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Data: 7/2/22 Matrícula: 96708 P2 ELT 441

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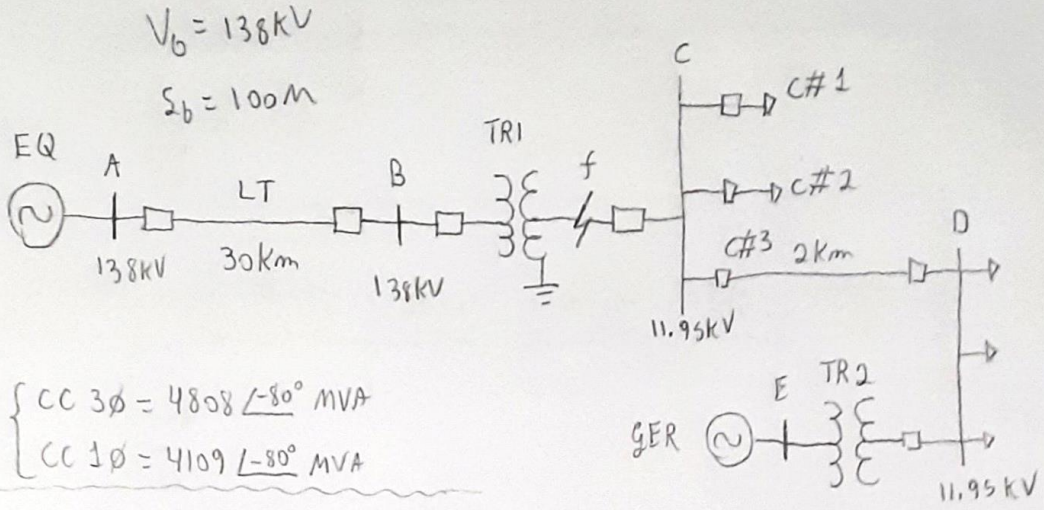


A $\begin{cases} CC\ 3\phi = 4808\angle -80° \text{ MVA} \\ CC\ 1\phi = 4109\angle -80° \text{ MVA} \end{cases}$

LT $\begin{cases} z^+ = 0.1902 + j0.4808\ \Omega/km \\ z^0 = 0.4414 + j1.7452\ \Omega/km \end{cases}$

TR1 $\{ 138/11.95\ KV - 15MVA - j8.68\%$

C#3 $\begin{cases} z^+ = 0.1903 + j0.3922\ \Omega/km \\ z^0 = 0.4359 + j1.8540\ \Omega/km \end{cases}$

TR2 $\{ 11.95/11.95KV - 2.5MVA - j5\%$

GER $\{ 11.95\ KV - 10MVA - X'_d = j30\%$

Fonte:

$$Z^+_{\%}(F) = \frac{S_B}{S^{3\phi}_{cc}} \times 100\% = \frac{100}{4808\angle -80°} \times 100 = (0.361 + 2.048j)\%$$

$$Z^0_+(F) = \left(\frac{3S_B}{S^{1\phi}_{cc}} - \frac{2S_B}{S^{3\phi}_{cc}}\right) \times 100\% = \left(\frac{300}{4109\angle -80°} - \frac{200}{4808\angle -80°}\right) \times 100$$

$$= (0.545 + 3.094j)\%$$

Transformador 1

$$Z_{TR1} = j8.68 \times \frac{100}{15} = 57.867j\ \%$$

Linha transmissão:

$$Z^+_{\%}(lt) = \frac{z^+ D}{Z_{Base}} = \frac{(0.1902 + j0.4808)30 \times 100}{\frac{138^2}{100}} = (2.996 + 7.574j)\%$$

$$Z^0_{\%}(lt) = \frac{z^0 D}{Z_{Base}} = \frac{(0.4414 + j1.7452)30}{\frac{138^2}{100}} \times 100 = (6.953 + 27.492j)\%$$

$$Z_{TR2} = 5j \times \frac{100}{2.5} = 200j$$

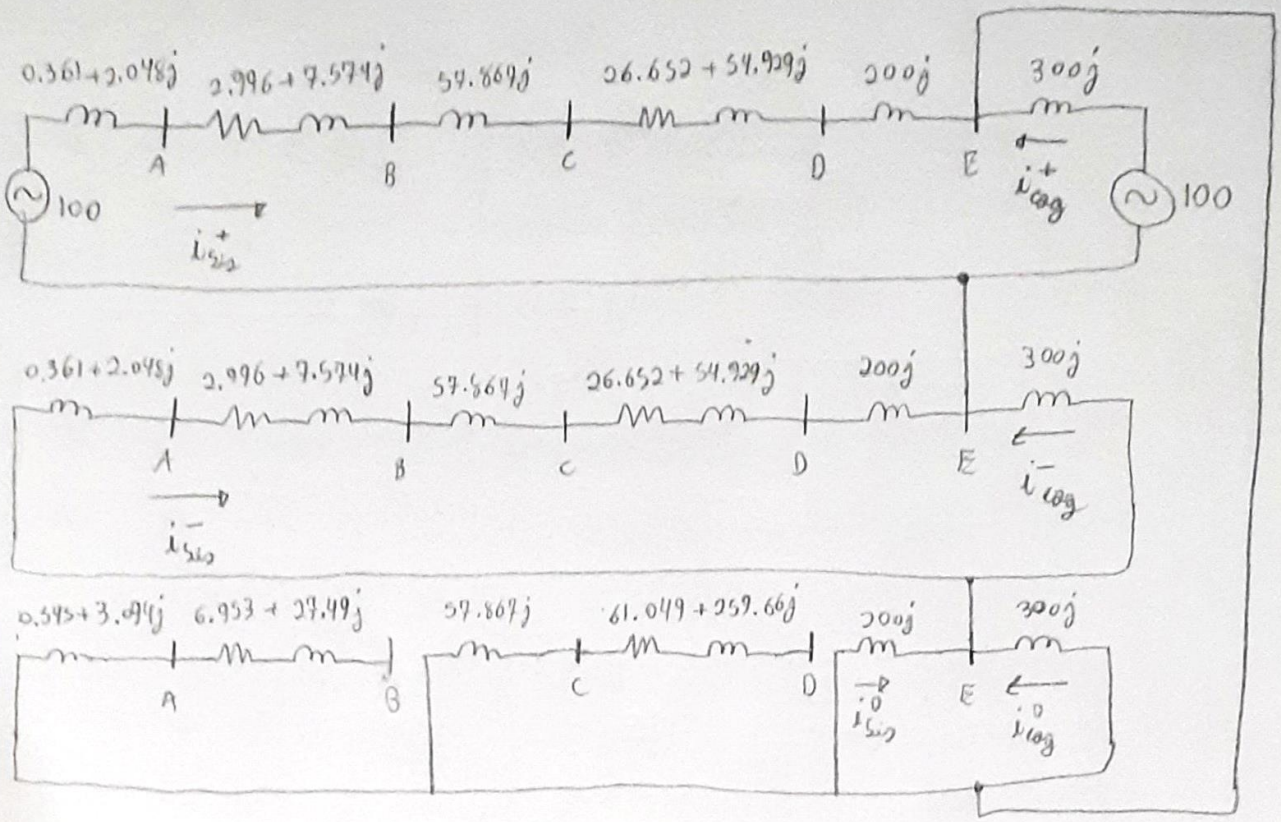
$$Z_{ger} = 30j \times \frac{100}{10} = 300j$$

Linha C#3:

$$Z^+_{\%}(C3) = \frac{(0.1903 + j0.3922)2}{\frac{11.95^2}{100}} = (26.652 + 54.929j)\%$$

$$Z^0_{\%}(C3) = \frac{(0.4359 + j1.8540)2}{\frac{11.95^2}{100}} = (61.049 + 259.659j)\%$$

a) Corto circuito monofasico barra E



$Z^+_{Sis} = (30.009 + 322.418j)\,\%$, $Z^+_{Cog} = (300j)\,\%$ $\Rightarrow Z^+ = Z^+_{Sis} // Z^+_{Cog} = (6.955 + 155.738j)\,\%$

$Z^-_{Sis} = (30.009 + 322.418j)\,\%$, $Z^-_{Cog} = (300j)\,\%$ $\Rightarrow Z^- = (6.955 + 155.738j)\,\%$

$Z^0_{Sis} = (200j)\,\%$, $Z^0_{Cog} = (300j)\,\%$ $\Rightarrow Z^0 = Z^0_{Sis} // Z^0_{Cog} = (120j)\,\%$

$$i_A = \frac{3 \times 100}{Z^+ + Z^- + Z^0} = 0.695 \angle -88.15^\circ \rightarrow i_+ = i_- = i_0 = 0.232 \angle -88.15^\circ \text{ pu}$$

$$I^E_{Base} = \frac{100M}{\sqrt{3} \times 11.95K} = 4831.383 \text{ A} \rightarrow \boxed{I_A = I^E_{Base} \times i_A = 3357.811 \angle -88.15^\circ \text{ A}}$$

$$\boxed{I_B = I_C = 0 \text{ A}}$$

b) $i^+_{Sis} = i_+ \dfrac{Z^+_{Cog}}{Z^+_{Cog} + Z^+_{Sis}} = 0.112 \angle -85.39^\circ$ pu $\rightarrow \boxed{I^+_{Sis} = I^E_{Base} \times i^+_{Sis} = 541.115 \angle -85.39^\circ \text{ A}}$

$i^+_{Cog} = i_+ - i^+_{Sis} = 0.120 \angle -90.72^\circ$ pu $\rightarrow \boxed{I^+_{Cog} = I^E_{Base} \times i^+_{Cog} = 580.978 \angle -90.72^\circ \text{ A}}$

$\boxed{I^-_{Sis} = I^+_{Sis} = 541.115 \angle -85.39^\circ \text{ A}}$ $\boxed{I^-_{Cog} = I^+_{Cog} = 580.978 \angle -90.72^\circ \text{ A}}$

$i^0_{Sis} = i_0 \times \dfrac{300j}{500j} = 0.139 \angle -88.15^\circ$ pu $\rightarrow \boxed{I^0_{Sis} = 672.529 \angle -88.15^\circ \text{ A}}$

$i^0_{Cog} = i_0 - i^0_{Sis} = 0.093 \angle -88.15^\circ$ pu $\rightarrow \boxed{I^0_{Cog} = 449.319 \angle -88.15^\circ \text{ A}}$

$$\begin{vmatrix} I_{Sis_A} \\ I_{Sis_B} \\ I_{Sis_C} \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{vmatrix} \begin{vmatrix} I_{Sis}^{+} \\ I_{Sis}^{-} \\ I_{Sis}^{0} \end{vmatrix} = \begin{vmatrix} 1754.278 \angle -86.45^\circ \\ 134.588 \angle -99.31^\circ \\ 134.588 \angle -99.31^\circ \end{vmatrix} A$$

$$\begin{vmatrix} I_{cargA} \\ I_{cargB} \\ I_{cargC} \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{vmatrix} \begin{vmatrix} I_{carg}^{+} \\ I_{carg}^{-} \\ I_{carg}^{0} \end{vmatrix} = \begin{vmatrix} 1610.949 \angle -90.00^\circ \\ 133.638 \angle 80.61^\circ \\ 133.638 \angle 80.61^\circ \end{vmatrix} A$$

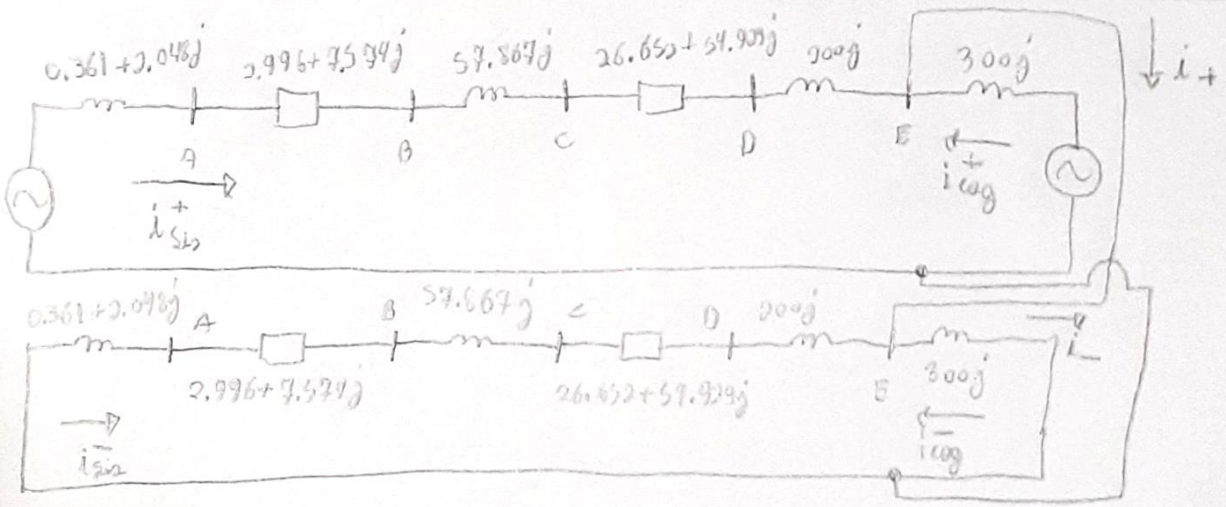
c) $V_C^{+} = 100 - (67.573 \angle 87.15^\circ)(0.232 \angle -88.15^\circ) \rightarrow 0.843 \angle 0.186$ pu

$V_C^{-} = 0 - (67.573 \angle 87.15^\circ)(0.232 \angle -88.15^\circ) \rightarrow 0.157 \angle 179.00^\circ$ pu

$V_C^{0} = 0$ pu

$$\begin{vmatrix} V_A^C \\ V_B^C \\ V_C^C \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{vmatrix} \begin{vmatrix} 0.843 \angle 0.18^\circ \\ 0.157 \angle 179^\circ \\ 0 \end{vmatrix} = \begin{vmatrix} 0.686 \angle 0.46^\circ \\ 0.934 \angle -111.54^\circ \\ 0.929 \angle 111.67^\circ \end{vmatrix} \times 138kV \rightarrow \begin{vmatrix} 94.668 \angle 0.46^\circ \\ 128.892 \angle -111.54^\circ \\ 128.202 \angle 111.67^\circ \end{vmatrix} kV$$

d)



Conforme o letra a), temos:

$Z^{+} = (6.955 + 155.738j)\%$

$Z^{-} = (6.955 + 155.738j)\%$

$$i_+ = \frac{100}{Z^{+} + Z^{-}} = 0.321 \angle -87.44^\circ \text{ pu}$$

$I_+ = I_{Base}^{E} \times i_+ = 1549.581 \angle -87.44^\circ$ A

$I_- = -I_+ = 1549.581 \angle 92.56^\circ$ A

$I_0 = 0$ A

$$\begin{vmatrix} I_a \\ I_b \\ I_c \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{vmatrix} \begin{vmatrix} I_+ \\ I_- \\ I_0 \end{vmatrix} = \begin{vmatrix} 0 \\ 2683.953\angle 177.44 \\ 2683.953\angle 2.56^\circ \end{vmatrix} A$$

e)

$$I_{Sa}^{+} = I_+ \frac{Z_{cog}^{+}}{Z_{cog}^{+} + Z_{Sa}^{+}} = 746.018\angle -84.68^\circ A; \quad I_{cog}^{+} = I_+ - I_{Sa}^{+} = 805.231\angle -90^\circ A$$

$$I_{Sa}^{-} = -I_{Sa}^{+} = 746.018\angle 95.32^\circ A \; ; \; I_{cog}^{-} = -I_{cog}^{+} = 805.231\angle 90.00^\circ A$$

$$I_{Sa}^{0} = 0 = I_{cog}^{0}$$

$$\begin{vmatrix} I_{Sa\,A} \\ I_{Sa\,B} \\ I_{Sa\,C} \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{vmatrix} \begin{vmatrix} I_{Sa}^{+} \\ I_{Sa}^{-} \\ I_{Sa}^{0} \end{vmatrix} = \begin{vmatrix} 0 \\ 1292.141\angle -174.68^\circ \\ 1292.141\angle 5.32^\circ \end{vmatrix} A$$

$$\begin{vmatrix} I_{cog\,A} \\ I_{cog\,B} \\ I_{cog\,C} \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{vmatrix} \begin{vmatrix} I_{cog}^{+} \\ I_{cog}^{-} \\ I_{cog}^{0} \end{vmatrix} = \begin{vmatrix} 0 \\ 1394.7\angle -180^\circ \\ 1394.7\angle 0^\circ \end{vmatrix} A$$

f) $V_c^{+} = 100 - (67.573\angle 87.15^\circ)(0.321\angle -87.44^\circ) \rightarrow 0.783\angle 0.08^\circ$ pu

$V_c^{-} = 0 + (67.573\angle 87.15^\circ)(0.321\angle -87.44^\circ)$