

The heart of the intelligent building

Danfoss VLT Drives regional manager John Martin examines how variable speed drives are rectifying the situation in poorly designed commercial buildings

As the spectre of climate change looms ever larger and as energy costs continue to rise, it becomes ever more imperative for businesses to take action on energy savings. This requirement is so critical that it has even been enshrined in law by the new building regulations. That part concerning energy efficiency, Part L, is now 'live' and mandates a substantial improvement of between 23 per cent and 28 per cent in energy performance of non-domestic buildings.

This target is, in many cases, perfectly achievable because the air conditioning systems of modern buildings offer the greatest potential for energy savings. The fans, pumps, cooling towers and humidification systems of today's buildings comprise some 40 per cent of that building's energy costs. Particularly where older HVAC systems are concerned there is invariably enormous scope for energy savings.

Unfortunately, when the majority of our buildings' air-conditioning systems were designed and installed, energy efficiency was not a priority and systems were designed to meet the lowest installed cost. Despite the need for close building environmental control over wide-ranging outdoor conditions, the control mechanisms employed were crude and simplistic.

Electronics usher in new age

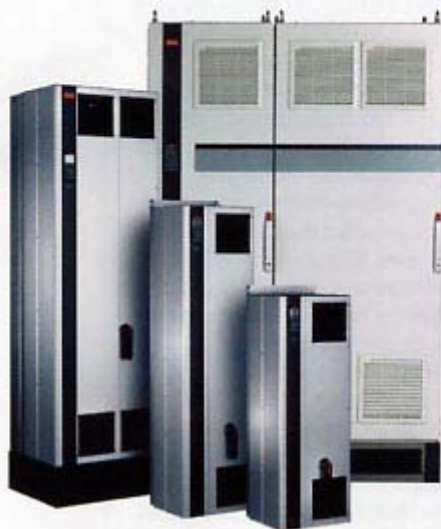
The systems being installed in modern buildings these days could not be more different. Electronics have ushered in an age of superior building management systems (BMS) linked via fieldbus networks such as BACnet, to a complex network of sensors and variable speed drives (VSDs) controlling the motors that drive the numerous fans and pumps that constitute a modern, efficient climate control system. The result is a more

stable, comfortable working environment, right through the year and even on the hottest days.

The greatest contribution to energy efficiency, however, has come from efficient variable speed control of the fan and pump motors themselves. This is where the largest consumption of energy takes place and where the need for efficiency is greatest. Considering the fickle UK climate, it is

inevitable that all of the fans and pumps must be oversized a great deal of the time. Even under the most extreme operating conditions, most systems are designed with a generous 'service factor' and seldom work beyond 75 per cent capacity. Previously, inefficient throttles and dampers were employed to control an oversized system.

The problem with this is that all of the fans and pumps employed in buildings are centrifugal devices that operate to disadvantageous affinity laws governing their power consumption and noise production. The power absorption of a centrifugal fan or pump is a direct function of its speed cubed. The noise of a fan is directly proportional to its speed to the



Integration of a drive is now very straightforward

power five! This means that running fans and pumps at full speed when full output is not required, i.e. most of the time, is both energy inefficient and excessively noisy.

The solution is to vary the speed of the drive motor. In recent years, variable frequency inverter drives (VSDs) have become highly cost competitive and significantly more efficient of themselves. They offer close accurate speed control of standard ac induction motors, and it is from this that an enormous energy-saving opportunity stems. The cube law characteristic of fans and pumps, facilitates an enormous reduction in energy absorbed as their speed is reduced. Theoretically, a speed reduction of 25 per cent would result in a 42 per cent reduction in energy absorbed. A 50 per cent reduction, not at all uncommon, would reduce energy by 87.5 per cent. In practice, damper and vane systems do offer energy reductions as they are closed down, (see Fig.1) but nowhere nearly as significantly as does variable speed control.

Accordingly, it is today rare for a major new building project not to have full VSD control of the HVAC system linked to the BMS. This is

spectacular buildings such as the Swiss Re Tower (the Gherkin) where VSDs from Danfoss were used in the HVAC installation. There are a number of reasons for this. One is that only has there been a significant and continuing reduction in energy per kW of installed power. Inverters themselves are now compact and efficient. It is now a common practice in many countries to install the VSD next to the motor/pump/fan it operates instead of mounting it in a separate control panel. The main advantages of this are that it reduces the size of the main switchboard or control panel and results in simpler installation and easier commissioning.

Matching drive with motor

Along with this is the availability of software facilities that make integration into an overall building environment child's play. Modern inverter drives now can control the speed of the motor by virtue of powerful digital control algorithms, automatic energy optimisation (AEO) which tunes the inverter to the demand of the motor, forming a matched pair that at all loads and speeds drive efficiency is maintained. In addition, the intervention of an inverter between the motor and the mains supply means that the pair exhibits a power factor of unity, a significant benefit.

The energy-saving capabilities of VSDs is best illustrated where fans and pump systems have been refurbished and VSDs incorporated, providing a before and after comparison. An example is Belfast International Airport where Danfoss VLT inverters have been fitted to 28 of its AHUs. This is expected to save over 1m kWh worth £60,000 per annum and recovered the total installation costs in around eight months.

Variable speed drives are leading to much more comfortable conditions in modern offices

