GROWING DEMAND FOR DESALINATION REQUIRES BETTER ENERGY EFFICIENCY

The water industry must focus on striking the right balance

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Water demand is continuing to increase as the global population grows. Clean water is required by people for drinking, cooking, and washing, and by industrial facilities for cooling and other processes. Agriculture in particular is a major consumer of water, with irrigation using about 70 percent of the world's fresh water.

One water industry segment experiencing significant growth is desalination. Desalination is one of the most energy intensive areas of the water and wastewater industry; although it produces less than 1 percent of the world's fresh water, it accounts for around 5 percent of the industry's electricity use.

During desalination, it is the pumping processes which use the most energy. This includes, for example, raising sea water to the level of the facility, high-pressure desalting with semi-permeable membranes, and high-pressure pumping for reverse osmosis. The energy required to run high pressure pumps accounts for approximately 25 to 40 percent of the overall cost of desalinated water.

Thanks to advances in technology, reliability, and economies of scale, the average capacity of desalination plants has increased from producing 100,000 cubic meters of desalting water per day to 500,000 cubic meters a day. This is expected to grow even further due to the effects of climate change.

The most widespread desalination method is reverse osmosis (RO), a complex, multi-stage process that forces seawater through the minuscule pores of a membrane. Each stage involves its own applications and technologies—many of them highly energy-intensive—such as seawater intake pumps, booster pumps, and high-pressure pumps. The process requires vast amounts of electrical energy, making electricity one of the highest running costs in desalination. The greenhouse gas emissions created in generating the required power, especially in the Middle East, where fossil fuels are widely used, significantly contribute to global warming.

The water industry must focus on striking the right balance between energy efficiency, reliability, and cost-effectiveness when choosing the technology to use in the desalination process. As a result, key stakeholders, including desalination process managers and operators, original equipment manufacturers (OEMs), system integrators, and engineering, procurement, and construction companies (EPC) are demanding more energy-efficient solutions.

ENERGY EFFICIENCY THROUGH OPTIMIZED MOTOR CONTROL

The ratings of motors and drives are increasing to meet the demand of larger membranes and higher operating pressures. High pressure pumps are currently rated up to 11 kilovolt (kV) and 7.5 megawatt (MW).

Optimizing the production cost of a large desalination plant requires a focus on the cost of running and the cost of not running a motor (i.e., unscheduled downtime). Running cost is directly linked to the motor's efficiency, therefore pairing variable speed drives (VSDs) with energy-efficient motors results in a lower total cost of ownership (TCO).

For medium voltage (MV) motors used in desalination applications, it's critical to design the pump and motor together to ensure the complete system runs at its best efficiency point (BEP). This requirement applies to both variable speed control and direct online motor control start-ups.

Optimized control systems significantly reduce the energy consumed by motors used to drive pumps and other equipment compared to traditional suction-valve control, while using VSDs with high-efficiency motors can lower energy use in clean water, desalination, and

wastewater processes by about 25 to 30 percent.

Moreover, VSDs will help save energy in almost any process that requires a change from full-speed operation—especially those using pumps. This is because, rather than running the motor flat-out and adjusting the pump output by throttling, the VSD enables the load on the motor to be adjusted precisely to deliver the required output.

In the case of a VSD, any potential issues with poor power quality related to harmonics (sometimes known as 'electrical pollution') can be mitigated using an ultra-low harmonic (ULH) drive. This type of drive also reduces the risk of disturbance to other sensitive equipment connected to the mains.

DATA-DRIVEN SOLUTIONS TO REDUCE PLANT DOWNTIME

Desalination plants are usually located close to the sea with high humidity and variable temperatures, which affect the lifecycle of motors and drives. When specifying motors, plant operators must ensure they are suitable for such harsh, corrosive environments, including taking into account a thermal safety limit for insulation and bearings. This helps to extend the lifetime of the motors and reduce their overall maintenance requirements.

It is also important to take a continuous approach to energy optimization—something that can be achieved, for example, through digitally connected motors and pumps with the capability to track energy usage. In fact, the entire system architecture of a desalination plant can be optimized through continuous condition monitoring.

Data insights coming from this connected equipment can be used to identify opportunities for potential energy savings and carbon dioxide equivalent emissions reductions, as well as to track and trace rotating equipment to improve operational efficiency, reduce waste, and maintain compliance with regulations.

TO THE CLOUD AND BEYOND

Data gathered from VSDs' built-in sensors and loggers, together with that collected from sensors fitted to motors, bearings, and pumps, can be aggregated, stored, and further accessed via the cloud. Gathering and analyzing this data can reveal information on the status and condition of equipment so that operators can service activities more logically and effectively over the course of its lifetime.

Digital services, such as remote condition monitoring, provide alerts and information to enable the prediction and mitigation of issues before failure can occur. In turn, these solutions enable improved control, efficiency, and safety of water distribution networks. They can also be integrated with water leakage and quality management systems, and are scalable to any network size.

MODERN DESALINATION IN ACTION IN SINGAPORE

Having enough clean water has always been a challenge for the island state of Singapore, even though it's surrounded by water. The Keppel Marina Desalination Plant (KMEDP) is the latest step for Singapore in its use of advanced technology to meet its current demand of up to 430 million gallons a day. It is one of the first in the world with a dual-mode facility—capable of treating rainwater or seawater, depending on prevailing weather conditions. This makes the plant weather-resilient to provide a stable water supply to the community and meet 7 percent of Singapore's daily water demand.

The plant utilizes various cutting-edge ABB technologies, including automation and control systems, as well as instrumentation and water analyzers. With ABB's supply of energy efficient motors, VSDs and switchgear, together with process optimization aimed at increasing efficiency, the potential gains could help reduce electricity consumption by up to 40 percent. A range of sensors and water-monitoring equipment is also being used in the plant.

An ABB distributed control system—a user-friendly digital platform that gives engineers wide visibility and precise control from a central command center—unifies plantwide control systems. The plant's operations can be extended from device to edge to cloud with the control system. The intelligent and integrated solution allows uniformity of procedures and helps improve the quality of operational processes.

SOLVING THE WATER SCARCITY CHALLENGE

High-efficiency motor-drive packages can lower costs and boost energy efficiency, making desalted water more affordable and accessible to more people for not only safe consumption, but also use in many critical agriculture and industrial processes.

By using the latest technology, we can bring modern desalination processes to the regions that most need them—creating a safe, secure, cost-effective, and high-quality water supply for future generations.

LUCA RIZZO is industry manager of water and power MV motors and generators for ABB. ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation, and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels. With a history of excellence stretching back more than 130 years, ABB's success is driven by about 105,000 talented employees in over 100 countries. For more information, visit **www.abb.com**.