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Abstract (305 Kb)

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A Novel Approach for Multiple DG Allocation in Distribution System of Jaipur City

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Abstract: ***A novel approach has been proposed in this paper to find out optimal position of DG units in radial distribution system. An objective function is formulated to find out the optimal size, quantity and position of DG units for real power loss reduction and voltage profile enhancement. A new mathematical expression, Power Voltage Sensitivity Constant (PVSC), has been proposed to solve the allocation problem. The total size of DG units is also restricted up to 50% of total load of system. The results of the proposed technique are validated on standard IEEE 33 bus system and 130 bus 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 approach.***

Keywords: Radial Distribution system (RDS), PVSC, Power loss, DG units

I. INTRODUCTION

As per Indian scenario significant part of the system losses (around 21%) are distribution losses. Therefore, myriads of efforts have been made for the reduction of losses in distribution networks like as: optimal capacitor placement and distributed generation usage. DG units came into picture from last two decades due to the development in DG technologies and deregulation of electricity market in addition to other factors like economical and regulatory changes in distribution system. DG can utilize the power of both renewable and non-renewable energy sources. Optimal DG Allocation (OPDG) can enhance the system performance with the point of view of voltage stability, minimal system losses and flows, better power quality and improved reliability of power supply. The problem in DG allocation is to find the optimal location, size and quantity of DG units to be installed into existing distribution networks that can satisfy all the operating constraints of electrical network. The OPDG is a complex heterogeneous nonlinear problem of optimization. The problem of optimal DG allocation has therefore drawn the concern of many researchers in last fifteen years. G. Levitin [1] presented a solution by combining genetic algorithm and fast energy loss method. The solution was using fast energy losses that based on the daily load curve calculates the losses and does not require to compute load flow to evaluate the annual energy losses. Kyu-Ho Kim et. al. [2] adopted hybridized method to determine optimal location of DGs along with their capacities in distribution networks. The authors combined the Genetic algorithm with theory of fuzzy set. M. Gandomkar et. al. [3] suggested a method that works as a new hybridized algorithm for deciding the optimal DG site and size in medium voltage systems. The GA was correlated to Simulated Annealing (SA) metaheuristic methods and employed for DG allocation. N. Acharya et. al. [4] presented an analytical method to calculate the optimal capacity of DG. A direct equation derived from the sensitivity factor equation calculates the optimal size of DG corresponding with each network bus. S. Kamalinia, et. al. [5] proposed a solution for the problem of optimal DG placement developed by using a technique of MADM (Multi-Attribute Decision Making) and Genetic algorithm. To determine the optimal capacity and location of DG units, authors used Analytic Hierarchy Process (AHP) along with Data Envelopment Analysis (DEA) as the technique of multi attribute decision-making. M.A. Kashem et. al. [6] established a deterministic methodology that was based on the SQP algorithm for determining the optimal location and size of DG in distribution network systems. Wichit and Deependra Singh et. al. [7] introduced a technique using GA for placement of distributed generation. Three types of loading conditions (peak, medium and low) were examined. M. Abbagana et. al. [8] derived a methodology based on the technique of Differential Evolution to calculate the size and location of DG in distribution network while meeting all the constraints of optimality. The authors presented decision making techniques to find the solution for OPDG. M. Sedighi et. al. [9] evaluated the optimal location and capacity of single and multiple DGs by adopting PSO method. S. Nawaz et al. [10] presented sensitivity analysis technique and tested it on 33 bus system at different loading condition. Rajkumar Viral et.al [11] proposed an analytical approach to determine the best position and size of DG units in balanced distribution system to reduce real power.

In this paper, a novel approach to solve allocation of multiple DG units' problem is presented for active power loss minimization and voltage profile enhancement. A new mathematical expression is formulated that is called PVSC (Power Voltage Sensitivity Constant). This constant evaluates size and location of DG units at the same time. The total size of DG units is also restricted up to 50% of total load of system, so that less size of DG units produce maximum loss reduction. Standard 33 bus distribution system and 130 bus practical system of Jamawaramgarh area of Jaipur city are used to validate the above mentioned approach. The obtained results

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