Power Factor Correction

Improving Electrical Energy

The installation of power factor correction capacitors produces many benefits

Improve energy efficiency

Reduces system currents and saves kw losses.

Eliminates reactive power charges

Excess kvar charges and power factor adjustments all eliminated. Supply kVA reduced.

Releases additional capacity

Operating current capacity in transformers, switchgear and supply cables made available.

Security of supply

Reduces peak currents to prevent fuse failure and loss of supply.

Environmentally friendly

Reduces kwh losses on the system and consequent harmful generation of CO2.

What is Power Factor?

Power factor is the relationship between working (active) power and total power consumed (apparent power). Essentially, power factor is a measurement of how effectively electrical power is being used. The higher the power factor, the more effectively electrical power is being used and vice versa.

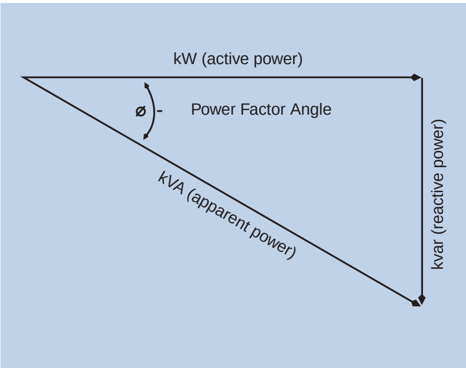
A distribution system's operating power is composed of two parts: Active (working) power and reactive (non-working) magnetising power. The ACTIVE power performs the useful work ... the REACTIVE power does not as its only function is to develop magnetic fields required by inductive devices.

Generally, power factor decreases (ø increases) with increased motor loads. Therefore, when more inductive reactive power is needed, more apparent power is also needed. This geometric relationship of apparent power to active power is traditionally expressed by the right angled triangle relationship of:

$$\text{Cos } \text{ø} = \text{p.f.} = \frac{\text{kW}}{\text{kVA}}$$

Why Improve Low Power Factor?

Low power factor means poor electrical efficiency. The lower the power factor, the higher the apparent power drawn from the distribution network.



When low power factor is not corrected, the utility must provide the non-working reactive power IN ADDITION to the working active power. This results in the use of larger generators, transformers, bus bars, cables, and other distribution system devices, that otherwise would not be necessary. As the utility's capital expenditures and operating costs are going to be higher, they are going to pass these higher expenses down the line to industrial users in the form of power factor penalties.

Basic Concept

Most loads on an electrical distribution system can be placed in one of three categories:

- Resistive
- Inductive
- Capacitive

The most common of these three on modern systems is the inductive load. Typical examples include transformers, fluorescent lighting and AC induction motors.
All inductive loads require two kinds of power to function properly:

- Active power (kW) - actually performs the work
- Reactive Power (kvar) - sustains the electro-magnetic field

As an example with an unloaded AC motor, one might expect the no-load current to drop near zero. In truth, however, the no-load current will generally show a value between 25% and 30% of full load current. This is because of the continuous demand for magnetising current by any induction load.

Why Electricity Boards Charge

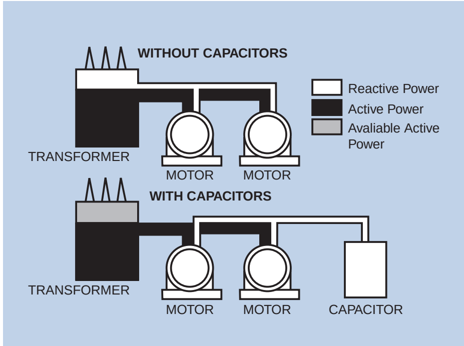
As the Electricity Board's distribution system has to cater for both the active and reactive power drawn from the system then it is natural for both components to incur a charge. However compared with the active power charge (kwh), the reactive power charge (Kvarh) is less and often a proportion of the reactive power requirement incurs no charge at all.

In the tariffs currently in operation a reactive power charge is most often made for reactive power units (kvar hours) in excess of 50% of the active power units (kilowatt hours). However, many industrial (and also commercial premises which have a significant air handling plant) can be found operating with a reactive power load in excess of 75/80% of the active power load. Reactive power charge then becomes a significant item to be saved.

However, it is a charge which can be avoided if the customer takes appropriate steps to install his own "reactive power generating equipment".

How To Produce Your Own Reactive Power

In electrical terms, capacitance is also considered as a "reactive power" component but in fact its characteristic in an electric circuit is to neutralise or compensate for the inductive reactive power. Thus we have an item of electrical equipment which can be used to effectively offset a proportion of the reactive power drawn from the supply.



Without capacitors connected the motors draw active and reactive power and the transformer feeding the installation is fully loaded. With appropriately rated capacitors connected in parallel with the motors the reactive power drawn from the supply is neutralised and the transformer only feeds active power. This means that the reactive power supplied by the Electricity Board is reduced and reactive power charges eliminated.

The power capacitor is however a static device (no moving parts) so maintenance is minimal. They are also electrically very efficient so their use on a network makes no significant increase in the active power requirement from the supply authority

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