Variable speed drives offer Winter warmers

WITH A WINTER OF POWER SHORTAGES LOOMING, PLANT AND MACHINERY BUILDERS ARE SHOWING A RENEWED INTEREST IN VARIABLE SPEED DRIVES. BOB DOBSON REPORTS.

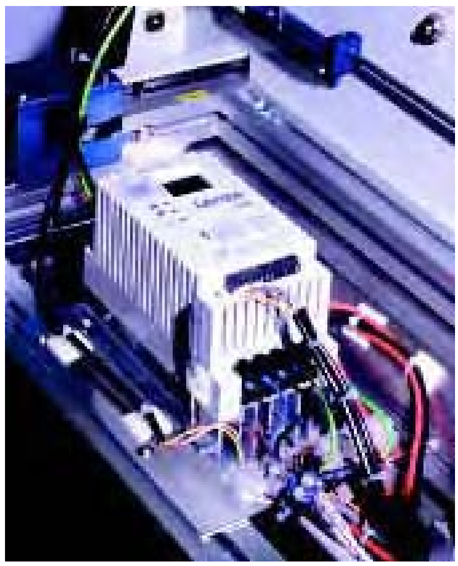
As North Sea gas reserves dwindle, the UK is becoming more reliant on overseas suppliers but the security of delivery is far from certain. And with so many of our power stations converted to run on gas, a shortage automatically means compromises in electrical supply too. The government is preparing us for disruptions throughout the energy hungry winter months and has hinted that industry can expect to suffer as a non-essential consumer.

This situation is compounded by the fact that electricity prices are on a long upward spiral, having been held artificially low in the pre and post-privatisation periods. Industrialists are now planning for year-on-year price rises far above the rate of inflation: many are predicting a trebling of prices from about the 2.2p/kWh they are currently paying to well over 6p/kWh. The effect of this on the overall profitability of major energy users stands to be significant, and even lesser consumers will see an adverse effect.

A related issue worth noting is that the recent hard hitting hurricanes have taken a heavy toll on electricity generation in the US and other Gulf Coast countries. This has served as a powerful demonstration of the effects of underperforming energy supply on both highly developed and emerging manufacturing economies. This is of immediate concern to industrialists in the region and the knock-on effect is that organisations considering relocating major operations to low cost economies are likely to take far more notice of power generation and supply infrastructure in the future.

So, are machinery builders and plant operators changing their outlook on energy efficiency, taking the view that it is imperative and compelling? If so, this is a complete turnaround on just a few years ago when the Climate Change Levy was the government's main tool for encouraging efficiency.

Then, rather than embracing energy saving technologies, many users preferred to shop around the suppliers for the best deal – often ending up with an 'overseas' supplier. The advantages were seen as: energy bills were contained, no capital investment was required and finance directors could brag about how they manfully brought a supplier to heel.



Speed control: *Lenze SMD drives provide a cost effective means of regulating speed on fan motors*

The arguments in favour of using drives to save energy are well known. The basic idea is that power savings are proportional to the square of the reduction in speed at which a motor runs. Reduce the speed by half and you will cut 75 per cent from your energy bill.

Idling most of the time

Many motors in industry actually idle most of the time, only running under load for a small proportion of the working day. Stopping the motors rather than idling them offers the promise of significant savings. Creating a speed profile so that the motor never consumes excess energy, or building a closed loop control system so that the motor responds in real time to changing demands are further options of energy saving with an inverter drive.

Payback periods for the capital outlay of a drive system, plus the cost of installation and any loss of production during installation, are typically under two years. In the early days of drives technology, say 20 years ago, this was simply too long for finance directors whose focus was right on short term profits.

Now companies are being forced to consider a rather more rational approach to energy usage, and seem willing to look at payback periods that extend across more than one accounting year. However, it may be that drives suppliers should not get too optimistic - there is always the possibility that electricity buyers end up doing the same as all those car owners who said they would give up driving if petrol ever went over a pound a gallon!

With such radical changes in the financial landscape many engineers are revisiting previously-shelved projects and wondering if a drive is a justifiable investment after all. However they must pay due account to the advances in the technology since their initial investigation. While the basic concepts of drives can be said to have reached a level of maturity 10 or 15 years ago, each intervening year has seen at least some further development.

So any proposal more that a couple of years old will require significant reworking. The first stage of this is to update the cost figures, but engineers should also re-assess their system design to see if it is still relevant. The developments in drives technology and associated control strategies since they last reviewed the project may also have a significant effect on systems capabilities.

One of the most significant developments just coming to the fore is a blurring of the boundaries between induction motor performance and servo motor performance. Previously, induction motors and inverters were the cost conscious solution, with servos reserved for high performance where costs could be justified. Now closed-loop vector inverters can honestly claim to encroach into the servo's performance envelope, while 'low-cost' servos are really beginning to make a mark as a viable solution for many applications that previously would have been the domain of an inverter.

It is almost impossible to get a true assessment of the relative merits and market positions of inverters and servos because most suppliers are committed to one solution or the other, and naturally will favour their offering over rival solutions. Those that can offer both solutions consider accurate analysis of the actual breakpoints to be far too commercially sensitive for public discussion, but interestingly some suppliers are rationalising servos and inverters into a single range while others are very firmly in favour of keeping them separate.

Other key developments within the drives spectrum include the adoption of communications capabilities and on-board intelligence options. It is now well understood that drives are an integral part of machine control systems, so must be able to communicate with other local devices and to central controllers.

In Europe at least, Ethernet is on an unstoppable march to become the preferred communications medium, although control companies with vision are also backing a couple of other horses such as Java. At the device level ASi, Profibus and CC-Link continue to slug it out, with each dominating a major economic region (America, Europe and Asia respectively). Significantly, it is often found that drives and servos are best served by a dedicated motion communications protocol, such as SSCNet.

Part of the communications debate is the need for local intelligence, which can either be on board the drive or resident in a nearby PLC or other controller. The on-board camp tends to have to rely on plug-in modules fitted to 'dumb' inverters to personalise them to the job in hand. The PLC proponents argue that their resultant systems architecture is far more flexible and adaptable, so better able to cope with the inevitable reconfiguration that is a regular feature of most plants.

A buzzword current in drives circles at the moment is 'matrix inverters' with some suppliers now claiming commercial viability of a technology that offers the benefits of minimal harmonics and regenerative braking.

Ordinary drives convert the incoming AC supply to DC, and then convert the DC back to AC at the required frequency and voltage. The section of the drive in which this is done is referred to as the DC bridge, and can produce harmonic distortions in the mains supply.

In contrast, matrix drives use an array of insulated gate bipolar transistors (IGBTs) to connect the three phases of the supply directly to the motor in a precisely timed sequence. This is said to reduce harmonics generation to about 10 per cent that of conventional drives, while also offering almost unity power factor – that is, no wasted energy.

The elimination of the DC-bridge section of the drive makes it easy to arrange for energy to be returned to the supply during braking, and also removes the need for energy-wasting, heat-generating braking resistors.

Matrix deals with harmonics

Thus matrix drives are promoted as being an attractive option in applications such as lifts, cranes and presses where regeneration is a particular benefit, and in sensitive environments, such as hospitals and computer centre installations where harmonics must be minimised. However they are likely to cost more than equivalent conventional drives, a hurdle which will have to be overcome in a market where price is often the deciding factor for purchasers.

While the matrix route claims to deal with harmonics issues by removing the generating mechanism, the conventional way to address the problem is with RFI filters.

Harmonics became an issue as the amount of equipment using 'chopping circuits' increased, and came to a head about ten years ago. At this time Europe introduced legislation requiring users of such equipment to protect the mains from their corruption. However America took a different view, saying that mains pollution was inevitable and advising users that they had a duty to protect themselves against it. This legislative difference is still in place today, so machine builders with customers on both sides of the Atlantic may need to have two different designs to hand.

The initial European solution was to provide a small filter for each piece of equipment likely to create harmonics. However another concept is now also available, interestingly based on technology developed in America. This is to provide a large filter that covers the whole machine, suite of machines or even an entire factory. These filters are not simply scaled up versions of standard filters, but actively identify how much machinery is in use at any moment, predict the expected levels of corruption and adjust to this level.

The most obvious attraction of a central active filter is the simplicity of its installation and maintenance compared to a mass of individual filters. But a notable secondary benefit is that it is a more energy efficient solution, which is pretty much where we came in. ■

Decentralised vacuum pump cuts costs

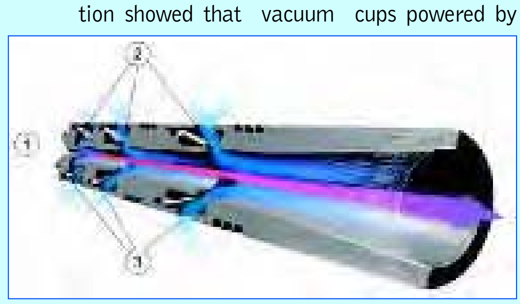
Piab has announced a new compressed-air driven vacuum pump said to provide increased flow and reduced energy consumption compared with conventional units.

The compact nature of the P6010 pump – 77 x 73 x 214mm – allows it to be mounted much closer than usual to the point of suction, reducing compressed air requirements and so saving further energy.

In addition, the system can be equipped with the Piab Cruise Control which automatically maintains a pre-set level of vacuum in a suction cup when handling leak-prone materials such as paper and corrugated board, and Automatic Vacuum Management that stops the air flow when the set vacuum level is achieved on materials such as plastic or glass.

The pump itself is based on the Piab Coax system in which compressed air flowing through the pump nozzles entrains an additional volume of air, creating suction at the inlets.

According to Piab a study of a US application showed that vacuum cups powered by decentralised Coax-based pumps each cost $1 a year in energy consumption against the previous $200 each in a system based on a centralised vacuum pump.



The Coax system: *When compressed air (1) flows through the pump nozzles (2), air from outsiude the pump will be entrained by the jet of air at the nozzle outlet. Suction will then be generated at the openings to the various stages (3)*

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