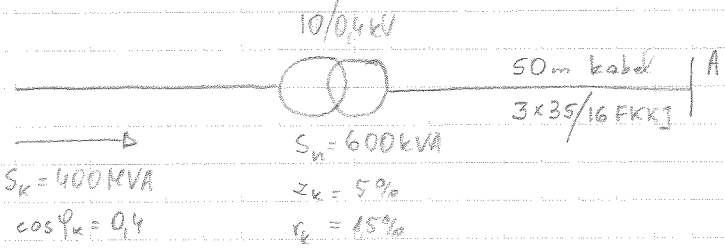


Impedansesummering: $U_e = 0,4kV$

Nätet: $S_k = \frac{U_e^2}{Z_k} \Rightarrow Z_k = \frac{U_e^2}{S_k} = \frac{0,4}{400} = 0,4 \cdot 10^{-3}$ Ω/fas

$R_k = Z_k \cdot \cos\varphi_k = 0,4 \cdot 10^{-3} \cdot 0,4 = 0,16 \cdot 10^{-3}$ Ω/fas

$X_k = Z_k \cdot \sin\varphi_k = 0,4 \cdot 10^{-3} \cdot 0,916 = 0,37 \cdot 10^{-3}$ Ω/fas

Transformatorn:

$R_k = r_k \cdot \frac{U_e^2}{S_n} = 0,015 \frac{0,4^2}{0,6} = 4 \cdot 10^{-3}$ Ω/fas

OBS!

$X_k = x_k \cdot \frac{U_e^2}{S_n} = \sqrt{0,05^2 - 0,015^2} \cdot \frac{0,4^2}{0,6} = 12,7 \cdot 10^{-3}$ Ω/fas

Kabel FKKJ (Cu - PE)

Enl. fig 6.5 s 32 $\Rightarrow$ R = 0,524 Ω/km ; X = 0,079 Ω/km /fas

$R_k = 0,05 \cdot 0,524 = 26,2 \cdot 10^{-3}$ Ω/fas

$X_k = 0,05 \cdot 0,079 = 3,95 \cdot 10^{-3}$ Ω/fas

$\Sigma R_k = (0,16 + 4,0 + 26,2) \cdot 10^{-3} = 30,36 \cdot 10^{-3}$ Ω/fas

$\Sigma X_k = (0,37 + 12,7 + 3,95) \cdot 10^{-3} = 17,02 \cdot 10^{-3}$ Ω/fas

$Z_{kA} = \sqrt{30,36^2 + 17,02^2} \cdot 10^{-3} = 34,8 \cdot 10^{-3}$ Ω/fas

$I_{kA} = \frac{U/\sqrt{3}}{Z_{kA}} = \frac{0,4}{\sqrt{3} \cdot 34,8 \cdot 10^{-3}} = \underline{6,64 kA}$

$S_{kA} = \sqrt{3} \cdot U \cdot I_{kA} = \sqrt{3} \cdot 0,4 \cdot 6,64 = \underline{4,6 MVA}$

Delkortslutningseffekter:

Nätet: $S_k = 400\ MVA$

Trafo: $S_k = \frac{S_n}{z_k} = \frac{600 \cdot 10^3}{0,05} = 12\ MVA$

Kabel:

Enl. tidigare: $R_k = 26,2 \cdot 10^{-3}\ \Omega/fas$

$X_k = 3,95 \cdot 10^{-3}\ \Omega/fas$

$$Z_k = \sqrt{26,2^2 + 3,95^2} \cdot 10^{-3} = 26,5 \cdot 10^{-3}\ \Omega/fas$$

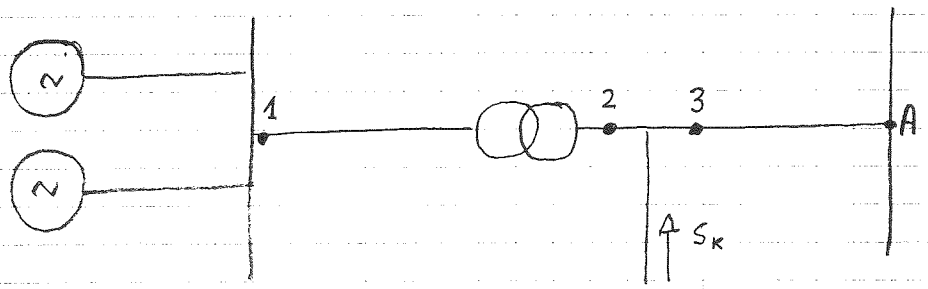
$$S_k = \frac{U^2}{z_k} = \frac{0,4^2}{26,5 \cdot 10^{-3}} = 6,04\ MVA$$

$$\frac{1}{S_{kA}} = \frac{1}{400} + \frac{1}{12} + \frac{1}{6,04}$$

$$\Rightarrow \underline{S_{kA} = 3,98\ MVA} \quad \Rightarrow I_{kA} = \frac{S_{kA}}{\sqrt{3}U} = \frac{3,98}{\sqrt{3} \cdot 0,4} = \underline{5,74\ kA}$$

Tänkvärt att diskutera

$S_{kA} = ?$; $I_{kA} = ?$ 11.3



1) Generatoren ; $S_n = 50\ MVA$; $S_k = 6 \times S_n$

$$S_{k1} = 2 \cdot 6 \cdot S_n = 2 \cdot 6 \cdot 50 = 600\ MVA$$

2) Trafo $$S_{kT} = \frac{S_n}{\alpha_k} = \frac{100}{0,1} = 1000\ MVA$$

$$S_{k2} = \frac{S_{k1} \cdot S_{kT}}{S_{k1} + S_{kT}} = \frac{600 \cdot 1000}{1600} = 375\ MVA$$

3)

$$S_{k3} = S_{k2} + S_k = 375 + 120 = 495\ MVA$$

Luftleitung: $$S_{kL} = \frac{U^2}{X} = \frac{130^2}{30} = 563,33\ MVA$$

A) $$\underline{S_{kA}} = \frac{S_{k3} \cdot S_{kL}}{S_{k3} + S_{kL}} = \frac{495 \cdot 563,33}{1058,33} = \underline{263,5\ MVA}$$

$$\underline{I_{kA}} = \frac{S_{kA}}{\sqrt{3} \cdot U} = \frac{263,5}{\sqrt{3} \cdot 130} = \underline{1,17\ kA}$$

$S_{kW2} = ?$; $\varphi_{kW2} = ?$; $I_{sQ1} = ?$; $I_{sQ2} = ?$

Räkna med impedanssummeringsmetoden då fasvinkeln skall anges.

1. Q1 - sidan

Nätet: $S_k = 800$ MVA (räkna på 70 kV - sidan)

$$Z_N = \frac{U^2}{S_k} = \frac{70^2}{800} = 6{,}125\ \Omega/\text{fas}$$

$$R_{kN} = Z_N \cos\varphi_k = 6{,}125 \cdot \cos 90^\circ = 0$$

$$X_{kN} = Z_N \sin\varphi_k = 6{,}125 \cdot \sin 90^\circ = 6{,}125\ \Omega/\text{fas}$$

Trafo T1

$$R_{kT1} = r_k \frac{U^2}{S_n} = 0{,}02 \frac{70^2}{50} = 1{,}96\ \Omega/\text{fas}$$

$$X_{kT1} = x_k \frac{U^2}{S_n} = \sqrt{0{,}1^2 - 0{,}02^2} \cdot \frac{70^2}{50} = 9{,}6\ \Omega/\text{fas}$$

$$\underline{Z}_{Q1} = 0 + 1{,}96 + j(6{,}125 + 9{,}6) = 1{,}96 + j\,15{,}725 = 15{,}85\angle 82{,}9^\circ\ \Omega/\text{fas}$$

$$I_{Q1} = \frac{U}{\sqrt{3}\, Z_{Q1}} = \frac{70 \cdot 10^3}{\sqrt{3} \cdot 15{,}85} = 2550\ \text{A}$$

$$\underline{I_{sQ1} = 2{,}5 \cdot 2550 = 6375\ \text{A}} \quad (\text{ca } 6400\ \text{A})$$

2. Q2 - sidan

$$Z_{Q2} = \frac{U^2}{S_k} = \frac{70^2}{400} = 12{,}25\ \Omega/\text{fas} \qquad \cos\varphi_k = 0{,}342 \Rightarrow \varphi_k = 70^\circ$$

$$\underline{Z}_{Q2} = 12{,}25\angle 70^\circ = (4{,}19 + j\,11{,}51)\ \Omega/\text{fas}$$

$$I_{Q2} = \frac{U}{\sqrt{3}\, Z_{Q2}} = \frac{70 \cdot 10^3}{\sqrt{3} \cdot 12{,}25} = 3300\ \text{A}$$

$$\underline{I_{sQ2} = 2{,}5 \cdot 3300 = 8250\ \text{A}}$$

3. Q1-sidan // Q2-sidan

$$\underline{Z}_{W1} = \frac{\underline{Z}_{Q1} \cdot \underline{Z}_{Q2}}{\underline{Z}_{Q1} + \underline{Z}_{Q2}} = \frac{15,85\angle 82,9^\circ \cdot 12,25\angle 70^\circ}{1,96 + j\,15,725 + 4,19 + j\,11,51} =$$

$$= \frac{194,16\angle 152,9^\circ}{27,92\angle 77,28^\circ} = 6,95\angle 75,62^\circ\ \Omega/\text{fas} = (1,73 + j\,6,73)\ \Omega/\text{fas}$$

4. Trafo T2 (vid 70 kV)

$$R_{KT2} = r_K \frac{U^2}{S_n} = 0,02\ \frac{70^2}{15} = 6,53\ \Omega/\text{fas}$$

$$X_{KT2} = x_K \frac{U^2}{S_n} = \sqrt{0,09^2 - 0,02^2}\ \frac{70^2}{15} = 28,66\ \Omega/\text{fas}$$

5.

$$\underline{Z}_{W2} = 6,53 + 1,73 + j\,(28,66 + 6,73) = 8,26 + j\,35,39 =$$

$$= 36,34\angle 76,86^\circ\ \Omega/\text{fas} \qquad \text{(vid 70 kV)}$$

$$\varphi_{KW2} = 76,86^\circ$$

$$S_{KW2} = \frac{U^2}{Z_{W2}} = \frac{70^2}{36,34} = 134,8\ \text{MVA}$$

$$\left(I_{KW2} = \frac{S_{KW2}}{\sqrt{3} \cdot U_{W2}} = \frac{134,8}{\sqrt{3} \cdot 20} = 3,89\ \text{kA} \right)$$