Optimal Dispatch of Generating Units of the Itaipu Hydroelectric Plant

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Abstract: This article is concerned with the optimal dispatch of generating units of Itaipú, the world's largest hydroelectric plant in operation. Itaipú is a 12.6 GW hydro plant, located on the Paraná river in South America, composed of 18 identical 700 MW generating units. A dynamic programming model has been developed to optimize the number of generating units in operation at each hour of the day in order to attain the total generation scheduling of the plant in the most economic way. The model highlights the trade-off between start-up/shut-down of generating units and hydro power efficiency, taking into account variations in tailrace elevation, penstock head losses, and turbine-generator efficiencies. The methodology has been tested for a typical generation scheduling, and the results show that the number of the turbine-generator sets dispatched has a major influence on the overall hydroplant efficiency, and therefore it is a key aspect to be considered in the dispatch of hydro generating units. In the case of Itaipú, the economic benefits, in terms of greater power efficiency with respect to actual operation, are in the range of millions of dollars per year.

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Modeling and Analysis of Custom Power Systems by PSCAD/EMTDC

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Abstract: This paper addresses the timely issue of modeling and analysis of custom power controllers, a new generation of power electronics-based equipment aimed at enhancing the reliability and quality of power flows in low-voltage, distribution networks [2],[3]. The modeling approach adopted in this article is graphical in nature, as opposed to mathematical models embedded in code using a high-level computer language. The well-developed graphic facilities available in an industry standard power system package, namely, PSCAD/EMTDC, are used to conduct all aspects of model implementation and to carry out extensive simulation studies. Graphics-based models suitable for electromagnetic transient studies are presented for the following three custom power controllers: the distribution static compensator (D-STATCOM), the dynamic voltage restorer (DVR), and the solid-state transfer switch (SSTS). Comprehensive results are presented to assess the performance of each device as a potential custom power solution. The paper is written in a tutorial style and aimed at the large PSCAD/EMTDC user base.

Keywords: Custom power, D-STATCOM, DVR, SSTS, PWM, voltage source converter.
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A Cobweb Bidding Model for Competitive Electricity Markets

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Abstract: The new competitive framework that has been established in several electricity markets all over the world has changed the way that electric companies attain benefits. Under this new scenario, generation companies need to develop bidding models not only for the sake of achieving a feasible dispatch of their units, but also for maximizing their benefits. This paper presents a new bidding strategies model that considers the global policy of a company, but also specifies the bid of each generating unit. The proposed model produces a maximum price bid and an optimal bidding quantity by means of an iterative procedure using the generating company's residual demand curve. It is based on an economic principle known as the cobweb theorem, frequently used to study stability in trading markets. A realistic case study from the Spanish daily electric market is presented to illustrate the methodology.

Keywords: Electricity markets, bidding strategies, residual demand, Nash-Cournot equilibrium, cobweb theorem.
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Power System Dynamic Performance

Valuation of Dynamic Reactive Power Support Services for Transmission Access

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Abstract: Competitive procurement of reactive power support services is rapidly becoming a reality for deregulated electricity markets. It has resulted in a great need to quantify the value of reactive power support from var sources. This article presents research results on the development of new concepts and schemes for equitable reactive power support valuation. Performance characteristics of the proposed method are determined and practical application issues are addressed. The validity of the method is verified through sensitivity studies. This work emphasizes that the valuation of reactive power support services should be based on their contributions to system security and stability. The dynamic var is the primary concern for the reactive power valuation problem.

Keywords: Reactive power support, voltage security, ancillary services, and open access.
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Nonlinear Decentralized Disturbance Attenuation Excitation Control via New Recursive Design for Multimachine Power Systems

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Abstract: In this article a new nonlinear decentralized disturbance attenuation excitation control for multimachine power systems is proposed based on recursive design without linearization treatment. The proposed controller improves system robustness to dynamic uncertainties and also attenuates bounded exogenous disturbances on the system in the sense of L_2-gain [1]. Computer test results on a six-machine system show clearly that the proposed excitation control strategy can enhance transient stability of power systems more effectively than other excitation controllers.

Keywords: Nonlinear system, power system stability, recursive design, disturbance attenuation, decentralized control.
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Power System Instrumentation and Measurement

A Neural-Fuzzy Classifier for Recognition of Power Quality Disturbances

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