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Sizing of a standalone photovoltaic water pumping system using hybrid multi-criteria decision making methods (2018) *Solar Energy*, 159, pp. 1003-1015.

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Abstract

Photovoltaic water pumping system (PVPS) is considered one of the most important and promising application of solar energy in remote and rural areas. The random nature of solar energy is one of the main obstacles that encounter the designer to design an effective PVPS. Thus, an optimal and effective sizing approach is essential to ensure satisfactory performance. In this paper, a technique for order performance by similarity to ideal solution (TOPSIS) method integrated with analytic hierarchy process (AHP) method is proposed to optimally size PVPS based on techno-economic aspects. The loss of load probability (LLP) and excess water volume are considered as technical criteria, whereas the life cycle cost (LCC) is represented as an economic criteria to size the system. The hybrid AHP-TOPSIS sorts the PVPS configurations from the best to worst based on predefined weights for each criteria. The optimal configuration is found 5 PV modules and 4 PV strings are connected in series and parallel, respectively with 79 m³ as a maximum capacity of storage tank. The performance of system is tested based on the proposed optimal configuration over a year using hourly meteorological data. The results show that the proposed system offers high reliability throughout the year with LLP, LCC, and deficit water volume around 0.0004, 10524.9 USD, and 4.4629 m³, respectively. © 2017 Elsevier Ltd

Author Keywords

Analytic hierarchy process; Life cycle cost; Loss of load probability; Multi-criteria decision making; Photovoltaic water pumping system

Index Keywords

Analytic hierarchy process, Decision making, Digital storage, Electric load loss, Hierarchical systems, Life cycle, Meteorology, Photovoltaic cells, Pumping plants, Pumps, Solar energy, Solar power generation; Analytic hierarchy process (ahp), Life cycle costs (LCC), Lifecycle costs, Multi criteria decision making, Multi-criteria decision making methods, Performance of systems, Photovoltaic water pumping, Technique for order performance by similarity to ideal solution methods (TOPSIS); Loss of load probability; analytical hierarchy process, cost analysis, decision making, design, life cycle analysis, multicriteria analysis, performance assessment, photovoltaic system, probability, pumping, size, solar power

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