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NETWORK RECONFIGURATION UNDER NORMAL AND FAULT CONDITION WITH THE PRESENCE OF DISTRIBUTED GENERATION IN A DISTRIBUTION SYSTEM

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Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

This thesis presents the implementation of network reconfiguration in radial distribution system with the presence of distributed generation to improve the distribution system performance in terms of loss minimisation and voltage profile improvement. The network reconfiguration is performed by altering the topological structure of distribution feeders. During normal operating condition, networks are reconfigured to reduce the system real power losses. The optimal sectionalising – tie switch pairs were determined by the TOPO application available in the power system simulation programme for planning, design and analysis of distribution system (PSS/Adept). This application determines optimal sectionalizing – tie switch pairs based on minimum losses configuration and at the same time, all nodes are assured for the supply. The introduction of distributed generation into the distribution system can significantly impact the distribution system depending on the system operating condition, distributed generation characteristic, location and sizing. Therefore, a proper placement plays a very important role. In this thesis, the suitable location for distributed generator was pre-determined using the previously developed sensitivity indices derived from voltage stability improvement with respect to changes in injected active and reactive power at a bus. The optimal capacity sizing of the distributed generation was pre-determined using the Evolutionary Programming (EP) optimisation technique. Various locations and sizes of distributed generation were tested in order to realize the effect of location and sizing of distributed generation in terms of loss minimisation and voltage improvement during network reconfiguration. In order to study the effect of location and sizing of distributed generation to the power losses and voltage profile during network reconfiguration for service restoration, a three phase fault is applied at an identified location. The network is reconfigured after the fault is isolated. The study was implemented on the IEEE 69-bus test system. The studies also compare the network performance in terms of loss minimization and voltage profile improvement achieved by optimal network reconfiguration when compensating capacitor present in the system.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The increase in demand has posed a challenging task to power system engineers in maintaining a reliable and secure system economically. Limited area and slow progress in network expansion has also caused the formation of areas with high load densities. During the peak load, the load current has drawn from the sources increases and this may lead to an increase in voltage drop and system losses. In addition, rural electrification networks are experiencing poor network performance in terms of large voltage drop and high distribution losses along the lines. Distribution utilities are trying very hard to strengthen and expand their networks with limited source from the grid and also capital. With this regards, changes in economic and commercial environment of power system design and operation have necessitated the need to consider active distribution network by incorporating small sources [1], [2].

There are several operational schemes in power distribution systems to improve the performance of a system assurance of supply. One of these operational schemes is network reconfiguration, which is defined as altering the topological structures of distribution feeders by changing the open/closed states of a sectionalising and tie-lines switches. During normal operating condition, networks are reconfigured to reduce the system real power losses and to relieve overloads in the network (load balancing). Another configuration management operation involves the restoration of service to as many customers as possible during a restorative state following a fault [3].