1

$V_a^{cos}(\omega t+\theta) = \cancel{V_a \cos\omega t \cos\theta - V_a \sin\omega t \sin\theta}$

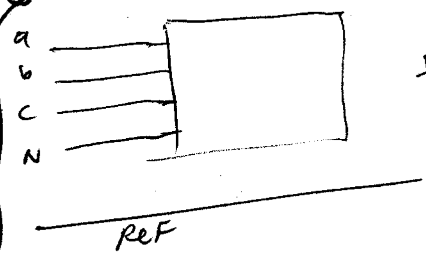
$V_b^{v}(\omega t+\theta-120^\circ) = V\cos(\omega t+\theta)\cos(-120) + V\sin(\omega t+\theta)\sin(-120)$

$V_c^{v}(\omega t+\theta+120^\circ) = V\cos(\omega t+\theta)\cos(120) + V\sin(\omega t+\theta)\sin(120)$

$$\Sigma = V\cos(\omega t+\theta)\underbrace{\left[1+\cos(-120)+\cos(120)\right]}_{1 \; -\frac{1}{2} \; -\frac{1}{2} \; =0} + V\sin(\omega t+\theta)\underbrace{\left[\sin(-120)+\sin(120)\right]}_{-\frac{\sqrt{3}}{2}+\frac{\sqrt{3}}{2} \; =0}$$

Balanced 3ϕ set $\Sigma = 0$

2



$p(t) = v_{aR}(t)\, i_a(t) + v_{bR}(t)\, i_b(t) + v_{cR}(t)\, i_c(t) + v_{NR}\, i_N(t)$

$i_N(t) = -i_a - i_b - i_c$

$p(t) = (v_{aR}-v_{NR})\, i_a + (v_{bR}-v_{NR})\, i_b + (v_{cR}-v_{NR})\, i_c$

$(v_a - v_R) - (v_N - v_R)$

$= v_{aN}$

so $p(t) = v_{aN} i_a + v_{bN} i_b + v_{cN} i_c$

N wires,
(N-1) meters

3

$V_{aN}\cos(\omega t+\theta_a)\, I_a\cos(\omega t+\phi_a)$

$V_{aN} I_a \left[\dfrac{\cos(\omega t+\theta_a-\omega t-\phi_a)+\cos(2\omega t+\theta_a+\phi_a)}{2}\right] + \cdots$

$\dfrac{V_{aN} I_a}{2}\left[\cos(\theta_a-\phi_a) + \cos(2\omega t+\theta_a+\phi_a)\right]$

$\dfrac{V_{bN} I_b}{2}\left[\cos(\theta_a-\phi_a) + \cos(2\omega t+\theta_a+\phi_a-240^\circ)\right]$ -120

$+\dfrac{V_{cN} I_c}{2}\left[\quad + (\quad -240)\right]$ $+120$

~~pulsating~~ double freq cancel out

~~N wires, (N-1) meters.~~

Balanced 3ϕ, $p(t) = $ Const.

3 Important Concepts in Polyphase Systems