Calculation of impulse voltage distribution in transformer windings with Comsol Multiphysics.

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Lightning surges are one of the most dangerous and common causes that can lead to damage to the internal insulation of power transformers. When a transformer is exposed to a lightning impulse, a complex electromagnetic process will occur in the winding, as a result of which the voltage between adjacent turns or coils of the winding can exceed the insulation strength and lead to failure of the transformer. Overvoltages between the turns (or coils) and the grounded magnetic circuit of the transformer can also be dangerous. Therefore, calculating or measuring the distribution of overvoltages along the winding is a very important and pressing issue when designing transformer insulation structures. In this article, the authors propose a method for calculating the distribution of lightning overvoltages along a winding when exposed to a standard test lightning impulse 1.2/50 μs, based on the use of software packages designed for modeling transient processes using the finite element method, in particular, using the COMSOL Multiphysics software package. It is shown that the oscillograms of interturn winding voltages obtained by calculation coincide well with the results of experimental measurements of these voltages on a real transformer of the TDTs-125000/220 type. The key advantages of the method are its simplicity, clarity, high accuracy of the results obtained, as well as the absence of the need for complex preparatory work to calculate the parameters of equivalent circuits - lumped capacitances and inductances. To perform calculations, it is enough to have initial data on the design of the transformer and the physical properties of the materials used, which in most cases are widely presented in the reference literature.

Key words: lightning overvoltage; lightning protection, interturn winding voltage, Comsol Multiphysics, transformer.