Power and the glory

Electric motor loading is key to energy efficiency. That's the warning from Marek Lukaszczyk, who wants plant engineers to assess their electric motors as a matter of urgency. Brian Tinham reports

Ensuring that electric motors are properly loaded enables users to make informed decisions about priorities for replacement. That is the key advice from Marek Lukaszczyk, European marketing manager with Weg Electric Motors, who adds that measuring motor loads is relatively quick and easy – and that plant engineers should do so as part of preventive maintenance and energy conservation programmes.

"Analysis is necessary, because there is not much point replacing existing ac motors with energy efficient types, if they are mismatched or oversized," he explains. "Too often, motors are oversized or have been rewound several times, leading to gross inefficiencies in their operation," he adds.

For him, the point is that most electric motors are designed to run at 50% to 100% of rated load, with maximum efficiency around 75%. Fleshing that out, he says: "As a general rule, high efficiency motors garner the maximum savings when they are loaded in excess of 75% and are operated for more than 4,000 hours a year."

Cost loading

That matters, because the problem with motor efficiency is that it tends to decrease dramatically below 50% load – which is bad news for the 80% of motors in the UK thought to be over-sized. "It is also bad news, in terms of energy costs... A single percentage point increase in efficiency will save lifetime energy costs generally equivalent to the purchase price of the motor," warns Lukaszczyk.

Meanwhile, although over-sizing is the most common problem, under-sizing can be just as wasteful, because such motors are likely to be overloaded – causing them to overheat, lose efficiency and probably fail prematurely.

One of the reasons, opines Lukaszczyk, is that the term 'motor service factors' is often interpreted too liberally. "A service factor is a multiplier that indicates how much a motor can be overloaded under ambient conditions," he explains. "For example, a 10kW motor with a 1.15 service factor can handle an 11.5kW load for short periods. However, running motors continuously above rated load reduces efficiency and motor life."

Incidentally, overloading should never be allowed when the voltage is below nominal, or when cooling is a problem, due to high ambient temperature or dusty motor surfaces. "When motors operate at less than 95% of design voltage, [they] lose two to four points of efficiency and also suffer temperature increases of up to 7°C, greatly reducing insulation life and impairing reliability," advises Lukaszczyk.

That is why he calls for plant engineers to survey and test motors operating for more than 1,000 hours per year, and separate them into three categories:

- Motors significantly oversized and under-loaded – replace with more efficient, properly sized models at the next opportunity
- Motors moderately oversized and under-loaded – replace as above, but wait until they fail
- Motors that are properly sized, but of standard efficiency – replace with energy-efficient models, but, again, wait until they fail.

One problem is that it can be difficult to determine the characteristics of motors that have been in service for some time. Why? Because nameplates may be lost or painted over. Further, if the motor has been rewound, efficiency may have been reduced.

Lukaszczyk's solution: "Efficiency values must be determined at the operating load point. This involves using power, amperage or slip measurements to identify the load imposed and then obtaining a motor part-load efficiency value. If direct-read power measurements are available, derive a revised load estimate, using both the power measurement at the motor terminals and the part-load efficiency value."

As for rewound motors, he suggests that two points be subtracted from a standard motor efficiency on motors less than 30kW and one point for larger motors. PE

Marek Lukaszczyk, European marketing manager with Weg Electric Motors: time to check your motors