Modeling of the Network Reconfiguration Considering Electric Vehicle Charging Load

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Abstract— The new electrical motor used as the automotive engines seen to be very efficient which use only clean energy generated as one of the efforts to minimize the carbon emissions. The high usage of electric vehicle around the world for responding to the demands of taking care the ecological system has establish many Electric Vehicles (EV) charging station to accommodate the user. However, high charging loads of fast charging stations result in increased peak load demand, reduced reserve margins and voltage instability. Thus, the optimal distribution network reconfiguration with interconnection of charging station is this solution for this issue. The finding of the optimal reconfiguration in this study are used to improve the voltage profile and minimize the power loss of the distribution system. The best reconfiguration is searched by using Cuckoo Search Algorithm (CSA). The result of the finding then will be verified by comparing to other research papers for its efficiency of the method used.

Keywords— *placement, Cuckoo Search Algorithm, electric vehicles, charging station, distribution network reconfiguration*

I. INTRODUCTION

Replacement of internal combustion engine (ICE) powered vehicles with electric vehicles (EVs) was implemented to reduce carbon emissions impacts. Thus, the number of EVs increased and followed by an increase in the demand for charging. Hence, the increase establishment of charging stations puts an extra burden onto the electricity grid. The uncoordinated charging of Electric Vehicle also has depleted the voltage profile, increase the peak load, and causes the harmonic disturbance to the electricity grid [1]–[3]. Therefore, to improvise the distribution network voltage profile and minimize the loss of power in the power grid, the optimal location of Distribution network with the interconnection of EV charging station should be modelled.

There are many research have been conducted in order to optimize the distribution network reconfiguration using optimization algorithms. Naidu et al. [4] concluded Hybrid Particle Swarm Optimization (HPSO) can be used to configure charging station and reconfigure the network which can reduce in distribution system power loss. Hybrid Particle Swarm Optimization and Imperialist Competitive Algorithms also investigated (PSO-ICA) by Mehdinejad et al

[5] and found PSO-ICA also capable of quick and effective solving the Optimal Reactive Power Dispatch. Moreover, Ma et al. [6] propose Dual Hybrid algorithm method to be used as the combination of Improved Binary Particle Swarm Optimization (IBPSO) and Particle Swarm Optimization (BPSO). The method used to show the faster optimization speed. Reduction of power loss and minimization of support voltage successfully achieved, thus can be used as distribution network reconfiguration. Furthermore, Nguyen [7] find Improved Cuckoo Search Algorithm (ICSA) method can be used to cater the Distribution Network Reconfiguration (DNR) problem with multi-objective function efficiently and capable in finding optimal solution. In this paper, we propose the use of CSA to the optimal power loss reduction with the placement of fast charger at different places in IEEE 33-bus system.

Hence, the objectives of this paper are to model the optimal DNR with the interconnection of EV charging station using CSA. In this paper, Section I explain about background about this paper. Section II shows the simulation modelling of CSA on different cases of placement in bus system. Section III shows the result and analysis of simulation modelling. Section IV is the conclusion of this paper.

II. SIMULATION MODELLING

This part will discuss on the methodology for the optimum reconfiguration of the distribution system with the interconnection of EV charging station to improvise the distribution network voltage profile and reduce power loss. In this research, the Cuckoo Search Algorithm (CSA) will be used in order to find the optimum solution. This chapter also will provide a detailed description of the objective functions, program flow and the case study used.

A. Cuckoo Search Algorithm

Cuckoo Search Algorithm (CSA) is a unique metaheuristic algorithm designed to solve optimization problems. CSA is inspired by the parasite cuckoo species which lay their eggs in the nests of other host birds. Compared to GA and PSO, this is a very effective algorithm. In [8], the authors has used the CSA method to enhance the distribution network voltage profile and reduce the power loss. The authors claim that the proposed algorithm is