Parte II

a) $V_b = 150\,kV$

$S_b = 100\,MVA$

$P_G = 0,9\,\mu$ $\qquad X_{L3} = X_{L1} = \omega l d = 100\cdot\pi\cdot 1,2\times10^{-3}\cdot 100 = 37.699\,\Omega = 0.16751\,\mu$

$P_S = -0,9\,\mu$ $\qquad X_{L2} = 2\omega l d = 2X_{L1} = 75.398\,\Omega = 0.335102\,\mu$

$P_1 = 0$

$$[-B] = \begin{bmatrix} \frac{1}{x_{L1}}+\frac{1}{x_{L2}} & -\frac{1}{x_{L1}} & -\frac{1}{x_{L2}} \\ -\frac{1}{x_{L1}} & \frac{1}{x_{L1}}+\frac{1}{x_{L3}} & -\frac{1}{x_{L3}} \\ -\frac{1}{x_{L2}} & -\frac{1}{x_{L3}} & \frac{1}{x_{L2}}+\frac{1}{x_{L3}} \end{bmatrix}$$

$$\begin{bmatrix}\theta_2\\ \theta_3\end{bmatrix} = [-B]^{-1}\cdot\begin{bmatrix}P_2\\ P_3\end{bmatrix} = \begin{bmatrix}\frac{1}{x_{L1}}+\frac{1}{x_{L3}} & -\frac{1}{x_{L3}} \\ -\frac{1}{x_{L3}} & \frac{1}{x_{L2}}+\frac{1}{x_{L3}}\end{bmatrix}^{-1}\cdot\begin{bmatrix}0.9\\ -0.9\end{bmatrix} = \begin{bmatrix}0.037699\\ -0.075397\end{bmatrix}$$

$\theta_1 = 0$

$\theta_2 = 0.037699$

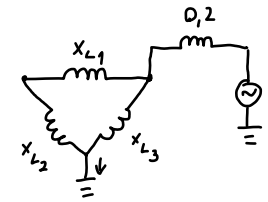
$\theta_3 = -0.075398$

$$P_{12} = \frac{\theta_1-\theta_2}{x_{L1}} = -0.225\,\mu = -22.5\,MW$$

$$P_{23} = \frac{\theta_2-\theta_3}{x_{L3}} = 0.675\,\mu = 67.5\,MW$$

$$P_{13} = \frac{\theta_1-\theta_3}{x_{L2}} = -0.225\,\mu = -22.5\,MW$$

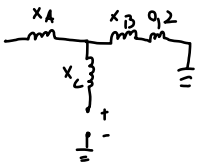
b)



$$S_{cc} = V_0\cdot I_{cc} = \frac{V_0^2}{x_{th}} = \frac{1}{x_{th}} = 3.07\,\mu \Rightarrow 307\,MVA$$

$V_0 = 1\,\mu$

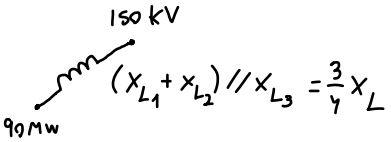
$$x_{th} = x_C + x_B + 0,2 = \frac{1}{2}x_L + \frac{1}{4}x_L + 0,2 = 0.325625$$

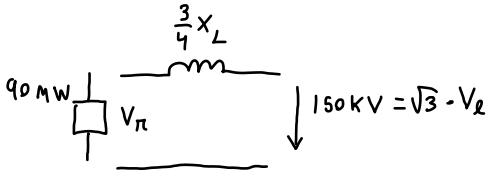


$$x_C = \frac{x_{L1}\cdot x_{L3}}{x_{L1}+x_{L2}+x_{L3}} = \frac{2x_L^2}{4x_L} = \frac{1}{2}x_L$$

$$x_B = \frac{x_{L1}\cdot x_{L3}}{x_{L1}+x_{L2}+x_{L3}} = \frac{x_L^2}{4x_L} = \frac{1}{4}x_L$$

c)





$$\begin{cases} V_\ell = V_\pi + \frac{3}{4}x_L j\cdot I \\ 90\,MW = 3\cdot V_\pi\cdot I^* \end{cases} \Leftrightarrow \begin{cases} \frac{150k}{\sqrt{3}} = V_\pi + \frac{3}{4}\cdot 37.699\cdot j\cdot I \\ 30\,MW = V_\pi\cdot I^* \end{cases}$$

a)

$Z_L = j \cdot \omega \cdot L = j\,60.9464$

$Y_T = j \cdot \omega \cdot C = j\,75.4 \times 10^{-3}$

$P_m = \frac{V_m^2}{Z_0} = \frac{V_m^2}{\sqrt{\frac{L}{C}}} = 170\ MW$

b)

$A = \cos(\beta d)$

$B = j Z_0 \sin(\beta d)$

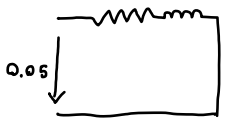
$C = j \frac{1}{Z_0} \sin(\beta d)$

$\begin{bmatrix} A & B \\ C & A \end{bmatrix} \cdot \begin{bmatrix} 220kV \\ \frac{300M}{3 \cdot 220K} \end{bmatrix} \Rightarrow V_l = 230.24\ kV$

c) $V_l = 230.243\ kV$

$I_l = 775.124\ A$

Em cc:

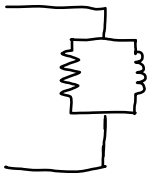


$P_{cc} = R_t \cdot I_m^2 \Leftrightarrow R_t = 0.0051\mu$

$Z_t = \frac{V_{cc}}{I_m} = 0,05$

$X_t = \sqrt{0,05^2 - 0,005^2} = 0,0497\ \mu$

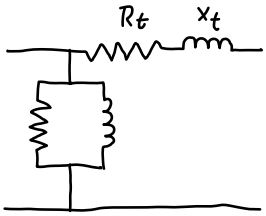
Em aberto



$P_0 = G_m V_0^2 \Leftrightarrow G_m = 0.0025\ \mu$

$Y_m = \frac{I_0}{V_m} = \frac{100}{\frac{200M}{\sqrt{3} \cdot 10K}} = 0.00866\ \mu$

$B_m = -\sqrt{Y_m^2 - G_m^2} = -0.00829\ \mu$



$P_{CM} = R_t \cdot I^2 = 0.005 \cdot \left(\frac{\frac{775.124}{2}}{\frac{200M}{\sqrt{3} \cdot 220K}} \right)^2 = 0.002726\ \mu \rightarrow 0.545\ MW$

$P_{Fe} = G_m \cdot V^2 = 0.0025 \cdot \left(\frac{230.243\ kV}{220kV} \right)^2 = 0.002738\ \mu \rightarrow 0.548\ MW$