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Short-Term Hydro Scheduling considering Risk Aversion in a MINLP Approach

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Abstract. This paper presents an optimization model to help a hydro generating company to schedule its hydroelectric units in the short-term under a competitive environment. The hydro generating company considered has the ultimate goal of maximizing profits, taking also into account some risk aversion criterion. The problem is formulated as a mixed-integer nonlinear programming problem. An application to a real case study is presented. Conclusions are duly drawn.

Key words

Hydro scheduling, competitive environment, risk averse, mixed-integer nonlinear programming.

1. Introduction

In this paper, the short-term hydro scheduling (STHS) problem of a head-dependent hydro chain is considered. Hydro plants with only a small storage capacity available are known as run-of-the-river. Due to the reservoirs small storage capacity, the operating efficiency becomes sensitive to the head—head change effect. The cascaded hydraulic configuration coupled with the nonlinear head change effect, augments the problem dimension and the complexity.

The main goal in the STHS problem is to maximize the value of total hydroelectric power generation throughout the time horizon, satisfying all physical and operational constraints, and consequently to maximize the profit of the hydro generating company from selling energy into the electric market [1]. Also, as a new contribution to earlier studies, some risk aversion criterion is taken into account.

Indeed, any producer should self-schedule its units to maximize the expected profit assuming a given level of risk. This self-schedule is then used by the producer to derive an appropriate bidding strategy to the pool [2].

Mixed-integer linear programming (MILP) is becoming often used for STHS [3, 4], where integer variables allow modeling of start-up costs, which are mainly caused by the increased maintenance of windings and mechanical equipment, and by malfunctions of the control equipment.

In this paper, a mixed-integer nonlinear programming (MINLP) approach is proposed to solve the STHS problem. The proposed approach considers not only head-dependency but also discontinuous operating regions. We report our experience with the proposed approach on a real case study.

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