UNIVERSITI TEKNOLOGI MARA

OPTIMUM TUNING OF UNIFIED POWER FLOW CONTROLLER (UPFC) VIA ANT COLONY OPTIMIZATION (ACO) TECHNIQUE

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ABSTRACT

Unified Power Flow Controller (UPFC) is a Flexible Alternating Current Transmission System (FACTS) device that can control the power flow in transmission lines by injecting active and reactive voltage components in series with the lines using power converter modules, based on an externally dc-link voltage. As the power flow has been controlled, this device is capable of minimizing the overall system losses and simultaneously improves the voltage stability. To be able effectively control the power flow so that losses and voltage stability are at optimum level, UPFC parameters need to be tuned by using optimization algorithm. This thesis describes how Ant Colony Optimization (ACO) technique can be used to tune the parameters of FACTS device in order to improve power system performance. 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 algorithm was implemented in MATLAB applied to the IEEE-30 Bus Reliability Test System (RTS). Comparative studies were conducted based on performance of UPFC in terms of their number and locations for installations in power system. The outputs obtained from the study revealed that the proposed technique gave promising results.

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CHAPTER 1

INTRODUCTION

1.1 Background on Power System Voltage Stability

Voltage stability becomes a major concern for planning and operation of a power system, since now the occurrence of voltage collapse is at critical level. Uncontrollable decay of system voltage at one or more load buses or even over a significant portion of power network as a response to load variations, generation or structure disturbances and etceteras has been observed in power systems worldwide. This has been termed as voltage instability and the process of voltage decrease has been termed as a voltage collapse process. Mostly, the collapse of voltage and instability of power system are mainly due to heavily loaded busses, shortage of reactive power support, faulty condition outage of generator, transmission lines, transformer and busbar, and higher degree of utilization on power system [1].

The terms voltage stability also implies the ability of power system to maintain steady and acceptable voltage magnitude at all busses if any disturbances happen [2]. Stability also related to system voltage magnitude, angle, and the operating frequency, which affect the steady state and dynamic performance of power system [3]. Instability that happens as a result of load shedding, outage of equipments, and load dynamic would lead to high line losses, low voltage profile, and hence voltage collapse occurrence. There are a lot of mitigations techniques applied as a result of power system instability, for instance voltage control, reactive power compensation by capacitor bank, reactive power management, rotor angle stability, protective relaying and many more. Among the method, the impressive, flexible, sophisticated and alternative method to improve performance of power system in terms of stability and loss minimization is by establishing flexible alternating current transmission system (FACTS) devices.