



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
ELECTRICAL POWER AND MACHINES DEPARTMENT

***SMART PERFORMANCE OF DISTRIBUTION
SYSTEM MICRO-GRID FORMATION***

Thesis is submitted in partial fulfillment of the requirements for the M.Sc.
degree in
Electrical Engineering

By:

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B.Sc. Electrical Engineering, Ain Shams University, 2018

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STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the requirements for M.Sc. degree in Electrical Engineering.

The included work in this thesis has been carried out by the author at the department of electrical power and machines, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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Abstract

Micro-Grid (MG) with hybrid power resources can supply its electric loads independently. In case of surplus power, the neighborhood micro-grids can be integrated together in order to supply the overloaded micro-grid. The challenge is to select the most suitable, optimal and preferable micro-grid within a distributed network, which consists of islanded MGs, to form that integration .

In this thesis, an intelligent decision-making criterion for optimal selection of micro-grid integration in case of overloaded event is presented. The intelligent decision making criterion is relying on the Weighted Arithmetic Mean (WAM) of different technical indices. The overloaded event may take place due to either unusual increase in consumed power or any deficiency in power generation. Overloading is expected due to excess increase or decrease in weather temperature. This may lead to extreme increase of load due to increase of air conditioning or heating loads respectively .

The proposed arithmetic mean determination based on six multi-objective indices, which are voltage deviation, frequency deviation, reliability, power loss in transmission lines, electricity price and CO₂ emission is applied. This work is developed through three main scenarios. The first scenario studies the effect of each index on the integrated micro-grid formation. The second scenario is the biased optimization analysis. In this stage, the optimal micro-grids integration is based on intentionally chosen multi-objective index weights to fulfil certain requirements. The third scenario targets the optimal selection of the multi-objective indices' effectiveness weights for power system optimum redistribution. The sharing weights of each index will be optimally

selected by intelligent optimization scenarios (IOS). IOS utilize the Water Cycle Optimization Technique (WCOT), Cuckoo Optimization Technique (COT) and Genetic Algorithm (GA). They address the system optimal power sharing through optimum micro-grids reformation (integration). WCOT, COT and GA are simulated using MATLAB (R2017a, The Math Works Ltd, Natick, MA, USA).

The developed work is applied to a distributed network which consists of a five micro-grid tested system, with one overloaded micro-grid. The three modules are utilized for multi-objective analysis of different alternative micro-grids. WCOT, COT and GA results are compared. In addition, it is investigated to find and validate the optimum solution. Final decision-making for optimal combination is determined, aiming to reach a perfect technical, economic and environmental solution .

These new techniques have been proved an effectiveness of selecting an optimum solution and satisfied a perfect economical, technical and environmental solution. The results indicate that the optimal decision may be modified after each individual index weight exceeds a specific limit.

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