Advances in Energy Research, *Vol. 7, No. 1 (2020) 67-84*
DOI: http://doi.org/10.12989/eri.2020.7.1.067

An application of LAPO: Optimal design of a stand alone hybrid system consisting of WTG/PV/diesel generator/battery

Navid Shiva[1a], Abolfazl Rahiminejad[1b], Amin Foroughi Nematollahi[2c] and Behrooz Vahidi[*2]

[1]*Department of Electrical and Computer Science, Esfarayen University of Technology, Esfarayen, Iran*
[2]*Department of Electrical Engineering, Amirkabir University of Technology, Tehran, 1591634311, Iran*

(Received May 1, 2019, Revised April 8, 2020, Accepted April 10, 2020)

Abstract. Given the recent surge of interest towards utilization of renewable distributed energy resources (DER), in particular in remote areas, this paper aims at designing an optimal hybrid system in order to supply loads of a village located in Esfarayen, North Khorasan, Iran. This paper illustrates the optimal design procedure of a standalone hybrid system which consists of Wind Turbine Generator (WTG), Photo Voltaic (PV), Diesel-generator, and Battery denoting as the Energy Storage System (ESS). The WTGs and PVs are considered as the main producers since the site's ambient conditions are suitable for such producers. Moreover, batteries are employed to smooth out the variable outputs of these renewable resources. To this end, whenever the available power generation is higher than the demanded amount, the excess energy will be stored in ESS to be injected into the system in the time of insufficient power generation. Since the stand-alone system is assumed to have no connection to the upstream network, it must be able to supply the loads without any load curtailment. In this regard, a Diesel-Generator can also be integrated to achieve zero loss of load. The optimal hybrid system design problem is a discrete optimization problem that is solved, here, by means of a recently-introduced meta-heuristic optimization algorithm known as Lightning Attachment Procedure Optimization (LAPO). The results are compared to those of some other methods and discussed in detail. The results also show that the total cost of the designed stand-alone system in 25 years is around 92 M€ which is much less than the grid-connected system with the total cost of 205M€. In summary, the obtained simulation results demonstrate the effectiveness of the utilized optimization algorithm in finding the best results, and the designed hybrid system in serving the remote loads.

Keywords: hybrid system; standalone; meta-heuristic optimization algorithm; renewable energy resources

1. Introduction

There is an increasing trend toward utilization of renewable energy resources since fossil fuels are running out and cause irreversible environmental damages(Wang and Nehrir 2008). Moreover,

*Corresponding author, Professor, E-mail: vahidi@aut.ac.ir
[a]Student, Email: navidshiva1991@gmail.com
[b]Ph.D., Email: abolfazl.rahiminezhad@gmail.com
[c]Student, E-mail: amin.forooghi@aut.ac.ir

 ISSN: 2287-6316 (Print), 2287-6324 (Online)

Wu, B., Maleki, A., Pourfayaz, F. and Rosen, M.A. (2018), "Optimal design of stand-alone reverse osmosis desalination driven by a photovoltaic and diesel generator hybrid system", *Solar Energy*, **163**, 91-103. https://doi.org/10.1016/j.solener.2018.01.016.

CC