SO MANY BUSINESSES UNKNOWINGLY THROW MONEY AWAY ON REACTIVE POWER!

Based on recent feedback from a specialist power quality improvement service business, the issue of high reactive power and poor power factor is becoming increasingly common in the UK today, an issue which apparently used to be considered much more widely by electrical engineers and facility managers.

While many business owners and finance directors appear to put great effort into saving a few percent on their energy bills through negotiating better energy prices, many remain oblivious to the fact that as much half of the electricity being consumed by their business could be literally going to waste. **Julian Grant from Chauvin-Arnoux UK**, explains what reactive power is, and discusses how it is causing many businesses to be seriously falling short of what is required to be electrically efficient. An issue, that could be alleviated with some simple monitoring and correction equipment, significantly cutting energy bills.

Apart from high energy bills, high reactive power also impacts on the reliability of the network itself, it impacts on the capacity to add new loads when a business expands, and can cause a variety of electrical issues that may result in the early failure of capital equipment. This equipment often gets replaced at great expense without the root cause ever being observed or identified.

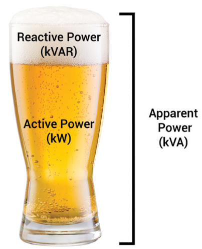
Saving money by using a cheaper supplier and employing an energy comparison consultant to get the best deal is an obvious thing to do, and easy to justify. However, high reactive power levels indicated by poor power factor, is now such an issue that the businesses installing power factor correction, and saving their customers thousands of pounds on their electricity bills by doing so, are literally inundated with work.

WHAT IS REACTIVE POWER AND POWER FACTOR?

Some electrical equipment used in industrial and commercial buildings requires an amount of Reactive Power in addition to Real or Active Power in order to work effectively. These tend to be items with copper windings in them, especially transformers, motors, induction heaters, arc welders and compressors, etc., even fluorescent lighting.

Reactive Power (kVAr) is the vector difference between Real or Active Power (kW) and the total power consumed, which is called Apparent Power and measured in kVA. Power factor is a ratio of the Real Power that is used to do work and the Apparent Power that is supplied to the circuit.

In an electric power system, a load with a low power factor draws more current than a load with a high power factor for the same amount of useful power transferred. The higher



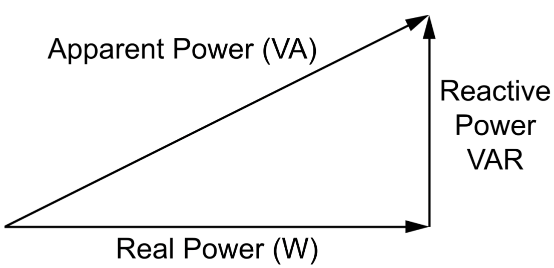
currents increase the energy lost in the distribution system, and require larger wires and other equipment. Because of the costs of larger equipment and wasted energy, electrical utilities will usually charge a higher cost to industrial or commercial customers where there is a low power factor.

It's quite easy to understand if you consider a pint of beer, where the whole glass that you pay for is the apparent power, the bit you want most (the beer) is the active power, and the bit you want as little of as possible (the head) is the reactive power.

A full pint with no head would represent a power factor of 1, or unity power factor, and in that situation, there would be no reactive power. In reality a power factor greater than 0.95 is generally aimed for, 0.98 if you can get it. A pint with a nice small head on it!

Most installations will have reactive power levels measured, and power factor corrected using a power factor correction (PFC) system, when they are first connected. However, changes to the electrical system and the equipment connected to it, expansion of a business over time, and the gradual degradation and failure of PFC equipment, will almost guarantee that it changes.

According to The Carbon Trust it is not uncommon for industrial installations to be operating with high levels of reactive



power giving power factors of between 0.7 and 0.8, which is surprising since measuring power factor is not at all difficult. It can be routinely measured using portable test instruments, or alternatively, can be permanently monitored in real-time with constantly displayed values, while also showing a multitude of other useful parameters including voltage, current and energy consumption. In this situation it is also possible to set alarms to remotely warn the facility manager if the power factor strays below a pre-set limit.

Similarly, while specification of a PFC system to reduce reactive power requires knowledge of several factors including the voltage level and typical usage of the reactive loads on-site, the usage profile across the site, and the power quality required by the on-site loads, all of this is easily measured and calculated. PFC systems are a fraction of the cost of the potential savings they can bring.

The simplest form of PFC involves fitting capacitors, and it is worth shopping around and taking expert advice on the system that will suit you. If a single machine has a poor power factor, capacitors can be connected in parallel with the device, so that they compensate for the poor power factor whenever the machine is switched on.

If the power factor of a site is permanently poor and no single item of equipment is solely responsible, fixed PFC can be connected across the main power supply to the premises.

Where many machines are switching on and off at various times, the power factor may be subject to frequent change. In this case the amount of PFC needs to be controlled automatically. In other words, the banks of capacitors need to be selectively switched in and out of the power circuit appropriately. There are various solutions on the market for performing this capacitor bank switching automatically.

Monitoring 29/6/2016 - 1/7/2016	Measured	Monitoring 3/1/2017 - 10/1/2017	Measured
Voltage (V)	414.00	Voltage (V)	417.90
Power Factor	0.73	Power Factor	0.98
L1 (A)	313.10	L1 (A)	284.60
L2 (A)	312.90	L2 (A)	260.80
L3 (A)	287.50	L3 (A)	248.70
Power (Kw)	171.50	Power (Kw)	182.48
Apparent Power (KVA)	210.20	Apparent Power (KVA)	184.41
Reactive Power (KVAr)	119.30	Reactive Power (KVAr)	7.54

CASE STUDY

Following a request in June 2016 to monitor its electrical supply by a metal fabrication business specialising in the design and manufacture of tubular and sheet metal sub-assemblies and screens, an average power factor of 0.73 was measured over a period of 4 days.

To put that into perspective, a power factor of 0.7 requires approximately 43% more current to do the same thing as an installation with unity power factor. A power factor of 0.5 requires approximately 200% (twice as much) current to handle the same load.

After the installation of appropriate automatic power factor correction equipment in January 2017 the average power factor monitored over a complete week increased to 0.98. The apparent power was reduced by just over 13%. Current dropped by between 10% and 17% per phase, and reactive power was reduced from 119kVAr to less than 8kVAr. These reductions were made even with a slight increase in demand during the 6 months between the initial measurements and the corrective action.

Based on a real to apparent power difference prior to the power correction of 38.7 and a real to apparent power difference after the power factor correction of 2, and assuming an electricity cost of £0.15 per kWh, this would equate to a saving of over £8800 per year in reduced electricity charges.

In light of the ever-growing price of the electricity you are buying, it is probably about time you checked your power factor to see how much of that electricity is being paid for but not used. www.chauvin-arnoux.co.uk