

The Energy-Water Nexus

Applying Electric Utility Tools to Improve Water Systems

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WHITE PAPER

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Electric utilities are rapidly deploying the Smart Grid by automating their electrical supply networks with advanced metering infrastructure (AMI), advanced distribution automation (DA), synchrophasor measurement technologies or other strategies. Water utilities can also benefit from improved monitoring and control in their retail distribution system. This paper seeks to identify the advantages and challenges of applying AMI, intelligent water meters and other tools to the potable water distribution system, while identifying synergies that may exist with the electric utility Smart Grid to help overcome these challenges.

Plentiful but Precious Resource

Water is a reasonably abundant resource in the United States today, but many factors may impact the availability of this precious resource in the years to come. Challenges to water resource availability can be separated into two fundamental areas: inefficiencies at the supplier level and inefficiencies at the consumer level. Consider that water covers approximately 70 percent of the Earth's surface, but less than 1 percent of that volume is available for human consumption. Water breaks occur on our current infrastructure at a rate of just over one per minute, equating to over half a million bursts per year across 1.8 million miles of water distribution lines. If the water utility industry chose to utilize today's Smart Grid technologies, the industry could potentially minimize the loss of water while improving leak detection.

The entirety of the solution, however, cannot rest squarely on the shoulders of the water utilities at the supplier level. The Environmental Protection Agency (EPA) estimates that homes use more than half of the publicly supplied water in the United States. The U.S. Geological Survey estimated that in 2005, the water used to irrigate more than 60 million acres of American land was around 128 billion gallons per day. Combine these facts with documented cases of commercial and industrial facilities that have gone months before detecting leaks, and it becomes apparent that a tiered approach at the supplier and consumer levels may provide an end-to-end solution for the water industry.

Identifying the Solutions

Many factors can contribute to an enhanced and more efficient water distribution network. For municipalities, implementing intelligent water meters as a standalone solution could provide some benefit if an existing meter data transport infrastructure providing notification of leaks or anomalies can be utilized.

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Consider a municipality with water and electric utilities that have overlapping service territories. In this case, the opportunity to realize benefits of a converged AMI deployment is much greater. The deployment of AMI in recent years has, in many cases, been included in the overall Smart Grid business plan. The telecommunication system that supports the electric AMI network could serve as backhaul for intelligent water meters and offer the advantages of an intelligent network for two independent commodities — electricity and water — for a nominal additional cost.

Utilizing the telecommunications network for water and electricity meters helps justify deployment costs and allows data or control messages to traverse the same infrastructure.

Finding Benefits

An AMI network could help identify and pinpoint losses in a water distribution system. Early burst prevention and leak detection decreases total system losses, leading to a reduction of unexplained water losses. Intelligent water meters coupled with an AMI communications infrastructure and meter data management (MDM) system provide the necessary tools to realize these benefits.

Intelligent meters could also enable supplier staff to perform “rolling” meter reading from a vehicle, increasing efficiency in meters read per unit staff. This improvement in efficiency could mean less staff required to perform the same number of reads, which could decrease the utility’s need for staff vehicles and fuel. Intelligent meters also help detect service theft and allow for remote disconnect of residential service.

The benefits of an AMI network can be realized at more than just the supplier level. The residential customer benefits by receiving real-time usage information that may prompt a curtailment of consumption or the purchase of more efficient in-home devices such as low-flow toilets, shower heads or faucets.

Residential customer service and satisfaction has also been at the forefront of intelligent water meter installations, offering flexibility to customers and utilities. Utilities using an AMI network in parallel with an MDM system can detect leaks and notify customers promptly. The MDM system is an integral part of the utility’s smart metering deployment, acting as the information repository and clearinghouse for multiple metering systems, including AMI, AMR and manual read systems. As the clearinghouse for meter data, the MDM securely manages information sharing with other utilities who are utilizing the same metering and communications infrastructure as well as other applications that use metering information. This data can allow supplier workforce management systems to notify the customer or dispatch a repair crew. Utilities have also used intelligent water meter installations as an opportunity to add customer-

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side water valves, allowing customers to shut off their water once a leak has been detected or during maintenance or construction.

Economic and Technology Challenges

Financial challenges may exist when considering a utility-wide AMI and/or intelligent water meter deployment. Larger utilities may have more readily available financial mechanisms for such a deployment. Municipalities may also realize similar benefits of system-wide integration, but infrastructure costs for an AMI deployment could be too significant. The opportunity to utilize existing infrastructure (water towers, microwave towers, power plant stacks, etc.) can be used to decrease deployment costs. Moreover, urban areas often have taller and more densely constructed buildings, which can impede wireless technologies. Rural areas often span long distances between data aggregation points, increasing the complexity of an AMI deployment. When considering these challenges and considering that water is a plentiful resource in much of the United States, the cost for a communications infrastructure in support of intelligent water meters must be considered carefully.

Technological differences between meter manufacturers also create challenges in an AMI deployment. The need for meters to communicate using a standards-based open communication model is coming to the forefront as a market requirement, and the current state of protocol standards for AMI does not provide plug-and-play interoperability between different manufacturer's equipment. In contrast, many meter manufacturers have attempted to bridge this gap by allowing purchase of radio and metrology chipsets in their meters from other companies. Due to technological differences between meter manufacturers, timing and vendor-specific deployment have become critical when deploying large quantities of meters. This means that when considering augmenting an existing network, meters with proprietary radio chipsets or protocols may already be installed. That could limit future choices for water meters functioning over an existing infrastructure.

Establishing a Base for the Future

In order for utilities to be successful and continue to improve efficiency and customer service, they should plan to explore a range of technologies that will justify the cost of their investment. AMI systems applied to the electric grid are gaining wide acceptance, but the full scope of impact on our nation's water systems is yet to be realized.

Conclusion

Water is a reasonably abundant resource today, but it is becoming increasingly scarce and more expensive. It is transported over an aged infrastructure. Building on the success of the Smart Grid and AMI for the electric utility industry, utilities that seek to improve leak detection and burst prevention can employ AMI in conjunction with an MDM system as a solution to these problems. Cost justification is a priority, but benefits are increasingly apparent. It is becoming clear that the deployment of such systems must be tempered to meet current needs and provide scalability for the future, allowing all to realize benefits for years to come.