Surge Protection Devices

Transmission Effects of Surge Protectors on Category-5 Cable Systems

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Abstract: Surge protectors may be used on paired-conductor telecom circuits to provide protection against unwanted electrical energy surges. These protectors may have capacitance, inductance, or series resistance that can affect transmission. This paper provides numerical analyses of voltage-limiting and current-limiting protectors insofar as they impact insertion loss, return loss, and timing on a category-S circuit. It is shown that surge protectors can significantly degrade transmission unless they are selected to be compatible with high-frequency applications by minimizing capacitance of voltage limiters and series impedance of current limiters.

Keywords: Surge protectors, arresters, protection/safety, transmission, attenuation, insertion loss, return loss, timing, category-S.

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Potential Distribution Analysis of Suspended-Type Metal-Oxide Surge Arresters

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Abstract: Nonuniformity of potential distribution of metal-oxide (ZnO) surge arresters reduces service lifetime of the arresters. The metal-oxide surge arresters of polymer housings developed can be suspended in different places. A combined method of electrical field and electric circuit is proposed to analyze the potential distribution of the suspended arresters. The equivalent electric circuit is obtained from a charge simulation method (CSM) and matrix transformation, and the potential distribution is solved from the electric circuit analysis by the first law of Kirchhoff. The complicated electromagnetic field problem is then converted to a simple electrical circuit problem. The calculation results show a good agreement with experimental results. Potential distributions of surge arresters suspended on a conductor by a wall, on a framework, and on a transmission-line tower are presented.

Keywords: Potential distribution, surge arrester, numerical analysis, charge simulation method.

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Thermal Characteristics of High-Voltage Whole-Solid-Insulated Polymeric ZnO Surge Arrester

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Abstract: A new type of 110 kV and 220 kV whole-solid-insulation polymeric ZnO surge arresters are developed. The power loss characteristics of ZnO varistors are discussed, which are simulated by an artificial neural network (ANN) model. The thermal performances of the new developed polymeric arresters are analyzed by the finite element method (FEM). The thermal dispersion capability and thermal stability of the developed whole-solid-insulation polymeric ZnO surge arresters are presented.

Keywords: Thermal characteristic, surge arrester, finite element method, artificial neural network, power loss.

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Transformers

Modeling of Hysteresis and Power Losses in Transformer Laminations

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Abstract: In this paper, a method for the representation of hysteresis and power losses in the laminations of power transformers is proposed. The developed model is based on data supplied from a steel manufacturer and able to predict hysteresis and eddy current losses.

Keywords: Transformer modeling, hysteresis, eddy current, lamination.

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Computation of Very Fast Transient Overvoltages in Transformer Windings

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Abstract: The paper deals with the computation of very fast transient overvoltages (VFTO) in transformer windings. For this purpose an algorithm is developed. The applied algorithm uses a hybrid model, which is a combination of the multi-conductor transmission line model (MTLM) and the single-transmission line model (STLM). By means of the STLM, the voltages at the end of each coil are calculated. Then, these values are used in the MTLM to determine the distributed overvoltages along the turns. Also, this method significantly reduces the number of linear equations that needs to be solved for each frequency to determine the required voltages in frequency domain. The algorithm uses a modified continuous Fourier transformation that provides an accurate time domain computation. As an example, the inter-turn voltage distributions for two 500 kV auto-transformers are computed and compared with measurements provided by other publications.

Keywords: Fast transients, modified Fourier transformation, overvoltages, switching surges, transformer.

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Transmission and Distribution

Soil Heating Around the Ground Electrode of a HVDC System by Interaction of Electrical, Thermal, and Electro-Osmotic Phenomena

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Abstract: This article evaluates the influence of several parameters interacting in the electrical, thermal, and electro-osmotics phenomena that rule the transient/dynamic behavior of the soil temperature rising process. The aim is to provide a safe design of ground electrodes concerning the risk of soil collapse ("vitrification") as a consequence of thermal instability. An objective electro-osmosis modeling—rather accurate, applicable to generic geometries of ground electrodes, not only for homogeneous but also for nonhomogeneous soils—has been developed. Sensitivity analysis correlating design parameters and the grounding behavior for a basic geometry of a toroidal ground electrode is shown herein. The inadequacy of the simplified methodologies available in the technical literature leads to inconclusive results in terms of installation safety, taking into account the omissions of the electro-osmosis phenomenon.

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