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Deriving optimal end of day storage for pumped-storage power plants in the joint energy and reserve day-ahead scheduling

M. Chazarra Jover; J.I. Pérez-Díaz; J. García González

Abstract-

This paper presents a new methodology to maximise the income and derive the optimal end of day storage of closed-loop and daily-cycle pumped-storage hydropower plants. The plants participate in the day-ahead energy market as a price-taker and in the secondary regulation reserve market as a price-maker, in the context of the Iberian electricity system. The real-time use of the committed reserves is considered in the model formulation. The operation of the plants with the proposed methodology is compared to the ones that use an end of day storage of an empty reservoir or half of the storage capacity. Results show that the proposed methodology increases the maximum theoretical income in all the plants analysed both if they only participate in the day-ahead energy market and if they also participate in the secondary regulation service. It is also shown that the increase in the maximum theoretical income strongly depends on the size of the plant. In addition, it is proven that the end of day storages change notably in the new reserve-driven strategies of pumped-storage hydropower plants and that the proposed methodology is even more recommended if the secondary regulation service is considered.

Index Terms- pumped-storage hydropower plants; secondary regulation service; end of day storage; price-maker approach; water value

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