



direct e-mail: reactiva@circutor.es

Compensating reactive energy in LV or MV ?

Despite having common features, it is necessary to know the technical differences between compensating in LV and in MV.

The penalties for energy consumption have evolved rapidly worldwide in recent years, appearing for the first time in some countries and becoming stricter or stronger in others. Many users consider how they will carry out power factor correction in their installations, but especially where.

Installation topologies

First of all, we must know the topology of our system and where energy meter measurements are established; in other words, we must know what our system looks like and where it invoices.

There are several topologies and invoicing types that are specific in each case, but to simplify we can find these four types of systems:

In the situation where there are only loads in LV (figure A and B) the power factor correction may be effected in the following manners:

- In diagram A it must be compensated in LV
- In diagram B it may be done two ways:
 - Compensation of loads in LV, plus the fixed compensation of the transformer also in LV.

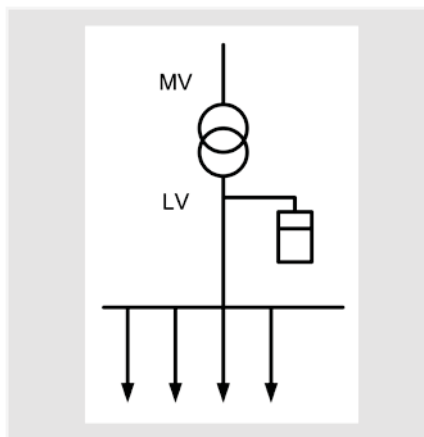


fig.A Loads in LV and energy meter in LV

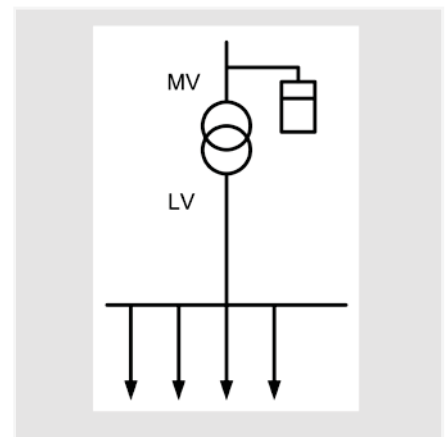


fig.B Loads in LV and energy meter in MV

- Compensation of the whole assembly in MV.

The conditions for using either system will respond to the demand behaviour of the installation. For reactive power consumption that is very variable or lower than approximately 1000 kvar, it is better to consider the power compensation in LV. For stable consumption with little variation of consumption, one or two levels of reactive power consumption, or consumption greater than 1000 kvar, the option to compensate in MV may be studied.

It will all be determined by the degree of monitoring of the load curve.

From the economical perspective, the cost of capacitors in kvar/€ is lower in MV than in LV. For power greater than 1000 kvar, there is over 1.7 times the difference between MV and LV capacitors.

In the situation in which there are MV loads (figure C and D), the power factor correction should be compensated in MV.

Compensation of loads in MV

The most common loads to compensate in MT are transformers and motors.

The reactive power of transformers

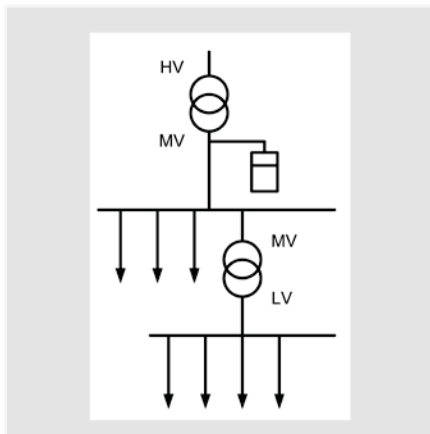


fig.C Loads in MV and/or LV and energy meter in MV

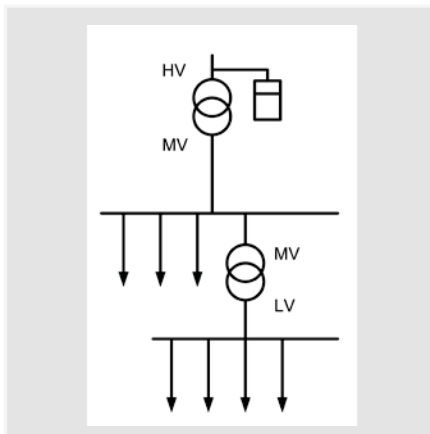


fig.D Loads in MV and/or LV and energy meter in HV

of vital importance that the current supplied by the capacitor does not exceed 90% of the magnetizing current or the non-load current, since after the disconnection of the assembly, the motor would absorb the capacitive current of the capacitor bank, exciting the motor with its discharge and potentially causing damage to people or property. Because of this, it is always advisable to use the option with an operation element which disconnects the capacitor bank when the motor is disconnected.

depends on two factors: reactive power with non-load and in load.

$$Q_T = Q_0 + u_{cc} \cdot S_N \cdot \left(\frac{S}{S_N}\right)^2$$

- Q_T .Transformer reactive power
- Q_0 . Transformer non-load power
- U_{cc} . Short-circuit voltage
- S .Demanded apparent power
- S_N .Transformer apparent power

For example, a power transformer from 8000 kvar to 20 kV, short-circuit voltage of 8% and Q_0 of 1% gives us the following reactive curve (fig.E). Therefore, we can see that with a fixed compensation of approximately 500 kvar, we compensate up to a load rate of 80%, which is more than enough.

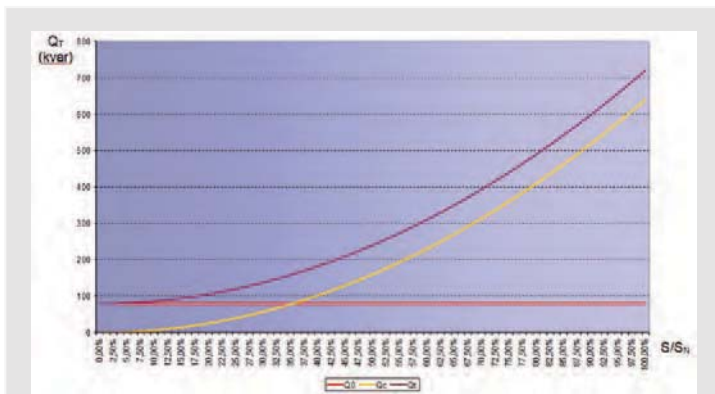


fig.E

Some prefer to automate this fixed compensation in two steps, to further optimize the fixed compensation of the transformer and not excessively overcompensate. For example, it is common to set a first fixed step for reactive power corresponding to 35-40% of the load index and a second step up to 80-85% of the load index, never compensating more than 10% of the apparent power of the transformer.

The compensation of asynchronous motor can be done individually or in groups.

Individual compensation can be performed with direct connection to the capacitor bank (figure 1.a) or by using an operation element (figure 1.b.)

In the case of direct compensation, it is

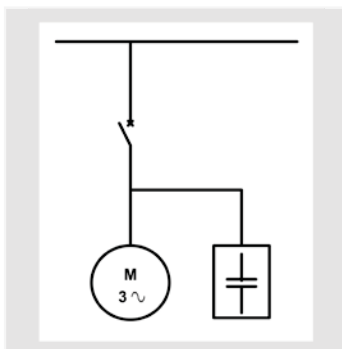


fig 1.a Direct connection

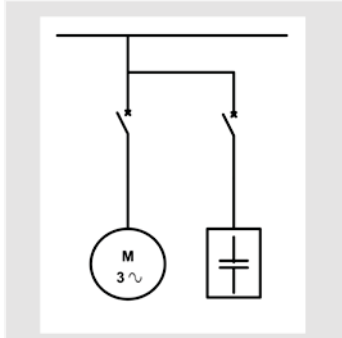


fig 1.b. Connection with an operation element

If performing direct compensation is required, any of the following three terms may be used, always bearing in mind that a $\cos\phi$ no greater than 0.95 can be achieved with this method. ▸

Known non-load current:

$$Q_N \leq 0,9 \cdot I_0 \cdot \sqrt{3} \cdot U_N$$

Initial known rated active power and $\cos\phi_i$:

$$Q_N \leq 2 \cdot P_N \cdot (1 - \cos\phi_i)$$

Rated active power of the engine:

$$Q_N \leq 0,3 \cdot P_N$$