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AN EXTENSIVE REVIEW ON OPTIMAL RECONFIGURATION OF POWER DISTRIBUTION SYSTEM WITH VOLTAGE STABILITY INDEX

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Abstract- Today's the power distribution system is closely operating to its stability limits. The stability of the distribution system (DS) by many researchers estimated mostly using voltage stability index. The existing distribution system is incapable to meet the required demand with power quality. The cost function is a prominent factor in operation of the existing as well as incorporating new distribution system. Therefore, reconfiguration and integration of renewable sources is an alternate way to meet the demand in distribution system at optimal cost. In this paper an extensive literature of reconfiguration categorized into three ways with various optimization techniques are presented.

Key words: Reconfiguration, Voltage stability index, Optimization technique

I. INTRODUCTION

RDS is typically preferred in DS due to its simplicity and affordability. In that there is only one passage between the substation and the customer, radial constructions are akin to trees in this regard. Branch impedance, load demand at the receiving end, as well as sending end voltage, are just a few of the variables that will affect the branch current. As a result, for economical/minimized PL as well as for efficient operation/reliability of the power system, a suitable route for power flow is necessary according to branch current. The purpose of switching the power's path.

The reconfiguration of power DS (PDS) is classified into three categories which are as under:

i. Power DS reconfiguration (PDSR) having heuristic based approach (HBA).
ii. Power distribution reconfiguration (PDSR) based on mathematical optimization approach (MOA).
iii. PDSR based on metaheuristic approach (MA).

The literature of reconfiguration based on the three mentioned approach considering individually is as under:
Power DS reconfiguration (PDSR) having heuristic based approach (HBA).
Merlin and Back [1] had proposed pioneer based optimization method as well as heuristic approach such as branch and bound method for loss minimization in meshed and RDS. In this work, the authors considered that all tie lines are first closed and then open the one branch at a time to maintain the radiality of the proposed DS. Castro [2] reported a heuristic search algorithm for feeder load balancing and system restoration in PDS. The proposed algorithm maintain the feeder loading as well as radiality using network reconfiguration. Ross *et al.* [3] represented loss minimization as well as feeder load balancing based on branch exchange method using heuristic approach in PDS. Aoki *et al.* [4] had reported an approximate method which was based on heuristic rule for balancing of feeder load as well as minimization of total PL. Civanlar *et al.* [5] had reported branch exchange method for loss estimation based on heuristic approach which was used for approximate loss estimation in PDS. Baran and Wu [6] presented an algorithm for loss minimization by using feeder load balancing in RDS. The proposed algorithm was based on branch exchange hueristic approach for RDS. Liu *et al.* [7] reported a composite load model for LF problem to minimize the loss in RDS. This heuristic approach was used for uniform distributed as well as concerntrated load.

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Shrimohammadi and Hong [8] presented a switch opening method using compensation meshed and radial for analysis of LF. The method was used for optimal power flow pattern by considering all tie lines should be closed and successively branch to be opened to maintain the radiality of the system. Castero and Watanabe [9] had proposed a hueristic branch exchange method for loss minimization by using loss estimation formula in RDS. Huddleston *et al.* [10] reported branch exchange heuristic approach for loss minimization using quadratic loss function with multiple switch pair in its each iteration. Taylor and Lubkeman [11] presented heuristic rule base mehtod for loss minimization as well as prevention of transformer feeder overloading in RDS. This was the first searching method in RDS. Wagner *et al.* [12] reported Gauss Siedel method for loss minimization by using combination of two heuristic approach such as optimum power flow as well as branch and bound method. Chen and Cho [13] had reported energy loss minimization as objective function by using branch exchange as well as heuristic approach for 3-φ LF analysis in RDS which was used for optimal switching on hourly basis in a day. [14] Goswamia and Basu had proposed switching opening method for loss minimization in meshed as well as radial LF problem which was used to close done tie line with removal of one branch in a loop having minimum current. Rosetti *et al.* [15] reported a combined heuristic constructive algorithm for energy loss minimization with distributed generation allocation in meshed DS. Ahmadi and Marti [16] presented a switch opening method which was based on heuristic algorithm for loss minimization in meshed DS. Benardon *et al.* [17] reported branch exchange method based on real time DS with DG by using weighted sum multi objective in RDS. Ding and Lapro [18] had proposed a combined approach as branch exchange based on hueristic approach for minimization of loss with voltage and radiality are constraints in unbalanced RDS. Ghasemi and Moshtaghi [19] had proposed an improved branch exchange method which was based on hueristic algorithm for minimizing cost in unbalanced RDS. Oliveira *et al.* [20] had reported sensitive calculation by using branch exchange method based on heuristic for minimization of loss subject to current and constraints are voltage and radiality in unbalanced RDS.

PDSR based on mathematical optimization approach (MOA).

Aoki *et al.* [21] reported loss minimization based on recursive quadratic programming approach with voltage, radiality and substation capacity as constraints in meshed RDS. Augugliaro *et al.* [22] had proposed switch opening method for loss minimization in reconfiguration by adopting non-linear programming in meshed RDS. Wagner *et al.* [23] had proposed a loss minimization approach by using two hueristic approach such as optimum power flow as well as branch and bound method. Abur [24] had presented loss minimization using linear programming simplex method with voltage and radiality which are constraints in radial LF analysis. Morton and Mareels [25] had reported a brute force solution through an exhaustive search for loss minimization in reconfiguration of RDS. Ramos *et al.* [26] had presented mixed integer linear programming method for loss minimization with voltage and radiality as constraints in radial LF problem. Schmidt *et al.* [27] had reported loss minimization problem by using mixed integer method in LF of RDS. EI Ramli *et al.* [28] had reported loss minimization of RDS using ordinal optimization. Jabr *et al.* [29] had presented mixed integer convex as well as non linear programming for loss minimization with distributed generation as constraints. Dall' Anese and Giannakkis [30] had proposed a novel convex reconfiguration formulation for weighted sum multi-objective feeder load balancing in 3-φ LF problem. Deese [31] had presented loss minimization problem by using dynamic programming based method in meshed RDS.

PDSR based on metaheuristic approach (MA).

The meta heuristic approach is categorized into various methods for reconfiguration which are as under:

a. *Genetic algorithm method for reconfiguration:*

Many researchers have reported reconfiguration in RDS using genetic algorithm. Nara et al [32] had presented earliest GA for loss minimization with voltage as well as radiality are constraints in reconfiguration of RDS. Zhong [33] had proposed Fussy multi-objective model using enhanced GA for network configuration in RDS. Shin *et al.* [34] had reported loss minimization as well as interruption cost using Genetic Tabu search algorithm for network reconfiguration in DS. Hong and Ho [35] had reported fussy multi-objective model to minimize PL as well as voltage deviation using refined GA in RDS. Mendoza *et al.* [36] had reported multi-objective problem as minimize construction cost as well as energy node supplied by using strong pareto GA in analysis of meshed DS. Maza *et al.* [37] had reported non-dominated genetic algorithm-II based on netwrok reconfiguration to minimize the energy which is not supplied in RDS.

b. *Simulated annealing (SA) based method:*

Chang and Kuo [38] had proposed loss minimization problem by using simplified line equation to speed up the SA process in analysis of RDS. Su and Lee [39] had reported loss minimization with improvement in voltage profile using reconfiguration by optimal placement of capacitor in RDS. Geon and Kim [40] had reported loss minimization problem for network reconfiguration by using hybrid approach such as Tabu search mixed with

simulated annealing in RDS. Chen *et al.* [41] had reported minimization of loss as objective function with voltage and radiality as constraints by using simulated annealing immune algorithm.

c. Evolutionary programming (EP) based method

Venkatesh and Ranjan [42] had proposed minimization of PL as well as deviation using fuzzy adaptive EP based on branch exchange method. Hsiao [43] had proposed minimization of PL, voltage deviation as well as ensuring the reliability issue related to the customers by using EP and fuzzy. The proposed algorithm was reconfigured using EP and reliability objective considered by fuzzy. Venkatesh *et al.* [44] had reported minimization of loss as well as voltage deviation using EP based on branch exchange method for the analysis of LF. Delberm *et al.* [45] had proposed multi-objective planning of DS by using evolutionary algorithm with graph chain representation for the analysis of radial LF.

d. Differential evolution (DE) based method

Su and Lee [46] had proposed minimization of loss using improved hybrid DE algorithm with voltage as well as radiality as constraints for LF analysis in RDS. Chiou et al [47] had proposed an hybrid DE based algorithm for loss minimization with radiality as well as voltage are constraints for the analysis of LF in RDS. Jazebi and Vahidi [48] had reported a multi-objective function which includes loss minimization, total harmonic distortion as well as voltage sag by using DE in RDS.

e. Artificial Neural Network (ANN) based method

Kim and Hung [49] had reported loss minimization problem using network reconfiguration based on ANN mapping ability in RDS. Kashem *et al.* [50] had proposed loss minimization problem using network reconfiguration based on ANN in RDS. Siti *et al.* [51] had proposed phase balancing as well as loss minimization by using combination of hueristic approach and ANN for the analysis of unbalanced LF problem in RDS.

f. Tabu search (TS) based method

Augugliaro *et al.* [52] had proposed loss minimization by using three methods such as Tabu search, genetic algorithm and simulated annealing for reconfiguration in meshed and radial LF analysis. Li *et al.* [53] had reported minimum loss as objective function using Tabu list for preventing trapping of local maxima for reconfiguration in RDS. Mishima *et al.* [54] had presented a Tabu search based with DG as objective function for minimization of loss with constraints in RDS. Abdelaziz *et al.* [55] had reported TS method with modified dynamic Tabu list for minimization of loss in reconfiguration with voltage and liability as constraints.

g. Ant colony optimization (ACO) based method

Su *et al.* [56] had proposed minimization of loss with penalty function by using ACO based on reconfiguration in RDS. The results were compared with SA and GA based reconfiguration in RDS. Ahuja *et al.* [57] had presented a multi-objective function as loss minimization, transformer load balancing and voltage deviation by using hybrid ACO for network reconfiguration in DS. Chang [58] had reported loss minimization having plenty function based on ACO for reconfiguration with capacitor placement in RDS. Niknam [59] had reported hybrid PSO and ACO for multi-objective function as loss minimization, voltage deviation, number of switching and feeder load balancing in reconfiguration of RDS. Wu *et al.* [60] had presented ACO with DG for loss minimization as well as feeder load balancing in network reconfiguration problem.

h. Artificial Immune System (AIS) algorithm based method

Ahuja *et al.* [57] had presented an hybrid ACO and AIS for loss minimization as well as voltage deviation in reconfiguration of DS. Oliveira *et al.* [61] had presented minimization of cost that involved in energy loss at each load which was based on colonel selection AIS algorithm for recofiguration in RDS.

i. Bacterial foraging (BF) based method

Satish Ana Jayabharthi [62] had reported loss minimization using BF based network reconfiguration with voltage and radiality as constraints. Hooshmand and Soltani [63] had presented 3-φ LF analysis using BG combined with nelder mead algorithm for network reconfiguration.

j. Honey bee mating optimization (HBMO)

Niknam [64] had reported hybrid PSO and HBMO algorithm for reconfiguration using minimization of loss, voltage deviation and feeder load balancing in RDS. Niknam *et al.* [65] had proposed modified HBMO algorithm for reconfiguration of DS using minimization of loss voltage deviation and cost involved in generation with constraints are considered for network recofiguration. The proposed algorithm have wind generator, photovoltic cell and fuel cell for the generation are considered. Olamaei *et al.* [66] had proposed modified HBMO algorithm for reconfiguration with objective function as loss minimization as well as voltage deviation.

k. Particle swarm optimization (PSO) algorithm based method

Sivanagaraju *et al.* [67] had proposed discrete PSO for loss minimization and feeder load balancing in network reconfiguration. Niknam [65] had proposed hybrid PSO algorithm for network reconfiguration by minimizing loss, voltage deviation and feeder load balancing. Amanulla *et al.* [68] had proposed binary PSO for network reconfiguration with probabilistic reliability evaluation using PL minimization and maximizing the reliability of the network. Niknam *et al.* [69] had proposed hybrid algorithm using fuzzy logic and adaptive PSO for network reconfiguration with minimum loss as objective function. Sedighizadeh *et al.* [70] had presented hybrid Big Bang-Big Crunch PSO algorithm for network reconfiguration using minimization of loss voltage, deviation and feeder load balancing.

l. *Harmony search algorithm (HSA) based method*

Rao *et al.* [71] had reported HSA based network reconfiguration using loss minimization as objective function with voltage and radiality as constraints. Abdelaziz *et al.* [72] had reported ACO and HS based network reconfiguration for minimization of loss with voltage and radiality as constraints in RDS. Rao *et al.* [73] had presented HSA based network reconfiguration having DG placement for minimization of loss with voltage and radiality as constraints.

m. *Plant Growth Simulation (PGS) based method*

Wang and chang [74] had proposed PGS based algorithm for loss minimization in reconfiguration with its constraints. Teaching learning based optimization (TLBO) based method. Azad-Farsani *et al.* [75] had proposed hybrid chaotic PSO-TLBO based network reconfiguration with loss minimization as objective function for the analysis of RDS. Kavousi-Fard *et al.* [76] had proposed probabilistic TLBO for network reconfiguration with objective function as minimization of loss, cost of energy generation and voltage deviation.

n. *Quantum fire fly algorithm (QFA) based method*

Shareef *et al.* [77] had reported QFA based network reconfiguration for minimization of loss as well as maximizing the reability indices in RDS.

o. *Shuffled frog leaping algorithm (SLFA) based method*

Niknam and Farsani [78] had proposed hybrid self adaptive PSO and modified SFLA for network reconfiguration using loss minimization with its constraints. Kavousi-Fard and Zadeh [79] had proposed improved SLFA for network reconfiguration with enhanced reliability indices and loss minimization in RDS.

p. *Discrete artificial bee colony (DABC) based method*

Aman *et al.* [80] had proposed DABC method based on graph theory for network reconfiguration using minimization of voltage deviation and maximisation of loadability margin in RDS.

q. *Binary group search optimization (BGSO) based method*

Teimourzadeh and Zare [81] had proposed BGSO based network reconfiguration with loss minimization as objective function with its constraints.

r. *Bat algorithm (BA) based method*

Kavousi-Fard and Niknam [82] had reported self adaptive modified BA for network reconfiguration using minimization of loss and maximization of reliability with LF as probabilistic. Sivanagaraju *et al.* [83] had proposed an enhancing voltage stability of RDS by using network reconfiguration. The results were tested on 69 node RDS. The main objective is to maximize the loading and the system even can assure the voltage stability.

Hemdan *et al.* [84] had proposed an efficient and simple method for the assessment of voltage stability in steady state of RDS. The condition for voltage collapse is lie between 1 and 0. The maximum value for voltage collapse is 1 and 0 specify the no load condition.

M.Arun and P.Aravindhababu [85] had reported voltage stability enhancement by using recofiguration of RDS. The authors presented multi-objective function which includes minimum loss, improve voltage profile and additional equipment cost of installation.

N.C.Sahoo and K.Prasad [86] had proposed a fuzzy genetic approach to enhance voltage stability as well as minimized the PLfor network reconfiguration in RDS. The results were tested on 69 and 33 bus RDSs.

Conclusion: Operation of the current distribution system as well as the addition of new distribution systems both heavily rely on the cost function. Reconfiguring the distribution system and incorporating renewable sources is a different strategy to satisfy demand at the lowest possible cost. This paper presents an important collection research on reconfiguration that is divided into three categories and uses various optimization methods.

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