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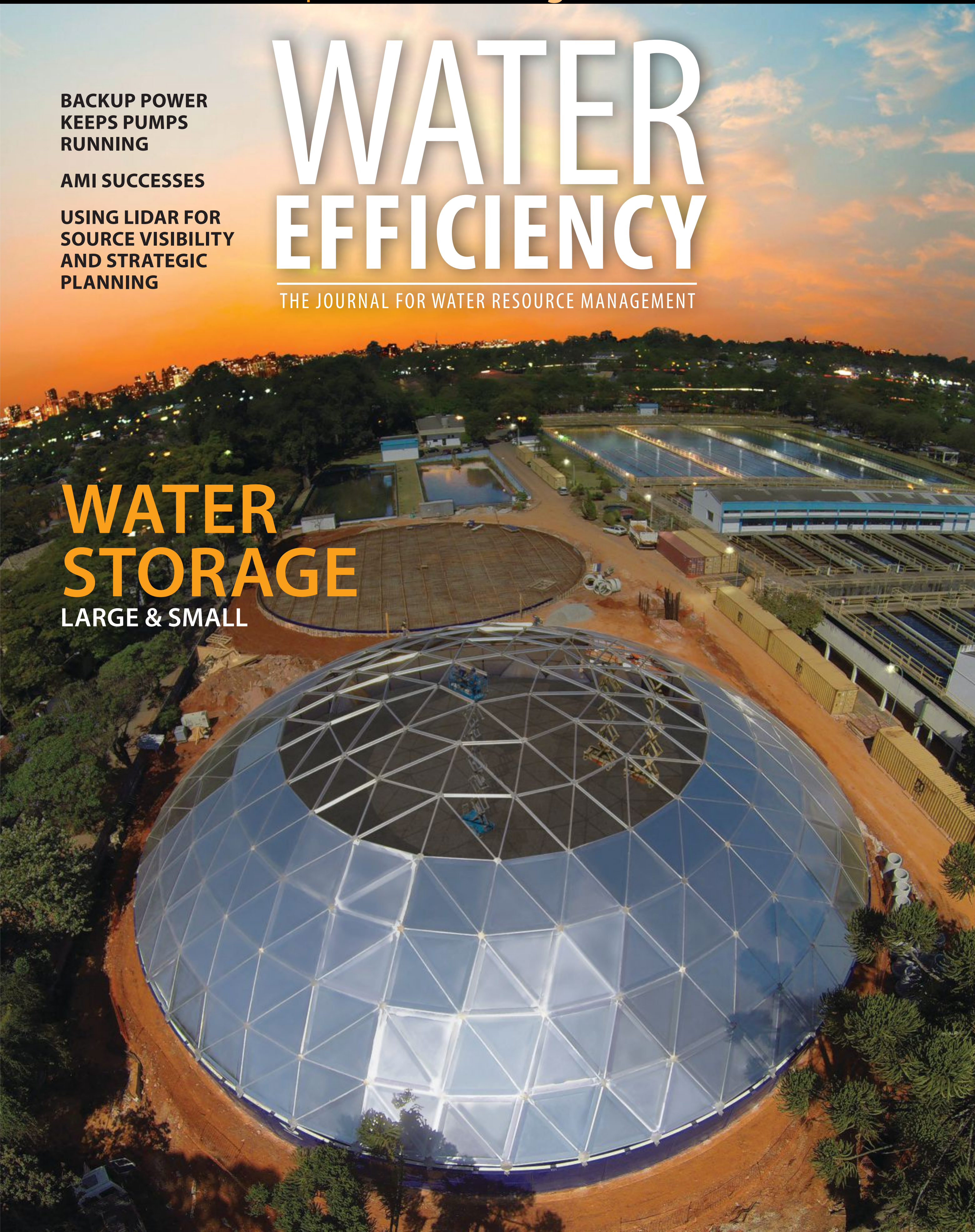

Keeping the Pumps Running When the Lights Go Out

There are many considerations that go along with having a backup power system

By William Atkinson

When it comes to keeping water utilities operating, pumps are considered to be the highest priority. So, what does it take to keep the pumps running, especially if a water utility suffers a power outage from the local electric grid?

There are several steps that water utilities can and should take in this regard.

The first three strategies involve energy efficiency in general for pumps:

1. The first is to ensure that they have the most energy-efficient pumps possible.
2. The second is to conduct energy audits of the pumping system.
3. The third is to introduce other energy efficiency strategies into the utility's pumping system, which might be the result of the energy audit's findings.

These three steps are important. If and when power does go out, backup power sources (such as generators) won't need to be as large or work as hard to keep the pumps running during the outage if you have energy-efficient pumps to begin with, as well as other energy efficiency strategies in place that reduce the need for excess amounts of energy.

The next steps involve arranging backup sources if and when the power goes out:

4. The fourth is to consider a series of stand-alone generators that connect to the electric system and can begin to operate existing pumps again.
5. The fifth is to consider a series of stand-alone pumps that have their own generators.
6. The sixth is to consider a series of stand-alone pumps that can run directly on fuel.

A sewer bypass at the Buckman Waste Water Treatment Plant in Jacksonville, FL

THOMPSON PUMP

EFFICIENT PUMPS

According to "Energy Efficiency and Water Pumping Fact Sheet," published by the Water Research Foundation (WRF), 80% of the energy used in water treatment and distribution is used to pump water. Given the large amounts of energy that are required by the pumps to lift and move water, and because energy costs are often the second highest cost in a water utility's operating budget, the proper selection of pumps, motors, and controls is critical in order to ensure an efficient system and be able to control costs.

According to "Improving Pumping System Performance: A Sourcebook for Industry," published by the US Department of Energy (DOE), in order to ensure that you select the most efficient pumps, it is important to know the rates of flow and pressure in the pumping system. There are many combinations of pumps and components, and the challenge is to be able to identify the most cost-effective and energy-efficient mix in order to be able to match the design of the pumping system.

When evaluating pumping systems for ways to improve efficiency and reduce costs, the DOE recommends that water utilities should identify indicators of inefficient pump system operations. These indicators include pumps with high maintenance requirements, oversized pumps that operate in a throttled position, badly worn pumps, and noisy pumps or valves.

As part of pump system improvement, the DOE recommends that water utilities should evaluate the pump motor. Motors control pump speed and are directly tied to the efficiency of the pumping system. If motors are operated for long periods of time (more than 50% of the time), then motor efficiency increases. They are most efficient when running 75% of the time. The DOE recommends that water utilities should develop plans to upgrade existing motors with premium efficiency models, since those motors can provide up to 10% more efficiency compared to standard models.

In addition, according to the WRF, the installation of variable frequency drives (VFDs) is one of the easiest energy reduction improvements a water utility can implement. VFDs are electronic controllers that adjust the rotational speed of an electric motor (such as a pump motor) by controlling the frequency or voltage of the electric power supplied to the motor. VFDs should be considered when a pump is oversized, or when a throttling valve is used in pump operations. The WRF estimates that the use of VFDs can reduce energy by as much as 50%, because VFDs match the motor speed to the specific energy demanded. As a result, energy is conserved, because the drive operates at lower speeds when appropriate.

One manufacturer offering energy-efficient pumps is Flygt, a division of Xylem. Flygt offers "N-Technology Pumps," which are designed for self-cleaning. "They have backswept leading edges, so, rather than having horizontal leading edges, where material such as rags and other trash can get caught on the impeller, our pumps have a horizontal backswept leading edge, so debris gets cleared off the impeller each time it rotates," says Lisa Riles, North America municipal transport marketing and business development manager. "This eliminates clogging. If you are pumping clean water, efficiency will usually be level. However, if you are pumping wastewater, there will be a decrease in efficiency when you have rags and other debris clogging it." Flygt guarantees a 25% energy savings on its N-Technology pumps compared to standard pumps.

Flygt also offers an Experior solution, called SmartRun, which includes the N-Technology (the self-cleaning function that provides more efficiency), as well as VFD technology. "Each time the pump comes on, an intelligent control system looks at the last time it was on, how long it was operating, what frequency it was operating on, and then adjusts the frequency in order to minimize energy usage," says Riles. "This provides an additional 25% energy savings over the N-Technology pump alone, for a total of up to 50% energy savings."

As noted, VFDs are used to save energy and improve performance. However, many wastewater pump stations experience problems with clogging, due to the fact that the parameters in the VFD are not set correctly. Flygt's SmartRun intelligent control combines the functionality of VFD with a simple interface. A number of key functions for wastewater pumping are pre-programmed, and parameters are pre-set. The control unit provides the intelligence to capitalize on the full benefits of VFD pumping. The SmartRun includes an energy minimizer function that typically reduces energy consumption by 30% compared to conventional on/off systems.

One customer happy with the Flygt solution is Bradley Zellers, town manager and wastewater superintendent for Winamac, Indiana. Zellers was approached by Flygt in 2013 to conduct a study on one of the utility's lift stations. "We were having issues with flushable rags getting stuck in our pumps," he says. "We were pulling pumps a couple of times a week to unclog them." Flygt installed an Experior pump in April 2014. "Since that time, we haven't had to pull it even once," he says. "We are also set up with a SmartRun VFD, and our electric consumption is one-third to one-half less than before.”

> **Inefficient pump systems’ indicators include pumps with high maintenance requirements, oversized pumps that operate in a throttled position, badly worn pumps, and noisy pumps or valves.**

ENERGY AUDITS

As part of its TotalCare program, the Xylem Water Solutions business provides a Xylem Energy Auditing service. A Xylem auditing team diagnoses the entire system and offers recommendations to reduce energy and other operating costs.

The two-day energy audits follow the flow of liquid through a facility, from source to destination. The team tests and measures pressures, flow rates, power usage, and other key metrics at all points in the system. The team also inspects the performance of its own (as well as competitors’) products and equipment, and looks at the interaction between the system’s pieces (pumps, pipes, controls, and treatment equipment) to identify how savings can be achieved. At the end of the audit, the team presents its findings, including recommendations for improving overall pumping system design, upgrading or optimizing equipment, repairing leaks and blockages, and making other system improvements.

Another component of the audit is the Westworth-Flygt Pumping System Efficiency Index, which compares how much a pumping system currently costs to how much it would cost if the system had been designed, installed, and was being operated in the most energy-efficient way.

At one wastewater pump station, which was utilizing four fairly old 55-kilowatt pumps, each of them running about 4,000 hours a year, the team identified improvements that would save between 150,000 and 200,000 kilowatt hours per year.

IMPROVED ENERGY EFFICIENCY IN GENERAL

More and more these days, water and wastewater utilities are placing attention to energy efficiency in general as a way to reduce energy costs, and a lot of these efforts are focused on pumps, which, as mentioned, are the largest users of power. One such utility is the Eugene Water and Electric Board (Eugene, OR). “Our focus on energy efficiency is associated with our pump station rehabilitation efforts," says Jason Carman, water pumping and controls supervisor.

This involves three steps. "First, we use premium efficient motors in all our pump station rehabs, and ensure that the pumping equipment is sized properly," he says. Second, the utility utilizes VFDs at constant-run pump stations, and at those installations where pumps operate against partially-closed valves. Third, it utilizes VFDs at booster pump stations to correct poor power flow and enable more efficient pumping strategies.

"In 2015, our Water Operations department is beginning to performance-test existing pumps to document current pump conditions and eventually create more efficient pumping strategies," says Carman. "This will help us discover the pumps that are not performing as designed or are a mismatch for the specific application."

Another way water utilities can improve pump energy efficiency is to introduce hydraulic models. According to the Water Research Foundation, as water distribution systems become more complex, it often becomes more challenging for water utilities to manage energy use. Hydraulic models enable the utilities to simulate the behavior of the water system and help predict the system's response to changing conditions. These models are typically used for long-term planning, such as for design of new systems and expansion of existing systems.

STAND-ALONE GENERATORS

One company providing backup generators for water and wastewater utilities is Kohler Power Systems. "We offer a full line of gas and diesel generators as emergency gen-sets," says James Kukla, senior channel manager. "If natural gas is available, utilities can use that. If not, they can use diesel."

"It takes a lot of starting kilovolt amps to start generator motors, about six to seven times more than is required to actually run the motors once they have been started," says David Schuh, channel manager for Kohler. "We offer oversized alternators to provide starting kVA [1,000 volt-amps] on our gen-sets to meet the extra demands for starting."

According to Kukla, since starting kVA is an issue, some engineers at water plants have installed soft-starting devices to reduce the starting kVA, so they can use smaller generators. "However, when you do that, the devices pull a non-linear current, or a current that doesn't match the AC sine wave, which causes the voltage to distort on the gen-set," he says.

The Eugene Water and Electric Board takes advantage of generator technology for backup purposes. "We use diesel-powered portable and site-installed generators," says Carman. "The permanently-installed generators are at select sites. We also have several trailer-mounted generators that can be deployed in a variety of configurations."

When considering backup generators,

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it is also important to consider the technology that is necessary to connect the generators to the equipment being operated. Most permanent generators are connected with automatic transfer switches, such that if the power goes out, the switches automatically activate the generators by switching from the utility to the generator.

ESL Power Systems is one company offering connection equipment. "For pumps at water treatment and wastewater plants, our most popular unit is the TripleSwitch, which is a manual load-bank testing and portable generator docking station unit," says Richard Traver, technical sales. "It is popular because it is used with a permanent standby generator and an automatic transfer switch. This allows the utility to load-bank test their permanent generators, which may need to be done monthly." TripleSwitch allows them to quickly connect the load bank and run their tests.

TripleSwitch is a three-way transfer switch that uses three interlocked disconnects to isolate standby generator circuits during COPS (Critical Operation Power Systems) load bank testing. This eliminates the need to strip and reconnect connections each and every time, and is handled automatically with cam connections. It can also double as a manual transfer switch to provide a quick and safe method to connect to a portable generator for redundant backup power. "The TripleSwitch is designed such that, depending on the code for the state, county, or city that requires testing of the permanent backup generator to make sure it is working properly, in case of an emergency, there is a reasonable expectation that the generator will work," says Traver. "Over time, governing bodies have started to make these requirements more stringent. One reason is that, after some of these large storms we have had around the country, it turned out that a lot of these permanent backup generators simply didn't work. And they find out they had never been tested."

Connections are also needed at remote sites. That is, while providing power to the main plant is the most important goal, it is also important to make sure that other locations have power. One effective tool for this is ESL Power's StormSwitch, a manual transfer switch that provides an economical solution for businesses that want to be prepared for emergency power loss. It ensures a simple hookup to a portable power generator during a power outage. "This is used extensively in remote locations where there are pumps that are critical to the operation of the system, but where there are not permanent standby generators in place," says Traver. These may include lift stations and bypass stations. The utility can install a StormSwitch at each location. Then, it can contract with a generator vendor in the area such that, if the power goes out, the vendor can deliver the generators to the remote locations. "Since the StormSwitch is already in place at the station, the company's employees can hook the generator up and start it up," he says. "The water utility doesn't need to send anyone out there at all. The generator company can handle everything, as long as the StormSwitch is in place." There is also an option to include remote monitoring on the StormSwitch. "For this, we will provide the contact and wiring through the breakers, and the utility can provide a signaling device, such as Wi-Fi, that will monitor the StormSwitch from a remote location," he says. Then, if there is an outage, the signal goes to the central utility office, which then sends a request to the generator provider, which then delivers the generator to the station and hooks it up.

STAND-ALONE PUMPS AND GENERATORS

While many utilities opt for backup generators as a way to keep power available to their existing pumps, others opt for stand-alone backup pumps that come with their own generators.

One company offering such technology is Godwin, a division of Xylem. According to Riles, the Godwin DBS (Dri-Pump Backup System) is a combination backup diesel generator and pump, providing dependable backup pumping for use during primary power and switch gear failure, as well as for primary pumping during routine maintenance. It can be used on a temporary basis or as a permanently-installed pump station backup. During use, it will operate at various duties, allowing a single pump to be used at several pump station bypass locations, which provides energy savings through reduced fuel use.

STAND-ALONE FUEL-POWERED PUMPS

A third option for backup power, beyond stand-alone generators and generator-operated pumps, are stand-alone fuel-powered pumps. According to Thompson Pump, independent backup pumps are becoming more popular than generators as the ideal contingency plan. These permanently-installed standby units continue pumping, despite power loss or primary pump failures. They can also act as the primary pumping system during maintenance or repairs. In addition, since they don't involve generators, there is no need for transfer switching systems.

"Our highest efficiency pumps are the JSC and JSV Series," says Bobby Zitzka, national sales manager for Thompson. "Most of our pumps are diesel-driven, but we do offer alternative power sources, such as natural gas and LP gas. These seem to be a growing trend."

Thompson also offers high-efficiency impellers that reduce the amount of horsepower required to move water, which reduces the amount of fuel required. The impellers are enclosed, rather than open, so there is less recirculation of the fluid that is being pumped. "Our pumps can be set up with auto-start/stop systems, so the pumps only run when they need to pump," says Zitzka. "Automatic throttling systems are an option on our pumps, which speeds up or slows down the engine to meet flow requirements, instead of running at full speed all of the time, which also reduces fuel needs." WE

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