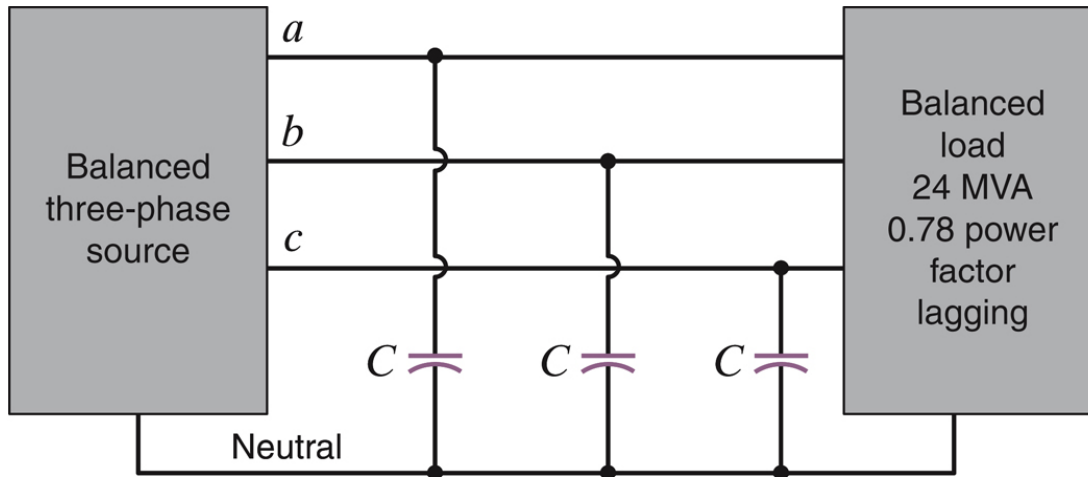


LEARNING EXAMPLE

$f = 60\text{Hz}$, $|V_{line}| = 34.5\text{kV rms}$. Required: $\text{pf} = 0.94$ leading



$$\left. \begin{aligned} P_{old} &= 18.72\text{MW} \\ \text{pf}_{new} &= 0.94 \text{ leading} \end{aligned} \right\} \Rightarrow Q_{new} = -6.8\text{MVA}$$

$$\Delta Q = -6.8 - 15.02 = -21.82\text{MVA}$$

$$Q_{\text{per capacitor}} = -7.273\text{MVA}$$

$$Y\text{-connection} \Rightarrow V_{\text{capacitor}} = \frac{34.5}{\sqrt{3}}\text{kV rms}$$

$$-7.273 \times 10^6 = -2\pi \times 60 \times C \times \left(\frac{34.5 \times 10^3}{\sqrt{3}} \right)^2$$

$$C = 48.6\mu\text{F}$$

$$S = P + jQ$$

$$P = |S| \cos \theta_f$$

$$Q = |S| \sin \theta_f$$

$$\text{pf} = \cos \theta_f$$

$$Q = P \tan \theta_f$$

$$\tan \theta_f = \frac{\text{pf}}{\sqrt{1 - \text{pf}^2}}$$

$$\text{lagging} \Rightarrow Q_{old} > 0$$

$$\text{pf} = \cos \theta_f \Rightarrow \sin \theta_f = \sqrt{1 - \text{pf}^2} = 0.626$$

$$|Q_{old}| = 15.02\text{MVA}$$

$$P_{old} = 18.72\text{MW}$$

