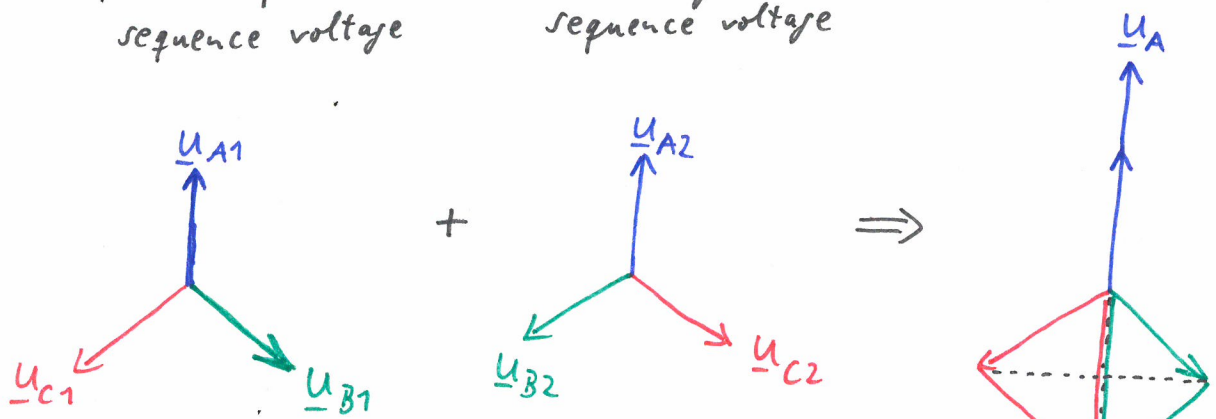
Behaviour of a balanced load with YN-E connection during presence of a negative sequence voltage

Assumption:

100% positive sequence voltage

100% negative sequence voltage



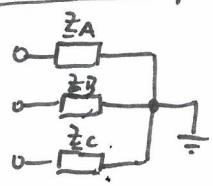
$\underline{U}_A = 2 \cdot \underline{U}_{A1}$

$\underline{U}_B = -\underline{U}_{A1}$

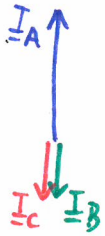
$\underline{U}_C = -\underline{U}_{A1}$

Why does a balanced load with constant power generate a zero sequence current flow if this voltage is applied?

Load with constant impedance



Assumption: $\underline{Z}_A = \underline{Z}_B = \underline{Z}_C = R$



$$\Rightarrow \underline{I}_A = \frac{\underline{U}_A}{\underline{Z}_A} = \frac{2 \cdot \underline{U}_{A1}}{R} = 2 \cdot \underline{I}_{A1}$$

$$\underline{I}_B = \frac{\underline{U}_B}{\underline{Z}_B} = \frac{-\underline{U}_{A1}}{R} = -\underline{I}_{A1}$$

$$\underline{I}_C = \frac{\underline{U}_C}{\underline{Z}_C} = \frac{-\underline{U}_{A1}}{R} = -\underline{I}_{A1}$$

$$\Rightarrow 3 \cdot \underline{I}_0 = \underline{I}_A + \underline{I}_B + \underline{I}_C = (2 - 1 - 1)\underline{I}_{A1} = 0$$

Load with constant power

Assumption: $\underline{S}_A = P_A$

$\underline{S}_B = P_B = P_A$

$\underline{S}_C = P_C = P_A$

$$\Rightarrow \underline{I}_A = \left(\frac{\underline{S}_A}{\underline{U}_A}\right)^* = \left(\frac{P_A}{2 \cdot \underline{U}_{A1}}\right)^* = \frac{1}{2} \cdot \underline{I}_{A1}$$

$$\underline{I}_B = \left(\frac{\underline{S}_B}{\underline{U}_B}\right)^* = \left(\frac{P_A}{-\underline{U}_{A1}}\right)^* = -\underline{I}_{A1}$$

$$\underline{I}_C = \left(\frac{\underline{S}_C}{\underline{U}_C}\right)^* = \left(\frac{P_A}{-\underline{U}_{A1}}\right)^* = -\underline{I}_{A1}$$

$$\Rightarrow 3 \cdot \underline{I}_0 = \underline{I}_A + \underline{I}_B + \underline{I}_C = \left(\frac{1}{2} - 1 - 1\right)\underline{I}_{A1} = -1{,}5\,\underline{I}_{A1}$$