

Calculo parcial diciembre 2014:

$$U := 6.3 \text{ kV} \quad \omega := 2 \cdot \pi \cdot 50 \text{ Hz} \quad R := 4 \text{ ohm}$$

$$X_{red} := \frac{U^2}{250} \cdot 1j \quad X_{red} = 0.159j \quad X_{Td} := 0.07 \cdot \frac{U^2}{7.5} \cdot 1j \quad X_{Td} = 0.37j \text{ ohm}$$

$$X_{To} := X_{Td}$$

Datos de cable 6 kV 50 mm² Al:

$$Z_{Ld} := 0.8 + 0.11j \text{ ohm/km}$$

$$L_{tot} := 2 + 2 + 2 + 2 + 1 \text{ km}$$

$$Z_{Lo} := 3 \cdot Z_{Ld} \quad C_L := 0.205 \frac{\mu F}{km} \quad I_{Ctot} := 3 \left(1j \cdot \omega \cdot C_L \cdot L_{tot} \cdot \frac{U}{\sqrt{3}} \right) \cdot 10^{-3}$$

$$|I_{Ctot}| = 6.325 \text{ A} \quad I_{51N} := 2 \cdot |I_{Ctot}| \quad I_{51N} = 12.65 \text{ A}$$

Corrientes de cortocircuito 3F :

$$I_{CC3Fbarra} := \frac{\left(\frac{U}{\sqrt{3}} \right)}{X_{red} + X_{Td}} \quad |I_{CC3Fbarra}| = 6.873 \text{ kA}$$

$$I_{CC3FA1} := \frac{\left(\frac{U}{\sqrt{3}} \right)}{X_{red} + X_{Td} + Z_{Ld} \cdot 2} \quad |I_{CC3FA1}| = 2.059 \text{ kA}$$

$$I_{50} := \frac{\left(\frac{U}{\sqrt{3}} \right)}{X_{red} + X_{Td} + Z_{Ld} \cdot 2 \cdot 0.8} \quad |I_{50}| = 2.489 \text{ kA}$$

$$I_{CC3FB1min} := \frac{\left(\frac{U}{\sqrt{3}} \right)}{X_{red} + X_{Td} + Z_{Ld} \cdot (2 + 2 + 1 + 2) + 40} \quad |I_{CC3FB1min}| = 0.08 \text{ kA}$$

$$I_{51} := 0.8 \cdot |I_{CC3FB1min}| \quad I_{51} = 0.064 \text{ kA}$$

Impongo 200 ms de margen fusible-interruptor, curva MI:

$$T_{dF} := \frac{0.21}{13.5} \cdot \left(\frac{|I_{CC3FA1}|}{I_{51}} - 1 \right) \quad T_{dF} = 0.487 \text{ seg}$$

Corrientes de cortocircuito F-Tierra :

$$I_{CC_{FTmax}} := \frac{3 \cdot \left(\frac{U}{\sqrt{3}} \right)}{(X_{red} + X_{Td}) \cdot 2 + X_{To} + 3 \cdot R} \quad |I_{CC_{FTmax}}| = 0.903 \quad \text{kA}$$

$$I_{CC_{FTA1}} := \frac{3 \cdot \left(\frac{U}{\sqrt{3}} \right)}{(X_{red} + X_{Td} + Z_{Ld} \cdot 2) \cdot 2 + Z_{Lo} \cdot 2 + X_{To} + 3 \cdot R}$$

$$|I_{CC_{FTA1}}| = 0.541 \quad \text{kA}$$

$$I_{50N} := \frac{3 \cdot \left(\frac{U}{\sqrt{3}} \right)}{(X_{red} + X_{Td} + Z_{Ld} \cdot 2 \cdot 0.8) \cdot 2 + Z_{Lo} \cdot 2 \cdot 0.8 + X_{To} + 3 \cdot R}$$

$$|I_{50N}| = 0.588 \quad \text{kA}$$

Impongo 200 ms de margen fusible-interruptor, curva EI. De la curva del fusible, para 541 A, el fusible abre en 25 ms:

$$T_{dT} := \frac{0.2 + 0.025}{80} \cdot \left(\left(\frac{|I_{CC_{FTA1}}|}{I_{51N} \cdot 0.001} \right)^2 - 1 \right) \quad T_{dT} = 5.147 \quad \text{seg}$$

$$I_{CC_{FTB1min}} := \frac{3 \cdot \left(\frac{U}{\sqrt{3}} \right)}{(X_{red} + X_{Td} + Z_{Ld} \cdot (2 + 2 + 1 + 2)) \cdot 2 + Z_{Lo} \cdot (2 + 2 + 1 + 2) + X_{To} + 3 \cdot (R + 40)}$$

$$|I_{CC_{FTB1min}}| = 0.068 \quad \text{kA}$$

Cálculo umbral de tensión relé sobretensión residual (59N):

$$U_{59N} := 3 \cdot R \cdot |I_{CC_{FTB1min}}| \quad U_{59N} = 0.818 \quad \text{kV}$$

Resumen:

$$|I_{50}| = 2.489 \quad \text{kA}$$

$$|I_{51}| = 0.064 \quad \text{kA}$$

$$|I_{50N}| = 0.588 \quad \text{kA}$$

$$|I_{51N}| = 12.65 \quad \text{A}$$

$$T_{dF} = 0.487 \quad \text{seg}$$

$$T_{dT} = 5.147 \quad \text{seg}$$

$$U_{59N} = 0.818 \quad \text{kV}$$

Corriente nominal Trafos:

$$I_n := \frac{125}{\sqrt{3} \cdot U} \quad I_n = 11.455 \quad \text{A} \quad I_{sal} := 4 \cdot I_n \quad I_{sal} = 45.821 \quad \text{A}$$

$$I_{inrush} := 12 \cdot I_n \quad I_{inrush} = 137.464 \quad \text{A} \quad t_{inrush} := 100 \quad \text{ms}$$

I_{2t} de Trafo:

$$5 \cdot I_n = 57.277 \quad \text{A} \quad \text{para } t = 50 \text{ seg}$$

$$25 \cdot I_n = 286.384 \quad \text{A} \quad \text{para } t = 2 \text{ seg}$$

Verificación fusible:

$$I_{fus} := 15 \quad \text{A}$$

$$I_{3fus} := 4 \cdot I_{fus} \quad I_{3fus} = 60 \quad \text{A}$$

$$|I_{CC_{FTB1min}}| = 0.068 \quad \text{kA}$$

$$T_{59Nmin} := 80 \cdot \frac{T_{dT}}{\left(\frac{|I_{CC_{FTB1min}}|}{I_{51N} \cdot 0.001}\right)^2 - 1} \quad T_{59Nmin} = 14.687 \quad \text{seg}$$

$$T_{59N} := T_{59Nmin} + 0.2 \quad T_{59N} = 14.887$$

Elección del descargador Ur= 6 kV, con tiempo de actuación 13 seg (ktov=1.06)

$$U_{soport} := 1.06 \cdot 6 \quad U_{soport} = 6.36 \quad \text{menor que } 7,2 \text{ kV, no sirve}$$

$$60 \cdot 0.7 = 42 \quad \text{kV, mayor residual admisible}$$

Elección del descargador Ur= 8 kV, con tiempo de actuación 13 seg (ktov=1.06)

$$U_{soport2} := 1.06 \cdot 8 \quad U_{soport2} = 8.48 \quad \text{mayor que } 7,2 \text{ kV, sirve}$$

$$60 \cdot 0.7 = 42 \quad \text{kV, mayor residual admisible}$$