AN OPTIMAL POWER FLOW ALGORITHM TO REDUCE POWER LOSS BY PLACEMENT OF DG IN DISTRIBUTION SYSTEM

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Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa
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Thesis submitted in partial fulfilment of the requirements for the degree Master of Science in Electrical Engineering

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DECLARATION OF THE CANDIDATE AND SUPERVISOR

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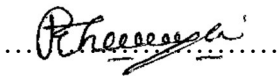

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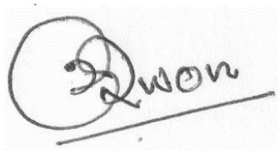
(R.M.T. Lakmali)

The above candidate has carried out research for the Masters Thesis under my supervision.



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(Prof. K. T. M. U. Hemapala)

ABSTRACT

Distributed generation is a small-scale and renewable-based energy source (ex: solar/ wind/ biomass) near to loads in distribution networks. It is becoming more prominent in the present world due to incremental demands for electricity. The integration of DGs in the distribution system is profitable, loss reduction and voltage-profile improvement if it is optimally sized and optimally placed. Research work included in this thesis focuses on using an optimization methodology for identifying the most appropriate location and size of DG.

Initially, detailed study of optimal DG planning was carried regarding objective functions, constraints, load and design variables, and mathematical approaches. In this dissertation, a novel combined methodology for optimal DG planning is presented by Newton Raphson's (NR) power-flow solution and optimization algorithm named Particle Swarm Optimization(PSO). A multi-objective function has been modified by considering real and reactive power loss minimization and cost minimization to attain the optimal size and optimal location of DGs. Moreover, voltage-profile improvement and power system stability improvements are obtained.

The performance of the proposed methodology is tested on the IEEE-30 bus system and program is developed and simulated from MATLAB software. Two types of DGs are evaluated using the proposed model which is called a single DG source delivering only real-power and a single DG source delivering both real and reactive power. The method is executed on the same 30-test bus system for different weighting factors.

Results in the test bus system show the effectiveness of the developed mathematical model with higher power loss reduction and cost reduction percentages.

Furthermore, the proposed methodology is applied to select two distribution feeders in Sri Lanka with time-varying loads to allocate solar PV and biomass as DGs. In order to have a techno-economic solution for optimal size of DG and best location, the proposed algorithm can be used on any MV distribution feeder providing relevant line and load details.

Keywords : optimal size of DG, best location, multi objective function, power loss reduction, cost reduction, Newton Raphson (NR), Particle Swarm Optimization (PSO), MV distribution system, MATLAB

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LIST OF ABBREVIATIONS

DG - Distributed Generation

NR - Newton Raphson

PSO - Particle Swarm Optimization

OPF - Optimal Power Flow

PV - Photo Voltaic

NPV - Net Present Value

CEB - Ceylon Electricity Board

PF - Power Factor