



# A guide to using variable-speed drives and motors in hospitals and healthcare centres

# Helping healthcare meet the energy and CO<sub>2</sub> reduction challenge

With energy expenditure amounting to £750\* million per year, the healthcare sector needs to look at how it uses energy and identify ways of improving efficiency. The National Health Service (NHS) alone has a carbon footprint of 25\*\* million tonnes of carbon dioxide (CO<sub>2</sub>) per year. So to halt and reduce this is going to represent a significant challenge. A hospital is an extremely energy intensive building. Electricity accounts for around 18 percent of a hospital's delivered energy use and it represents over 50 percent of a hospital's energy costs. So if energy consumption can be reduced, financial savings can be made as well as substantial reductions in CO<sub>2</sub> output.

In no other building is indoor air quality as critical as in hospitals. It acts as more than just a facilitator of comfort; it impacts on a patient's recovery. While temperature and humidity requirements are important in hospitals, it is bacteria concentration and cross-contamination that are of critical importance in heating, ventilation and air conditioning (HVAC) design. Within hospitals the HVAC system is also the greatest drain on electricity. So if HVAC systems can be made to work more efficiently, huge sums of money can be saved.

## Variable-speed drives and electric motors

By investing in energy efficient variable-speed drives (VSDs) and high efficiency electric motors to control HVAC systems, hospitals can potentially lower their energy use from 20 to 70

percent, making huge strides toward freeing up valuable funding for further capital investment. These devices control the flow of pumps and fans to eliminate the energy waste that is common with conventional pump and fan control methods.

## How variable-speed drives work

Many existing pump and fan systems are based on throttling arrangements: the motor is driven at full speed and then the flow of liquid or air is regulated by dampers, valves, vanes or similar throttling mechanisms. Throttling the output in this way, wastes energy. A VSD can increase the system's efficiency by adjusting the motor speed to the correct operation point and eliminating the need for throttling.

A small reduction in speed can make a big difference in energy use. A centrifugal pump or fan running at 80 percent speed consumes only half as much energy as a unit running at full speed. This is because the power required to run a pump or fan changes with the cube of the speed.

Because many pump and fan systems run at less than full capacity for much of the time, VSDs can produce huge savings. If a 100 kW pump is throttled by 20 percent, for example, the investment in a VSD will have a payback of typically six months based on continuous operation.

\*Green Investment Bank - A healthy saving: energy efficiency and the NHS

\*\*Sustainable Development Unit Carbon Footprint update for NHS in England 2012





## Benefits of variable-speed drives

### Commercial

- Reduced energy consumption – typically from 20 to 70 percent
- Fast payback – from six months
- Reduced CO<sub>2</sub> emissions
- Enhanced Capital Allowances available

### Technical

- Lower maintenance costs
  - Starting, stopping and braking can easily be programmed to reduce stress on mechanical equipment
  - Increases equipment life and reduces maintenance requirements for pumps, motors and pipework
- Easily retrofitted into an installation
- Real time clock
  - Can easily set up programmes with different running speeds at different times or on different days, making the drive ideal for hospital applications
- Low harmonic solutions available as part of installation design

### Staff and patients

- Clean air circulation throughout critical hospital areas
- Tighter control over temperature changes
- A more comfortable temperate environment

### Facilities manager

- Gain control of heating, air conditioning and ventilation costs
- Easy to retrofit VSD into an installation

# Using variable-speed drives

## Controlling motor-driven applications

Many HVAC distribution systems operate at a constant flow rate, however peak demand may only be required for a small part of the day. The conventional response to control heating and cooling within hospitals is to control flow to individual rooms, while maintaining peak flow in the central HVAC system. However, this consumes considerable energy and equipment lifespan is shortened.

A much better approach is to use a VSD on HVAC pumps and fans to vary air or liquid flow to meet changing load demands more precisely.

Applying a VSD to a 75 kW motor in continuous duty, can save nearly £15,000 per year on one single application, as well as significant reductions in the building's carbon footprint.

## Retrofitting VSDs onto existing motors

It has been estimated that only one in four motors used in HVAC applications are controlled by a VSD. This means that there are many pumps and fans that could benefit from being controlled by a VSD, resulting in significant savings, greater comfort for staff and patients, lower noise levels and reduced maintenance costs.

Installing a VSD onto an existing motor - retrofitting - can be readily achieved for many applications.

The best way of determining the cost effectiveness of a potential VSD retrofit is to look at the power needed at each operating condition, firstly with and then without a VSD.

Proposed energy savings can then be calculated by taking the reduction in power at each condition and estimating the savings based on the actual or expected operating time of that condition.

The Hammersmith and Charing Cross NHS Trust has retrofitted more than 70 high-efficiency electric motors and VSDs at its two London hospitals. The project was carried out with minimal disruption to the normal operation of the hospital and has resulted in improved HVAC efficiency with savings of over 25 percent.



### Replacing existing VSDs improves efficiency

Existing VSDs can be considered for replacement, even if they have not actually failed. An old VSD could be costing money unnecessarily, compared to more modern and efficient products.

ABB offers a replacement VSD and motor scheme in which it will help with the transfer from old to new, more efficient equipment. As part of the scheme, ABB can help dimension, install and start-up the drive and motor.

Part of the dimensioning might involve an energy appraisal to ensure that the maximum energy saving and CO<sub>2</sub> reductions are achieved. ABB also advises of any finance or Enhanced Capital Allowances for which the VSDs or motors may qualify.

During the site visit guidance will be given on any specific engineering that is needed including fuse rating, cabling and any mechanical modifications.

Once installation and start-up is complete, ABB will dispose of the drive or motor in accordance with the latest environmental legislation.

Following recycling, ABB issues a certificate that can be used for environmental audits by end-users complying with ISO 14001.

### Save on commissioning with BACnet

Within hospitals it is common to have a range of installation equipment from multiple manufacturers. BACnet allows for simple, cross-system integration in buildings. BACnet communication protocol is essentially a set of rules for building automation and control networks, governing the way in which equipment communicates over a computer network. It eliminates the need for adding software gateways reducing installation time from between two and three hours, down to 15 minutes, saving money during installation.

Blackburn Hospital is taking advantage of the communication protocol with more than 100 ABB HVAC drives playing a key role in handling the air and water for the facility. The project was the first major building in the UK to use the BACnet communications protocol to control its building services, saving significant time during commissioning.

### Help is available

ABB has a 50+ persons Energy and Productivity Appraisal Team that can provide, within half-a-day, an analysis of the energy saving potential within motor-driven applications.

The team comprises ABB engineers and selected technical partners, all of whom have extensive practical experience of carrying out energy appraisals over the past 20 years and have attended ABB's intensive energy saving training courses.

The team provides organisations with a free, no obligation energy appraisal, in which the installed motor base, is examined and applications that can benefit from the installation of VSDs identified.



# Practical applications

## Bradford hospitals to save over £26,000 on air handling energy costs



### Challenge

Bradford Teaching Hospitals NHS Foundation Trust wanted to save energy as part of an initiative which includes the ongoing development of a long-term policy to conserve energy and minimise investment costs by optimising the phased replacement of older motors throughout Bradford Royal Infirmary (BRI) and St Luke's Hospital.

### Solution

ABB standard drives for HVAC, rated from 0.75 kW to 30 kW, were fitted to 28 air handling units (AHUs) across the BRI and St Luke's sites in critical areas such as theatres and infection control zones. The load on the AHUs varies with the outside temperature, but the biggest difference is between day and night. The fans typically run at half speed at night to conserve energy, reduce noise and minimise wear.

The drives were installed by ABB's authorised value provider, Halcyon Drives, who carried out the project in four phases. The ear, nose and throat department at BRI was first, followed by maternity. Then St Luke's plant room 1 and finally plant room 2

Each drive is connected into the wider building management system (BMS) using the ABB HVAC drives standard protocol BACnet.

### Benefit

The variable-speed drives are delivering savings of more than £26,000 a year to the Bradford Teaching Hospitals NHS Foundation Trust and they are saving more than 200,000 kWh and 110 tonnes of CO<sub>2</sub> per year.

## Medway Maritime Hospital saves £9,000 on HVAC energy costs



### Challenge

Medway Maritime Hospital (MMH) is an acute and general hospital primarily serving the needs of people in Medway, Swale and North Kent. The hospital's main aim is to keep their CO<sub>2</sub> contribution low, as well as cutting energy costs. It was increasingly concerned by the energy consumption of the air handling units (AHUs) in the three plant rooms serving the hospital's Block A

### Solution

The hospital asked ABB authorised value provider IDrives to make recommendations for improving its energy efficiency.

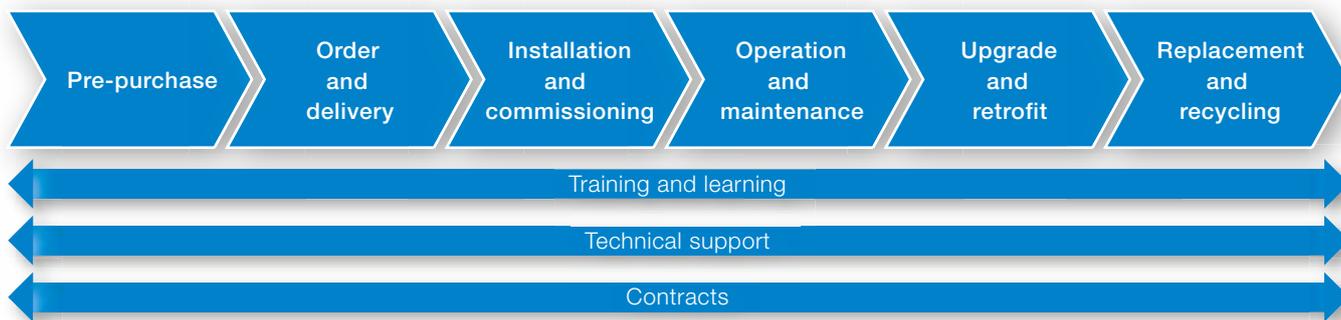
Each plant room has one supply and three extract fans. IDrives measured the power consumption and determined that the AHUs cost a total of over £21,000 a year to run.

IDrives installed 12, ABB standard drives for HVAC, rated between 1 kW and 11 kW. At night, the speed of the fans is set back to 80 percent, while in the daytime they are set to 90 percent. The drives are integrated with the building management system (BMS) so the night set-back is engaged by the BMS to a centrally controlled time schedule. IDrives worked closely with the hospital's BMS vendor to ensure the correct I/O for the drives.

### Benefit

The drives are saving MMH £9,000 a year on the cost of running its AHUs with 32 tonnes of CO<sub>2</sub> saved per year.

# Expertise at every stage of the value chain



The services offered for ABB's VSDs span the entire value chain, from the moment a customer makes the first enquiry through to disposal and recycling of the drive. Throughout the value chain, ABB provides training and learning, technical support and contracts. All of this is supported by one of the most extensive global VSD sales and service networks.

## Pre-purchase

ABB provides a range of services that help guide the customers to the right products for their applications. Examples of services include correct drive selection and dimensioning, harmonic survey and EMC assessment.

## Order and delivery

Orders can be placed through any ABB office or through ABB's authorised value providers. Orders can be placed and tracked online.

ABB's sales and services network offers timely deliveries including express delivery.

## Installation and commissioning

While many customers have the resources to undertake installation and commissioning on their own, ABB and its authorised value providers are available to advise or undertake the entire VSD installation and start-up.

## Operation and maintenance

With remote monitoring, ABB can guide the customer through a fast and efficient fault-finding procedure as well as analyse the operation of the VSD and the customer's process. From maintenance assessment to preventive maintenance and reconditioning of drives, ABB has all the options covered to keep HVAC installations operational.

Should corrective maintenance of drives be needed, ABB offers on-site and workshop repair, fully backed up by the most extensive spare holding.

## Upgrade and retrofit

An existing ABB VSD can often be upgraded to the latest software or hardware to improve the performance of the application.

Existing installations can be economically modernised by retrofitting the latest drive technology to mechanical control equipment, such as inlet guide vanes or dampers or older generations of VSDs.

Instead of replacing an entire VSD or system, it is often more economical to modernise the old installation by reusing all relevant parts of the original equipment and purchasing new where necessary.

## Replacement and recycling

ABB can advise on the best replacement VSD while ensuring that the existing one is disposed in a way that meets all local environmental regulations.

## Entire value chain services

The main services available throughout the value chain include:

- ABB's Bristol Training Centre offers product and application training in the classroom. ABB also offers training courses at customer sites and on the Internet.
- Technical support – At each stage of the value chain, an ABB expert is available to offer advice to keep the customer's process or plant operational.
- Contracts – DriveCare contracts and other types of agreements, from individual services through to complete drive care covering all repairs and even drive replacements, are available.

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