

# ELECTRICITY

## QUESTION

During April 2003, a plant recorded a maximum demand of 600 kVA and average power factor (PF) of 0.82. The electricity utility requires a minimum PF of 0.92. For every 1 percent below this PF, a penalty of US\$ 250 per month has to be paid. The plant installed a 100 kVAr capacitor at the end of April 2003.

1. Calculate the improvement in PF for May 2003
2. Calculate the penalty to be paid during May 2003

## SOLUTION

### 1. Calculate the improvement in PF for May 2003

Operating kW

$$\begin{aligned} &= \text{kVA} \times \text{PF} \\ &= 600 \text{ kVA} \times 0.82 \\ &= 492 \text{ kW} \end{aligned}$$

kVAr required at 0.82 PF

$$\begin{aligned} &= (\text{kVA}^2 - \text{kW}^2)^{0.5} \\ &= (600^2 - 492^2)^{0.5} \\ &= 343 \text{ kVAr} \end{aligned}$$

New kVAr after capacitor installation

$$\begin{aligned} &= \text{kVAr required} - \text{kVAr capacitor} \\ &= 343 \text{ kVAr} - 100 \text{ kVAr} \\ &= 243 \text{ kVAr} \end{aligned}$$

New kVA at new kVAr

$$\begin{aligned} &= (\text{kVAr}_{\text{new}}^2 + \text{kW}^2)^{0.5} \\ &= (243^2 + 492^2)^{0.5} \\ &= 548 \text{ kVA} \end{aligned}$$

New PF at new kVA

$$\begin{aligned} &= \text{kW} / \text{kVA} \\ &= 492 / 548 \\ &= 0.898 = 0.90 \end{aligned}$$

### 2. Calculate the penalty to be paid during May 2003

Difference in required and actual PF

$$\begin{aligned} &= 0.92 - 0.90 \\ &= 0.02 \text{ or } 2\% \end{aligned}$$

Penalty to be paid for May 2003

$$\begin{aligned} &= \text{US\$ } 250 \times 2 \\ &= \text{US\$ } 500 \end{aligned}$$