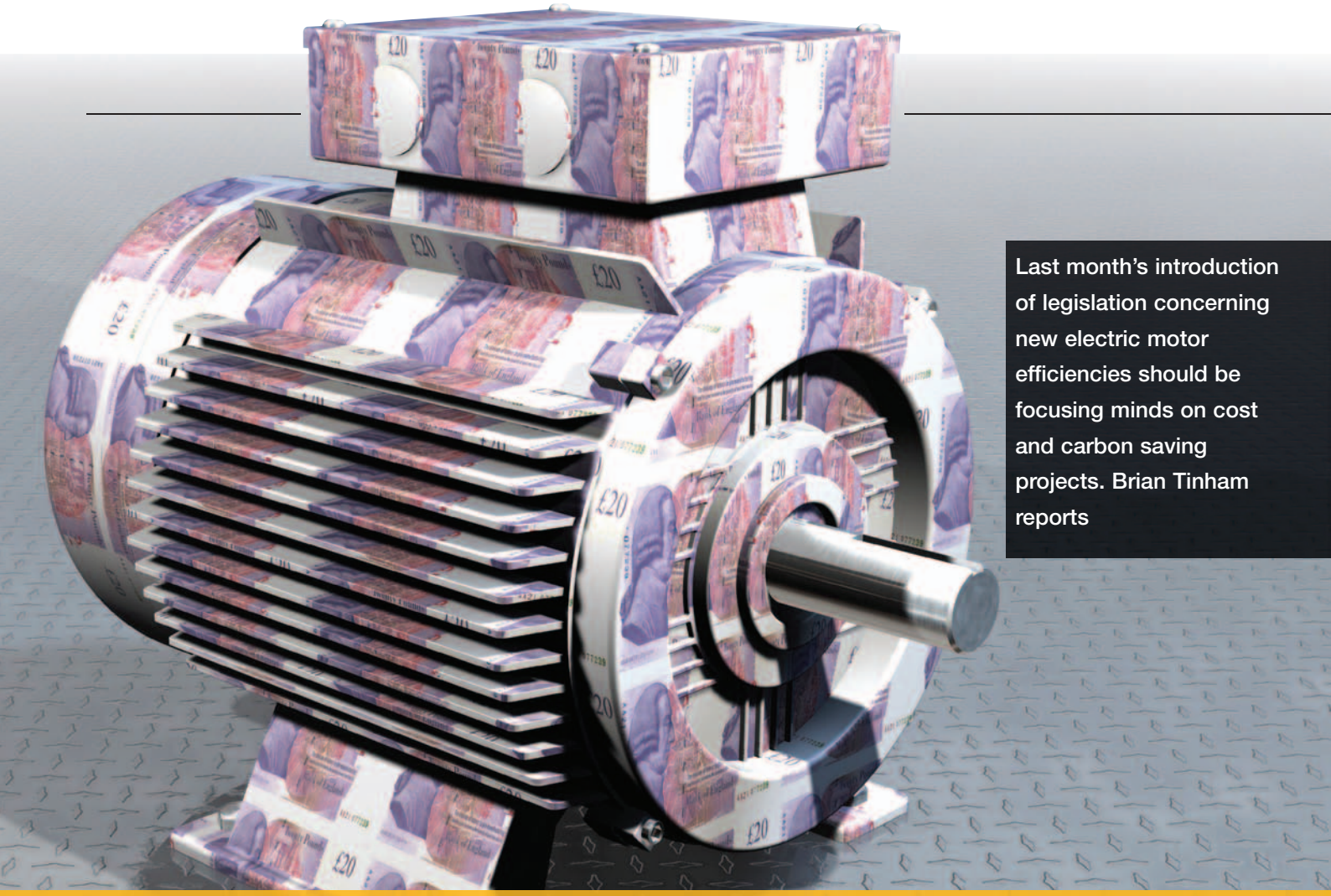


Last month's introduction of legislation concerning new electric motor efficiencies should be focusing minds on cost and carbon saving projects. Brian Tinham reports

Feet flat on the

It makes little difference whether you're driving a one, two or three litre engined car: you wouldn't floor the accelerator and the brake at the same time, would you? You know that would be crazy. So if that metaphor for running electric motors at full fixed speed, but then throttling back their output with dampers (on fans) or valves (for pumped fluids), doesn't make you stop and think about the serious energy you're wasting, probably nothing will.

Sounds somewhat extreme? Not according to Steve Ruddell, ABB UK's energy spokesperson. He believes there is almost always a case for installing a variable speed drive (VSD) on electric motors – even those where there is no requirement to vary the speed. To be fair, Ruddell suggests prioritising projects by looking first at your inventory of motors, and singling out those that are running for more than 4,000 hours per annum (so not just pumping for half an hour a day) and heavily throttled. However, he insists it's not that simple.

"If the dampers or valves involved are not actuated, then they're just trimming the flow, so it is well worth starting with these. For example, if they're 20% closed, then, because of the cube [affinity] law, you're wasting 50% of your energy, compared with reducing motor speed to the real requirement, using a VSD. But equally, if they are actuated, then check to see how much they're moving: if they're fluctuating wildly, then there are excellent opportunities for VSDs. And if they're spending a significant amount of time closed, then again you need to get rid of them and go for a drive."

However, VSDs aren't the only game in town, particularly where the requirement is less speed reduction/modulation, and more switching motors on and off. Here, a simple contactor starter is the most economical choice. Otherwise, if the issue is ramping them up and down in a controlled manner, to avoid

Charts check motor efficiency choices

Plant engineers who are unsure whether their chosen motors comply with the new energy efficiency requirements, effective 16 June 2011, or who want to examine alternatives for an application, can use Nord Drivesystems' decision tree software, which is available for download from the website (www.nord.com > IE2 motors > decision tree).

Also available online is an interactive energy-saving calculator that determines the operating cost savings offered by IE2 motors, compared with IE1 during continuous operation, based on given plant and machine data. Other major motors and drives manufacturers, such as ABB and Siemens, offer similar facilities.

mechanical strain and/or damage to the couplings, soft starts provide a good – and arguably better – alternative to VSDs.

Think about escalators and conveyors, for example, that are required to operate at full speed most of the time: using a VSD here could reduce, rather than improve, energy efficiency. As Eaton's Phil George puts it: "Even the best of VSDs have some inherent losses. These are small – around 2% for small to medium sized drives – but they are still significant. With fixed speed motor starters using modern components, the losses are so small as to be negligible."

Burning money

And not only do soft starters provide controlled acceleration and deceleration; they usually also incorporate a bypass contactor, which means that once the motor is up to speed, they are as efficient as a contactor starter. Alternatively, for motors that are running with light loads, George advises that they can be left in circuit to improve power factor and overall efficiency.

But it doesn't stop there: ABB's Ruddell also suggests there is a strong case for replacing 15 to

Phil Holmes

floor

20 year-old motors. Not only are they likely to be 20–30% over-sized (for that plant expansion that never happened), so operating further down the load curve, but also they will be IE1 (Eff2) or lower efficiency models. That means they will be running at 93% efficiency (or, more likely, substantially below), while IE2 high efficiency motors run at 95%.

"It's almost always more economical to write off an old asset and replace it with a new, high efficiency motor, because the purchase price is such a small fraction of the running cost," asserts Ruddell. "Our calculations show that, if a motor is running 24/365, irrespective of size, it consumes its purchase price in power within 30 days." So, assuming a pessimistic 10-year lifespan, your motor will consume more than 100 times its purchase price in electricity alone. Looked at that way, the 3% efficiency uplift of an IE2 motor over an IE2 unit pays for the capex three times over; even six times over, if the motor runs for an entirely feasible 20 years.

Further, rising energy costs make those estimates conservative – which also makes the additional outlay for an IE2 motor (around 15–20%) a no brainer. Particularly when the Enhanced Capital Allowance has been left unchanged at least until April 2012 (meaning that, even though IE2 motors are now mandatory, you can still claw back 25–30% of the price) and when motor giants such as ABB and Siemens are offering lucrative 'scrappage' schemes.

So why is so little of this happening? Steve Brambley, deputy director of the GAMBICA industrial automation trade association, believes that lack of confidence and cash are partly to blame – with engineers unable to convince management, in the current climate, of the benefits. "Energy and efficiency have traditionally been fairly low down on the priority list when it comes to motors," he says. "Also, where plants do have energy managers, it's rarely their main role, so it doesn't get the focus."

However, he blames the middle men, who sit between the equipment vendors and users, for most of the problem. "Most OEMs and system integrators have little or no interest in energy consumption. So,

Eaton's Phil George: "Even the best of VSDs have some inherent losses"

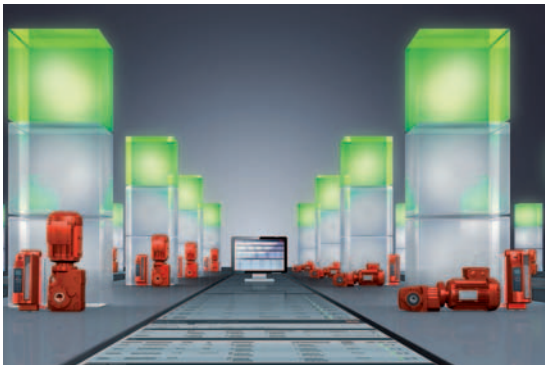
Drives maintenance service goes on line

SEW-Eurodrive has launched what it calls a Complete Drive Management (CDM) service that integrates maintenance and servicing of industrial drives with an online database. UK service manager Karl Rigg explains that its CDM databank provides an overview of all drives in a factory or group, including installed units and drives in storage.

Hence, users can see at a glance the condition of each drive and access its service history, so helping plant mangers to reduce downtime by identifying potential problems early and scheduling appropriate maintenance. Rigg also argues that the system helps managers to cut unnecessary stock, but also improve energy efficiency and reduce costs by targeting older drives for replacement.

"Because CDM is an interface, it's a bit like having SEW-Eurodrive in the factory all the time, as part of the user's maintenance team," he states. "It's all about raising the bar, delivering excellence, minimising the total cost of ownership and increasing uptime."

Rigg gives the example of a manufacturer with two plants and a warehouse. A maintenance engineer, he explains, could log on and open a list of all plant and equipment that use drive technology. Clicking on one of the production lines takes the user to a list of drives on that line, with each unit identified by a code – meaning no more crawling around with a torch to read the nameplate. The database provides the name and location of all drives, irrespective of brand. Selecting any one of the components in the list then presents all documentation, including the product CAD drawing, as installed on the line, a photo and operating instructions.



Left: SEW-Eurodrive's Complete Drive Management (CDM) service that integrates drives' maintenance and servicing with an online database

Soft starter hammers motor running costs for EdF

When EdF needed a starter for the MV drive fitted to a hammer mill, most suppliers claimed that only a variable speed drive (VSD) would do the trick. Softstart UK, however, disagreed and offered a cheaper MV soft starter that EdF project engineer Graham Wolsey reports has proved entirely satisfactory and is saving the firm thousands of pounds.

The equipment was installed at EdF's Nottingham site, adjacent to Cottam Power Station, where the company pulverises olive cake and mixes it with coke to form an environmentally friendly biofuel for the power station. The hammer mill receives the olive cake via a triple screw feeder at up to 30 tonnes per hour, driven by a 350kW 3.3kV electric motor. The drum, with hammers attached, has very high inertia and takes up to 15 seconds to reach the full operating speed of 3,000 rpm.

Clearly, conventional direct-on-line starting was not an option: at the very least, high torque would probably damage the couplings. However, Wolsey says that most MV drive suppliers insisted that a soft starter could not provide consistently accurate starting control, so a VSD was the only feasible solution.

With Softstart's support, EdF selected a PLC-controlled unit from its MV-DS range. In brief, connections in the MV section use MV cable, eliminating any need for costly partial discharge testing. Further, the MV section has been isolated from the controls by a fibre optic link for gate firing control. Incidentally, these soft starters' line contactors use vacuum switching, so they are reliable and zero maintenance devices.

Wolsey says the team was slightly anxious, in view of the dire warnings. "We needn't have worried, as … the mill performed exactly as we wanted. I would have absolutely no hesitation in recommending [Softstart UK] to anyone who has unusual and challenging starting requirements," he states.

for them, there is no incentive to improve the motor efficiency or add a VSD, when a simple contactor could control the motor. They're just not looking at the lifecycle costs of the machinery they produce."

Brambley cites a recent IEA (International Energy Agency) white paper, which provides independent evidence that power usage could be slashed, if VSDs were more widely adopted, and says that GAMBICA is now redoubling its efforts to improve awareness among purchasing managers. "By including the lifetime energy cost of the application in their quote to the customer, [machine builders and system integrators] can both mark themselves out in comparison to their competitors and provide a better, more cost effective service to the end user," he explains.

"Ultimately, I would like to see a consistent standard applied to all industrial systems that would clearly delineate their energy efficiency," he adds. "Something similar to the miles-per-gallon ratings, used for vehicles, would give a clear comparison and be easily understood by non-technical people."

In the meantime, how about taking a leaf out of Ricoh's and Tamar Foods' books (page 28) and reviewing your installed base of motors to cut costs? And not just those big 250kW prime movers, but also the hundreds of 15kW units around the plant. As long as aspects such as flange and feet dimensions don't make replacement unviable, the savings will be significant and relatively fast.

However, remember, there is little point in changing the motors, but then missing out on the really big returns by failing to tackle your throttling kit. PE

Europe's new motor efficiency requirements explained

New minimum efficiency levels for LV motors became mandatory last month (16 June 2011), with the introduction of Commission Regulation EC 640/2009 – EU MEPS (Minimum Energy Performance Standard). Its requirements immediately cover most two-, four- and six-pole three-phase induction motors in the power range 0.75–375kW.

In brief, all motors in that range placed on the European market must now achieve a minimum of IE2 (International Efficiency standard level 2) high efficiency – formerly Eff1 on the now superseded voluntary CEMEP scheme. IE1 (standard efficiency) motors may no longer be purchased, unless they are already on the market – meaning stocked for sale or spares by vendors or plant operators respectively.

The IEC standard also defines IE3, premium efficiency, while IE4, super premium efficiency, will be added at some time in the future. All these efficiency designations have been adopted in the UK under BS EN 60034-30:2009.

Using higher efficiency motors leads to big cost savings and carbon footprint reductions. The Ecodesign Directive (2009/125/EC) documentation estimates that, with an 11kW motor running for 8,000 hours per year, energy savings from an IE2 motor, instead of an IE1 unit, amount to £2,400 per annum, with CO_2 slashed by 15 tonnes. IE3 motors are even more impressive, bringing a cost reduction of £4,000 and a 25 tonne drop in CO_2.

Some motors, such as those for explosive atmospheres, are currently excluded from EU MEPS, but ABB and others anticipate that these will also have to comply with standard BS:EN 60034-30. Indeed, ABB is already providing such motors with IE markings.

The second stage of EU MEPS will apply from January 2015, when the minimum requirement for motors with output powers above 7.5kW will be IE3 efficiency levels – or IE2, if combined with a variable speed drive. The third stage, which will come into force from January 2017, will extend the requirement for IE3 efficiency levels, or IE2 with a variable speed drive, to include electric motors down to 0.75kW power output.