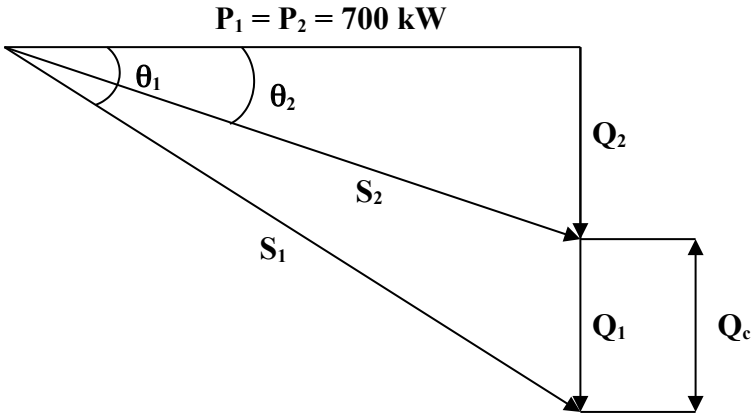
Chapter 11, Solution 94

$$\cos\theta_1 = 0.7 \longrightarrow \theta_1 = 45.57°$$
$$S_1 = 1\ \text{MVA} = 1000\ \text{kVA}$$
$$P_1 = S_1 \cos\theta_1 = 700\ \text{kW}$$
$$Q_1 = S_1 \sin\theta_1 = 714.14\ \text{kVAR}$$

For improved pf,

$$\cos\theta_2 = 0.95 \longrightarrow \theta_2 = 18.19°$$
$$P_2 = P_1 = 700\ \text{kW}$$
$$S_2 = \frac{P_2}{\cos\theta_2} = \frac{700}{0.95} = 736.84\ \text{kVA}$$
$$Q_2 = S_2 \sin\theta_2 = 230.08\ \text{kVAR}$$



(a) Reactive power across the capacitor

$$Q_c = Q_1 - Q_2 = 714.14 - 230.08 = 484.06\ \text{kVAR}$$

Cost of installing capacitors $= \$30 \times 484.06 =$ **$14,521.80**

(b) Substation capacity released $= S_1 - S_2$

$$= 1000 - 736.84 = 263.16\ \text{kVA}$$

Saving in cost of substation and distribution facilities

$$= \$120 \times 263.16 =$$ **$31,579.20**

(c) **Yes**, because (a) is greater than (b). Additional system capacity obtained by using capacitors costs only 46% as much as new substation and distribution facilities.