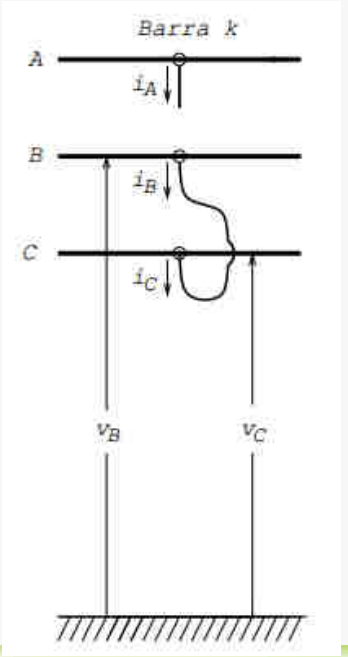
Sistemas Elétricos de Potência

Aula 04-P1 – Curto-Circuito Bifásico



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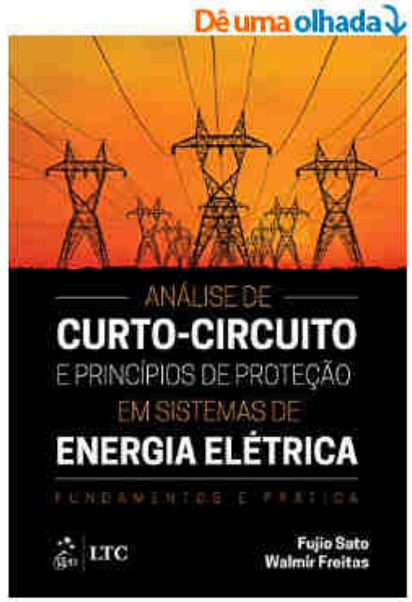
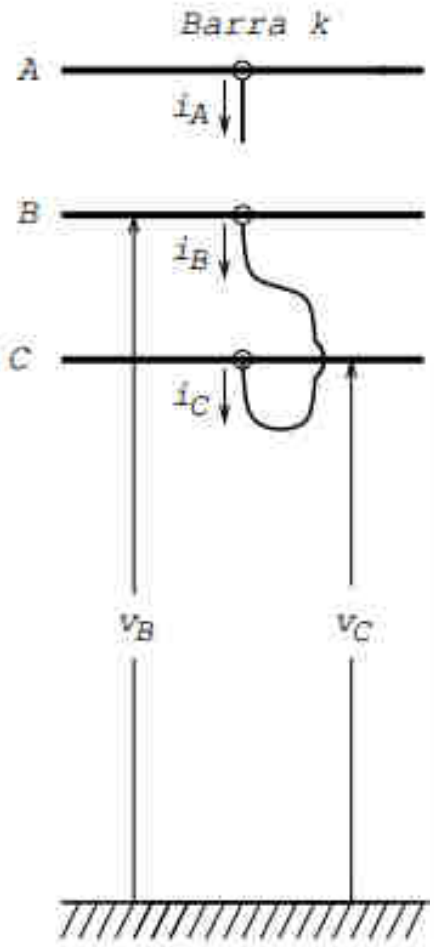
Tópicos abordados

- Capítulo 4

- Curto-circuito Bifásico



Curto-circuito Bifásico



Condições de contorno

$$i_A = 0$$

$$i_B = -i_C$$

$$v_B = v_C$$

$$\underline{i}_S = T^{-1}\underline{i}_P$$

$$\begin{bmatrix} \hat{i}_{A+} \\ \hat{i}_{A-} \\ \hat{i}_{Ao} \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & a & a^2 \\ 1 & a^2 & a \\ 1 & 1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0 \\ \hat{i}_B \\ -\hat{i}_B \end{bmatrix}$$

$$\hat{i}_{A+} = -\hat{i}_{A-}$$

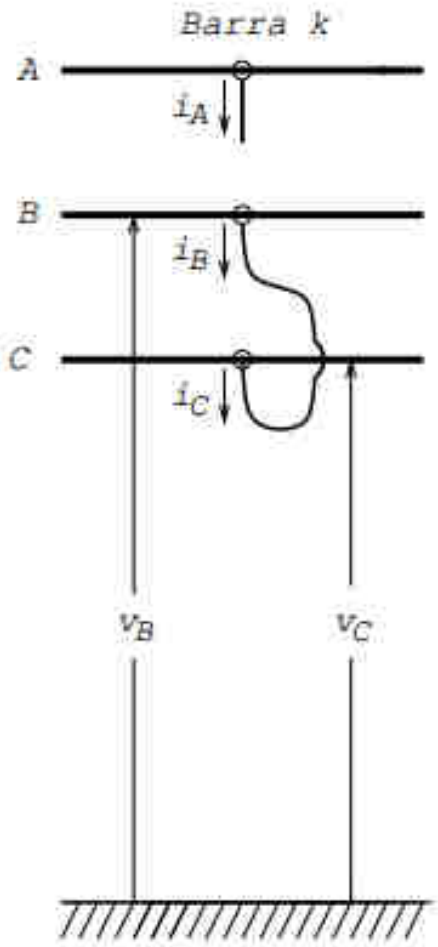
$$\hat{i}_{A0} = 0$$

$$\hat{i}_{A+} = \frac{1}{3}(a\hat{i}_B - a^2\hat{i}_B) = j\frac{\sqrt{3}}{3}\hat{i}_B$$

$$\hat{i}_{A-} = \frac{1}{3}(a^2\hat{i}_B - a\hat{i}_B) = -j\frac{\sqrt{3}}{3}\hat{i}_B$$

$$\hat{i}_{Ao} = \frac{1}{3}(\hat{i}_B - \hat{i}_B) = 0$$

Curto-circuito Bifásico



Condições de contorno

$$i_A = 0$$

$$i_B = -i_C$$

$$v_B = v_C$$

$$\underline{v}_S = T^{-1}\underline{v}_P$$

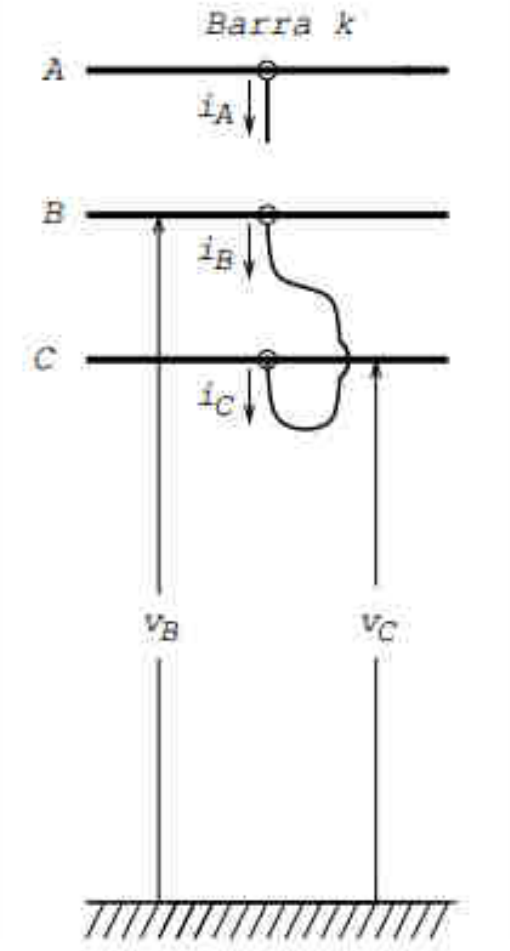
$$\begin{bmatrix} \hat{v}_{A+} \\ \hat{v}_{A-} \\ 0 \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & a & a^2 \\ 1 & a^2 & a \\ 1 & 1 & 1 \end{bmatrix} \cdot \begin{bmatrix} \hat{v}_A \\ \hat{v}_B \\ \hat{v}_B \end{bmatrix}$$

$$\hat{v}_{A+} = \hat{v}_{A-}$$

$$\hat{v}_{A+} = \frac{1}{3}(\hat{v}_A + a\hat{v}_B + a^2\hat{v}_B) = \frac{1}{3}(\hat{v}_A - \hat{v}_B)$$

$$\hat{v}_{A-} = \frac{1}{3}(\hat{v}_A + a^2\hat{v}_B + a\hat{v}_B) = \frac{1}{3}(\hat{v}_A - \hat{v}_B)$$

Curto-circuito Bifásico



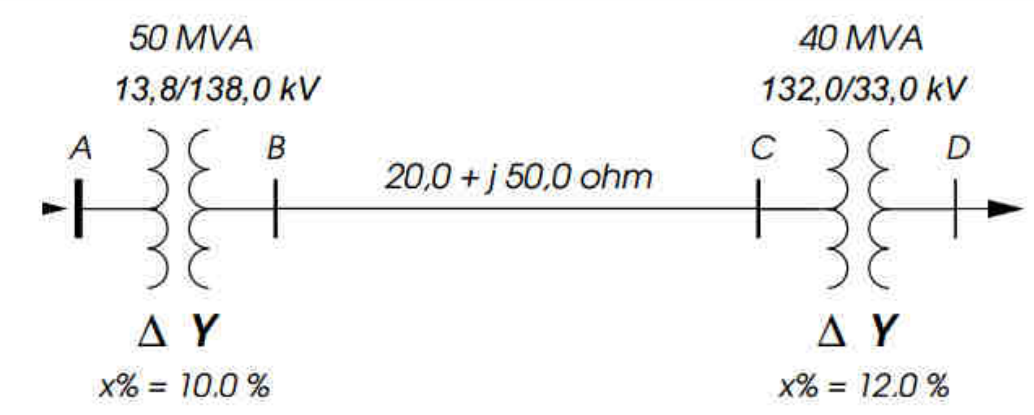
$$\hat{v}_{A+} = \hat{e}_A - \hat{i}_{A+} Z^{+}_{k,k}$$

$$\hat{v}_{A-} = 0 - \hat{i}_{A-} Z^{-}_{k,k}$$

$$\hat{i}_{A-} = -\hat{i}_{A+} \qquad \hat{v}_{A+} = \hat{v}_{A-}$$

$$\hat{i}_{A+} = \frac{\hat{e}_A}{Z^{+}_{k,k} + Z^{-}_{k,k}}$$

Curto-circuito bifásico na barra D

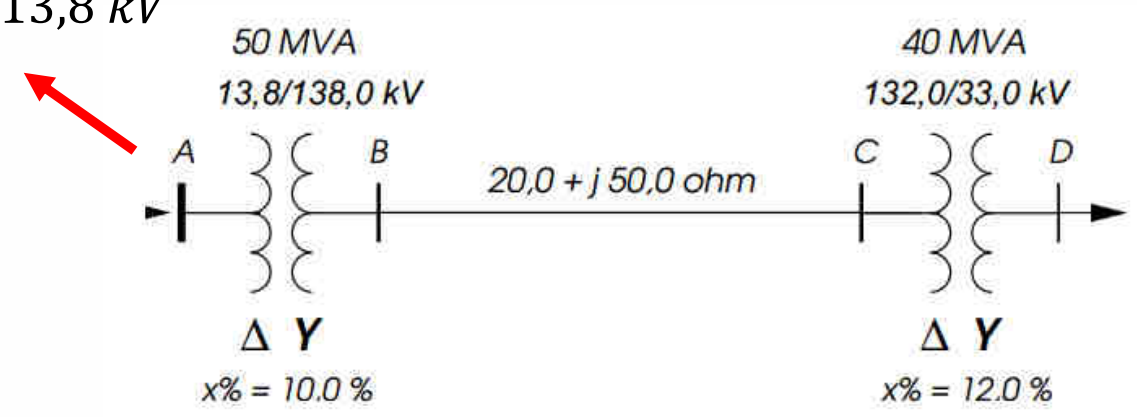


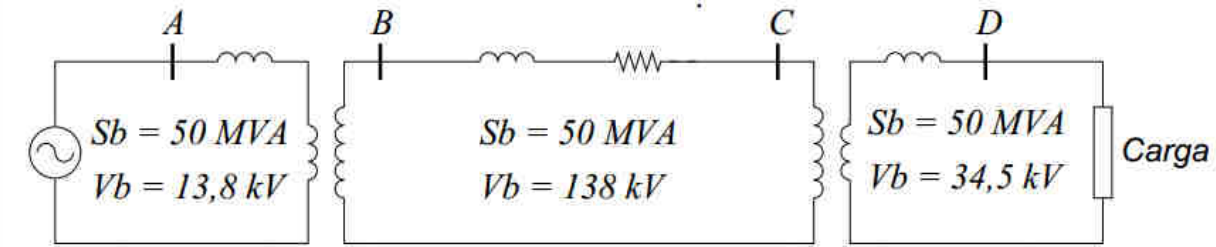
a) Calcule a corrente de curto circuito bifásico na barra D.

b) Calcule a tensão na barra C.

Exemplo – Cálculo de curto-circuito Bifásico

Considere $V_A = 13{,}8\ kV$





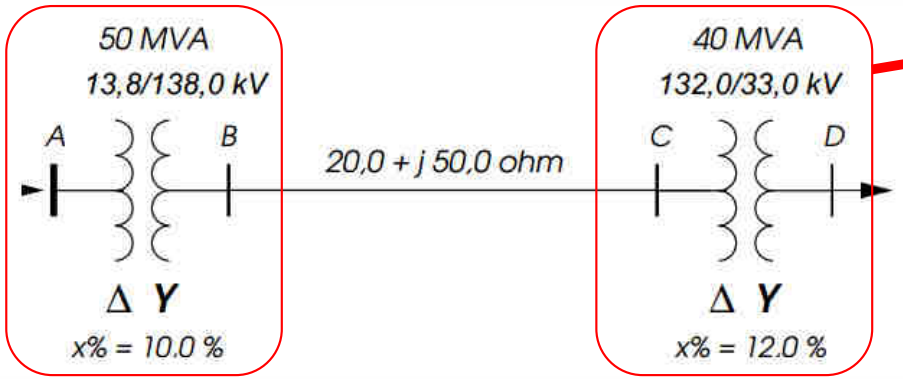
$$z_l\% = \frac{(20,0 + j50,0)}{\frac{138^2}{50,0}} 100\% = 5,251 + j13,127\ \%$$

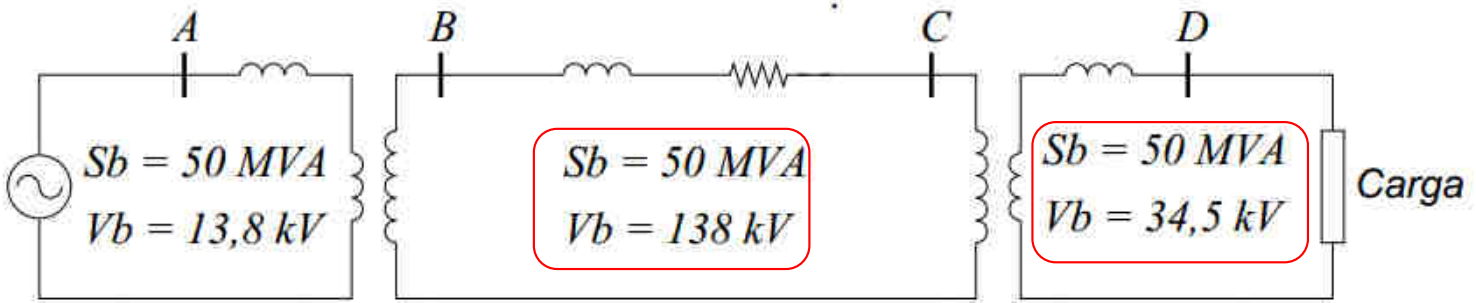
$$Z_B = \frac{138^2}{50} = 380{,}88\ \Omega$$

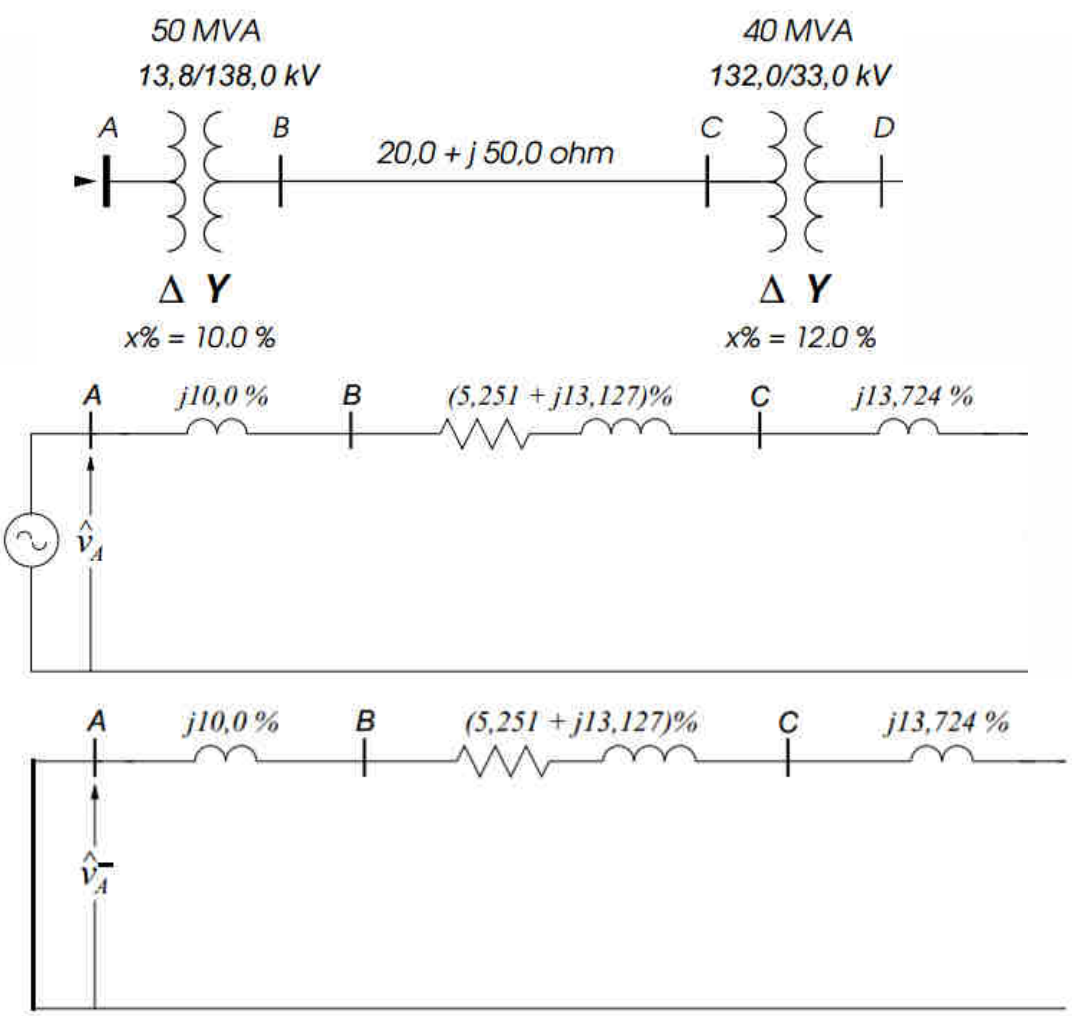
$$x_{te}\% = j10,0\ \%$$

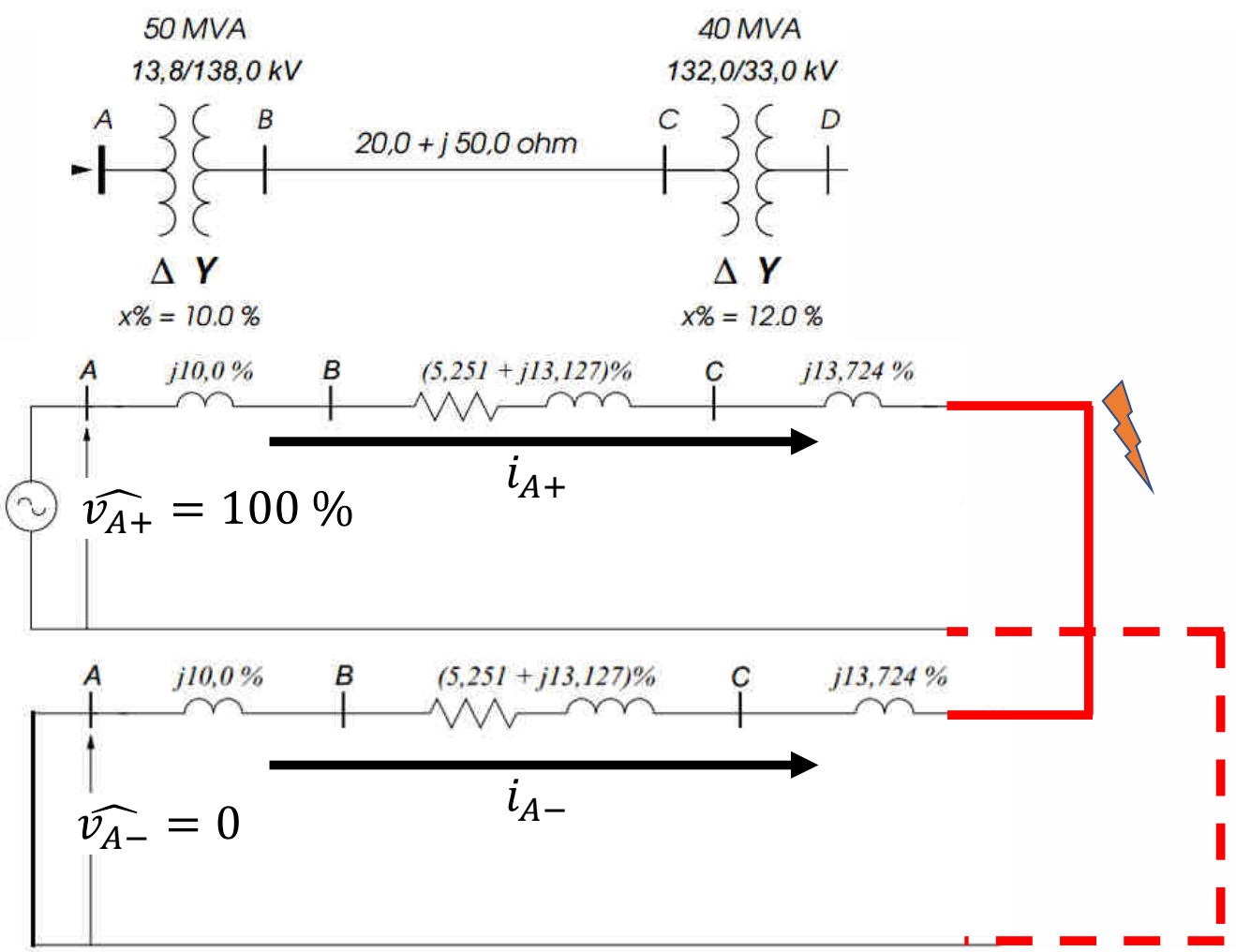
$$x_{ta}\% = 12,0(\frac{50}{40})(\frac{132}{138})^2$$

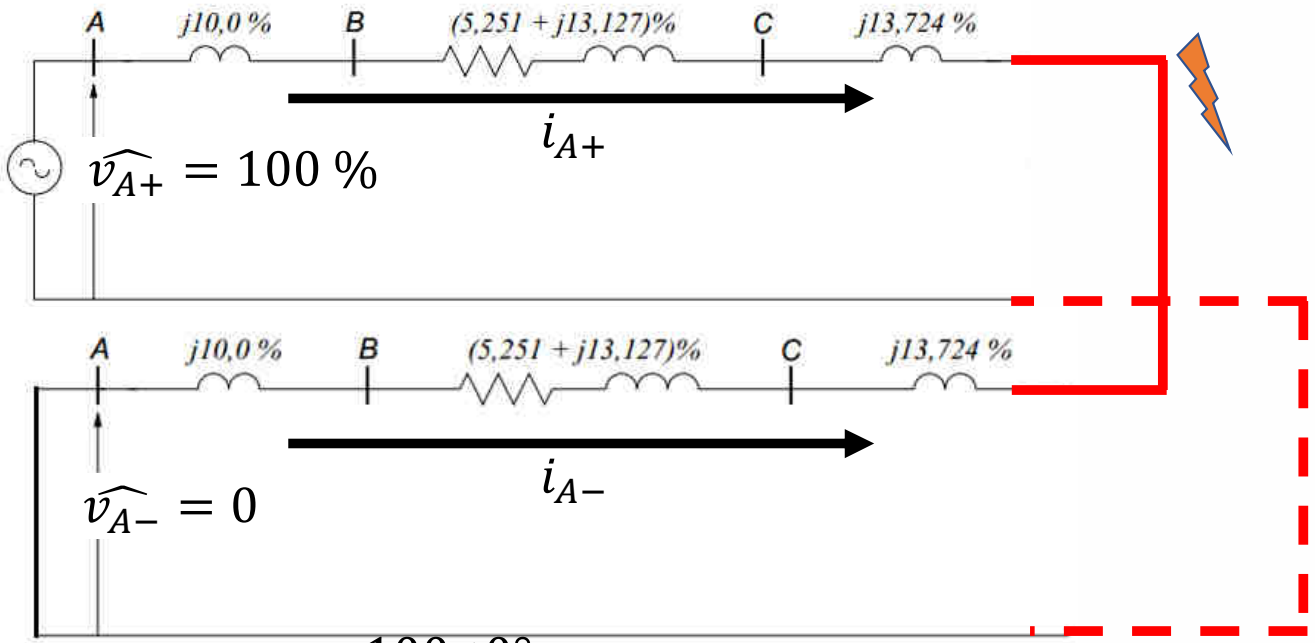
$$x_{ta}\% = j13,724\ \%$$






50 MVA
13,8/138,0 kV
40 MVA
132,0/33,0 kV
A
B
20,0 + j 50,0 ohm
C
D
Δ Y
Δ Y
x% = 10.0 %
x% = 12.0 %
A
j10,0 %
B
(5,251 + j13,127)%
C
j13,724 %
$\hat{V}_A$
A
j10,0 %
B
(5,251 + j13,127)%
C
j13,724 %
$\hat{V}_A$


50 MVA
13,8/138,0 kV
40 MVA
132,0/33,0 kV
A
B
20,0 + j 50,0 ohm
C
D
Δ Y
x% = 10.0 %
Δ Y
x% = 12.0 %
A
j10,0 %
B
(5,251 + j13,127)%
C
j13,724 %
i_{A+}
$\widehat{v_{A+}} = 100\ \%$
A
j10,0 %
B
(5,251 + j13,127)%
C
j13,724 %
i_{A-}
$\widehat{v_{A-}} = 0$

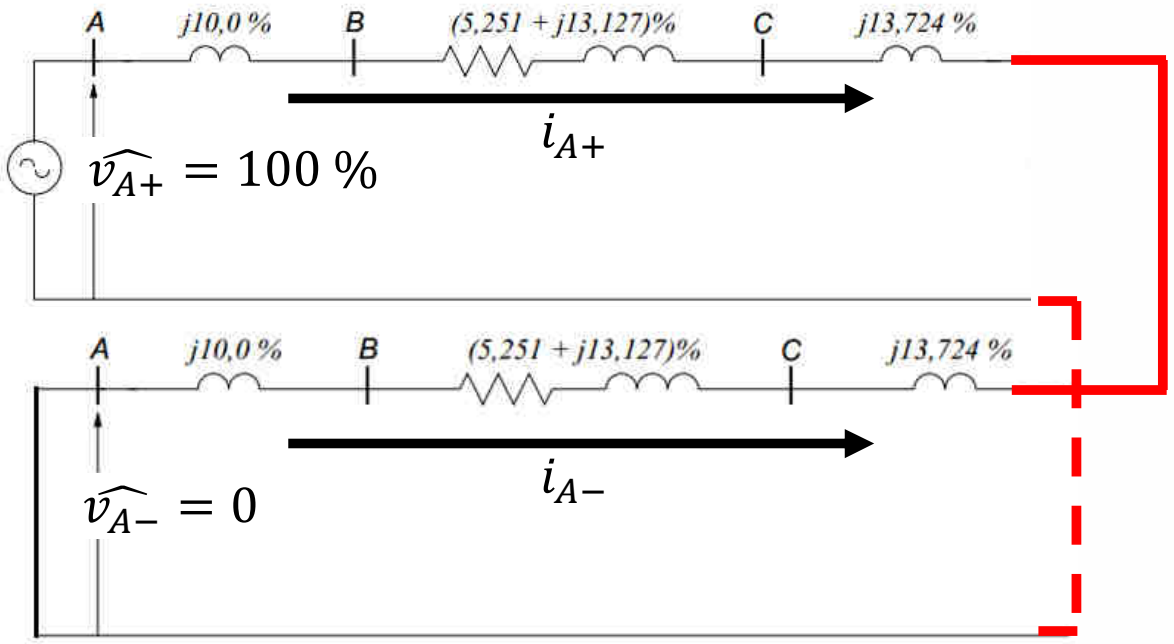


$$i_{A+}^{D}\% = \frac{100\angle 0°}{2 \times 37{,}223\angle 81{,}89°} = 1{,}343\angle -81{,}89° pu$$

$$I_{base}^{D} = \frac{50 \times 10^{6}}{\sqrt{3} \times 34{,}5 \times 10^{3}} = 836{,}74\ A$$

$$I_{A+}^{D} = 836{,}74 \times 1{,}343\angle -81{,}89°$$

$$I_{A+}^{D} = 1.123{,}9\angle -81{,}89° A$$

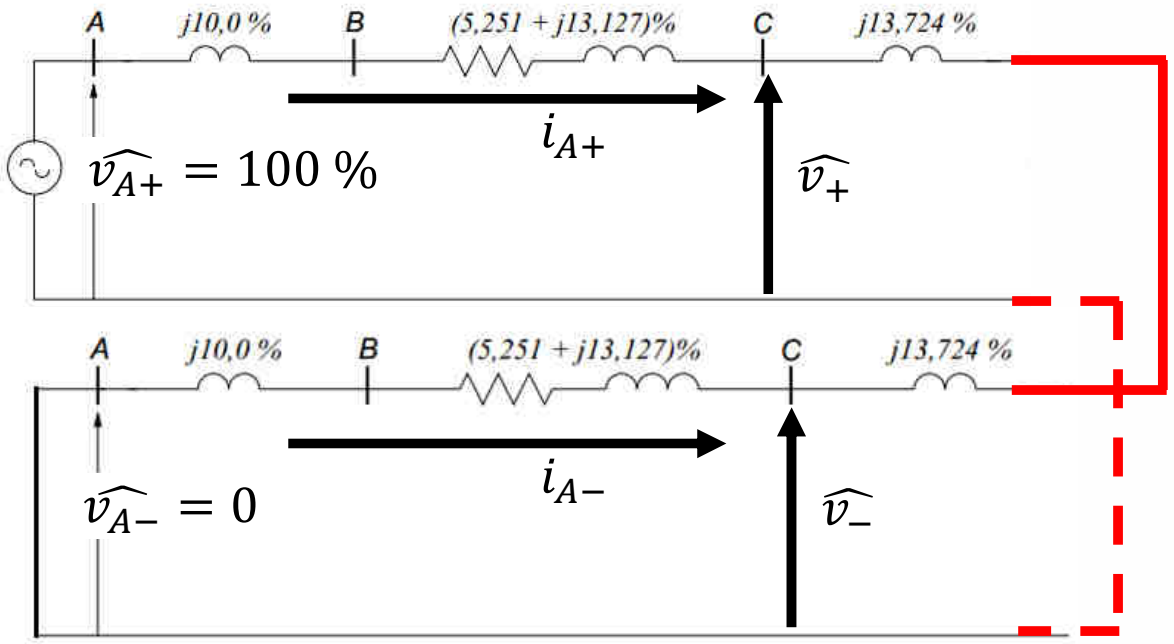


$$I_{A+}^{D} = 1.123{,}9\angle -81{,}89°A$$

$$I_{A-}^{D} = -1.123{,}9\angle -81{,}89°A$$

$$\begin{bmatrix} I_A^D \\ I_B^D \\ I_C^D \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{bmatrix} \begin{bmatrix} I_{A+}^D \\ I_{A-}^D \\ I_{A0}^D \end{bmatrix}$$

$$\begin{bmatrix} I_A^D \\ I_B^D \\ I_C^D \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{bmatrix} \begin{bmatrix} 1.123{,}9\angle -81{,}89° \\ -1.123{,}9\angle -81{,}89° \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1.946{,}7\angle -171{,}89° \\ 1.946{,}7\angle 8{,}11° \end{bmatrix} \text{A}$$



$$\begin{bmatrix} V_A^C \\ V_B^C \\ V_C^C \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{bmatrix} \begin{bmatrix} V_+^C \\ V_-^C \\ V_0^C \end{bmatrix}$$

$$\widehat{v_+} = 100\angle 0° - 23{,}716\angle 77{,}21° \times 1{,}343\angle -81{,}89° \rightarrow 0{,}683\ \angle 2{,}1821° pu$$

$$\widehat{v_-} = 0 + 23{,}716\angle 77{,}21° \times 1{,}343\angle -81{,}89° \rightarrow 0{,}318\ \angle -4{,}6825°\ \text{pu}$$

$$\begin{bmatrix} V_A^C \\ V_B^C \\ V_C^C \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ a^2 & a & 1 \\ a & a^2 & 1 \end{bmatrix} \begin{bmatrix} 0{,}683\angle 2{,}1821° \\ 0{,}318\angle -4{,}6825° \\ 0 \end{bmatrix} = \begin{bmatrix} 1\angle 0° \\ 0{,}55\angle -145{,}20° \\ 0{,}63\angle 149{,}88° \end{bmatrix} pu$$

$$\begin{bmatrix} V_A^C \\ V_B^C \\ V_C^C \end{bmatrix} = \begin{bmatrix} 1\angle 0° \\ 0{,}55\angle -145{,}20° \\ 0{,}63\angle 149{,}88° \end{bmatrix} \times 138 \cdot 10^3 = \begin{bmatrix} 138\angle 0° \\ 76{,}45\angle -145{,}20° \\ 86{,}95\angle 149{,}88° \end{bmatrix} kV$$

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Obrigado!

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