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Design recommendations and cost assessment for non-stop off-grid plants of seawater desalination based on PV-driven with wind/diesel energy backup

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ABSTRACT

An off-grid multi-generation model (solar photovoltaic, wind power, and diesel) has been used to assess the performance of a low scale (up to 250 m^3/d) seawater reverse osmosis desalination plant with four different operating modes: fix, variable (180–250 m^3/d), modular-fix (100 + 150 m^3/d) and modular-variable operation (100 + 115–150 m^3/d). The high-pressure pump and energy recovery system have been selected for each case according to the flow requirements; reverse osmosis membrane simulations have been made to know the power demand, product water flow and quality for the whole operating range of each option. The use of real solar and wind data allows to preliminarily assess the performance of the system. A specific battery charge/discharge strategy has been considered to take maximum advantage of wind and solar available energies. The most relevant technical and economic results have been presented, finding out the pros and cons of the different analyzed cases. A sensitivity analysis complements the study to identify the key parameter values addressed to achieve a minimum water cost under 2.2 €/m^3. A new index is proposed to assess the performance of the whole system.

Keywords: PV powered desalination; Seawater reverse osmosis; Water cost; Off-grid multigeneration for 24/365 operation

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