Adequacy Assessment of Power System Generation Using a Modified Simple Genetic Algorithm

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Abstract: A new method for the assessment of generation system reliability is based on a modified version of the simple genetic algorithm (MSGA). A genetic algorithm (GA) is used not for its traditional objective of optimization but as a search tool to truncate the probability state space and to track the most probable failure states. The GA stores system states, in which there is generation deficiency to supply system maximum load, in a state array. The given load pattern is then convoluted with the state array to obtain adequacy indices. State array is also used to obtain useful information about the contribution of different states and generation unit combinations to the probability of system failure.

Keywords: Genetic algorithms, power generation reliability.

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An Extended Nonlinear Primal-Dual Interior-Point Algorithm for Reactive-Power Optimization of Large-Scale Power Systems with Discrete Control Variables

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Abstract: This paper presents a new algorithm for reactive-power optimization of large-scale power systems involving both discrete and continuous variables. This algorithm realizes successive discretization of the discrete control variables in the optimization process by incorporating a penalty function into the nonlinear primal-dual interior-point algorithm. The principle of handling these discrete variables by the penalty function, the timing of introducing the penalty function during iterations and the setting of penalty factors are discussed in detail. To solve the high-dimension linear correction equation speedily and efficiently in each iteration, a novel data-structure rearrangement is proposed. Compared with the existing data structures, it can effectively reduce the number of nonzero fill-in elements and does not give rise to difficulty in triangular factorization. The numerical results of test systems that range in size from 14 to 538 buses have shown that the proposed method can give near-optimum solutions, has good convergence, and is suitable for large-scale system applications.

Keywords: Discrete control variables, data structure, nonlinear primal-dual interior-point algorithm, quadratic penalty function, reactive-power optimization.

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Combined Pool/Bilateral Dispatch, Part II: Curtailment of Firm and Nonfirm Contracts

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Abstract: This paper deals with the dispatch of power networks under mixed pool/bilateral trading. Three major questions are examined in separate parts of this three-part paper. To what degree does the relative level of pool versus bilateral trading influence performance in terms of individual power levels, costs, prices, and revenues? What is the comparative performanceof mixed trading with firm and nonfirm bilateral contracts under various curtailment strategies? Is the revenue derived from the pool and bilateral trading consistent with the corresponding unbundled costs? The eventual goal is to help generator and load-serving entities choose appropriate relative levels of pool versus bilateral trades while considering risk, economic performance, and physical constraints. In Part II, two types of bilateral contracts, firm and nonfirm, are introduced together with their respective curtailment and noncurtailment bids. The optimal power flow problem from Part I is now modified to accommodate this new type of operation.Technical and economical performance measures defined in Part I (namely, generation revenues from bilateral and pool sales, pool demand payments, plus generation and load expenditures to cover transmission loss and congestion management attributed to bilateral exchanges) are also used here together with revenues from contract curtailment and expenditures due to noncurtailment bidding.Simulation results illustrate the effects of firm and nonfirm contracts and their bidding strategies on the relative levels of pool/bilateral trading, as well as on economic performance of market participants.

Keywords: Pool operation, bilateral contracts, mixed trading strategies, costs, incremental costs, prices, revenues, firm and nonfirm contracts, curtailment and noncurtailment bidding strategies.

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Mixed Pool/Bilateral Operation, Part III: Unbundling Costs of Trading Services

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Abstract: Some of the various services provided under mixed pool/bilateral electricity trading are power to satisfy bilateral contract demand, power for transmission losses and congestion management due to bilateral contracts, power for transmission losses and congestion management due to wheeling contracts, and power for transmission losses and congestion management due to pool demand. A procedure is developed and tested to unbundle these MW services as well as their corresponding costs, thus allowing the calculation of the average cost of each service. Comparison of the average and marginal costs serves to evaluate the relative profitability of each service. The goal of these results is to help generator and load-serving entities choose appropriate relative levelsof pool versus bilateral trades while considering risk, economic performance, and physical constraints.

Keywords: Pool/bilateral/wheeling markets, cost unbundling, losses, congestion management, average and marginal costs.

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Nondiscriminatory System Losses Dispatching Policy in a Bilateral Transaction-Based Market

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Abstract: A new method to allocate transmission losses for simultaneous bilateral transactions is proposed. The methodology utilizes a circuit approach of the system in conjunction with a classical power flow. For a given operating point, it is possible to derive system loss expression as a sum of partial terms due to each transaction. These transaction loss components, supplied by slack buses, can turn into costs associated to the respective transactions. Alternatively, in this paper, it is proposed that each transaction provides for its own loss, thus eliminating the need for a balancing mechanism. In this case, the developed methodology evaluates the increase of active power at each transaction generator through loss contributions not arbitrarily assumed but calculated from a developed loss allocation formula. The main advantage of the developed method lies in its simplicity and capability of treating multiple transactions simultaneously.

Keywords: Loss allocation, simultaneous bilateral contracts, multiple wheeling transactions.

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