

BRI GGS FRANCO SOIBI

17/ENG04/015

ELECT/ELECT

$$S = 25 \text{ kVA} \quad V_L = 415 \text{ V}, \quad 3-\phi, \quad 4\text{-pole}$$

$$f = 60 \text{ Hz} \quad X_2 = 1.5 \Omega \quad R_2 = 0 \quad \cos \theta, \text{ pf} = 0.8 \text{ lag}$$

a)

$$E_a = V_p + jX_2 I_a + R_2 I_a \Rightarrow V_p + jX_2 I_a$$

$$\cos \theta = 0.8$$

$$\theta = 36.87^\circ$$

$$V_L = 415 \rightarrow V_p = 415 / \sqrt{3} = 239.6 \angle 0^\circ$$

$$I_a = \frac{S}{\sqrt{3} \times V_L} = \frac{25 \times 10^3}{\sqrt{3} \times 415} = 34.78 \angle -36.87^\circ$$

$$\begin{aligned} E_a &= V_p + jX_2 I_a \Rightarrow 239.6 \angle 0^\circ + 1.5 \angle 90^\circ \times 34.78 \angle -36.87^\circ \\ &= 270.9 + j4.74 \text{ V} \\ &= 274.1 \angle 8.74^\circ \end{aligned}$$

b)

$$I_a = \frac{E_a}{jX_2} = \frac{E_a}{1.5} = 1.2 \times E_a = 1.2 \times 274.1 = 328.92$$

$$E_1 \sin S_1 = E_2 \sin S_2$$

$$\sin S_2 = \frac{E_1 \sin S_1}{E_2} = \frac{241.1 \sin 8.76^\circ}{228.92}$$

$$\sin S_2 = 0.127 \quad S_2 = 7.47^\circ$$

$$I_a = \frac{328.92 \angle 7.47^\circ - 239.6 \angle 0^\circ}{1.5 \angle 90^\circ}$$

$$I_a = 64.35 \angle 63.71^\circ$$

$$pf = \cos \theta$$

$$= \cos (-63.7)$$

0.4 lagging

$$(ii) Q = \sqrt{3} \times V_L \times I_L \times \sin \theta = \sqrt{3} \times 415 \times 64.35 \times \sin 63.7$$

$$= 41466.85 \approx 41.5 \text{ KVAR}$$

c)

$$(i) I_A = I_{A_2} - V$$

$jX_2$

since it's using the same condition

$$274.1 \angle 90^\circ - 239.6 \angle 0$$

$$1.5 \angle 90$$

$$= 164.73 + j 159.73$$

$$= I_{A_2} = 229.46 \angle 44.12$$

$$(ii) pf = \cos \theta$$

$$= \cos (44.12) = 0.7 \text{ leading}$$

$$(iii) Q = I_3 \times V_L \times I_L \times \sin \theta$$

$$\sqrt{3} \times 415 \times 229.46 \times \sin 44.12$$

$$= 114822.40$$

$$11.5 \text{ KVAR}$$