ACLARA®

Using Advanced Metering Infrastructure to Control Water Loss

Executive Summary

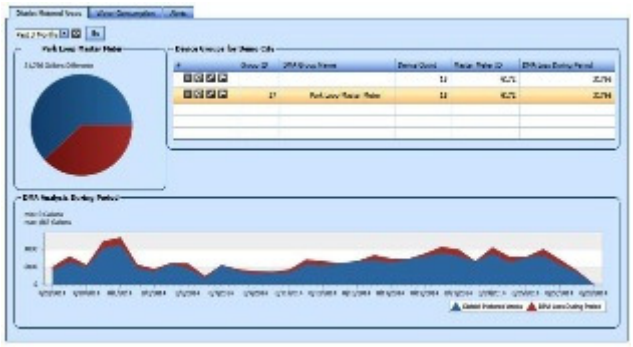
Leakage is one of the primary concerns for water utilities worldwide, yet North American investment in water loss has, historically, not addressed the problem with sufficient urgency or expertise.[i]

Slowly, the regulatory lag to efficiently control leakage is beginning to shift. Currently, 29 states in the U.S. have at least one agency that either mandates or incentivizes some form of water loss control.[ii] Aging distribution systems, economics, water scarcity, and regulatory pressure incentivize water loss control programs in light of costly replacement and repair decisions. Agencies are driven to evaluate their losses and invest in economic leakage management solutions as water resources become scarcer and more expensive.

Water loss control can be challenging, confusing, and time consuming. Currently, the industry lacks the maturity to effectively implement track, record, and proactively find leaks. Effective water loss control requires a multi-step process, including:

1. Water Audit (also referred to as a Water Balance)
2. Component Analysis
3. Intervention

Each water loss control phase is data heavy, requires accuracy, and can be labor intensive. Data quality and data collection prove the greatest challenge for utilities when completing a water audit for the first time. System input and customer volume inaccuracy is a primary flaw due to meter inaccuracy and unmetered usage. Moreover, executing targeted leak control can be labor intensive. Utilities with manual meter readers identify increasing the speed of repairing leaks and setting up district metered areas as extremely time-consuming.



As water loss control and leak mitigation gain traction as an industry standard over the next decade, increasing data validity and minimizing the labor intensity associated with data collection will become a main objective of reducing non-revenue water (NRW). First, utilities will require accurate metering at the production and the customer level in order to obtain a good water balance validity score. After, as utilities transition past the audit phase, they will have to reduce labor-intensive leakage intervention and monitoring solutions.

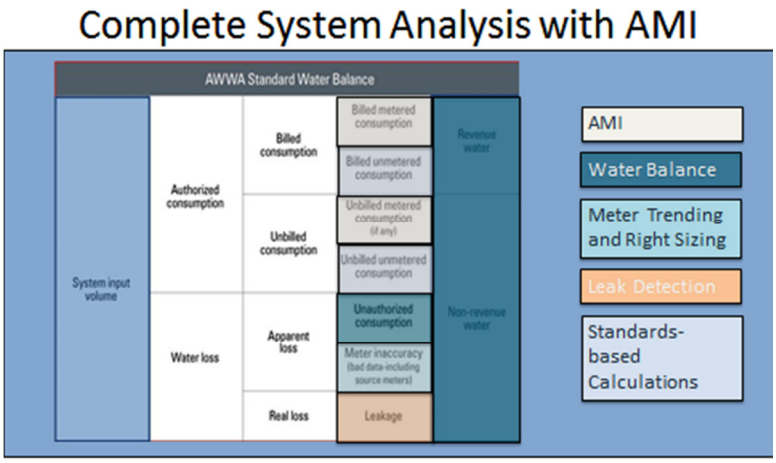
Water Loss Control Process

The spectrum of water loss reduction strategies varies. Some states mandate that all public water systems conduct annual water audits and follow leak abatement Best Management Practices (BMPs).[iii] California incentivizes water loss control by attaching associated NRW reduction requirements to grant application processes. [iv] Other states, such as Connecticut and Nevada, require water loss mitigation within the broader water supply and conservation plans.[v]

An effective water loss control requires a multistep process. First, utilities must conduct a "top down" water audit to quantify and track water distribution losses. Second, the agencies should conduct a Component Analysis to identify where the leaks are occurring and the leakage type in order to plan for an efficient and economic leakage control intervention. Once the utility has determined the economically appropriate means to reduce overall water loss, it is ready for the intervention stage. Increasing the speed of repairing leaks and proactive leak detection are two effective strategies to manage real losses.

Water Audit

Water loss control audits are gaining popularity as the first step to quantify and track water losses across distribution systems. They enable a utility to account for all water uses and calculate NRW. Mandating or incentivizing water utilities to conduct an IWA/AWWA Water Audit Methodology, or a similarly structured water balance, is one popular water loss control mechanism that is beginning to gain traction across the US. [vi] To date, 18 states require some form of mandatory audit with corresponding water loss control performance targets.[vii]



The AWWA Free Water Audit Software serves as a basic tool to compile a "top-down" water audit. The purpose of the spreadsheet-based water audit tool is to help "quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery."[viii] It establishes baseline volumes of real losses through tracking production and billing data. The AWWA Audit software "calculates the overall system wide volume of real losses by deducting the authorized consumption volume and the apparent losses volume (customer meter inaccuracies, data handling errors and unauthorized consumption) from the system input volume."[ix]

Component Analysis

While the IWA/AWWA Water Audit is foundational to a utility's overall water loss control program, it is an incomplete NRW tool. A Component Analysis goes one step further to plan an efficient and economic leakage control intervention. It offers a Real Loss Breakdown Assessment that identifies where the leaks are occurring and the leakage type. The total volume of real losses determined by the water audit is separated into three components: Background Leakage, Unreported Leakage and Reported Leakage. It enables utilities to determine the most efficient and cost-effective water loss reduction strategy.[x]

Intervention

A main objective of the component analysis is to prioritize which interventions the utility should take based on the types of leakage encountered in the system. Increasing the speed of repairing leaks and proactive leak detection are two intervention strategies that effectively manage real losses.[xi]

In order to increase the speed of repairing leaks, utilities require better systems that accurately record the life cycle of the repair. Utilities must record when the call for the leak came in, at what time the crew was sent out to fix the leak, and the point of containment. It is necessary that the start and finish times of repair records reflect the run-time of the leak from awareness to containment.[xii]

Setting up DMAs can be an effective proactive leak detection strategy to identify hidden losses. This method isolates one part of the distribution in order to find abnormal consumption patterns. Potential leaks are identified through continuous monitoring of pressure and flow data.[xiii]

Challenges

As utilities begin to implement water loss control programs, they recognize that the process can be challenging, confusing, and time consuming. The industry still lacks the maturity to effectively implement track, record, and proactively find leaks. Each phase is data heavy, requires accuracy, and can be labor intensive if a utility must manually read meters.

Water Audit Challenges

Data quality and data collection prove the greatest challenge for utilities when completing a water audit for the first time. System input and inaccurate customer consumption is a primary flaw due to imprecise meters and unmetered usage.[xiv]

Component Analysis Challenges

The lack of leakage failure data is one of the main barriers to effectively executing a component analysis. Increasing the speed of effectively measuring failure response time proves challenging for utilities. A utility must record when the call for the leak came in, at what time the crew was sent out to fix the leak, and the point of containment.[xv] In addition to lagging failure data, effectively reducing repair times is labor intensive and time consuming for utilities with manual meter readers.[xvi]

Intervention Challenges

Proactive leak detection is an effective water loss management tool. Setting up DMAs is one invention strategy (although still a fairly uncommon proactive leak detection practice in the United States). While this method effectively measures leakage throughout the distribution system, it can be extremely time consuming and labor intensive. It requires 24-hour monitoring to identify the minimum flow point or weekly monitoring to calculate metered consumption and storage tank levels against total water supplied.[xvii]

Solutions

Increasing data validity and minimizing the labor intensity associated with data collection will become a main objective of reducing NRW. First, Water Balance validity requires accurate metering at the production and the customer level. Next, once utilities transition past the water balance phase, they will require leakage intervention and monitoring solutions with minimized labor intensity.

Switching to an AMR/AMI network is an effective water loss control tool. Aclara's STAR network offers utilities just the solution they require to reduce NRW throughout all phases of the water loss control process.

STAR_*prestige* Analytics for Balancing, Right-Sizing and Trending

- Offers a water balance application that makes it easier to quickly identify lost and wasted water.
- Mapped against geospatial districts, STAR_*prestige* water balance analytics help operators accurately compare production costs with revenue.

Aclara's STAR_*prestige* offers utilities certainty of meter accuracy.

- The auditing function goes to the source of the data to accurately account for meters.
- Meter right-sizing applications quickly identify lost revenue from incorrectly sized meters
- Account mappings make it easier for operators to investigate discrepancies and map work orders for more effective remediation and meter replacements.
- Aclara's meter trending applications make your capital budgets and operations more effective by enabling operators to identify and replace meters.

Aclara's STAR_*prestige* decreases labor intensity

- Eliminates the need for workers to manually read all the meters; thus more effectively reducing the location and repair time for reported service leaks and setting up DMAs with ease.

Aclara's STAR ZoneScan, state of the art leak detection technology, combines acoustic data loggers from Gutermann International with Aclara's STAR Network technology to provide fully integrated leak detection through fixed-network advanced metering infrastructure (AMI).

- Time-synchronized sound recordings are initiated through the STAR ZoneScan meter transmission unit (MTU).
- The 3300 water MTU delivers hourly, time-stamped reads, providing detailed information about water usage and identifying anomalies, such as potential leaks and meter tampering.
- Web-based application software correlates the data between loggers and provides visual identification of high probability leak locations.
- The identification of precise leak locations with correlated, time-synchronized sound recordings requires minimal attention by operators, reducing the labor intensity generally associated with leak detection.

Conclusion

As water loss control and leak mitigation gain traction as an industry standard over the next decade, utilities will require solutions that improve data accuracy challenges, assisting utilities in faster leak repair and decreasing labor-intensive DMA analyses. Aclara's STAR_*select* network configuration addresses all the leading barriers to effectively managing NRW today. The hosted meter data management, analytics, and data presentment solution enables water utilities to fully utilize AMI-collected data to perform analytics, including water balancing, meter trending, and meter rightsizing. STAR_*prestige* calculates potential NRW losses and visually displays the percentage of lost-to-metered water. As a utility advances its water loss control program and is ready for the intervention stage of the program, Aclara's state of the art leak detection technology, ZoneScan, combines acoustic data loggers from Gutermann International with Aclara STAR Network technology to provide fully integrated leak detection through fixed-network AMI.

References and Endnotes

[i] The Smart Water Networks Forum (SWAN). 2014. *SWAN: Global Utility Survey*. Surrey: SWAN Forum. Available at: http://www.swan-forum.com/research.html

[ii] See sources:

Jernigan, Will. 2012. State of the States: Emerging Water Loss Regulations in the United States. Presentation at the WaterSmart Innovations Conference.

Alliance for Water Efficiency (AWE). 2012. *The Water Efficiency and Conservation State Scorecard: An Assessment of Laws and Policies*. Chicago: Alliance for Water Efficiency.

[iii] Georgia's Water Stewardship Act mandates that public water agencies (water systems with 3,300 connections or greater conduct annual water audits. See: Georgia Department of Natural Resources, Encouraging Voluntary Water Conservation and Enhancing the State's Water Supply (December 2012). Available at: http://webcache.googleusercontent.com/search?client=safari&rls=en&q=cache:Kk5IptkmgtUJ:https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/2012FINALSB370_annual_rpt_Dec2012c-1.doc%2BGeorgia's+Water+Stewardship+Act&oe=UTF-8&hl=en&&ct=clnk

[iv] California Urban Water Conservation Council (CUWCC) BMP 1.2 requires that "All agencies shall quantify their current volume of apparent and real water loss. Agencies shall complete the standard water audit and balance using the AWWA Water Loss software to determine their current volume of apparent and real water loss and the cost impact of these losses on utility operations at no less than annual intervals." Available at: http://www.cuwcc.org/Resources/Memorandum-of-Understanding/Exhibit-1-BMP-Definitions-Schedules-and-Requirements/BMP-1-Utility-Operations-Programs

California Assembly Bill 1420 mandates that urban water suppliers must comply with California's Best Management Practices in the California Urban Water Conservation Council (CUWCC) Memorandum of Understanding (MOU) in order to qualify for state water management grants and Loans. Available at: http://www.water.ca.gov/wateruseefficiency/docs/compliance-ab1420.pdf

[v] See sources:

Jernigan, Will. 2012. State of the States: Emerging Water Loss Regulations in the United States. Presentation at the WaterSmart Innovations Conference.

Alliance for Water Efficiency (AWE). 2012. *The Water Efficiency and Conservation State Scorecard: An Assessment of Laws and Policies*. Chicago: Alliance for Water Efficiency.

[vi] Chastian-Howley, Gasner, Kate, and Will Jernigan. 2014. AWWA Webinar Program: Tools for Water Loss Control – The Next Generation. Available at: http://www.awwa.org/portals/0/files/education/webcast/waterlosscontrolhandouts.pdf

[vii] Jernigan, Will. 2012. State of the States: Emerging Water Loss Regulations in the United States. Presentation at the WaterSmart Innovations Conference.

[viii] American Water Works Association (AWWA). 2015. Water Loss Control Resource Community [Online]. Available at: http://www.awwa.org/resources-tools/water-knowledge/water-losscontrol.aspx?ct=4ec53100328ca772b638d0bf74e55d82a9e6315da55c37fe58639e819116b34c0e9700c641fae86e0b743c9b15f2f081b37a0453811068d17d2f6b445bb4acfa

[ix] Sturm, Reinhard, Gasner, Katherine, Wilson, Timothy, and Stephen Preston. 2014. *Real Loss Component Analysis: A Tool for Economic Water Loss Control*. Denver, CO.: Water Research Foundation. Available at: http://www.waterrf.org/Pages/Projects.aspx?PID=4372

[x] Water Research Foundation1 in collaboration with Water System Optimization (WSO) released the free Real Loss Component Analysis Software Tool in May 2014.
See Sources for further explanation regarding the Component Analysis Process and Software:

ECONorthwest. 2010. *Process Evaluation of the PG&E, SCE, SDG&E and SCG Water Pilot Programs*. Prepared for Southern California Edison. Study ID SCE0294.01.
ECONorthwest. 2011. *Embedded Energy in Water Pilot Programs Impact Evaluation.* Prepared for the California Public Utilities Commission Energy Division.
Hodgins, Maureen, Sturm, Reinhard, Gasner, Katherine and Chris Leauber. 2014. What are the Best Economic Options for Managing Leakage? Webinar. Available at: http://www.waterrf.org/resources/webcasts/pages/PublicWebcasts-detail.aspx?ItemID=28
Sturm, Reinhard, Gasner, Katherine, Wilson, Timothy, and Stephen Preston. 2014. *Real Loss Component Analysis: A Tool for Economic Water Loss Control*. Denver, CO.: Water Research Foundation. Available at: http://www.waterrf.org/Pages/Projects.aspx?PID=4372

[xi] Hodgins, Maureen, Sturm, Reinhard, Gasner, Katherine and Chris Leauber. 2014. What are the Best Economic Options for Managing Leakage? Webinar. Available at: http://www.waterrf.org/resources/webcasts/pages/PublicWebcasts-detail.aspx?ItemID=28

[xii] See Sources:

Gasner, Kate. 2012. WaterRF 4372: Effective Organization and Component Analysis of Utility Leakage Data. Presentation at the WaterSmart Innovations Conference.

Sturm, Reinhard, Gasner, Katherine, Wilson, Timothy, and Stephen Preston. 2014. *Real Loss Component Analysis: A Tool for Economic Water Loss Control*. Denver, CO.: Water Research Foundation.
http://www.waterrf.org/Pages/Projects.aspx?PID=4372

[xiii] Fanner, P. V., R. Sturm, J. Thornton, R. Liemberger, S. E. Davis, and T. Hoogerwerf. 2007. *Leakage Management Technologies*. Denver, Colo.: AwwaRF.

[xiv] Data collection challenges were identified from the following reports and presentations:

Sturm, Reinhard, Gasner, Katherine, Wilson, Timothy, and Stephen Preston. 2014. *Real Loss Component Analysis: A Tool for Economic Water Loss Control*. Denver, CO.: Water Research Foundation. Availlable at:
http://www.waterrf.org/Pages/Projects.aspx?PID=4372

> "California Urban Water Conservation Council (CUWCC) showed that about 35% of water audits produced by the CUWCC's member agencies contained implausible results."

Falcon, Penny and Marcus, Sofia. 2012. Cutting Our Losses: The Los Angeles Water Loss Audit Experience Presentation at the WaterSmart Innovations Conference.

> Los Angeles Department of Water and Power identified unmetered connections and under registering inlet meters a main concern when they conducted the AWWA Water Balance and Component Analysis.

Moeti, Lebone T. and Skeens, Brian M. 2012. Georgia Water Loss and Auditing Reports—Results and Analysis. Presentation at the WaterSmart Innovations Conference.

> Throughout an AWWA audit software training between Fall 2011 and Spring 2012, Georgia state utility workers identified system input data from owned sources and master meter error adjustments as the two greatest areas for data validation improvement. Improving customer-metering inaccuracies was the third greatest priority identified.

[xv] See sources:

Falcon, Penny and Marcus, Sofia. 2012. Cutting Our Losses: The Los Angeles Water Loss Audit Experience. Presentation at the WaterSmart Innovations Conference.

Hodgins, Maureen, Sturm, Reinhard, Gasner, Katherine and Chris Leauber. 2014. What are the Best Economic Options for Managing Leakage? Webinar. Available at:
http://www.waterrf.org/resources/webcasts/pages/PublicWebcasts-detail.aspx?ItemID=28

[xvi] Executive Director of Water & Wastewater Authority of Wilson County (WWAWC) states that the component analysis recommended the utility reduce location and repair time for reported service leaks from 9.2 days to 2 days and unreported from 6.5 to 2 days. Completing a failure analysis is challenging for WWAWC because it takes a week to manually read meters. See source:
Hodgins, Maureen, Sturm, Reinhard, Gasner, Katherine and Chris Leauber. 2014. What are the Best Economic Options for Managing Leakage? Webinar. Available at:
http://www.waterrf.org/resources/webcasts/pages/PublicWebcasts-detail.aspx?ItemID=28

[xvii] ECONorthwest. 2011. *Embedded Energy in Water Pilot Programs Impact Evaluation.* Prepared for the California Public Utilities Commission Energy Division.