Example: Calculate the single-phase short-circuit current in the network location highlighted below. Component parameters are as follows.

G: $x_d''^{(1)} = 40$ %, $x_d''^{(2)} = 20$ %, $x_d''^{(0)} = 10$%, $U_n = 15$ kV, $S_n = 200$ MVA;

T1: $u_k = 10$ %, $U_n = 15$ kV, $S_n = 500$ MVA, p = 15/400 kV; V1: X = 0.4 Ω/km, $\ell = 200$ km;

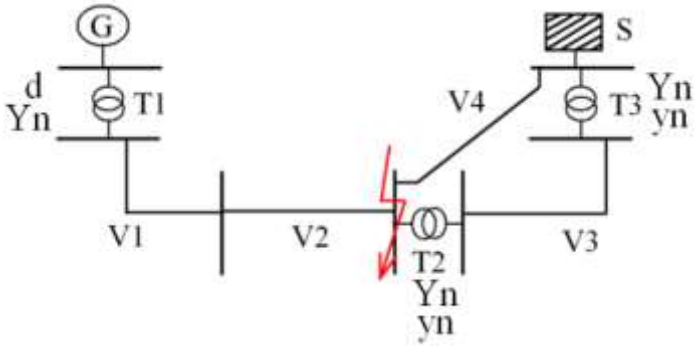
V2: X = 0.35 Ω/km, $\ell = 400$ km; T2: $u_k = 12$ %, $U_n = 400$ kV, $S_n = 250$ MVA, p = 400/220 kV;

V3: X = 0.4 Ω/km, $\ell = 150$ km; V4: X = 0.4 Ω/km, $\ell = 200$ km;

T3: $u_k = 10$ %, $U_n = 400$ kV, $S_n = 500$ MVA, p = 400/220 kV;

S: $c_{max} = 1.05$, $U_n = 400$ kV, $I_{k3f}'' = 40$ kA, $X_{s0} = 3X_{s1}$.

For all power lines is $X_0 = 3X_1$. Note: Neglect all resistances (real part of impedances) in the network. Power sources are symmetrical.



Calculation:

$$X_G^{(1,2,0)} = \frac{x_d^{''(1,2)}}{100}\frac{U_n^2}{S_n}\frac{1}{(15/400)^2} = 320\,\Omega\,(160\,\Omega, \times)$$

$$X_T^{(1,2,0)} = \frac{u_k}{100}\frac{U_{nT}^2}{S_{nT}}\frac{1}{(15/400)^2} = 32\,\Omega$$

$$X_{V1}^{(1,2,0)} = X_{V1}l_{V1} = 80\,\Omega\,(80\,\Omega, 240\,\Omega)$$

$$X_{V2}^{(1,2,0)} = X_{V2}l_{V2} = 140\,\Omega\,(140\,\Omega, 420\,\Omega)$$

$$X_{V4}^{(1,2,0)} = X_{V4}l_{V4} = 80\,\Omega\,(80\,\Omega, 240\,\Omega)$$

$$X_S^{(1,2,0)} = \frac{cU_n}{\sqrt{3}I_k''} = 6.06218\,\Omega\,(6.06218\,\Omega, 18.18653\,\Omega)$$

$$X_{T2}^{(1,2,0)} = \frac{u_k}{100}\frac{U_{nT}^2}{S_{nT}}\frac{1}{(220/400)^2} = 76.8\,\Omega$$

$$X_{V3}^{(1,2,0)} = X_{V3}l_{V3}\frac{1}{(220/400)^2} = 198.3471\,\Omega\,(198.3471\,\Omega, 595.0413\,\Omega)$$

$$X_{T3}^{(1,2,0)} = \frac{u_k}{100}\frac{U_{nT}^2}{S_{nT}}\frac{1}{(220/400)^2} = 32\,\Omega$$

Total short-circuit sequence impedances in fault location:

$$X_k^{(1)} = 61.99502\ \Omega, \quad X_k^{(2)} = 59.49102\ \Omega, \quad X_k^{(0)} = 153.44185\ \Omega$$

Final value of single-phase short-circuit current:

$$I_{k1f}^{"} = \frac{\sqrt{3}cU_n}{X_k^{(1)} + X_k^{(2)} + X_k^{(0)}} = 2646\,\mathrm{A}$$