Suppose we are given the following situation:

\[ \text{Load: } 20 \text{ KVA} \]
\[ \text{pf. } 0.7 \text{ Lagging} \]

(a) Find the \( I_L \) with existing system.

Since apparent power is \( S = V \times I \text{Rms} \),

and \( S = 20,000 \text{ V} \cdot \text{A} \)

\[ \text{I}_{\text{Rms}} = \frac{20,000}{220} = 90.91 \text{ A} \]

It is required to place a capacitor in parallel with the load so that the power factor is changed to 0.97. Find the value of the capacitor and the new value of \( I_L \).
We have

\[ \cos \theta = 0.7 \]
\[ B = 46.6^\circ \]

\[ P = 20k \cos \theta = 20k \times 0.7 = 14kW \]
\[ P_{1/2} = 20k \times 0.156 = 14.2kW \text{ VAR} \]

We want

\[ \cos \theta_{new} = 0.97 \]
\[ B_{new} = 10.2^\circ, 97 \]
\[ P_{new} = 14.07^\circ \]

\[ \tan 14.07 = \frac{Q_{new}}{14k} \]
\[ Q_{new} = 14k \tan 14.07 = 3.509 \text{ VAR} \]
\[ Q_{cap} = Q_{old} - Q_{new} = 14.29 - 3.509 \]
\[ Q_{cap} = 10.78 \text{ VAR} \]

Now,

\[ \Delta Z_{cap} = \frac{V_{rms}}{Z_{cap}} = \frac{220^2}{J/\omega C} = -j 320 \frac{\omega}{C} \]
\[ S_{np} = -j R_{np} = -j \times 0.78 \ \text{V/Ar} = -j \times 280 \ \text{V} \]

\[ C = \frac{10.780}{2 \pi \times 377} = 16 \ \text{mF} \]

\[ C = 1600 \ \mu \text{F} \]

A formula

\[ C = \frac{P [\tan \theta_1 - \tan \theta_2]}{\omega V_{rms}} \]

\[ \theta_1 = 45.6^\circ, \quad \theta_2 = 14.07^\circ \]

\[ C = \frac{14,000 [\tan 45.6^\circ - \tan 14.07^\circ]}{220^2 \times 377} \]

\[ C = 1000 \ \mu \text{F} \]
Now find $I_{new}$.

We are told the new load apparent power is

$$S_{new} = \frac{P}{\cos \theta} = \frac{19,000}{\cos 14.87^\circ}$$

$$S_{new} = 14,432 \text{ KVA}$$

$$I_{new} = \frac{14,432}{220} = 65.6 \text{ A}$$

So we have increased the line current from

$$I_{old} = 90.91 \text{ A}$$

$$I_{new} = 65.6 \text{ A}$$