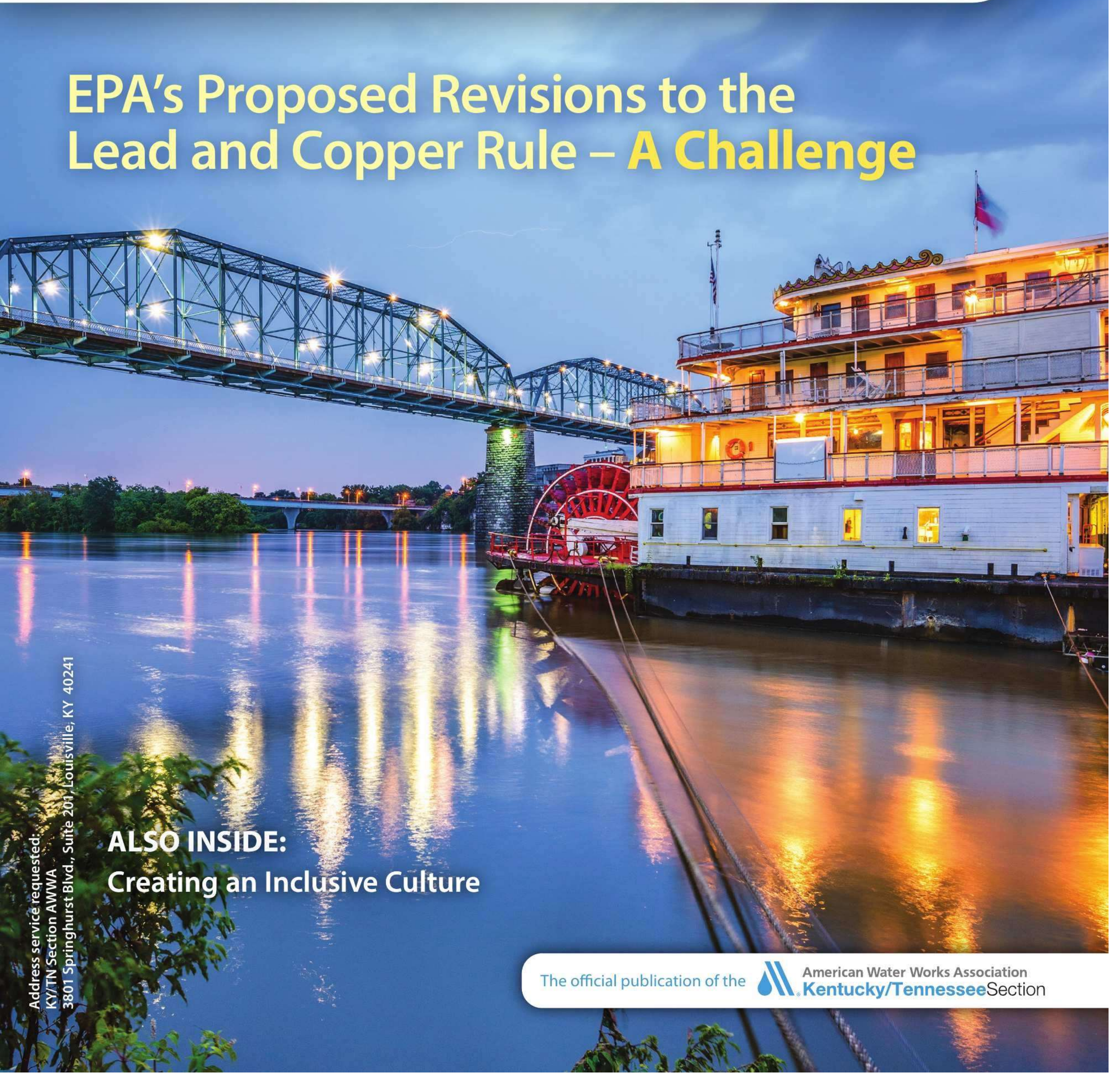
Straight from the Tap

Winter/Spring 2020



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The official publication of the American Water Works Association Kentucky/Tennessee Section

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American Water Works Association
Kentucky/Tennessee Section

The American Water Works Association is an international, nonprofit, scientific and educational society dedicated to providing total water solutions assuring the effective management of water. Founded in 1881 by 22 scientists, engineers, and educators, the Association is the largest organization of water supply professionals in the world. AWWA is the authoritative resource for knowledge, information and advocacy to improve the quality and supply of water in North America and beyond.

AWWA advances public health, safety, and welfare by uniting the efforts of the full spectrum of the water community. Through our collective strength we become better stewards of water for the greatest good of the people and the environment.

Today, AWWA has 50,000 members in 43 Sections, and over 5,000 volunteers who are committed to ensuring the quality of water throughout North America and the world. To find out more about water utilities and safe water, visit our public information website, *www.drinktap.org*.

The KY/TN Section of AWWA was founded in 1925 with a mission to provide resources to effectively manage water and protect public health throughout Kentucky and Tennessee. The KY/TN Section AWWA relies on the expertise of our members to advance technology, science, management, and government policies related to water and provides educational opportunities, technology transfer, and advocacy through the united voice of our diverse membership.

There are over 1,320 members of the KY/TN Section AWWA representing municipal and private utilities, consulting engineering firms, government agencies, manufacturers, industries, and academia. The vision of the KY/TN Section AWWA is better communities through safe water.

www.kytnawwa.org

For information on how to submit articles for publication or to contact the magazine editors, send an email to *memberservices@kytnawwa.org*.

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Features

Departments

Flying Blind No More:

Specific Energy provides the operational dashboard managers, engineers and operators have needed for decades

Mike Bernard, PE, Smith Seckman Reid, Inc.
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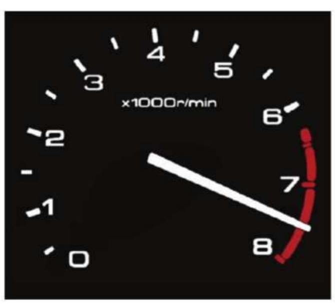
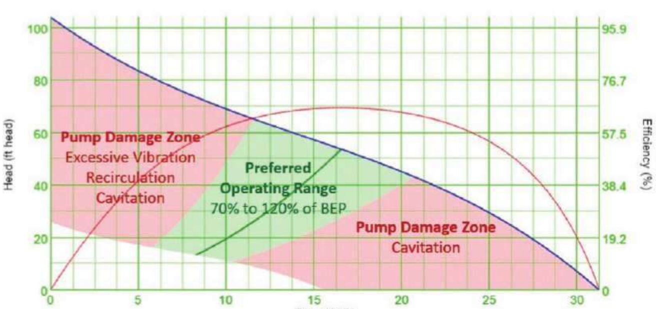


If you looked down at your dashboard and saw this, what would you do? For those of us who remember how to drive a stick, hopefully the answer that popped into your head was "Shift" or maybe "Let off the gas." Redlining a car isn't good for it, right? Would you even consider buying a new car that didn't have a dashboard? How could you properly operate it if you had no idea how fast the engine was turning, how fast the vehicle was going, no idea what gear you were in, and no idea whether there was any gas in the tank? We wouldn't dream of buying, much less operating, a vehicle like that. So why do we do it with our pumps every day? I will bet that right now many of you are operating pumping systems worth far more than your cars, and you are flying blind without any real data on how those systems are operating.

Also, have you ever been told that VFDs save you money? For my entire career, I have been told that putting a VFD on a pump would save my clients money. Who was I told that by? VFD sales people. Know what they left out? A lot. First, VFDs are expensive, so you don't really save money unless you operate the VFD in a way that results in energy savings greater than the cost of the equipment. This is compounded by the fact that VFDs are not 100% efficient. You can expect a 3–4% loss across the VFD, which is why they produce so much heat. You can therefore expect to pay out roughly that same amount of energy again to cool the room to reasonable temperatures.

But that's not the real challenge. The real challenge is associated with how centrifugal pumps work on VFDs. That is a really complicated subject, and one that I personally don't believe is taught very well either in our engineering schools or in our operator training. Did you know that either spinning a pump too fast or spinning it too slow can cause cavitation that damages the pump? How fast is too fast? How slow is too slow?



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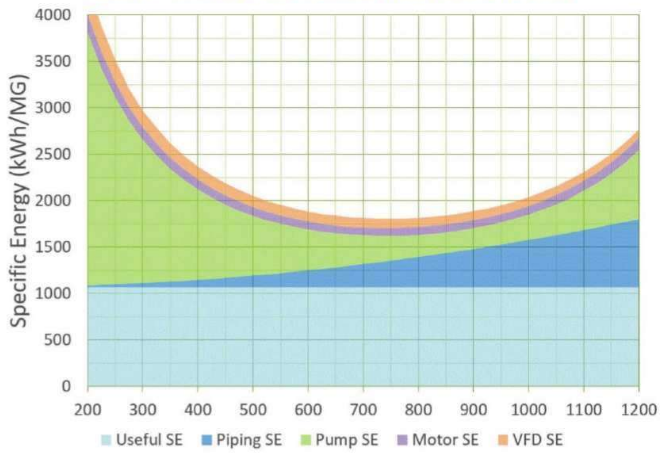
As I mentioned, this is a very complicated topic, and the answer varies from system to system. I once was told that you are OK as long as you don't turn the VFD lower than 45 Hz. It turns out that this rule of thumb is wrong in a great deal of situations.

Over a decade ago, I realized that Murfreesboro had a pumping system where the pumps were being damaged by running too fast. It turns out that this system was designed to temporarily run at reduced speeds until a future date when the operating conditions would change. Unfortunately, this knowledge was not passed down from the previous plant manager to the current one. The operators had no possible way of knowing that they needed to run these pumps at reduced speeds. This is a perfect example of institutional knowledge being lost as a generation of managers retire and the next generation takes over. This example also sent me on a quest to find a software "dashboard" that could help the operators run their pumps correctly. Twelve years later, I finally found that "dashboard." It is provided by a company called Specific Energy. We just commissioned their system on two of Murfreesboro's pumping systems, and it turns out that one was in fact occasionally turning too fast and the other was occasionally turning too slow. For that system, the pumps could only be operated down to 55 Hz before they left their Preferred Operating Range (POR) and potentially experienced the damaging effects of cavitation.

Specific Energy is a Texas-based software developer that has created a platform to help operators better operate their pumps, managers better manage those assets, and engineers to better engineer the systems. It is the first such platform that I have ever seen that is equally valuable to all three job classifications. For operators, the software provides a real-time dashboard that shows exactly how each pump in the system is operating, and will either suggest better operating points, or even control the VFDs to get to those points if desired. For managers, the Asset Management component tracks the health of each pump over time and predicts when repairs or replacement of the pump would be less expensive than continuing to run a worn-out pump. Instead of running pumps to failure, managers can now decide based on real data when it would be cheaper to repair or replace them. And for engineers, the historical data that

FIGURE 1- USEFUL SPECIFIC ENERGY AND LOSSES VS FLOW



the software generates can be used to determine whether conditions in the pipeline have changed over time due to sediment accumulation or tuberculation, and whether a different pump may be more appropriate to the real-world conditions.

The company takes its name from the concept of specific energy, which is defined as energy per unit mass. In their case, Specific Energy optimizes pumping systems to operate at the lowest possible levels of kilowatts-hours per million gallons pumped. Earlier, I asked "How fast is too fast?" and "How slow is too slow?" It turns out that you can plot the specific energy of any given pumping system to determine that answer. Each component of a pumping system exerts a measure of specific energy into the system. The Useful Specific Energy is essentially the static lift associated with how high you are lifting the water that is to be pumped and remains relatively constant. So do the specific energies associated with the motor losses and the VFD losses. The Piping Specific Energy is related to the friction loss of the system and is a squared function of the velocity in the system. The really interesting part, however, is Pump Specific Energy. It is a parabolic function that is dependent upon the design of the particular pump. As you can see in Figure 1, spinning this pump either too slow or too fast not only increases the potential for cavitation, it also results in a significantly higher energy expenditure for every million gallons pumped. The situation gets more and more complicated as pumps are operated in parallel, especially if the pumps are of different sizes or are operated at different speeds. Specific Energy's algorithms calculate all of this every second and relays the information into a dashboard that is a tool for operators and managers to more effectively operate their systems.

The Specific Energy systems at Murfreesboro's two raw water pumping stations have only been in operation for about a month, but they are already proving their value. The operators now choose the operating point with the lowest specific energy at the remote pumping station and then trim to the required flow from the onsite pumping station. This will reduce

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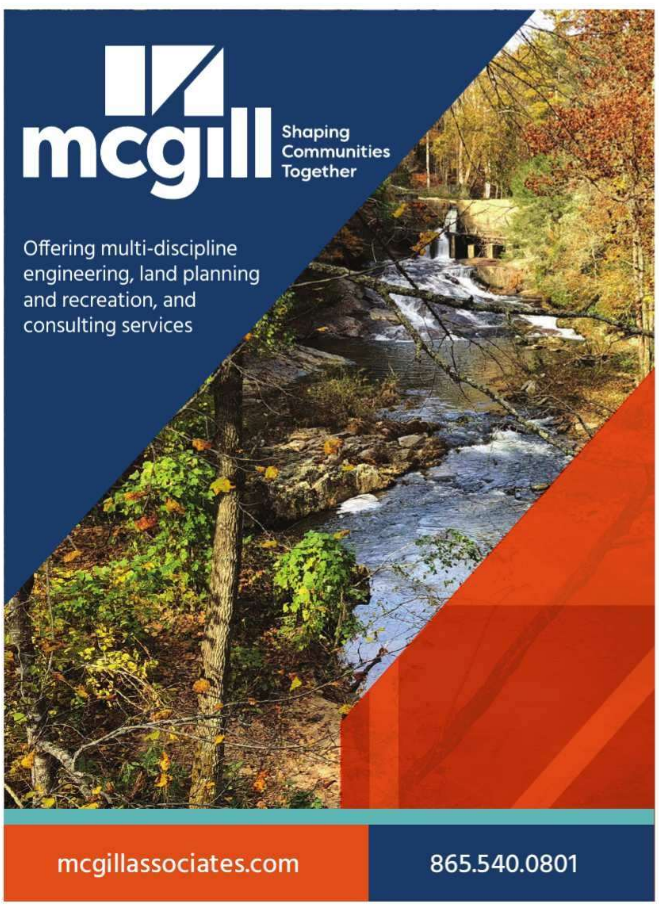
the overall electrical costs for the combined system. They can also ensure that all of the pumps are operating within their POR envelopes, which should lead to longer pump lives.

Another unexpected benefit of the system is that it is an effective predictor of pump plugging. On several occasions, the data indicated that pumps were producing less flow and head than they should, but consuming more power. Each of these instances occurred during high flows in the river caused by heavy rains. Specific Energy hypothesized that the loss of production had to be from plugging. In order to test the hypothesis, Murfreesboro's maintenance personnel backflushed all six of the river pumps and then ran pump tests on each of them. Each of the pumps returned to their predicted operating conditions, proving Specific Energy's hypothesis correct. Murfreesboro now knows to watch for similar loss of production after heavy rains, and to backflush the pumps accordingly. This should further reduce both energy expenditures and overall maintenance costs on the pumps.

Please come see our presentation at the Water Professionals Conference in Chattanooga this year where we will have even more data to share. Please also feel free to visit Specific Energy's website at *www.specificenergy.com*. It contains a blog that includes descriptions and demonstrations of the platform's abilities as well as several other case studies.



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