Leverage AMI for Sustainability

Leak-detection technology allows utilities to focus on conservation, create a sustainable future, and improve customer service. BY BRIAN FIUT AND MARK PATIENCE

NONREVENUE WATER is among the top issues facing water utilities. Each day, more than 300 bil gal of freshwater are pumped throughout the world, and about 34 percent of that water ends up as nonrevenue water, resulting primarily from leaks or unbilled usage. The loss amounts to $500 million and 7,080 gW·h of electricity to acquire, pump, treat, and distribute the nonrevenue water.

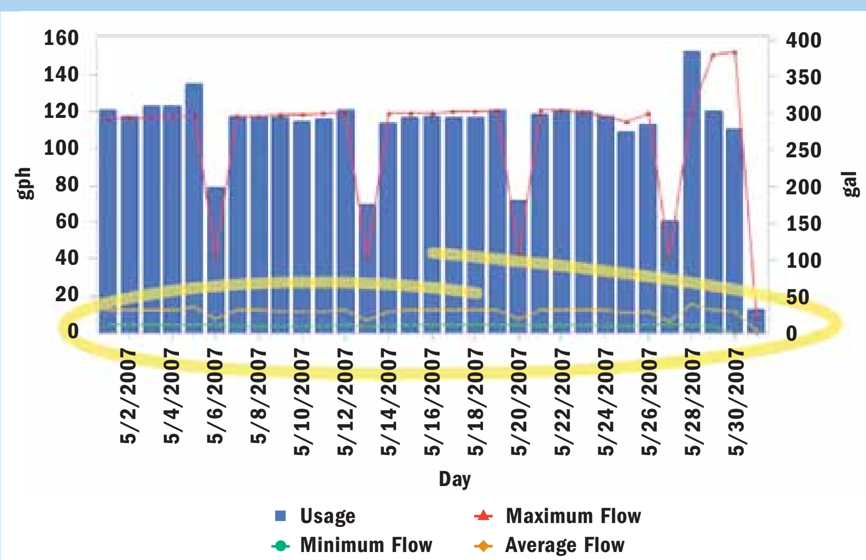
Water conservation programs are essential to preventing nonrevenue water losses and protecting precious water resources. An advanced metering infrastructure (AMI) system can be a fundamental conservation component. Through detecting and stopping leaks, utilities can conserve otherwise wasted water.

There are three distinct approaches to water conservation using AMI leak detection, each of which leverages specific aspects of the technology to detect leaks in different ways:

- Metered leak detection
- District metering leak detection
- Acoustic leak detection

Figure 1. Leak Line Graph

A leak line graph illustrates water that was lost or wasted while a leak existed.



METERED LEAK DETECTION

With some AMI systems, an alert is sent when continuous flow of a metered account is detected over a specific time frame, signaling a potential leak. More specifically, a communication module reads and records consumption each hour on the hour. When the reading is taken, the module detects if there was flow (consumption greater than zero) or no consumption (consumption equal to zero) during the previous hour. If there are 168 hours (1 week) of nonzero consumption (i.e., continuous flow, such as a faucet left running or a continuously leaking pipe), the module marks the account as having a potential leak and includes a "leak flag" with its next data transmission.

The data pass through the AMI collection engine and are ultimately accumulated in a data repository where leak and other data can be viewed in the user interface. A user can view the trended minimum consumption values over time (called the "leak line") to determine when the potential leak began, whether it's improving or getting worse, and when it was ultimately resolved.

AMI systems can help utilities and consumers detect and stop leaks to conserve water that otherwise would have been wasted.

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When graphed over time, the area under the curve of the leak line also represents water that was lost or wasted for the leak's duration (Figure 1). Using a standard linear regression formula, an average consumption line can be calculated from the leak data collected by the system. This line can be forecast into the next 12-month period to graphically display the estimated amount of water that would be saved or conserved by addressing the leak with the customer. The forecasted data can also be aggregated for all accounts that had leaks during the previous 12-month period to display the total amount of water that was conserved by the utility based on the collected data.

DISTRICT METERING

District metering analysis is performed by grouping and aggregating data stored in a software application. This process consists of a few simple steps:

- Identify the meter or group of meters that feed water into the district (master meter).
- Aggregate these meters' total consumption on an interval-by-interval basis. Accrue the aggregated consumption of the district into a virtual meter.
- Compare the master meter's net consumption (the measured input to the district) with the aggregated district's metered consumption (the measured consumption within the district) on a time-synchronized, interval-by-interval basis. The difference between the net consumption of the master meter and the aggregated consumption of the virtual meter is considered nonrevenue water, which can include leaks. A key component of this analysis is the precise time-synchronization of all readings on the hour or some other reference point. In other words, don't compare the master meter's Monday consumption to the virtual meter's Tuesday aggregated consumption. For accuracy, the analysis must consist of an instantaneous comparison of water-in and water-out at the same moment (Figure 2).

Nonrevenue water can result from leaks, theft, mis-metering, and nonmetered services such as usage through fire hydrants. However, when district metering analysis has been conducted and the data repository has ranked the various districts according to severity, much more information is available regarding where to look for leaks throughout the network than was known before the analysis was conducted, all without requiring personnel to leave the office.

Figure 2. Time Synchronization

Master meter consumption is compared with the metered consumption of the aggregated district.

PHOTOGRAPH AND FIGURES: ITRON

Some software applications allow district metering analysis results to be viewed graphically by comparing the district meter consumption graph with the virtual meter's aggregated consumption graph (Figure 3).

ACOUSTIC LEAK DETECTION

A dynamic combination of acoustic leak sensors—AMI technology and innovative data analysis software—enables proactive leak mitigation. Using a communication module with an integrated acoustic leak sensor, users can collect and analyze vibration patterns from anywhere in the distribution system to significantly improve their ability to proactively maintain critical water infrastructure (Figure 4).

The value of having a proactive acoustic leak-detection system is the ability to reduce nonrevenue water in the distribution system and conserve resources through early warning. This allows a utility to optimize system performance with automatic daily surveying for distribution leaks. Utilities lower pipeline repair costs by finding and repairing leaks before they become costly main breaks, which also reduces the risk of bacteria and viruses entering the water supply through bursting pipes. By pumping and treating less water, utilities prolong the life of their facilities and may delay the expense of facility expansion to meet future water demand.

SUSTAINABILITY

Through metered leak detection, district metering, and acoustic leak detection, utilities can reduce the number of distribution system and customer-side leaks as well as reduce the amount of water they must pump and treat to meet current and future demands. Doing so reduces the amount of energy required to pump the water, the cost of treatment chemicals, the amount of water lost, and the amount of carbon dioxide produced. Ultimately, such technology enables utilities to focus on conservation and create a sustainable future for their customers and businesses.

Figure 3. District Metering Analysis

Consumption from the district meter is compared with the aggregated consumption of the virtual meter.

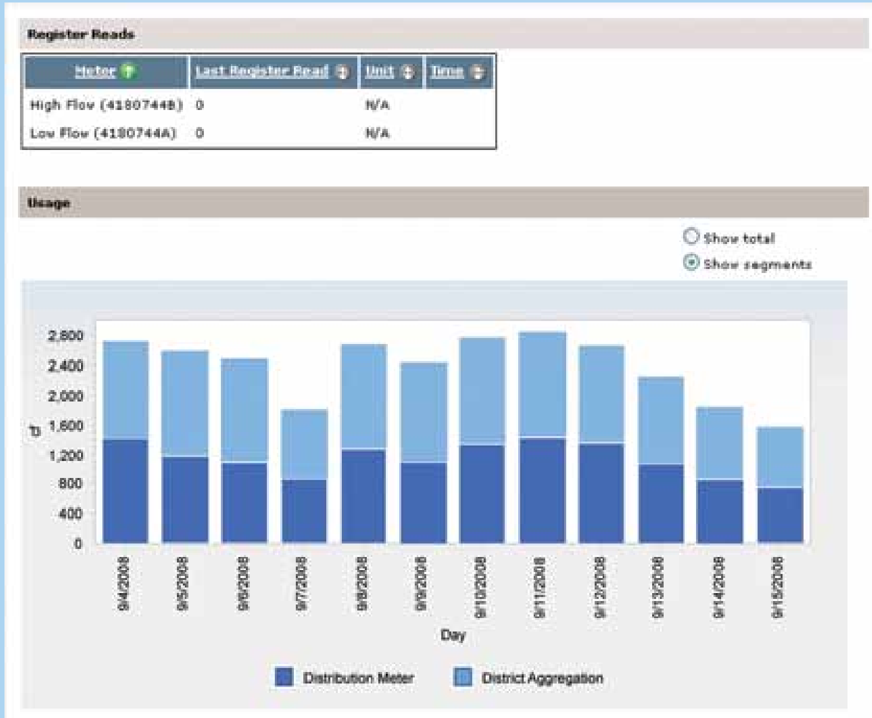

Figure 4. Proactive Leak Mitigation

A communication module monitors consumption on the meter's service side while an acoustic leak sensor listens for leaks on the meter's distribution side.