ous potential differences within the manhole and on the surrounding ground surface during ground faults in the substation. Possible protective measures are discussed.

Minimum Losses Reconfiguration of MV Distribution Networks Through Local Control of Tie Switches

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Abstract: This paper deals with the problem of optimal reconfiguration of radial distribution networks for minimum loss operation. The proposed control strategy of the open-closed status of the tie switches is distributed, since every MV/LV node is provided with local controllers having some measured entities as input. It also does not prevent the system from the future implementation of centralized control; instead, it may represent the first step towards a complete automation of the distribution system. The proposed strategy is organized in hierarchic levels, the highest of which may be in the future a central control. After introducing the general problem of network reconfiguration, a review of the state of art on the subject is reported, even though the solution methodologies are usually related to the centralized formulation of the reconfiguration problem. The proposed local control strategy is outlined, and a detailed description of its different parts is reported with special attention to all the measures for a better performance of the system. Results of a number of simulation runs are reported in order to test the behavior of the proposed local control system in different possible operating conditions.

Switchgear

A Novel Hybrid Current-Limiting Circuit Breaker for Medium Voltage: Principle and Test Results

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Abstract: Although many attempts have been made to design a fault current-limiting circuit breaker (FCLCB) for medium voltage electric power systems, no economically attractive solution has been achieved so far. A novel concept for an F CLCB is introduced based on a hybrid arrangement of semiconductors, temperature-dependent resistors, and a newly developed fast-opening mechanical switch. The latter utilizes one part of an electrodynamic repulsion drive, which is concurrent with the moving double contact system. Laboratory tests as well as computer simulations of the complete FCLCB verify as an example the feasibility for the goal ratings 12 kV and 2/20 kA (single phase). A cost analysis shows the FCLCB to be more expensive than a conventional generator circuit breaker but to be in the price range of the Is-limiter and below the costs of superconducting FCL principles. It is concluded that the method provides the basis for further commercial product development.

Transformers

Study of Abnormal Electrical Phenomena Effects on GSU Transformers

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Abstract: Three generator step-up (GSU) transformers successively failed in recent years in a large pumped storage plant, resulting in a considerable economic loss for the utility. A comprehensive investigation was done to find out the possible failure causes. Several aspects are considered in this study, including switching transients resulting from routine switching operations, lightning overvoltages, and harmonics and spikes due to static frequency converter (SFC) operation. The study showed that circuit breaker and disconnector restriking may affect transformer insulation due to their frequent occurrence, gas insulated switching gear (GIS) side surge arresters provide inadequate lightning protection to GSU transformers, and SFC operation has little effect on transformer insulation. This paper presents the simulation results. Methods to lower the lightning transients at the transformer terminals were provided and implemented.

A New Data Mining Approach to Dissolved Gas Analysis of Oil-Insulated Power Apparatus

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Abstract: This paper proposes a genetic algorithm for tuned wavelet networks (GAWN) for data mining of dissolved-gas-analysis (DGA) records and incipient fault detection of oil-insulated power transformers. The genetic-algorithm-based (GA) optimization process automatically tunes the parameters of wavelet networks, translation and dilation of the wavelet nodes and the weighting values of the weighting nodes. GAWNs can identify the complex relations between the dissolved gas content of transformer oil and corresponding fault types. The proposed GAWNs have been tested on the Taipower Company's diagnostic records, using four diagnosis criteria, and compared with artificial neural networks (ANNs) and conventional methods. Experimental results demonstrate that GAWNs have remarkable diagnosis accuracy and require far less learning time than ANNs for different diagnosis criteria.

Transmission and Distribution

Calculation of Electric Field and Potential Distributions into Soil and Air Media for a Ground Electrode of an HVDC System

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Abstract: The present article describes a methodology that allows suitable calculations of the electric field as well as the potentials and

current densities due to current in the ground electrode of a HVDC system in any point of nonhomogeneous soils and air media, taking into account the complexities of the problems involved. Results of these variables are shown for the case of a toroidal ground electrode of a HVDC system installed in homogenous and nonhomogenous soils.

Prediction Model for Radiated Magnetic Field at Industrial Frequency due to Randomly Placed Conductors Pairs

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Abstract: The statistical analysis of the magnetic flux density due to sinusoidal steady-state 50 Hz (or 60 Hz) currents in conductor pair randomly placed inside a conduit is carried out by means of a suitable developed computation model. From the statistics of the field, an equivalent deterministic model is derived. This model allows one to estimate the magnetic flux density levels without knowing the exact position of the conductors. The results are compared with those measured in two laboratory experimental setups.

Stochastic Evaluation of Voltage Sags in Series Capacitor Compensated Radial Distribution Systems

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Abstract: Voltage sags, also known as dips, are important to industrial reliability. This paper presents a Monte Carlo based approach to evaluate the maximum voltage sag magnitudes in series capacitor compensated radial distribution systems. In this context, investigations have been conducted on a sample distribution system model taking into consideration the uncertainty of several factors associated with the practical operation of a power system. The Power System Blockset of MATLAB is used in the simulation studies.

Design of Step Dynamic Voltage Regulator for Power Quality Enhancement

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Abstract: The design of a step dynamic voltage regulator is considered for the purpose of restoring load voltage without incurring excessive phase angle shift. As a type of custom-power device devoid of any significant energy-storage capability, the process of voltage restoration by the regulator has to depend on the power in-feed from external supply system. As a consequence, the analysis shows that there are inherent limits imposed on the device for achieving successful voltage restoration. Pertinent expressions are derived which relate the limits to the parametric values describing the supply system and loads. When the expressions are used in conjunction with a proposed computational procedure, a method to determine suitable regulator design for the purpose of power quality enhancement is obtained.

Harmonic Domain Dynamic Transfer Function of a Nonliner Time-Periodic Network

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Abstract: This paper presents a new concept called harmonic domain dynamic transfer function (HDDTF), which characterizes the dynamics of a nonlinear time-periodic network as seen from a port (or multiple ports) in terms of the frequency response of harmonic perturbations superimposed on its underlying periodic steady state. It pertains to the transient behavior superimposed on the steady state. The HDDTF is a transfer-function matrix $H(s)$ relating the vectors of harmonic domain input and output endowed with s-domain properties. Because the network can contain saturable (nonlinear) elements and periodically-switching (time-periodic) power electronics components, the HDDTF may be used for the analysis of power quality problems. It may also serve for the identification of a reduced-order dynamic equivalent of a nonlinear time-periodic network to be used in time-domain transient simulations. The HDDTF is obtained by linearization about the periodic steady state of the nonlinear state equations describing a given network. Following the derivation of the HDDTF, a modal analysis to characterize the HDDTF by its diagonalization is presented. Two test systems are used to produce numerical examples.

Stockbridge Type Damper Effectiveness Evaluation, Part I: Comparison Between Tests on Span and on the Shaker

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Abstract: This paper deals with an experimental measurement campaign carried out with a modified dynamometric Stockbridge damper clamped to a laboratory test span. The aim is to get the force and the torque exerted between the cable and the damper on a span. This approach obtains the mechanical impedance of the damper under real working conditions, with the possibility to separate the contribution of the torque and of the force out of the global losses, and to compare these results with those obtained on a shaker where only the vertical motion is imposed, with no rotation. More than 100 experimental tests were executed from February 2001 to July 2001, also looking for a metrological validation of the results and for quality assessment of the collected data. Some results are shown, pointing out a comparison between the damper behavior on the span and on dynamic exciter.

Stockbridge Type Damper Effectiveness Evaluation, Part II: The Influence of the Impedance Matrix Terms on the Energy Dissipated

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Abstract: This paper deals with a methodology to evaluate the 2x2 mechanical impedance matrix of a nonsymmetric Stockbridge type damper, based on damper translational tests on a shaker and on a 6 d.o.f model of the damper itself. A series of comparisons with data measured on a laboratory span are reported in order to investigate the effect of the single matrix terms on the global energy dissipation. The results of a software simulating the aeolian vibration behavior of a cable and