In the DRIVING seat

Motors, drives and controls have been advancing fast, with a goal of improving plant operations, energy efficiency and the bottom line. Steed Webzell explores new systems, emerging best practice and top tips

Free installation guide

GAMBICA (the trade association for companies in instrumentation, control, automation and laboratory technology) and REMA (Retroreflective Equipment Manufacturers' Association) have updated their joint publication on power drive systems. The 'Installation Guidelines for Power Drive Systems' is available as a free download from the GAMBICA website.

It incorporates the results of investigations to review safe mechanical and electrical installation and the avoidance of EMC problems. Steve Brambley, deputy director of GAMBICA and convener of the organisation's variable speed drive (VSD) group, makes the point that good operation of drive systems is dependent on satisfactory installation.

"This is the fourth edition of the guide, with updates on power drive systems, including the drive, motor and load, together with cabling, site considerations, circuit protection, earthing and harmonics. 'Power drive systems' is an IEC term that covers the VSD, motor and sensors used for feedback control information to the drive, as well as auxiliary parts, like filtering and protection." More information at: http://collateral.prmax.co.uk/collateral/30166.pdf

With high and premium efficiency electric motors widely available and coming down in price, and drives and controls, too, getting smarter, cheaper and easier to use, it's more important than ever to ensure the correct specification, installation and commissioning of these vital components.

At present, the driver behind many selection decisions in this technology area is, perhaps unsurprisingly, energy efficiency. With seemingly endless energy price hikes and the introduction of the Ecodesign Directive, plants need to ensure they deploy equipment that delivers genuine savings.

This matters: according to recent analysis by the International Energy Agency, electric motors account for about 70% of all industrial electricity consumption within the EU (more than twice as much as lighting)

and often there is significant wastage. As a result, the European Commission is looking to improve their energy efficiency.

During the first phase of this work, a regulation concerning the required minimum energy efficiency of motors was developed. As a continuation of this, the EC has since given CENELEC a mandate to create methods and standards allowing comparison of the energy efficiency of motor-driven systems – including variable speed drives (VSDs), the driven electric motor and the load. This work has resulted in the creation of a preliminary European standard (pr EN 23551), setting out the required methods.

When this arrives, it will add to other energy efficiency standards, such as the latest IEC 60034-30:2009, a harmonised IE (International Efficiency) grading standard, which is central to the EU's new Ecodesign Directive 2005/32/EC.

Many manufacturers have anticipated the new standards, producing energy-efficient products to comply. But is this enough? One company, WEG, thinks not, and has significantly exceeded the requirements of standards in its latest motor and drive designs.

Super-premium efficiency

The first evidence of this is WEG's WQuattro line of super-premium efficiency electric motors. These employ a hybrid motor, integrating a conventional three-phase distributed winding, and a rotor with an aluminium cage, as well as internal high-energy magnets. Together, these eclipse the requirements of the impending IE4 Super Premium Efficiency classification across their output range. Also, with no energy (joule) losses from its rotor, the motor demands less energy from the grid, translating into lower total cost of ownership.

Of course, there's nothing secret about energy efficient or premium efficient motors. In the process of converting input power into useful work, some energy is always lost to heat, friction and the windings. By reducing losses in these areas, motor manufacturers have made their products more efficient. Compared with standard motors, for example, some energy-efficient models use longer stator and rotor cores to reduce core losses. They also have additional copper in the windings, which decreases copper losses, as well as open or shielded bearings (lubricated) to reduce friction.

But improving the efficiency of motor-driven systems is rarely only about electric motors. Consider motors used on fans, air handling equipment and air conditioning systems. These are heavy consumers of electricity, but they comprise a series of components, including intake louvers, ducting, air filters, coils and heat exchangers, dampers, attenuators and grilles – all of which have a resistance to air flow. All can have an impact on the energy consumed by the air handling unit fan motor, as it works to push and pull air through the sequence and move it into the required areas.

"Unfortunately, there is a lot of air handling plant in use today that's not designed with energy efficiency in mind," says Peter Dyment, energy consultant at Camfil Farr. "And the typical life of an air handling unit is 35 years, so there are systems in the field that were built in the 1980s."

He gives the example of filter problems. "These generally use commodity filters made from synthetic media that rely on electrostatic charge to filter dust. However, dust conducts charge away very quickly, usually rendering the filter just 10% efficient after only a month of operation. This makes it a costly operation for a fan to push air."

The solution: a combination of a low-energy air filter upgrade and using VSD control on air-handling units can deliver significant reductions in energy usage. What's more, since VSDs have developed significantly over recent years – and now commonly come with built-in control functions – it's not difficult to adopt sophisticated speed control strategies for both fan and pump motors in air conditioning systems.

According to Dyment, energy reductions available from inverter control come in two parts. First, any small, but constant reduction of fan speed will yield

Serious cost savings

Among the increasing number of those benefiting from the latest drive technology is Aberthaw Power Station near Cardiff, where savings of £350,000 per year are being reported on its oil costs, following the installation of ABB variable speed drives (VSDs). ABB recommended 7.5kW drives to replace direct on-line fan motors used to blow oil from injecting lances that light the power station's boilers.

Remaining in Wales, TI Automotive at Flint is also achieving savings, following the installation of ABB VSDs. The company, which makes plastic fuel tanks, first installed a 75kW ABB standard drive on a compressor, which had previously been a fixed-speed unit. Running the motor at half speed, the drive produced an energy consumption saving of 35%.

Another application was the pumps used for the factory's chilled water circuit that cools the mould tools, extruder feed zones and gearboxes, as well as the mould hydraulics and electrical panels. Installing 11kW ABB standard drives on the three pumps resulted in a 30% energy saving. In total, the plant is reporting energy savings of £24,000 a year.

The cross-sector demand for the latest VSD technology is further highlighted at Doncaster-based electrical engineering company HS Harbon & Sons, which has standardised on ac drives from Control Techniques for its 60kW variable speed wind turbines. The turbines are designed to optimise blade power output by modifying the rotor speed to reflect changing wind conditions. Hence Harbon uses a VSD in regeneration mode to return generated power to the mains grid.

an energy saving to the cube of the speed differential (using the fan laws). Secondly, built-in time-clocking functions in the inverter, combined with use of sensor input signals, enable a high degree of demand-led control and further energy savings. With filters and other components optimised for low pressure drop, fans can also operate close to their maximum efficiency point.

Clearly, then, it's vital for plants to understand that controls and automation can be used to optimise energy consumption, simultaneously cutting running costs and reducing carbon emissions. Indeed, according to Eaton, this is the number one industry trend at present.

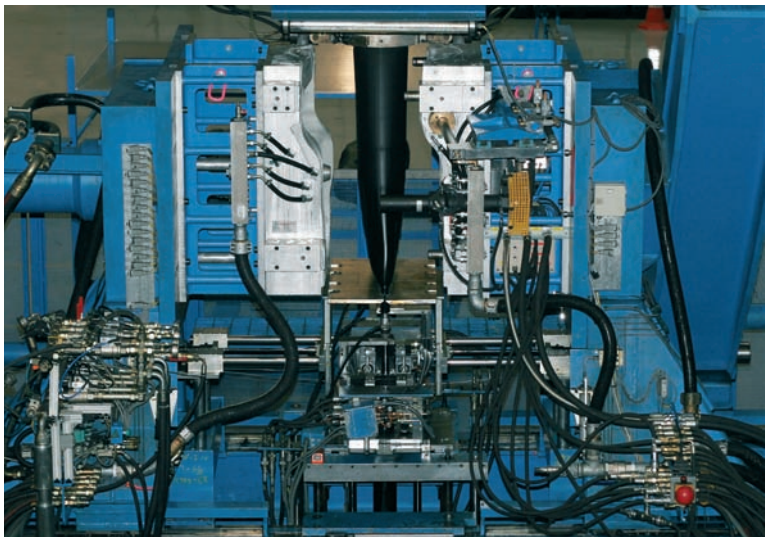
"Projects currently consuming my time are those looking to bridge the gap between automation and control gear, and panels," explains Eaton's product marketing manager for industrial control and automation Stuart Greenwood. "Standardising equipment and making the whole process more transparent are paramount for plants. But it's also important for engineers to see how much current is being drawn, for example, and whether a system is close to tripping."

Wireless zone

Conventionally, this would require specialist, expensive relays and current transformers. But among technologies helping to make improvements is Eaton's SmartWire-DT system, which all but eliminates the need for control wiring in panels and machines. In fact, in many applications, programmable control relays with integral SmartWire-DT connectivity now make it possible to implement control systems without the need to use PLCs, However, if a PLC-based control system is preferred, motor protection circuit breakers with SmartWire-DT also allow users to monitor the operation of their motors in detail and in real time.

According to Greenwood, process environments, including refrigeration, automotive and HVAC, are increasingly frequent consumers of this technology. Why? Because a key benefit is that, in many cases, it allows emerging problems to be identified and addressed before a motor trip occurs. SmartWire-DT, along with integrated HMI/PLC, forms the core of what Greenwood describes as the fast-developing concept of 'lean automation'. In essence, this refers to automation systems that mirror many of the benefits of lean manufacturing.

Left: Eaton's SmartWire-DT system all but eliminates the need for control wiring in panels and machines



Above: Flint, North wales-based TI Automotive is reporting annual savings of £24,000, using ABB variable-speed drives

For example, lean automation makes the design and implementation of automation systems more efficient. It also facilitates continuous improvements in the performance and capabilities of those systems, And it provides scalability that eliminates wasted design effort, by allowing the same basic design of automation system to be used for a range of machines.

Here, bus-based control wiring systems transform the design and construction of control panels. All conventional control wiring is eliminated, replaced by a single bus cable that loops around the devices within the panel, including, for example, motor starters, inverters, pushbuttons and indicator lights. This single cable links all of the devices direct to the PLC or smart relay.

In addition, the bus-based connections not only carry control signals to and from automation devices, but also data. This means, in principle, that any control device, whether as simple as a sensor or as complex as a motion controller, can send data to the PLC for onward transmission to a high-level SCADA (supervisory control and data acquisition) system, thereby providing data transparency.

Greenwood says that, in the near future, it will be possible to go even further down the road to lean automation by using a single bus-based wiring system inside and outside the control panel, thereby eliminating the need for a separate fieldbus.

Whatever the future holds, one thing is certain: smarter, leaner and more energy-efficient motor, drive and control options will continue to be essential components of any plant's economic well-being. PE