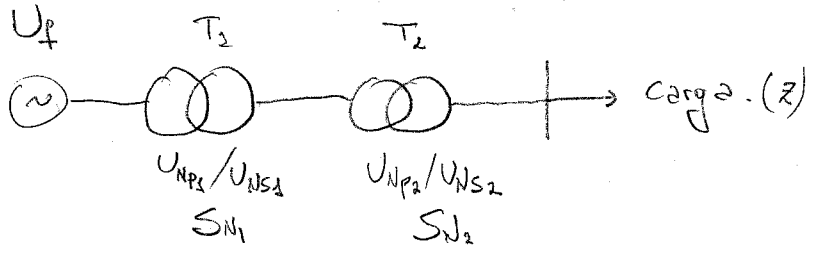
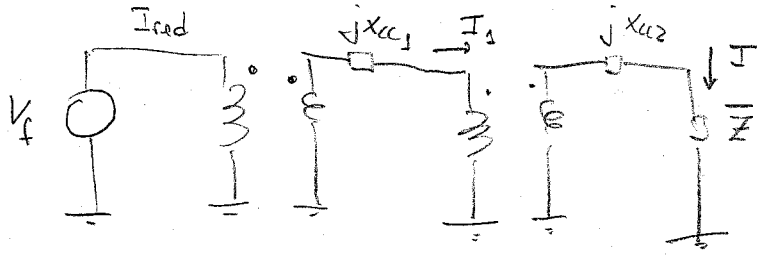
Transformadores en "Cascada"





$$V_f = \frac{U}{\sqrt{3}}$$

$$I_1 = \frac{U_{NS2}}{U_{NP2}} I \qquad I_{cad} = \frac{U_{NS1}}{U_{NP1}} I_1$$

para saber cual transformador limita se debe comparar I_1 con $\rightarrow I_{NS1}$ o $\rightarrow I_{NP2}$.

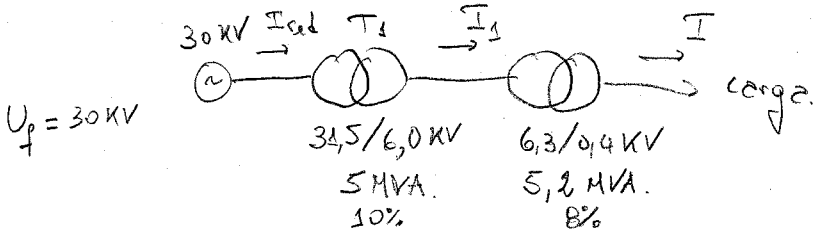
$$I_{NS1} = \frac{S_{N1}}{\sqrt{3}\, U_{NS1}} \qquad I_{NP2} = \frac{S_{N2}}{\sqrt{3}\, U_{NP2}}$$

$\Rightarrow$ Si $I_{NS1} < I_{NP2} \Rightarrow$ limita T_1

Si $I_{NS1} > I_{NP2} \Rightarrow$ limita T_2

Si $I_{NS1} = I_{NP2} \Rightarrow$ ambos limitan.

Ejemplo.



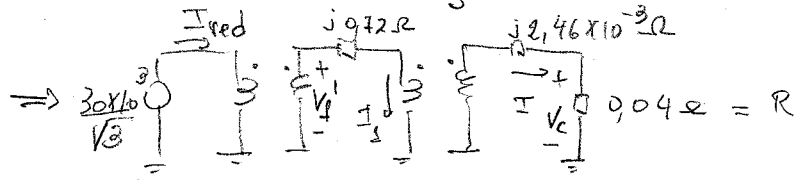
$$I_{NS1} = \frac{5 \times 10^6}{\sqrt{3}\, 6000} = 481{,}7 \text{ A} \qquad I_{NP2} = \frac{5{,}2 \times 10^6}{\sqrt{3} \times 6300} = 477{,}1 \text{ A}$$

$\Rightarrow$ Limita T_2 pues cuando $I_1 = \frac{0{,}4}{6{,}3} I$ alcance el valor de 477,1 A no se puede seguir agregando carga en el secundario de T_2, a los efectos de no sobrecargar a T_2.

Supongamos $\bar{Z}$ / a 380 V consume 3,6 MW con $\cos\varphi = 1$

$$\Rightarrow \bar{Z} = R = 3\frac{(380/\sqrt{3})^2}{3{,}6\times10^6} = \frac{380^2}{3{,}6\times10^6} = 0{,}04\,\Omega.$$

$$X_{a_1} = 9{,}1 \times \frac{6^2}{5} = 0{,}72\,\Omega. \qquad X_{a_2} = 908 \times \frac{0{,}4^2}{5{,}2} = 2{,}46\times10^{-3}\,\Omega.$$

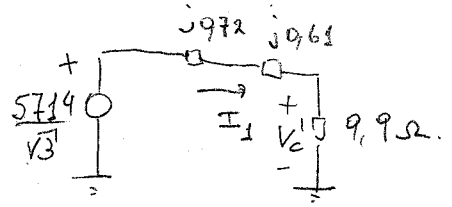


Todo a nivel 6 KV $\Rightarrow$

$$X'_{a_2} = \left(\frac{6{,}3}{0{,}4}\right)^2 2{,}46\times10^{-3} = 0{,}61\,\Omega$$

$$R' = \left(\frac{6{,}3}{0{,}4}\right)^2 \times 0{,}04 = 9{,}9\,\Omega.$$

$$V'_f = \frac{30\times10^3}{\sqrt{3}} \times \frac{6}{31{,}5} = \frac{5714}{\sqrt{3}} = 3303\,V$$



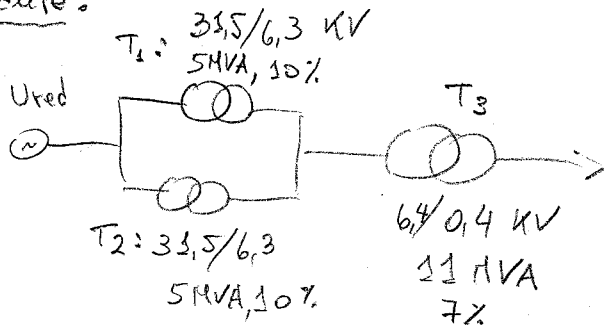
$$I_1 = \frac{5714/\sqrt{3}}{9{,}9 + j\,1{,}33} = \frac{3303}{\underbrace{9{,}99}_{\simeq 10}\angle\alpha} \simeq 330\,A$$

$$\Rightarrow T_1: \frac{330}{481{,}7} = 0{,}685 \Rightarrow \underline{68{,}5\%} \qquad T_2 = \frac{330}{477{,}1} = 0{,}692 \Rightarrow \underline{69{,}2\%}$$

Tensión sobre la carga: $V'_c = 9{,}9 \times 330 = 3267 \Rightarrow V_c = \frac{0{,}4}{6{,}3} \times V'_c = 207{,}4\,V$

$$\Rightarrow U_c = \sqrt{3}\,V_c = \underline{358{,}8\,V}$$

Variante:



T_1 y T_2 con iguales tensiones nominales e iguales $U_2 \Rightarrow$ se cargan a igual % de sus corrientes nominales $\Rightarrow$ llegan juntos al 100% de sus I_N.

$\Rightarrow$ Cumplo: $I_{N_{S12}} = \frac{10\times10^6}{\sqrt{3}\times6300} = 917{,}5\,A$ con: $I_{N_{T3}} = \frac{11\times10^6}{\sqrt{3}\times6400} = 993{,}5$

$\Rightarrow$ limitan T_1 y T_2 #