How achieving best efficiency point in pumping delivered cost savings for Lower Burdekin Water

ABB in Australia has helped a Queensland irrigation provider achieve cost savings, lower energy consumption in operations, and realise long-term operational efficiency with ABB's ACS880 ultra-low harmonic variable speed drives (VSDs).

Lower Burdekin Water is a water service provider for irrigation and aquifer recharge in Northern Queensland, Australia. They've been replenishing groundwater since 1965 to deliver sustainable water services to industries, communities, and the agriculture sector. Their Northern Division operates thirteen irrigation pump stations with a total water allocation of 156,000 mL. The distribution system runs for 203 kilometers and a total pumping capacity of 1,075 megalitres per day (mL/day).

Addressing application key needs and rising electricity costs

Every major river system has an aquifer of some kind; the Burdekin River has one of the largest coastal aquifers within Australia. This river forms part of the Burdekin Delta, which is an open aquifer in which the freshwater resource has been managed wisely through replenishment activities.

As part of their application, Lower Burdekin Water's Northern Division extracts the 1,075 mL of water per day out of the Burdekin River system through irrigation withdrawal and river recharge. This river pumping activity lifts water from the Burdekin River for distribution to recharge areas, or to supply water to agricultural customers.

The major challenge being experienced by Lower Burdekin Water was increasing electricity costs. The cost of electricity already makes up about 30% of their yearly annual budgets. These increased electricity costs are reflected in higher water prices for their customers who are facing their own mounting electricity overheads connected with their on-farm infrastructure.

Lower Burdekin Water recognised the potential to achieve significant electricity usage savings and mitigate the effects of electricity prices by optimising pumping at their pump stations.

That's when Lower Burdekin Water approached ABB and local expert consultant Queensland Engineering Enterprise (QEE) about the best way to use advanced technologies to identify and utilise each pump's best efficiency pumping (BEP) point. The approach would help them lower energy peak demands overall by installing more innovative, smart, connected technologies, and create a balance of pump delivery and system demand.

David Sartori, Executive Officer at Lower Burdekin Water said, "the driving force behind us wanting to find a more energy efficient solution was to give us the ability to then pass on reduced costs to our customers. It was a case of mitigating the cost increases from our electrical supplier by reducing energy consumption, so we could successfully maintain a sustainable water cost level for our farming customers, residential communities, and businesses. This in turn allows them to operate their businesses and everyday requirements more cost effectively."

It was also important for Lower Burdekin Water to find an ultra-low harmonic solution to prevent electrical network disruption. Harmonics pollute the electrical network and make equipment connected to it behave erratically. They can cause damage to sensitive electronic infrastructure, interfere with communications equipment, and give false readings on measurement devices. Because of the weak electricity network in far North Queensland – common in natively expansive rural geographical locations in Australia, a solution with inherent ultra-low harmonic performance was a necessity. It's also a requirement of the power authority in Queensland to ensure a clean network for all users.

Additionally, various stakeholders involved in the project presented diverse priorities. The approved system needed to uphold the values of all those involved. Emphasis was placed on infrastructure that would endure the elements and remain independently reliable for at least 30 years, one that could deliver solid risk mitigation for all stakeholders when it came to project delivery and operational performance, and one that was easy to service and maintain. Minimising loss of supply due to unplanned downtime would mean that irrigation needs could be consistently met therefore eliminating any negative consequences for customers who rely on this critical resource.

Lower Burdekin Water also found strong affiliation with ABB's shared business value of personnel safety which was paramount in their project specification and needed to be evident in the end solution.

Telling results via deep application analysis

ABB and QEE worked with Lower Burdekin Water to undergo a deep analysis of their application, existing pump performance and system. This included a harmonic investigation, as requested by the local power authority.

It was determined that the pumps were bound by a limitation to only run at full speed, and that the control system only permitted a mode of operation that adversely resulted in frequent starting and stopping. Control of pumps in this way produces several negative impacts, including shock loading to the pumps and pipe network.

Triggering shock loads to motors, couplings, and pumps substantially reduces equipment lifetime and demands increased maintenance. Instigating pumps to start and stop in this way also generates heavy hydraulic shock loading within the piping network. This effect is commonly associated with system leakage and damage to components within the network.

Additionally, ABB and QEE evaluated the profitable total cost of completion for a proposed solution – products and installation included. This was predicated on Lower Burdekin Water's specifications and calculated savings for investment return.

Answering the needs of Lower Burdekin Water

ABB and QEE's approved proposal features a system that includes ABB's ACS880 ultra-low harmonic (ULH) variable speed drives (VSDs). This technology keeps the electrical network clean, reduces the risk of disturbances, and prevents interference with communications equipment.

Alternative, older technologies like 6-pulse drives were not a good match for Lower Burdekin Water's site due to the pollution and disruption to the electrical network that they would have caused.

ABB also combined sine and common mode filters into the technology to prevent both motor winding and premature bearing failure in the pre-existing older pumps that would remain in operation on site. The alternative would have been to replace the existing motor cables with 36 shielded cables each at a length of over 100 metres per cable, totalling 4km. The cost to implement this, along with excavation costs, would have been significantly higher.

Installing an integrated, type tested, and arc flash rated product such as the ACS880, allowed for both a safe installation and the utilisation of the existing infrastructure at this pumping station. This considerably reduced the total cost commitment without compromising on safety.

David emphasised that ABB's type tested unit which simultaneously substantiated certified arc flash containment was a key proposition value. "As an end user, having a cleaner, all-in-one solution is most advantageous for us. Our entire needs are met, and we experience piece of mind knowing we have a consistently reliable mode of operation, plus ongoing support," he says.

Keeping in mind that the Lower Burdekin Water's ultimate goal was to reduce their cost per litre of water supplied, ABB and QEE were able to show them that by installing the ACS880 units, they would be able to control the speed of the pumps to what was most efficient to move the required amounts of water on any given day.

To enable this a smart control system was designed to manage the best efficiency set points for each pump. Lower Burdekin Water could enter their water requirement into the controller, and the system would auto calculate the best pump and speed combination to prioritise BEP and peak average demand.

In addressing the mechanical shock loading issue due to the regular start-stops, the ACS880 drives have enabled Lower Burdekin Water pump stations to now operate continuously and consistently without the need for frequent starting and stopping. As a result, it's expected that Lower Burdekin Water will see impressive savings in the future by avoiding pipe network repairs.

Driving distinction - a product backed by an extensive lifetime and remote support

Lower Burdekin Water didn't just purchase a product to fit their needs. They were sold on the full availability of a preventative maintenance schedule, spare parts kits, and customised product lifecycle plans. This distinctive combination is why Lower Burdekin Water chose ABB over other suppliers.

It's expected that their new solution will withstand at least 30 years of vigorous application activity. They've also significantly reduced the need to acquire re-placement solutions which commonly happens every 10 years. This is manifested in ABB's operating model and business strategy to embed sustainability across all aspects of the value chain. It contributes to a circular economy of reducing waste by increasing energy efficiency and fostering durability which can also be experienced by customers.

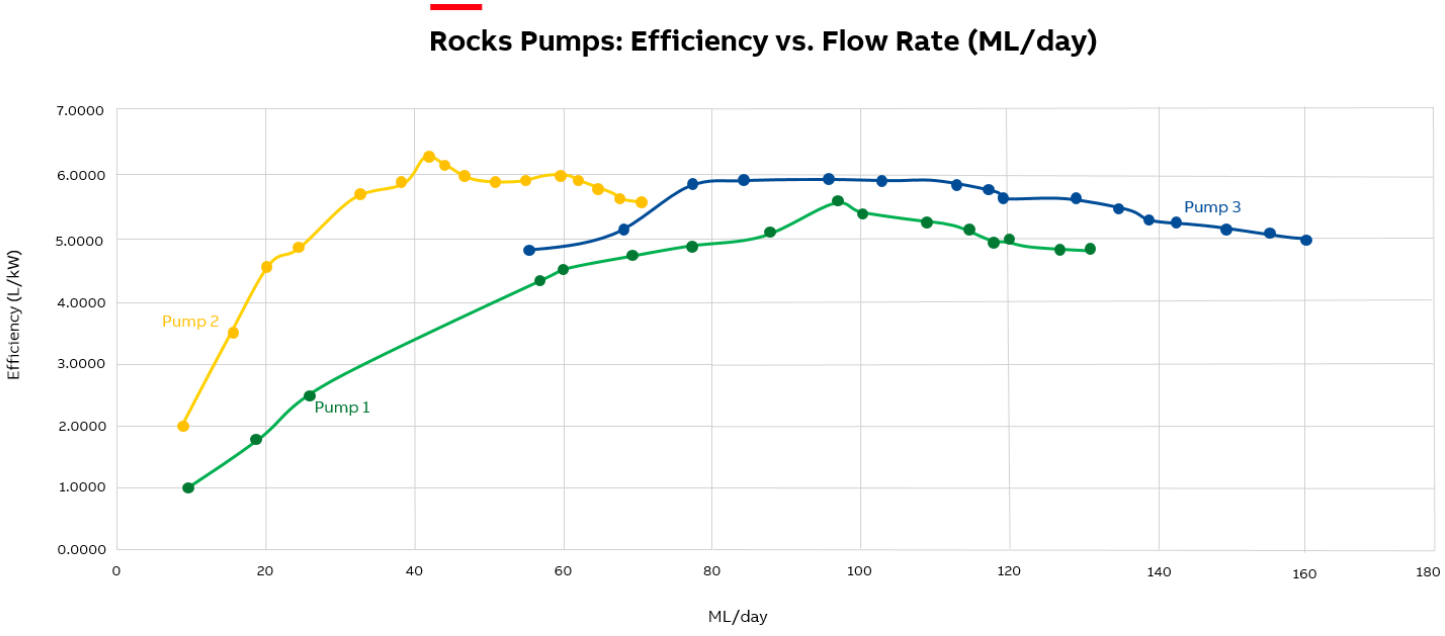
The ACS880 – already making positive impacts

Data analysis of Lower Burdekin Water's Rocks Pump Station performance relative to litres per kilowatts (kW) in efficiency versus the flow rate of water in megalitres per day (mL/day), has already shown positive results. Through the simple intro-duction of variable speed pumping BEP mapping has become clearly visible.

Figure 1 shows that Pump 2, whilst running at 40ML per day is the most efficient operating point for this pump station. Facilitating a lower flow rate also supports fewer starts and stops. It's also been highlighted that whilst Pump 1 and Pump 3 are identical systems, Pump 1 is operating with a considerably reduced potential efficiency. This is caused by a smaller sized impeller in Pump 1 which is a traditional method used to reduce power and pump capably at full speed.

Now that variable speed pumping has been introduced into the application, Lower Burdekin Water can simply increase Pump 1's impeller back up to a standard size to gain increased efficiency by approximately 18%.

Figure 1



Litres per kilowatts (kW) in efficiency versus the flow rate of water in megalitres per day (ML/day) – a comparison of three pumps at Lower Burdekin Water's Rocks Pump Station.

Mike Briggs, Head of Motion for ABB in Australia says, “ABB is proud to be a part of helping Lower Burdekin Water to achieve their mission of responsibly supporting the sustainable management of groundwater resources in the Burdekin delta area and creating a more energy efficient and sustainable lifecycle for their infrastructure.”

Learn more about ABB’s ACS880-37 variable speed drives.
Understanding harmonics and how to overcome these challenges.

New ABB AC880-37 Drives being retrofitted into the existing switch house.

Installed ACS880-37 variable speed drives.

Burdekin River and Rocks Pump Station Pump intakes.

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