EPM 333: Economics of Generation &Operation

Power Factor Correction: Problems – 2008/2009

1. Explain why
    a. Industrial customers usually install capacitors for power factor correction at their premises.
    b. It is generally not economical to improve the power factor of an installation to unity.
    c. Installation of capacitors improves voltage regulation.
    d. Low power factor means higher energy losses.
    e. Low power factor penalties are charged from industrial customers and not from residential customers.
2. Find the power factor of a station supplying the following loads: 250 kW @ unity PF, 1.5 MW @ 0.9 lagging PF, 700 kW @ 0.9 leading PF, and 1 MW @ 0.8 lagging PF.
3. A single phase 440 V 50 Hz motor operates at a lagging PF of 0.7 and draws a current of 40 A. it is proposed to put a shunt capacitor at the motor terminals to improve the power factor. Find the rating of the capacitor needed to improve the PF to 0.9 lagging.
4. The power factor of a 200 kW, 3-phase, balanced load is to be improved from 0.707 to 0.9 lagging by connecting loss-free capacitors in delta across the 3.3 kV supply. The cost of suitable capacitor and controls is 120 $/□F. The annual tariff charge is 6.50 $/kVA m.d. and the interest and depreciation charges total 12 %. Calculate:
    a. The total kVAR rating of the capacitors.
    b. The required value of capacitance in □F / phase.
    c. The annual net saving.
    d. The time taken to save the initial cost of the capacitors and controls.
5. A load of 700 kVA m.d. @ 0.7 PF lagging is to be corrected to the most economical power factor. The annual tariff charge may be taken as 5 $/kVA m.d. and the initial cost of static, loss-free capacitors, including that of the necessary controls, is 7 $/kVAR. The annual interest and depreciation charges total 15 %. It is required to calculate:
    a. The most economical PF.
    b. The kVAR rating of the capacitor required.
    c. The annual net saving.
    d. The time taken to save the initial cost of the capacitors and controls.

6. A customer's supply transformer is rated at 500 kVA and the present load is 350 kW @ 0.7 PF lagging. It is required to add a further load of 110 kW at the same PF. This increase may be achieved by either:
    a. Installing an additional transformer and its associated switchgear at a total cost of 4 $/kVA; or
    b. Raising the PF of the new total load so that its kVA does not exceed the rating of the existing transformer. The cost of suitable loss-free capacitors is 6 $/kVAR.

    The interest and depreciation charges for either scheme total 12 % and the annual tariff charge may be taken as 4 $/kVA m.d. Calculate the total annual running cost of each scheme.

Good Luck

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