Self-Healing in Power Systems: An Approach Using Islanding and Rate of Frequency Decline Based Load Shedding

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Abstract: This paper provides a self-healing strategy to deal with catastrophic events when power system vulnerability analysis indicates that the system is approaching an extreme emergency state. The system is adaptively divided into smaller islands with consideration of quick restoration. Then an adaptive load shedding scheme based on the rate of frequency decline is applied. The proposed scheme is tested on a 179-bus, 20-generator sample system and shows very good performance.

Keywords: Slow coherency based grouping, islanding, load shedding, self-healing.

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Power System Instrumentation and Measurement

Temperature Responses to Step Changes in the Load Current of Power Transformers

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Abstract: Comprehensive load/thermal testing was performed on a 400/400/125 MVA, ONAF-cooled transformer. It was shown that the local hot-spots in the windings, core, and structural parts rise much faster at load increase than what an exponential function based on the time constant of top oil would predict. This paper analyzes these fast rises more in detail for hot-spots in windings, core, yoke clamps, and tie plates. An alternative mathematical model of the winding hot-spot response is presented. Different cooling modes, like ONAF and OFAF, are dealt with. Also different modes of oil circulation through the windings, in horizontal (zig-zag) or axial cooling ducts, are compared. The results are verified by fiberoptic installations and tests on several large power transformers in the range of 250 - 650 MVA. Hot-spot responses predicted by the *IEEE Loading Guide*, Annex G, are also compared to measured values.

Keywords: Power transformers, temperature, windings.

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Symmetrical Components Estimation through Nonrecursive Newton Type Numerical Algorithm

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Abstract: This paper reports on new software developments for symmetrical components estimation. The nonrecursive Newton type algorithm is extended with the second stage algorithm for symmetrical components calculation from the estimated fundamental phasors of three-phase signals (arbitrary voltages or currents). The algorithm is not sensitive to power system frequency changes and to the harmonic distortion of input signals. The algorithm is tested through computer simulations and by using laboratory obtained input signals and those recorded in the real distribution network.

Keywords: Symmetrical components, nonlinear estimation, Newton type algorithm, numerical algorithm.

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Power System Operations

A Hybrid LR-EP For Solving New Profit-Based UC Problem Under Competitive Environment

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Abstract: With the opening of the power industry to competition, power system structure is changing. According to these changes, power system operation, planning and control need modifications. In the past, utilities had to produce power to satisfy their customers with objective to minimize costs and all demand/reserve were met. However, it is not necessary in a restructured system. Under new structure, generation companies (GenCo) schedule their generators with objective to maximize their own profit without regard for system social benefit. Power and reserve prices become important factors in decision process. This paper proposes a new tool, profit-based unit commitment (UC) considering both power and reserve generatings. The proposed method helps GenCo to make a decision, how much power and reserve should be sold in market and how to schedule generators in order to receive the maximum profit. A hybrid method between Lagrange relaxation (LR) and evolutionary programming (EP) is used for solving this problem. Simulations are carried out to show the performance of the proposed methodology.

Keywords: Competitive environment, deregulation, evolutionary programming, Lagrange relaxation, power system operation planning and control, restructured system, profit-base unit commitment.

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Fault Section Diagnosis of Power System Using Fuzzy Logic

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Abstract: This paper proposes a fast diagnosis system for estimating the fault section of power system by using hybrid cause-effect network and fuzzy logic. The proposed system builds the cause-effect networks, which represent the fuzzy relations of protective relays and circuit breakers for selection of faulty sections in blackout areas. In order to deal with the uncertain information in the process of diagnosis, a fuzzy logic method is derived. Because the cause-effect network is well suited for parallel processing and the fuzzy logic has fast solution advantage, so the inferential speed can be improved significantly. An error detector also was developed in this system to handle malfunction of relays and circuit breakers. Many tests have been run to show its effectiveness. Results show that the proposed system is very effective.

Keywords: Fault section diagnosis, fuzzy logic, cause-effect network.

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Power System Relaying

A Practical Fault Location Approach For Double Circuit Transmission Lines Using Single End Data

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Abstract: Double circuit transmission lines are frequently subjected to a variety of technical problems from the perspective of protection engineering. These problems are mainly due to the mutual coupling effects between adjacent circuits of the line. A new fault location approach for double circuit transmission lines is introduced. It depends only on the data extracted from one end of the line. This practically facilitates implementing and developing this approach, as it needs no information from