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MULTI-FACTS DEVICES INSTALLATION FOR LOSS MINIMIZATION AND TECHNO-ECONOMIC IMPACT ASSESSMENT BASED ON COMPUTATIONAL INTELLIGENCE TECHNIQUE

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PhD

January 2015

AUTHOR 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 degree or qualification.

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MULTI-FACTS DEVICES INSTALLATION FOR LOSS MINIMIZATION AND TECHNO-ECONOMIC IMPACT ASSESSMENT USING EPSO APPROACH

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ABSTRACT

This thesis presents a new meta-heuristic approach technique for optimal location and sizing of multi-unit Flexible Alternating Currents System (FACTS) device installation using single- and multi-objective problems. It also considers techno-economic impact in the system. In this research, the first objective is to develop heuristic technique Single-Objective Particle Swarm Optimization (SOPSO) for optimal location and sizing of single-unit FACTS device installation with loss minimization, voltage monitoring and taking into account the cost of installation in the system. The verification was conducted through comparative studies with Single-Objective Evolutionary Programming (SOEP) and Single-Objective Artificial Immune System (SOAIS) techniques. The effect of weight coefficient, c_1 and c_2 and the effect of population size of loss minimization are also investigated. The second objective is to determine the location and sizing of multi-unit and multi-type FACTS device installation using SOPSO and SOEP. Consequently, the third objective of this research is to develop a new meta-heuristic technique termed as Evolutionary Particle Swarm Optimization (EPSO) for optimal placement and sizing of multi-unit FACTS device with single-objective problem. Comparative studies with respect to traditional PSO and classical EP techniques indicated that EPSO has its merit in terms of loss minimization. In addition, the cluster formation of FACTS device installation is also derived from the obtained results. The cluster formation of FACTS device installation was derived by looking at how many times (frequency) the load buses are selected for FACTS device installation identified by EPSO, PSO and EP techniques. The fourth objective in this research is to develop a new optimization technique termed as sigma-Multi-Objective EPSO (σ-MOEPSO) technique for optimal location and sizing of FACTS devices installation for multi-objective problem to minimize the transmission loss and cost of installation in power system. Finally, the fifth objective is to assess the techno-economic impact of FACTS device installation in power system. This assessment is performed by using a hybrid Evolutionary Particle Swarm Optimization - Net Present Value (EPSO-NPV) for assessing the impact of FACTS devices installation in duration up to 20 years. Comparative study has been done with Evolutionary Programming - Net Present Value (EP-NPV) technique. It was found that the proposed technique has been able to produce better performance as compared to other techniques and could be beneficial to power system planner in order to perform FACTS devices installation scheme for the minimization of loss and cost in their systems.