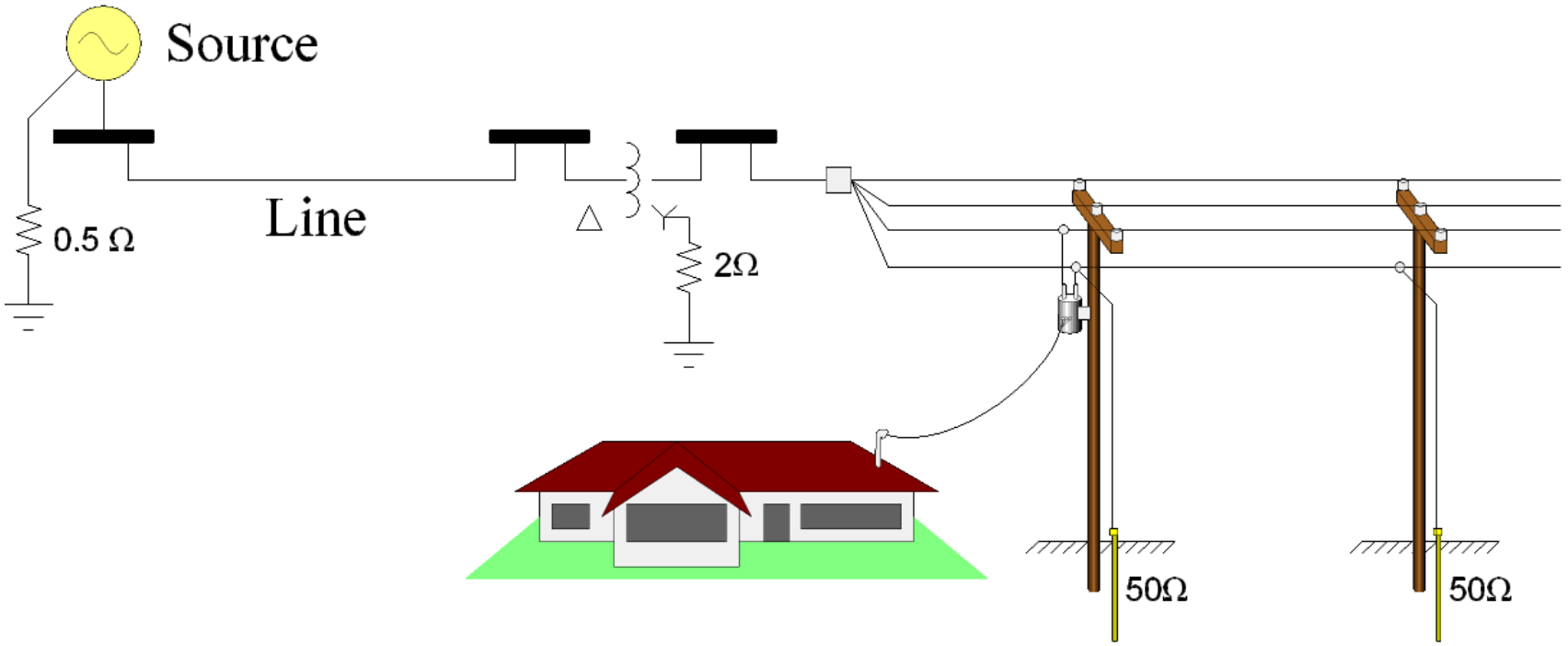
Example: GPR Calculations



Source:

$Z_1 = Z_2$ = j9.8 Ohms
Z_0 = j6.6 Ohms
Z_g = 0.5 Ohms

115 kV Line:

$Z_1 = Z_2$ = 0.306 + j0.7362 Ohms/Mile
Z_0 = 0.5285 + j2.99 Ohms/Mile
115 kV Line Length: 23.5 miles

Example
GPR Calculations

Distribution Line Model

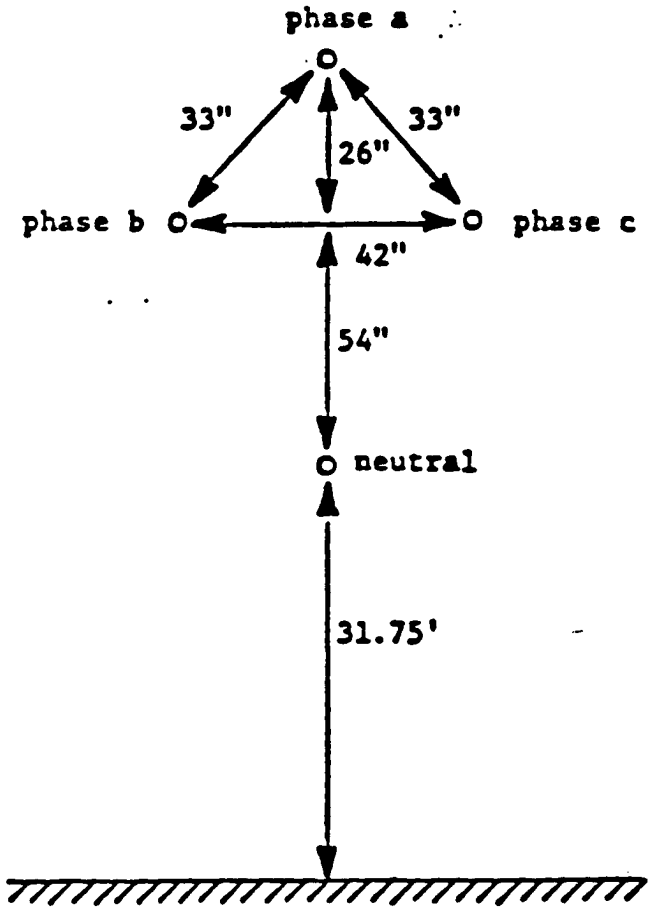
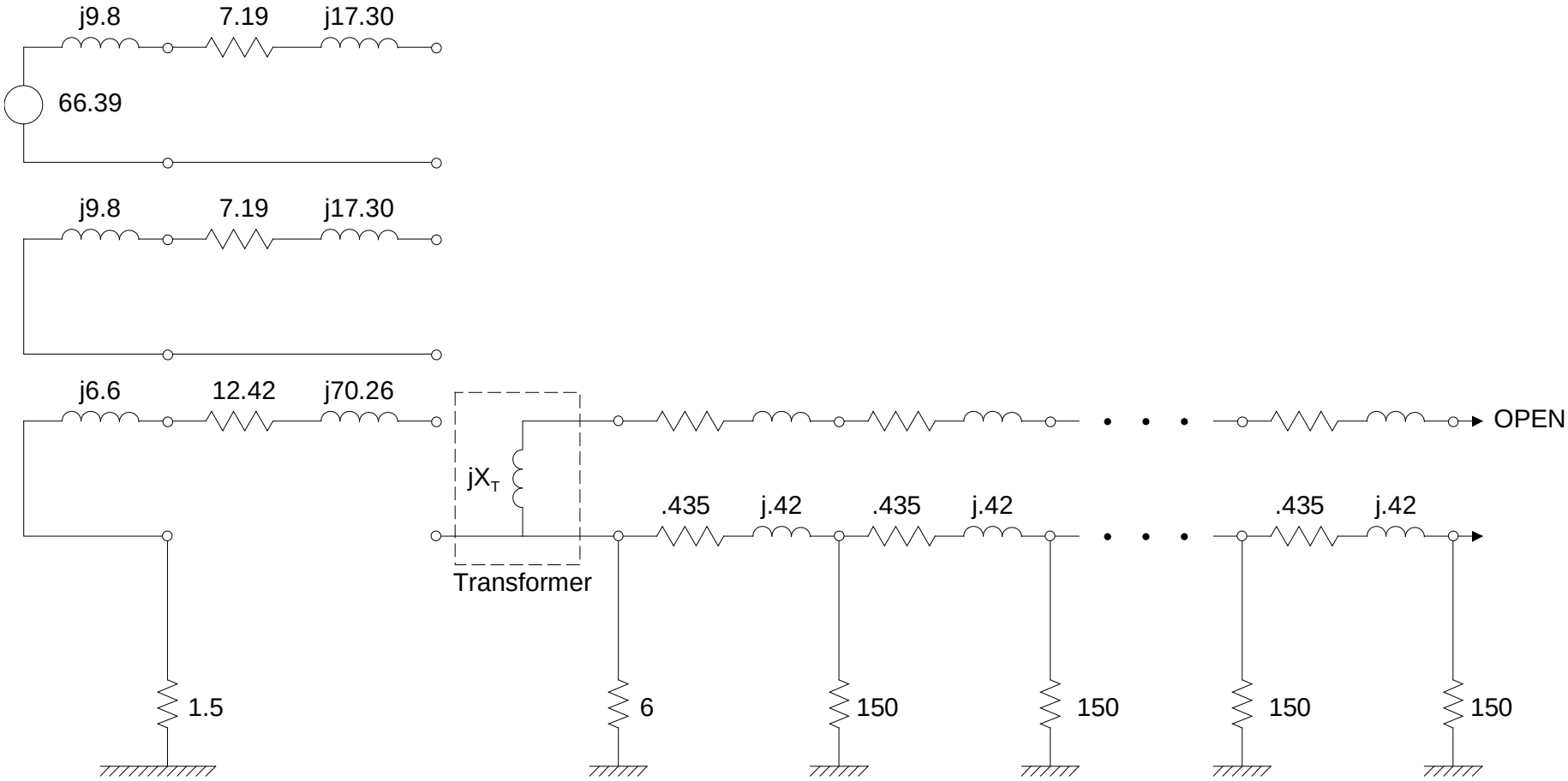


Figure Design of a 12 kV Distribution Line With a Neutral Conductor

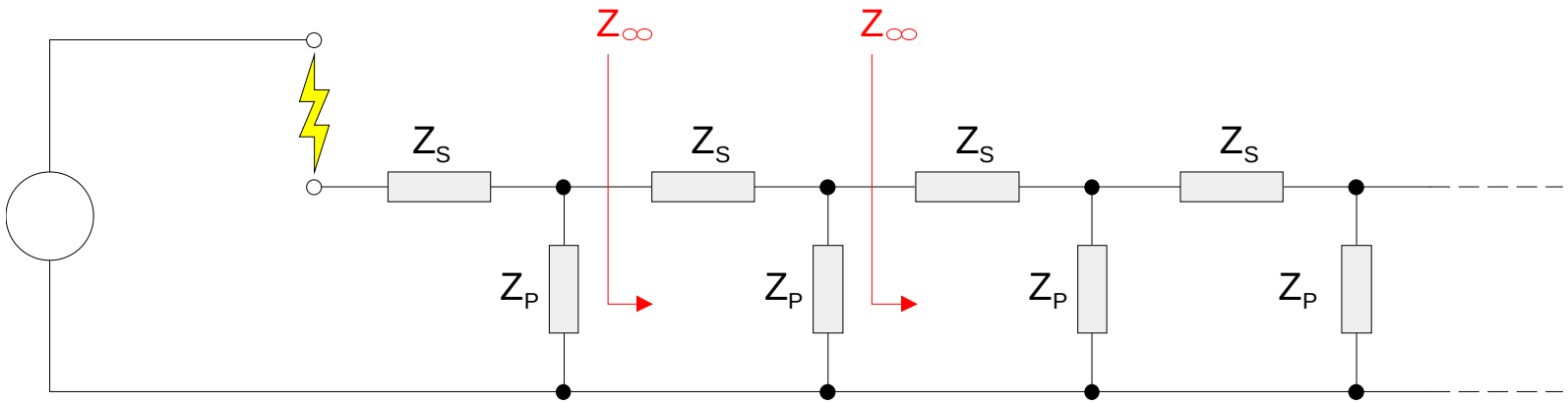
Data: Phase Conductor : 1/0 A
Neutral Conductor : #2 A

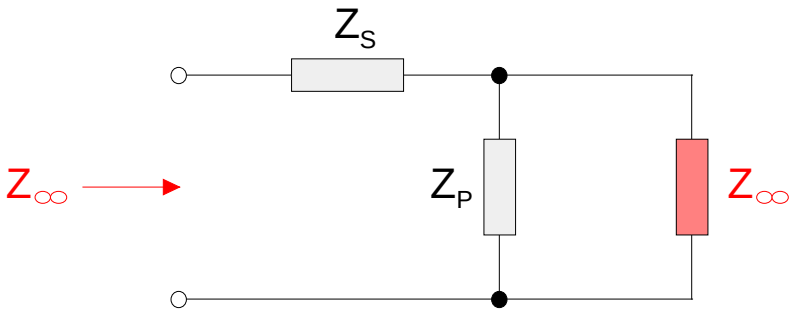
Example: GPR Calculations

Sequence Networks



Network Reductions





$$Z_\infty = \frac{Z_S}{2} + \sqrt{\left(\frac{Z_S}{2}\right)^2 + Z_S Z_P}$$

Computation of GPR and Transfer Voltage

$$Z_S = 3\left[r_n + r_e + j(0.00466)(60)\log\left(\frac{D_e}{d_n}\right)\right]\ell_{span}$$

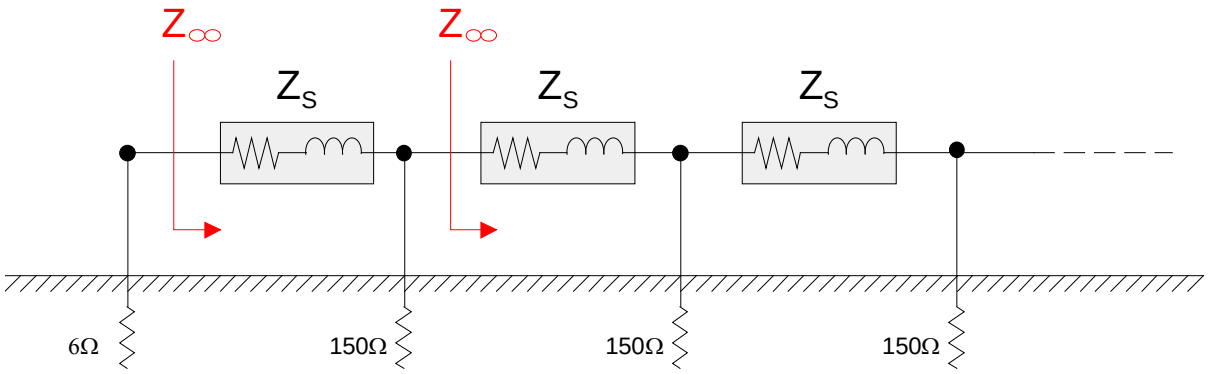
$$r_n = 1.65\Omega / mile$$

$$r_e = 0.0954\Omega / mile$$

$$D_e = 5380\ feet$$

$$d_n = 0.00504\ feet$$

$$\ell_{span} = 0.0833\ miles$$ (12 spans per mile)

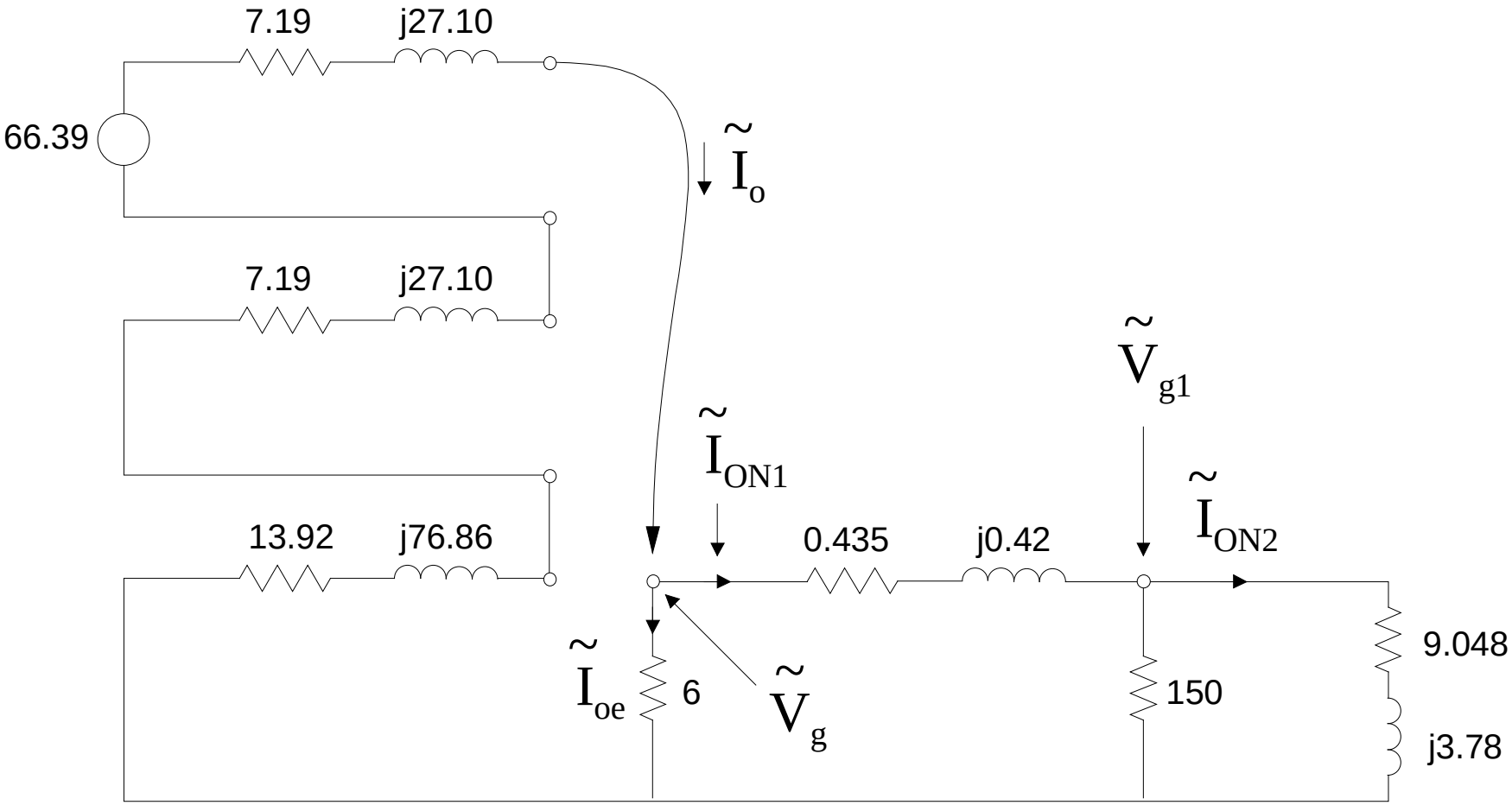


$$Z_s = 0.435 + j0.42\ ohms$$

$$Z_\infty = \frac{Z_S}{2} + \sqrt{\left(\frac{Z_S}{2}\right)^2 + Z_S Z_T}$$

$$Z_\infty = 9.048 + j3.78\ ohms$$

Computation of GPR and Transfer Voltage



$$\tilde{I}_0 = 0.49e^{-j76.32^0}\,kA \qquad \tilde{V}_g = 1.858e^{-j67.75^0}\,kV \qquad \tilde{I}_{ON2} = 0.179e^{-91.79^0}\,kA$$

$$\tilde{I}_{oe} = 0.31e^{-j67.75^0}\,kA \qquad \tilde{I}_{ON1} = 0.1894e^{-90.42^0}\,kA \qquad \tilde{V}_{g1} = 1.752e^{-j69.11^0}\,kV$$