Design of Hybrid Power Generation Systems Connected to Utility Grid and Natural Gas Distribution Network: A New Contribution

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Abstract

Hybrid power generation system (HPGS) is an active research area, which is in need of a continuous improvement. It represents the best solution for the most complex problems facing the world in the last decades. These problems are known as the shortage of energy, or lack of electricity, which logically are the results of the continuous increasing demand. Therefore, the researchers do their best to overcome all expected roadblocks facing the development, where the most applicable solutions to solve these problems are introduced. In this paper, the HPGS includes; wind turbine (WT), photovoltaic (PV), storage battery (SB), gas turbine (GT), and utility grid (UG). The GT of this system is fueled directly from the natural gas distribution network considering all operational conditions of it, which may be affected by fueling the natural gas for the GT. So, the natural gas distribution network is becoming an important component of the HPGS, and it is included in the HPGS for the first time. Multi metaheuristic optimization techniques are applied to obtain the components sizing of this system, where cuckoo search algorithm (CSA), firefly algorithm (FA), and flower pollination algorithm (FPA) have been applied. Therefore, this paper introduces a new contribution not only to the new configuration of the HPGS, but also in applying the new optimization techniques as solving tools. The output results are compared to show the effectiveness and the superiority of the applied techniques as well as extract a recommendation for the best solving technique.

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