Multiperiod Auction for a Pool-Based Electricity Market

Arroyo, Jose M.; Conejo, Antonio J.

Author Affiliation: University of Castilla-La Mancha.

Abstract: This paper presents a market clearing tool for the market operator of a pool-based electricity market for energy. This tool is transparent and fair for the market participants and simple to implement and interpret. It preserves the privacy of the corporate information of the participants and provides the right signals to achieve economic efficiency. It recognizes and properly models the technical (physical and intertemporal) constraints of the participant thermal power generators. From a mathematical point of view, the proposed tool results in a mixed-integer linear programming problem that can be efficiently solved using currently available branch and cut software. To illustrate the adequate functioning of the proposed market clearing procedure, different realistic ease studies are analyzed in detail.

Keywords: Pool-based electricity market, maximum net social welfare, mixed-integer LP, market clearing tool.

Preprint Order Number: PE-544PRS (06-2002)

Discussion Deadline: November 2002

ARIMA Models To Predict Next-Day Electricity Prices

Contreras, Javier; Espinola, Rosario; Nogales, F.J.; Conejo, Antonio J.

Author Affiliation: Universidad De Castilla-La Mancha.

Abstract: Price forecasting is becoming increasingly relevant to producers and consumers in the new competitive electric power markets. Both for spot markets and long-term contracts, price forecasts are necessary to develop bidding strategies or negotiation skills in order to maximize benefit. This paper provides a method to predict next-day electricity prices based on the ARIMA methodology. ARIMA techniques are used to analyze time series and, in the past, have been mainly used for load forecasting due to their accuracy and mathematical soundness. A detailed explanation of the aforementioned ARIMA models and results from mainland Spain and Californian markets are presented.

Keywords: Electricity markets, market clearing price, forecasting, time series analysis, ARIMA models.

Preprint Order Number: PE-561PRS (06-2002)

Discussion Deadline: November 2002

Voltage Stability Protection and Control Using a Wide Area Network of Phasor Measurements

Milosevic, Borka D.; Begovic, Miroslav

Author Affiliation: Georgia Institute of Technology.

Abstract: This paper presents a concept for local monitoring of the onset of voltage collapse and protective and emergency control in the presence of voltage sensitive loads. The onset of voltage collapse point is calculated based on the load characteristics and simulated voltage and current phasors measurements, which are provided by a network of phasor measurement units. If the stability margin is small and the reactive power reserves nearly exhausted, then controls to steer the power system away from the critical point will be activated.

Keywords: Emergency control, load modeling, protective relaying, voltage stability, voltage stability index.

Preprint Order Number: PE-672PRS (06-2002)

Discussion Deadline: November 2002

A Simulation Approach to Balancing Annual Risk and Reward in Retail Electrical Power Markets

Gabriel, Steven A.; Genc, Mehmet F.; Balakrishnan, Swaminathan

Author Affiliation: University of Maryland; Clark Construction Group; ANB Enterprises, Inc.

Abstract: Retail electrical power marketers, also known as retailers, typically set up contracts with suppliers to secure electricity at fixed prices on the one hand and with end users to meet their load requirements at agreed upon rates on the other hand. Providing future load requirements accurately to the suppliers is an integral part of these supply contracts. We analyze a series of retailer strategies to determine future loads using simulation at the hourly level for a simulated year (8,760 hours). We provide numerical results based on actual data for the PJM market and provide insights into these retailer strategies.

Keywords: Decision-making, risk analysis, simulation.

Preprint Order Number: PE-072PRS (06-2002)

Discussion Deadline: November 2002

Unit Commitment with Identical Units: Successive Subproblem Solving Method Based on Lagrangian Relaxation

Zhai, Qiaozhu; Guan, Xiaohong; Cui, Jian

Author Affiliation: Xian Jiaotong University.

Abstract: When the Lagrangian relaxation based methods are applied to solve power system unit commitment, the identical solutions to the subproblems associated with identical units may cause the dual solution to be far away from the optimal solution and serious solution oscillations. As a result, the quality of the feasible solution obtained may be very unsatisfactory. This issue has been long recognized as an inherent disadvantage of Lagrangian relaxation based methods. In this paper, the homogeneous solution issue is identified and analyzed through a simple example. Based on this analysis, a successtve subproblem solving method is developed. The new method combines the concepts of augmented Lagrangian relaxation and surrogate subgradient to produce a good search direction at the high level. The low-level subproblems including those corresponding to the identical units are solved successively so that the commitments of the identical units may not be homogeneous in the dual solution. Compared with the standard Lagrangian relaxation method, the new method can obtain better dual solutions and avoid the solution oscillations. Numerical testing shows the new method is efficient and the quality of the feasible solution is greatly improved.

Keywords: Unit commitment, Lagrangian relaxation, surrogate subgradient, homogeneous solution oscillations.

Preprint Order Number: PE-091PRS (06-2002)

Discussion Deadline: November 2002

Price-Taker Bidding Strategy Under Price Uncertainty

Conejo, Antonio J.; Nogales, Francisco J.; Arroyo, Jose M.;

Author Affiliation: University of Castilla-La Mancha.

Abstract: This paper provides a framework to obtain the optimal bidding strategy of a price-taker producer. An appropriate forecasting tool is used to estimate the probability density functions of next-day hourly market-clearing prices. This probabilistic information is used to formulate a self-scheduling profit maximization problem that is solved taking advantage of its particular structure. The solution of this problem allows deriving a simple yet informed bidding rule. Results from a realistic case study are discussed in detail.

Keywords: Pool-based electricity market, price-taker producer, self-scheduling, bidding strategy, forecasting, MILP.

Preprint Order Number: PE-152PRS (06-2002)

Discussion Deadline: November 2002