TRAFOS-12112015

Un transformador trifásico de 600 kVA, 10.000/400 V., en conexión triángulo-estrella, fue sometido a los ensayos de vacío y cortocircuito y se obtuvieron los siguientes resultados:

E. VACIO: 400 V., 60 A., 3.000 W.

E. CORTO: 400 V., 20 A., 4.000 W.

Determinar:

1) El circuito equivalente del transformador referido al lado de AT
2) El circuito equivalente del transformador referido al lado de BT
3) La tensión en el secundario del transformador cuando este funciona a media carga y con cosφ=0,6 inductivo
4) Rendimiento del transformador para las condiciones del apartado anterior.

$S_n = \sqrt{3}.U_{1n}.I_{1n} \Rightarrow I_{1n} = \frac{S_n}{\sqrt{3}.U_{1n}} = \frac{600\times10^3}{\sqrt{3}\ 10\times10^3} = 34,64\ A$ (1-Δ)

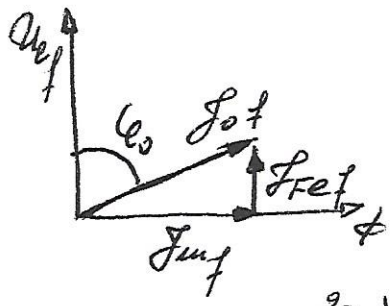
$I_f = \frac{I_m}{\sqrt{3}} = 20\ A$

$r_t = \frac{10.000}{\frac{400}{\sqrt{3}}} = 43,30$

$P_0 = \sqrt{3}\ U_0 I_0 . \cos\varphi_0 \Rightarrow \cos\varphi_0 = \frac{P_0}{\sqrt{3}\ U_0 I_0}$

$\cos\varphi_0 = \frac{3.000}{\sqrt{3}.400.60} = 0,072 \quad \varphi_0 = 85,86$

$\operatorname{sen}\varphi_0 = 0,9974$



2-λ $\Rightarrow I_{0f} = I_0$

$I_{Fef_{BT}} = I_{0f}\cos\varphi_0 = 60.0,072 = 4,32\ A$

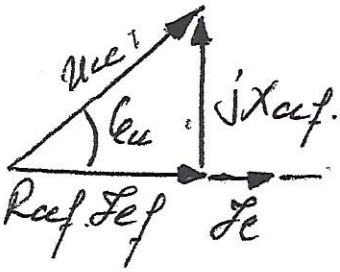
$I_{\mu f_{BT}} = I_0.\operatorname{sen}\varphi_0 = 60.0,9974 = 59,844\ A$

$R_{Fe_{BT}} = \frac{U_{ef}}{I_{Fef_{BT}}} \overset{2-\lambda}{=} \frac{400/\sqrt{3}}{4,32} = 53,458\ \Omega \qquad X_{\mu f_{BT}} = \frac{U_{ef}}{I_{mf_{BT}}} = \frac{\frac{400}{\sqrt{3}}}{59,844} = 3,86\ \Omega$

$R_{Fef_{AT}} = r_t^2 . R_{Fef_{BT}} = 43,30^2 \times 53,458 = 100.228\ \Omega \qquad X_{\mu f_{AT}} = 43,30^2 . 3,86 = 7.237\ \Omega$

$P_{cc} = \sqrt{3}.U_{cc} I_e . \cos\varphi_{cc} \Rightarrow \cos\varphi_{cc} = \frac{P_{cc}}{\sqrt{3}.U_{cc} I_e} = \frac{4.000}{\sqrt{3}.400.20} = 0,2887$

$\varphi_{cc} = 73,22° \rightarrow \operatorname{sen}\varphi_0 = 0,9574$



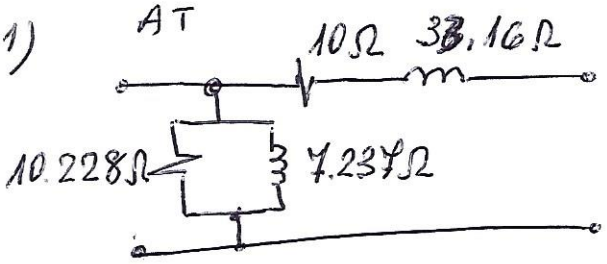
$R_{ccf_{AT}} = \frac{U_{ccf}.\cos\varphi_{cc}}{I_{ef}} = \frac{400.0,2887}{\frac{20}{\sqrt{3}}} = 10\ \Omega$ (1-Δ)

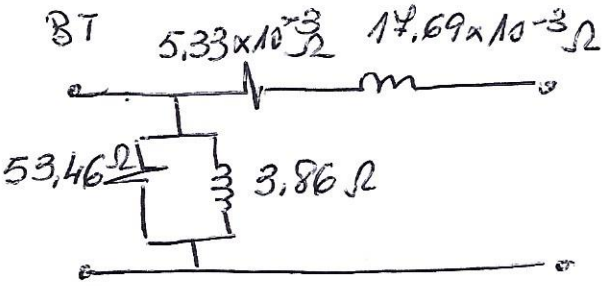
$X_{ccf_{AT}} = \frac{U_{ccf}.\operatorname{sen}\varphi_{cc}}{I_{ef}} = \frac{400.0,9574}{\frac{20}{\sqrt{3}}} = 33,16\ \Omega$

$R_{ccf_{BT}} = \frac{R_{ccf_{AT}}}{r_t^2} = \frac{10}{43,30^2} = 5,33\times10^{-3}\ \Omega$

$X_{ccf_{BT}} = \frac{X_{ccf_{AT}}}{r_t^2} = \frac{33,16}{43,30^2} = 17,69\times10^{-3}\ \Omega$

1)





3) $U_{1f} = r_t U_{2f} + R_{cc} \cdot I_{1f} \cdot \cos\varphi_2 + X_{cc} \cdot I_{1f} \operatorname{sen}\varphi_2$

$I_{1f} = I'_{2f}$ $\quad$ $I_{1f} = I'_{2f}$

$$I_{1f} = \frac{I_{1nf}}{2} = \frac{20}{2} = 10A \quad \cos\varphi_2 = 0,6 \quad \operatorname{sen}\varphi_2 = 0,8$$

$$10000 = 43,30\, U_{2f} + 10.10.0,6 + 33,16.10.0,8$$

$$10.000 = 43,30\, U_{2f} + 281,28 \qquad U_{2f} = \frac{10.000 - 281,28}{43,30} = 224,45V$$

$$2-\lambda \Rightarrow U_2 = \sqrt{3}\, U_{2f} = \sqrt{3}.224,45 = 388,76V$$

4)

$$\eta_c\% = \frac{\sqrt{3}.U_2.I_{2n}.c.\cos\varphi_2 * 100}{\sqrt{3}\,U_2 I_{2n} c \cos\varphi_2 + P_0 + c^2 P_{ccn}} = \frac{\sqrt{3}.388,76.866.0,5.0,6.100}{\sqrt{3}.388,76.866.0,5.0,6 + 3000 + 0,5^2.12.000}$$

$$I_{2n} = \frac{S_n}{\sqrt{3}.U_{2n}} = \frac{600.10^3}{\sqrt{3}.400} = 866\,A \qquad \eta_c = 96,68\%$$

$$P_{ccn} = 3.R_{ccf}.I'^2_{2nf} = 3.10.20^2 = 12.000$$