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ANT COLONY OPTIMIZATION (ACO) TECHNIQUE FOR REACTIVE POWER PLANNING IN POWER SYSTEM STABILITY ASSESSMENT

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ABSTRACT

This thesis presents Ant Colony Optimization (ACO) Technique for Reactive Power Planning in Power System Stability Assessment. ACO is a new cooperative agent's approach, which is inspired by the observation of the behaviours of real ant colonies on the topics of ant trial formation and foraging method. The set of cooperating agents called "ant" cooperate to find good solution for voltage stability studies in power system. This study involved the development of ACO technique for estimating optimal maximum loadability (OML), optimal reactive power dispatch (ORPD), optimal transformer tap changer setting (OTTCS) and optimal reactive power planning (ORPP) in power system. The ACO algorithm is written in MATLAB and tested on IEEE 30-bus Reliability Test System (RTS) in order to verify the proposed technique. Comparative studies were also conducted between the results obtained from the proposed techniques with those obtained by previously developed techniques. The OML technique was used to find the maximum reactive power loading at particular load bus before the system become unstable. The purpose of ORPD, OTTCS and ORPP technique in reactive power planning (RPP) study is mainly to improve the voltage profile or to minimize transmission losses in the system. The ORPD is implemented to the system by injecting reactive power to the generator buses, while OTTCS aimed to modify the transmission line parameters in order to improve voltage profile and also to reduce total loss in the system. The ORPP has been conducted by combining ORPD and OTTCS which provided better result in terms of voltage profile improvement and total loss minimization at loaded bus.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Voltage stability is a major concern in planning and operation of electric power systems. It refers to the ability of a power system to maintain steady acceptable voltages at all buses in the system at normal operating conditions and after being subjected to disturbances [1]. Voltage stability is a problem in power systems due to heavily loaded situation, faulty condition outage of generators or lines and also shortage of reactive power support. The nature of voltage stability can be analyzed by examining the production, transmission and consumption of reactive power. The problem of voltage stability concerns the whole power systems, although it usually has a large involvement in one critical area of the power system [2].

Power system is stable if voltages after a disturbance are close to voltages at normal operating condition. A power system becomes unstable when voltages uncontrollably decrease due to outage of equipment such as generator, line, transformer, busbar, etc., increment of load, decrement of production and weakening of voltage control [2].

Power system stability can be categorized into three categories namely the voltage, angle and frequency. Voltage stability is closely associated with other aspects of power system steady-state and dynamic performance. Voltage stability is very close related to power security which characterises the ability to update stably during the pre-disturbance and post-disturbance. It has been widely known that instability condition is duly caused by the presence of disturbance in the power system network. Among the possible disturbances are line outage, generator outage, load shedding, stress condition and change of load. The main consequences of voltage instability phenomenon are high