ГОДИШНИК на Минно-геоложкия университет "Св. Иван Рилски", Том 53, Св.III, Механизация, електрификация и автоматизация на мините, 2010
ANNUAL of the University of Mining and Geology "St. Ivan Rilski", Vol. 53, Part III, Mechanization, electrification and automation in mines, 2010

ASPECTS REGARDING THE SHORT-CIRCUIT OPERATING MODE OF THE STATIONS AND TRANSFORMERS POSTS

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ABSTRACT: The study of the short-circuit regime at electric power transformers used in power stations and electric power distribution transformer connected to the National Energy System, is made since their design phase with the reference voltage circuit element and the related scurcircuit losses .

НЯКОИ АСПЕКТИ НА РАБОТА В РЕЖИМ НА КЪСО СЪЕДИНЕНИЕ В ЕЛЕКТРОСТАНЦИИ И ТРАНСФОРМАТОРНИ ПОСТОВЕ

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РЕЗЮМЕ: Статията представя резултатите от проучване в режим на късо съединение при трансформатори, работещи в електростанции и разпределителни мрежи в рамките на Националната енергийна система на Румъния.

1.Introduction

The transformers short-circuit regime appears when the impedance is connected to secondary winding terminals tending to value 0.The transformers nominal short circuit voltage is usually expressed as a percentage of nominal voltage primary winding.

Establishing the nominal short-circuit volatge t is very important in the functioning of electrical transformers, its value being written on plate of the transformer manufacturing.

Based on these considerations, the paper aims to carry out a case study on an electrical transformaor to explain the operating short-circuit regime and defining measurements that characterize the operating system.

2. The short-circuit regime study for power transformer

At the decrease of the load impedance Z_S connected to the terminals of the transformer secundary winding (fig.1), current i_2 increases. In the limit case when $Z_S=0$, the terminals of the transformer secondary winding short-circuit connects the blade, when $U_2=0$. This operating mode of the transformer is called short-circuit regime. In addition, if the primary winding is supplied at rated voltage $U_{1n,}$ the current passing through at short-circuit I_{1k} it is 10-20 times higher than the rated current I_{1n} of the transformer. If one starts from the equation :

$$\underline{E}_2 = \underline{U}_2 + R_2\underline{I}_2 + jX_{\sigma 2}\underline{I}_2 = \underline{U}_2 + \underline{I}_2\left(R_2 + jX_{\sigma 2}\right) = \underline{U}_2 + \underline{Z}_2\underline{I}_2 \quad (1),$$

characterizing the state of the power-transformer secondary winding under load, for the short-circuit regime in which $\underline{U}_2=0$ is obtained:

$$\underline{E}_2 = \underline{I}_{2k}\left(R_2 + jX_{\sigma 2}\right) = \underline{Z}_2\underline{I}_{2k}$$

From where:

$$\underline{I}_{2k} = \frac{\underline{E}_2}{\underline{Z}_2}$$

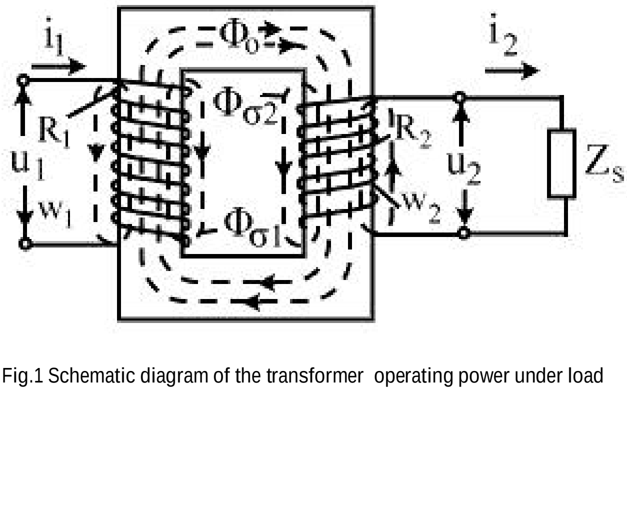

Fig.1 Schematic diagram of the transformer operating power under load

Because $Z_2 = \sqrt{R_2^2 + X_{\sigma 2}^2}$ has relatively low value, the effective value of the secondary current in the short-circuit regime $\underline{I}_{2k} = \frac{\underline{E}_2}{\sqrt{R_2^2 + X_{\sigma 2}^2}}$ is very high. are

In this case, the current at no load I_{10},can be neglected is permitted $I_{10} \approx 0$, so that from the equation :

$$w_1 \underline{I}_{10} = w_1 \underline{I}_1 + w_2 \underline{I}_2 \qquad (2)$$

it results:

$$w_1 I_{1k} \approx -w_2 I_{2k} \qquad (3)$$

Consequently, the I_{1k} current passing through primary winding it is consumed entirely to defeat thecurrent magnetic reaction. Sensitive growth under short-circuit current increases by several times of fluxution dispersion, so it increases the voltage drops in rezultant dispersion. Several times increase the resistance and voltage drops assets. In this case, an important part of primary voltage U1 is balanced (see equation 1.4) with the voltage drops $R_1 I_{1k}$ and $X_{\sigma 1} I_{1k}$ resulting in reducing t.e.m. E_1. Reducing t.e.m. E_1 under short-circuit size reduction is due to flux core value $\Phi_k << \Phi_0$.

Passing large currents in the circuit causes the heating of the transformer windings causing damage to their insulation. In addition, due to the interaction of these currents are generated considerable electrodynamic forces, the action which, can destroy the transformer windings. That is why the regime at nominal voltage circuit terminals is dangerous for the transformer primary winding and the emergence of receiver turn necessarily disconnected from the mains. In order to study phenomena in the transformer in short-circuit operation without it being dangerous in practice often the attempt is made laboratory cage (with reduced supply voltage), which is studied in the future. From equation (1.8)results:

$$-\frac{\underline{I}_{1k}}{\underline{I}_{2k}} \approx \frac{w_2}{w_1} = \frac{1}{k} \qquad \text{sau}$$

$$\underline{I}_{1k} = -\frac{\underline{I}_{2k}}{k} \qquad (4)$$

unde:

$k = \frac{w_1}{w_2}$ - Transformation ratio of the transformer..

In fig.2 it is presented in this chart for inductive load with inductive character. .

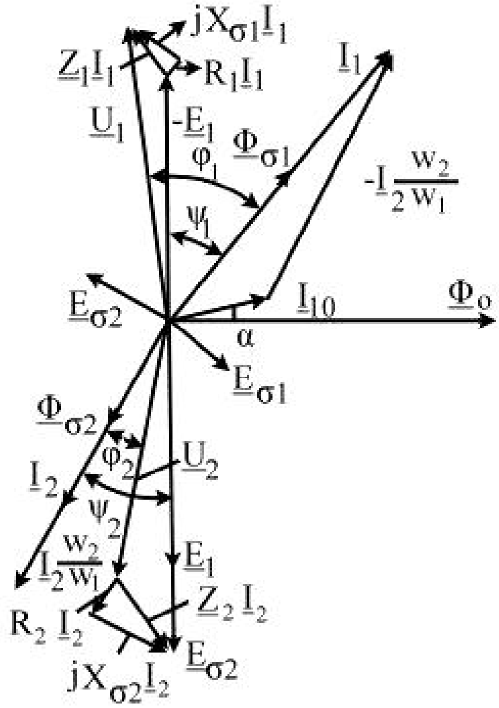

Fig.2 Transformer phasor diagram under inductive load character

3.Conclusions

The Equality (4) indicates that the two currents are inversely and transformers under short-circuit may be used to transform the current relatively accurately compared with actual values high currents with low actual values needed to measurements with ordinary appliances .

Transformers specially for this purpose, whose operating system is rated at the circuit and are called measuring current transformers. In addition, for electrical measurements, very often in practice, besides to measuring current transformers in circuits with large currents there are included different protection or safety equipment.

Characteristic peculiarity of measuring current transformers is that due to strong action demagnetize of the secondary windings, they operate with relatively low magnetic flux. In addition, unlike ordinary transformers, here,the size primary current is determined by the consumers and practically does not depend on measuring the secondary current.

Hence, in the operation of current transformer, if the circuit's secondary winding stops,the primary current which is keeping it's size , becomes fully magnetized.This increases the magnetic flux sensitive and the t.e.m. induced by it.

In addition, the voltage at the terminals of secondary winding reaches sensitive dangerous values to operating personnel. Increasing of the magnetic flux causes rapid heat of magnetic core and destruction of winding insulation of the transformer.

For this reason,in the circuit current transformer secondary winding is not entered fuse and,the winding is protecting down.

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