

Discussion Deadline: January 2003

Online Risk-Based Security Assessment

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Abstract: The work was motivated by a perceived increase in the frequency at which power system operators are encountering high stress in bulk transmission systems and the corresponding need to improve security monitoring of these networks. Online risk-based security assessment provides rapid online quantification of the security level associated with an existing or forecasted operating condition. One major advantage of this approach over deterministic online security assessment is that it condenses contingency likelihood and severity into indices that reflect probabilistic risk. Use of these indices in control room decision-making leads to increased understanding of potential network problems, including overload, cascading overload, low voltages, and voltage instability, resulting in improved security related decision-making. Test results on large-scale transmission models retrieved from the energy management system of a U.S. utility company are described.

Keywords Security assessment, control center, probabilistic risk, uncertainty, voltage instability, cascading, overload, operations, decision-making.

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Software Implementation of Online Risk-Based Security Assessment

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Abstract: This paper describes software implementation for online risk-based security assessment that computes indices based on probabilistic risk for use by operators in the control room to assess system security levels as a function of existing and near-future network conditions. Focus is on speed enhancement techniques that are essential for online application and result visualization methods that offer clear and meaningful ways to enhance human assimilation and comprehension of security levels. Results of testing on a series of 1600 bus power flow models retrieved from the energy management system of a large U.S. utility are presented and serve to illustrate the benefits of the software.

Keywords Security assessment, control center, probabilistic risk, uncertainty, voltage instability, cascading, overload, operations, decision-making, visualization.

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Optimal Reliable Operation of Hydrothermal Power Systems with Random Unit Outages

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Abstract: A new model for long-term operation of hydrothermal power systems is introduced, and a method for obtaining an optimal solution is developed. We assume both reservoir inflows and energy demand are stochastic and all units are exposed to random outages. The objective is to minimize the total cost of the system as well as the expected interruption cost of energy (EIC) during a given planning horizon. This goal is reached through simultaneous determination of hydro plant discharges, thermal units energy output, and the system reliability level. Long-term hydrothermal system operation planning and system reliability determination are integrated in a unified model. Since the resulting model is a large-scale stochastic nonlinear program, an algo-

rithm is especially developed to solve it. This algorithm, which includes decomposition technique, Lagrangian relaxation, nonlinear and dynamic programming, finds an optimal solution within three stages. To test the method, it is implemented for the Khuzestan power system in Iran, and the results are analyzed.

Keywords Optimization, reliability, hydrothermal, decomposition, outage, interruption cost.

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A New Horizon for System Protection Systems Schemes

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Abstract: Interconnected grid operation, control, and security will be revolutionized by a system protection scheme that safeguards the grid's integrity by adapting its responses to the most severe unforeseen disturbances. The new approach takes advantage of power system resilience to the initial impact of even the most severe disturbances. The disturbance causes changes of system vulnerability parameters that are used by the protection to direct preselected measures to affected locations. A system protection scheme that sustains system voltage stability and incorporates a simple emergency strategy is outlined. The approach allows practical and reliable, modest cost schemes that can gain considerable financial benefits in the operation and control of the grid.

Keywords: System voltage instability, multiple contingencies, system collapse, emergency control, system protection schemes, breakdown process.

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Power System Planning and Implementation

Performance Evaluation of Electric Distribution Utilities Based on Data Envelopment Analysis

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Abstract: A method for benchmarking performance of electric distribution utilities based on data envelopment analysis (DEA) is presented. Basic theory of DEA is followed by case studies addressing performance analysis of 50 largest (based on MWh sales) electric distribution utilities in the USA. The results include performance efficiency, gaps in inputs and outputs of inefficient utilities, sensitivity based classification of utilities, and a gap report. Also, peer-to-peer comparison of inefficient with efficient utilities is provided. Based on these results inefficient utilities can develop strategic plans to improve performance.

Keywords Strategic planning, decision-making, data envelopment analysis, performance benchmarking, gap analysis.

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A Comparative Analysis of Congestion Management Schemes Under a Unified Framework

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Abstract: The restructuring of the electricity industry has spawned the introduction of new independent grid operators or IGOs, typically called transmission system operators (TSO), independent system operator (ISO) or regional transmission organizations (RTO), in various parts of the world. An important task of an IGO is congestion manage-