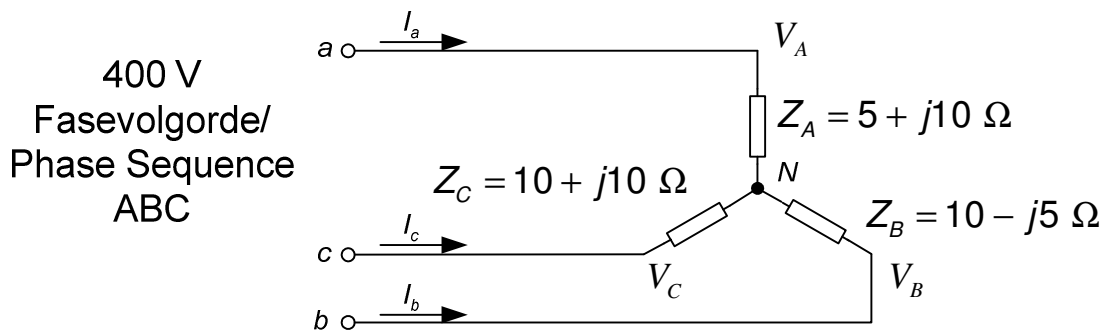


## Ongebalanseerde 3 – fase stelsels



Vir die baan hierbo getoon, bepaal:

- Die las-neutraalspanning  $V_N$ .
- Die lynstrome.
- Die drywing in elke fase van die las verkwis, sowel as die totale las-drywing.
- Die drywing deur elke fase van die bron gelewer, sowel as die totale bron-drywing. Aanvaar die bron-generators is in ster gekoppel.

a) Neutraalspanning

$$V_p = \frac{V_{lyn}}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 230,9 \text{ V}$$

$$I_a + I_b + I_c = 0$$

$$\frac{V_A - V_N}{Z_A} + \frac{V_B - V_N}{Z_B} + \frac{V_C - V_N}{Z_C} = 0$$

$$V_N = \frac{\frac{V_A}{Z_A} + \frac{V_B}{Z_B} + \frac{V_C}{Z_C}}{\frac{1}{Z_A} + \frac{1}{Z_B} + \frac{1}{Z_C}}$$

met  $V_A = 230,9 \angle 0^\circ$ ,  $V_B = 230,9 \angle -120^\circ$  en  $V_C = 230,9 \angle +120^\circ$  V

$$\begin{aligned} V_N &= \frac{\frac{230,9 \angle 0^\circ}{5 + j10} + \frac{230,9 \angle -120^\circ}{10 - j5} + \frac{230,9 \angle +120^\circ}{10 + j10}}{\frac{1}{5 + j10} + \frac{1}{10 - j5} + \frac{1}{10 + j10}} \\ &= \frac{20,652 \angle -63,435^\circ + 20,652 \angle -93,435^\circ + 16,327 \angle 75,00^\circ}{0,192 \angle -27,897^\circ} \\ &= \frac{26,33 \angle -62,33^\circ}{0,192 \angle -27,897^\circ} \\ &= 136,88 \angle -34,43^\circ \text{ V} \end{aligned}$$

b) Lynstrome

$$\begin{aligned} I_A &= \frac{V_{AN}}{Z_A} = \frac{V_A - V_N}{Z_A} = \frac{230,9 \angle 0^\circ - 136,88 \angle -34,43^\circ}{5 + j10} \\ &= \frac{141,16 \angle 33,26^\circ}{11,18 \angle 63,43^\circ} \\ &= 12,63 \angle -30,18^\circ \text{ A} \\ I_B &= \frac{V_{BN}}{Z_B} = \frac{V_B - V_N}{Z_B} = \frac{230,9 \angle -120^\circ - 136,88 \angle -34,43^\circ}{10 - j5} \\ &= \frac{254,20 \angle -151,77^\circ}{11,18 \angle -26,565^\circ} \\ &= 23,183 \angle -125,21^\circ \text{ A} \end{aligned}$$

$$\begin{aligned}
 I_C &= \frac{V_{CN}}{Z_C} = \frac{V_C - V_N}{Z_C} = \frac{230,9 \angle +120^\circ - 136,88 \angle -34,43^\circ}{10 + j10} \\
 &= \frac{354,32 \angle 129,46^\circ}{14,142 \angle 45,00^\circ} \\
 &= 25,408 \angle 84,46^\circ \text{ A}
 \end{aligned}$$

c) Las-drywings

$$\begin{aligned}
 S_A &= P_A + jQ_A = V_{AN} \cdot I_A^* \\
 &= 141,16 \angle 33,26^\circ \cdot 12,625 \angle +30,18^\circ \\
 &= 796,9 + j1594,1 \text{ VA}
 \end{aligned}$$

$$S_B = V_{BN} \cdot I_B^* = 5374,6 - j2687,3 \text{ VA}$$

$$S_C = V_{CN} \cdot I_C^* = 6455,4 + j6466,4 \text{ VA}$$

c) Bron-drywings

$$S_{las} = S_A + S_B + S_C = 12,63 + j5,36 \text{ kVA}$$

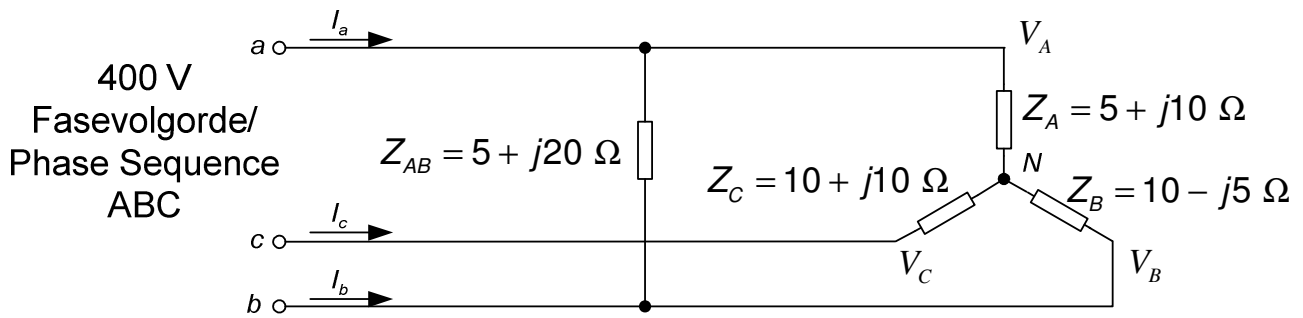
$$S_a = V_{an} \cdot I_a^* = 2520,53 + j1465,72 \text{ VA}$$

$$S_b = V_{bn} \cdot I_b^* = 5331,82 + j485,95 \text{ VA}$$

$$S_c = V_{cn} \cdot I_c^* = 4774,68 + j3410,49 \text{ VA}$$

$$\begin{aligned}
 S_{bron} &= S_a + S_b + S_c = 12,63 + j5,36 \text{ kVA} \\
 &\equiv S_{las}
 \end{aligned}$$

## Ongebalanseerde las – tweede voorbeeld



Die probleem bly presies dieselfde vir die ster-las gedeelte – al wat bykom is die stroom en drywing deur  $Z_{AB}$ .

$$I_{AB} = \frac{V_{AB}}{Z_{AB}} = \frac{400 \angle 30^\circ}{20,6155 \angle 75,964^\circ} = 19,4 \angle -45,96^\circ \text{ A}$$

$$\begin{aligned} I_a &= I_{AB} + I_A \\ &= 19,4 \angle -45,96^\circ + 12,625 \angle -30,18^\circ \\ &= 31,74 \angle -39,75^\circ \text{ A} \end{aligned}$$

Net so

$$\begin{aligned} I_b &= I_B - I_{AB} \\ &= 27,314 \angle -169,47^\circ \text{ A} \end{aligned}$$

$$\begin{aligned} S'_{las} &= S_{las} + S_{AB} \\ &= S_{las} + V_{AB} \cdot I_{AB}^* \\ &= 12627.027 + j5362.162 + 1882.353 + j7529.412 \\ &= 14509.380 + j12891.574 \text{ VA} \end{aligned}$$

$$\begin{aligned} S'_{bron} &= V_a \cdot I_a^* + V_b \cdot I_b^* + V_c \cdot I_c^* \\ &= 5635.257 + 14687.042 + 4099.441 + j4794.045 + 4774.682 + j3410.487 \\ &= 14509.380 + j12891.574 \text{ VA} \end{aligned}$$