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Natural gas bilevel cash-out problem: Convergence of a penalty function method

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Abstract: This paper studies a special bi-level programming problem that arises from the dealings of a Natural Gas Shipping Company and the Pipeline Operator, with facilities of the latter used by the former. Because of the business relationships between these two actors, the timing and objectives of their decision-making process are different and sometimes even opposed. In order to model that, bi-level programming was traditionally used in previous works. Later, the problem was expanded and theoretically studied to facilitate its solution; this included extension of the upper level objective function, linear reformulation, heuristic approaches, and branch-and-bound techniques. In this paper, we present a linear programming reformulation of the latest version of the model, which is significantly faster to solve when implemented computationally. More importantly, this new formulation makes it easier to analyze the problem theoretically, allowing us to draw some conclusions about the nature of the solution of the modified problem. Numerical results concerning the running time, convergence, and optimal values, are presented and compared to previous reports, showing a significant improvement in speed without actual sacrifice of the solution's quality. (C) 2011 Elsevier B.V. All rights reserved.

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