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Review on Distribution system Reconfiguration for Minimizing Losses and Utilization of DG for Improvement in Voltage Profile

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Abstract: Power distribution networks are mostly operated in a radial configuration. The dynamics of the distribution system operations often requires reconfiguration of the network. Distribution network reconfiguration is achieved by using sectionalizing switches that remain normally closed and tie switches that remain normally open. The main purpose of the reconfiguration is to minimize active power losses in order to improve distribution system performance addresses performance enhancement of distribution network with distributed generator (DG) integration using modified multi objective genetic (MG) algorithm. In the aim of network, reconfiguration is to minimize active power losses and to improve voltage quality. The constraints of the network reconfiguration problem are load flow equations, upper and lower limits of bus voltages, and upper and lower limits of line currents. The effort of performance enhancement is done by using optimization of distribution network configuration. The objective of the optimization is minimizing active power loss and improving voltage profile while the distribution network is maintained in the radial structure. In this study, configuration optimization method is based on a modified MG algorithm.

Keywords: DG, Network Reconfiguration, Power, Load.

INTRODUCTION

Distribution network reconfiguration (DNRC) is a system modifying process performed by power utilities of conveyance systems for various purposes. It is accomplished by adjusting the association status of dissemination organize branches by switching on/off regularly shut/open switches in the framework to such an extent that an ideal system topology accomplished, which gives the best execution concerning some predetermined destinations. These days, DNCR has more significance when extensive quantities of distributed generations (DGs) are normal and being introduced in the circulation system to help natural worries and in addition to enhance the energy security. Each DGs have different operating characteristics and especially solar and wind-based, which are available in abundance everywhere, have less/poor control over their reactive power output, which negatively impacts on maintaining the network voltage profile. Since, renewable based DGs are usually operated at unity power factor for economic reasons with no contribution of reactive power to the load, especially in low penetration of such type of renewable generations. However, due to an exponential increase in load, the demand for reactive power in the future is likely to require DGs to operate at varying power factor for additional reactive power support to meet acceptable voltage profile and also line losses are to be maintained within the limit in the network. Furthermore, at stressful loading conditions, especially during peak loading conditions, network reconfiguration alone may not be sufficient to support the network if the DGs are operated at unity power factor and, if the reactive power is supported by DGs then it will reduce net active power output, which can be considered as energy waste. In the worst case, renewable based DGs (solar and wind) could be removed/shut down from their operation if reactive power deficit cannot be managed from other sources/options. Therefore, to support the reactive power a number of sources are available but apart from it, there is another option to utilize DNCR, which help to alleviate reactive power deficit and reduces wastage of energy from DGs while simultaneously improving voltage profile as well in operating horizons. DNRC is an optimization problem which is considered a highly nonlinear, mixed integer type and a non-differentiable multi-objective problem which renders it impractical to solve with traditional optimization approaches. This is due to the discrete nature of the switches and the characteristics of different constraints and objective functions of the network reconfiguration problem. With the growing popularity of remote terminal units and

supervisory control and data acquisition (SCADA) for distribution automation, real-time DNRC has become more feasible option for power utilities for control and management of the electric grid. The optimization process is further complicated when the variations in the load and the generation from renewables DGs, e.g. the wind and solar are considered.

LITERATURE SURVEY

Research work has been done on the optimal distribution system re-configuration:

Goswami, Swapan Kumar et al. [1] In this power-flow-minimum heuristic algorithm for determining the minimum loss configuration of radial distribution networks. The proposed reconfiguration algorithm has been found to give better network configuration.

Taleski, Rubin et al[2].Radial network analysis-oriented element ordering, power summation method for power flow is used to presents an alternative to the power minimization methods for operation and planning purposes.

Kashem, M. A., et al. [3] They use a novel approach for formulating an algorithm to reconfigure distribution networks for loss minimization. The method can be effectively used to plan and design power systems before actually implementing the distribution networks for locating the tie-switches and providing the minimum number of sectionalizing switches in the branches to reduce installation and switching costs.

Jin, Xiaoling, et al. [4] In this paper they use Binary Particle Swarm Optimization technique for distribution network reconfiguration with the objective of load balancing. Test results based on a sample network have shown that the proposed feeder reconfiguration method can effectively keep load balancing, and the BPSO technique is efficient in searching for the optimal solution.

Das, Debapriya et al.[5] This paper presents an algorithm for network reconfiguration based on the heuristic rules and fuzzy multi-objective approach. Multiple objectives are considered for load balancing among the feeders and also to minimize the real power loss, deviation of nodes voltage, and branch current constraint violation, while subject to a radial network structure in which all loads must be energized.

Li, Zhenkun, et al. [6] This approach is a combination of the binary PSO algorithm and the discrete PSO algorithm. In the problem-solving process, the distribution network is simplified through grouping the branches, and then each group of branches is represented by one-dimensional coding. this improves the efficiency of the search process. Each cycle of iteration within the optimization process is accomplished through two steps. The first step is using the roulette bet method to choose the optimal group of branches that should be opened, and this method is based on the sigmoid ( ) function value in the binary PSO algorithm. The second step adopts the discrete PSO algorithm proposed in this paper to further select the optimal branch that should be disconnected in the group selected in the first step.

Olamaei, J., T. Niknam et al. [7] This paper presents a new approach to DFR at the distribution networks considering DGs. The main objective of the DFR is to minimize the deviation of the bus voltage, the number of switching operations and the total cost of the active power generated by DGs and distribution companies. The feasibility of the proposed approach is demonstrated and compared with other evolutionary methods such as genetic algorithm (GA), Tabu search (TS) and differential evolution (DE) over a realistic distribution test system.

Abdelaziz, Almoataz Youssef, et al. [8] This paper presents the particle swarm optimization (PSO) algorithm for solving the optimal distribution system reconfiguration problem for power loss minimization. The PSO is a relatively new and powerful intelligence evolution algorithm for solving optimization problems. It is a population-based approach.

Jazebi, S., S. H. Hosseinian et al. [9] This paper implements a combinatorial process based on reconfiguration and DSTATCOM allocation in order to mitigate losses and improve voltage profile in power distribution networks. The distribution system tie switches, DSTATCOM location, and size have been optimally determined to obtain an appropriate operational condition. Differential evolution algorithm (DEA) has been used to solve and overcome the complicity of this combinatorial nonlinear optimization problem. To validate the accuracy of results a comparison with particle swarm optimization (PSO) has been made.

Syahputra, Ramadoni et al. [10] This paper presents a reconfiguration methodology based on a fuzzy multi-objective approach for achieving the minimum active power loss and the maximum voltage magnitude of radial distribution networks with distributed generations. The multi-objective function is considered for load balancing among the feeders, minimization of the real power loss, deviation of nodes voltage, and branch current constraint violation, while subject to a radial network structure in which all loads must be energized.

Kumar, K. Sathish et al. [11] In this paper, a method based on bacterial foraging optimization algorithm (BFOA) is proposed for distribution network reconfiguration with the objective of loss minimization. A novel model to simplify a distribution network is presented. The feeder reconfiguration problem is formulated as a nonlinear optimization problem, and BFOA is used to find the optimal solution. According to the characteristics of the distribution network, some modifications are done to retain the radial structure and reduce the searching requirement.

Rao, R. Srinivasa, et al. [12] This paper presents a new method to solve the network reconfiguration problem in the presence of distributed generation (DG) with an objective of minimizing real power loss and improving voltage profile in the distribution

system. A meta- heuristic Harmony Search Algorithm (HSA) is used to simultaneously reconfigure and identify the optimal locations for installation of DG units in a distribution network. Sensitivity analysis is used to identify optimal location s for installation of DG units. Different scenarios of DG placement and reconfiguration of the network are considered to study the performance of the proposed method.

Syahputra, Ramadoni et al. [13] This paper presents an optimal distribution network reconfiguration with penetration of distributed energy resources (DER). The reconfiguration is done to achieve the minimum active power loss of radial distribution networks with DER penetration. In this study, the technique of network reconfiguration is based on an extended fuzzy multi-objective. The multi-objective function is considered for the power loss minimization, deviation of bus voltage, and load balancing among the feeders, while subject to a radial network structure in which all loads must be energized.

Ashari, Mochamad et al. [14] This paper proposes a strategy of power loss reduction of radial distribution network with distributed generator (DG) integration based on a fuzzy multi-objective method in order to improve the distribution system efficiency. Multi-objective functions are considered for power loss reduction, minimization of bus voltage deviation, and maintaining the load balancing among the feeder of the distribution network. These objective functions are modeled with fuzzy sets to evaluate the imprecise nature of each objective. The originality of this work is the fuzzy-based multi-objective optimization in the reconfiguration of distribution network including the distributed generator.

Syahputra, Ramadoni et al. [15] This paper proposed a Power System Stabilizer model based on Fuzzy-PSO for improving power system stability. Power System Stabilizer (PSS) is a device that can be used to enhance the damping of the power system during low-frequency oscillations. In multi-machine power systems, the PSS parameter tuning is a complex exercise due to the presence of several poorly damped modes of oscillation. In this PAPER, Delta w PSS and Delta Pa PSS has been used for comparison with the fuzzy-PSO PSS. The result shows that power transfer response using the fuzzy-PSO PSS is more robust than Delta w PSS and Delta Pa PSS, especially for three phase faults and phase to ground faults.

TABLE OF LITERATURE SURVEY

Authors Name	Year	Technology Used	Description
1 Goswami, Swapan Kumar et al.	1992	Power-flow-minimum heuristic algorithm	The proposed reconfiguration algorithm has been found to give better network configuration than those obtained by some other methods.
2. Taleski, Rubin et al.	1997	Radial network analysis-oriented element ordering, power summation method for power flow	It presents an alternative to the power minimization methods for operation and planning purposes.
3. Kashem, M. A., et al.	2000	A novel method for loss minimization in distribution networks	It provides the minimum number of sectionalizing switches in the branches to reduce installation and switching costs.
4. Jin, Xiaoling, et al.	2004	Binary Particle Swarm Optimization	BPSO technique is efficient in searching for the optimal solution.
5. Das, Debapriya et al.	2006	A fuzzy multi-objective approach for network reconfiguration of distribution systems.	In this paper algorithm for minimizing the number of tie-switch operations.
6.Li, Zhenkun, et al.	2008	A hybrid particle swarm optimization approach for distribution network reconfiguration problem.	In this paper, particles are evolving regularly, and this improves the efficiency of the search process.
7. Olamaei, J., T. Niknam et al.	2008	particle swarm optimization for distribution feeder reconfiguration considering distributed generators	DFR is to minimize the deviation of the bus voltage, the number of switching operations and the total cost of the active power generated by DGs and distribution companies.
8. Abdelaziz, Almoataz Youssef, et al.	2009	Modified particle swarm optimization algorithm.	Comparative studies are conducted on two test distribution systems to verify the effectiveness of the proposed PSO algorithm.
9. Jazebi, S., et al.	2011	DSTATCOM allocation in distribution networks considering reconfiguration using differential evolution algorithm.	PSO is used for effective and results show the effectiveness of the combinatorial approach in loss reduction and voltage profile improvement.
10. Syahputra, Ramadoni et al.	2012	Reconfiguration of distribution network with DG using fuzzy multi-objective method	These functions consider for load balancing and active power loss reduction.

CONCLUSION

In proposing a methodology for optimal reconfiguration of radial distribution network with the presence of DG using the modified Multi objective Genetic algorithm. The methodology was based on minimizing power losses and improving voltage quality in order to enhance distribution system performance. The methodology was tested on a standard of 33-bus radial distribution network test system and a practical 60-bus radial distribution system of districts. Based on the numerical results, it was shown that the algorithm is effective in enhancing the efficiency of the two test distribution systems. Efficiencies of the 33-bus radial system in the original condition, after integration of five DGs, and after network reconfiguration

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