A New Approach To Internal Pipe Condition Assessment

Ride the wave of non-invasive technology.

Pipe, as simple and benign as it appears to be, can be the Achilles heel of your facility. Piping is one of the few non-redundant components of mission critical operations, yet failure can be operationally crippling and potentially life threatening. When failure manifests, it is always inconvenient and can be very costly.

THREE QUESTIONS

- What would be the impact if a pipe was leaking water on your equipment or inventory?
- What if you lost cooling?
- What if your fire sprinkler pipe was too corroded to allow enough water flow to the sprinkler head to control a fire?

Any of those scenarios can be catastrophic, all are very real, and each is fully preventable. Let's be realistic. Pipe maintenance and failure prevention are thorns in the side of every mission critical facility engineer and ultimately boil down to two factors: cost and risk. In addition to the costs of the repairs themselves, one must include lost revenues from down time and the potential migration of customers to a competitor as risk factors. Since piping is not likely a revenue generating component of your business model, expenditures must be cost effective and efficient, which is nearly impossible to achieve without the proper tools to make smart decisions.

THE CORROSION CONUNDRUM

Degraded piping is an issue that is often swept under the rug because of budget restraints, the mentality to let a sleeping dog lie, there are simply "more important" things to worry about, current mitigation techniques seem to be ineffective, or some combination of all of the above. We've all seen pipe failure on

By Tim Frederick

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FIGURE 1. An example of a guided wave.

FIGURE 2. An example of a handheld ULGW scanner.

some level, so consider yourself lucky if it's only been a minor problem or nuisance, because losses can be significant and issues do not get better when left alone.

The problem typically goes unnoticed until debris is found in the sprinkler system or cooling loop filters during a flush, or maybe a rust spot or small drip from a pinhole leak, and then you find yourself in an endless quagmire, trying to justify the mitigation expense within your limited budget and without creating unnecessary risk to your operations. And of course this won't happen during normal business hours. Failure can happen at any time, including nights, weekends, and holidays; when emergency service calls are double or triple the cost.

So what's the source of this headache and how do you deal with it effectively? MIC, selective leaching (loss of zinc coating in galvanized pipe), oxygen corrosion, scale, velocity erosion, and other pipe corrosion issues like pitting from trapped air and water are your culprits. Or more than likely, your problem stems from a combination of these things. The real trick is in knowing how to address these issues with the least amount of work, minimal disruption to operations, and lowest cost; but that requires knowledge of the system condition.

Internal pipe corrosion is nothing new, nor are the ways to detect and evaluate it. Unfortunately, the most common methods have largely remained unchanged since the advent of metallic pipe itself. In years past, you only had clues like a visual leak, a running preaction sprinkler compressor, reduced life of desiccant filters, excessive loss of nitrogen, or debris found during an obstruction test to justify further action.

INTERNAL CORROSION INVESTIGATION METHODS

Common methods used to investigate internal corrosion issues include:

- Replacing leaking pipe
- Testing the water or pipe cutout
- Running a borescope video scan
- Installing corrosion coupons

These methods:

- Require system shut down and draining.
- Create asset risk from technician error, introduce additional points of failure from opening the system, and require the use of bulky equipment
- Expose a serious potential for failure when bringing the system back online

Due to their highly intrusive nature, these tactics are typically employed "after the fact," when deeper issues may have evolved to a point that could result in

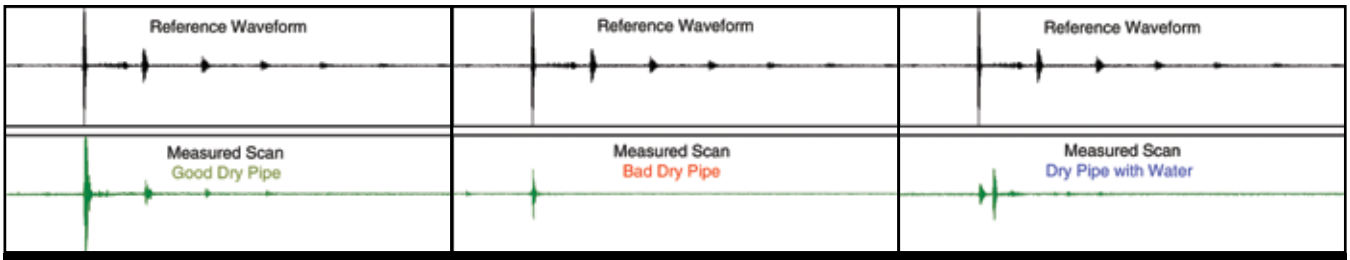

FIGURE 3. ULGW provides a corrosion map of the piping system.

leaking or degradation causing system failure, unnecessarily risking customer assets, your reputation/SLA, and most importantly, human life.

Additionally, all commonly used inspection methods provide a very small representative sample of the system condition and all leave out important bits of information, often requiring multiple methods to gain any useable insight.

- Water tests are ineffective for dry systems but reveal water quality in wet pipe; however they will not show the impact of the water on the pipe itself. Just because the water has potential to be corrosive does not mean that it is having a significant impact on your system piping. The most important information is missing, which is the location and degree of pipe corrosion.
- Lab samples require system drainage, so there is risk to client assets during the removal of test pieces, the data only represents a very small portion of the system, and it's expensive.
- Borescope video results in a limited representation of the system condition, uses a best guess on where to run the scope, provides no scans on small pipe, and there's no way to measure pitting underneath nodules.
- Corrosion coupons, when foreign material is added to see if it corrodes, require system drainage at installation and they create additional points of failure. At best, you must wait for a reaction and then guess if that corrosion is elsewhere in the system. It looks like you're back to using the crystal ball.

How do you justify replacement or repair of a system without knowing exactly where or why the issues exist or the best way to address them? Do all the pipes need to be replaced or just a few bad sections, will the use of a corrosion inhibitor or nitrogen (in dry sprinkler systems) actually help, do you need to install air vents or drains, etc.?

Since there is no silver bullet for corrosion mitigation, odds are good that the solution will require a combination of all of the available tools, so without comprehensive knowledge of the system condition, mitigation is a guessing game.

Full replacement or performing repeated "patch" repairs on a degraded system are very expensive options, particularly when the services are provided during off-hour premium billing times.

A NEW WAY

Ultrasonic localized guided wave (ULGW) technology is a non-destructive pipe inspection solution in which ultrasonic sound waves are beamed around the circumference of the pipe from the outside wall, creating an ultrasonic wave pattern (Figure 1). Within seconds, conditions inside the pipe impact the sound wave, revealing internal pipe condition before leaks or other catastrophes occur.

- Inspections are performed by a team of two technicians using a small handheld device, and are typically performed without any impact on daily operations (Figure 2).
- Most inspections are performed while the systems stay 100% operational. That means no shutdown and therefore no need to bring back online later. In addition, there is no system drainage, no worry of spilling water or dropping pipes or tools on sensitive equipment, and no introduction of new oxygenated bacteria rich water.
- ULGW ultrasound is safe to use around people, electronics, and sensitive inventory.
- There will be little to no incurred logistical outlay.
- Convenience now allows for a preventive approach, so issues can be found and repaired before failure and on your schedule and no down time.
- Typical ULGW inspections will reveal the location and severity of internal pipe wall conditions through direct measurement techniques. It is important to differentiate this from other inspection sources, as you will now know what is happening to the pipe walls throughout the system, without inferring condition based off snippets of circumstantial data or the use of a magic crystal ball.
- Instead of using water tests or coupons to determine potential for corrosion, ULGW will directly reveal the presence of corrosion on the pipe wall.
- Rather than use random borescope inspections representing a small percentage of pipe and guessing pit depth under nodules, a ULGW inspection will represent the entire system and accurately measure severe pitting, even under corrosion buildup.

- Why guess the locations of trapped water or air? ULGW can pinpoint the air/water interface and measure pipe condition at that exact location, where corrosion issues are typically at their worst.
- As referenced in Chapter 14 of NFPA 25 (2014ed), ultrasound can satisfy the five-year "Internal Piping Condition and Obstruction Investigation" requirement without flooding the system and potentially damaging valuable assets, and ULGW is the only ultrasonic inspection technique that can directly detect the presence of trapped air or water.

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With a corrosion map of the piping system, you are now armed with the knowledge to make effective mitigation decisions. Replace what's bad, repair what's salvageable, and save the rest (Figure 3).

- The ULGW report will reveal which sections of pipe have the most severe issues, narrowing down pipe replacement to the bare minimum needed to maintain system integrity.
- Installation of drains and air vents can be an inexpensive fix preventing more severe issues in the future, but only if you know where to install them. This requires a guess, or use ULGW to know the exact locations.

At a glance, traditional inspection methods appear to be less expensive, however the cost scale tips to the benefit of ULGW when examining the total cost model.

- Perform mitigation at your convenience, as opposed to reactive repairs which often happen during off-hour peak billing periods or heavy production times.
- Know exactly what needs replacement and what other repairs or alterations are needed, so the most educated and efficient resolution can be chosen; eliminating unnecessary repairs, repeated trip charges, and money wasted on ineffective solutions.
- Through implementation of preventive methods, collateral damage to equipment and interruption of services is all but eliminated, thereby reducing unnecessary equipment repair/replacement costs and maintaining customer satisfaction and service level agreements.

While each methodology can provide value at various stages of the corrosion assessment process, ULGW is the only pre-emptive assessment process. ■

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