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EEE 326 Assignment II

Solution

$S = 25KVA \quad V = 415V_q \ 3-\phi, \ 4pole \ f = 60Hz, \ x_2 = 1.5$
$R_2 = 0$

(a) E_a:

$E_a = V_p + jx_2 I_a + R_2 I_a$
$= V_p + jx_2 I_a$
$\cos\theta = 0.8$
$\therefore \quad \theta = 36.87$
$V_R = 415 \longrightarrow V_p = \frac{415}{\sqrt{3}} \quad 239.6 \angle 0$

$I_A = \frac{S}{\sqrt{3} \times V_L} = \frac{25 \times 10^3}{\sqrt{3} \times 415} = 34.78$

$\triangleq 34.78 \angle -36.87$

$E_a = V_p + j x_2 I_A$
$E_a = 239.6 \angle 0 + 1.5 \angle 90^\circ \times 34.78 \angle -36.87$
$= 270.9 + j 41.74$
$\sim 274.1 \angle 8.76V$

b) if increased 20%, find I_A, P.F & Q

(i) I_A

$I_a = \frac{E_a - V}{jx_2}$

$I_A = \frac{E_{a2} - V_L}{jx_2}$

$E_{a2} = 1.2 \times E_a = 1.2 \times 274.1$
$= 328.92$

$E_1 \sin\delta_1 = E_2 \sin\delta_2$

$\rightarrow \sin S_2 = \frac{E_1 \sin S_1}{E_2}$

$= \frac{274.1 \sin 8.76}{328.92}$

$\sin S_2 = 0.127$

$S_2 = 7.47$

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

$= 28.51 - j57.69$

$I_A \approx 64.35 - 63.7A$

ii) $P.F = \cos\theta$

$= \cos(-63.7)$

$= 0.4$ lagging

iii) $Q = \sqrt{3} \times V_L \times I_L \times \sin\theta$

$\sqrt{3} \times 4.5 \times 64.35 \times \sin 63.7$

$= 41466.85$

≈ 41.5 KVAR

c) $I_{A3} = \frac{E_{a3} - 0}{I X_L}$

Since its using the same condition as in (a)

$= \frac{274.1 \angle 90^\circ - 239.6 \angle 0}{1.5 \angle 90}$

$= 164.13 + j159.73$

$I_{A3} = 229.46 \angle 44.12$

ii) $PF = \cos\theta$

$= \cos(44.12) = 0.7$ leading

(ii) $\sqrt{3} \times V_L \times I_L \times \sin\theta$

$\sqrt{3} \times 415 \times 229.61 \times \sin 44.12$

$= 11482.48$

≈ 11.5 KVAR