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   Abstract (268 Kb)

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An Analytical Approach for Optimal Allocation of DG Unit in Distribution System

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***Abstract*— The advancement of Decentralized Generators or Distributed Generation (DG) introduces new changes to the long-established power system. Distribution Generation plays a prime function in distribution system by upgrading the systems reliability, curtailment in power losses and uplifting the voltage profile. This paper proposes an analytical approach to apprehend the optimal size and optimal allocation of DG entities in reconfigured distribution network to alleviate the losses. Lack of proper connection and sizing of DG causes the power losses to enhance and also might cause the voltage to operate beyond the allowable limit. The DG penetration level is also taken into account. The propound method is applied on the standard IEEE 85-bus test system at three different load levels using analytical approach. The obtained results are analogized with the other techniques of DG allocation and the propound method is found to be more efficient in terms of upgradation in voltage profile and the curtailment in real power losses.**

Keywords*— Distribution system, Distributed Generation, DG penetration level, Loss reduction, Voltage Profile, Analytical approach.

I. INTRODUCTION

In power system, the distribution system has vital portion of losses which is resembled about 13% in the literature [1]. A noteworthy voltage drop and an elevated R/X ratio produce notable losses in distribution system. Usually, distribution system has radial feeders. The electrical utilities are going through quick restructuring procedures in these days and are planning to expand the electrical network to meet the increasing power demand. So, to fulfill this necessity, the concept of Distributed Generation (DG) is introduced. DG is a contemporary evolution in the electrical power industry which is deployed to sustain the escalated power entail. The concept of DG comprises many applications and technologies. There is not a clear definition of DG. The term "Dispersed Generation", "Embedded Generation" and "Decentralized Generation" is deployed by different countries for DG. According to [2], the locale of Distributed Generation is delineated as "The setting up and operation of DG units directly interfaced to the distribution network and it cites to a scaled -down (1kW-50MW) generation of electric power which produces electricity very close to the customer site".

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Nevertheless, there are numerous issues regarding unifying DG's with existing network of the power system; that entails to be addressed [3- 4]. The collaboration of Distributed Generation alters the power system from passive to active network, which influences the operation and reliability of electrical power system network [4]. Moreover, the non-optimal allocation of DG can result in rise of the real power losses and consequently producing the voltage profile less than permissible limit [5]. As electrical utilities are formerly facing the technical and non-technical complications, they cannot bear such supplementary issues. So, an optimal allocation of DG is entailed in order to obtain minimal system losses and hence intensifying the voltage profile. Many electric utilities are investing in the renewable energy sources by using DG. For example, in England and Wales, Distributed Generation was only 1.2 GW throughout 1993-1994 and currently this statistic has piled out up to 12GW [6]. The technologies [7, 8] which are used for DG sources are photovoltaic cells, fuel cells, combustion engine, wind generation etc. The aggrandizement of DG proffer aids such as uplifting the voltage profile, mitigation of on-peak operating costs, reducing congestion in feeders, mitigate capital and operational expenditure, diminution in real power losses, stability improvement, efficacy of peak shaving, environmental viability, abeyance of extension plans, security enhancement and reliability. The tenor of electricity charge elevates the locale and time base pricing schemes. At pinnacle periods, Distributed generation can be deployed to some load exactions, thus mitigate the price of electric power which is taken from the network throughout the giant electricity charges [9]. The usage of DG in the power system can provide the protection opposed to transmission and distribution extension costs. The on- site generation of electricity could result in cost savings regarding of transmission and distribution of nearly 30% cost of electricity energy [10].

The main purpose for progressively vast utilization of DG can be summed up thusly [11]:

- It is cinch to discern sites for small generators.
- Distributed generation units are nearer to the consumer in order that T&D (Transmission & Distribution) costs is curtailed.
- Large and exorbitant heat networks are not entailed by Combined Heat and Power (CHP) groups.