Spot Pricing When Lagrange Multipliers Are Not Unique

Classical spot pricing theory is based on multipliers of the primal problem of an optimal market dispatch, i.e., the solution of the dual problem. However, the dual problem of market dispatch may yield multiple solutions. In these circumstances, spot pricing or any standard pricing practice based on multipliers cannot generate a unique clearing price. Although such situations are rare, they can cause significant uncertainties and complexities in market dispatch. In practice, this situation is solved through simple empirical methods, which may cause additional operations or biased allocation. Based on a strict extension of the principles of spot pricing and surplus allocation, we propose a new pricing methodology that can yield unique, impartial, and robust solution. The new method has been analyzed and compared with other pricing approaches in accordance with spot pricing theory. Case studies support the results of the theoretical analysis, and further demonstrate that the method performs effectively in both uniform-pricing and nodalpricing markets.