

The image shows a large-scale industrial facility with numerous large, silver-colored pipes and a complex metal support structure. The pipes are arranged in a series of vertical and horizontal sections, some with 90-degree bends. The background is a clear blue sky with light, wispy clouds. In the foreground, there is a large, curved pipe that dominates the left side of the frame. The overall scene is brightly lit, suggesting a clear day.

 PipeSense

A wide-angle photograph of a long pipeline stretching across a vast, flat desert landscape under a hazy sky. The pipeline is supported by concrete pillars and recedes into the distance towards a range of low mountains. A large, semi-transparent green circular graphic is overlaid on the center of the image.

Fighting to protect communities
and the environment through
pipeline technology that works



PipeSentry family of products



PipeGuard

Advanced pipeline
leak detection



PipeTrack

Real-time pig
tracking (coming
soon!)



PipeTest

Advanced hydrotest
monitoring & leak location



PipeScan

Pre-existing leak
location & blockages

PipeGuard

Advanced pipeline leak detection



Leak detection challenges & our solution

False alarms significantly increase cost to operators

Lack of sensitivity means missed leak events

Slow detection of leak leads to higher risk and cost of damage

Lack of accuracy in location increases operation downtime & cost of repair

Pipeline system complexity & product diversity

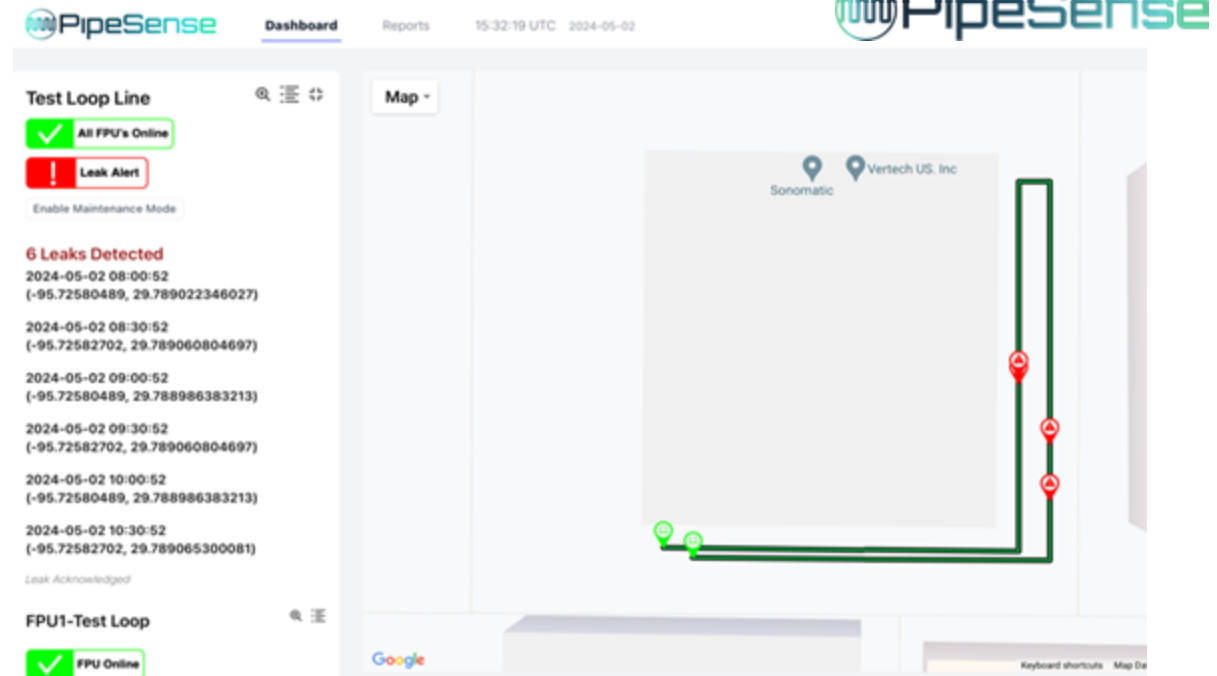
New AI based approach reduces false positives to near zero

Increased sensitivity to smaller pressure events means smaller leaks captured

Detects leaks and notify the operator typically within 2-5 minutes

Highly accurate leak location typically within 20-50ft

Works for any pipeline configuration and transported product



Pipeline Sensors

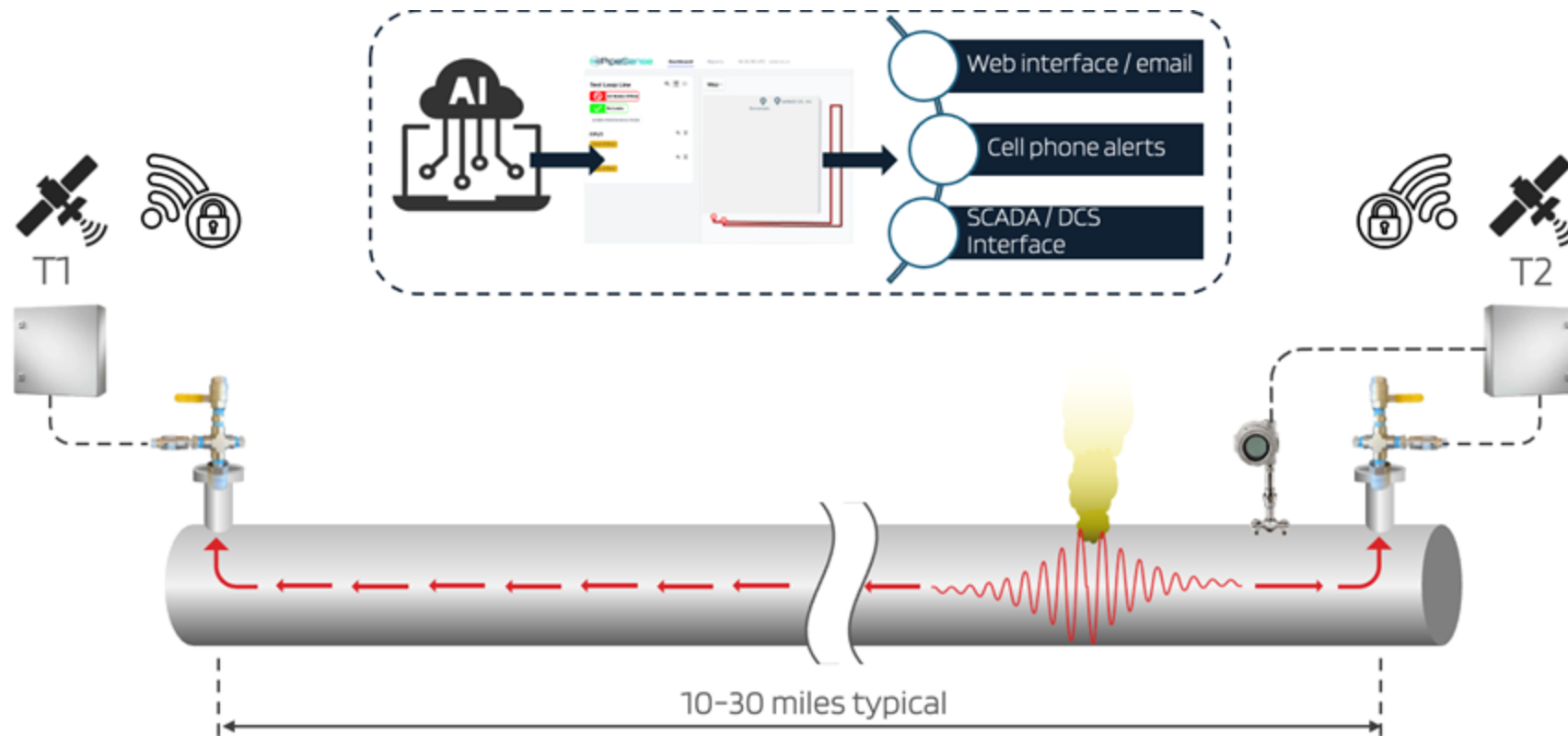
- Distributed sensors
- Attached via small bore branch
- 1kHz sample – pressure events to be accurately detected and located

Processing Hardware

- Real time processing of high-speed data using common hardware solution
- Rugged field proven industrial hardware with a modular design

Customer Notification

- Flexible system deployment aligned with customer cyber-security
- Accurately confirms leak detection and calculates and displays leak location
- Operator notification via mobile, text, web app or SCADA
- Flexible notification levels with automatic escalation to prevent unacknowledged events



Sensor Connection

Connected to small bore branch at typical intervals of 10 - 30+ miles

Detection

Leak event results in instantaneous pressure pulses which can be detected by the distributed sensor system

Calibration

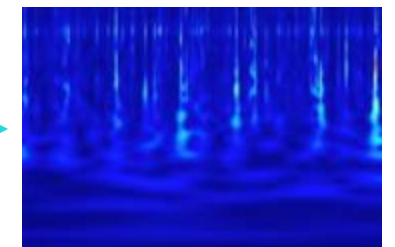
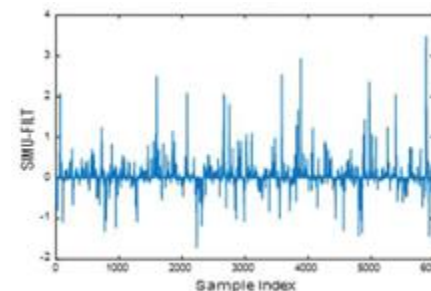
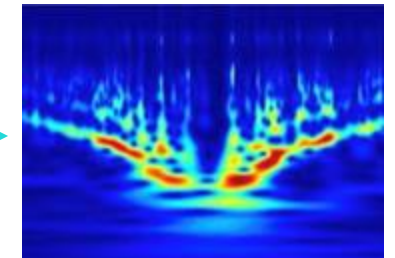
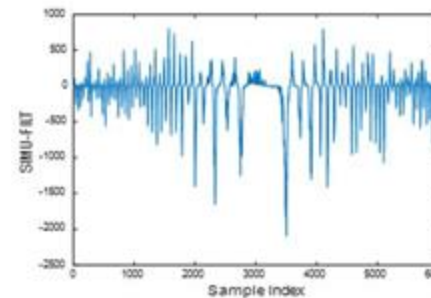
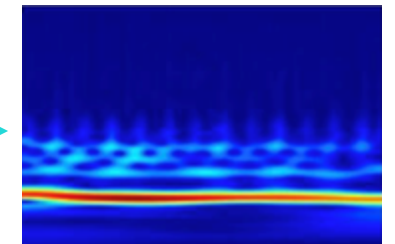
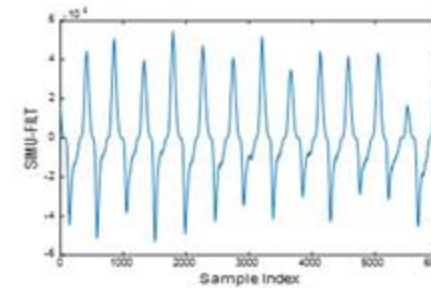
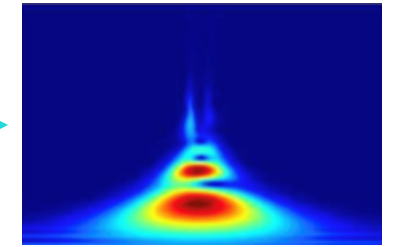
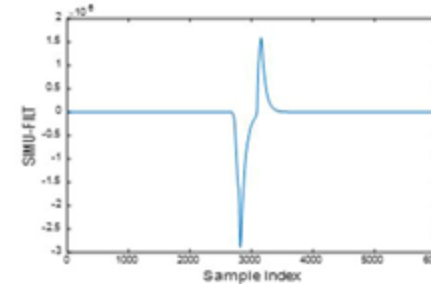
Real time system calibration at time of leak results in improved location accuracy

Redundancy

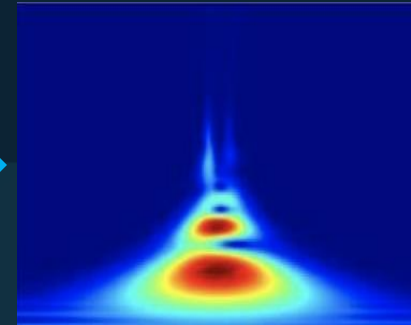
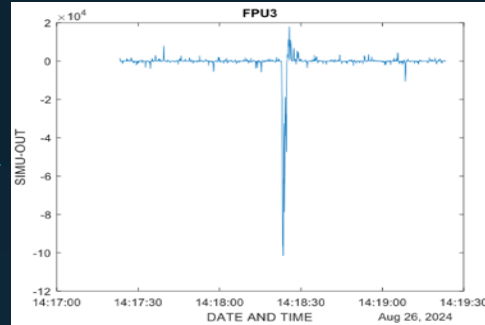
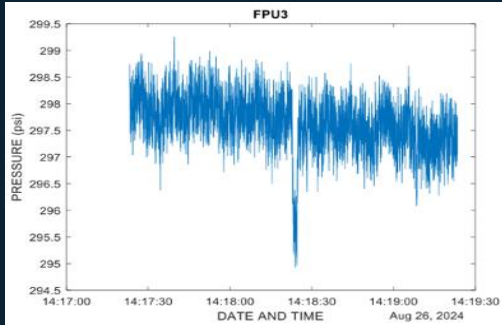
FPU's work independently of each other which can provide for system redundancy

Mitigating False Positives

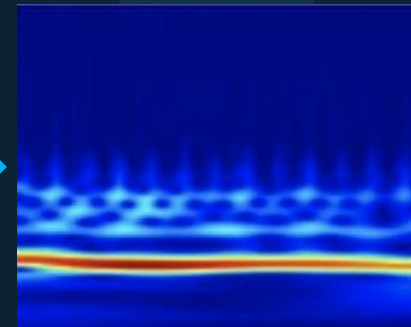
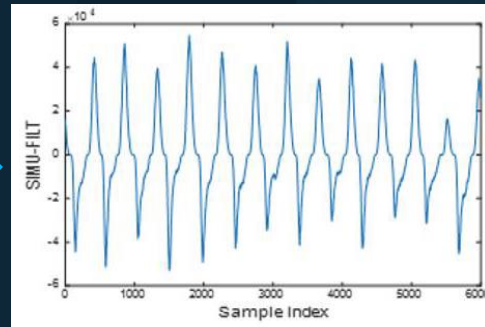
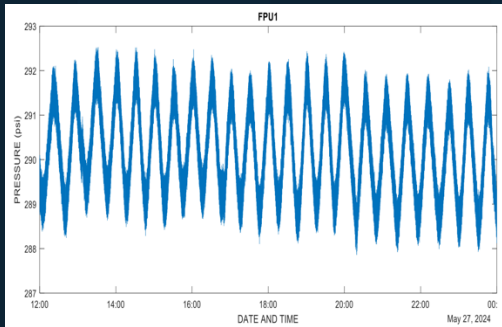
- Initially constructed from extensive testing on 50-mile liquid propane line 2021 – 2023
- Additional data used from crude oil, natural gas, and water pipelines
- High speed data sampling = 1kHz
- Normal pipeline operation includes variety of pressure events and anomalies
- Included simulated leak events
- Expanded to include mixed pressure events
- 35,000+ images, with 5,000 used for validation



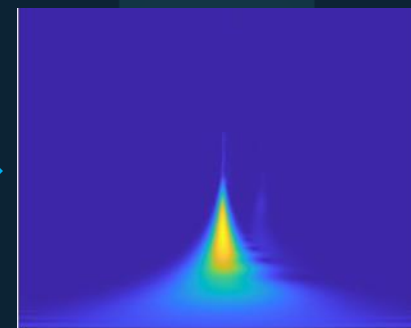
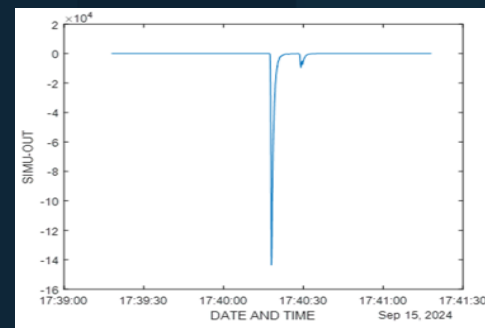
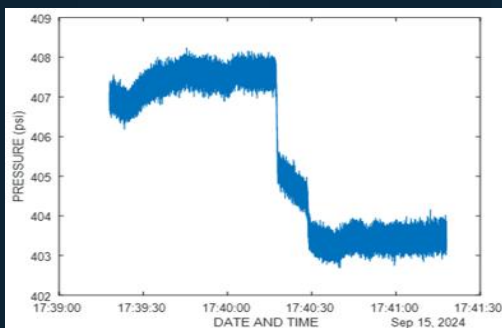
True Leak Event



Normal Operation



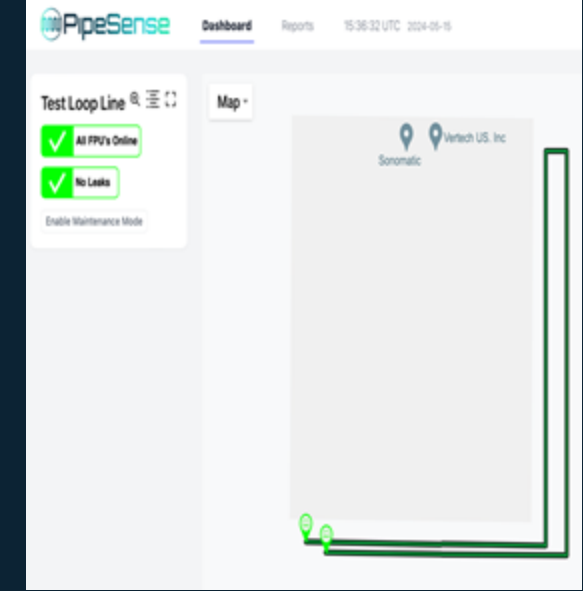
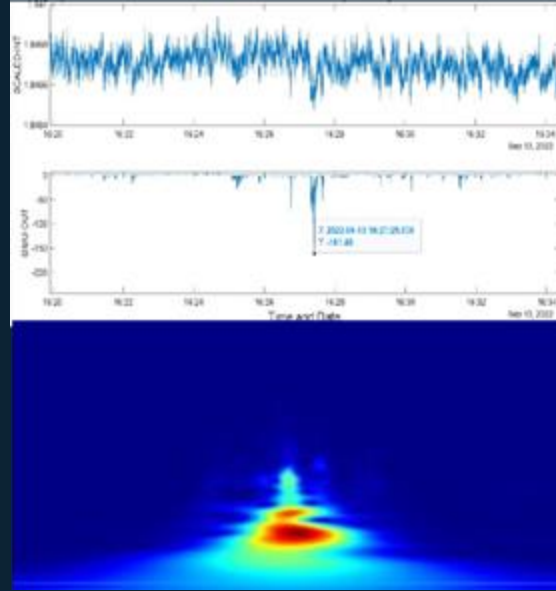
Also Normal Operation



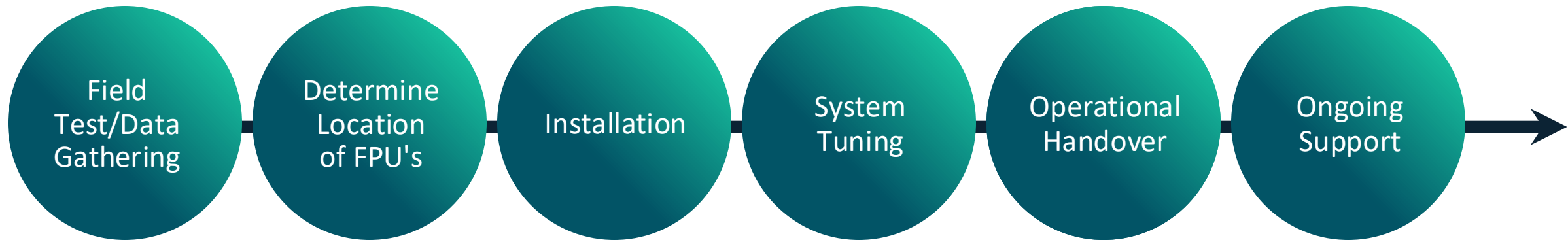
Pressure

Filtered

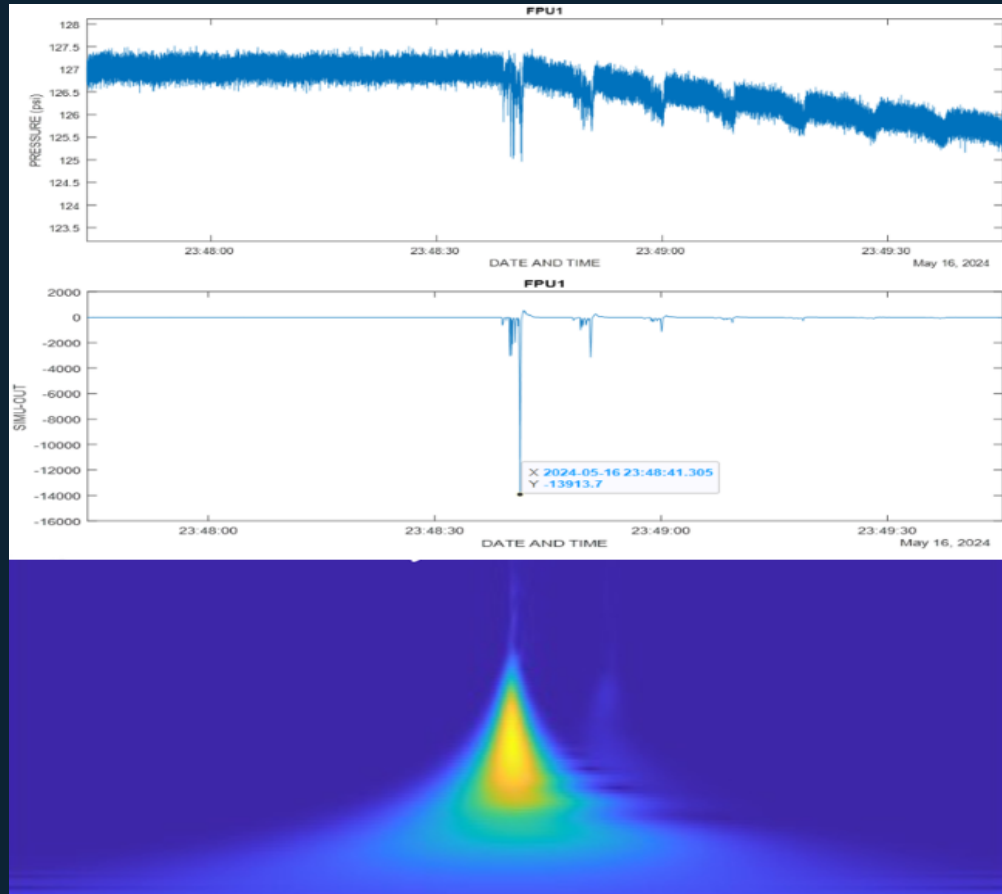
Frequency



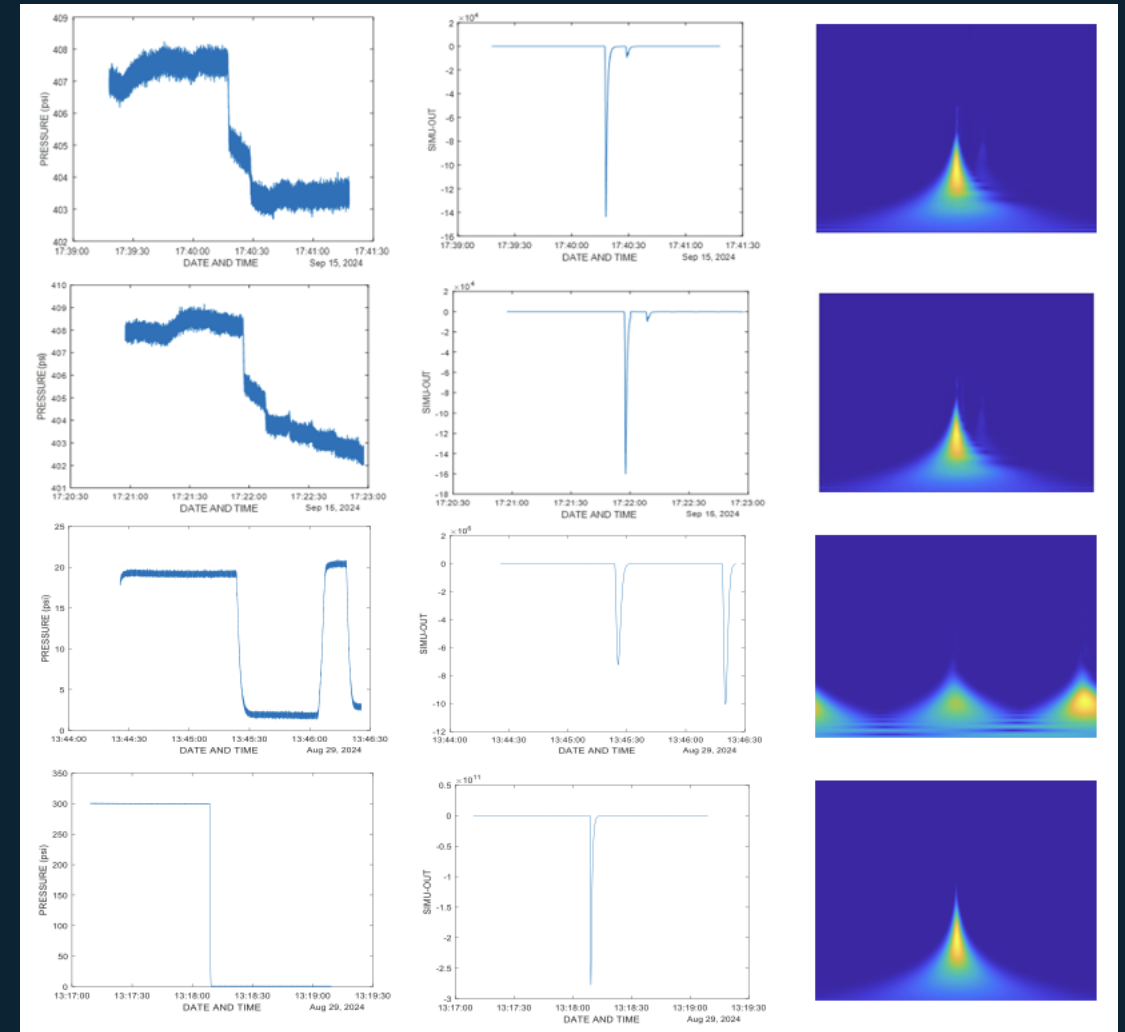
Typical implementation process



The challenge.....

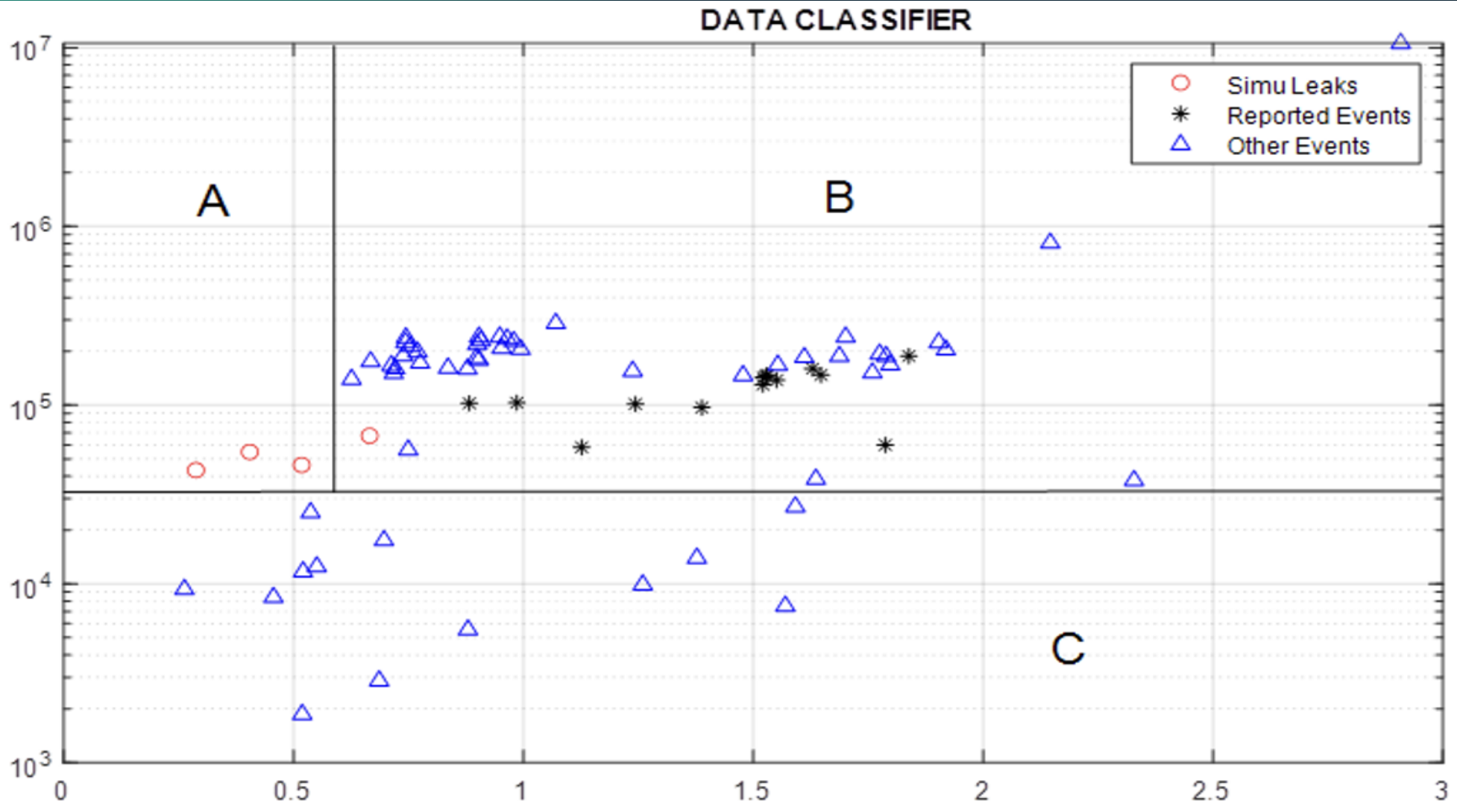


Simulated leak release

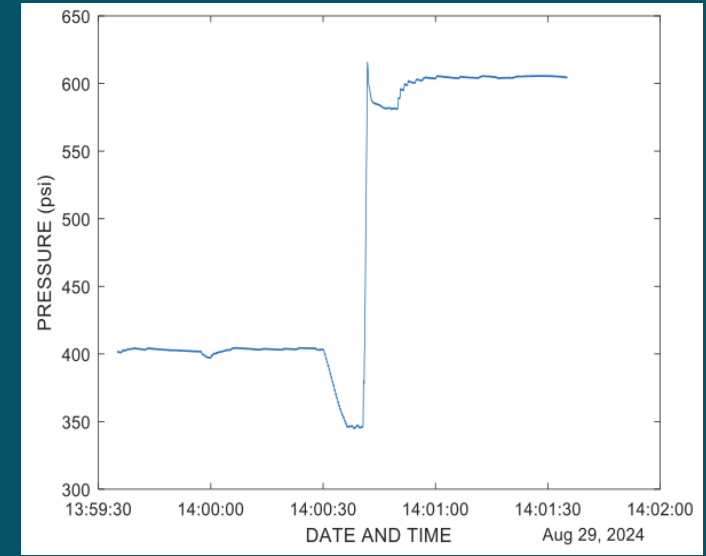
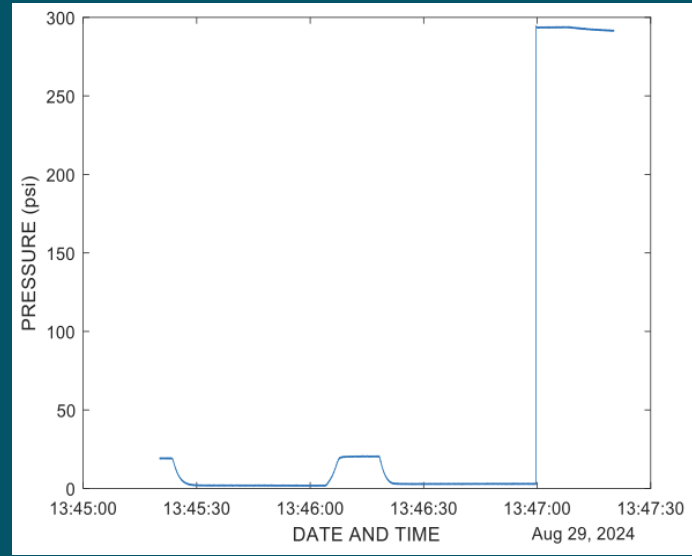
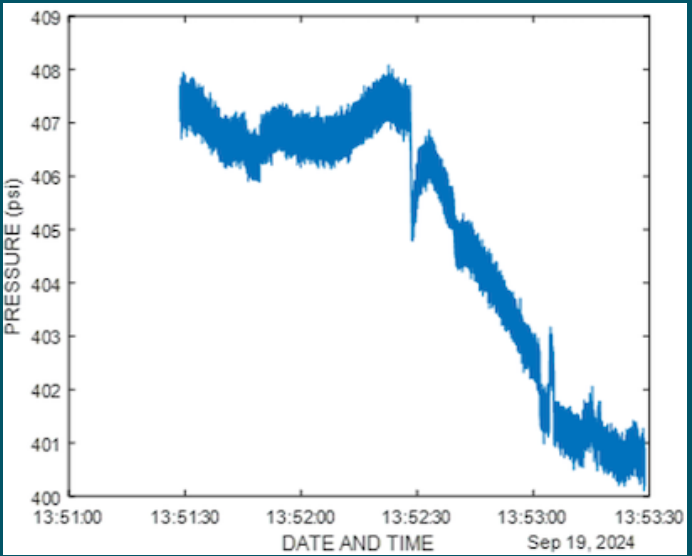
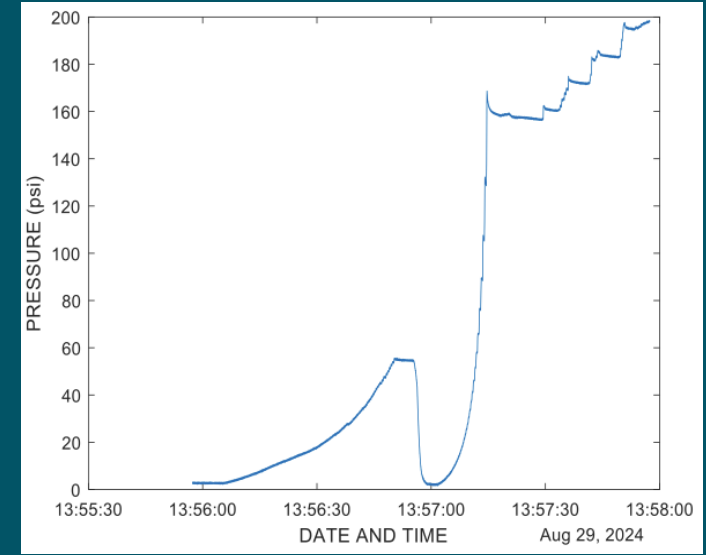
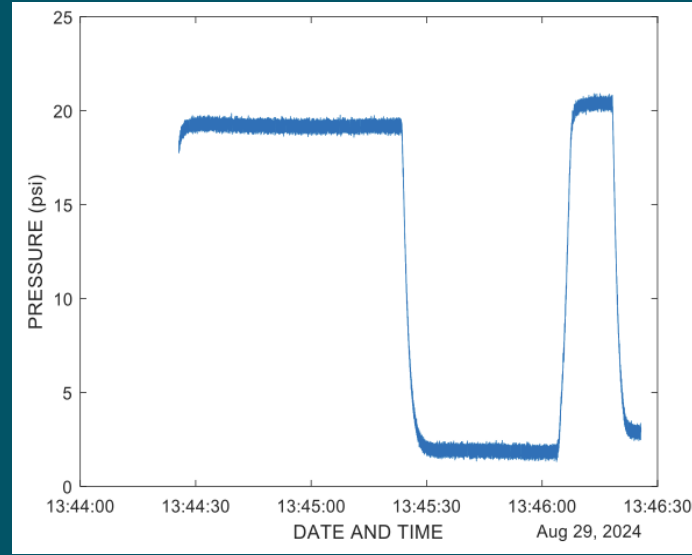
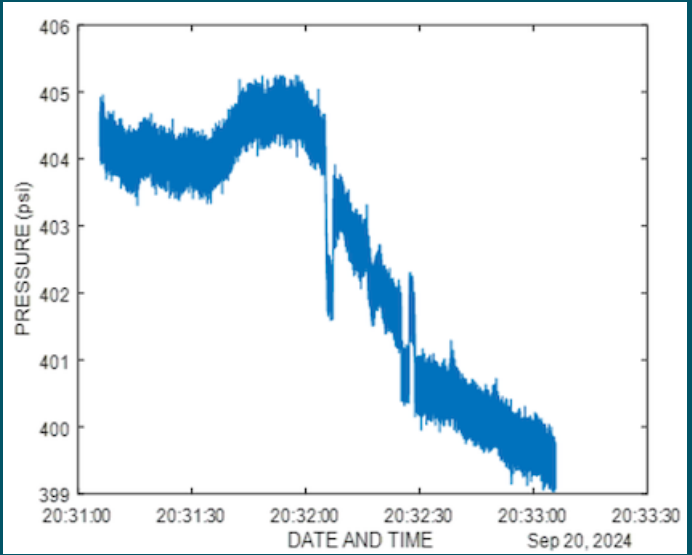


Normal operation events

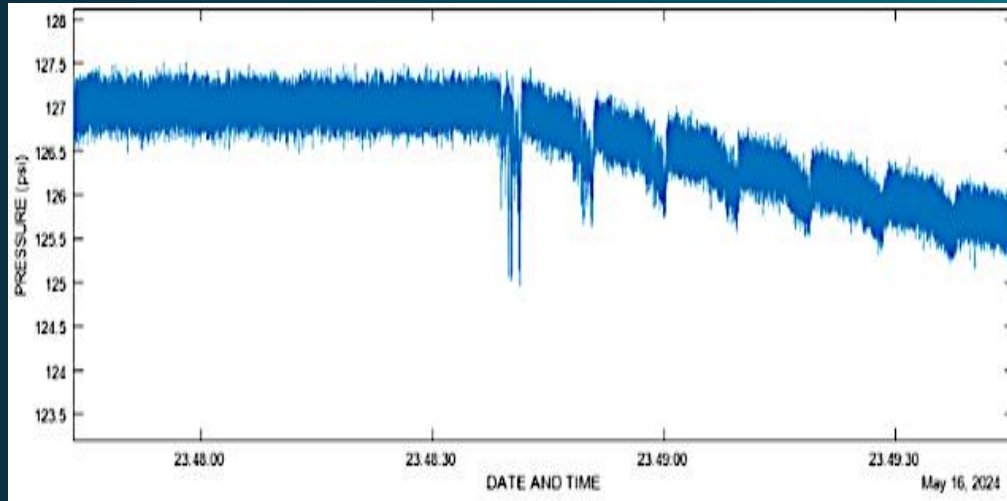
Statistical based analysis



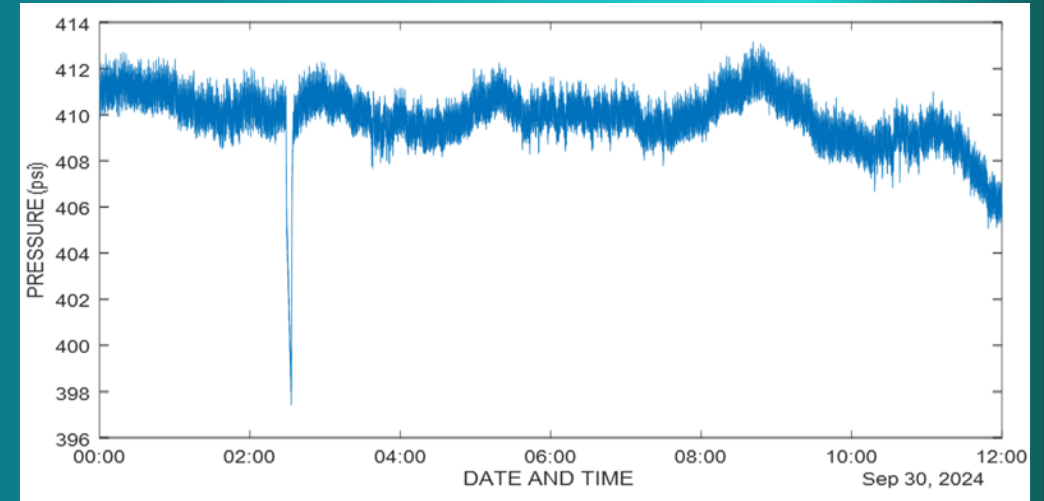
Grouping of event patterns



The result with lots of re-run data



Simulated leak release



Extreme normal operational event



Before



After

Regulator Study Comparison

- PHMSA funded PRCI study completed in 2021
- Studied three (3) operators CPM system performance with and without simulated leaks
- Included false positive events and simulated leaks detected in determining system accuracy
- A comparison to the PipeSense leak detection system supplied for large US pipeline operator is provided below

“99.95% Lower False Positive Rate”

“99.99% System Accuracy”

performance



PHMSA Operator Average

| | |
|------------------------------|-------|
| Sample Period (Days) | 126 |
| Minutes with False Positives | 410 |
| % Time with False Positives | 1.47% |
| System Accuracy | 79% |

PipeSense US Operator

| | |
|------------------------------|--------|
| Sample Period (Days) | 189 |
| Minutes with False Positives | 2 |
| % Time with False Positives | 0.001% |
| System Accuracy | 99.99% |

Clean integration of multiple assets

- Simple accurate mapping of leak events without false positives
- Multiple pipeline assets can be integrated on one dashboard
- Drill down for a detailed view

The dashboard shows a regional map of the Midwest with a green circle highlighting a specific area. The sidebar on the left lists four asset categories, each with a green checkmark and status indicators:

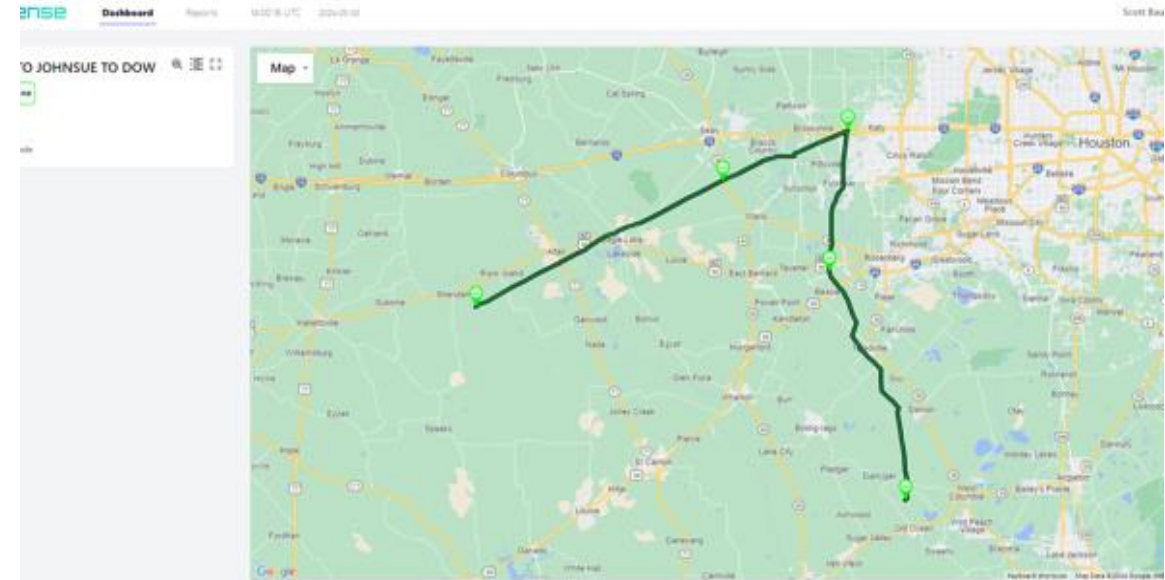
- KC-Landfill:** All FPU's Online, No Leaks
- Canton_Landfill:** All FPU's Online, No Leaks
- FPU_1_Canton:** FPU Online
- Eco:** All FPU's Online, No Leaks

The detailed map view shows a specific area with a green line tracing a path. The sidebar on the left lists the same four asset categories, each with a green checkmark and status indicators:

- KC-Landfill:** All FPU's Online, No Leaks
- Canton_Landfill:** All FPU's Online, No Leaks
- FPU_1_Canton:** FPU Online
- Eco:** All FPU's Online, No Leaks

Example system performance

- Very large operator >70,000 miles
- 100-mile pipeline section
- Just 5 field processing units
- Located at already available above ground connections
- Maximum spacing of 33 miles!
- Successful in being able to detect leak events down to 1/8th inch
- Zero false positives since deployment of our new machine learning approach



Final system performance



The aim - to provide an accurate, robust, yet flexible leak detection system

- Effective detection of small leaks
- Near zero false positive alarms
- Leak location within 50ft
- Leak notification within 2-5 minutes of occurrence
- Simple yet informative user interface
- No leak detection expertise required!

Test Loop Demo

test-loop-1.pipesense.cloud/dashboard

PipeSense Dashboard Reports 15:38:45 UTC 2024-05-05 Administrator

Test Loop Line

- All FPU's Online
- No Leaks
- Enable Maintenance Mode

Map

Google Keyboard shortcuts Map Data ©2024 Google Terms

Event Log

Live View Playback

Pressure Readings

27.50psi
27.00psi
26.50psi
26.00psi
25.50psi
25.00psi

10:37:50 10:38:00 10:38:10 10:38:20 10:38:30

— PRESSURE

Contracting



Hardware purchase

Upfront payment for hardware, system engineering and install

Monthly payment for operation & maintenance



Design, install, tune and maintain

Software leak detection optimization

All hardware and software ongoing support

Total Solution

Quarterly system performance review

Annual onsite performance review

Annual onsite equipment inspection and calibration

Questions ?



Contact us
as follows:

Josh Holmes

VP of Sales

jholmes@pipesense.com

+1 651-338-3153



www.pipesense.com