A Review of Various Techniques for Optimal Placement of Capacitors for Reactive Power Control

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***Abstract* - Reactive power management has been a vital downside for the last a few years. The role of reactive power will be understood because it affects voltage stability, power issue and losses during a grid. To unravel this downside several approaches are utilized in the literature. Capacitors are used for identical. However the matter lies to find the best location and size of the capacitors. This paperreviews all the literature existing till date to the best of my knowledge in the field of locating the best placement of capacitors and size of the capacitors deployed. The merits and demerits of the various techniques are discussed and concluded with our own proposition.**

***Keywords* - Reactive Power Management, Optimal placement of Capacitors, Plant Growth Simulation Algorithm**

I. INTRODUCTION

Power Compensation

Except in an exceedingly only a few special things, current is generated, transmitted, distributed, and utilised as AC. However, AC has many distinct disadvantages. one in all these is that the necessity of reactive power that has to be provided along side active power. Reactive power will beheading or insulant. While it's the active power that contributes to the energy consumed, or transmitted, reactive power doesn't contribute to the energy. Reactive power is associate degree inherent a part of the ‘‘total power.’’ Reactive power is either generated or consumed in virtually each part of the system, generation, transmission, and distribution and eventually by the hundreds. The resistivity of a branch of a circuit in associate degree AC system consists of 2 parts, resistance and electrical phenomenon.

Filtering components

- High voltage reactors
- Electronic products for high voltage applications
- Reactive Power Compensation and Filtering equipment
- High voltage shunt capacitor banks

II. BASIC PRINCIPAL OF POWER COMPENSATION IN TRANSMISSION:

It shows the simplified model of an influence transmission. 2 power grids square measure connected by a cable that is assumed lossless and painted by the electrical phenomenon XL. 11δ∠V and 22δ∠V represent the voltage phases of the 2 power system buses with angle δ= δ1- δ2 between the 2.

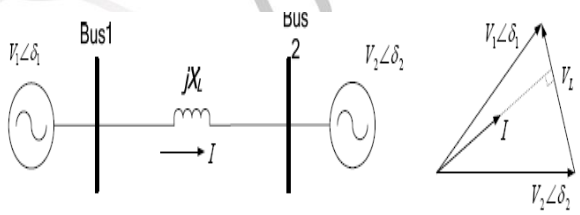

Figure: 1.1. Power transmission system: (a) simplified model; (b) phase diagram [10]

The magnitude of this within the cable is given by:

$$I = \frac{V_L}{X_L} = \frac{\left|V_1\angle\delta_1 - V_2\angle\delta_2\right|}{X_L} \quad (1)$$

The active and reactive parts of this flow at bus one square measure given by:

$$I_{d1} = \frac{V_2 \sin\delta}{X_L}, \qquad I_{q1} = \frac{V_1 - V_2\cos\delta}{X_L} \quad (2)$$

III. LITERATURE SURVEY

Kannan, S. M., et al.[6] proposes capacitor placement in radial distribution feeders to reduce real power loss, to increase voltage profile and to get economical saving. The weak buses identification, where capacitors are placed is decided of rules given by fuzzy expert system. Node voltage and power loss indices are used as inputs to fuzzy expert system and output is index sensitivity that gives weak buses in system where capacitor to be placed. The size of capacitors is modeled by objective function to attain the maximum savings while using the Multi Agent Particle Swarm Optimization and Differential Evolution. To consider the applicability of algorithms, the simulation is displayed on existing IEEE 34 bus and 15 bus distribution feeders. The conclusion of these approaches is compared with HPSO, PSO techniques and with results.

Mohkami, H.banks et al. [11] has been projected based on bacterial foraging oriented by particle swarm optimization algorithm. This algorithm is used for meshed and radial networks in presence of the unbalanced and nonlinear loads. The objective function considers the decrement of total energy loss costs and network total harmonic distortion index, capacitor installation cost and deviation of voltage fundamental component from permitted value. These parameters do not have same variation and unit ranges; a membership degree is identified to each parameter by fuzzy sets. The IEEE 123- Bus distribution network has been used to test the method. The simulation results of algorithm are compared with BF, particle swarm optimization and genetic algorithms to display efficiency of method to decrease system costs.

Prakash, K. et al. [16] has invented an approach to determine the optimal size and location of the capacitors on radial distribution systems to prolong the voltage profile and reduce the active power loss. Capacitor placement & sizing are done by Loss Sensitivity Factors and Particle Swarm Optimization respectively. The concept of Loss sensitivity Factors that considered as new contribution in area of the distribution systems. Loss Sensitivity Factors provide important information about sequence of the potential nodes for capacitor placement. These factors can be determined while using the single base case load flow. Particle Swarm Optimization has well applied and searched to effective in the Radial Distribution Systems.

Sultana, Sneha et al. [27] has been described (TLBO) teaching learning based optimization technique to decrease the energy cost and power loss by the optimal placement of capacitors in the radial distribution systems. The algorithm can be based on two basic concept of the education teaching phase and learning phase. In the first phase, learners can prolong the knowledge and ability with teaching methodology of the teacher and in the second part learners can improve their knowledge by the interactions among themselves. To check feasibility of proposed method which can be applied on the standard 22, 69, 85 and 141 bus radial distribution systems. These numerical experiments can included to describe the teaching learning based optimization can attain better solution quality than several existing techniques like particle swarm optimization, genetic algorithm, mixed integer linear programming and direct search algorithm approach.

Sundhararajan et al. [28] has been discussed a new methodology design to determine the location, size, number and type of capacitors to be located on radial distribution system is displayed. The main objective is decreases the energy losses and peak power losses in distribution system to consider the capacitor cost. A sensitivity analysis method can be used to choose the candidate locations for capacitors. In this optimization technique use a Genetic Algorithm to determine the fixed selection of capacitors. These test results can be displayed along with discussion of algorithm.

Tabatabaei, S. M et al. [29]have been planned a novel method for optimal location and size of the shunt capacitors in the radial distribution systems. It is based on fuzzy decision making that uses new evolutionary method. The capacitor placement optimization problem involves: decreasing cost of peak power, reduces energy loss and improves the voltage profile. The installation node has been opted by fuzzy reasoning which is supported by fuzzy set theory in step by step procedure. An evolutionary algorithm called as bacteria foraging algorithm is utilized to solving objective multivariable optimization problem and optimal node for the capacitor placement is described.

Taher, Seyed Abbas et al. [30]has been briefed genetic algorithm which used for simultaneous optimal placement, power quality improvement, and fixed capacitor banks in the radial distribution networks with the nonlinear loads and distributed generation imposes voltage–current harmonics. In the distribution systems, nonlinear loads and Distributed generations can be considered as harmonic sources. To optimize the capacitor sizing and placement in distribution system, the objective function involves cost of energy losses, power losses and capacitor banks. At same time, constraints consists the number/size of installed capacitors, voltage limits and power quality limits of the standard IEEE-519. In the study of fitness function which is used to solve constrained optimization problem with the discrete variables. The simulation results for two IEEE distorted networks can be displayed and solutions are compared with described methods .

Reddy, M. Damodar et al. [19] has been described the methodology of Real Coded Genetic Algorithm and fuzzy for placement of the capacitors on primary feeders of radial distribution systems to decrease power losses and to increase voltage profile. The two-stage methodology can be used for capacitor placement problem. In first stage, fuzzy approach used to find theoptimal capacitor locations and in second stage, Real Coded Algorithm is used to find the sizes of capacitors. The sizes of capacitors corresponding to higher annual savings are determined. It is tested on 15-bus, 69-bus and 34-bus test systems and the results are displayed.

Davoodi et al. [5]has proposed the power distribution system of optimal placement capacitors which the designers pay attention many years ago. The important benefit of the capacitor placement is voltage profile improvement, loss reduction, increment of the power factor and freeing up power system capacity. It displays a new approach for the capacitor allocation in sample distribution system. The problem formulation has been considered most effective parameters in capacitor installation. One of characteristics of implementation of Genetic Algorithm for the optimal capacitor placement in the distribution system is multifunction capability. The method on capacitor placement and detecting the optimum capacitance has implemented and tested in the 9-bus IEEE in DIGSILENT and MATLAB environments .

Dehkordi, B et al. [3] has been projected the optimal placement of capacitors in the TABRIZ radial distribution system to decrease the investment energy loss, cost, reduction, improvement of the voltage profile. Optimal capacitor placement & sizing are completed by the determination of loss sensitivity factors and particle swarm optimization. The Loss sensitivity factors can be used as vital parameter for sequencing to effective nodes in loss reduction. In this paper, combination of method with PSO algorithm issued as a novel approach for optimal capacitor placement. This method tested on buses distribution system and applied all feeders of Roshanaei and Golestan regions of the Tabriz Electric Power Distribution Company .

Karayat, Mamta, et al. [8]determined optimal sizes Static Capacitors and Type -2 Distributed Generators together with optimal locations in radial distribution systems so that maximum possible reduction in power loss is obtained. The algorithm searches locations in system particular size of the capacitor or Distributed generation and locations them at the bus maximum reduction in power loss. Type 2 Distributed generation Distributed generation active and consumes the reactive power from system. The power factor considered can be 0.82 lagging. Discrete sizes of the capacitors and Distributed generations are considered. The algorithm is an extension of with little modification. The modification is compensating for the additional reactive power 2 DG. The new algorithm 3-stages tested on the standard 69 bus systems. In first stage, capacitive compensation can be done.

Baran, Mesut E et al. [2]proposed the interface of distribution system between bulk power system and consumers. Among systems, radial distributions system is well known because of simple design and low cost. In the distribution systems, voltages buses decreases moved away from substation, the losses are large. The decrease voltage and high losses is insufficient amount of the reactive power that can be given by shunt capacitors. But placement of capacitor with optimal size is always challenge.

IV. CONCLUSION AND FUTURE SCOPE

A novel plan of plant growth simulation algorithm program has been developed during this thesis to resolve the reactive power management down side of the facility system. Reactive power is a very important parameter in power grid that affects several factor like stability, voltage level, losses etc. to search out the best location of the electrical condenser to manage the reactive power may be a difficult task. To resolve this down side a unique approach has been mentioned during this thesis. In future alternative algorithms are often tried on identical bus system. additionally the projected algorithmic program are often tested on alternative bus systems. Additionally hybrid algorithm are often developed to resolve the matter. Additionally STATCOM and SSSC etc are often accustomed enhance the performance.

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