Product Brochure

Atmos Wave Flow

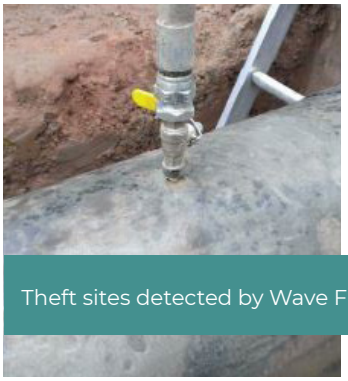
ATMOS INTERNATIONAL

Combining proven leak detection methods for increased confidence under all conditions.

The challenge

Many variables affect the performance of a leak detection system; including topology, telecommunication, instrumentation, the type of leak, and modes of operation. With several different ways of losing product and numerous different conditions for product loss, it has become clear that one single technology is not always sufficient to detect every product theft, leak, and rupture on a specific pipeline during all the operating conditions.

Atmos Wave Flow combines several different detection technologies to optimize sensitivity, detection speed, reliability, and accuracy regardless of the specific pipeline where it is applied.



Theft sites detected by Wave Flow

The individual strengths of each method assure:

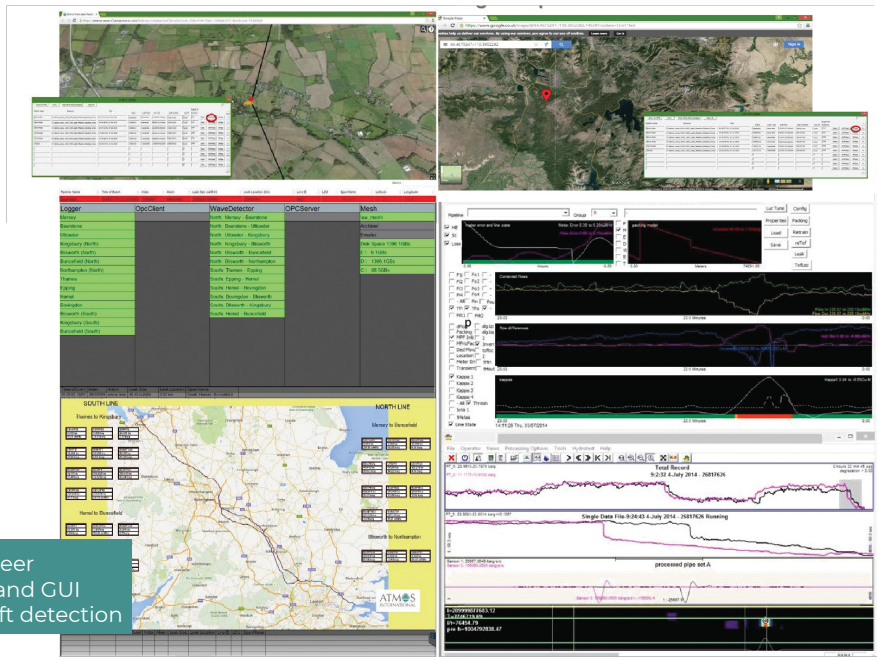
- Fast detection time
- Accurate leak location
- High sensitivity (exceeding flow meter performance)
- Low false alarms

Deploying multiple methods of leak detection will increase the confidence of pipeline operators who must decide on a suspected leak or theft.

Main features

- Confirmed leak alarm with very little product release
- Leak size as small as 0.04%* of flow rate
- High leak location accuracy typically below 0.25% of monitored section length
- Enhanced algorithms that detect slowly opening and closing thefts
- Detects permanent or intermittent illicit connections
- Detects new and existing leaks
- Leak detection and location during shut-in, transient, and steady state conditions
- Detects ruptures in seconds to minutes
- High resolution, off-the-shelf, pressure sensors, and standard flow meters
- AWAS data acquisition units store data to mitigate losses from communication failures
- Designed for all pipeline operations, especially, gathering lines, high consequence areas, weeping leaks, and ruptures
- RTTM for inventory (line pack) and integrated hydraulic profile
- Complies with API 1130, API 1155, API 1149, API 1175, CSA Z662 and TRFL

*requires a specific sensor arrangement to achieve sensitivity down to 0.04%.



Atmos Wave Flow engineer displays including map and GUI displays for leak and theft detection

What is Atmos Wave Flow?

Atmos Wave Flow merges the high reliability and accuracy of the mass balance (flow) elements with the proven sensitivity and accuracy of the negative pressure (wave) techniques to achieve the highest sensitivity and location accuracy, and the fastest detection time with few false leak alarms.

Mass balance (Flow)

The mass, volume, or flow balance element of Atmos Wave Flow is the proven industry method enhanced with additional algorithms to correct for instrumentation errors and uncertainties and automated learning capabilities to compensate for variations. This assures correction for any measurement errors such as meter drift in the system. A real-time transient model (RTTM) corrects the actual flow difference for the inventory change. Atmos Wave Flow then alarms if the calculated imbalance is greater than the configured sensitivity.

Although Wave Flow's flow balance method and traditional mass balance technologies both use flow meters to identify leaks and their properties, only Atmos uses a sophisticated multi-element real-time model to reduce the uncertainties in the system, this significantly reduces the response time.

The main benefits of this method are:

- Sensitivity to slowly developing leaks
- Accurate leak location
- Low false alarm rate
- Fast leak detection time

Acoustic/negative pressure wave

When a leak occurs, negative pressure waves are generated. These waves travel through the fluid and are sensed by the high-resolution pressure meters upstream and downstream of the leak. The magnitude of the pressure drop and the time it takes for the pressure waves to reach the meters determine the leak size and location. The analogue pressure data is associated with a rarefaction wave created by an onset leak. Three comprehensive algorithms then filter process noise and interference from the pressure data to create a detailed 3-dimensional map. This map allows the system to clearly differentiate true leak/theft events from the pressure changes caused by transient operations and declare loss of containment events quickly and reliably.

The negative pressure wave method has been successfully implemented in pipelines with very challenging operational conditions. Extensive performance evaluation and field trials have proven that Atmos Wave is superior to competitive systems in the market*.

The main benefits of this method are:

- Fast leak detection
- Accurate leak location
- Improved sensitivity

* "Field Testing of Negative-Wave Leak Detection Systems", API 2014 Pipeline Conference and Cybernetics Symposium. Proceedings 8-10 April 2014, San Antonio USA.

Optional Atmos Wave Flow modules

Atmos Wave Flow can also include additional complimentary methods to detect product loss faster and locate it even more accurately.

Pressure distribution analysis (PDA)

This module works by monitoring the pipeline pressure on pressure meters distributed along the line. The system models the pressure decay along the line against the actual readings. If a leak occurs, the model clearly displays the deviations from the expected output. A minimum of three pressure meters is required for leak detection and leak location using this module.

Dynamic model analysis (DMA)

This module uses pattern recognition to detect the onset of a leak. An onset leak can often be identified as a rise in inlet flow while outlet flow, inlet pressure, and outlet pressure may drop. DMA works at SCADA sampling rate, analyzing data over short spans. This means flow meter drift does not affect leak detection sensitivity.

Rupture detection

Atmos uses a combination of PDA, DMA, KL and inventory algorithms to detect a pipeline rupture. The system gives the operator the confidence to shut down the pipeline, limiting product loss, environment damage, and fines. The rupture detection module will alarm and locate a rupture on a pipeline that is running, shut in or starting up, with or without flow meters. The system will alarm in seconds to minutes, and will alarm even if the pump trips within 10 seconds after a rupture occurs.

Atmos Pipeline Guardian

Atmos Wave Flow is part of the Pipeline Guardian line that includes hardware solutions to overcome traditional LDS limitations such as lack of instrumentation, power and communication. Pipeline Guardian assures a turnkey LDS wherever sensitive leak and theft detection is required.

Components for easy installation anywhere sensitive leak detection is needed:

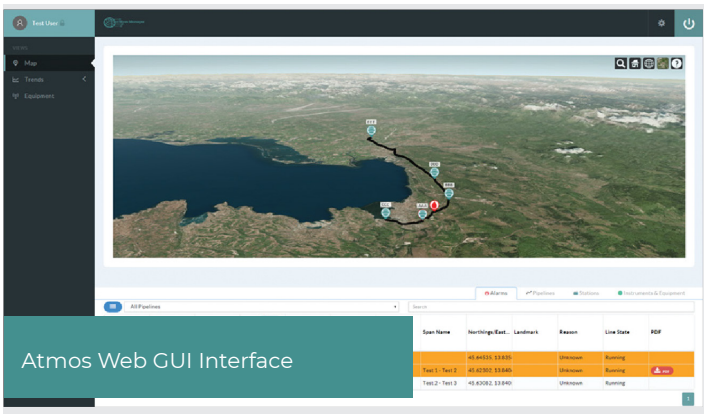
- Stub pipelines
- Inter-refinery and terminal pipelines
- River crossings
- HCAs
- Any location, no matter how remote

Data source

- SCADA, DCS or PLC/RTU
- Pressure, flow, density, and temperature data is acquired with the proprietary Atmos AWAS unit

System outputs

- Leak alarm
- Leak location
- Leak rate
- Volume lost
- Leak time
- Watchdogs via OPC
- SMS for leak alarms
- Emails for leak alarms
- Web GUI (Graphical user interface)
- Workstation GUI (Graphical user interface)



Atmos Web GUI Interface

Hardware options

- High resolution pressure meters selected for leak detection
- High performance flow meters tailored for leak detection
- Wall mounted enclosures
- ATEX enclosures
- Multiple alternative communications architecture available if required (GSM, satellite, radio)
- Density/composition, temperature, and viscosity data is acquired where available for flow standardisation calculations

Atmos International (Atmos) provides pipeline leak detection and simulation technology to the oil, gas, water, and associated industries. The company was founded in 1995 in the UK by the inventor of the statistical pipeline leak detection system – Atmos Pipe, now one of a suite of leak and theft detection solutions from Atmos. These technologies are implemented on hundreds of pipelines in over 50 countries, including major oil and gas companies such as Shell, BP, ExxonMobil, and Total.

With associated offices in the USA, China, Russia, Singapore and Costa Rica, and local agents in 28 countries, the multi-cultural and multilingual team can provide effective support all over the world.

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