Iran energy storage for load shifting

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As can be seen from previous research, most studies of stand-alone hybrid systems designing are presented as deterministic and without considering the uncertainty of renewable energy resources generation and also load demand. So, due to continuous changes in the load demand and also changes in the renewable power generation, the designing of the hybrid systems should be performed considering the uncertainties of the generation and load to achieve accurate values of the cost and reliability.

In Sect. 2, the modeling of the hybrid system is presented. In Sect. 3, the problem formulation is described. The proposed meta-heuristic approach and implementation process are described in Sect. 4. In Sect. 5, the results are presented and also discussed. Section 6 given the conclusion.

The PV/WT/Batt renewable system is considered as a hybrid energy system that includes WT, PV panel, battery, DC/DC converter, AC/DC converter, and also inverter. Schematic of hybrid PV/WT/Batt renewable system is showed in Fig. 1. The battery is used to enhance the system"s reliability.

In the hybrid PV/ WT/Batt system, the battery is charging when the power of the renewable resource is higher than the load level. When the generated power of the renewable units is less than the load demand, the battery is in discharge mode. Of course, under equal conditions of generation and consumption, battery energy is unchanged.

Wind speed changes due to the height of the wind tower should be considered in the design of WTs. In this study, the power law is used to transfer anemometer data at a certain height and the relationship of this model is as follows [9].

In this study, wind speed uncertainty and wind power are considered in the design of the hybrid system. To model wind power uncertainty, the most suitable PDF is the Weibull distribution function, so for wind speed, the Weibull PDF is used as follows [30,31,32,33,34,35]:

The PV/WT/Batt system design, the battery based on charge and discharge management has been applied to compensate the power fluctuations of the renewable resources and to improve the load reliability.

Under charging conditions, the output power of renewable resources is higher than the load level that excess power is injected into the storage system. Battery energy at time t in charge mode is defined as follows [36, 37].

In discharge conditions, the output power of the renewable resources is lower than the load, which deficit power is compensated by the battery discharge. The battery capacity at time t in discharge mode is defined as follows [36, 37].

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