

EFFECT OF NETWORK RECONFIGURATION ON POWER QUALITY OF DISTRIBUTION SYSTEM

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Abstract - This Paper presents effect of network reconfiguration on power losses in distribution system has been investigated. The Network reconfiguration is restructured of distribution system with an objective to improve the power quality. The general objective of losses minimization, power quality along with related objective such as harmonics distortion, voltage unbalance and voltage sag are identified as the objectives of network reconfiguration. Every of the objectives are solved by the Branch exchange technique. It can be used as very an effective tool to improve the power quality of distribution system. The Distributed energy sources also have great effect on distribution system. Their location and size are found to have great importance on the voltage unbalance, Harmonic distortion, power loss, and voltage sag. The effectiveness of the network reconfiguration on power quality issues have been studied on 25-bus unbalance radial distribution network with Distributed generators and Capacitors.

Key Words: Distribution system, Power quality, Network reconfiguration, Branch exchange technique.

1. INTRODUCTION

The Importance electrical distribution system delivers electricity to the customers by carrying it from transmission system. Distribution of electric power to various clients is completed with much minimum voltage point. The distribution of electric power from bases to the end levels is complemented with power losses at all times. Power losses arise in distribution systems due to Joule's effect which can calculation for as much as 13% of the produced energy [1-3]. Energy losses occur in the process of supplying electricity to consumers due to technical and commercial losses. The technical losses are due to energy dissipated in the conductors and equipment used for transmission, transformation, sub- transmission and distribution of power. These technical losses are inherent in a system and can be reduced to an optimum level.

The losses can be further sub grouped depending upon the stage of power transformation & transmission system as Transmission Losses (400kV/220kV/132kV/66kV), as Sub transmission losses (33kV /11kV) and Distribution losses (11kV/0.4kv). The commercial losses are caused by pilferage, defective meters, and errors in meter reading and in estimating unmetered supply of energy.

Thus, loss reduction in distribution systems has constituted one of the most important objectives for researchers and engineers. In the recent years, many researchers have been interested in considering reliability related issues in the distribution network reconfiguration process.

Reconfiguration of distribution network has long been identified as a very useful method for the improved power quality of the system.

2. PAPER REVIEWED

Priyesh Kumar at [1] have performed on Analysis of Network Reconfiguration Technique for Loss Reduction in Distribution System. An electric distribution structure plays a significant character in achieving satisfactory power supply. The quality of power is measured by voltage stability and profile of voltage. But because of losses in distribution system, its voltage profile affects. In this paper we analyze different techniques to reduce these losses in distribution system and examine the Network Reconfiguration method based on various parameters in detail and find out the optimum one.

S.K.Goswami at [2] have performed, Effect of network reconfiguration on power quality issues of distribution system has been investigated. The problem of network reconfiguration is reformulated with an objective to improve the power quality of the distribution system. Along with the traditional objective of loss minimization, power quality related objectives such as minimization of harmonic distortion of the voltage waveform, minimization of voltage unbalances at the nodes and maximization of sag voltages are identified as the objectives of reconfiguration. They has been Branch exchange technique used to establish each of the objectives.

Aboelsood Zindan at [3] performed, Distribution system reconfiguration for energy loss reduction considering the variability of load and local renewable generation. In this paper method based on GA (genetic algorithm) is presented to investigate the distribution system reconfiguration problem taking into consideration the effect of load variation and the stochastic power generation of renewable DG (distributed generators units). The presented method determines the annual distribution network reconfiguration scheme considering switching operation costs in order to

minimize annual energy losses by determining the optimal configuration for each season of the year.

Sasan Ghasemi [4] performed on Balanced and unbalanced distribution networks reconfiguration considering reliability indices. Distribution system reconfiguration problem is a complex optimization process to find a structure with minimum losses in which the satisfaction of both sides, those are consumers and distribution system companies, need to be met. One of the most significant parameters in this regard is to increase the reliability of the system. This parameter, on one hand, increases the satisfaction of power consumption and on the other hand, improves the economic benefits of distribution companies. Distribution system reconfiguration, considering the reliability parameters, seems to make the attempts to solve the problem of optimization difficult. In this paper, a modified heuristic approach for distribution system has been presented. Also, in order to consider reliability indexes, a number of new formulas have been presented.

J.S.Saviar [5] performed on Loss allocation to consumers before and after reconfiguration of radial distribution networks. the research allocation of power losses to consumers connected to radial distribution network before and after network reconfiguration in a deregulated environment. Loss allocation is made in a quadratic way, which is based on identifying the real and imaginary parts of current in each branch and losses are allocated to consumers. Comparison of loss allocation after multi-objective approach based distribution network reconfiguration is made with those before reconfiguration. For network reconfiguration, multiple objectives are considered for minimization of system real power loss, deviations of nodes voltage, branch current constraint violation and transformer loading imbalance and they are integrated into an objective function through appropriate weighting factors which is minimized for each tie switch operation.

Distribution system reconfiguration for loss reduction was first proposed by Merlin and Back [6]. They have used a branch exchange and bound type optimization technique to determine the minimum loss configuration. In this method, all network switches are first closed to form a meshed network. The switches are then opened successively to restore radial configuration.

Vahid Farahani at [7] have performed on Reconfiguration and Capacitor Placement Simultaneously for Energy Loss Reduction Based on an Improved Reconfiguration Method. Network reconfiguration and capacitor placement have been widely employed to reduce power losses and maintain voltage profiles within permissible limits in distribution systems. Reconfiguration method proposed in this paper is based on a simple branch exchange method of single loop. In this simple method of branch exchange, loops selection sequence affects the optimal configuration and the network loss. Therefore, this method has been improved by

optimizing the sequence of loops selection for minimizing the energy losses in this paper. Discrete genetic algorithm (GA) is used to optimize the location and size of capacitors and the sequence of loops selection. In fact, the capacitor sizes have been considered as discrete variables. Simulated annealing (SA) is also applied to compare the performance of convergence. The proposed algorithm is effectively tested on a real life 77-bus distribution system with four different kinds of load patterns.

Mohammad Hossein Karimi and Seyed Abbas Taher at [8] have performed on Optimal reconfiguration and DG allocation in balanced and unbalanced distribution systems. This paper investigates feeder reconfiguration in balanced and unbalanced networks and presents an efficient method to optimize practical distribution systems by means of simultaneous reconfiguration and distributed generation (DG) allocation. A precise and robust load flow algorithm is applied and a composite multi-objective function is formulated to solve the problem which includes: 1. voltage profile, 2. power loss saving, 3. current unbalance of the system, and 4. voltage unbalance. The genetic algorithm (GA) is utilized to search for optimal solution.

3. OBJECTIVES OF NETWORK RECONFIGURATION

In recent years various power quality problem, harmonics, voltage sag and voltage unbalance issues are solve with intense attention because of the increased use of sensitive load in distribution system. The network reconfiguration problem has been solved to voltage sag, harmonics and minimization of power loss problem. In this method loss minimization ,reliability and voltage sag access are incorporate in the network reconfiguration problem. Branch exchange technique [2] has been applied to determine the optimum reconfiguration strategy, so as to minimize the effects of various power quality issues along with the network losses.

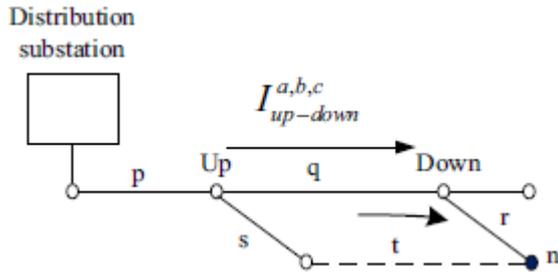
Thus, the objectives of network reconfiguration may be formulated as[2]:

- [1] Minimize Power loss in the network.
- [2] Maximize Sag voltage in the network during fault or switching.
- [3] Minimize Harmonic distortion of the node voltages.
- [4] Minimize System unbalances

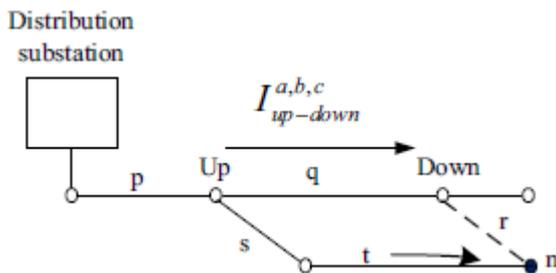
3.1 Branch exchange technique

Electrical power distribution network generally have necessary configuration. Reconfiguration distribution network, But, they have tie branches which are normally kept unenergized. These tie branch absorb in the distribution network by closing the tie switches at the ends of the branches. In this technique, one tie branch is include

in the distribution network and different branch, which was generally closed, and is opened to restore the radial configuration[2]. The process may be explained considering the network in Fig. 1(a), where branch 't' is the normally open tie branch[2].



(a) Before configuration



(b) After configuration

Fig. 1. Power flow paths in a radial distribution network before and after reconfiguration[2]

A load connected at node 'n' is fed through branches p-q-r. The power flow path to the node 'n' may be changed by closing the line 't' and opening line 'r' thus, changing power flow path as p-s-t to the node 'n'. The resulting network configuration is shown in Fig. 1(b). The greatest advantage of branch exchange technique is that, radial configuration is automatically maintained and no computation and search procedure is needed for this purpose.

4. COMPARISON WITH OTHER METHOD

In [8] network reconfiguration problem has been solved for loss minimization, node voltage improvement, voltage unbalance reduction and minimization of total harmonic distortion of the node voltages. A fuzzy-Genetic algorithm (GA) approach has been used where the fitness function for optimization through GA has been formed using fuzzy membership functions for the cost, bus voltage, harmonic voltage distortion and voltage unbalance factor. Results are produced for the IEEE 33-bus test system with 5 tie switches.

The formulation in the present paper is very close to that in [8], with the only difference in the objective function is that, voltage sag maximization has been considered instead of

node voltage improvement. The solution algorithm however is totally different from that in [8]. The network configuration obtained also is somewhat different from [8]. The network, load and harmonics data used for the study are as given in [8]. The three cases mentioned in the table are those defined in [8] and are mentioned as below.

It may be observed that, the network configuration obtained by the proposed algorithm results in a lower power loss than that obtained by the method in [8]. Voltage sag, voltage distortion and voltage unbalances are all well within the permissible limits, though these values are somewhat on the superior side in the configuration of [8]. This is due to the fact that in the proposed branch exchange algorithm, the loss reduction objective is given much higher priority when the power quality factors are not violated.

Table -1: Optimum configurations without any distributed energy and VAR sources for base 25-bus unbalanced radial distribution system[2]

Comparisons of different Objective					
Objective	P loss (kw)	P loss (H) (kw)	VTHD %	V sag %	V unb Pu
Initial	150.12	181.78	4.8375	0.430	0.806
Min. Ploss	133.49	162.06	4.3351	0.419	0.813
Min. VTHD	138.12	167.59	4.3126	0.419	0.814
Max. Vsag	138.12	167.59	4.3126	0.428	0.814
Min. Vunb	137.85	167.145	4.3279	0.4168	0.8141

Table 2: comparison of power quality issues in a 33-bus unbalanced radial distribution system.

Item	Method	Ploss (kW)	Ploss(H) (kW)	VTHD %	Vsag %	Vunb pu
Case1	Method in Ref. [1]	61.1362	73.5157	0.044	0.0245	0.0496
	Proposed method	62.9609	75.7099	0.6844	0.0496	0.0433
Case2	Method in Ref. [1]	32.3829	38.9402	1.4074	0.0123	0.0332
	Proposed method	37.904	45.5792	0.0274	0.0349	0.0403
Case3	Method in Ref. [1]	46.167	55.5154	0.4843	0.0351	0.0382
	Proposed method	62.7281	75.4299	0.6927	0.0477	0.0465

5. CONCLUSIONS

In this paper, we provide various losses in distributed system. The network reconfiguration is one of the most useful approach for various power quality issues such as voltage unbalance, voltage sag and harmonic distortion. Network reconfiguration has been formulated incorporating as above power quality problems component objective function and solution suggested using Branch exchange

technique. The Impression of the Branch exchange technique is most economic approach for loss reduction compare with other techniques in 25-bus unbalance radial distribution network.

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