Evolution of Hydrostatic Leak Detection

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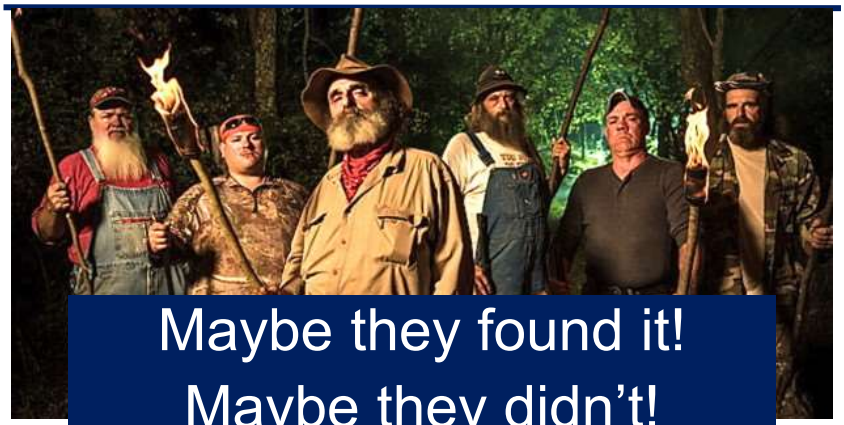
SPL Leak Detection

- IN THE BEGINNING …
  - According to PHMSA, hydrostatic testing for pipelines began in the 1940s.
  - MADE MANDATORY in 1968 by the Natural Gas Pipeline Act



Maybe they found it!
Maybe they didn't!

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Then they had a real mess!

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Sometimes it took WEEKS to locate the leak!

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- One way to detect a leak is by injecting an odorant into the water.

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- Another way is to inject a tracer gas.

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- AS TECHNOLOGY PROGRESSED … SO DID HYDROSTATIC LEAK DETECTION
- Even with the improvement in locating leaks, TIME was still CRITICAL to the operator!

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- New and Latest Technologies …
  - Pressure sensor, along with artificial intelligence, locate leaks as small as a drip.

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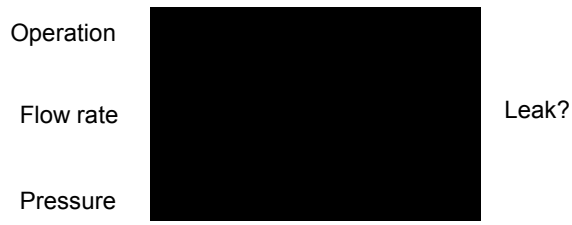
- Artificial Intelligence (AI)
  - The AI can be utilized to determine whether the pipeline has a leak or not based on the operation, flow rate, pressure, etc.



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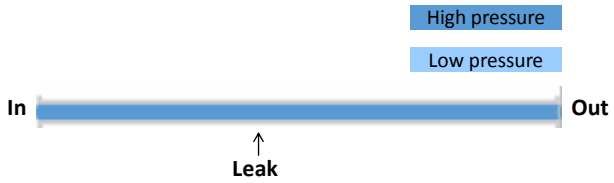
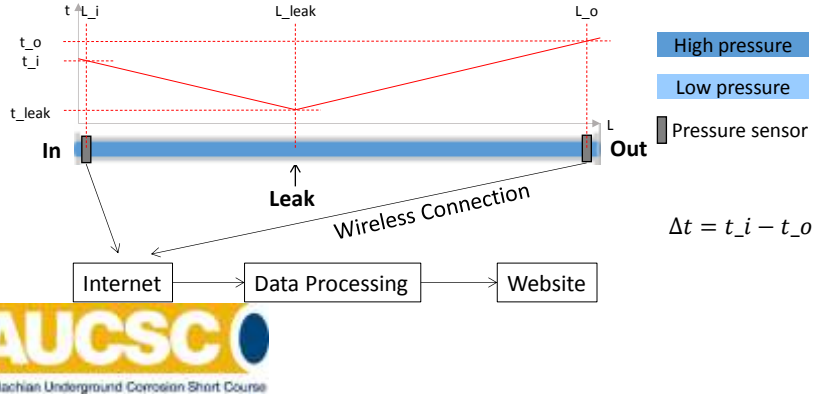
- Negative Pressure Wave
  - When a leak occurs a pressure drop takes place at the leak point.
  - The pressure drop propagates in both directions of the pipeline in the form of a negative pressure wave.



Methods

- Negative Pressure Wave Detection
  - The propagation of the Negative Pressure Wave (NPW) along a pipeline, which provides the location information of the leak.



- The negative pressure wave detection can only be used to monitor the pipeline without a leak.
- When the leak occurs, the pressure information is measured by the sensors.
- Then the leak can be localized based on the negative pressure wave detection.

What if there is a leak existing?

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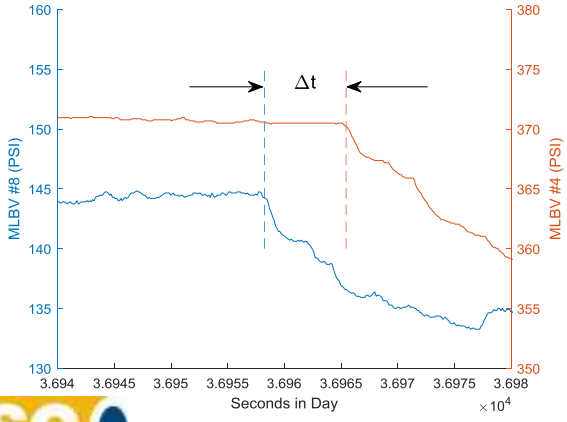
- A typical NPW signal is shown below.



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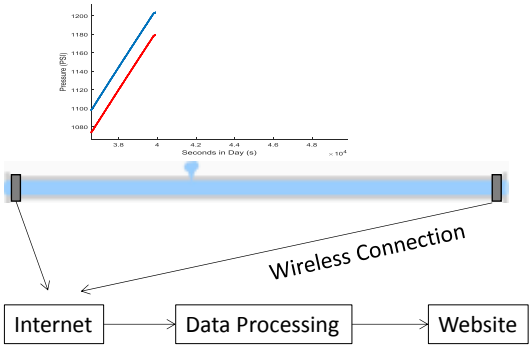
- Hydrostatic Testing
  - Pumping phase



High pressure
Mid pressure
Low pressure
Pressure sensor

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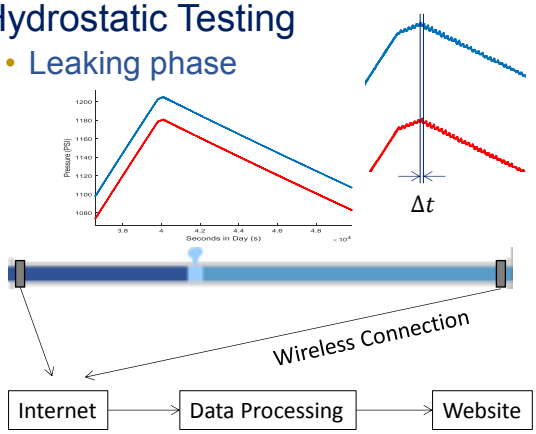
- Hydrostatic Testing
  - Leaking phase



High pressure
Mid pressure
Low pressure
Pressure sensor

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- Leakage Location Method
  - Based on the time-difference, Δt, the location of the leakage can be estimated.

$$L_1 = (\mu - V)\frac{(\mu + V)\Delta t + L}{2\mu}$$

  - where $L_1 = L\_leak - L\_i$, $\Delta t = t\_i - t\_o$, $L = L\_o - L\_i$, μ denotes the propagation velocity of the NPW, V denotes the contents flow velocity.

- Leakage Location Method
  - The NPW velocity $\mu = 0.7\ miles/s$ is considered for the leakage location. The content flow velocity is negligible compared to the NPW velocity and ignored, thus

$$L_1 = \frac{\mu\Delta t + L}{2}$$

- Each negative pressure wave is time-stamped, which will locate the leak at “x” number of feet from the upstream pressure sensor.

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- WHAT DOES THIS MEAN FOR YOU?
- Quickly find …
  - Leak size
  - Leak location

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- Avoid putting your technicians at risk …
  - Safety

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- and fewer headaches and problems for the operator

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