UNIVERSITI TEKNOLOGI MARA

AN ENHANCEMENT OF ENERGY EFFICIENCY BASED ON THE VOLTAGE REDUCTION WITH OPTIMAL CAPACITOR PLACEMENT AND SIZING

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ABSTRACT

Energy efficiency can be realized by minimizing the power loss with a sufficient amount of energy used in an electrical distribution system. In this report, a detailed analysis of the energy efficiency of an electric distribution system was carried out with an implementation of the optimal capacitor placement and sizing (OCPS). The particle swarm optimization (PSO) will be used to determine optimal location and sizing for the capacitors whereas energy consumption and power losses minimization will improve the energy efficiency. In addition, a certain number of busbars or locations are identified in advance before the PSO is performed to solve OCPS. In this case study one technique particle swarm optimimization with the pre-determined of busbar or locations for the power-loss-index (PLI) combine with conservative voltage reduction (CVR). The particle swarm optimization (PSO) is designed to provide a new population with improved sizing and location of capacitors. The total cost of power losses, energy consumption and capacitor installation are the components considered in the objective and fitness functions of the proposed optimization technique. Voltage magnitude limit, total harmonic distortion (THD) limit, power factor limit and capacitor size limit are the parameters considered as the constraints for the proposed of optimization technique. Satisfying these four constraints with any numerical set of variables means that the physical characteristics of the power system for optimization technique are fulfilled. These constrained optimization maybe used to minimize cost functions, representing all operational limits of the actual network In this research, the proposed methodologies implemented in the MATLAB® software will transfer the information, execute the three-phase unbalanced load flow solution and retrieve then collect the results or data from the three-phase unbalanced electrical distribution systems modeled in the SIMULINK® software. Effectiveness of the proposed methods used to improve the energy efficiency has been verified through several case studies and the results are obtained from the test systems of IEEE 13-bus unbalanced electrical distribution system and also the pragmatic electrical distribution system model of Sultan Salahuddin Abdul Aziz Shah (SSAAS) government building in Shah Alam,Selangor.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND AND SIGNIFICANCE OF RESEARCH

Energy is a crucial source in social and economic development of a country. In recent years, the energy consumption has been increased dramatically due to the world economic development [1]. With the increasing price of energy based petrol-fossil fuels and alternative energy sources, the economic growth the Association of Southeast Asian Nations (ASEAN) such as Singapore, Indonesia, Thailand, Vietnam, Cambodia, Myanmar and Laos are hindered. The dependency of fossil fuel as the energy source needs to be reduced in order to conserve the environment from pollution, which is caused by dangerous gas emission from fossil fuel to energy conversion. The issue regarding reducing the pollution has been considered as one of the initiatives to support the Kyoto Protocol which come into force in February 2005.. However in practical, implementation of energy saving or energy efficiency whilst sustaining the social economic growth is a very big challenge for power sector. In order to solve the energy problems faced particularly by the ASEAN, South East Asia countries including Malaysia have agreed to realize several objectives related to energy efficiency through the ASEAN Plan of Action for Energy Cooperation (APAEC) [2].

Malaysia has long been actively involved in implementing various programs and policies related to the energy efficiency, which was started in 1979 under the Utilization Objective of Malaysia's Energy Policy. The sequel for those programs and policies is the National Industrial Energy Efficiency Improvement Program in 1999 which was followed by the Eighth Malaysia Plan from 2001 to 2005 [3]. In relation to that matter, the National Industrial Energy Efficiency Improvement Program was supported with huge funds contributed by the Global Environment Facility, the United Nations Development Program, Japan, Denmark and the Malaysian Electricity Supply Industry Trust Account (MESITA) [4]. On one hand, the Ministry of Energy, Water and Green Technology (KeTTHA) was involved in the Eighth Malaysia Plan to undertake a more systematic and holistic approach which will accelerate the implementation of the energy efficiency or energy saving into the industrial,