Modilim Tochukwu Adrian
17/Eng04/041
Electrical/Electronics Engineering
EEE 326 assn

A 25kVA, 415V 3 phase 4 pole, 60Hz Wye connected synchronous reactance of 1.5Ω/phase

a) Determine excitation voltage when delivering kVA at 0.8pf
b) Ip increased by 20% w/o changing power and Ir and Q
c) What is steady state unit. Determine stator current

Solution

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

$n = 4$

$f = 60\ Hz$

$pf = 0.8 \text{ (lagging)} \therefore \cos\theta = 0.8 \Rightarrow \theta = 36.87$

a) $E_a = V_f + jX_s I_a + R_a I_a$

$= V_f + jX_s I_a$

$= \theta : 36.87$

$V_L = 415 \qquad V_f = \frac{415}{\sqrt{3}}$

$= 239.6 \angle 0$

17/Eng04/041

$I_a = \frac{S_c}{\sqrt{3} \times V_L} = \frac{25 \times 10^3}{\sqrt{3} \times 415}$

$= 34.78 \angle 36.87$

$E_s = V_p + jX_2 I_a$

$= 239.6 \angle 0 + 1.5 \angle 90 \times 34.78 \angle 36.87$

$= 270.3 + j41.74$

$\Rightarrow 473.51 \angle 8.7\ V$

b) $I_a = \frac{E_a - V}{jX_2}$ $\quad I_A = \frac{E_{a1} - V_1}{jX_2}$

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

$\sin\delta_2 = \frac{279 \sin 8.7^\circ}{628.20}$

$\sin\delta_2 = 0.127$

$\delta_2 = \sin^{-1} 0.127 \Rightarrow 7.41$

$I_A = \frac{328.2 \angle \delta_2 - 239.6 \angle 0^\circ}{1.5 \angle 90^\circ}$

$= \frac{328.2 \angle 7.41 - 239.6 \angle 0^\circ}{1.5 \angle 90^\circ}$

$= 2.844 - j57.21$

$= 63.90 \angle -65.6^\circ A$

17/Eng04/041

ii) $pf = \cos\theta \quad (\cos(-63.6))$

$= 0.4$ lagging

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

$\sqrt{3} \times 415 \times 63.90 \times \sin 63.6$

$= 414$ KVAR

c) $I_A = \frac{E_{A3} - V}{jX_2}$

n.3 = same conditions in a)

$= \frac{273.91 \angle 90 - 239.6 \angle 0}{1.5 \angle 90}$

$= 182.34 + j159.73$

$I_{A3} = 242.4 \angle 41.21$ A

i) $pf = \cos(41.21)$

$= +0.75$

Since it positive it is leading

$Q_L = \sqrt{3} \times V_L \times I_L \times \sin\theta$

$\sqrt{3} \times 415 \times 242.4 \times \sin(41.21)$

$= 115$ KVAR