ing"), the average current in parallel legs can be adjusted through feedback and control to equalize the average thyristor current loading. Additional feedback and control parameters are proposed, such as heatsink temperatures, which can be measured and utilized to program the "skip firing," in order to balance thyristor heat-sink temperatures.

Keywords: Silicon controlled rectifier, thyristor, synchronous machine exciter applications, ac generator excitation, rectifiers, digital systems, drives.

Preprint Order Number: PE-413EC (8-2001)

Discussion Deadline: January 2002

Insulated Conductors

On the Economic Selection of Medium Voltage Cable Sizes in Nonsinusoial Conditions

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Abstract: Selection of cable size in nonsinusoidal conditions is based only on ampacity considerations without any attention to the cost of the losses that will be suffered in the cable life. Since the cost of these losses (fundamental plus harmonics) can be high, the selection of a cross-section higher than required for ampacity considerations can result in large cost reductions. This article proposes a method that allows the optimal economic selection of medium voltage cables in nonsinusoidal operating conditions; it takes into account the initial investment costs and the cost in Joule losses, including the additional costs due to current harmonics. It employs simplified expressions similar to those adopted by IEC Standard in sinusoidal conditions, taking into account the harmonic presence by a proper definition of a harmonic loss factor and by the introduction of harmonic coefficients to be predicted. Numerical applications to medium voltage cables are developed and discussed, in order to show the sensitivity of the cable optimum size to variations in the coefficients that characterize the harmonic presence.

Keywords: Cables, economics, harmonic distortion.

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Discussion Deadline: January 2002

A Finite-Element Method Solution of the Zero-Sequence Impedance of Underground Pipe-Type Cable

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Abstract: In order to provide adequate circuit protection for underground pipe-type cable systems from ground fault currents, it is important to be able to determine the zero-sequence impedance of pipe-type cables. For better knowledge of the impedance, a more accurate method needs to be developed. In this paper, we present a numerical method for computing the zero-sequence impedance of a pipe-type cable. This method is developed based on a finite-element analysis. Special attention is paid to the nonlinear B-H characteristic of the steel pipe and an iterative procedure is employed for determining the permeability varying in the steel pipe. To validate the numerical method presented, measurements are made for the zero-sequence impedance at different current levels. A good agreement is observed between the numerical results and the measurement data.

Keywords: Zero-sequence impedance, pipe-type cable, nonlinear characteristic, finite-element method, iterative procedure, electromagnetics.

Preprint Order Number: PE-016PRD (8-2001)

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Power System Analysis, Computing, and Economics

Components of Nodal Prices for Electric Power Systems

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Abstract: A method is presented to provide a detailed description of each nodal price for electric power systems by breaking down each nodal price into a variety of parts corresponding to the concerned factors, such as generations, transmission congestion, voltage limitations, and other constraints or elements. This complete information for nodal prices can be used not only to improve the efficient usage of power grid and congestion management, but also to design a reasonable pricing structure of power systems, or to provide economic signals for generation or transmission investment. Several numerical examples demonstrate this approach.

Keywords: Nodal price, deregulation, optimal power flow, congestion, decomposition, active set, marginal cost.

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Model Predictive Control and the Optimization of Power Plant Load While Considering Lifetime Consumption

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Abstract: This paper describes a decision support system that indicates to a power plant operator the effect of daily operation on plant lifetime consumption and recommends short-term operating strategies that optimize plant economic performance. The recommended operating strategy is based on the optimization of an objective function that includes terms for revenues from energy sales, production costs, and plant ageing. Plant ageing is based on models that are directly load dependent and incorporate a memory aspect—a feature that is missing from common lifetime modeling techniques. The optimization results in a trade-off between maximization of immediate profits (i.e., earnings achieved by selling heat and power) and minimization of lifetime consumption. Model predictive control and the mixed logical dynamic (MLD) approach are used to solve the posed optimization problem.

Keywords: Power plant optimization, lifetime modeling, crack growth models, MLD approach, model predictive control.

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Discussion Deadline: January 2002

Monitoring HVDC Systems Using Wavelet Multiresolution Analysis

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Abstract: The paper presents a disturbance classification technique based on wavelet multiresolution analysis. The wavelet multiresolution transform is introduced as a tool for providing discriminative, translation-invariant features with small dimensions to classify different disturbances in an HVDC transmission system. The proposed method extracts features from signals monitored on both dc and ac sides of the HVDC system. It is shown that monitored signals show promising features that can classify different disturbances that may occur anywhere in the HVDC system.