Advances in Condition Assessment Technologies for Pipelines

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Condition Assessment

• All pipes/ pipe materials leak
• All pipes can break
  – 1 in 10 leaks will result in a break
• Industry figures show you can expect to find two leaks a mile in DI or CI transmission mains (>16”)
• Condition assessment helps you proactively manage pipelines
• Control helps you reduce the cost of main breaks
So What?

- Condition Assessment and Repair can help reduce or refocus CIP $

- Condition Assessment and Repair of a pipeline should be typically 10-12% of the replacement cost.

- If the technology or the repair is such that this number grows to >25% - you should replace the line

- Many criticality analysis programs comparing risk of failure with consequence of failure and they identify the priority pipelines.

- But these are largely desk top studies

- You need a cost effective means of validating/calibrating the desk top study and the priority list.
Condition Assessment Technologies

Minimum intrusion and inconvenience
LOOK BEFORE YOU DIG

Cost effective
To give you the ability to make INFORMED decisions
Investigator™
Condition Assessment of In-Service Distribution Mains via Fire Hydrants
Investigator™ Technology

• Simplified pipeline condition assessment technology
• Designed for distribution mains
• Non destructive inspection
• No disruption to service
• Single pass acoustic, CCTV video and sonde mapping
• In-line system increases accuracy
Quebec Ski Village – Saint Sauveur

- Investigator™ inspection of low pressure issues
- 6” and 12” metallic mains
- Identified significant tuberculation build-up on 6” line
- Validated that 12” line was in good condition
- 9 insertions completed with average distance of 150 feet
- Provided utility with information to target CIP investments on problem areas
Montreal Suburb – Dollard des Ormeaux

- Investigator™ inspection of main prior to road re-paving
- 6”, 8”, 12” metallic lines installed in 1960’s
- 5 insertions on lined and unlined pipe
- One line had substantial sediment and we validated need for flushing program
- Lined main in good condition but tuberculation identified on unlined T-joints
- Cable insertions averaged 15 to 180 feet depending on internal pipe conditions
Austin Low Flow Investigation

- Utility receiving low flow/pressure complaints from residents
- High end neighborhood
- Water main replacements scheduled for neighborhood
- Investigator inspection to help determine condition of water main and help determine replacement urgency
- 8” cast iron line installed in 1960s
Austin - Low Pressure Inspection
Fire Flow Test Failure Inspection

- Failed fire flow test, hydrant out of service near popular children's museum
- Utility had a free spinning valve near the hydrant but was not sure if it was in open or closed position
- 10” cast iron water main
- 2 inspection sites selected to help identify problem(s) via fire hydrant access points
- Investigator crew confirmed that free-spinning valve was in closed position and identified heavy tuberculation on main feeding the hydrant
Low Flow Investigation Results

Closed Valve
Camp Swift – 1940 Pipe Inspection
Operator Control
Simultaneous Video and Acoustic

Clear Peak Over Leak Site
Investigator Graphic:
Client Issue

- PVC pipe, up to 12 ft deep
- Correlators and leak sounding did not work
- Turned to Investigator™ Acoustic/CCTV in-line technology
- 31 insertions through fire hydrants (top insertion)
- Each insertion inspected up to 600ft of main
- Pressure in pipe ranged from 75 to 180 PSI
Example 1

• Concern about leak under culvert

Investigator™ confirmed that there was no leak under culvert...but...

Two leaks discovered on either side of a T-joint at a depth of 18ft leading to the culvert. Investigator™ was able to clearly distinguish individual leak sounds prior to challenging excavation/repair.
Example 2

- Acoustic and video confirmation of leaks at two pipe joints. Accurate leak locating with Sonde.
Value of video

- Visual identification of installation defects at the Point of Interest

Kink in pipe wall and poor joint connection. No current leak.

Joint gaskets exposed over 3 consecutive pipe sections. No current leak.
Austin: Does a 36” BF Valve work properly?

Watching the valve operate from inside the pipe
Know What’s Inside Your Pipe
The value of video

Investigator can identify:

- Closed valves
- Lost valves
- Undocumented valves
- Illegal service connections
- Undocumented junctions
- Flow direction
- Pipeline material
- Improperly installed liner
- Improperly repaired cracks
- Diameter changes
- Corrosion
- Pipe blockages & flow restrictions
- Damaged pipe
- Leaks
- Air pockets
- Various Repairs
- Operation of valves
- Tuberculation levels

What else do you want to KNOW about?
In-Line Asset Locating

Closed gate valve

Identification and location (GPS) of undocumented valve
Tuberculation and Flow Restrictions

Severe flow restrictions due to late stages of tuberculation build up. Leads to pressure loss.
Additional Access Points

Service Fittings

Air Valves

Ball Valves

Flow Meter Entry Points and any Direct Taping
System Mapping

- Critical for accurate uni-directional flushing plans and hydraulic modeling
- Confirmation of as-built drawings
- Pre-construction planning
- Emergency shut-down planning
- Asset mapping of PVC pipe can only be done from inside of pipe
Condition Assessment Information

Full data report on inspection process, location and findings
Still photos, Video and audio provided on CD/DVD

Coming soon - Tuberculation accumulation grading
GIS Integration

- Clickable GIS pipeline attributes
- GPS coordinates of insertion points
- Electronic and acoustic MPEG links
- Confirmation of distance inspected from location points
LDS1000™
Condition Assessment of Large Diameter Transmission Mains
LDS1000™ Technology

• Designed for transmission mains
• No disruption to service
• Single pass acoustic, CCTV video and sonde mapping/tracking
• In-line system increases accuracy
• Builds on in-line leak detection system developed by WRC over 15 years
• Global projects completed in US, Canada, England, Philippines and Australia
Process Overview

Surface tracking

Insertion Tube

Inspection equipment & operator control

Combined acoustic, CCTV & tracking sensor
Access to Pipelines

- 2 inch (ID) tap
- Existing Sahara chambers
- Air valves
- Service fittings
- Gate valves
- Pressure taps
Pipeline Inspection

- Operator is in control at all times
- Operator has “eyes and ears” in the pipe
- Operator has ability to stop to look at features
- Inspection typically occurs during implementation & pull back
- Increases inspection accuracy and minimize false/positives
Advanced Sensor Head

- Sensor head allows for simultaneous acoustic, CCTV and mapping/tracking
- Greater locating accuracy as system does not rely on stationed pinging
- Patented Agitator™ deployment system uses flow of water to push sensor in less turbulent zone around pipe wall
- Result is increased inspection efficiencies which reduces cost
Superior CCTV Image Quality

• High quality CCTV image quality
• Stable image due to patented Agitator™ deployment system
• No need for post processing – see immediate results
• Lighting optimized for large diameter mains
• CCTV signal quality does not degrade due to cable limitations
Corpus – 24” Steel Line
Low flow conditions or pipe crawlers can also be used to carry the LDS1000™ cable/sensor down the pipeline.
Distribution System Confidence to Make the Right Investments

• Eliminates needs for excavations
• Eliminates replacement/lining of pipes that are still in good condition
• Allows for comparison of pipeline degradation over time
• Provides understanding of actual pipe condition
• Maximize aging infrastructure investments
Once you have screened your lines cost effectively

- Better information to make prioritization decisions
- Can move to more intrusive/ expensive evaluations
  - Pigging solutions
    - PICA
    - PURE
  - Can justify excavations or taking lines out of service
Tool Box Approach

- **Leak and Gas Pocket Location**
  - Pit-hole, joint, bedding loss from leak
  - 95% of leaks are at joint
- **Internal CCTV inspection**
  - Liner, internal visual condition, valves, joints, laterals
- **Acoustic Pipe Wall Assessment**
  - *Average* stiffness, thickness
- **In-line EM inspection**
  - Localized defects in metallic pipe
  - Broken wires in PCCP
    - Requires line out of service OR >12” access into pressurized pipe
- **External MFL testing**
  - Testing at excavation *pit*, then predictive model
- **Ultrasonics**
  - In-line wall thickness
- **Monitoring performance**
  - Critical pipeline management
  - Solutions for small diameter with AMR/AMI,
  - Transmission mains?
Average Wall Stiffness/Thickness

- Relies on the measurement of the acoustic pulses as they propagate along the pipe
- The propagation velocity of an acoustic pulse is directly proportional to the stiffness of the medium that it travels through
- High propagation velocity indicates that the pipe wall has a high stiffness value
- The stiffness of the pipe wall is used to determine the general condition of the pipe
- Gives average wall thickness over lengths (500ft) of pipe.
- Indication of condition
- Needs homogeneous medium
- Smaller pipes better than larger pipes
Remote EM Field Testing (RFT)

- The HydraSnake™ and SeeSnake™ are electromagnetic In-Line Inspection tools that use RFT to directly measure wall thickness of pipe.
- Only RFT does not require “clean” wall contact for accurate and complete profiling of remaining wall thickness.

The exciter module emits an AC electromagnetic field.
- Field energy passes through the pipe wall, travels along the longitudinal axis, re-enters the pipe to an array of detectors.
- Wall thickness is measured to create colour map of pipe integrity.
The HydraSnake™ Inspection Process

Analysis & Reporting

• PICA takes data from the inspection and uses a patented analysis program, AdeptPro, to analyze and profile the pipe wall condition.

• The analysis is presented in a user-friendly format, helping clients make informed decisions on replacement, repair or rehabilitation options to improve pipe life-cycle performance.
PICA
Seesnake

• Most accurate system, according to Battelle/EPA
• Proven, repeatable
• Pigged version
• Tethered version
• Models available for specific pipe diameters
Alternative RFEC solutions

- Are proven for detecting broken wires in PCCP
- But require either line out of service OR
  12” tap into live PCCP

Do not give full wall coverage
Are not proven for metallic pipe
ECAT™ Magnetic Flux Leakage Testing
(similar to Broad Band Electromagnetic Testing)

Require excavation around pipe
ECAT™ Pipeline Inspection: Statistical Pitting Predictions

Statistical prediction of corrosion pitting in uninspected pipe, and likely future conditions

predictions include:

• Size & number of deepest pits
• Likelihood of through wall pits
• Likelihood of failure caused by significant structural defects
• The remaining life of the pipe

Along consistent conditions – pipeline and bedding
Monitoring of transmission pipelines
Solution

- An interesting monitoring technology for critical pipelines, that will detect leaks, breaks and variations in pressure and flows in transmission mains.
- Operates continuously
- Designed for transmission mains >12” diameter
- Sensors are attached to the pipe every 1500-2000 ft (depending on diameter, profile etc) and are working continuously 24/7.
- Data collected is sent through internet and analyzed using software models
- Alerts forwarded to the client, together with weekly, daily or monthly reports.
- The system seems ideal for critical lines (under rivers, bays, railroads, free ways etc).
- Data could be linked to a SCADA system or embedded in GIS.
Other Technologies

• BEM, Guided wave
• SuperPig / MegaPig - UT

Require excavation or the line out of service

If internal require clean wall and close contact
Ultrasonic wall thickness

• Based on proven external methods
• Inside pipe
• Do not take line out of service
PipeScanner: actual screen display
Actual wall thickness without pigging

PipeScanner
In line Inspection

PipeScanner

Based on Investigator Technology

Insertion at UK-based Hydrant on 6” line

Metallic, lined, PVC

Wall thickness, Video Leak detection ALL AT SAME TIME
Results Interpretation

- Hot spots flagged
- Using raster scanner
Pipescan

• Official launch at AWWA ACE conference
• Looking for 6” Pilots/ proof of concept opportunities.
• July/ August timeframe
• Alternative to intrusive and expensive systems
SAVING MONEY..........

“I’m not interested in squeezing the extra half a percent out of digging a hole – that is not the answer to me. It’s about asking the question do we need to dig the hole in the first place”
Summary

• Criticality matrix or priority list is a first step
• Before you spend money can you confirm recommendations/ findings?
• Inspection of all water distribution lines 2” to 102”+
• Should start with Low cost first pass evaluation
  – Video and leak detection and mapping
  – Lines remain in service

Look Before You Dig!!
Thank You
Wachs Water Services

Questions?