

Diagnostics of paper-oil insulation condition of transformers with the use of alternating current hopping conductivity

Abstract

Cellulose in the form of pressboard or paper impregnated with insulating oil is the most commonly used insulating material in power transformers. The main factor affecting the lifetime of this type of insulation is its moisture content. With the long-term operation of the transformer, there is a gradual increase in the moisture content in the paper-oil insulation, from the initial value, usually not exceeding 0,8 % by wt. to a critical value of approx. 5 % by weight. Nondestructive methods using measurements of electrical quantities are used in the diagnostics of the transformer insulation moisture level. In order to determine the moisture content of oil-paper insulation, it is necessary to know the standard characteristics obtained in laboratory tests.

The currently used methods of making samples of insulation with a known degree of moisture, necessary to carry out laboratory measurements, differ significantly from the phenomena occurring in transformers. One of the measurable effects of this work is development and patenting of a new method of wetting pressboard impregnated with insulating oil, identical to the wetting process in power transformers.

Using a newly developed method, paper-oil insulation samples with a critical moisture content of $(5,0 \pm 0,2)$ % by wt. were made. The samples were used for frequency-temperature measurements of standard characteristics using the FDS (Frequency Domain Spectroscopy) method. On the basis of obtained measurement results, the frequency-temperature characteristics of the DC and AC parameters of the liquid-solid insulation were determined.

Measurements of factory new oil and oil wetted by diffusion of moisture from impregnated pressboard with a moisture content of $(5,0 \pm 0,2)$ % by wt., were made. On the basis of the performed measurements, frequency-temperature characteristics of the loss angle tangent and electrical conductivity of the wetted oil were developed.

Keywords: oil-paper insulation, power transformers, AC measurements, FDS method, critical moisture level.