

PCCP Management

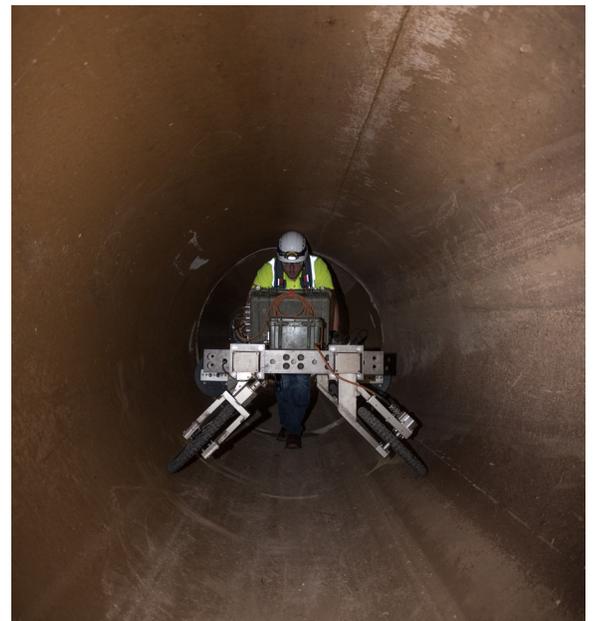
REDUCE RISK AND LONG-TERM CAPITAL COSTS WITH BEST-IN-CLASS PRESTRESSED CONCRETE CYLINDER PIPE MANAGEMENT

Prestressed concrete cylinder pipe (PCCP) is a very dependable pipe material. Failures are rare but tend to be sudden and catastrophic. PCCP is common in critical, large-diameter water mains and force mains. A failure can release a large amount of energy, damaging nearby property and infrastructure.

PCCP failures often result from poor design, manufacturing, installation, or operations. Fortunately, there are a number of proven technologies available to inspect and monitor PCCP condition. This means utilities can reliably detect and prevent problems long before they result in failure.

PCCP has proven reliable over thousands of inspections. Xylem has conducted electromagnetic inspections of more than 5,000 miles (3,100 km) of PCCP, and less than four percent showed signs of distress. PCCP also has one of the lowest leak rates of any pipe material.

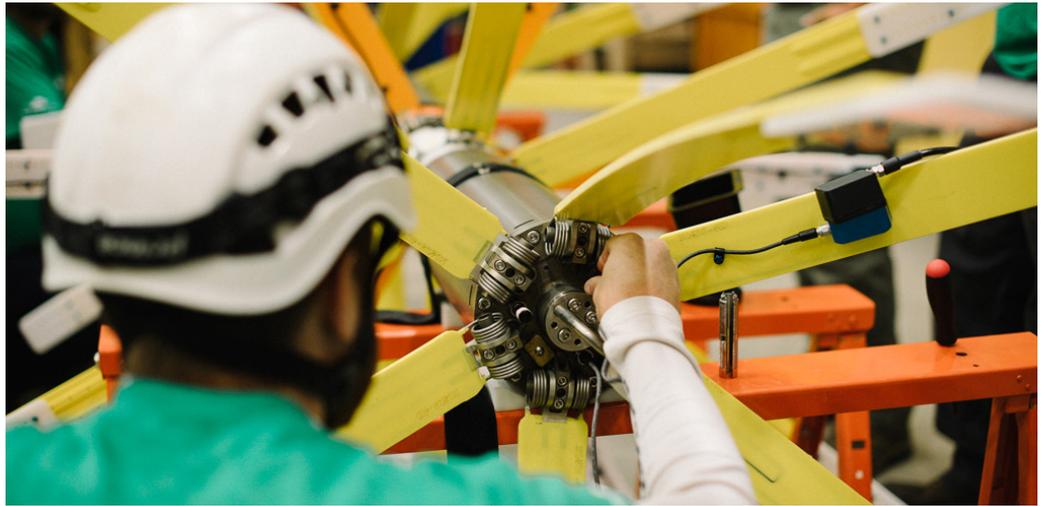
The best way to proactively manage any pipeline is to better understand its condition. Xylem's data-driven approach to managing PCCP is built on 20 years of experience. We have helped some of the largest PCCP users in the world reduce failures, optimize capital budgets, and increase confidence in the overall operation of their pipelines.



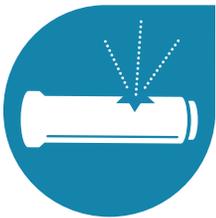
PCCP makes up more than 30,000 miles (48,000 km) of water mains and force mains in the U.S.^{1,2} It consists of a concrete core, a thin steel cylinder, high-strength steel prestressing wires, and a mortar coating. Broken wire wraps are the primary sign of deterioration in PCCP.

7,000+ mi
11,250+ km
Of PCCP inspected

830+ mi
1,340+ km
Of PCCP monitored



Benefits of a PCCP Management Program



● Reduce catastrophic failures

PCCP failures are expensive. Beyond emergency repair and rehabilitation costs, societal impacts such as service interruptions and property damage can double the cost of failure.³ However, utilities can better understand risk and the actual condition of their PCCP assets with proven condition assessment solutions. Data-driven PCCP management enables utilities to prevent failures and extend the life of their PCCP inventory.



● Optimize capital costs

Utilities are managing aging assets and making difficult decisions about where to spend limited capital budgets. Making repair and replacement decisions based on actual condition data is the most cost-effective way to manage PCCP. With over two decades of inspection data, we have found that less than four percent of PCCP has any indication of broken wire wraps. Less than one percent of pipes require immediate repair or replacement. Utilities around the world are demonstrating that PCCP can be safely managed for 10 to 20 percent of full replacement costs.



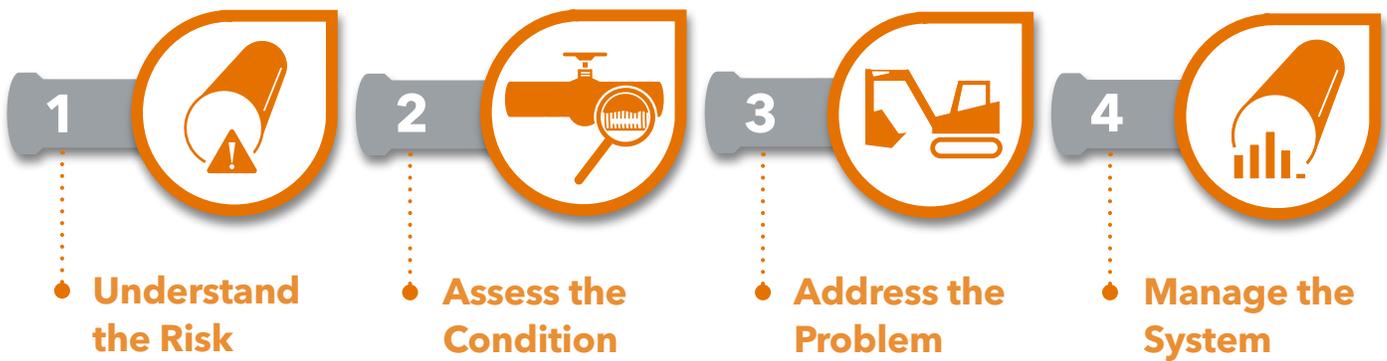
● Lower risk

Shift from reactive operation and maintenance to proactive planning with a data-driven approach to PCCP management. Inspection and monitoring tools can accurately assess the health of buried infrastructure. Advanced engineering analysis provides a clearer understanding of risk that informs short- and long-term repair and replacement strategies. This actionable data empowers utilities to make precise, planned repairs that minimize costs, limit disruption, and extend the life of PCCP assets.

¹ U.S. Environmental Protection Agency (2013) "State of Technology for Rehabilitation of Water Distribution Systems"

² Water Environment Research Foundation (2010) "Inspection Guidelines for Wastewater Force Mains"

³ AWWA Research Foundation (2007) "Analysis of Total Cost of Large Diameter Pipe Failures"



Xylem's Approach to PCCP Management

Utilities can virtually eliminate the risk of failure within their PCCP inventory and maximize long-term capital budgets. Xylem helps utilities develop a proactive PCCP strategy that balances risk reduction with system performance and cost.

Risk assessment

Understanding risk is an important first step in selecting the right inspection and management strategies for each pipeline. Using consequence of failure as a guide, utilities can determine what to assess and which techniques to use to best meet risk reduction goals. PCCP inspection planning involves reviewing existing data, conducting a preliminary risk assessment, and identifying information gaps.

Valve assessment

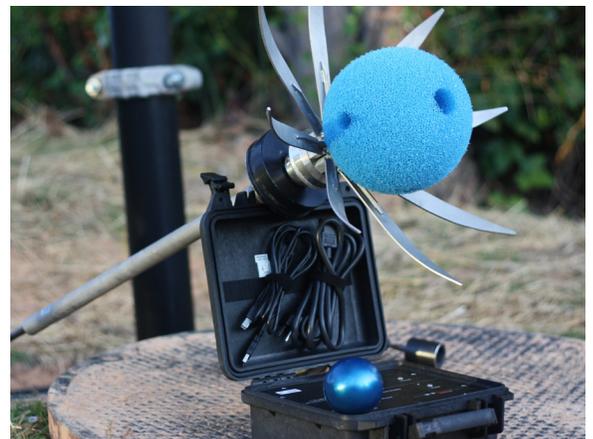
Valves are essential assets responsible for flow control and isolation of critical PCCP mains. Knowing the location and operating condition of valves helps utilities protect their pipeline, minimize consequence of failure, and improve ease of maintenance.

Leak and gas pocket inspection

Inline leak and gas pocket detection helps determine a pipe's baseline condition. In PCCP force mains, gas pockets can lead to hydrogen sulfide corrosion - one of the primary causes of force main failure. Xylem's free-swimming **SmartBall**® platform uses acoustic technology to accurately locate leaks and gas pockets and operates while the pipeline is in service.



Valve condition assessment and repair



SmartBall inline free-swimming pipeline inspection platform

Inline wall inspection

Prestressing wires are the main structural component in PCCP. Identifying and locating broken wire wraps provides a critical baseline for pipe degradation. Xylem offers several non-destructive, electromagnetic inspection techniques that meet different operational needs. The **PipeDiver®** platform is a free-swimming condition assessment tool that is easy to deploy and operates while the pipeline remains in service.

Continuous monitoring

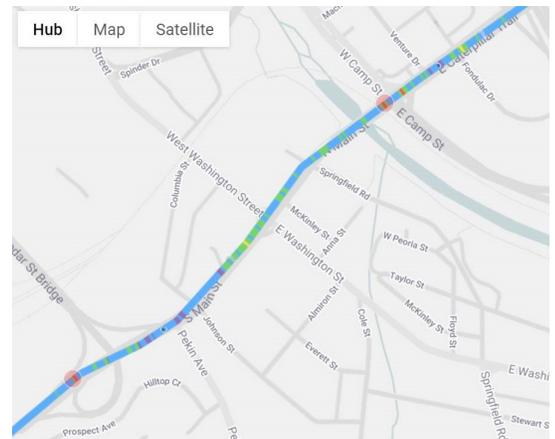
With continuous pipeline monitoring, utilities have an early warning system that helps prevent PCCP failures. Xylem's **SoundPrint® Acoustic Fiber Optic** monitoring system detects, locates, and alerts utilities to wire breaks in near real time. These system alerts give utilities time to plan for targeted pipe repair or replacement. Monitoring is particularly beneficial where the consequence of pipeline failure is unacceptable. PCCP deterioration is not uniform, so combining regular electromagnetic inspections with 24/7 monitoring is the best way to extend the useful life of these important assets.

Engineering assessment

Advanced engineering analysis turns inspection and monitoring data into actionable recommendations for PCCP owners. Structural evaluation services, such as finite element analysis and degradation modeling, help utilities make long-term capital planning decisions about reinspection, rehabilitation, and replacement while ensuring safe pipeline operation into the future.



PipeDiver inline free-swimming pipeline condition assessment platform



- ▶ Xylem's secure, map-based web portal is a system dashboard where utilities can access individual pipe condition history and other critical information. The data is available any time, on any device. Utilities can also seamlessly integrate monitoring data with their own management systems using API.

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