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Optimal Allocation of Capacitor Bank in Radial Distribution System using Analytical Approach

Sarfaraz Nawaz[1], M.P. Sharma[2], Abhishek Gupta[3]
[1]Poornima University, Jaipur, India
[2]RVPNL Jaipur, India
[3]Swami Keshvanand Institute of Technology Management & Gramothan, Jaipur, India

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ABSTRACT

In this paper, a novel analytical technique is proposed for optimal allocation of shunt capacitor bank in radial distribution system. An objective function is formulated to determine the optimal size, number and location of capacitor bank for real & reactive power loss reduction, voltage profile enhancement and annual cost saving. A new constant, Power Voltage Sensitivity Constant (PVSC), has been proposed here. The value of PVSC constant decides the candidate bus location and size. The achievability of the proposed method has been demonstrated on IEEE-69 bus and real distribution system of Jamawaramgarh, Jaipur city. The obtained results are compared with latest optimization techniques to show the effectiveness and robustness of the proposed technique.

Corresponding Author:

Sarfaraz Nawaz,
Poornima University,
Jaipur, Rajasthan, India.
Email: eesarfaraz1983@gmail.com

1. INTRODUCTION

Complexity of the modern power system is increased due to stressed conditions in a distribution networks, exponential increment in population and high ongoing demands on power grids are major concern of the design engineers with every passing day. As per Indian scenario significant part of the system losses (around 21%) are distribution losses. The power losses can be divided into two parts i.e. active power loss and reactive power loss. Reactive power loss can be compensated by installation of shunt capacitor units. Allocation of shunt capacitor units at appropriate location and of optimal size reduces the real power loss and improves the voltage profile of the system. The researchers suggested many optimization techniques to solve the problem of optimal allocation of capacitor units in radial distribution system. In [1], Prakash et.al.used Particle Swarm Optimization algorithm to determine the best location and size of capacitor units in radial distribution system. Carpinelliet al. [2] solved the problem of shunt capacitor placement and sizing by approximate power flow method. The cost of real power losses and cost of capacitors were included in the objective function. Nonlinear Programming [3], Genetic Algorithm (GA) [4], Simulated Annealing (SA) [5], Cuckoo Search Algorithm [6], Heuristic Algorithm [7], Particle Swarm Optimization (PSO) [8-9], Artificial Bee Colony(ABC) [10], Firefly Algorithm (FA) [11], Teaching Learning Based Optimization (TLBO) [12], Plant Growth Simulation Algorithm (PGSA) [13], Harmony Search (HS) [14] Cuckoo Search Algorithm (CSA) [15], Ant Colony Search Algorithm (ACO) [16], Bacteria Foraging (BF) [17], Flower Pollination Algorithm[18, 23], Direct Search Algorithm [21], *Differential Evolution algorithm* [22] are developed to solve optimal allocation of capacitor problem. However, no author tested their algorithm on real power distribution system.