

WHITE PAPER / PRESURRIZED PIPELINE NETWORK MONITORING

PRESSURE MANAGEMENT & TRANSIENT MONITORING: THE AXIS FOR WATER HAMMER REDUCTION AND LEAKAGE CONTROL

Water sustainability is fast becoming a top priority for water utilities around the globe. A new UN report states that drought frequency and duration have increased by nearly a third since 2000, resulting in mounting pressure on the global water supply. Couple this with a global population that has now surpassed 8 billion people with city dwellers expected to double by 2050 – the demand for clean water has never been higher.

Protecting the water that we have is paramount, but when it comes to supplying drinking water, not all treated water makes it through the system to the customer's tap. Leakage in water distribution systems is a big issue all over the world. Europe leakage rates average 26 percent but some major cities, including in North America have reported leakage rates of 30 percent or more. In developing nations, there have been reports of as high as 70 percent water loss. Although percentages do not offer the best metric for reporting leakage rates, these numbers still paint a clear picture that reducing leakage should be a prime concern for most water utilities.

The loss of this water comes at a great cost to water utilities when you also consider the chemicals and additives used in treatment, the cost of electricity to pump water through the system, and the wear and tear on infrastructure for a product that never makes it to the customer.

This article will examine how utilities around the world can clamp down on leakage quickly and effectively with pressure management and transient monitoring. And how cash-strapped utilities can be as effective as larger more technologically advanced cities with a scalable approach to deployment and prioritization of high-risk or critical infrastructure zones.

WATER UTILITIES ARE CHALLENGED TO DO MORE WITH LESS

According to the American Water Works Association (AWWA) state of the industry report, water professionals have ranked aging infrastructure and the ability to pay for renewal and replacement as the most pressing challenge for the last 10 consecutive years. The number one impact of aging infrastructure in a water distribution system is leakage and pipeline failures. Water utilities simply don't have the funds to replace the entire system, they need to find ways to prioritize and mitigate the consequence of failure by extending asset life wherever possible.

In other parts of the world, such as the United Kingdom which has a privatized water utility model, utilities face stringent regulatory requirements for leakage reporting. The government audits and regulates the performance of the utility in order for it to justify rates to the end user. This model has meant that UK water companies are arguably some of the most sophisticated utilities in the world, as striving for innovation means the delivery of better service to

customers and good management of resources to ensure longevity and profitability.

In North America, water utility customers also expect a high level of service with minimal to no disruptions in water supply. In response, many water utilities are implementing performance metrics centered on level of service including annual average minutes without water supply per customer – similar to what is often reported by electrical utilities. Customers are demanding more, and utilities are striving to improve customer experience even as pipelines failure rates continue to climb (Water Main Break Rates Study).

To meet these challenges water utilities, need to quickly adopt technology solutions that reduce leakage and identify surges that increase the stress on pipes which raises the potential for pipe bursts. As the water industry is rapidly adopting smart technologies to bring existing infrastructure online, there are a lot of solutions competing for dollars. Utilities are looking for solutions that can demonstrate an immediate and sustained impact on reducing leakage rates as well as reduce the occurrence of pipeline failures and provide a quick return on investment (ROI) to justify the allocation of further funding for larger deployments.

A STRAIGHT-FORWARD APPROACH TO AFFORDABLY MANAGING LEAKAGE

Of the many tools, approaches, and methodologies currently available to help reduce system leakage, there are two proven solutions that offer an immediate and sustained reduction in leakage level in a water distribution system: pressure management and transient monitoring.

Per the AWWA M36 best practice manual – Water Audits and Loss Control Programs – there are three types of leakage components, namely background leakage (the small weeping leaks often at joints or connections which are generally undetectable), unreported leaks (leaks that are not visible at ground surface but that are normally detectable), and reported leaks (leaks that are visible, and that can cause damage to other infrastructure – commonly referred to as a “main break”). The manual further identifies that the only pro-active solutions proven to have an impact at lowering all three types of leakage components are “pressure reduction” and “pressure stabilization” – both of which



revert to the benefits that proper pressure management and transient monitoring can bring to a water loss management program.

THE DIRECT RELATIONSHIP BETWEEN PRESSURE MANAGEMENT AND LEAKAGE

If you can decrease the pressure in a distribution system, it will decrease the leakage rate – it’s that simple. Demand for water is typically higher during the day, but at nighttime as demand is reduced, the pressure increases in the system due to lower friction losses within the pipeline network. It is not uncommon to see pressure change by 15 – 30 psi (1 – 2 bar) from daytime to nighttime averages.

In addition, pressure in a distribution system is almost always higher at the source and drops due to pipeline friction losses as it gets further away from that source and even more so if there is a topographic increase. Customers in areas close to the source are likely being supplied with too much pressure for what is required to serve the most distant or highest elevation customers. To reduce leakage, it is best to deliver just enough pressure to get the job done throughout the system.

Typically a 10% decrease in average pressure will yield a 10% reduction in the flow rate of any existing leaks and lower the frequency of pipeline failures by 15% [As highlighted in the



AWWA M36 manual]. Older systems can see even higher benefits as watermain tolerances to withstand daily pressure fluctuations diminish as these assets degrade and lose their structural strength. This reduction has been shown, in many applications around the world, to be a sustained savings – often cementing pressure management as the most cost-effective measure to reducing leakage rates and maintaining them at low levels.

The first level of pressure management is traditionally done by implementing pressure zones, which are designed more from a hydraulic and pipeline operational perspective than a leakage management perspective. Pressure management specifically designed from a leakage management perspective normally implies managing smaller segments of the network (often referred to as district metered areas (DMA)) where a pressure reducing valve (PRV) is set to a fixed outlet pressure to ensure a guaranteed minimum pressure to the critical point in the DMA network during maximum flow conditions.

Advanced pressure management using PRV controllers enables system pressure to be optimized even further by modulating the outlet pressure of the PRV based on changes in demand within the DMA network. However, not all loggers and controllers are created equal. Finding a reliable flexible solution that maximizes system coverage and delivers the right type and amount of data, is where utilities can optimize their spending and see big results..

FLOPATH ADVANCED PRESSURE MANAGEMENT ADVANTAGES

The Mobiltex FloPath pressure management controllers are industry-leading battery-operated full modulation PRV controllers that enable the pressure into a DMA network to be modulated between two user-defined limits (low and high) according to the demand (flow rate) or the time of day.

Built around a robust control architecture, the FloPath pressure controller offers the widest range of control options in the market. It Includes flow modulation, time of day modulation and a variety of combinations of flow/time modulation options unmatched by other controllers. The controller has a 16-entry user-defined control table setting allowing users to establish the pressure management regime that best suits the requirements to meet customer demand conditions while maximizing leakage reduction benefits.

The PRV is modulated hydraulically via highly reliable battery-operated solenoids. Hydraulic modulation offers more reliable and stable control of the PRV outlet pressure and allows for longer battery life. With proven deployments actively running in excess of 5-years on their original batteries, the FloPath pressure controller has proven itself as being an exceptionally energy-efficient controller.



The built-in data logger provides utility operators with vital information on the performance of the DMA network. The remote telemetry versions of the controller provides real-time alarms to system operators for abnormalities within the DMA and PRV maintenance requirements– allowing for timely interventions.

Transient detection, PRV operational performance and true minimum night flow assessment metrics can be assigned using the unique features of the datalogger that includes data organized into data files each acting as an independent data logger with its own start/stop time, sample rate and logging rate.

Engineered for the most extreme conditions, FloPath pressure controller has proven itself as the most robust, durable and dependable PRV controller. With an unmatched IP68 environmental rating, this pressure controller will provide water utilities with years of continuous service with minimal maintenance requirements.

THE DIRECT RELATIONSHIP BETWEEN TRANSIENTS AND PIPE BURSTS

Transients or surges cause stress and fatigue on pipelines and assets as they propagate through the network and can lead to cracks, leakage, and bursts. They are usually caused by network operations such as closing a valve, sudden pump shutdowns or large customer demand changes. It's common practice for water utilities to increase pumping overnight due to lower electricity rates so the probability for transients during this period increases as does the possibility for pipeline failures and leakage rates.



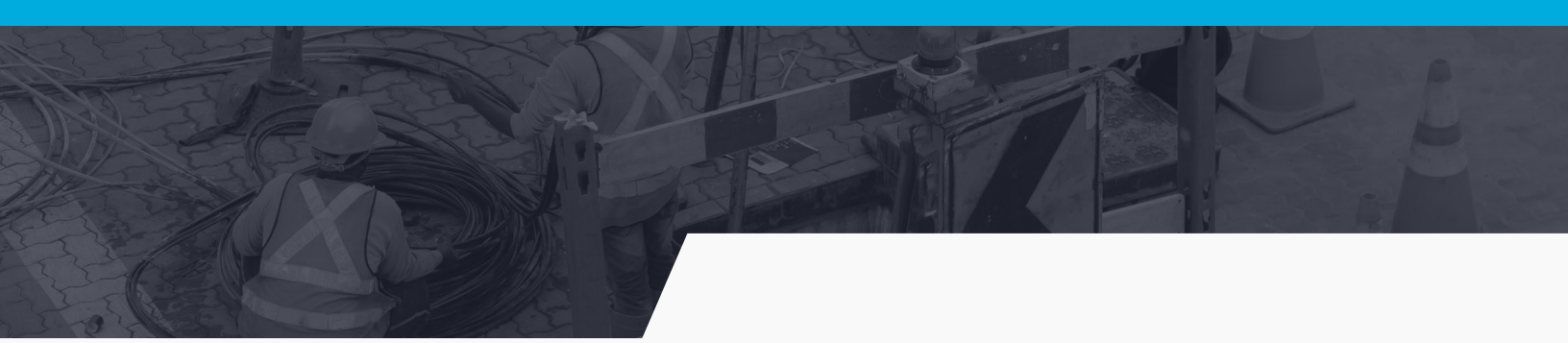
Some transients can be catastrophic causing pipelines to burst or affecting water quality by allowing contaminants to enter the pipeline. However, most transients will not suddenly break pipelines but will weaken them over time leading to eventual leaks & failures. As the trend to proactively monitor for the presence of transients increases, so does the knowledge that the occurrence of transients in our water distribution networks are a lot more common than most utility operators had thought!

Transient monitoring logs the changes in pressure due to a rapid change in flow in a pipe over time to help identify potential problems early such as a sudden decrease in pressure caused by an increase in flow rate can indicate a pipe burst or abnormal usage pattern. By monitoring for the presence of pressure transients, operators can also detect potential issues (such as malfunctioning control valves, illegal water usage from hydrants, impacts due to operational changes – i.e. pumping) and take steps to prevent the cause of these surges. But again, not all transient loggers are created equal.

THE FLOPATH DIFFERENCE WHEN IT COMES TO MONITORING TRANSIENTS

The MOBILTEX FloPath pressure transient logger surpasses the offering from all competitors by offering two loggers in one. Utilizing the same high-resolution pressure transducer, the FloPath transient logger can log continuous pressure readings to record the average pressure profile information in one channel and log "triggered" high-speed transient pressure readings in another channel. This feature is instrumental when using the transient logger within a network where it is unknown if pressure transients are present. It allows operators to quickly view the average pressure profile and superimpose transients if they occur. The logger memory is therefore optimized as high-speed recording during periods of no transient activity is avoided.

The FloPath transient logger offers the best performance for specialized transient monitoring applications and has an industry-leading sampling rate of up to 1,000 times per second. Users can



select transient logging rates of 10, 20, 100 and 1,000 Hz which is currently the widest range available.

Transient detection is optimized by offering fixed and rate of change triggers along with a slow differential trigger for slower-moving transients. With this exclusive feature, the FloPath transient logger can detect and record transient events that other loggers miss. The trigger threshold levels are user defined allowing the setting of the sensitivity level to be based on the application needs.

Once a trigger level threshold is reached, the logger transfers 1,000 pre-trigger readings at 10 Hz frequency from the buffer memory to the logger memory and starts logging at the defined "fast sample rate" for a user-set duration of time (typically 2-3 minutes). This optimizes the million reading transient memory capacity by only recording the relevant transient event data and not filling up memory space with unmeaningful fast sample data. At a fast sample rate of 100 Hz, there is enough storage capacity to record up to 100 transient events.

For local communication to PC, the logger offers a high-speed infra-red communication cable capable of downloading data at a 115,000 baud rate. For remote telemetry units that transfer data via cellular connection, FloPath uses a proprietary data compression algorithm to securely transfer the high-speed transient pressure data (and the average pressure data) to the water utility.

One emerging application for transient pressure monitoring is on the larger diameter water transmission mains. Transmission mains have a much larger consequence of failure and with fewer access points available, they are more of a challenge to monitor. Unlike acoustic sensors that need to be placed every 0.5km on average on transmission mains, FloPath loggers, can be spaced 5-10 km apart (depending on site conditions) reducing the number of units needed in the field and the cost of battery replacements, maintenance, and installations.

All FloPath loggers are designed and manufactured to last. They are completely waterproof and submersible. Battery life is 5 years plus, however, should the battery fail, the logger has 10 years of data retention protection. Software upgrades can be done in the field, or over the air if the unit is connected to cellular. They are easy to install and program with minimal training.

FLOPATH PRODUCTS IN ACTION

FloPath pressure management controllers and transient pressure loggers have been in the field since 2010 helping water utilities around the world to reduce leakage and save millions of litres of water per day. Here are some noteworthy applications:



Over the past five years, a very large water utility within the European Union has deployed in excess of 150 FloPath pressure controllers across their system. The majority of these controllers are set to flow modulation mode with some set as a two-stage PRV controller. This utility conducted several pilot trials with most major brands of battery-operated PRV controllers and chose the FloPath pressure controller because of its robustness, flexibility, performance and battery life. The pressure management leakage reduction program for this utility is currently managed by a contractor who confirms that the FloPath pressure controller outperforms all others and offers the lowest maintenance requirements in the industry.

Following a raw water pipeline failure at a large federally owned facility in Ontario, Canada, FloPath transient pressure loggers were utilized to investigate the potential cause for the failure. High-speed logging at the raw water pumping station identified that

the pump control valve timing had been improperly set causing the high lift pump to timeout and shut off before having the pump control valve shut fully. This resulted in a large transient with a pressure variation of over 70 psi to travel along this high-pressure main (average pressure of 260 psi). With the cause of the transient identified, modifications were made to the control valve cycle timing to ensure the valve fully closed before the pump times out. Following the adjustment, additional pressure transient monitoring confirmed proper operation of the pump control valve and showed that the large transient was no longer an issue. The control valve manufacturer confirmed that without the unique configuration features of the FloPath transient logger, the timing and operation of the control valve would not have been as accurately assessed, and the required timing adjustment needed would not have been as easily determined.

NEXT STEPS IN YOUR SUSTAINABILITY DATA CAPTURE JOURNEY

Whether a utility has leakage due to aging infrastructure or needs to increase monitoring to meet more stringent regulatory requirements, there has never been a better time to add sensors to water distribution networks. The water industry has lagged other resource industries, and as a result, technology has advanced and become less costly. Today's sensors are far more reliable and allow for the capture of detailed data to provide better analysis for accurate decision-making.

These solutions are also scalable, utilities can start with a pilot project to prove ROI for larger deployments. For financial asset managers and planners, this makes decisions a lot more definitive. As more cities are incorporating some kind of climate action task force, looking for ways to reduce emissions, energy use, and water loss, is becoming a priority. Water utilities that have solutions to help meet these targets, now have another ally for budget support.



When you consider that many of the world's aquifers are receding and that the demand for water globally is projected to increase by 55 percent between 2000 and 2050. Doing our part to reduce the loss of a life-dependent resource is not only the responsible thing to do, but vital in reducing political tension and protecting public health. FloPath pressure management and transient monitoring solutions have a key role to play in today's sustainable water utility.



LEARN MORE!

VISIT US ONLINE AND CONTACT US TO REVIEW YOUR PRESSURIZED PIPELINE MONITORING REQUIREMENTS.

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