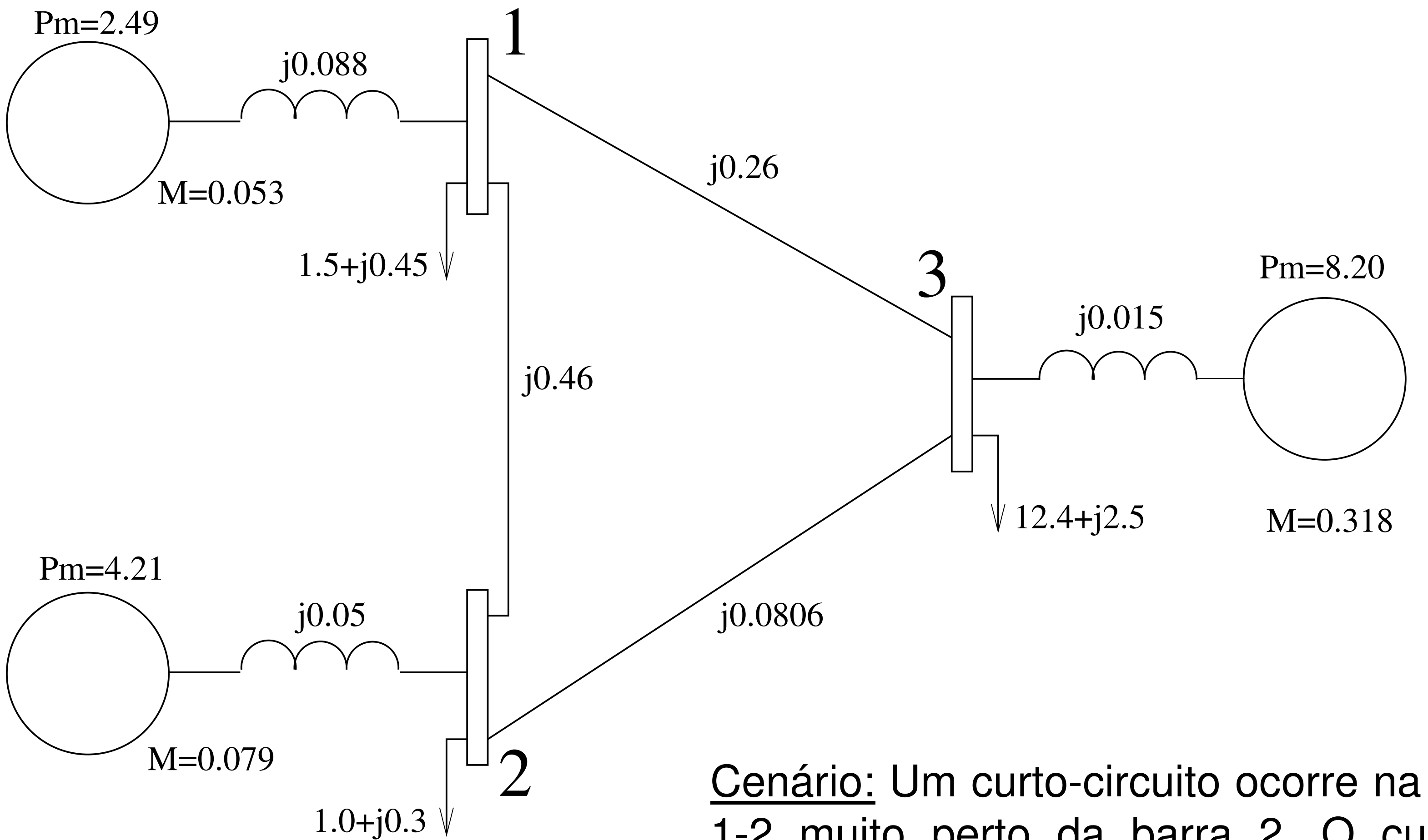
Sistema 3 geradores e 3 barras

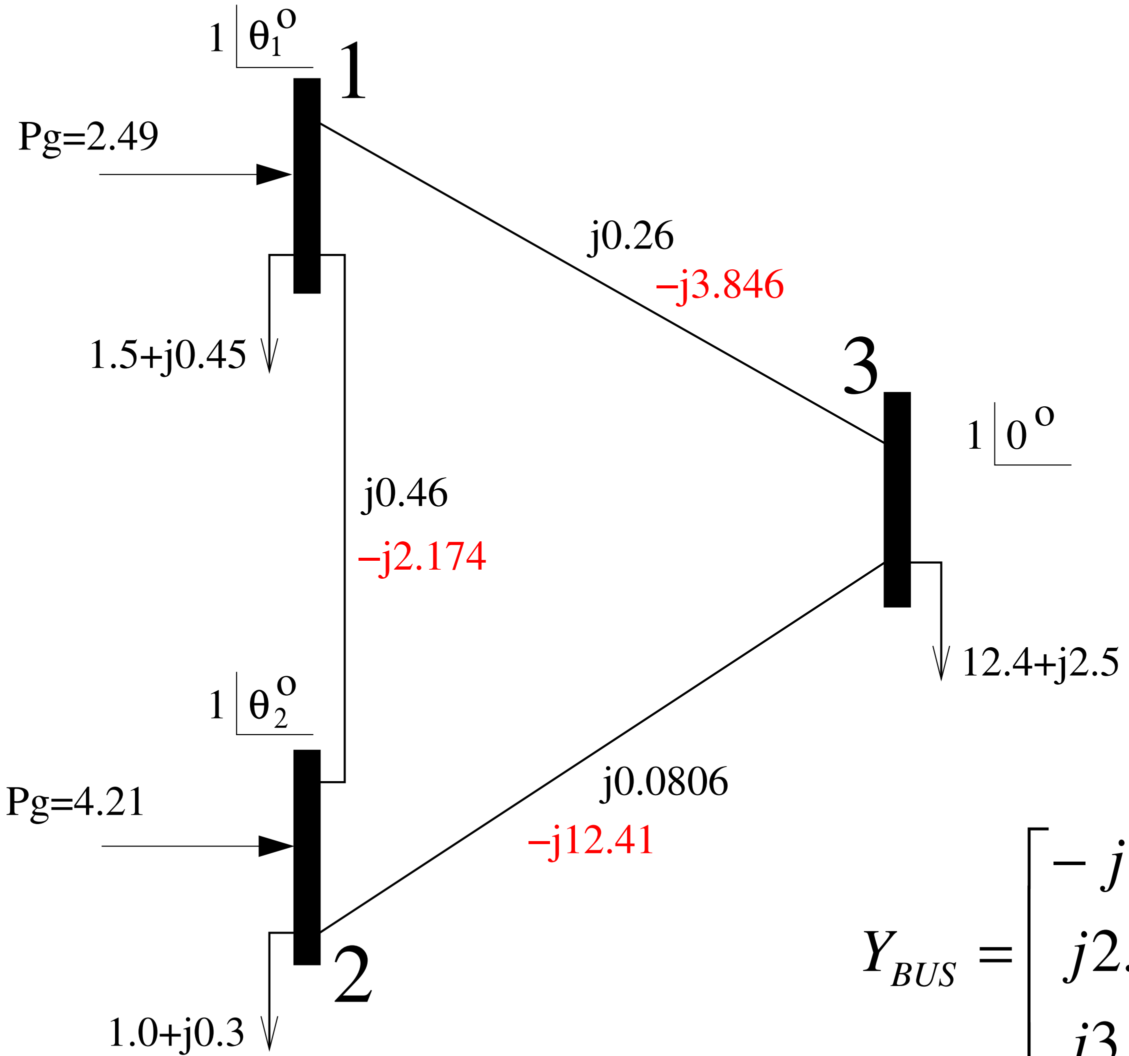
Análise de Estabilidade Transitória

Sistema 3 geradores e 3 barras



<u>Cenário:</u> Um curto-circuito ocorre na linha 1-2 muito perto da barra 2. O curto é eliminado pela abertura do disjuntor.

Fluxo de Carga



Resultado Fluxo de Carga:

$\Theta_1 = 15^{\circ}$

$\Theta_2 = 15^{\circ}$

$P_{g3} = 8.20$ pu

$$Y_{BUS} = \begin{bmatrix} -j6.02 & j2.174 & j3.846 \\ j2.174 & -j14.58 & j12.407 \\ j3.846 & j12.407 & -j16.25 \end{bmatrix}$$

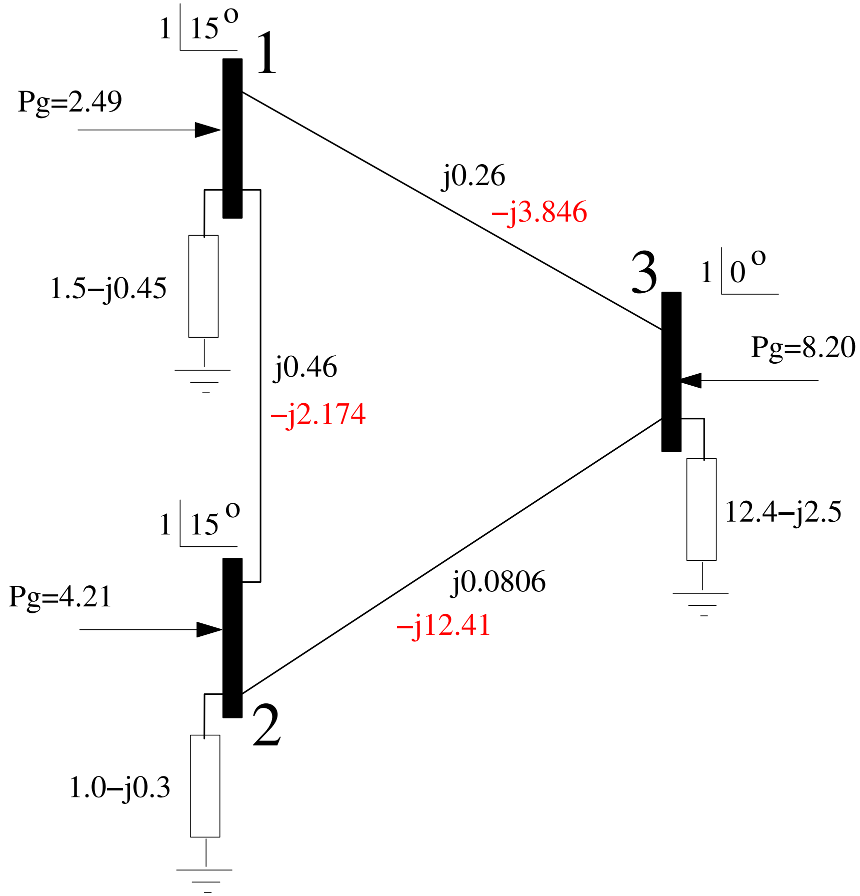
Convertendo Cargas em Impedância Constante

$$Y_L = \frac{S_L^*}{|V|^2} = \frac{P_L - jQ_L}{|V|^2}$$

$$Y_{L1} = \frac{1.5 - j0.45}{1^2} = 1.5 - j0.45$$

$$Y_{L2} = \frac{1.0 - j0.3}{1^2} = 1.0 - j0.3$$

$$Y_{L3} = \frac{12.4 - j2.5}{1^2} = 12.4 - j2.5$$



$$Y_{BUSL} = Y_{BUS} + Y_L = \begin{bmatrix} 1.5 - j6.47 & j2.174 & j3.846 \\ j2.174 & 1.0 - j14.88 & j12.407 \\ j3.846 & j12.407 & 12.4 - j18.75 \end{bmatrix}$$

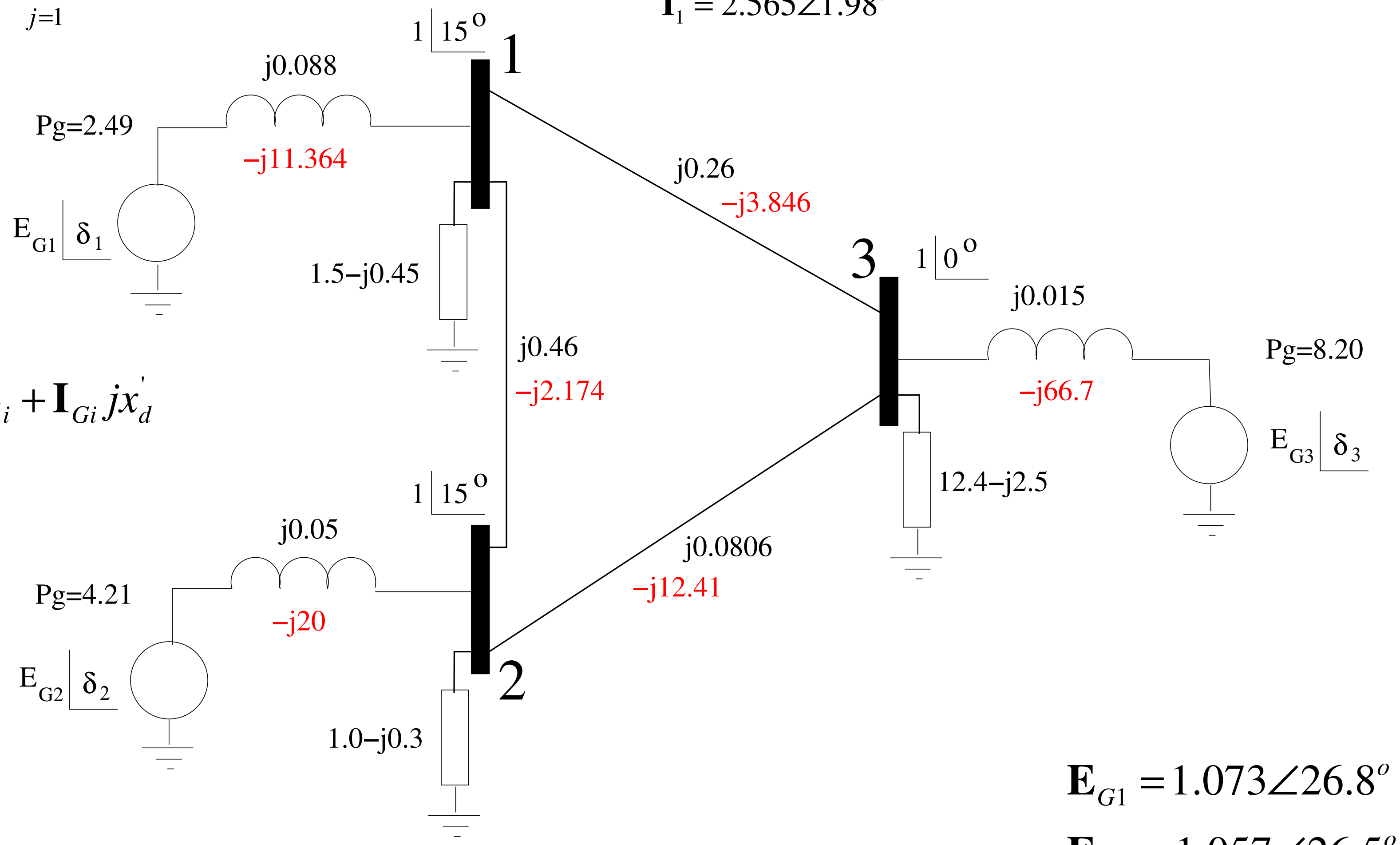
Calculando f.e.m. dos geradores

$$\mathbf{I}_{Gi} = \sum_{j=1}^{n} Y_{BUSLij}\mathbf{E}_j$$

$$\mathbf{I}_1 = (1.5 - j6.47)1\angle 15^o + (j2.174)1\angle 15^o + (j3.846)1\angle 0^o$$

$$\mathbf{I}_1 = 2.565\angle 1.98^o$$

$$\mathbf{E}_{Gi} = \mathbf{E}_i + \mathbf{I}_{Gi}\, jx_d^{'}$$



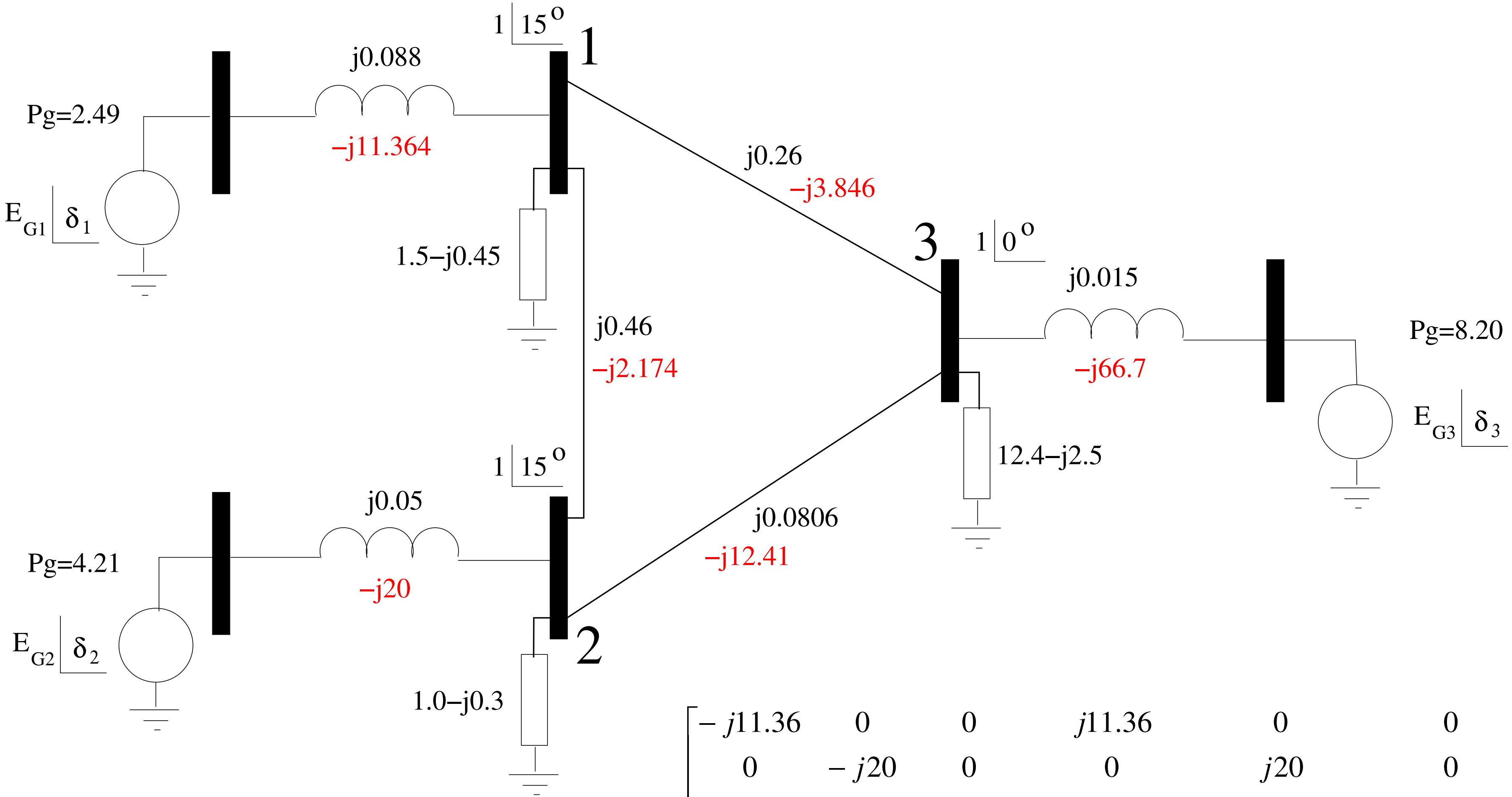
$$\mathbf{E}_{G1} = 1.073\angle 26.8^o$$

$$\mathbf{E}_{G2} = 1.057\angle 26.5^o$$

$$\mathbf{E}_{G1} = 1\angle 15^o + 2.565\angle 1.98^o 0.088\angle 90^o$$

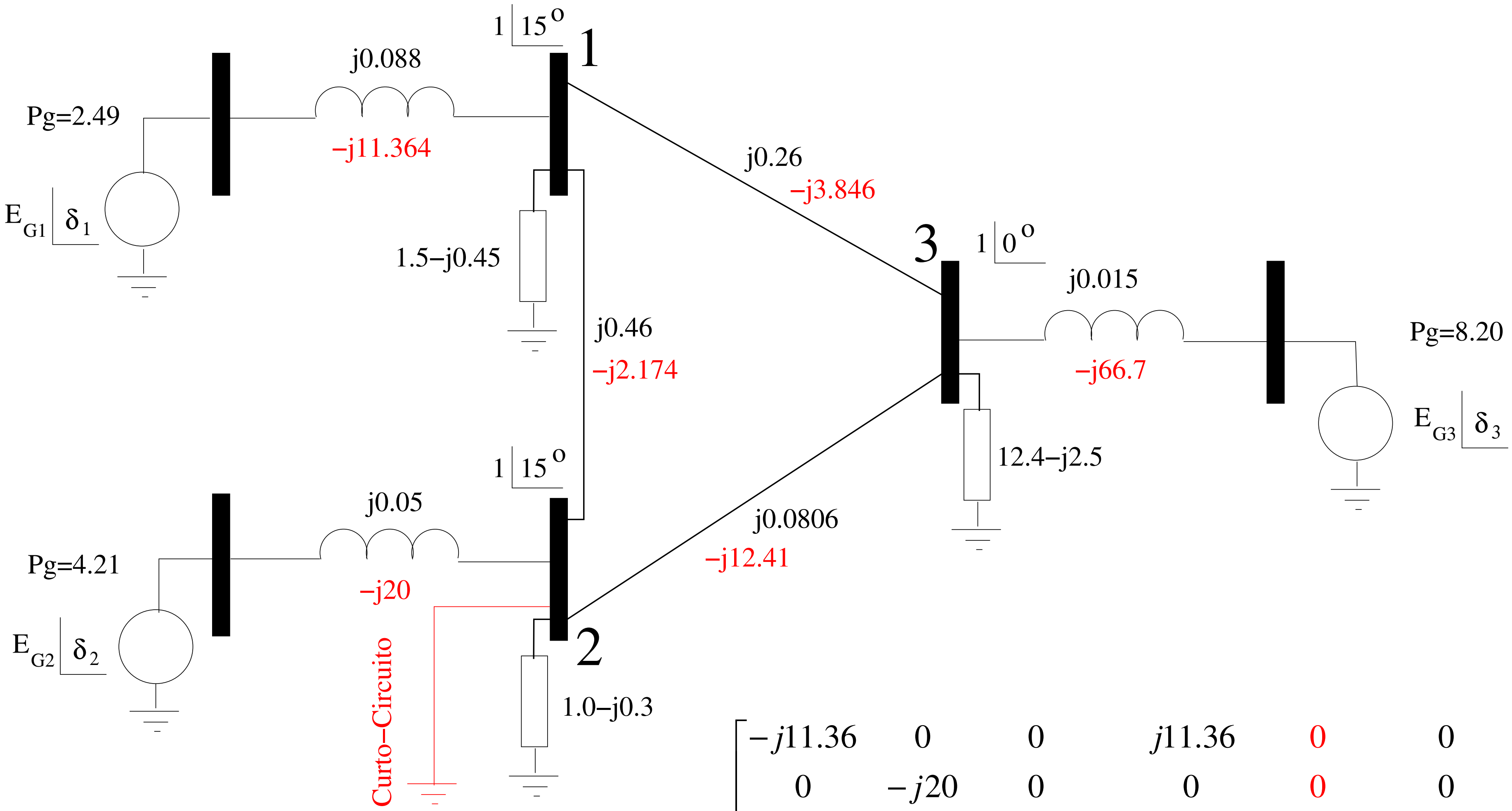
$$\mathbf{E}_{G3} = 1.053\angle 6{,}71^o$$

Matriz Admitância Completa Pré-Falta



$$\tilde{Y}_{BUS} = \begin{bmatrix} -j11.36 & 0 & 0 & j11.36 & 0 & 0 \\ 0 & -j20 & 0 & 0 & j20 & 0 \\ 0 & 0 & -j66.7 & 0 & 0 & j66.7 \\ j11.36 & 0 & 0 & 1.5-j17.83 & j2.174 & j3.846 \\ 0 & j20 & 0 & j2.174 & 1.0-j34.88 & j12.41 \\ 0 & 0 & j66.7 & j3.846 & j12.41 & 12.4-j85.4 \end{bmatrix}$$

Matriz Admitância Completa em Falta



$$\tilde{Y}_{BUS} = \begin{bmatrix} -j11.36 & 0 & 0 & j11.36 & 0 & 0 \\ 0 & -j20 & 0 & 0 & 0 & 0 \\ 0 & 0 & -j66.7 & 0 & 0 & j66.7 \\ j11.36 & 0 & 0 & 1.5-j17.83 & 0 & j3.846 \\ 0 & 0 & 0 & 0 & 1.0 & 0 \\ 0 & 0 & j66.7 & j3.846 & 0 & 12.4-j85.4 \end{bmatrix}$$

Modelo Falta

$$\tilde{Y}_{BUS} = \begin{bmatrix} -j11.36 & 0 & 0 & j11.36 & 0 & 0 \\ 0 & -j20 & 0 & 0 & 0 & 0 \\ 0 & 0 & -j66.7 & 0 & 0 & j66.7 \\ j11.36 & 0 & 0 & 1.5-j17.83 & 0 & j3.846 \\ 0 & 0 & 0 & 0 & 1.0 & 0 \\ 0 & 0 & j66.7 & j3.846 & 0 & 12.4-j85.4 \end{bmatrix}$$

$$Y_{red}^{f} = \begin{bmatrix} 0.62-j4.11 & 0 & 0.43+j1.85 \\ 0 & -j20 & 0 \\ 0.43+j1.85 & 0 & 7.58-j15.25 \end{bmatrix}$$

$$\dot{\delta}_1 = \omega_1$$

$$0.053\dot{\omega}_1 = 2.49 - 1.073^2 \times 0.62 - 2.09\sin(\delta_1 - \delta_3) - 0.485\cos(\delta_1 - \delta_3)$$

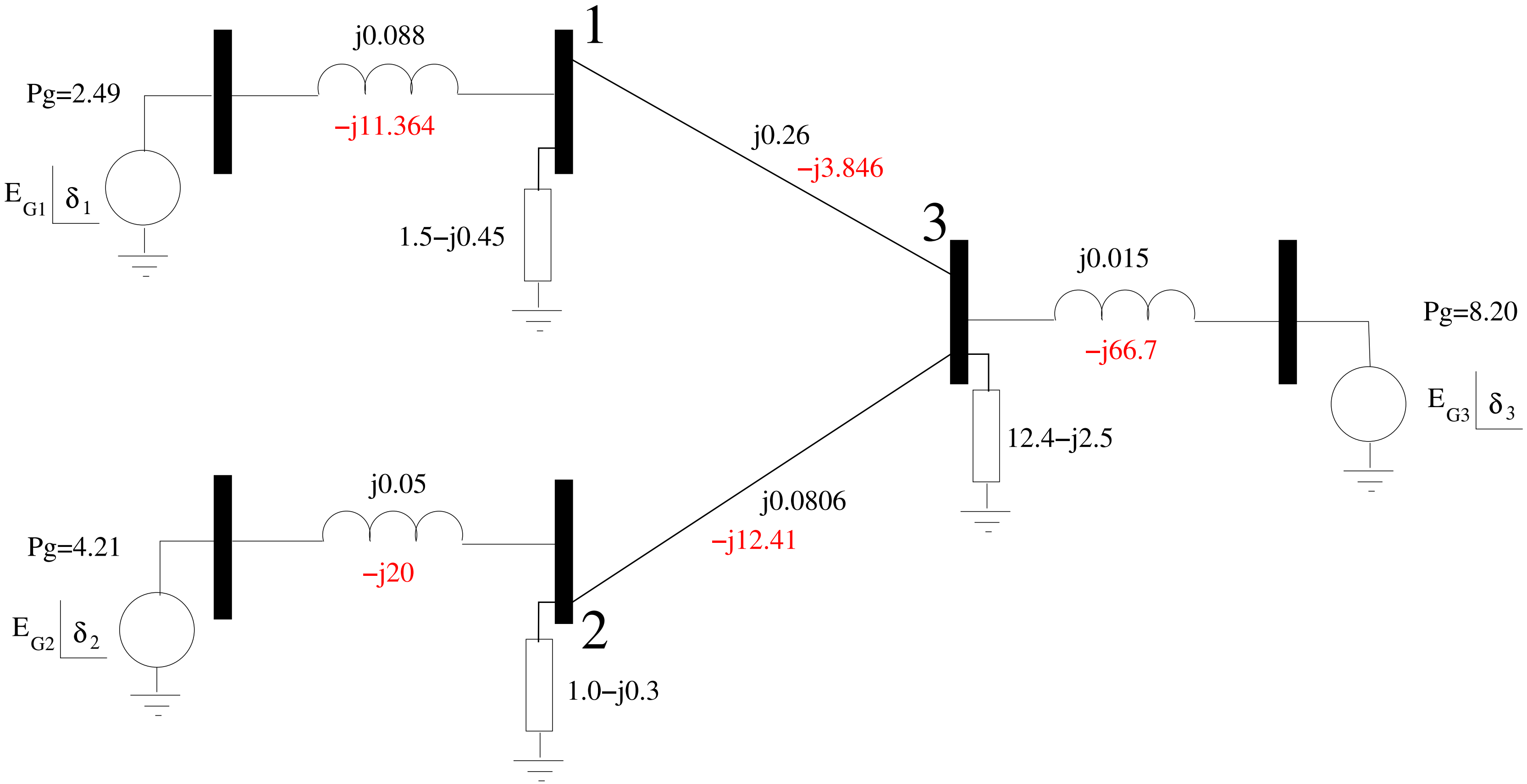
$$\dot{\delta}_2 = \omega_2$$

$$0.079\dot{\omega}_2 = 4.21$$

$$\dot{\delta}_3 = \omega_3$$

$$0.318\dot{\omega}_3 = 8.20 - 1.053^2 \times 8.61 - 2.06\sin(\delta_3 - \delta_1) - 0.48\cos(\delta_3 - \delta_1)$$

Matriz Admitância Completa Pós-Falta



$$\tilde{Y}_{BUS} = \begin{bmatrix} -j11.36 & 0 & 0 & j11.36 & 0 & 0 \\ 0 & -j20 & 0 & 0 & j20 & 0 \\ 0 & 0 & -j66.7 & 0 & 0 & j66.7 \\ j11.36 & 0 & 0 & 1.5-j15.65 & 0 & j3.846 \\ 0 & j20 & 0 & 0 & 1.0-j32.71 & j12.41 \\ 0 & 0 & j66.7 & j3.846 & j12.41 & 12.4-j85.4 \end{bmatrix}$$

Modelo Pós-Falta

$$\tilde{Y}_{BUS} = \begin{bmatrix} -j11.36 & 0 & 0 & j11.36 & 0 & 0 \\ 0 & -j20 & 0 & 0 & j20 & 0 \\ 0 & 0 & -j66.7 & 0 & 0 & j66.7 \\ j11.36 & 0 & 0 & 1.5-j15.65 & 0 & j3.846 \\ 0 & j20 & 0 & 0 & 1.0-j32.71 & j12.41 \\ 0 & 0 & j66.7 & j3.846 & j12.41 & 12.4-j85.4 \end{bmatrix}$$

$$Y_{red}^{pf} = \begin{bmatrix} 8.605-j12.32 & 0.573+j2.22 & 1.167+j6.149 \\ 0.573+j2.22 & 0.815-j3.103 & 0.073+j0.250 \\ 1.167+j6.149 & 0.073+j0.250 & 0.528-j7.087 \end{bmatrix}$$

$$\dot{\delta}_1 = \omega_1$$

$$0.053\dot{\omega}_1 = 2.49 - 1.073^2 \times 0.82 - 0.28\sin(\delta_1-\delta_2) - 0.078\cos(\delta_1-\delta_2) - 2.47\sin(\delta_1-\delta_3) - 0.63\cos(\delta_1-\delta_3)$$

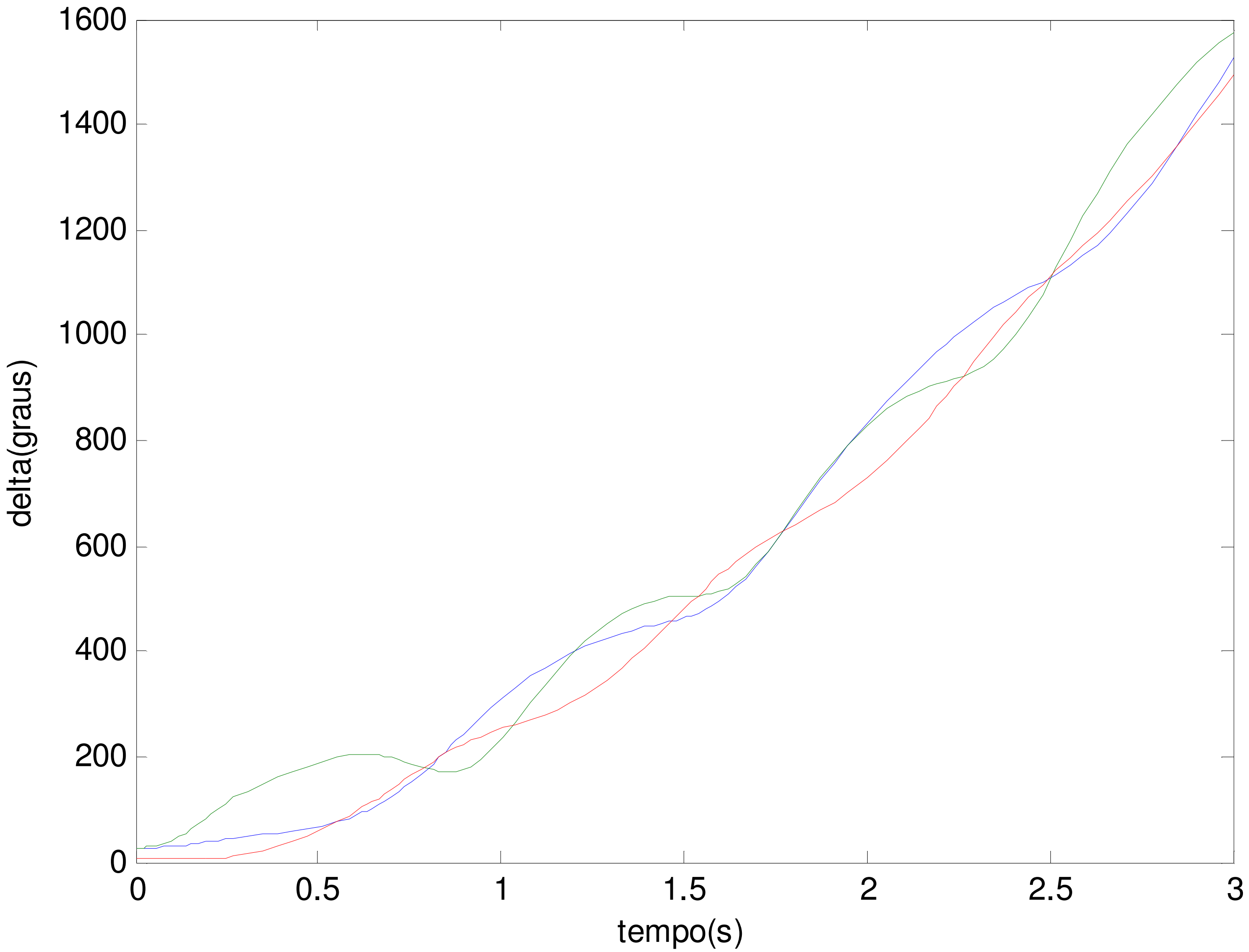
$$\dot{\delta}_2 = \omega_2$$

$$0.079\dot{\omega}_2 = 4.21 - 1.057^2 \times 0.53 - 0.28\sin(\delta_2-\delta_1) - 0.078\cos(\delta_2-\delta_1) - 6.84\sin(\delta_2-\delta_3) - 1.29\cos(\delta_2-\delta_3)$$

$$\dot{\delta}_3 = \omega_3$$

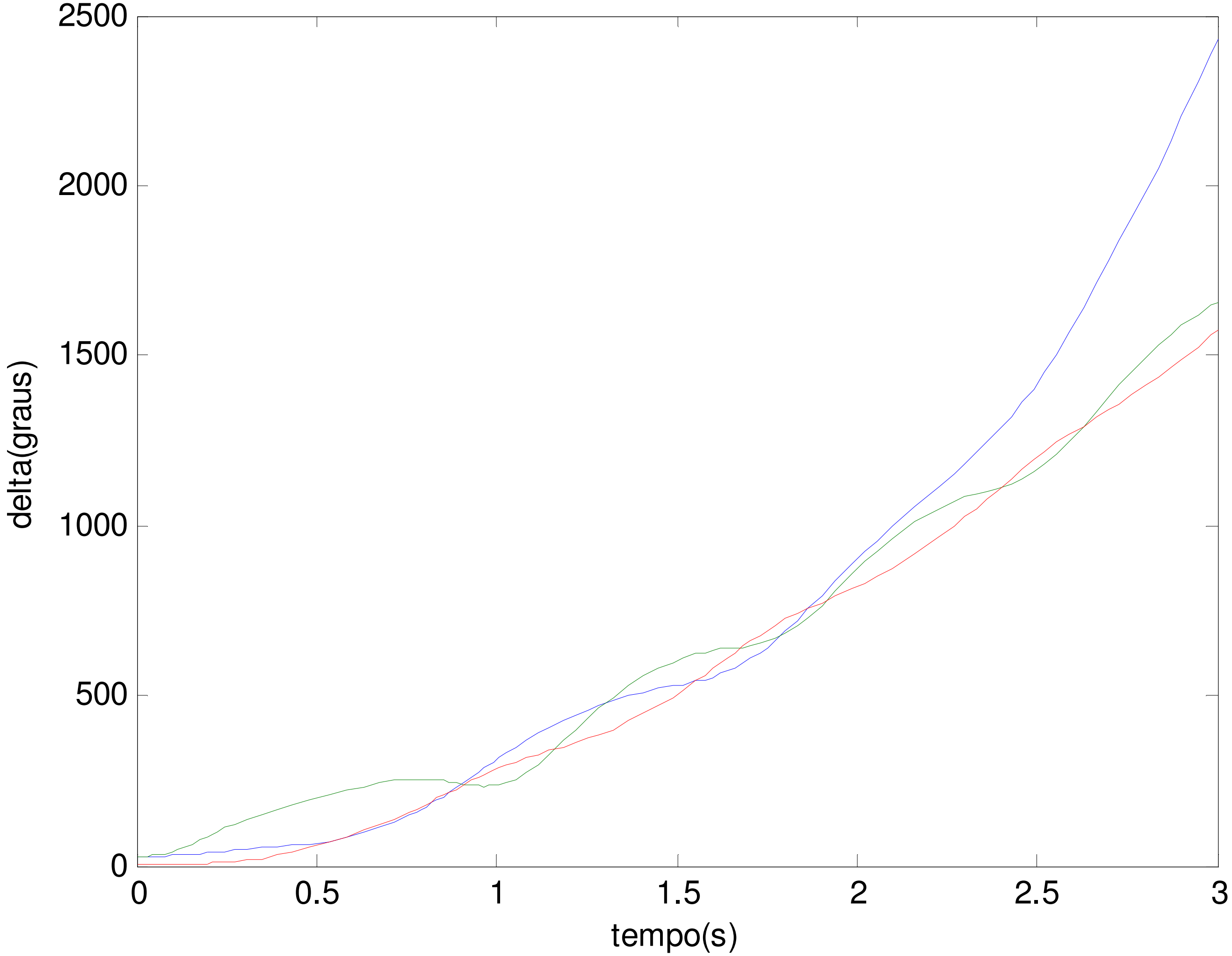
$$0.318\dot{\omega}_3 = 8.20 - 1.053^2 \times 8.61 - 2.47\sin(\delta_3-\delta_1) - 0.63\cos(\delta_3-\delta_1) - 6.84\sin(\delta_3-\delta_2) - 1.29\cos(\delta_3-\delta_2)$$

Simulação – Um caso estável



t_{ab}=194ms

Simulação – Um caso instável



t_{ab}=196ms