

been reduced in volume by 25% compared with conventional ones. This paper describes the specification and construction of the advanced arresters and the results of various evaluation tests.

Keywords: Zinc-oxide elements, metal oxide surge arrester, pole transformer, pole switchgear.

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Influence of Representation Model and Voltage Harmonics on Metal Oxide Surge Arrester Diagnostics

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Abstract: Test results have been presented to demonstrate the hysteretic character of the volt-ampere relation of a metal oxide surge arrester (MOSA). Using a compensation technique described in the paper, it is shown that the use of single valued average volt-ampere characteristics does not introduce large errors in simulation studies. Results from computer simulations are presented to demonstrate the considerable influence of harmonics in the applied voltage on the magnitude of diagnostic indicators.

Keywords: Metal oxide surge arrester, hysteretic volt-ampere relation, voltage harmonics, diagnostic indicators.

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Switchgear

Effect of Regenerative Load on a Static Transfer Switch Performance

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Abstract: A thyristor-based static transfer switch (STS) is used to connect an alternate source of ac power to a sensitive load when the main source fails. A main criterion for performance evaluation of an STS is the transfer time from the main to the alternate source. The transfer time depends upon the commutation process of the outgoing and incoming switches, which in turn depends on the system parameters and the load characteristics. This paper investigates the effect of a regenerative load on the transfer time/total load-transfer time of an STS and identifies the worst-case scenario(s) in which maximum transfer time occurs. The IEEE STS benchmark models STS-1 and STS-2 are chosen to demonstrate the STS performance under various fault/disturbance conditions in a medium-voltage distribution system and a low-voltage experimental set-up system. The simulations are performed using the PSCAD/EMTDC package. The paper shows that a hybrid load can operate in regenerative mode depending on the load parameters and fault/disturbance characteristics.

Keywords: Power quality, bus transfer, sensitive loads, static transfer switch, UPS systems.

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Transmission and Distribution

DC Current Interruption in HVDC SF₆ Gas MRTB by Means of Self-Excitation

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Abstract: The Kii-Channel HVDC link under construction in Japan is equipped with metallic return transfer breakers (MRTBs) in one converter station. A new MRTB for an interrupting current of 3500 A dc was developed. To interrupt a dc current, a method that produces a current zero point by superimposing a self-excited oscillatory current on a dc arc current was employed. For this purpose, an LC circuit was coupled in parallel to an SF₆ gas circuit breaker. Developing an SF₆ gas circuit breaker that has a large arc voltage drop gradient against currents permitted a large oscillatory current to be generated. A modified Mayr-type dynamic arc equation was newly presented. The dc interruption limits calculated using this equation agreed with the measured values.

Keywords: HVDC transmission, MRTB, dc circuit breaker, SF₆ gas circuit breaker, self-excited oscillation, arc voltage, Mayr-type dynamic arc equation.

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Voltage Balance and Control in a Multilevel Unified Power Flow Controller

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Abstract: The neutral-point-clamped multilevel converter is an attractive implementation of the unified power flow controller because it facilitates back-to-back operation, high-voltage operation (without direct series connection of devices), and low distortion (without the use of multipulse transformers). A UPFC using three converters is proposed. Two phase-shifted converters are required to provide a full range of voltage control of the series connection while ensuring low distortion and a balanced dc link. A single shunt converter is used. A commutation angle solution that balances the voltages of the multiple dc link capacitors is analyzed in terms of the active power balance at each node. Control of shunt reactive power requires a variable dc link voltage. Control schemes for both shunt and series converters are developed and verified in terms of voltage balancing and power flow control on a micro-scale experimental system using five-level converters.

Keywords: Power flow control, multilevel converter, unified power flow control, FACTS

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Characteristics and Modeling of Harmonic Sources-Power Electronic Devices

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Abstract: This paper presents a review of characteristics and modeling of major power electronic types of harmonic sources for the power system harmonic analysis. The power electronic switching types of harmonic sources to be reviewed include static power converters, static var compensators (SVCs), and cycloconverters. Discussions and comments for applications of these harmonic sources in harmonic modeling and simulation also will be described.