

Sistemas Elétricos de Potência

Aula 06-P1 – Cálculo de Curto-circuito **Trifásico** em um Sistema com **Co-gerador**



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Tópicos abordados

- Material complementar



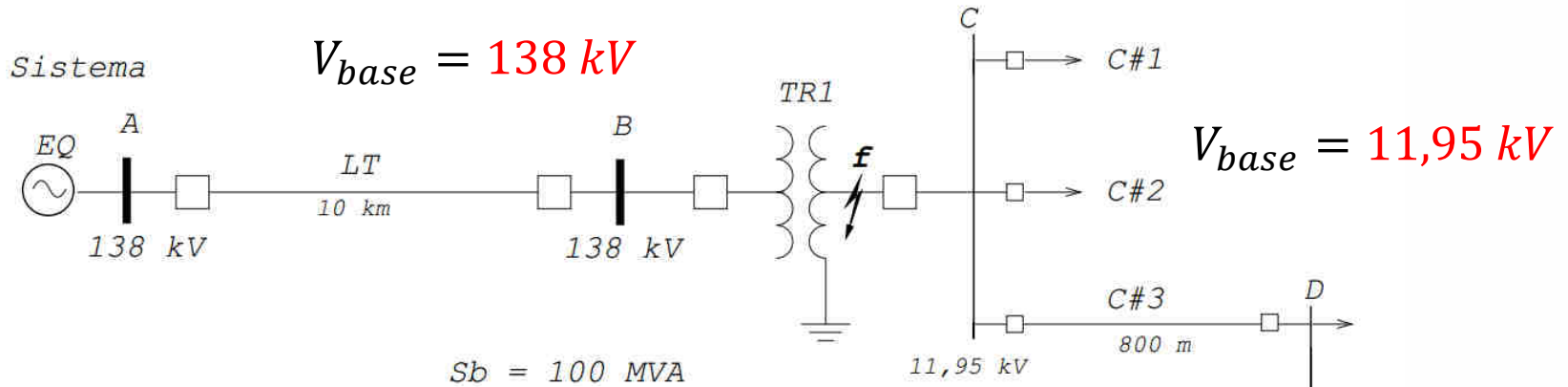
Universidade Estadual de Campinas
Faculdade de Engenharia Elétrica e de Computação
Departamento de Sistemas de Energia Elétrica

Cálculos de Curtos-circuitos em Sistema de Distribuição
Interligado com um Co-gerador

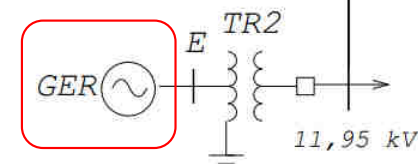
Prof. Fujio Sato



Sistema com Co-gerador



A	Curto-circuito trifásico = $4.808 \text{ MVA } -80^\circ$ Curto-circuito monofásico = $4.109 \text{ MVA } -80^\circ$
LT	$z_+ = 0,1902 + j0,4808 \text{ ohm/km}$ $z_o = 0,4414 + j1,7452 \text{ ohm/km}$
TR1	138,0/11,95 kV - 15 MVA - $j8,68 \%$
C#3	$z_+ = 0,1903 + j0,3922 \text{ ohm/km}$ $z_o = 0,4359 + j1,8540 \text{ ohm/km}$
TR2	11,95/11,95 kV - 2,5 MVA - $j5,0 \%$
GER	11,95 kV - 10,0 MVA - $x_d' = j20,0 \%$



Preparação dos dados: Equivalente da Fonte

$S_b = 100 \text{ MVA}$

A	Curto-circuito trifásico = 4.808 MVA -80° Curto-circuito monofásico = 4.109 MVA -80°
LT	$z^+ = 0,1902 + j0,4808 \text{ ohm/km}$ $z^0 = 0,4414 + j1,7452 \text{ ohm/km}$
TR1	138,0/11,95 kV - 15 MVA - j8,68 %
C#3	$z^+ = 0,1903 + j0,3922 \text{ ohm/km}$ $z^0 = 0,4359 + j1,8540 \text{ ohm/km}$
TR2	11,95/11,95 kV - 2,5 MVA - j5,0 %
GER	11,95 kV - 10,0 MVA - $x_d' = j20,0 \%$

$$z_{\%}^+(s) = \frac{100,0}{4808,0 \angle -80^\circ} 100\%$$

$$z_{\%}^+(s) = 2,08\% \angle 80^\circ$$

$$z_{\%}^0(s) = 3,14\% \angle 80^\circ$$

$$z_{\%}^+(s) = (0,36 + j2,04)\%$$

$$z_{\%}^0(s) = (0,55 + j3,09)\%$$

Preparação dos dados: Linha de Transmissão

$S_b = 100 \text{ MVA}$

A	Curto-circuito trifásico = 4.808 MVA -80° Curto-circuito monofásico = 4.109 MVA -80°
LT	$z_+ = 0,1902 + j0,4808 \text{ ohm/km}$ $z_o = 0,4414 + j1,7452 \text{ ohm/km}$
TR1	138,0/11,95 kV - 15 MVA - j8,68 %
C#3	$z_+ = 0,1903 + j0,3922 \text{ ohm/km}$ $z_o = 0,4359 + j1,8540 \text{ ohm/km}$
TR2	11,95/11,95 kV - 2,5 MVA - j5,0 %
GER	11,95 kV - 10,0 MVA - $x_d' = j20,0 \%$

$$z_{\%}^+(lt) = \frac{(0,1902 + j0,4808)10,0}{\frac{138,0^2}{100,0}} 100\%$$

$$z_{\%}^+(lt) = (1,00 + j2,53)\%$$

$$z_{\%}^0(lt) = (2,32 + j9,16)\%$$

Preparação dos dados: TR₁

$$S_b = 100 \text{ MVA}$$

$$z_{\%N}^+(tr1) = 8,68 \frac{100,0}{15,0}$$

A	Curto-circuito trifásico = 4.808 MVA -80° Curto-circuito monofásico = 4.109 MVA -80°
LT	$z_+ = 0,1902 + j0,4808 \text{ ohm/km}$ $z_0 = 0,4414 + j1,7452 \text{ ohm/km}$
TR1	138,0/11,95 kV - 15 MVA - j8,68 %
C#3	$z_+ = 0,1903 + j0,3922 \text{ ohm/km}$ $z_0 = 0,4359 + j1,8540 \text{ ohm/km}$
TR2	11,95/11,95 kV - 2,5 MVA - j5,0 %
GER	11,95 kV - 10,0 MVA - $x_d' = j20,0 \%$

Preparação dos dados: CH₃

$S_b = 100 \text{ MVA}$

A	Curto-circuito trifásico = 4.808 MVA -80° Curto-circuito monofásico = 4.109 MVA -80°
LT	$z^+ = 0,1902 + j0,4808 \text{ ohm/km}$ $z^0 = 0,4414 + j1,7452 \text{ ohm/km}$
TR1	138,0/11,95 kV - 15 MVA - $j8,68 \%$
C#3	$z^+ = 0,1903 + j0,3922 \text{ ohm/km}$ $z^0 = 0,4359 + j1,8540 \text{ ohm/km}$
TR2	11,95/11,95 kV - 2,5 MVA - $j5,0 \%$
GER	11,95 kV - 10,0 MVA - $x_d' = j20,0 \%$

$$z_{\%}^+(ld) = \frac{(0,1903 + j0,3922)0,8}{\frac{11,95^2}{100,0}} 100\%$$

$$z_{\%}^+(ld) = (10,66 + j21,97)\%$$

$$z_{\%}^0(ld) = (24,42 + j103,86)\%$$

Preparação dos dados: TR2

$$S_b = 100 \text{ MVA}$$

$$z_{\%N}^+(tr2) = 5,0 \frac{100,0}{2,5}$$

A	Curto-circuito trifásico = 4.808 MVA -80° Curto-circuito monofásico = 4.109 MVA -80°
LT	$z_+ = 0,1902 + j0,4808 \text{ ohm/km}$ $z_0 = 0,4414 + j1,7452 \text{ ohm/km}$
TR1	138,0/11,95 kV - 15 MVA - j8,68 %
C#3	$z_+ = 0,1903 + j0,3922 \text{ ohm/km}$ $z_0 = 0,4359 + j1,8540 \text{ ohm/km}$
TR2	11,95/11,95 kV - 2,5 MVA - j5,0 %
GER	11,95 kV - 10,0 MVA - $x_d' = j20,0 \%$

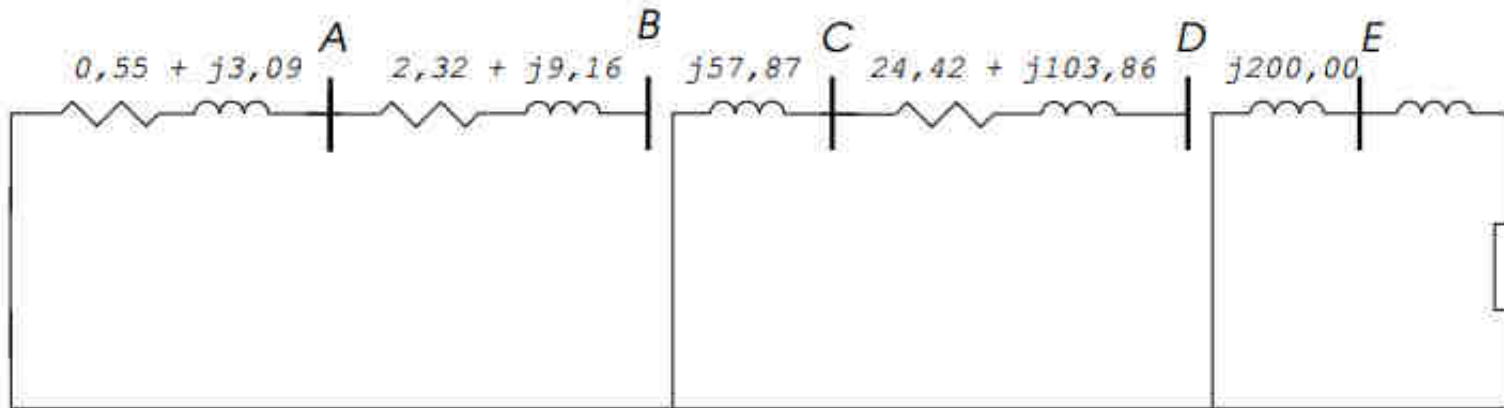
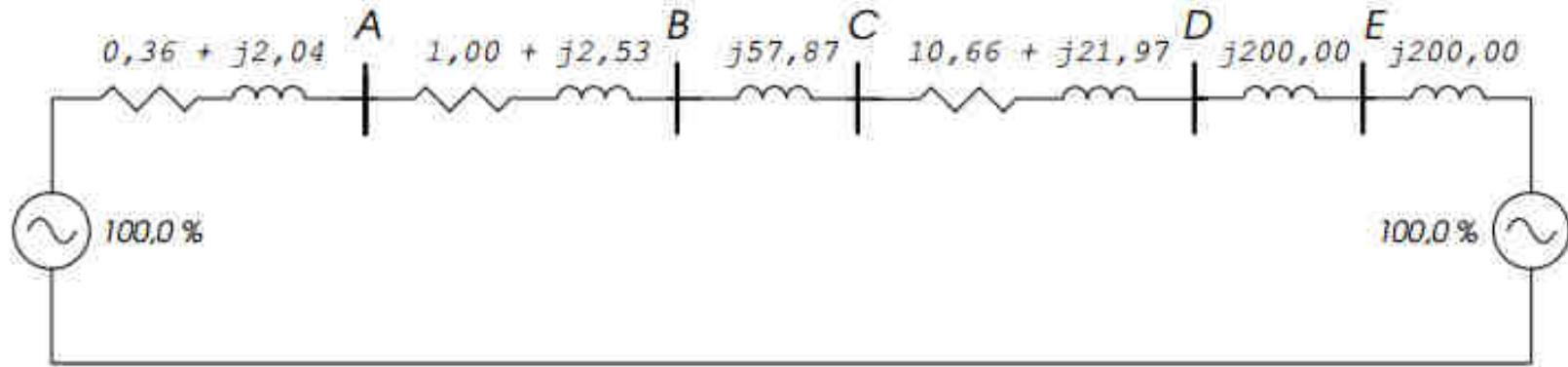
Preparação dos dados: Gerador

$$S_b = 100 \text{ MVA}$$

A	Curto-circuito trifásico = 4.808 MVA -80° Curto-circuito monofásico = 4.109 MVA -80°
LT	$z_+ = 0,1902 + j0,4808 \text{ ohm/km}$ $z_0 = 0,4414 + j1,7452 \text{ ohm/km}$
TR1	138,0/11,95 kV - 15 MVA - j8,68 %
C#3	$z_+ = 0,1903 + j0,3922 \text{ ohm/km}$ $z_0 = 0,4359 + j1,8540 \text{ ohm/km}$
TR2	11,95/11,95 kV - 2,5 MVA - j5,0 %
GER	11,95 kV - 10,0 MVA - $x_d' = j20,0 \%$

$$z_{\%N}^+(ger) = 20,0 \frac{100,0}{10,0}$$

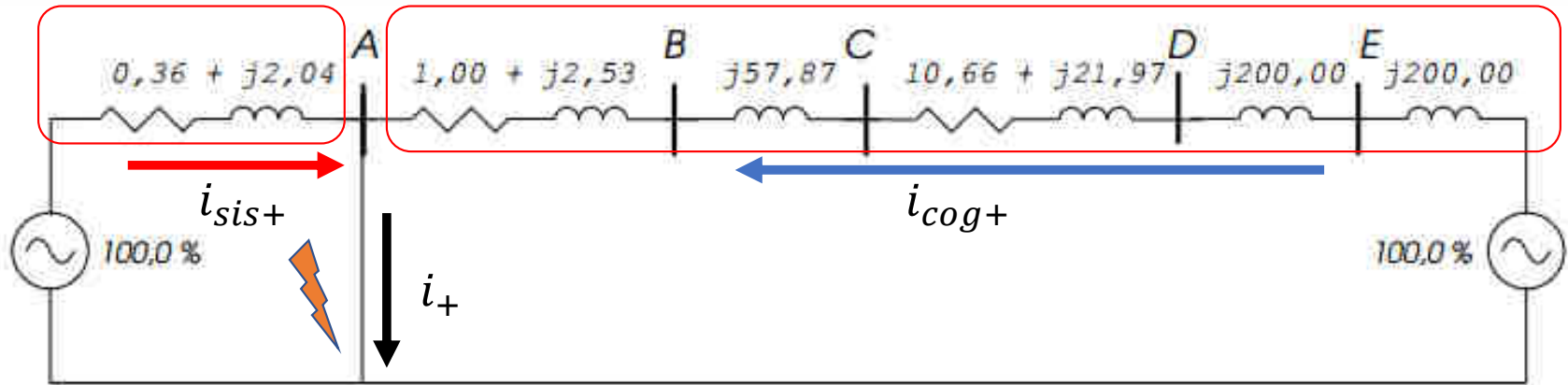
Preparação dos dados



Curto-circuito Trifásico – Barra A

$$z_{sis}^+ = 2,07 \angle 79,99^\circ \%$$

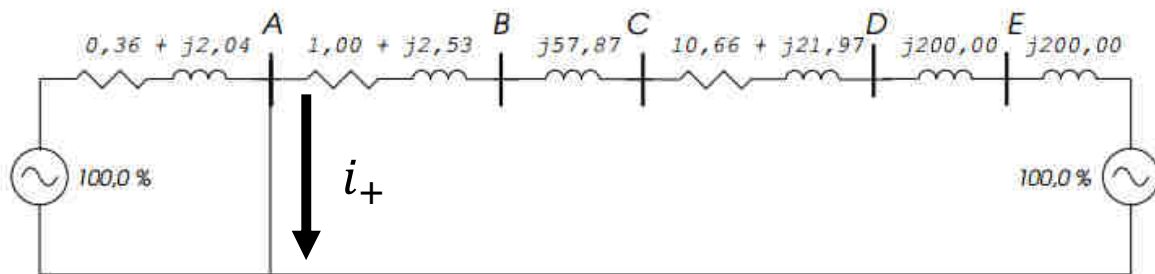
$$z_{cog}^+ = 482,51 \angle 88,62^\circ \%$$



$$z_{eq}^+ = z_{sis}^+ // z_{cog}^+ = \frac{2,07 \angle 79,99 \times 482,51 \angle 88,62}{2,07 \angle 79,99 + 482,51 \angle 88,62} = 2,06 \angle 80,03^\circ \%$$

Curto-circuito Trifásico – Barra A

$$z_{eq}^+ = z_{sis}^+ // z_{cog}^+ = 2,06 \angle 80,03^\circ \%$$



$$i_+ = \frac{100}{2,06 \angle 80,03}$$

$$i_+ = 48,48 \angle -80,03 \text{ pu}$$

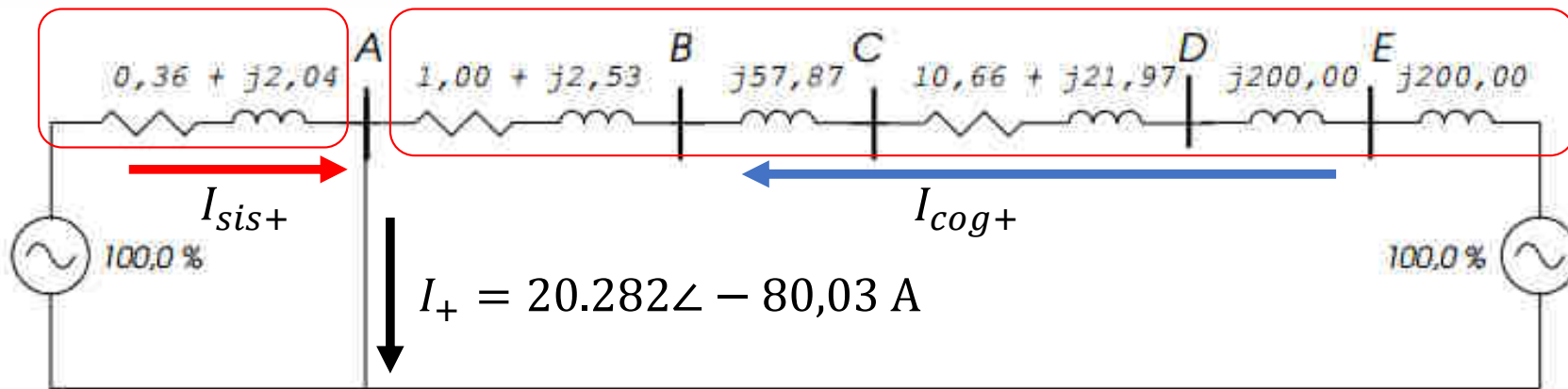
$$I_{base}^A = \frac{100 \times 10^6}{\sqrt{3} \times 138 \times 10^3} = 418,37 \text{ A}$$

$$I_+ = 48,48 \angle -80,03 \times 418,37 = 20.282 \angle -80,03 \text{ A}$$

Curto-circuito Trifásico – Barra A

$$z_{sis}^+ = 2,07 \angle 79,99^\circ \%$$

$$z_{cog}^+ = 482,51 \angle 88,62^\circ \%$$



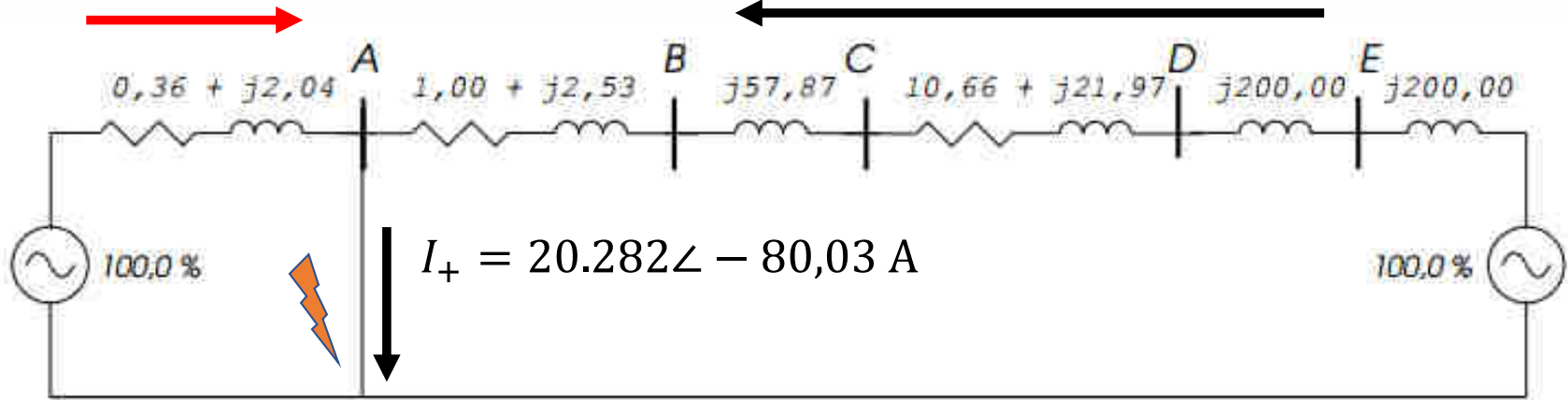
$$I_{sis+} = 20.282 \angle -80,03 \frac{482,51 \angle 88,62}{2,07 \angle 79,99 + 482,51 \angle 88,62} = 20.196 \angle -79,99^\circ \text{A}$$

$$I_{cog+} = 20.282 \angle -80,03 \frac{2,07 \angle 79,99}{2,07 \angle 79,99 + 482,51 \angle 88,62} = 86,71 \angle -88,62^\circ \text{A}$$

Curto-circuito Trifásico – Barra A

$$I_{sis+} = 20.196 \angle -79,99^\circ \text{ A}$$

$$I_{cog+} = 86,71 \angle -88,62^\circ \text{ A}$$





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Obrigado!

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