

CASE STUDY | MELBOURNE, AUSTRALIA | 2021-02-03

ABB's drive and motor package gives AlburyCity Council water plant an energy efficiency upgrade



In addition to preventing residential disturbances caused by power quality issues.

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(L-R) Anthony Merrett from Remtron and Mitchell Palmer from AlburyCity Council, beside ABB's M2BAX IE3 high efficiency motor.

AlburyCity Council in New South Wales (NSW), Australia, operates two water supply systems to manage and treat raw water to provide clear, potable water. The raw water scheme uses three pump stations to deliver raw water to the Water Filtration Plant where it is treated into safe and secure drinking water for 55,000 residents in the Albury and surrounding region. The Council manages and supplies a separate raw water scheme that delivers untreated water to several large businesses in the area including a paper mill, golf club and equestrian centre.

One section of the clear water reticulation system features a water boosting pump station responsible for pumping to water storage tanks on a nearby hill. From here, the system uses gravity to distribute the treated water to nearby communities. It is on standby 24 hours a day, 7 days a week, with actual pumping operations of between 6 hours per day in winter months and up to 16 hours per day during the summer months.

A result of many decades of steady development, the pumping station area now sits amongst various dwellings including a public school, as close as 20 m.



When equipment causes electrical disturbances

A problem was recognised in the power system each time the station's pumps would start. It was causing a burdensome inconvenience and intrusive electrical disturbance whereby the lights in nearby buildings would dim each time the pumps were started or stopped.

In response, AlburyCity Council engaged ABB Channel Partner, Remtron, to conduct an analysis of the problem and provide a solution with long-term resolve.

Remtron identified the power quality disturbance was caused by the system's installed softstarter motor controller. Modern solid-state power conversion equipment (PCE), such as softstarters, are effective at soft starting a motor however the side effect is harmonic distortion introduced into the power network during the starting and stopping of the motor.

"When the softstarter would activate the associated softstarting action created unwanted distortion on the power network," said Anthony Merrett, Automation Support Engineer - Drives and Power Quality for Remtron.

The electrical stress caused by harmonics and high starting currents pollute electrical networks with dirty power that can make connected equipment behave erratically. In severe cases they can cause damage to sensitive electronic equipment, interference in communication equipment, and give false readings on measurement devices. In the case of the nearby dwellings, it was these harmonics that

were responsible for interferences in their electrical lighting systems. Across summer months, when treated water consumption increases, and the network demand is at its limit, the impact on the network was even greater.

It became Remtron's goal to not only solve the network disturbances, but also assist the Council in optimising their system's overall infrastructure to reduce the risk of operational failure, extend equipment lifetime, increase energy efficiency, reduce their carbon emissions, and therefore subsequent electricity costs.

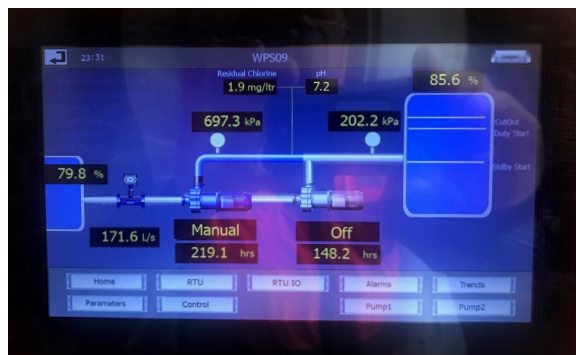
Inefficiencies identified in the existing pumping system

Analysis of the existing softstarter and motor pumping system indicated efficiency gains can be realised by using variable speed drive control.

A more efficient method to pump water is by using variable flow control and operating at pump's Best Efficiency Point (BEP). The BEP is found along the pumping curve by measuring water flow rate and pressure.

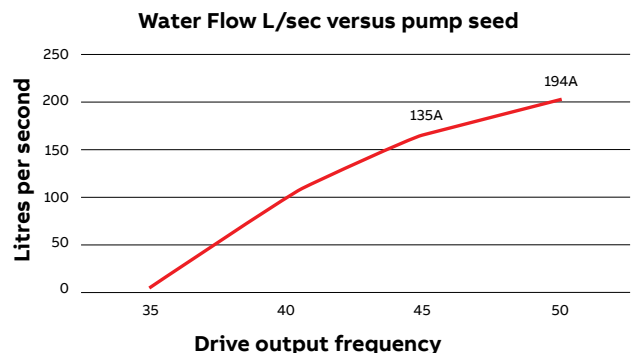
After installing a variable speed drive (VSD), it was observed that when operating at motor frequency 45Hz water was pumping at 176 litres per second. As a comparison, when the motor frequency was increased to 50Hz, water was pumping at a higher flow rate of 210 litres per second. Remtron determined that although that 50Hz achieves a greater flow rate, because it's not at the BEP, it costs significantly more to pump.

Figure A



AlburyCity Council's pumping system interface, with pressure and flow rate indicators.

Figure B



Pumping chart shows the flow rate at 45Hz and 50Hz, and the relative energy consumed in amps (A).

Figure B proves that by decreasing the motor speed frequency from 50Hz to 45Hz results in higher pumping energy efficiency per litre of water pumped.



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01 Installed ABB ACQ580 ULH variable speed drive on site at the water pumping station operated by AlburyCity Council

02 Second ABB ACQ580 ULH drive installed in the pump room on site, used to optimise existing application as a customised approach by Remtron to give AlburyCity Council the best outcome. The Control System also features ABB automation equipment including an ABB AC500 PLC and ABB CP610 HMI touchscreen visual display unit for accurate, digitalised monitoring.

03 ABB's drive and motor package, installed in AlburyCity Council's pump room



Technologies to solve the problem, easily

A drive and motor package was identified to be the best solution for AlburyCity Council. It featured ABB's ACQ580 ultra-low harmonic (ULH) variable speed drives (VSD) and ABB's M2BAX IE3 premium efficiency motor.

ACQ580 water dedicated drives are engineered to reduce harmonics in the power network. They easily integrated into the Council's existing system without concerns of wider disruption. This meant there was no need to oversize the electrical system or budget for broader investment in additional infrastructure. Also, by using this clean technology, the need for any additional filters or power quality equipment is eliminated.

Alternative 6 pulse drives emit 30-45% Total Harmonic Distortion (THDi) compared to ULH drives which typically emit less than 3%. In contrast to other harmonic mitigation technology that use external filters, ACQ580 ULH drives are also much easier to install with minimal wiring required thanks to their design and small footprint. The ACQ580 drives improved the quality of the power network and enabled the system to advance from a fixed speed application to variable speed. The ULH drive ensured that THDi was less than 3%, even when the motor pump speed was varied.



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"We knew we would be saving energy by knocking a couple of Hz off the speed of a motor by installing a VSD, but through this project we now understand how to choose the best motor speed and more importantly all of the other benefits achieved by installing a VSD." said Mitch Palmer, Electrical Supervisor for Construction and Maintenance at AlburyCity.

AlburyCity Council now benefits from the efficiency delivered by variable speed motor control (Figure B). It was proven that running at 50Hz full speed results in pumping 1.03 litres per second per ampere, however this was less efficient than running at 45Hz, which results in higher efficiency pumping at 1.22 litres per second per ampere consumed.

By lowering the speed of the pump, the Council benefits from better performance overall whilst lowering energy consumption. "It's essentially optimising the demands of the process with less wear and tear, lower pump cavitation and hydraulic stress through the pipes, just by being able to reduce motor speed by 10% via the drive," says Anthony. "But first and foremost, it solves the original problem - there's no more light flickering for any building in the area."

ABB's M2BAX low voltage IE3 premium efficiency motors were also installed at the pumping station site. The motors, supplied by ABB Channel Partner A1 Electric Motors, are a cast iron motor especially designed for applications like pumping, because they're robust and reliable even in tough, ambient conditions.

Electricity needed to power equipment like motors has long known to be the culprit of lofty operating costs. Premium, high-efficiency motors provide greater overall cost savings for users thanks to their low energy operational needs and long-term product lifecycle. This also supports in the reduction of environmental impact across the entire motor lifetime.

The combined drive and motor package affords the Council with guaranteed performance that stems from one manufacturer, delivering a quality-backed and integrated solution.

Results that exceed expectations

The newly upgraded system equipment has allowed the Council to run their pump at BEP. They've already gained 20-30% in energy savings which has resulted in reduced electricity running costs. During the starting of the pump there have been no disturbances to the power system.

The Power Factor (PF) on site has improved from 0.87 to 1 under all load conditions. A PF of one or "Unity Power Factor" means no extra reactive current is needed to attain the required power output.

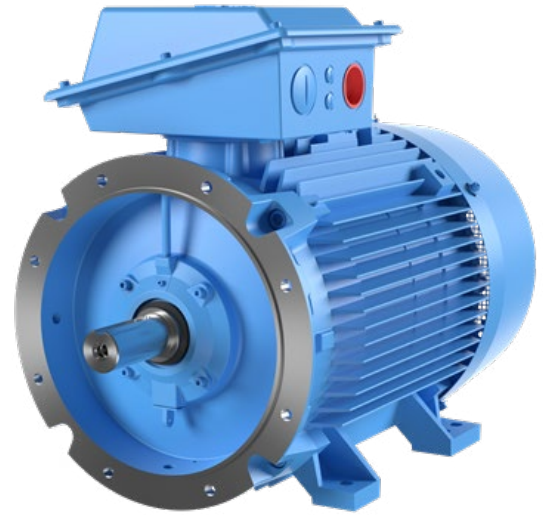
The harmonics remain low during operation, exceeding Australian AS61000 standards guidelines, and the pump efficiency can now be matched to the system efficiency, slowing the pump to 45Hz, to achieve greater overall energy efficiency.

An 8kHz switching frequency has been used on the M2BAX IE3 efficiency motor to eliminate any high frequency whistle and to reduce noise when the motor is in operation.

In reflecting on the project work he undertook with ABB Channel Partners Remtron and A1 Electric Motors, Mitch says, "I had a somewhat thorough knowledge of motors and drives and while I knew there was more to learn, these guys blew me away. I really enjoyed working alongside Remtron and A1 motors. Not only did they share their knowledge of equipment solutions and all things electrical, their mechanical comprehension was invaluable. The effects mechanical and electrical components can have on one another when there is a problem is profound, but equally so when all factors have been considered and aligned. The results are genuinely impressive."

Mitch adds, "using energy efficient motors and ultra-low harmonic drives, with the added benefit of Unity Power Factor has allowed us to capture cost savings in total power consumption."

In the end, AlburyCity Council succeeded in not only solving the problem of the electrical lighting disturbance in the nearby dwellings, but also upgrading their ageing infrastructure to enable their water supply system to operate more efficiently and cost effectively. As the development of suburban buildings continues to encroach upon pumping station surroundings, the Council can rest assured that with their new infrastructure, they will no longer run the risk of causing network disturbances.



Learn more: ABB's [M2BAX IE3](#) premium-efficiency motor



Learn more: ABB's [ACQ580](#) water dedicated drives

Learn more about ABB's efficient and reliable solutions for water applications.