別紙様式８

研 究 主 論 文 抄 録

論文題目　ARTIFICIAL INTELLIGENCE BASED OPTIMAL CONFIGURATION OF HYBRID POWER GENERATION SYSTEM
（知識工学を適用したハイブリッド発電システムの最適構成）

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Abstract

Diesel generator (DG) unit is one of the suitable options for supplying electricity in remote areas due to their compact design and high specific power. However, DG systems have problems, such as hard maintenance, required fuel supply, high generation cost and generate CO_2 emission due to combustion of fossil fuel. The hybrid power generation systems consisting of combination of wind turbine, photovoltaic (PV), battery banks and DG are economically feasible in many cases for electric energy supply in isolated areas where the electric utility is not available. This dissertation focuses on the optimization and operation of the renewable energy power sources for the isolated island. The artificial intelligence methods were utilized in this research to optimize the system. Genetic Algorithm (GA) has been utilized to solve the optimization problem of hybrid power generation system involved of Wind-PV-Diesel-Battery system in isolated area in Indonesia. The objective function of this case is minimization of total annual cost consisting of annual capital cost, annual operation maintenance, annual replacement cost and annual fuel cost. From the simulation results, the proposed system was able to minimize the total annual cost of the system under study and reduce CO_2 emission from DG.

The basic function of a modern electric power system is to provide an adequate electrical supply to its customers as economically as possible and with a reasonable level of reliability. The fluctuation nature of wind turbines has the serious problem to the stability in the power system. Therefore, the penetration ratio of wind power must be in the range of constraint to prevent instability of the system. In this research, the objective function includes both CO_2 emission consideration and reliability calculation. The reliability was evaluated by using basic probabilistic

concept in order to find loss of load probability (LOLP). Meanwhile, in order to evaluate LOLP, the effect of forced outage rate (FOR) of each unit of DG, battery bank and wind turbine were included in the simulation program. From the simulation results incorporating wind turbine to the existing DG system increase the reliability and decrease overall cost of system.

The performance of GA to find the optimal size of hybrid power generation system has been tested successfully. However, a new intelligence technique well known as particle swarm optimization (PSO) has been invented and reported from many researchers is faster than GA. Hence, in this research also presents a method for optimal sizing of hybrid power generation system consisting of PV, DG and battery banks based on PSO. The aim of this research is to provide a reference for total cost reduction of the system related to constraints and satisfactions of load demand. The cost objective functions include the total cost for minimizing CO_2 emissions and customer damage cost function for the compensation cost due to the electricity shortages. The PSO algorithm is a relatively simple computation technique to reach the global optimum, compared with genetic algorithm (GA) method. The simulation result has been confirmed from costs reduction and environmental point of views.

New innovation of PV technologies either in materials and its applications has advanced dramatically. One of these new advancements includes a newer-thin film which is lighter and cheaper than the old one. Hence, choosing the suitable PV specifications associated with their prices is very crucial. The last chapter in this study performs GA method with binary coded for representation of the chromosomes to find the exact number of renewable energy component associated with their overall cost of system. Three PV panel technologies (ASE-300, Astropower AP-120 and Kyocera KC-120) were utilized to compare their capabilities to satisfy load demand with the minimum cost of system. Simulation results show that the optimum size can be obtained by using AP-120 with the size of PV, battery banks and DG unit are 139,250×120W, 5×5MWh and 12MW, respectively.