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

Meeting your Carbon Reduction Commitment (CRC)

Power and productivity
for a better world™

Helping healthcare meet the energy and CO_2 reduction challenge

With energy expenditure amounting to £400 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 18 million tonnes of carbon dioxide (CO_2) per year. Since 1990 the NHS's carbon footprint has increased by 40 percent so to halt and reverse 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_2 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.

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 by as much as 50 percent and above, making huge strides toward freeing up valuable funding for further capital investment.

The CRC Energy Efficiency Scheme

Hospitals that consume more than 6 GWh/year and use a half-hourly meter, must register for the CRC Energy Efficiency Scheme - a mandatory scheme to promote energy efficiency and reduce carbon emissions. CRC is a UK based cap and trade scheme and is the UK government's preferred method when it comes to controlling emissions. Although revenue neutral to the Exchequer, CRC will have cash flow implications for qualifying organisations. An energy saving of 5 percent will be needed to cover the average cost of administration within an organisation.

CRCs treat whole sections of the economy as a single entity and set targets for group rather than individual companies. Each organisation is allocated an agreed number of carbon allowances which decreases over time. Those individual organisations that can reduce their emissions easily are able to sell their allowances to those organisations who have not met their targets. The cost of carbon allowances will be paid back to participating organisations. However, payment will be based upon a league table of energy efficiency performance.

Those organisations able to reduce their consumption the greatest receive the initial cost plus an additional 10 percent in year one and those at the bottom of the table get their initial cost minus 10 percent.

Variable speed drives

Hospital electricity costs can be significantly reduced by as much as 50 percent with VSDs from ABB. 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 gas is regulated by 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.

Benefits of variable speed drives

Commercial

– Reduced energy consumption – typically from 20 to 50 percent
– Fast payback – from six months
– Reduced CO_2 emissions
– Enhanced Capital Allowances available
– Interest-free loan available from the Carbon Trust in partnership with Salix Finance

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 condition and ventilation costs
– Easy to retrofit VSD into an installation

Healthcare applications that benefit from variable speed drives

HVAC systems with variable speed drives

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 water flow to meet changing load demands more precisely.

Savings in running costs

Pumps and fans offer the best energy savings potential of any equipment in hospitals. 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.

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 new facility. The project is the first major building in the UK to use the BACnet communications protocol to control its building services, saving significant time during commissioning.

Retrofitting

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.

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.

Estimating running costs

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.

Replacing existing drives improves efficiency

Existing VSDs should also 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 drive and motor scheme in which it will help with the transfer from old drives or motors to new, more efficient drives and motors. 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_2 reductions are achieved. ABB will also advise of any finance or Enhanced Capital Allowances for which the drives 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. Where recycling is not possible ABB will properly dispose of redundant products.

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

What help is available?

Finance

For private organisations, the Carbon Trust may be able to help with interest free loans up to £500,000, email: **www.carbontrust.co.uk**

For public organisations, Salix Finance is an independent company funded by the Carbon Trust. It works specifically with public sector organisations to reduce energy cost and carbon emissions by providing interest-free funding for investment in capital projects aimed at improving energy efficiency. For further information about Salix financial services, email: **info@salixfinance.co.uk**, or call **020 3043 8800**.

Practical applications

ABB motors and drives arrive just-in-time for Coventry Hospital

Challenge

Coventry Hospital needed to install a new HVAC system to control airflow throughout the site, ABB was chosen to supply the VSDs on a just-in-time basis in order to meet the installation time table of Air Handling Systems, the suppliers of the ventilation system.

Solution

ABB supplied a range of VSDs and motor packages ranging in size from 0.55 kW to 45 kW. Because the 230 VSDs and motors packages are matched to each other, the site benefits from extremely efficient power consumption. ABB also provide a 24-hour support service to keep the installation up and running should anything go wrong.

Benefit

Using VSDs to control the flow of air and water in the HVAC system can save well over 50 percent of the energy, compared to using traditional control methods such as throttling valves and vanes. On a large site like Coventry Hospital, this can have a significant impact on running costs. Matched pairs of ABB high efficiency motors and VSDs will reduce energy consumption at the new Coventry Hospital by over 1,400 MWh per year for the ventilation system in block A. Similar savings are expected for the planned blocks B and C.

Clean air supply benefits UK's largest hospital

Challenge

The £210 million Edinburgh Royal Infirmary, needed to install an air handling system to deal with critical and non-critical areas. This included installation into operating theatres where clean air conditions are critical.

Solution

The UK's largest acute teaching hospital is installing ABB VSDs, supplied by one of its HVAC partners, to maintain a clean air supply in its operating theatres. The building will use over 100 VSDs, of varying sizes, from ABB's VSD range throughout the hospital for its air handling applications.

All of the 20 operating theatres are classed as critical applications and each will have three to four ABB VSDs.

The building management system (BMS) monitors the system for any reduction in performance. The BMS then signals the VSD to increase the airflow accordingly. The theatres are not in constant use, therefore the VSDs are often employed in a standby mode, maintaining a reduced airflow in order to save energy.

Benefit

The operating theatres now operate a filtered airflow with a maintained air volume. As static pressure builds up over the air filters, the VSDs compensate for the reduction in flow rate maintaining the air volume.

Five of the operating theatres are dedicated to orthopaedics. Bone operations need a particularly clean environment, with more frequent changes of air. The VSDs need to maintain a flow rate of 1.65m3/s with the air filtered through special ultra-clean hoods containing extra filters. Other areas such as safety cabinets and fume cupboards also have air-handling units powered by ABB VSDs, maintaining a sterile environment.

Life cycle support

The drive for the future

When you choose an ABB VSD, you automatically become part of the most comprehensive product life cycle management scheme in the industry.

Product life cycle management model

The life cycle management model divides a product's life cycle into four phases: active, classic, limited and obsolete. Each phase has different implications for the end user in terms of services and support provided.

In the 'active' phase the end user benefits from warranty options and a full range of life cycle services, spare parts and maintenance materials. This phase ends when the volume production of a particular product ends and the 'classic' phase starts. In addition to offerings available in 'active' phase, end users may migrate to new technology by using upgrade and retrofit solutions providing improved performance and extension of the life cycle.

After the 'classic' phase products enter the 'limited' phase and end users are recommended to start planning a transfer to new technology before product support ceases.

Spare part services continue as long as components and materials are available, and throughout the course of time the use of reconditioned parts increases.

A product is transferred to the 'obsolete' phase when it is no longer possible to provide life cycle services within reasonable cost or the old technology is no longer available.

Benefits of product life cycle management

Product life cycle management maximizes the value of equipment and maintenance investments by:

- ensuring spare part and competence availability throughout the life cycle
- enabling efficient product support & maintenance for improved reliability
- adding functionality to the initial product by following the upgrade path
- providing a smooth transition to new technology at the end of a product's life cycle
- helping the end user to decide when an upgrade, retrofit or replacement is required

ABB's life cycle management model ensures that the required product support is always available and paves the way for a smooth transition to a new product at the end of the life cycle. A VSD product will remain current for about 5 to 10* years, known as the 'active' phase. After this, service support will remain available for a further 5 to 15 years, the 'classic' phase.

Through contact with ABB you will be kept up to date with the support plans for your VSD. At the end of the product life, you will be recommended an appropriate replacement. The old VSD will be removed and recycled in accordance with local regulations.

* Dependent on size of VSD

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