A comparison between optimal allocation of DG unit and reactive power compensator for voltage profile improvement and loss reduction using BAT algorithm

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***Abstract*— In this paper a novel method based on bat-inspired (BA) algorithm is investigated for optimal allocation of distinct types of DG units and reactive power compensator for voltage profile improvement and power losses reduction in a distribution system. The main goal of this study is to make a comparison between DG unit and reactive power compensator impacts on voltage profile improvement and power loss reduction. To make the investigation more practical, the loads are linearly varied in small steps of 1% from 50% to 150% of the base values. The optimal size and location of distinct types of DGs and reactive power compensator are assessed in each load step. This will support the distribution network operators (DNOs) to have a long term scheduling for the optimal management of DG units and reactive compensators to achieve the maximum performance. To verify the efficiency of proposed comparison method, it has been conducted to IEEE 33-bus radial distribution system. The simulation results demonstrate that installation of the type-2 DG has a significant effect on the voltage profile and loss reduction in comparison with the other type of DG unit and reactive power compensator.**

Keywords- distributed generation; reactive power compensator; load variations; loss reduction; voltage profile; bat-inspired algorithm (BA)

I. INTRODUCTION

Generation capacity optimization is a significant aspect in sub-transmission/distribution network planning in view of power loss reduction and voltage profile improvement. Therefore interconnection of DGs and capacitors at suitable locations is equally important to improve system performance such as increase of voltage stability margin. The definition of the distributed generation is a generation of power by facilities that are adequately smaller than central generating plants and can be adjoined at nearly any point in power system [1,2]. Due to the considerable progression in several generation technologies, power systems deregulation, environmental effects and fabrication issues of new transmission lines, the penetration level of DGs in power network have been developing during the last decade. [3,4]. In addition DG may result in various advantages such as control of voltage profile, ancillary services, improving in power quality and reliability characteristics, loss decrement, energy savings and distribution capacity deferral[5–9]. Lately, numerous papers have been presented to study the problems of optimal allocation and sizing in various condition. Using analytical method, the power loss minimization of system was preformed by suitable DG allocation [10]. An approach based on multi-objective index which was utilized to reduce voltage drop and power loss was suggested in [11]. In order to optimize corrective actions, planning and operation of distribution network, an algorithm based on multi-objective GA was recommended in [12].

From the methodology point of view, several algorithms have been utilized for suitable DG allocation such as hybrid GA and simulated annealing[13], combined GA and PSO [14], tabu search [15],non-linear and dynamic programming[16,17], differential evolution algorithm [18], artificial bee colony algorithm (ABC) [19] harmony search algorithm[20]. This study proposes a novel approach based on BAT algorithm which is investigated to ascertain the optimal DG and reactive power compensator allocation and sizing to improve voltage profile as the main factor for power quality improvement and reducing power losses of the distribution network. Also, from