
PipeSense

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

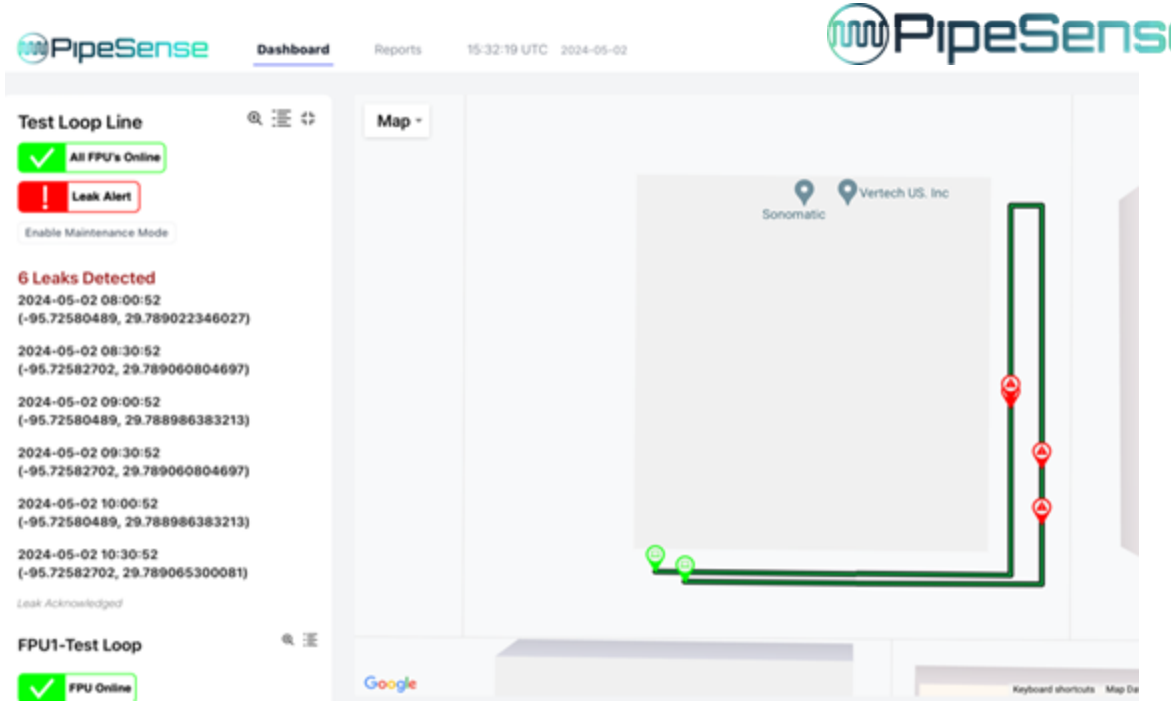
Pre-existing leak location & blockages

PipeGuard

Advanced pipeline leak detection

Leak detection challenges & our solution

False alarms significantly increase cost to operators	New AI based approach reduces false positives to near zero
Lack of sensitivity means missed leak events	Increased sensitivity to smaller pressure events means smaller leaks captured
Slow detection of leak leads to higher risk and cost of damage	Detects leaks and notify the operator typically within 2-5 minutes
Lack of accuracy in location increases operation downtime & cost of repair	Highly accurate leak location typically within 20-50ft
Pipeline system complexity & product diversity	Works for any pipeline configuration and transported product



Pipeline Sensors

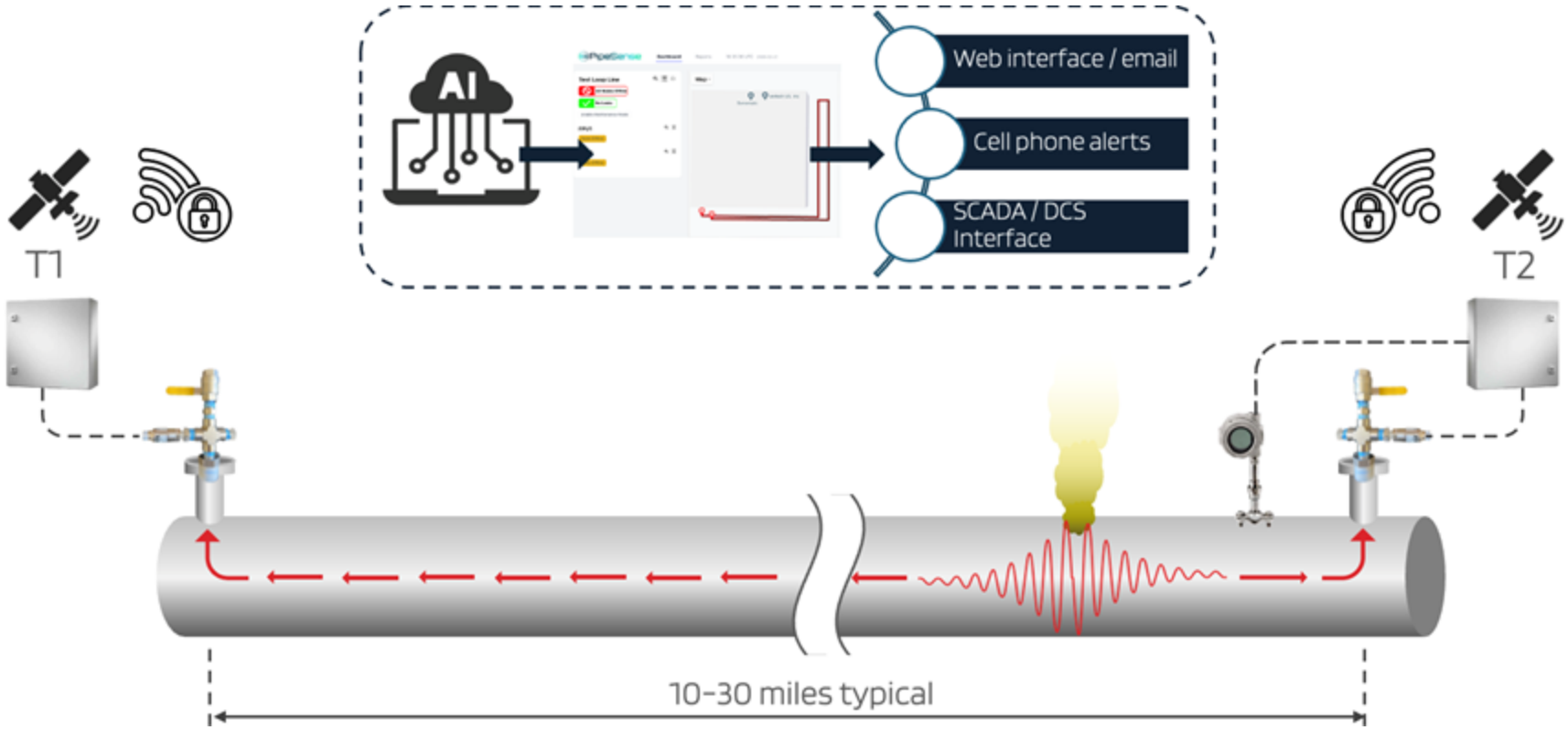
- Distributed sensors
- Attached via small bore branch
- 1kHz sample – pressure events to be accurately detected and located

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

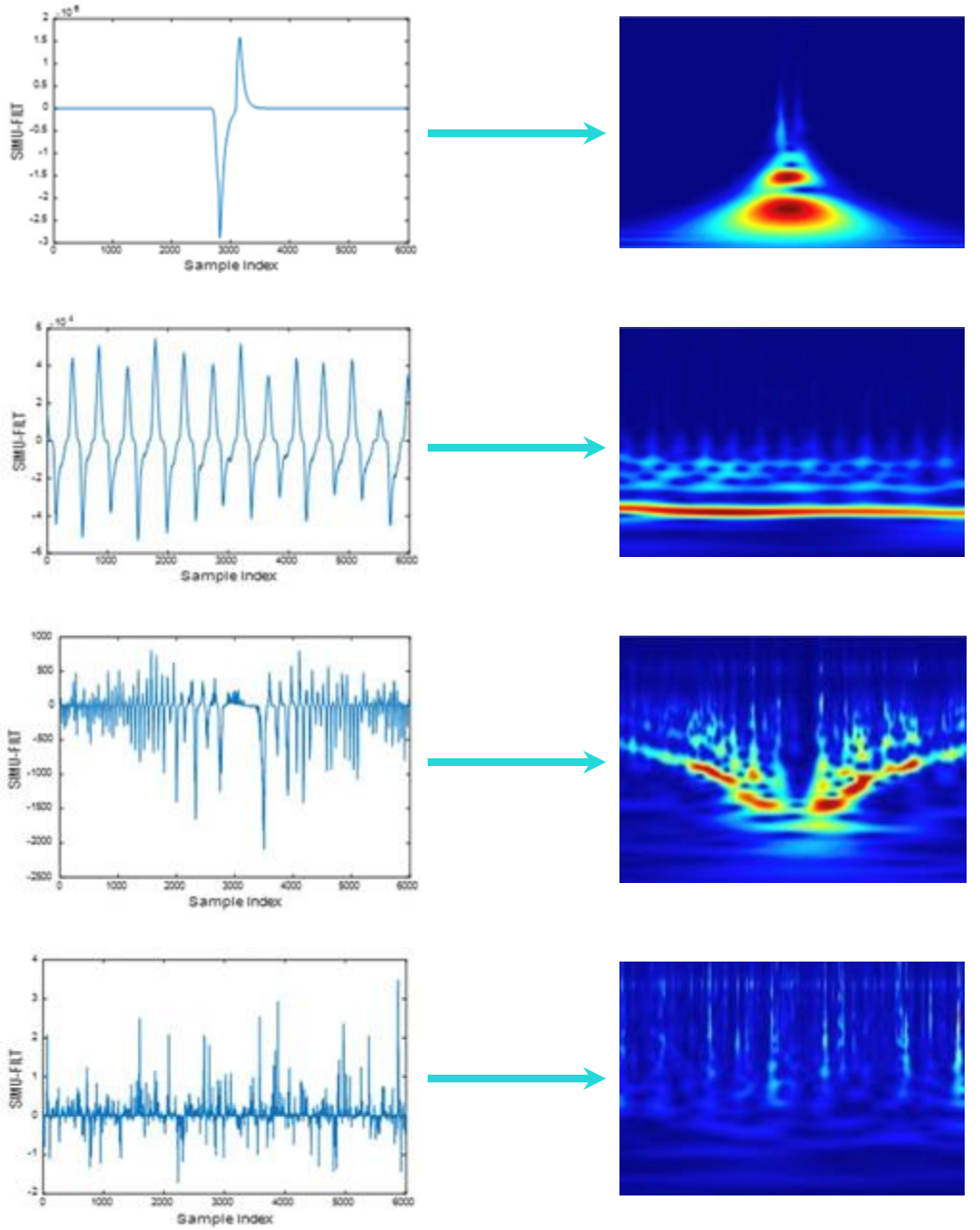
Real time system calibration at time of leak results in improved location accuracy

Redundancy

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

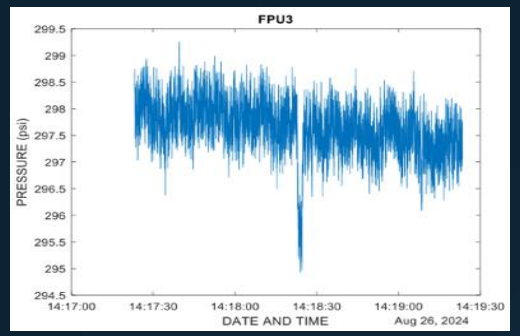
Mitigating False Positives

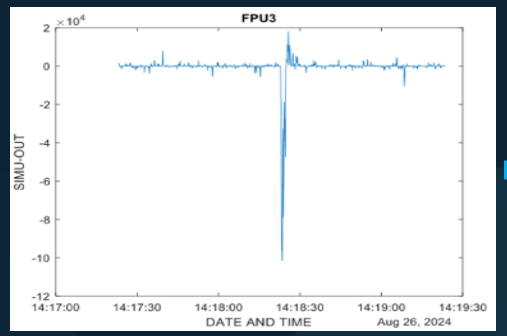
- Initially constructed from extensive testing on 50-mile liquid propane line 2021 – 2023
- Additional data used from crude oil, natural gas, and water pipelines
- High speed data sampling = 1kHz
- Normal pipeline operation includes variety of pressure events and anomalies
- Included simulated leak events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

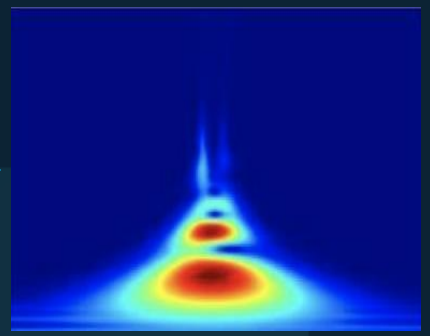


PipeSense

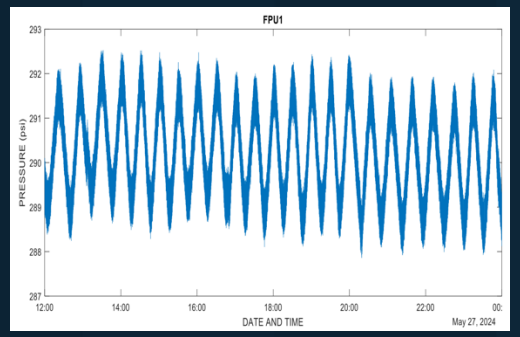
True Leak Event

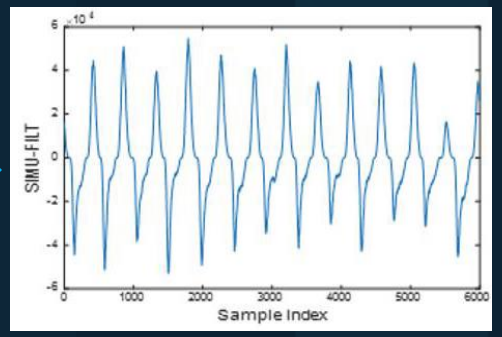


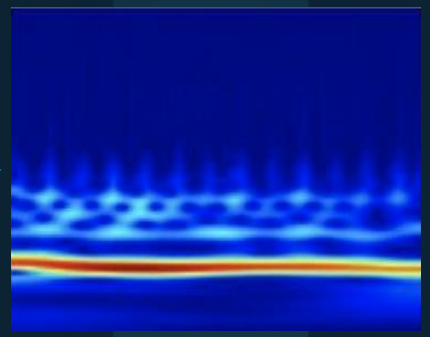




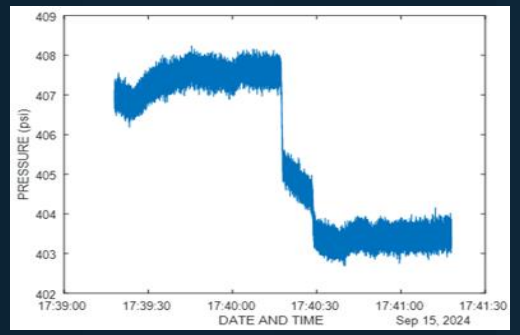
Normal Operation

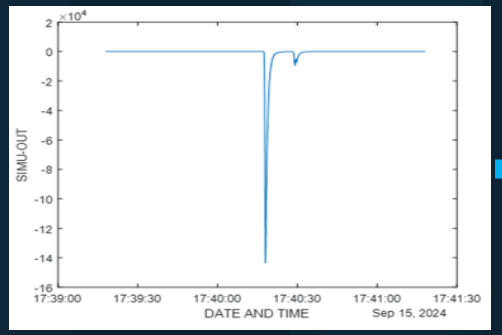


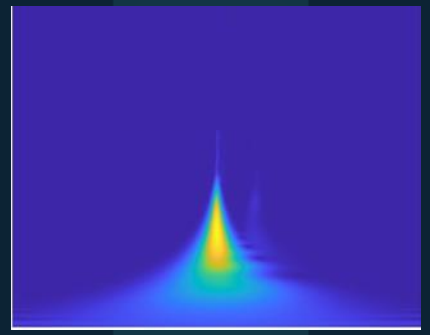




Also Normal Operation



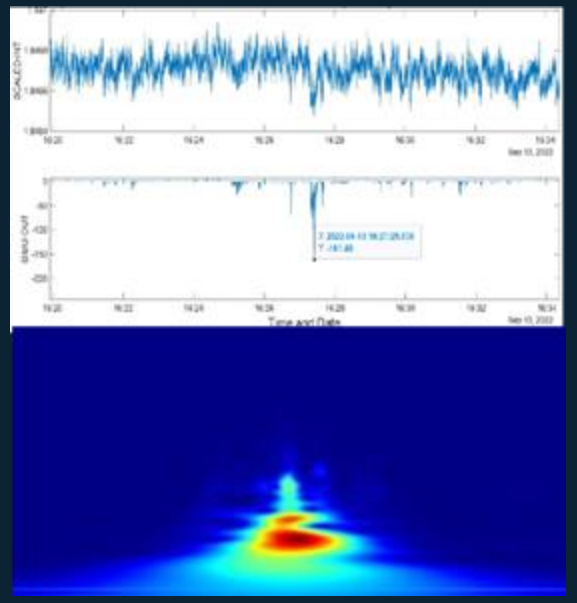




Pressure

Filtered

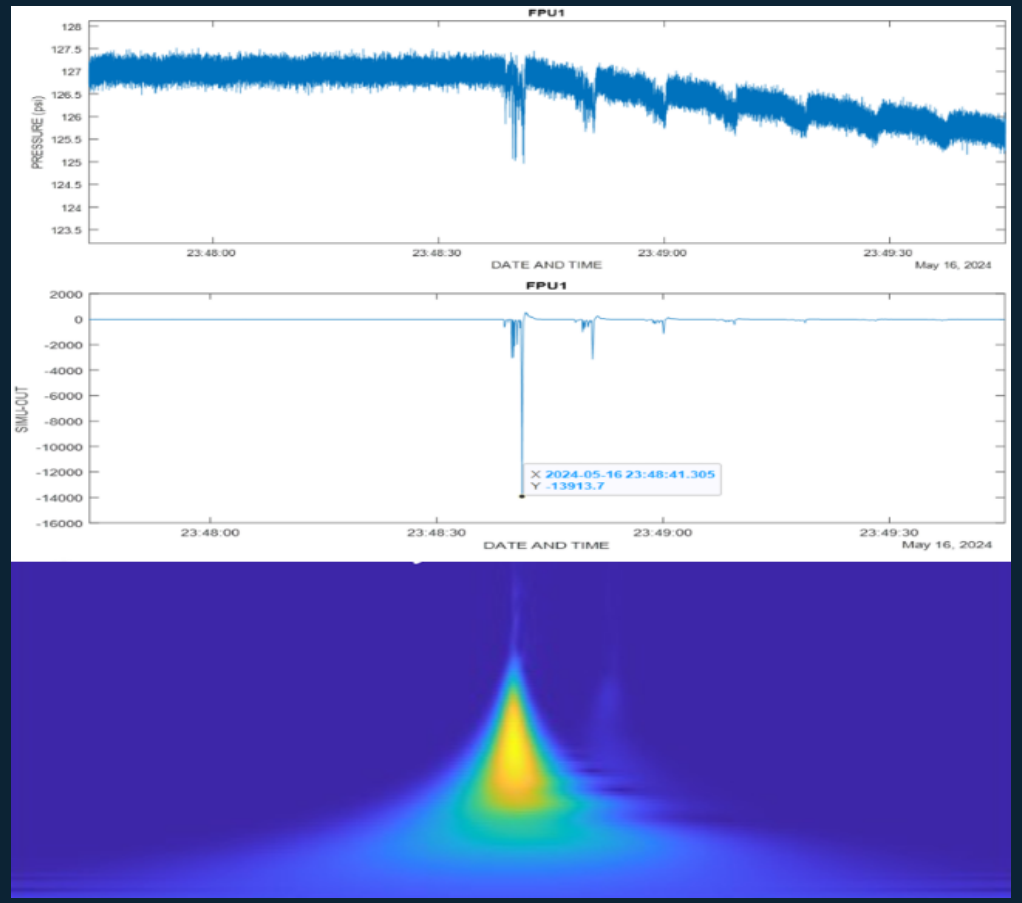
Frequency



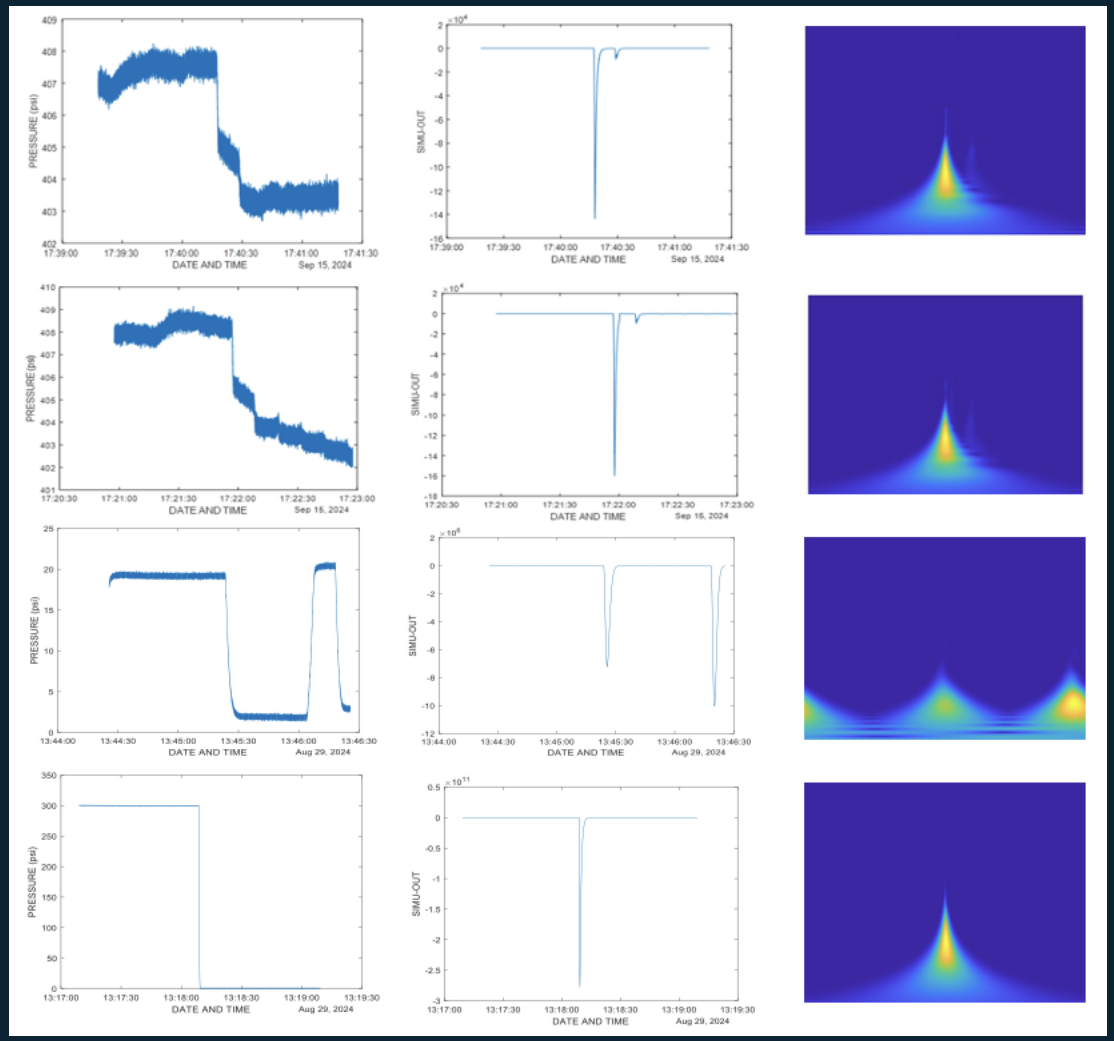
Typical implementation process

Field Test/Data Gathering → Determine Location of FPU's → Installation → System Tuning → Operational Handover → Ongoing Support

The challenge……..

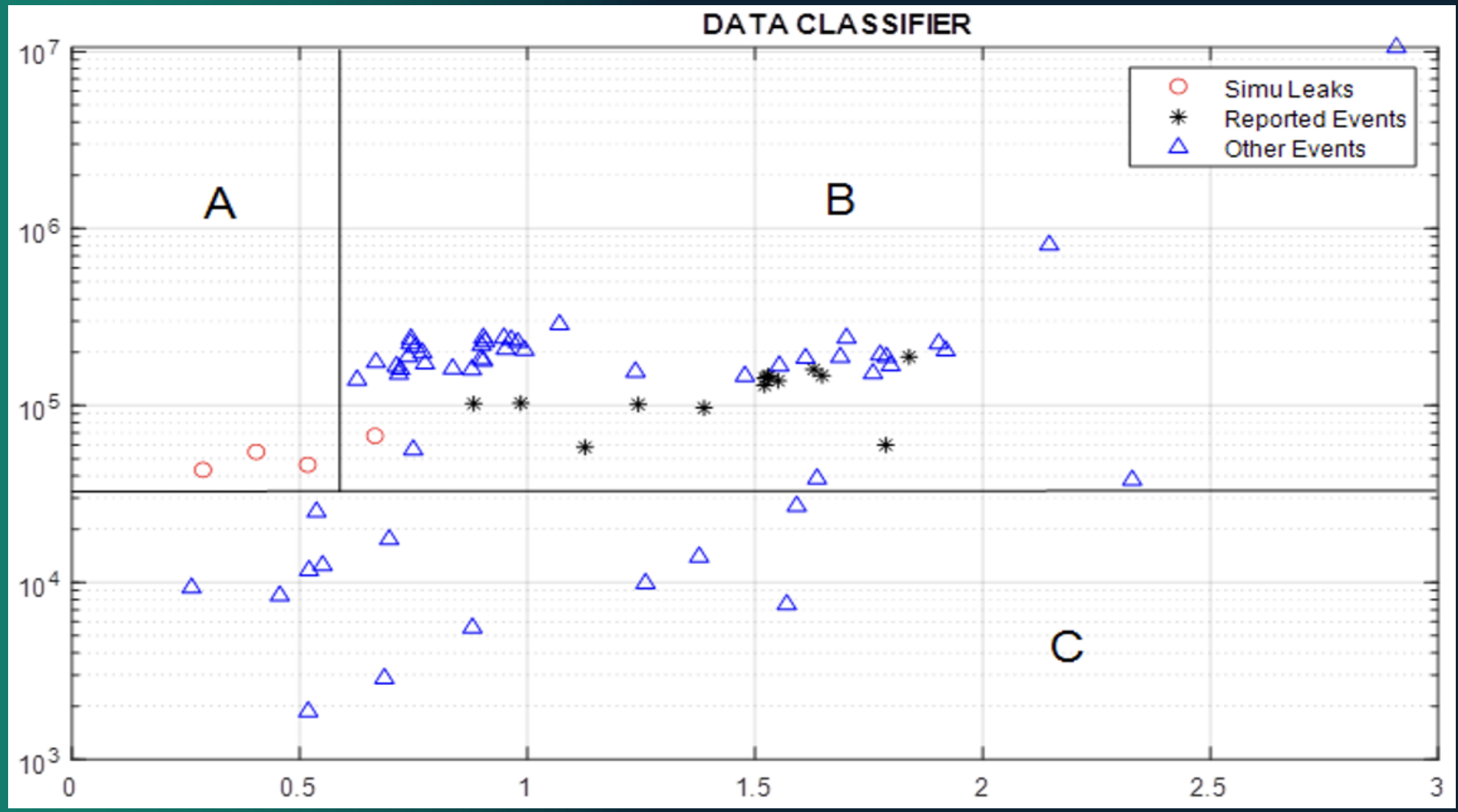


Simulated leak release

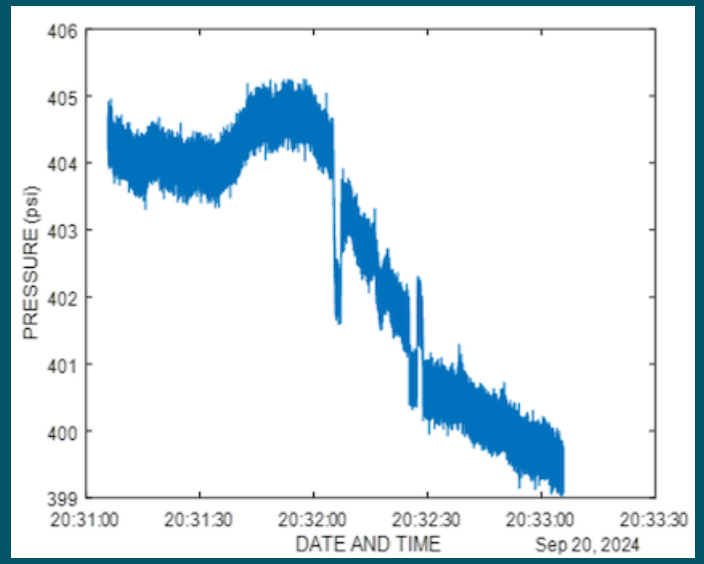


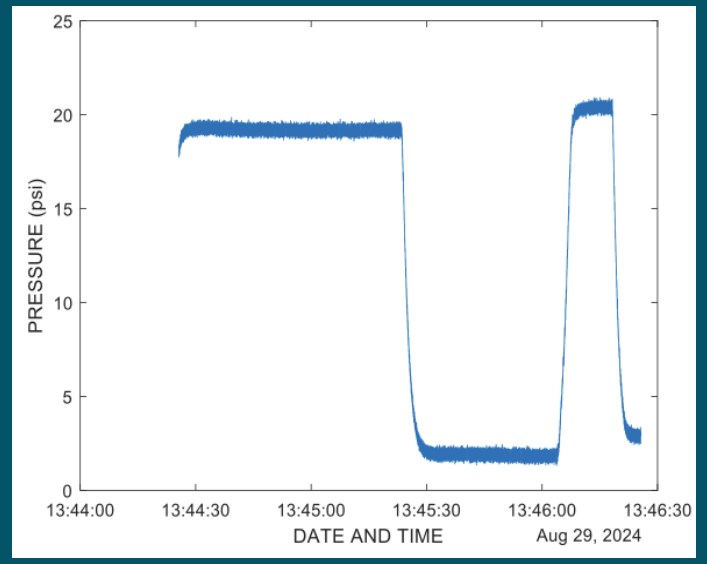
Normal operation events

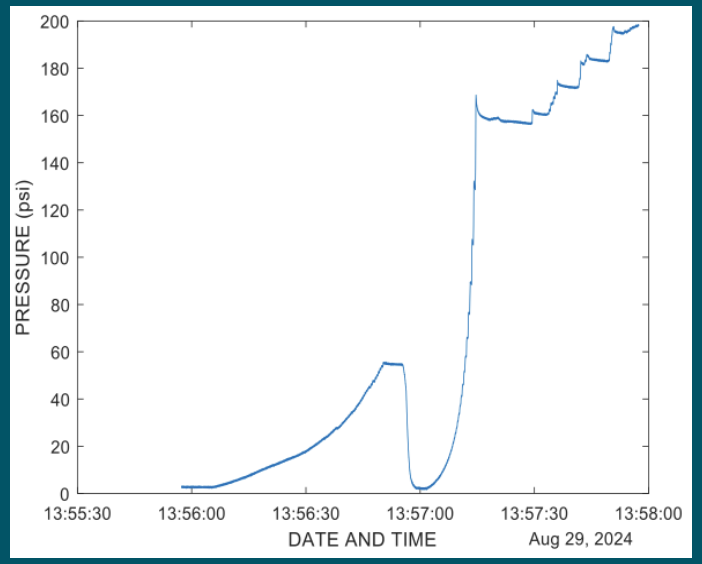
Statistical based analysis

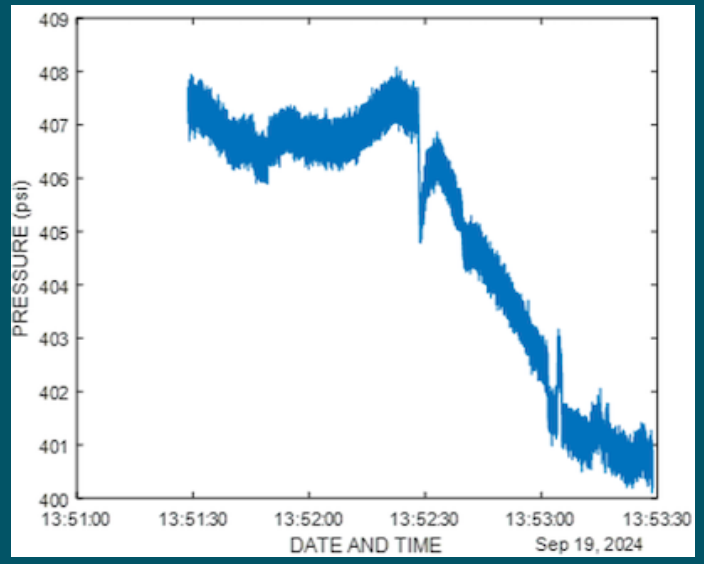


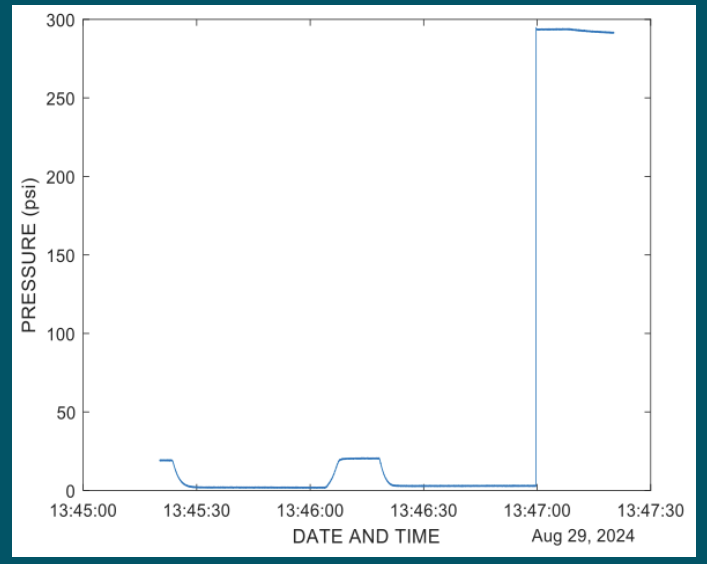
Grouping of event patterns

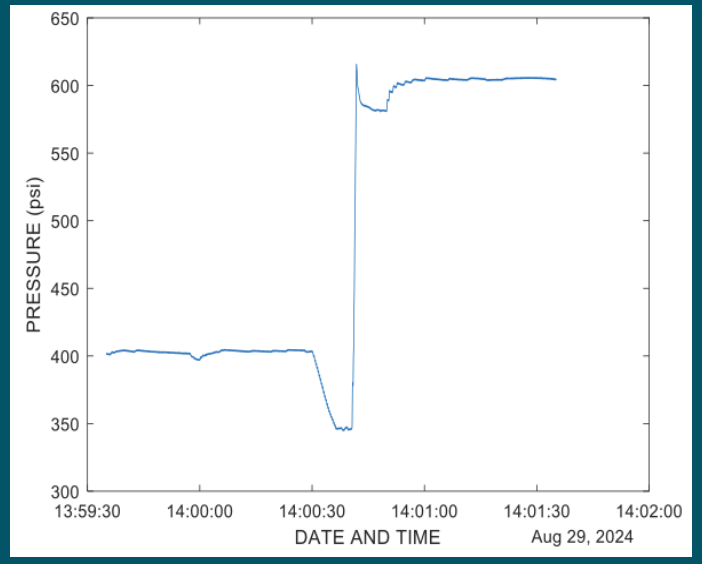




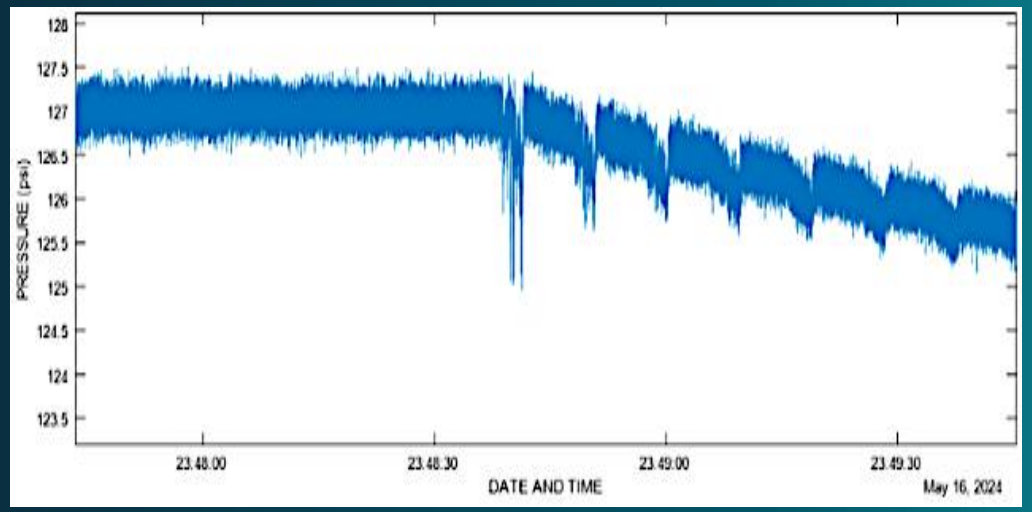




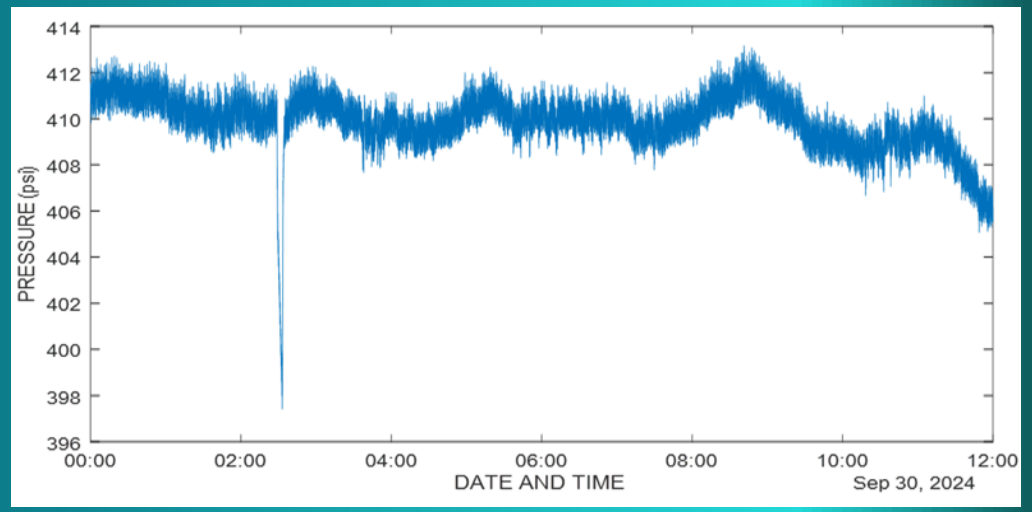




The result with lots of re-run data

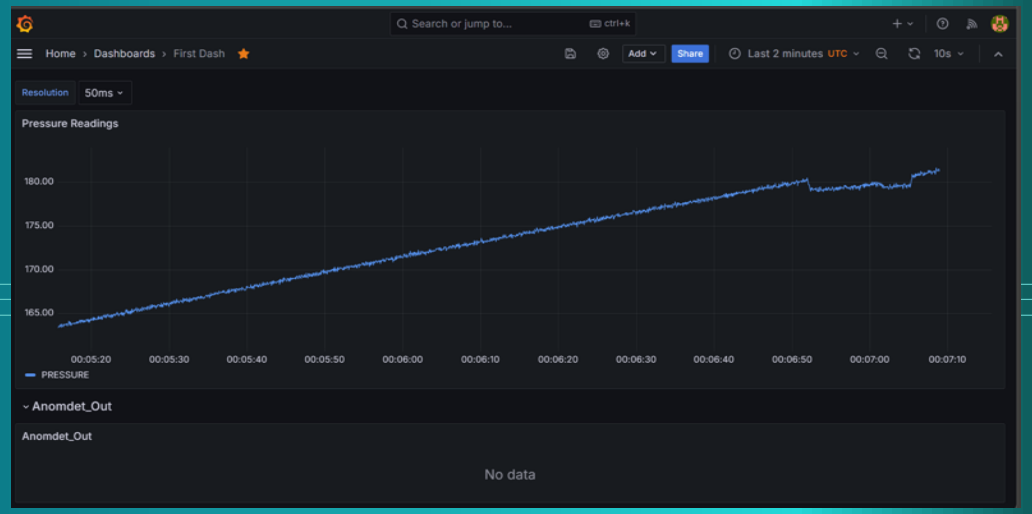


Simulated leak release



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

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
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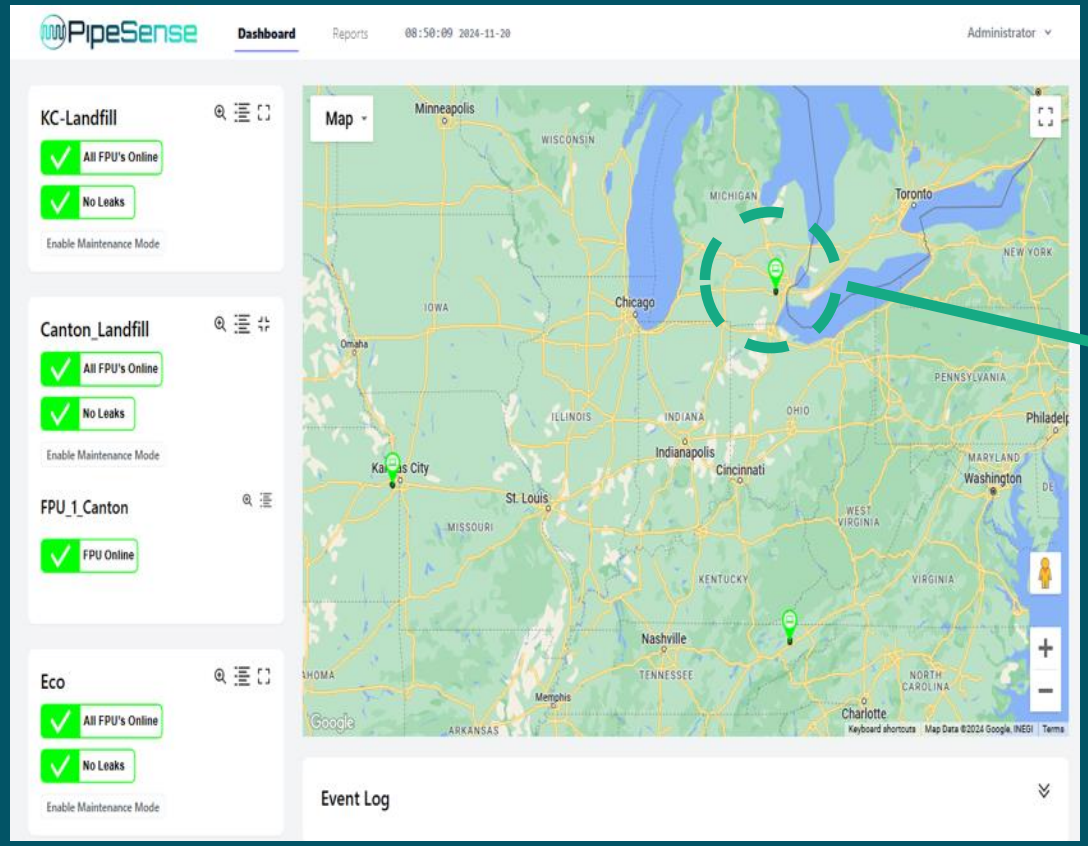
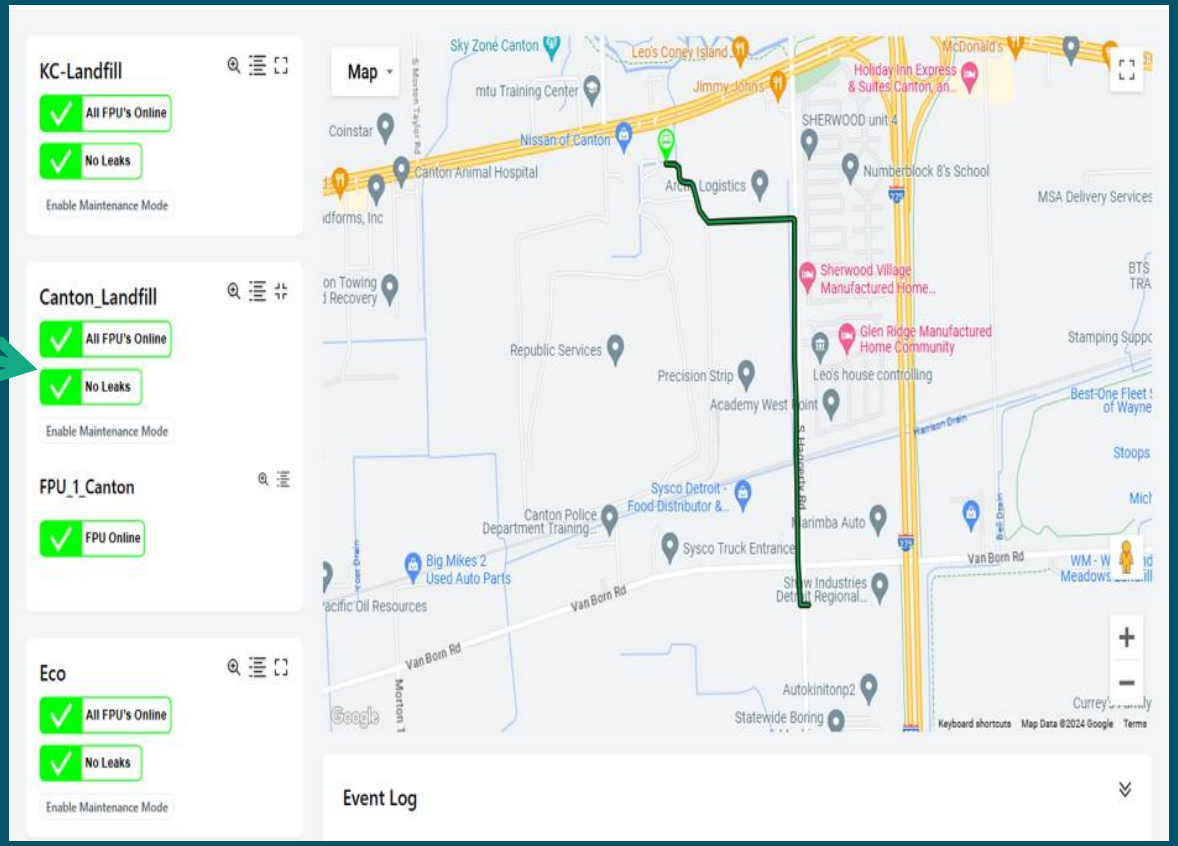
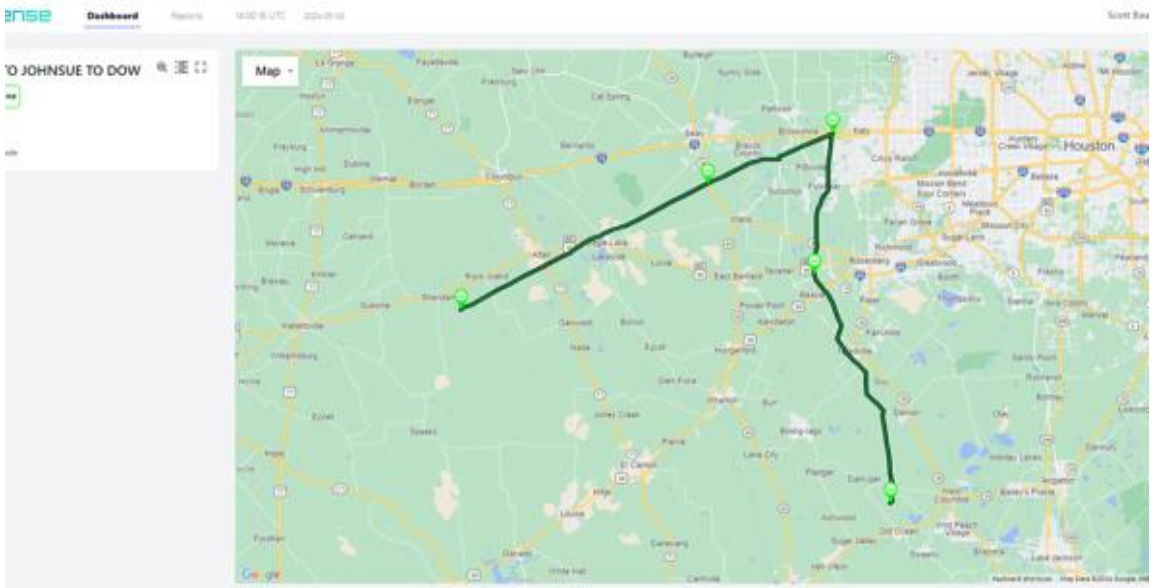




Example system performance

- 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

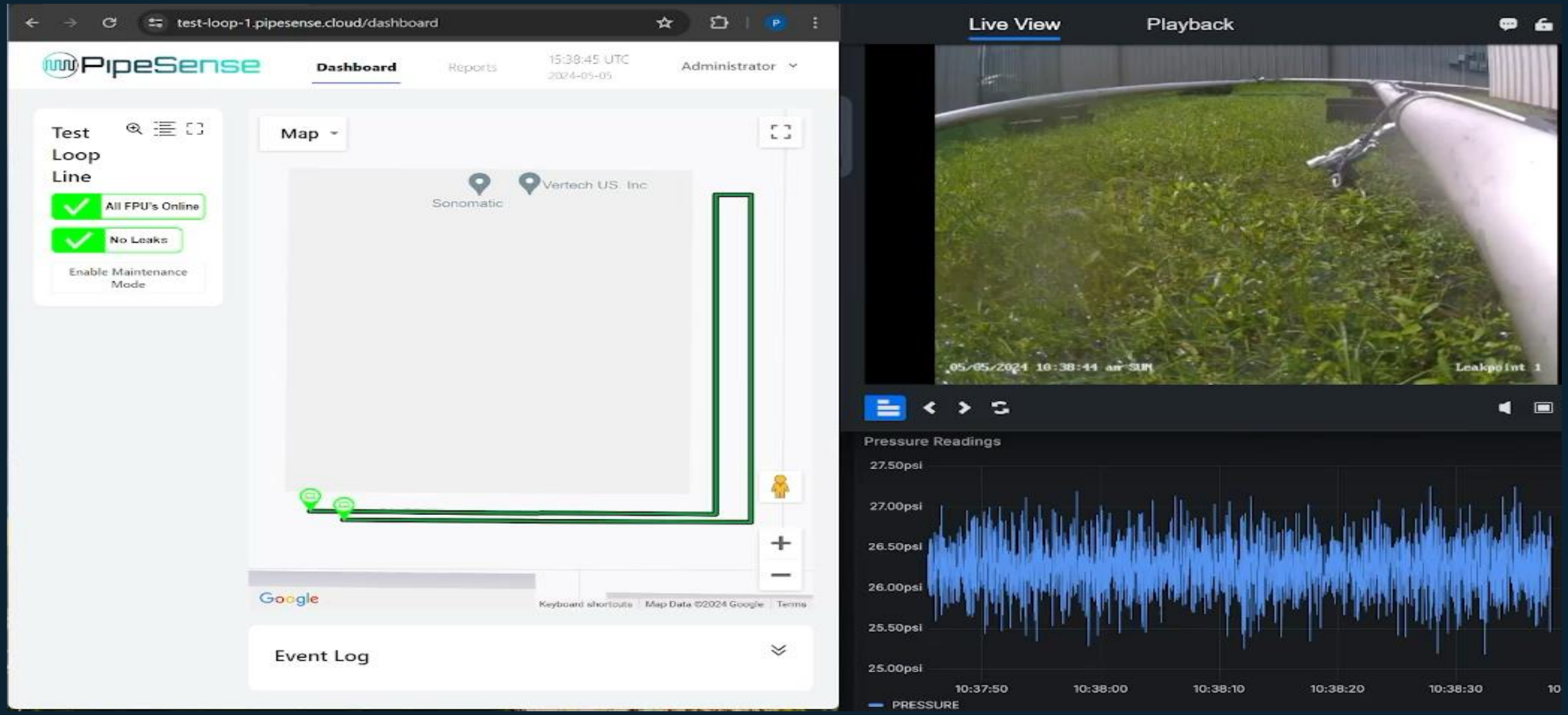


Final system performance

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



Contracting

Hardware purchase

Upfront payment for hardware, system engineering and install

Monthly payment for operation & maintenance

Total Solution

Design, install, tune and maintain

Software leak detection optimization

All hardware and software ongoing support

Quarterly system performance review

Annual onsite performance review

Annual onsite equipment inspection and calibration

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Questions ?

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