AN OPTIMAL APPROACH FOR PLACEMENT OF DISTRIBUTED GENERATION IN RADIAL DISTRIBUTION SYSTEM CONSIDERING LOAD VARIATION

MOHD NAZRI BIN ABD HALIM

A report submitted in partial fulfillment of the requirements for the degree of electrical engineering

Faculty Of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

JUNE 2018

DECLARATION

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in this reference"

Signature :____________________________

Name : Mohd Nazri Bin Abd Halim

Date :____________________________

DECLARATION

"I hereby declared that I have read through this report entitle 'An Optimal Approach for Placement of Distributed Generation in Radial Distribution System Considering Load Variation'''

Signature :____________________________

Name : Dr Aida Fazliana Bin Abdul Kadir

Date :____________________________

To my beloved mother and father

ACKNOWLEDGEMENT

First and foremost, thanks to Allah for giving me this great opportunity to live in this world and giving me this healthy body that enables to gain the knowledge, experience and able to finish this project. Therefore, I consider myself as a very lucky individual as I was provided with an opportunity to be a part of it. I am also grateful for having a chance to meet so many wonderful people and professional who led me through this final year project.

Secondly, bearing in mind previous I am using this opportunity to express my deepest gratitude and thanks to the Dr Aida Fazliana binti Abdul Kadir for his patience guidance and enthusiastic encouragement throughout the duration of this project. The supervision and patient guidance that he gave truly help the progression and smoothness of my final year report. The support and hard work are much appreciated indeed. Her is the one of the best and good lecturer that I ever met in UTeM.

Next, I express my deepest to my family and friend for giving moral support, provide advice and guidance needed also their prayer, I feel this is a very big contribution for me. I perceive this opportunity as a big milestone in my career development. I will strive to use gained skill and knowledge in the best possible way and I will continue to work on their improvement to attain desired career objectives.

ABSTRACT

Distributed generation (DG) devices can be advantageously placed in power systems for minimizing real power losses, grid reinforcement, improving bus voltages and efficiency of distribution system. One of the real concerns identified with the distributed generation (DG) is the effect on system stability because of the interaction amongst generators and load characteristic. It is shown that load in distribution system will affect significantly the optimal placement and sizing of DGs in distribution system. Load increase and vice versa the voltage profile will drop below tolerable limit along distribution feeders. Multi-objective function is generated to minimize the total power loss, average total voltage harmonic distortion and voltage deviation improvement in the distribution system. Six different load levels in percentage of load have been considered in this study. The improved gravitational search algorithm (IGSA) is proposed as an optimization technique and its performance is compared with other optimization techniques such as particle swarm optimization (PSO) and gravitational search algorithm (GSA). The Newton-Raphson load flow algorithm from MATPOWER was simulate in MATLAB to solve the proposed multi-objective. This method is tested on the 69-bus and 33-bus distribution system with six case studies. The result will illustrate the losses minimization, average voltage deviation improvement and average total harmonic distortion in the distribution system when load variation was considering by placement of DGs unit in distribution system. Data analysis and result obtain can be used to other else as a reference when related with optimal approach for placement DGs in distribution generation in radial network considering load variation.

ABSTRAK

Peranti generasi yang diagihkan (DG) boleh digunakan secara optimal dalam sistem kuasa untuk meminimumkan kehilangan kuasa sebenar, meningkatkan voltan bas dan kecekapan sistem pengedaran. Salah satu kebimbangan sebenar yang dikenalpasti dengan penghasilan pengagihan (DG) adalah kesan ke atas kestabilan sistem kerana interaksi di antara penjana dan ciri beban. Telah ditunjukkan bahawa model beban perbezaan dapat memberi kesan dengan ketara penempatan yang optimum dan saiz DG dalam sistem pengedaran. Beban dalam sistem pengedaran akan menjejaskan penempatan yang optimum dan saiz DGs. Beban meningkat dan sebaliknya menyebabkan profil voltan akan jatuh di bawah had yang boleh diterima di sepanjang pengumpan pengedaran. Fungsi multi-objektif dijana untuk mengurangkan jumlah kehilangan kuasa, purata voltan harmonik total voltan dan sisihan voltan dalam sistem pengedaran. Enam tahap beban yang berbeza dalam peratusan beban telah dipertimbangkan dalam kajian ini. Algoritma carian graviti yang lebih baik (IGSA) dicadangkan sebagai teknik pengoptimuman dan prestasinya dibandingkan dengan teknik pengoptimuman lain seperti pengoptimuman swarm partikel (PSO) dan algoritma carian graviti (GSA). Algoritma aliran beban Newton-Raphson dari MATPOWER adalah mensimulasikan dalam MATLAB untuk menyelesaikan pelbagai objektif yang dicadangkan. Kaedah ini diuji pada 69-bus dan sistem pengedaran 33-bus dengan enam kajian kes. Hasilnya akan menggambarkan penurunan kehilangan, peningkatan voltan dan jumlah keseluruhan penyelarasan harmonik dalam sistem pengedaran apabila variasi beban dugunakan oleh penempatan unit DGs dalam sistem pengedaran. analisis Data dan keputusan diperoleh boleh digunakan untuk orang lain sebagai rujukan apabila berkaitan dengan pendekatan optimum untuk penempatan DGs dalam penjanaan pengedaran dalam rangkaian radial berkaitan dengan variasi beban.

TABLE OF CONTENTS

CHAPTER **TITLE** **PAGE**

CHAPTER	TITLE	PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

DG	-	Distribution Generation
THD	-	Total Harmonic Distortion
IGSA	-	Improved Gravitational Search Algorithm
PSO	-	Particle Swarm Optimization
GSA	-	Gravitational Search Algorithm
MATLAB	-	Matrix Laboratory
PV	-	Photovoltaic
DER	-	Distributed Energy Resources
GA	-	Genetic Algorithm
Fyp	-	Final Year Project
IJEEAS	-	International Journal of Electrical Engineering and Applied Science

CHAPTER 1

INTRODUCTION

1.1 Introduction

Distributed generation can be said as technologies that generate electricity at or near where it will be used with using renewable energy to produce electricity. DG may provide as single structure for a residential and business, but also can be section of a micro grid, DG usually applied in industrial facilities, military base to provided power supply, or a large university. In other term ,DG could be “electric power generation within distribution networks or on the customer side of the network” [1]. Usually in Malaysia, DG technologies that available is solar photovoltaic while other technologies in DGs are wind power, biomass and solar thermal systems. People want the energy that purifier and has less impact to the surroundings. They tend to pick DG as main electricity supply due to the fact that DG can generate electricity with renewable source rather than fossil fuel and, accepted through many countries due to reduction in gasses emission is major criteria that lead for DGs implementation [2]. Provided peak load demand, minimizes branch current loadings, voltage profile and reduces losses can be improves with better placement and sizing od DG [3]. Allocation and sizing of DG power in inappropriate way toward the distribution network leads to power quality issues, increasing power losses, unstable power system, and rising operational cost [23]. The maximum potential benefits achieve from DGs relies upon on how optimal and placement of the installation on the network system. Details research about the effect load level varying in DG planning is investigating to get on how load effect locations and size of the DGs.

1.2 Research Motivation

Nowadays, electricity demand is very encouraging due to the expansion of the population and the improvement of technology that requires higher electricity by customer. Power system management has been facing major changing in power generation sector during the past decades. Power system company has trying to find the best way and solution to provided energy which is sufficient for customer and avoid many unwanted problems in power system such as losses in system, voltage stability, total harmonic distortion (THD) problem etc. Consequently, meeting of small generation has growth and cause rise of demand in DG utilization. The presence of DGs in the distribution system may result some advantages such as improved of power quality, voltage stability and reduction of the system but with inappropriate installation of DGs with improper design could either cause positive and negative impact. However, it must be depending on the operational characteristic of the DGs and criteria of the distribution network. Moreover, placement and optimal of DGs is quite important to be investigated for design a reliable power system.

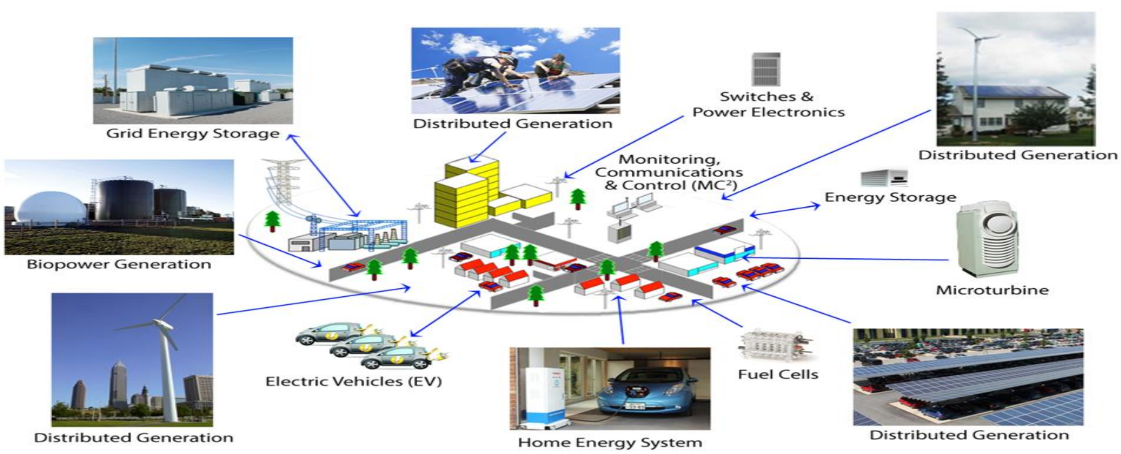

Figure 1.1: Concept of Distribution Generation [21]

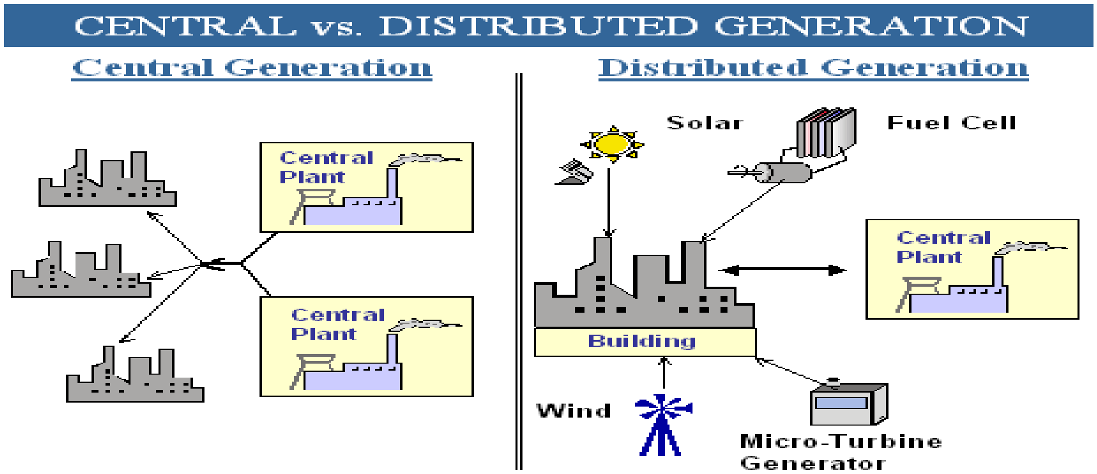

Figure 1.2: Difference Central Distribution with DG. [27]

1.3 Problem Statements

The proposed of this study is to analysis the effect of variation in load levels and in order to achieve reduction energy losses toward DGs placement on distribution generation. An optimization technique should be implement for an engineering system related with electrical system that can allowing the best allocation with less of undesired result. In electrical power system most of losses occur in distribution system. Nonstandard placement of DG units might also result in increased the losses, device value and voltage in a few load buses .System losses, system cost and voltage in some load buses may increase without optimal placement of DG units [4].

One of the real concerns identified with the distributed generation (DG) is the effect on system stability because of the interaction amongst generators and load characteristic. Load in distribution system will affect significantly the DGs planning for the optimal placement and sizing of DG and generally a constant power load model is assumed in most studies [5]. When load increase and vice versa the voltage profile will drop below tolerable operating limit along distribution feeders. Hence, power generating station is work simultaneously but when load increase, design for DGs placement and sizing should consider it load variation to avoid problem toward distribution system when load increases more and more then all generating stations can't bear the load and total blackout happens.

Several method have been introducing a lot to determine the optimal location and size of DG in distribution system. There a lot of heuristic method used for optimal DG placement and sizing that only accurate for the developed model and can be very complicated for solving complex system. Each method has it own strength and weakness.

1.4 Objectives

The objective of this research:

I. To identify the optimal placement and sizing of DG via improved gravitational search algorithm optimization technique.

II. To analyze the effectiveness of the optimal DGs planning with variation of load in distribution system.

III. To compare the performance of the proposed method improved gravitational search algorithm(IGSA) with particle swarm optimization(PSO) and gravitational search algorithm(GSA).

1.5 Scope of research

The scope of this project focuses on identify the optimal and sizing of solar distribution generation for radial system (rooftop PVs solar) considering variation of load in distribution system by using MATLAB simulation only. Proposed method improved gravitational search algorithm (IGSA) with particle swarm optimization (PSO) and gravitational search algorithm (GSA) will be discusses and comparison are made according to optimization method performance after the final result is archived refer to the objective research. The present method will apply on 33-bus and 69-bus test radial distribution network for variation load level.

1.6 Report outline

Chapter 1 introduces some introduction, problem statement, motivation, and scope of study related with this research. It is also covers the project outline that explain for every chapter roughly. Chapter 2 briefly review about the distribution generation with using renewable energy as generation of electricity. Heuristic method such as PSO, GSA, IGSA and GA also are discussed in this chapter on the concept and equation for each optimization technique. Lastly, it also will explain about previous research that related with this report and effects of DGs towards distribution system. Chapter 3 on this chapter, the milestone and Gantt chart are also provided, and the method of the ultimate placement and sizing of DG is mentioned while created the flowchart of this research will be showed out. Besides that, the test system used and the heuristic method as optimization technique will be carried out in flow chart. Finally, the case study will be developed in this chapter. Chapter 4 briefly discussed the result obtained from the simulation using MATLAB. The varying of load level that affect the losses, voltage deviation, total harmonic distortion and DGs sizes will be tabulated in this chapter with illustrated with graph. In addition, discussion and comparison of the result will be done in this chapter. Chapter 5 discusses and summarized the research based on the result for sizing and optimal placement of the DGs in distribution system considering load variation with heuristic method. A short summary of the whole project is made based on research outcome.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss the theory and previous research that related with this study. In recent years, this topic has been studied and be investigate in many aspects and using certain optimization technique by previous researcher to evolved the superior allocation of the DG in distribution networks. The most beneficial DG placement techniques used to offer the quality sizing and location of DGS to optimize electrical network operation according to many criteria such as total harmonic distortion reduction, voltage profile improvement, load variation for loss reduction, and other else. All these criteria have been study to provide the best optimal placement and sizing of DGs to achieve maximum benefits of the DG in distribution system. DGs installation will cause many advantages such as, increasing reliability, improve voltage profile, power losses reduction and power quality. Since most of the distribution system loads was uncontrolled, effect of load model on optimum sizing and location should be discussed. In addition, with application of loads, the voltage profile then to drop [6]. Therefore, proposing an optimal pattern for installing DGs, attract a lot of attention these day and DGs can be a better choice for better power generation in the future and it will account for almost 20% of total power generation in the coming days [4].

2.2 Types of DGs.

Solar energy, biomass, hydro generation, and wind energy are the renewable energy that present in Malaysia today. The most suitable energy for distribution generation in Malaysia is solar energy because clean energy source can be generated by Solar Photovoltaic Panel (PV) and it only uses sunlight to generate electricity. Hence, Malaysia is a country that gets lots of light during the 12 months. Consequently, solar system is specially appropriate for producing electricity.

2.2.1 Photovoltaic Distributed Generation.

The maximum important solar technology for dispensed generation of sun electricity to date is photovoltaic, makes use of solar cells assembled into solar panels to transform sunlight into electricity [29]. It's far a quick-developing technology doubling its international installed potential every couple of years. Since most assets of renewable energy and not like coal and nuclear, solar PV is a variable and non-dispatchable. However, has no gasoline prices, working pollutants, in addition to reduce mining protection and operational protection problems. It produces peak power round local noon each day and its potential factor is around 20 percent.