics. These include protection systems as well as measuring and metering devices.
- In most countries Distributed Generation is connected to the distribution network. In future however, large offshore wind farms larger than 110 MW could also be connected to the transmission grid.

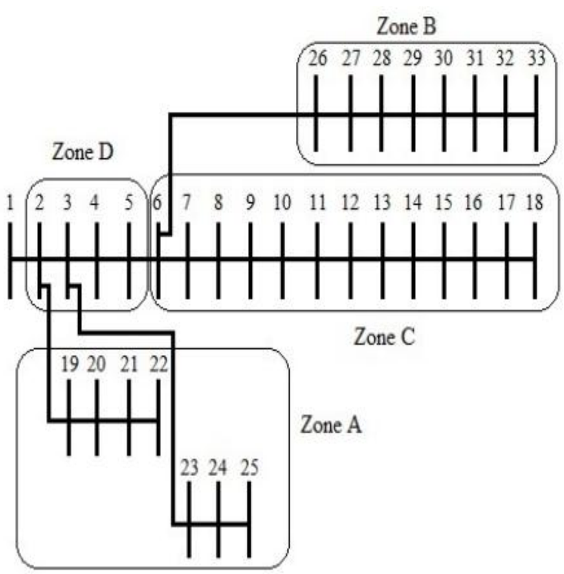

Figure 1 IEEE 33 bus radial distribution system zones for DG integration.

III. ADVANTAGES OF DISTRIBUTED GENERATION

The basic merits of Distributed Generation are given below:

- Reduces the cost as there is no use of long transmission line.
- Reduces the complexity.
- Environment friendly.
- Avoid the impact of massive grid failure.
- Easy to maintain and easy to operate as it consist of simple construction.
- Better power quality and reliability.
- The factor of high peak load shortage gets eliminated.
- Improves the efficiency of providing electric power.

IV. MAIN REASONS FOR THE INCREASINGLY WIDESPREAD USE OF DG

- It may be more economic than running a power line to remote locations.
- It provides supplementary support to the main power source.
- It can provide backup power during utility system outages, in case the end user requires uninterrupted service.
- It can provide higher power quality for electronic equipment.
- It can provide reactive power supply and voltage control by injecting and absorbing reactive power to control grid voltage.
- It can provide support for the system black-start.

V. LITERATURE REVIEW

Yuntao Ju, Wenchuan Wu, Boming Zhang, Hongbin Sun, proposed an efficient method for handling PV nodes based on loop analysis incorporated in forward backward sweep framework. In this paper, the PV nodes refer to nodes connected by distributed generators & the generators are provided with constant voltage control. Looking further into the paper, it is found that the proposed extension of forward backward sweep has satisfactory convergence even when the number of PV nodes increases for a wide range of branch resistance/reactance ratios. Authors performed numerical simulations with three-phase models to check the performance of forward backward sweep method, & the results were found satisfactory [1]. G. W. Chang, S. Y. Chu, H. L. Wang, explained an improved forward backward sweep algorithm for load flow analysis of radial distribution systems. In the backward sweep, Kirchhoff's Current Law and Kirchhoff's Voltage Law are used to calculate the upstream bus voltage of each line of distribution network. In the forward sweep, the voltage at each downstream bus is then updated by the real and imaginary components of the calculated bus voltage multiplying with the corresponding ratio of distribution system. The proposed algorithm is tested by the authors on three IEEE distribution systems. The results show that the algorithm is accurate and computationally efficient in comparing with two other methods [2]. Bompard, E. Carpaneto, G. Chicco, R. Napoli, explained that the most effective method for the load-flow analysis of the radial distribution systems is forward backward sweep. In the paper various properties of the forward backward sweep method are performed, taking into account different line resistance/reactance ratios and different types of voltage dependent loads. In the paper test results are also included for a tutorial two bus system and also for a real 84-bus system. The evolution of the forward backward sweep method has been analyzed at different loads, showing the differences for various load models at high load level, up to the theoretical load ability limit of the system. The paper also describes that in the normal operation of the distribution network, the load level is typically low and very distant from load ability limit, even with such conditions, the forward backward sweep method generally exhibits a fast and reliable convergence for any load model and with different initial conditions [3]. A. Augugliaro, L. Dusonchet, S. Favuzza, M.G. Ippolito, E. Riva Sanseverino, proposed a new forward backward methodology for the analysis of radial distribution systems with constant power loads, in this method, the loads are considered as constant impedances in the backward sweep & all the network variables (bus voltages and branch currents) are then evaluated considering a scaling factor. The forward sweep is eliminated and the node voltages calculation does not demand the sequentially needed forward backward sweep methodology. As per author, as compared to the latter method, the performances of the proposed algorithm are improved as far as the computation times are concerned, whereas the number of iterations is larger and increases as the number of PV nodes increase too. But the proposed solution methodology can find an efficient utilization, especially in the design problems for distribution systems with PV nodes. The improvements of the convergence features (for the use in working problems of the electrical systems) were the main aim of the authors' publication. The authors also came up with a solution process which is iterative and at every step loads are simulated by impedances. The paper further explains that it is necessary to solve a network made up only of impedances for example radial systems by expressing all the voltages and currents as linear functions of a single unknown current and for mesh system & two unknown currents for each independent mesh. Advantages of this method are: the method's possibility to take into account of any dependency of the loads on the voltage very reduced computational requirements and high precision of results [4]. K.Krushna Murthy, S.V. Jaya Ram Kumar, published a new, efficient power flow method for unbalanced radial distribution systems based on improved forward backward sweep algorithm. The proposed method utilizes simple and flexible numbering scheme and takes full advantage of the radial structure of distribution systems. The authors have tested the algorithm on an 8-bus three-phase unbalanced distribution system. The obtained numerical test proves that this method is very robust and has excellent convergence characteristics [5]. A. D. Rana, J. B. Darji, Mosam Pandya presented forward backward Sweep algorithm for power flow analysis of distribution network. In backward sweep, KCL and KVL are used to determine the bus voltage from farthest node. In forward sweep, downstream bus voltage is updated starting from source node. The method stops after the mismatch of the calculated and the specified voltages at the substation is less than a convergence tolerance. Transmission line losses are also calculated afterwards using updated bus voltage. This method is used to load flow solution for a distribution network can be obtained without solving any set of simultaneous equations. The authors tested the algorithm with IEEE 33 bus radial distribution system. The results are obtained by programming using MATLAB [6]. Das et al, described load-flow technique for solving radial distribution networks by calculating the total real and reactive power fed through any node using power convergence with the help of coding at the lateral and sub lateral nodes for large system that increased complexity of computation. This method worked only for sequential branch and node numbering scheme. They had calculated voltage of each receiving end node using forward sweep. They had taken the initial guess of zero initial power loss to solve radial distribution networks. It can solve the simple algebraic recursive expression of voltage magnitude and all the data can be easily stored in vector form, thus saving an enormous amount of computer memory [7]. S. C. Tripathy, G. D. Prasad, O. P. Malik, and G. S. Hope, presented a Newton-Raphson like method for solving ill-conditioned power systems. Their method showed voltage convergence but could not be efficiently used for optimal power flow calculations [8]. M. E. Baran and F. F. Wu, have explained an improved version of Newton-Raphson method. For each branch of the network three non-linear equations are written in terms of the branch power flows and bus voltages. The author found that number of equations was subsequently reduced by using terminal conditions associated with the main feeder, and the Newton- Raphson method is then applied to the reduced set of equations. The author further explains that the computational efficiency is improved by making some simplifications in the jacobian matrix [9]. Puthireddy Umapathi Reddy, Sirigiri

Sivanagaraju, Prabandhamkam Sangameswararaju provides a new approach for power flow and modeling analysis of three phase unbalanced radial distribution systems using the simple forward backward sweep-based algorithm. A three phase load flow solution is proposed considering voltage regulator and transformer with detailed load modeling, for the transformer modeling symmetrical components theory is used and zero sequence-voltage and-current updating for the sweep-based methods is shown. The validity and effectiveness of the proposed method is demonstrated by a simple 19-bus unbalanced system for grounded star-delta and delta grounded star transformer connections. The authors concluded that the results are in agreements with the literature and shows that the proposed model is valid and reliable [10]. Goswami and Basu presented a direct method for solving radial and meshed distribution networks. However, the main limitation of their method is that no node in the network is the junction of more than three branches, i.e. one incoming and two outgoing branches [11].

He Jun et al, presented a Z-bus based algorithm combined with the forward and backward algorithm to deal with power flow calculation of the distribution network with ring-net. The authors proposed that the topological structure of the network can be analyzed by decomposing the branch network into radial parts and ring-net parts through the forward path which is the concept of the signal flow graph. The researchers also found that using forward and backward algorithm on radial parts, calculation speed can be greatly improved by adopting parallel calculation. Finally a practical example analysis is done by the authors, which shows that the proposed method can not only process the ring network problems very well, but also improves the calculation speed. The method proposed in this paper is based on the forward and backward algorithm [12]. Takeru Inoue et al, worked on determining loss minimum configuration in a distribution network which is a hard discrete optimization problem involving many variables. Since more and more dispersed generators are installed on the demand side of power systems and they are reconfigured frequently, so developing automatic approaches is indispensable for effectively managing a large-scale distribution network. As per the paper, the existing fast methods employ local updates that gradually improve the loss to solve such an optimization problem. However, these methods eventually get stuck at local minima, resulting in arbitrarily poor results. This paper further presents a novel optimization method that provides an error bound on the solution quality. Thus, the obtained solution quality can be evaluated in comparison to the global optimal solution. Instead of using local updates, the proposed method constructs a highly compressed search space using a binary decision diagram and reduces the optimization problem to a shortest path-finding problem. The described method was shown to be not only accurate but also remarkably efficient; optimization of a large-scale model network with 468 switches was solved in three hours with 1.56% relative error bound & these researchers have developed an efficient network reconfiguration method that yields an error bound solution [13]. Benjamin Kroposki et al discussed that with the increasing use of distributed energy (DE) systems in industry and its technological advancement, it is becoming more important to understand the integration of these systems with the electric power systems. New markets and benefits for DE applications include the ability to provide supportive services, improve energy efficiency, enhance power system reliability, and allow customer choice. This paper examined the system integration issues associated with DE systems and highlights the benefits of using PE interfaces for such applications. This paper describes the basic types and technological aspects of PE for DE applications. Clear benefits in using PE interfaces to interconnect DE systems were discussed and evaluated. The paper further discusses that the proper design and use of PE-based systems can be done in a modular approach by targeting the overall system needs, PE interfaces can improve power quality of the customer by improving harmonics and providing extremely fast switching for sensitive loads, PE can provide benefits to the connected electric power system by providing reactive power control and voltage regulation at the DE system connection point. The paper also explained the unique property of a PE interface to eliminate fault current contributions from DE system & it is also discussed that how PE interfaces provide flexibility in operations with various other DE sources, & how can they potentially reduce overall interconnection costs through standard devices [14]. Mukhtiar Singh et al, this paper presents a novel control strategy for achieving maximum benefits from inverters used for grid interconnection when installed in 3-phase, 4-wire distribution systems. The inverter is designed to perform as a multiple functioning device by incorporating active power filters. The described design of inverter can be used as: 1) power converter to inject power generated from photovoltaic cells to the grid, 2) shunt APF to compensate unbalance & harmonics in the load current, & 3) reactive power compensation for load. The combination of proposed inverter and the 3-phase, 4-wire linear/non-linear unbalanced load at point of common coupling appears as balanced linear load to the grid. It has been proven that the discussed inverter can be efficiently used for power conditioning without any affect on normal operating conditions. The authors concluded that proposed inverter design approach can be utilized to inject real power generated from photovoltaic cells to the grid & operate as a shunt active power filter [15]. J.A. Pecas Lopes et al, this paper presents an overview of the key issues concerning the integration of distributed generation into electric power systems that are of most interest today. The main drivers behind the focus on DG integration, especially of the renewable type, in many countries around the world are also discussed. The paper gives emphasis on the need to move away from the policy of connecting DG to electric power systems through the approach of fit and forget to power system planning and operation through actively managing the distribution networks and applying novel concepts. The paper also analyses the unwanted outcomes in transmission system operation and expansion that are results of the connection of large amounts of DG which adversely impacts the steady state operation, dynamic behavior analysis, contingency analysis, protection coordination. The author shown the results from studies performed in the interconnected Portuguese transmission system. Opportunities that could be utilized in integration and hence greater efficiency of DG into power systems are also explored in the paper. This paper continues with a detailed discussion on the main drivers of DG integration in many countries across the world. The issues discussed are more important and compelling today than they were a decade ago, when DG systems were recognized as an important issue in electricity supply. Brief dialogs are made in the paper about the main challenges that are required to be overcome in the DG integration with electricity supply systems & in this paper [16]. Musa and Sanusi described a method called Ranked Evolutionary PSO which is a hybrid of Evolutionary Programming and PSO. The method explained by the authors uses a ranking process to find best particle out of a group of particles. The explained method improves the voltage profile of the radial distribution network by optimizing the DG size and the site for placement of DG source [17]. Rao and Raju described a method for voltage regulator placement & the method uses plant growth simulation algorithm. The paper explained a process to locate voltage regulators in such optimal way that an improved voltage profile is achieved; the method works in connection with a candidate location technique to give optimal voltage profile for the system [18]. Shivarudraswamy and Gaonkar performed a sensitivity analysis for the voltage at the buses to determine the outputs of multiple DGs in radial networks to get the best possible voltage profile & this enabled coordinated voltage control of the network. Lantharthong and Rugthaicharoencheep explained a method for radial distribution network reconfiguration along with optimal operation of the system. The authors used tabu search method to allocate DG sites and sites for capacitor placement in the radial networks for reactive power compensation. Sharma and Vittal proposed heuristic rules & an index for network performance enhancement to choose location and size of DG source at the different buses, by this way; the overall performance of radial distribution network is improved. The paper discussed measurement of voltage profile using an index for voltage profile improvement. Naik et al, proposes a method for optimization of network based on optimal location of DG through analysis of voltage sensitivity index. The method discussed by the authors uses the forward backward sweep method for power flow analysis & the paper proves that the proposed method is effective for calculations of load flow analysis in distributed networks which are connected radially. Kumar and Navuri, the authors demonstrated a method of DG optimal placement and sizing of DG source in a radial distribution network. In the paper, the optimal site for DG is searched through the use of loss sensitivity factors; these factors helped the author to reduce the search space to a region where the optimal buses were located. The authors used a search method known as simulated annealing for determining the size of DG at the optimal location. Abu-Mouti and El-Hawary put an optimization method of radial network, which basically deals with allocation of DG sites and sizing of DG source in the radial network. The author achieved the task through the use algorithm known as artificial bee colony algorithm. Chenning and Xuequin presented backward forward sweep network load flow method in an improved manner. The proposed method calculates load flow without updating the reactive power flow in the system. The paper has given results by considering various sizes and different locations of DG in the considered networks used for tests. The authors have also made a comparison between the results obtained by the authors' previous work to those results which were obtained through their current work. Khanabadi et al discussed optimal distributed generation size and site allocation in order to eliminate power system's congestion based on AC optimal power flow (ACOPF) with binary variables and the authors solved it by using mixed integer programming. DG's have nonlinear impacts on the power transmitted between any two locations of the network, thus the authors proposed a procedure, which uses ACOPF for completely capturing the impacts of DG installations on the variables like voltage & power flow in the system. The test conducted by the authors on the IEEE-14 bus test system showed that with optimal DG's sizing and allocation, the total cost of operation of the system can be decreased & the congestion related to transmission can also be totally reduced. The results obtained in the paper can lead to lower energy prices for loads which will consequently improve the social welfare & also the losses across the system were significantly decreased.

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Table 1: Optimal DG Locations in the IEEE 33 Bus Radial Distribution System.

Optimization method	Objective function	Optimal DG bus location	Number of front -of- meter DG sources
Fuzzy logic[21]	Power loss	6	1
Whale algorithm [22]	Power loss	30	1
Genetic algorithm+regression [23]	Power loss Voltage stability	11,16,32	3
Genetic algorithm [24]	Power loss	6	1
Particle swarm optimization [26]	Power loss	6,30	2
Power loss[20]	BA +OPF	13,30	2

VI. POWER LOSS CALCULATION IN THE PRESENCE OF DG SOURCES

In order to minimize power loss, it is essential to have accurate power loss calculations. Power loss in a power system operating at steady state is calculated using bus voltages and branch currents [7]. Bus voltages and branch currents are obtained by performing load flow analysis. Load flow analysis solves nonlinear algebraic power equations subject to the following conditions.

• The power system is in steady state.

• The power system topology is fixed.

• The load power demand at each bus is fixed.

• The generated power at P-|V| buses is fixed. The final solutions are obtained when the power equations converge to definite values [8], [9]. By design, transmission systems have almost perfectly balanced three phase loads and a lower R/X ratio in the power lines compared to distribution systems, where R and X are the resistance and reactance, respectively. Moreover, bus voltage magnitudes in a transmission system are significantly larger compared to the currents carried by the conductors. Finally, they are typically designed in a mesh architecture. On the contrary, distribution systems have a large number of unbalanced three phase loads. Furthermore, the low inductance and high resistance of the system components leads to a high R/X ratio. Moreover, the distribution systems have comparable current and voltage magnitudes and they are mostly radial in architecture [3]. As a result of these differences, different load flow algorithms have to be used with transmission and distribution systems. Newton-Raphson (NR) and Gauss-Seidel (GS) based load flow methods are widely used to analyze transmission systems while the forward/backward sweep (FBS) method is more suitable for distribution systems [1], [2].

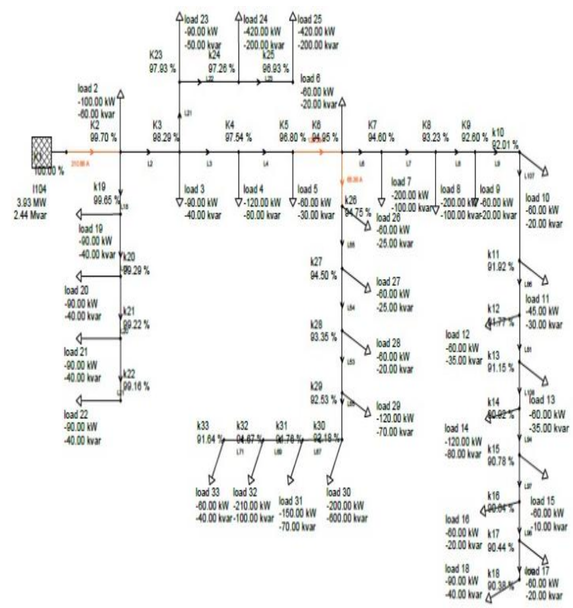
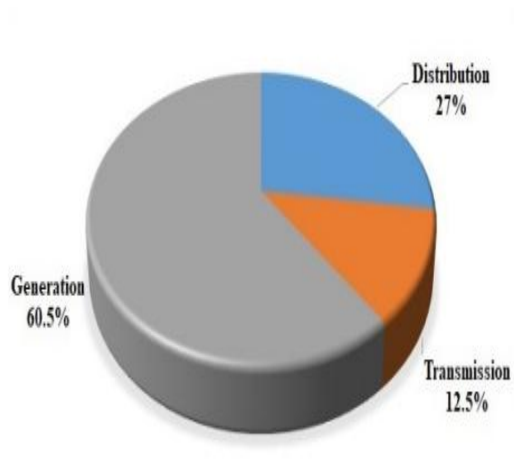


Figure 2: PSS SINCAL model of the IEEE 33 bus radial distribution system.

VII. EXISTING LOSS REDUCTION METHODS

The most common approaches adopted by power utilities to minimize power loss are briefly described below



Capacitor Placement:- Power loss in distribution systems has been reduced by adding shunt capacitors [6], [7], [8]. In this method, shunt capacitors are added to the power system to supply reactive power and improve power factor. As a portion of the active power loss depends on reactive current, the addition of capacitors can reduce the reactive current supplied by the power system thereby reducing active power loss. Consequently, the efficiency of the power system is improved [9]. Cable size and the number of capacitors required are major limitations of this method. Moreover, power loss resulting from the in-phase current component is not affected by the capacitors [1].

Network Reconfiguration:- Network reconfiguration is another approach to reducing power loss in distribution systems. This is achieved by changing the network topology via switches [10]. Tie and sectional switches are employed which are normally open and closed, respectively. Network reconfiguration improves system reliability and power quality by improving the voltage profile. Furthermore, it affects operational costs by reducing power loss and restoring power under fault conditions. It also allows utilities to plan system outages for maintenance. The challenge with this method is to ensure that the topology after network reconfiguration continues to energize all feeder sections while maintaining the initial radial structure. In addition, overload conditions and voltage drop limits for feeders and transformers must be adhered to [10], [11]. Moreover, continuously changing switch positions makes protection 3 coordination a challenge as it is not easy for dispatchers to follow the reconfigured system. Reconfiguration also increases the risk of temporary power outages [1]. These challenges limit the use of network reconfiguration.

Distributed Generation Integration:- Distributed generation (DG) is achieved with electric power sources that are connected directly to a distribution system [12]. Recent technological developments enable small commercial and residential units to generate and feed power to distribution systems. These can be renewable or non-renewable. This has led to increased DG integration in distribution systems. Rising concerns about increased greenhouse gas emissions and the high cost of fossil fuels have made renewable energy based DG sources popular. DG improves distribution system operation by reducing loss and improving the voltage profile [13], [14].

VIII. DISTRIBUTED GENERATION ISSUES

- High peak load: With a scarcity in capability of supply system to supply the peak demand, distributed generation systems that can reduce the peak demand by switching in during peak load period are seen as the most efficient solution to the problem.

- High transmission and distribution losses: Power loss amounts to a remarkable percentage of the total existing energy so distributed power generation systems can greatly reduce the line losses and improve the reliability of the network.

- Remote and inaccessible areas: In many parts of the country, the expansion of the grid is not economically realistic so, in such areas distributed generation can play most important role. Rural electrification: Rural electrification has been recognized as a main concern for rural development by the government of India. Wherever grid extension is not viable, there decentralized distributed generation services with local distribution network can be provided.

- Faster response to new power demands: The modular nature of distributed generation system tied to power electronic devices enables the trouble-free capacity additions when required.

- Improved supply reliability and power quality: interruptions such as grid failure can be prohibited as electricity is produced locally near the consumer. The quality of power, voltage and frequency can also be maintained easily.

IX. OVERVIEW OF FORWARD BACKWARD SWEEP METHOD

The effectiveness of the backward forward sweep method in the analysis of radial distribution systems has already been proven by researchers, by comparing it to the traditional load flow methods. The forward backward sweep method is commonly used due to its computational efficiencies and solution accuracies [7] [3].

One of the distinguishing features of the radial distribution network is that there is a unique path from any given bus to the source. This is the key feature exploited by the backward/forward sweep class of algorithm [8]. This method is based on updating voltages and currents or power flows along the unique distribution paths. There are many variations to backward/forward sweep method but the basic forward backward sweep method is applicable in many systems like studies of waves in oceans etc [9]. There are several possible modifications that can be done in this method, which lead to the other variants that can applied to various kind of systems. Several methods based on the forward/backward sweep concept have been proposed by researchers.

In the dissertation, forward backward sweep method is used for load flow solution, & thus here the forward sweep & backward sweep are used as per electrical calculations [2]. The backward sweep is based on KCL for finding each branch current and on KVL for calculating each bus voltage [1]. All currents and voltages are calculated in phasor forms during the backward sweep. For the forward sweep, the feeder network at each phase is decomposed into two independent resistive networks representing the real and the imaginary components. Therefore, the linear proportional principle is employed in the forward sweep for each decomposed network and to obtain the new three-phase voltage at each bus [2].

X. CONCLUSION

Development of intelligent systems which can control the fault current to low level by cutting out distributed generation sources at the time of fault. Development of systems can cut out the section which is facing fault & switch in the active & reactive power source at the healthy bus. Development of method based on exact algorithm like integer programming for radial distribution system analysis. Searching of optimal buses used for DG placement through some other search methods like search etc. The resizing of DC source using other methods like simulated annealing, artificial bee colony algorithm etc. Verification sweep up of DG site & size allocation by communally using particle swarm optimization & the differential evolution techniques.

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