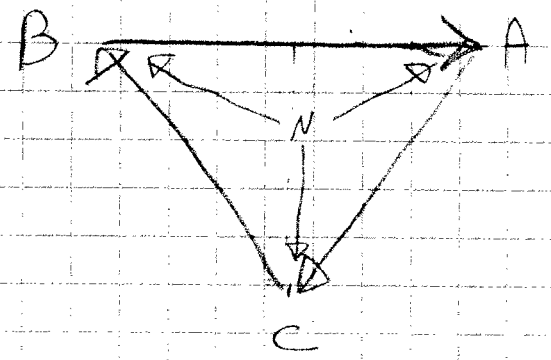
Let $V_{AN} = 1 \angle 30^\circ$

$V_{BN} = 1 \angle 150^\circ$

$V_{CN} = 1 \angle 270^\circ$

(1)

Converting To Phase To Phase



$V_{AB} = \sqrt{3} \angle 0^\circ$

$V_{BC} = \sqrt{3} \angle 120^\circ$

$V_{CA} = \sqrt{3} \angle 240^\circ$

$V_{CB} = -V_{BC} = 1 \angle (120 - 180) = 1 \angle -60^\circ$

$I_a = 1 \angle \theta + 30^\circ$

$I_b = 1 \angle \theta + 150^\circ$

$I_c = 1 \angle \theta + 270^\circ$

where $\theta = \cos^{-1}(pf)$

Now Connect a 2 element meter where

$$S_1 = V_{AB} I_A^* = (\sqrt{3} \angle 0^\circ)(1 \angle -\theta - 30^\circ)$$

$$S_2 = V_{CB} I_C^* = (\sqrt{3} \angle -60^\circ)(1 \angle -\theta - 270^\circ)$$

$$Re\{S_1\} = \sqrt{3} \cos(-\theta - 30^\circ)$$

$$Re\{S_2\} = \sqrt{3} \cos(-\theta + 30^\circ)$$

Let $\theta = 0$

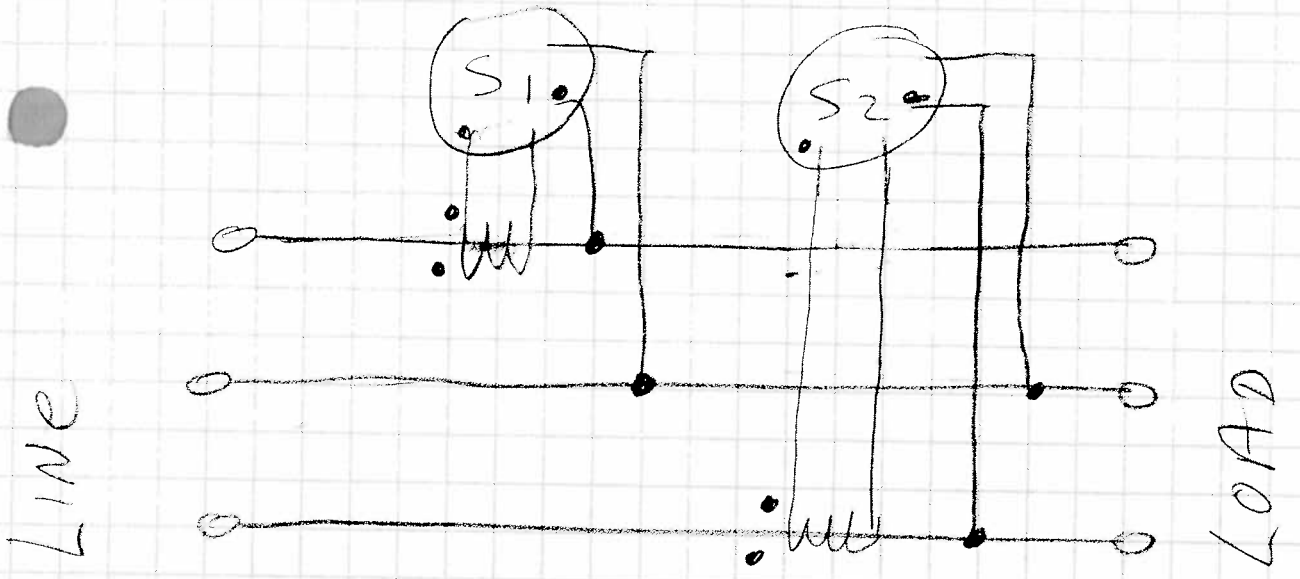
$$Re\{S_1\} = \sqrt{3} \cdot \frac{\sqrt{3}}{2} = \frac{3}{2}$$

$$Re\{S_2\} = \sqrt{3} \cdot \frac{\sqrt{3}}{2} = \frac{3}{2}$$

$$Re\{S\} = P = Re\{S_1\} + Re\{S_2\} = \frac{3}{2} + \frac{3}{2} = \boxed{3}$$

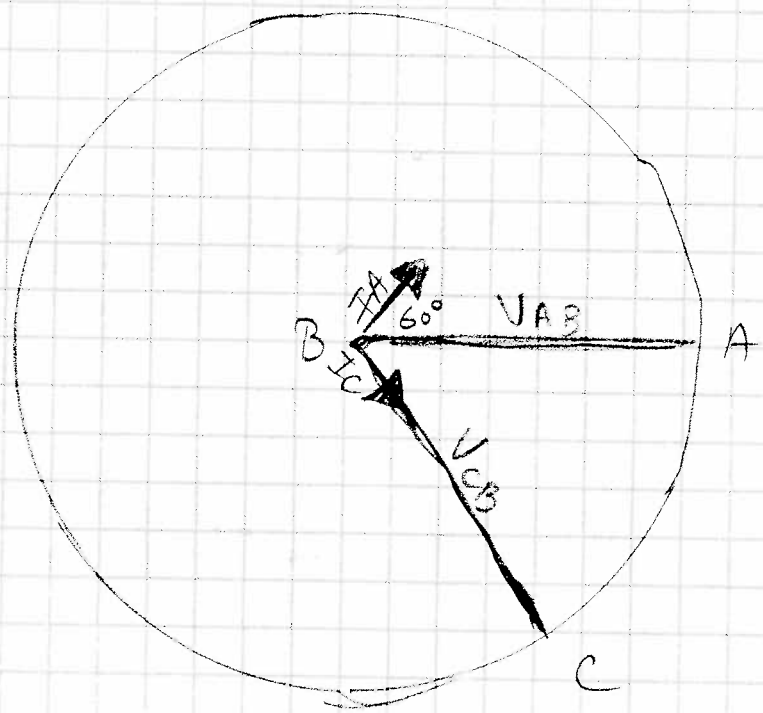
$$P = V_{aN} I_a^* + V_{bN} I_b + V_{cN} I_c = 1 + 1 + 1 = \boxed{3}$$

Proves a 3ϕ, 3 wire System only Requires 2 Elements.

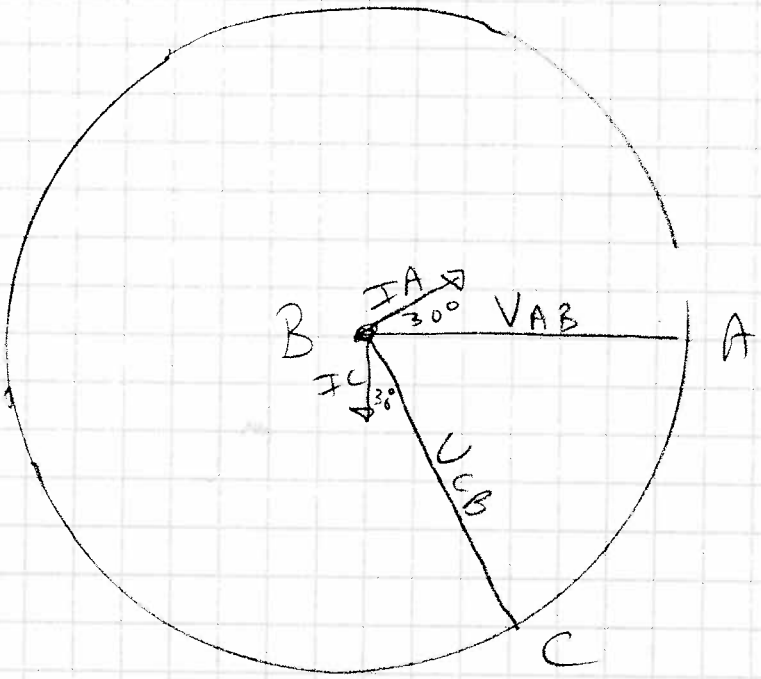


Element Wiring

Phasor for 30° Leading Pf



Phasor for Unity p.f.



Phasor for 30° Lagging Pf