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Recent advancements in water meter technology are providing solutions that will help utilities capture more revenue, provide unprecedented business intelligence, reduce meter maintenance costs, and protect natural water resources. BY BRIDGET BERARDINELLI

TAKING MEASURE OF ADVANCED WATER METER TECHNOLOGIES

RISING LABOR AND ENERGY COSTS are forcing water utilities to do more with less. Focused on improving operational efficiencies, many utilities are exploring and using advanced metering infrastructure (AMI) to manage those costs.

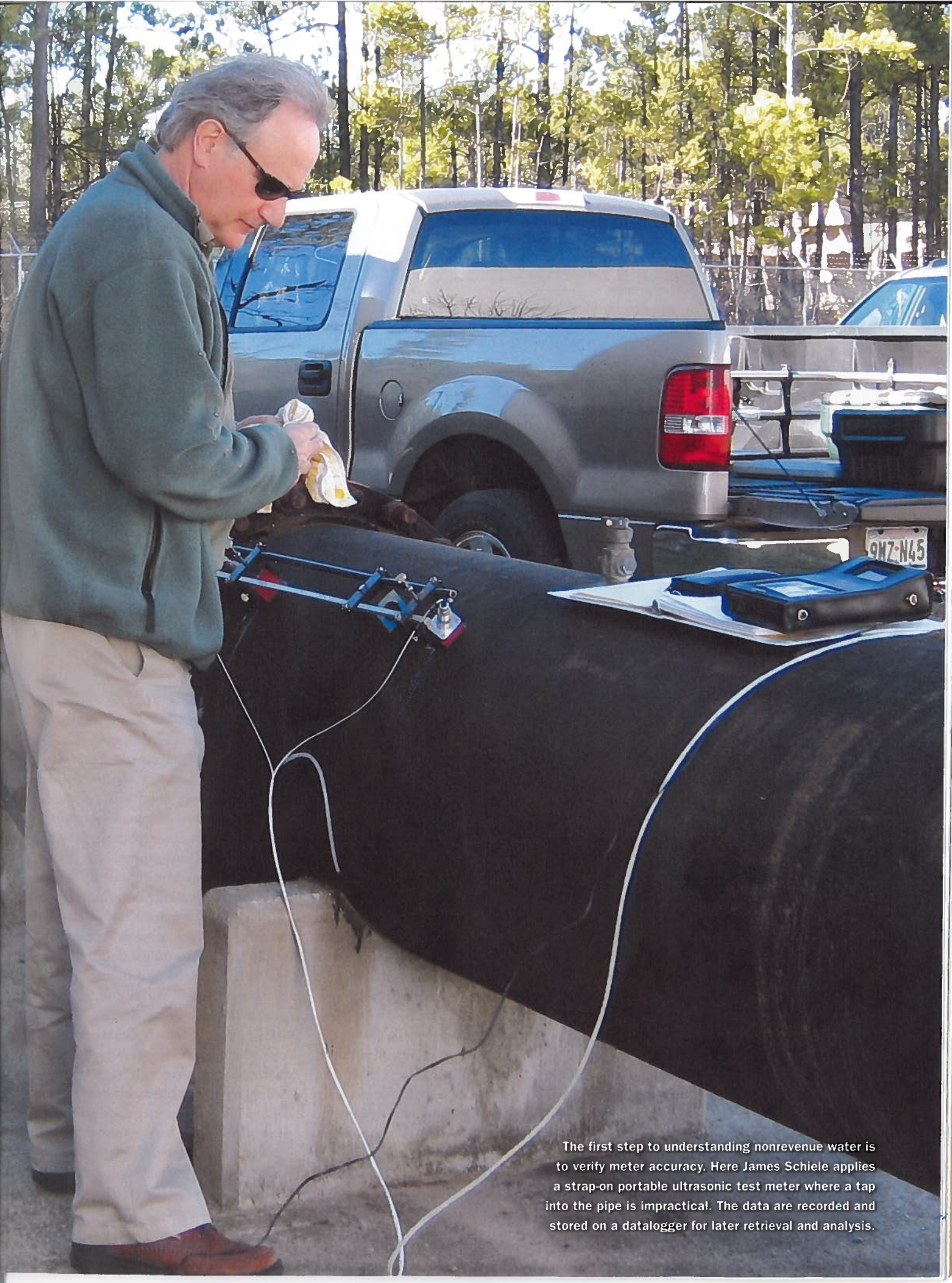
With new choices in flow measurement technologies, utilities can

- capture more revenue by accurately measuring a wider range of high and low flows.
- reduce the cost of owning and operating meters.
- decrease energy consumption over the life cycle of a meter.
- reduce water loss, energy use, and repair costs through superior leak detection and proactive notification of trouble conditions.

AMI stems from automatic meter reading (AMR) technology, which was introduced in the United States in the 1960s. Early AMR systems used network telephone systems as a communication link. Today such systems have been surpassed by an ever-increasing wave of new AMR/AMI technology, products, and systems that use radio frequency (RF) technology to transmit data among today's high-tech meters and data collection computers.

RF is employed via walk-by, drive-by mobile, and fixed networks, which are most applicable for large systems. RF has now become the preferred AMR "information highway," and it's one of the most rapidly advancing technologies in the water industry.

PHOTOGRAPH: JBS ASSOCIATES



The first step to understanding nonrevenue water is to verify meter accuracy. Here James Schiele applies a strap-on portable ultrasonic test meter where a tap into the pipe is impractical. The data are recorded and stored on a datalogger for later retrieval and analysis.

COMMON METERING TECHNOLOGIES

The water industry is undergoing significant regulatory and technological changes, with solid-state meters providing an alternative to mechanical meters. It's important to understand the pros and cons of common metering technologies found in ultrasonic meters, fluidic oscillator meters, and magnetic flowmeters.

Ultrasonic Meters. In these meters, an ultrasonic transducer sends sound waves upstream and downstream through the water. The difference in the sound waves determines water velocity, which is translated into water volume. Ultrasonic meters don't have a measuring element impeding water flow, so there's no reduction of accuracy over time.

However, ultrasonic meters require sound, and sound requires power. The high sampling rate required for high accuracy (nearly continuous sampling) results in a heavy power drain. To conserve power and battery life, the sampling rate can be reduced and periodic measurements averaged, but doing so diminishes accuracy, especially at low-flow rates.

Fluidic Oscillator Meters. These meters measure the frequency with which a fluid entering the meter attaches to one of two opposite diverging sidewalls and then to the other. The tendency of a fluid jet to attach itself to a nearby surface is known as the Coandă effect.

A fluidic oscillator meter measures only the flow of water, so the meter isn't affected by the presence of air in the water system. And, because it has no moving parts, the meter can be used when sand and grit are present in the water. However, the meter struggles at low-flow measurements, because it requires a minimum flow rate (given specific vessel size) for the Coandă effect to start.

Magnetic Flowmeters. These meters are based on Faraday's law of induction. When ionized water flows through a magnetic field, an electrical signal is measured. The faster the water flows, the more voltage is created and measured.

Water meters equipped with remanent field technology require less energy and can help increase revenue by accurately capturing low-flow water usage.

Because voltage is linearly proportional to speed, voltage and volume increase as water speed increases.

A magnetic flowmeter contains no mechanical measuring element inside the flow chamber, so there's no wearing of mechanical parts that would reduce accuracy over time. Measuring performance is linear across the flow range, and the meter maintains accuracy at forward- and reverse-flow directions.

However, in traditional magnetic meters, creating a magnetic field and sustaining the right electrical environment for accurate readings requires a controlled magnetic field and a considerable amount of energy.

RECENT INNOVATIONS

Significant technological advancements in AMI systems have overshadowed recent breakthroughs for smart water meters, but new metering technologies are critical nonetheless. Many technological advances in water meters are enabling even more precise leak detection and intelligent water management.

Floating Ball Technology. Floating ball technology (FBT), a variant of turbine water metering, significantly reduces pressure loss and eliminates component wear while improving accuracy across an extended flow range. The technology offers water utilities many benefits, from improved billing accuracy to decreased maintenance costs. However, most important for water conservation and leak detection, FBT is characterized by a thermoplastic ball that's weightless in water and rises and falls according to small changes in flow. Therefore, FBT easily detects low-flow leaks that once would have continued to flow and go on wasting water at a silent cost to the utility.

Remanent Field Technology. Remanent field technology, in conjunction with magnetic metering technology, requires far less energy than traditional magnetic meters and provides greater accuracy, even at intermittent or low flows. Remanent field

PHOTOGRAPH: SENSUS

New solid-state flow measurement technologies are enabling meters to deliver real business benefits—cost savings, new revenues, and a competitive edge.

technology also uses a pulse of current in a drive coil to magnetize a small piece of magnetic material. The remanent material holds its magnetic field strength without consuming battery current and keeps electrical noise low, allowing accurate measurement of lower flows of water.

Each time a pulse of energy is emitted to the material, the magnetic field is reversed, thereby inducing voltages of opposite polarity on each magnetic field reversal. Traditional magnetic meters have difficulty with low flow because, as water flow slows, the voltage signal is reduced and can be lost in the electronic noise.

Remanent field technology is particularly well suited when sediment and sand are present in the water, where customers have fire sprinklers or other mission-critical water services, or when well water is being metered. By reducing pressure loss 40–50 percent relative to traditional meters, utilities spend less to achieve acceptable water pressure at customer premises.

For systems with elevated water storage tanks and towers, reducing pressure loss at the meter allows customers to sustain water pressure with far less stored water. For pumped systems, less resistance at the meter level means less energy required to push water through the system.

Putting "Smart" In the Grid. According to AWWA's Manual of Water Supply Practices M6: *Water Meters—Selection, Installation, Testing, and Maintenance*, more than half of all the water meters sold in the United States are equipped for some form of AMR/AMI functionality. Whereas early systems used cable or telephone networks, these have been surpassed by the ever-increasing use of RF technology. Fixed wireless communications—the hallmark of AMI—allow meters to be read, monitored, and managed from a remote, central location. This capability eliminates the need to send a fleet of vehicles to a service area, which also reduces fuel consumption and greenhouse gas emissions.

Water is a precious commodity to be used and conserved wisely. Leaks in a water distribution system or at customer sites cost a utility money in terms of nonrevenue water and the cost of energy to treat, pump, and distribute water that isn't used. Remote system intelligence enables utility personnel to be proactive regarding notification of leaks, tampering, out-of-threshold operating conditions, low battery power, and more. In addition, utilities can alert customers before the customers become aware of problems and damage occurs, and then quickly identify, troubleshoot, and resolve the problems.

Radio-based endpoints can be attached to new or existing water meters, allowing utilities the flexibility of adopting AMR/AMI benefits without having to replace existing assets.

AMI connectivity allows utilities to be informed of these events in real time for faster resolution and improved customer service. Peak-flow and consumption data, measured at utility-defined intervals ranging from 15 minutes to 24 hours, are stored in the system datalog to provide the utility with additional information on consumer usage patterns.

BUSINESS BENEFITS

Water meters, largely unchanged for decades, have historically been viewed as a utilitarian component of a water delivery system. Now, new solid-state flow measurement technologies are enabling meters to deliver real business benefits—cost savings, new revenues, and a competitive edge.

These technologies can help utilities reduce annual energy and maintenance costs, remotely manage meter reads, proactively identify potential problems, and capture nonrevenue water by accurately measuring a full range of low-to-high flow water use over a system's lifetime.

RESOURCES

- AWWA Manual of Water Supply Practices M36: *Water Audits and Loss Control Programs*, 2009 (catalog No. 30036), and M22: *Sizing Water Service Lines and Meters*, 2004 (catalog No. 30022).
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