

Case note

Heritage building halves energy costs with ABB standard drives for HVAC



Total energy use has been reduced by 1,800 MWh, saving AU\$160,000 per year.

The State Library of Victoria, Australia, founded in 1854, is a reference and research library with over one million visitors a year. The library holds more than two million books and occupies an entire city block of two hectares, comprising reading rooms, galleries, exhibition spaces, conference centre and café.

Energy appraisal reveals potential

An energy appraisal carried out at the library concluded that significant energy savings could be made by replacing the existing flow control, which used throttling valves, with variable speed drives.

The library has four, water-cooled chillers with eight motors ranging from 15 to 55 kW; five cooling tower fans with one 11 kW motor each; and two gas-fired heating boilers with one 22 kW and one 30 kW motor on the hot water circulation pumps.

The chillers were running with 50 to 60 percent throttling at the discharge end, as well as across the evaporator and condenser vessels. The same flow is now produced without throttling but with motor speed reduced to between 75 percent and 90 percent of full speed.

The five cooling tower fans were controlled by continuous starting and stopping of the single speed motors, running approximately five minutes each time. These motors now run continuously at approximately 50 percent speed.

Consumption reduced by 1,800 MWh

Using 15, ABB standard drives for HVAC, from 5.5 kW to 55 kW, energy savings of between 30 to 60 percent were achieved across the various applications. With combined motor ratings of 400 kW and 24/7 plant operation, the total energy consumption was reduced by 1,800 MWh annually, saving the library nearly AU\$160,000 per year. The projected payback was 16 months, however actual payback, including maintenance savings, was closer to 13 months.

“I was surprised by the large savings that could be achieved by reducing the speed of fan and pump motors by just a little,” says Mike Brown, facilities manager at the State Library of Victoria.

“In the past we only used AC drives to control speed when we wanted a specific flow rate. Through the energy appraisal, I became aware that great energy savings could be achieved as well.”

“Oversizing is the norm in most HVAC installations. The expected load is usually known when the system is designed, however, there are many other factors that are not known, such as the resistance of the new pipework. Also, users often want to allow for possible future expansion. For these reasons, specifiers tend to design systems slightly larger than needed,” explains Daniel Mancin, ABB market development manager for HVAC in Australia.

“However, an oversized HVAC system uses more energy than is actually needed to control the indoor climate. The variable speed drive can give the over-capacity back to you in the form of energy savings, instead of wasting the excess energy through the use of throttling valves. The installation of drives optimizes the energy performance.”

Improved efficiencies

The accurate pump speed control offered by the AC drives has improved the chiller compressor’s efficiency. For each degree the return water temperature deviates from the design temperature, the compressor becomes 1.5 percent less efficient. Circulating cooling water at the optimum speed means less energy is needed to run the compressor.

In addition, AC drive control gives more accurate fan control in the cooling towers, as it has eliminated margin around the setpoint: the so-called deadband.

Significant noise reduction

As well as reducing energy consumption, the drives have significantly cut noise pollution from the cooling tower fans, thereby eliminating disturbance for library visitors while improving living conditions in nearby residential blocks.

Maintenance is reduced compared to stop-start control, as the drives’ soft-starting reduces wear of motor bearings, fan bearings and fan belts.

“Working with energy efficiency can be a challenge in an old building,” says Brown. “No matter how hard we try to raise efficiency, it will never match a modern building. The library is 150 years old and heritage listed. Its large halls with high ceilings make it difficult to air-condition. Some of the walls are a metre thick, which makes it hard to achieve the desired temperature.

“Under these conditions, using AC drives is a useful way to save energy where we can. It also helps us control conditions accurately – the temperature needs to be controlled to 22 degrees and humidity to 50 percent to protect manuscripts, paintings and the two million books in the library.

“The system has exceeded expectations,” Brown says. “It has been very reliable and produced massive savings in energy and maintenance that will be reaped in the coming years.”



Throttling valves on the water-cooled chillers have been replaced with variable speed drives.

Challenge

- Reduce the energy consumption of chillers and cooling towers in an existing HVAC system

Solution

- AC drives eliminate energy waste caused by oversizing of the system and subsequent throttling

Benefits

- Energy savings of between 30 to 60 percent across the various applications
- Improved chiller compressor efficiency with accurate speed control
- Precise control of return flow eliminates the need for deadband in cooling tower fans
- Less noise from cooling tower fans
- Soft start reduces maintenance of motor bearings, fan bearings and fan belts

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