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Power Factor correction: fit it but don't forget it!

Power factor correction is essential if you want to ensure that you only pay for energy that you actually use – but that doesn't mean it's something you can simply fit and forget, cautions **Julian Grant** of **Chauvin Arnoux**.

In this series of articles, we've already discussed power correction but there's one aspect we haven't covered in any detail: the importance of ensuring that your power factor correction system will continue to operate correctly – and safely – when you install additional plant or update existing plant. This is a key topic: get it wrong and you could end up with costly equipment failures as well as unnecessarily high energy bills.

Before explaining further, let's quickly recap what power factor is all about. Electric motors and many other types of load draw both active and reactive power from the supply system. You pay for both types of power, but it's only the active power that does useful work by driving a motor for example. Reactive power does nothing useful at all, so by paying for it, you are simply wasting money.

Reactive power can be either 'lagging', which is associated with loads that, like motors, are predominantly inductive, or 'leading' which is associated with loads that are predominantly capacitive. Lagging and leading reactive currents cancel each other out but, in almost all installations, lagging currents predominate. Power factor correction systems compensate for this by adding capacitors, and if they're properly designed, they can reduce reactive power to almost zero.

Power factor correction can be fitted on a load-by-load basis, but a far more common solution is to fit a single power factor correction system serving a whole site or a whole department.

Many factories and commercial sites have these systems installed and, because they need only minimal maintenance, they're often almost forgotten. This is bad news, because capacitors can lose capacitance over time, which means they're no longer able to provide the expected level of correction. As a result, reactive power goes up and so do the energy bills.

This is bad enough, but there are potentially far more serious issues that arise if you are installing new plant or updating existing plant. This is because the new or updated plant is very likely to incorporate non-linear loads, like variable speed drives and switch-mode power supplies, and non-linear loads produce harmonics. These may be well suppressed within the load itself – as many variable speed drives are carefully designed to minimise harmonic production – but this suppression isn't always completely effective and it's not at all unusual for harmonics to find their way into a factory distribution system.

But what does that have to do with power factor correction? To answer that question, remember first of all that harmonics

are currents and voltages at whole-number multiples of the supply frequency – 100, 150, 200, 250, 300 Hz and so on – for a 50 Hz supply. Then consider that power factor correction relies on capacitors but is always used in circuits where inductance is also present. Finally, remember that when capacitance and inductance are present in a circuit, it will, at some frequency, be resonant.

If the resonant frequency of the power factor correction system happens to be the same as the frequency of one of the harmonics, there's trouble ahead! Large currents will flow in the capacitors leading to heating and, in the worst cases, to their failure and even destruction. This is by no means a theoretical issue; cases of this type are becoming increasingly common as businesses update older plant that used simple starters, such as direct-on-line and star-delta types, by fitting variable speed drives that, in many applications, are much more energy efficient.

What's the solution? The crucial part of the answer is never to forget about your power factor correction installation. Even if you are not extending or modifying your plant, check it regularly, using a portable energy logger, to make sure that it's still working effectively. And, if you are carrying out work on your plant, be sure to carefully monitor harmonic levels before and after you make the changes, along with the currents that are being drawn from the supply system.

You should also ensure that your power factor correction system is 'detuned' which means that it has been designed so that the resonances created by its capacitive and inductive components do not coincide with any of the harmonic frequencies. This will probably be the case when the system was new, but don't forget that, as capacitors age, they tend to lose capacitance and it's possible that this may shift the resonances so that they become problematic. So even if you haven't made changes to your plant, ageing capacitors in your power factor correction installation can lead to excessive harmonic currents – regular checking is important!

A good portable energy logger, such as the Chauvin Arnoux PEL103, will tell you all you need to know about harmonics in your supply system. The best types are easy to use and, in many cases, can be connected without the need to turn off the power. Note that it's a good idea to leave the PEL in place for at least a typical working day, and if possible, longer, to be sure that data relating to all the operating conditions of your plant have been captured. Should you find that harmonic currents are exceeding acceptable values, additional harmonic mitigation measures will be needed, but these will be a lot less costly and lot less disruptive than failure of your power factor correction system.

Power factor correction is an essential requirement for every energy-conscious business. It is important, however, to check from time to time that the power factor correction system is still doing its job and it's absolutely essential to make sure that it is capable of operating reliably and safely when any major plant modifications or extensions are carried out. Investing in a modern PEL will make it easy to meet these requirements but, should you need further advice or guidance, the technical experts at Chauvin Arnoux will be pleased to help.

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