

Trends and challenges in the operation of pumped-storage hydropower plants

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Abstract— The increasing penetration of renewable energy sources (RESs) in the power system has highlighted the benefits of being able to store energy in a more efficient manner, and the need of holding additional operating reserves to manage the system under more demanding conditions due to the inherent uncertainty and variability of wind and solar power. Pumped hydroelectric energy storage (PHES) is by far the most established technology for energy storage at a large-scale. PHES units have also participated in the active power-frequency control for years, and last technical developments in PHES have been oriented to improve their capability of providing regulation reserves by means of variable speed design or by hydraulic short-circuit configurations. This fact, together with the impact of RES on spot-market energy and ancillary services prices, is changing the operation and market conditions faced by PHES plants. The aim of this paper is to review the current trends in the PHES operation, to discuss why current practices should be re-examined, and to present the main challenges faced by PHES operators who will need to adapt their scheduling and bidding models to optimize jointly the operation in the energy and in the ancillary services markets.

Index Terms— Pumped-storage hydropower plants; Operation; Trends; Challenges

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