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ORIGINAL ARTICLE

Optimal siting of capacitors in radial distribution network using Whale Optimization Algorithm

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Abstract In present days, continuous effort is being made in bringing down the line losses of the electrical distribution networks. Therefore proper allocation of capacitors is of utmost importance because, it will help in reducing the line losses and maintaining the bus voltage. This in turn results in improving the stability and reliability of the system. In this paper Whale Optimization Algorithm (WOA) is used to find optimal sizing and placement of capacitors for a typical radial distribution system. Multi objectives such as operating cost reduction and power loss minimization with inequality constraints on voltage limits are considered and the proposed algorithm is validated by applying it on standard radial systems: IEEE-34 bus and IEEE-85 bus radial distribution test systems. The results obtained are compared with those of existing algorithms. The results show that the proposed algorithm is more effective in bringing down the operating costs and in maintaining better voltage profile.

1. Introduction

Electric power distribution system normally operates at low voltage levels and current is generally high. Majority of the distribution systems feed inductive loads which leads to higher power losses in the distribution network and poor power factor accompanied by voltage sags. So, the cost of the power increases. It is reported that about 13% of the total generation is lost in the low voltage distribution network as line losses [1]. Therefore it is necessary to find alternate approaches to overcome these problems and ensure stability, reliability and quality of electric power supply. Connecting capacitors is a well-known solution to the above stated problems [2,3]. Shunt capacitors effectively reduce power loss in the system. Generally, these are used as reactive power compensators in the network. Capacitors will improve the overall system performance by maintaining voltage levels within the acceptable limits [4,5]. But improper placing of capacitors leads to even higher system losses and voltage drops [6].Therefore proper planning and designing is required to place the capacitors. In the recent past, research has concentrated on placing the capacitors in the

Abbreviations WOA, Whale Optimization Algorithm; RDS, Radial Distribution System; BFOA, Bacterial Foraging Optimization Algorithm; MILP, Mixed Integer Linear Programming; MINLP, Mixed Integer Non-Linear Programming; PGS, Plant Growth Simulation; PSO, Particle Swarm Optimization; GA, Genetic Algorithm; FPA, Flower pollination Algorithm; IHA, Improved harmony Algorithm; GSA, Gravitational Search Algorithm; BSOA, Backtracking Search Optimization Algorithm; TLBO, Teaching Learning Based Optimization

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