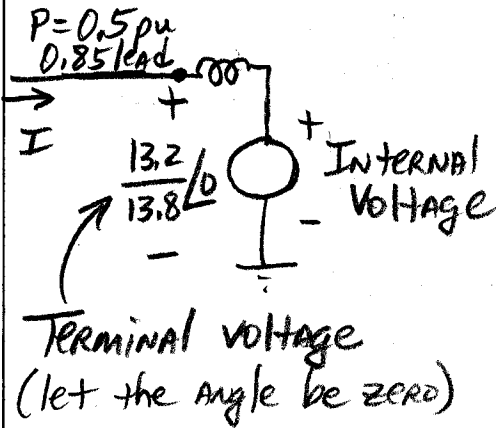


5.16

The conditions at the motor are (in pu)



$$VI^* = S = \frac{P}{\text{PF}} \angle \cos^{-1}(\text{PF}) = 0.588 \text{ pu} \angle -31.8^\circ$$

0.85 leading

$$I = \frac{S^*}{V^*} = \frac{0.588 \angle +31.8}{\frac{13.2}{13.8} \angle 0}$$

leading current yields -Q

$$I = 0.615 \angle +31.8 \text{ (leading current)}$$

(a) Motor current, transmission line current, generator currents are ALL $0.615 \angle 31.8$!

To get Amps, use I_B for the desired section

Using KVL, we get generator terminal voltage

$$\tilde{V}_{\text{gen term}} = \tilde{V}_{\text{mot term}} + \tilde{I}(Z_{T1} + Z_{\text{line}} + Z_{T2})$$

$$= 0.957 \angle 0 + 0.615 \angle 31.8 \left[j0.1372 + 0.0315 + j0.1575 + j0.24 \right]$$

$$= 0.957 \angle 0 + 0.615 \angle 31.8 \left[0.0315 + j0.535 \right]$$

$$= 0.957 \angle 0 + (0.615 \angle 31.8)(0.536 \angle 86.6)$$

$$\tilde{V}_{\text{gen term}} = 0.957 + 0.330 \angle 118.4 = 0.957 - 0.157 + j0.290$$

$$\tilde{V}_{\text{gen term}} = 0.800 + j0.290 = 0.851 \angle 19.9^\circ$$

(b)

$$\text{For Motor, } I_B = \frac{S_{B14}}{V_{BLN}} = \frac{S_{B3\phi}/3}{V_{BLN}/\sqrt{3}} = \frac{S_{B3\phi}}{\sqrt{3} V_{BLN}} = \frac{30 \times 10^6}{\sqrt{3}(138000)} = 125.5 \text{ A}$$

$$\text{So, } \tilde{I}_{\text{MOT}} = (0.615)(125.5) \angle 31.8 = 77.2 \angle 31.8 \text{ A}$$

$$\text{For TRANS line, } I_B = \frac{30 \times 10^6}{\sqrt{3}(138000)} = 125.5 \text{ A}$$

$$\tilde{I}_{\text{trans line}} = 77.2 \angle 31.8 \text{ A}$$

$$\text{For generator, } I_B = \frac{30 \times 10^6}{\sqrt{3}(138000)} = 125.5 \text{ A}$$

$$\tilde{I}_{\text{gen}} = 77.2 \angle 31.8 \text{ A}$$

Generator
Terminals

$$\tilde{V}_{\text{gen term}} = (0.851)(13.8 \text{ kV}) \angle 19.9 = 11.7 \text{ kV} \angle 19.9^\circ$$

Sending End
TRANS line

$$\tilde{V}_{\text{send}} = (0.881)(138 \text{ kV}) \angle 14.3 = 121.6 \text{ kV} \angle 14.3^\circ$$

$$\text{Gen Power, } (0.512 - j0.108)(30) = 15.36 \text{ MW, } -3.24 \text{ MVAR}$$

Now, if you want to factor in γ Δ phase shifts you can, but that is a simple matter of adding and subtracting 30° to \tilde{V} and \tilde{I} angles according to ANSI. P & Q are unchanged