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EDITORIAL

Editorial: special issue on "Hydropower Scheduling"

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1 Background

Scheduling of generation resources is an important task in power systems worldwide. In systems comprising hydropower with storage capacity, the generation scheduling problem involves the challenge of coordinating reservoir storages under uncertainty in inflow. The representation of other uncertainties, e.g., in demand and wind power production, adds to this challenge. Moreover, the integration with other markets, such as natural gas, hydrogen, and carbon markets adds additional complexity to the scheduling process. The long-term dynamics of hydropower reservoirs also introduces several challenges related to the planning of expansions and maintenance of the transmission and generation system. In terms of technology, design and geographical impact, no hydropower systems are alike. They differ in shaping of watersheds and storages, the various waterways used to control the water flows, power station configurations, the constraints imposed on the operation, and the unique regulatory framework under which each system operates. To this end, accurate and robust hydropower scheduling processes require detailed modeling of uncertainties and system components in optimization and simulation models that run in reasonable computational times.

This volume presents selected papers from the 7th International Conference on Hydropower Scheduling in Competitive Electricity Markets, arranged 12–13 September 2022 in Oslo, Norway. The conference was organized by SINTEF Energy Research and the Norwegian University of Science and Technology and was hosted by Statkraft. This conference has emerged as an intimate and world-wide forum for researchers and practitioners to present the latest research results, ongoing developments, best practices, and applications related to hydropower scheduling. The

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presentations from this and previous versions of the conference are available at https://www.sintef.no/projectweb/hydroscheduling/.

2 Contributions

A total of 15 papers are included in this special issue. These can be categorized in four thematic areas: Short-term scheduling, long-term scheduling, integration in power market models, and maintenance planning.

The topic of *short-term hydropower scheduling* is addressed in [1–6]. A method based on homotopy is presented in [1], solving the short-term non-linear and multi-purpose scheduling problem. In [2] a mixed integer linear programming formulation to prevent non-physical overflow in the short-term scheduling is presented, including a tailor-made heuristic. The authors in [3] present a stochastic mixed-integer nonlinear model, including nonlinear heuristic, for the bidding problem. A comparison between plant- and unit-based production functions for the short-term energy and reserve scheduling problem is provided in [4]. In [5] the impact of scenario tree generation and reduction methods on the solution of the short-term scheduling problem is quantified. Finally, [6] improves hydropower equivalents to better represent production peaks in the detailed hydropower systems.

Long-term hydropower scheduling, involving valuation of water resources, was addressed in [7–10]. The authors in [7] investigate the importance of representing correlations between power prices and inflows in the medium-term scheduling, while [8] compares the performances of the well-known stochastic dual dynamic programming (SDDP) algorithm with a proposed rolling-horizon simulator. Both [9] and [10] investigate the impact of various environmental constraints on the long-term hydropower scheduling, for systems with grid constraints [9] and pumps [10].

The *integration of hydropower in power market models* is addressed in [11–14]. A review on how uncertainties are represented in power market models, emphasizing models used for operational planning and applied to systems with hydropower, is presented in [11]. The authors in [12] presented a methodology for embedding uncertainty in monthly wind power production in the SDDP algorithm applied for scheduling the Brazilian interconnected power system. In [13] an integrated energy system model is applied to investigate how hydrogen import prices impact the scheduling and valuation of European hydropower resources. The authors in [14] analytically investigate the optimal generation mix and the corresponding price structure in power systems where variable renewable energy and electric energy storages are available.

Finally, the topic of *maintenance planning* is covered in [15], describing a framework for computing average and marginal costs related to start-up and shutdown of individual hydropower units, as well as costs related to ramping and operation at part load and maximum production are estimated.

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