Pipeline Integrity Monitoring with DAS

Protecting your Pipeline Assets with LivePIPE®
Fotech Group Ltd

Delivering Distributed Acoustic Sensor (DAS) Solutions for Linear Assets

FOTECH SOLUTIONS LTD
LINEAR ASSETS

Third Party Intrusion (TPI) Leak Detection Security

FOTECH OIL & GAS LTD

Completions Production Well Integrity

www.fotechsolutions.com
LivePIPE® is protecting 1,000s of kilometres of pipeline around the world today

- Third party interference
- Theft / hot-tapping
- PIG tracking
- LEAK DETECTION

LivePIPE® is built around Fotech’s Helios® Distributed Acoustic Sensor (DAS)
Helios® DAS converts a single optical fibre into the equivalent of tens of thousands of highly-sensitive vibrational sensors.
How it works
Distributed Acoustic Sensor (DAS)

The Fibre is the Sensor
How it works
Distributed Acoustic Sensor (DAS)

Using standard Single optical fibre:

Pulses of light are **sent**, 
Backscattered light is **received**.
How it works
Distributed Acoustic Sensor (DAS)

The backscatter is interrogated for:

Changes in characteristics
Caused by acoustic energy
**Product Type:** Water and Nitrogen

**Product supply pressure:** 7psi (0.48bar) to 280psi (19.3bar)

**Optical Fibre Cables Type:** Four different designs

**Cable Offset Position:** 0ft, 1ft, 3ft, and 5ft

**Cable Burial Configuration:** Direct and Conduit burial

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**Fotech scored 100% success, detecting leaks in all 359 test scenarios**

**ZERO FALSE ALARMS**
FIELD CUSTOMER VALIDATION
MAY 2017

45 individual Simulated Tests undertaken on a live pipeline for customer-facing System Acceptance Tests (SAT) over a 1 week period

- Nine test locations: 4.5km, 6km, 8km, 9km, 15km, 19km, 25km, 27km, 32km fibre distances on a total monitored length of 34km
- Four leak orifice sizes: 1mm, 1.5mm, 2.0mm, 5.0mm
- Operational pressure of 20bar
- Operational flowrate of 20 litres/minute

**Fotech scored 100% success, detecting leaks in all 45 test scenarios**

ZERO FALSE ALARMS IN ONE WEEK
FIELD CUSTOMER VALIDATION
JULY 2017

- 2 Test Locations: 5km, 10km, on a total monitored length of >40km.
- Single leak orifice size: 1.5mm
- Operational pressures: 40 Bar, 50 Bar, 60 Bar, and 90 Bar
- Commercial operational pipeline pressure of 90 Bar

THE WORLD’S FIRST DEMONSTRATION OF GAS LEAK DETECTION ON A LIVE PIPELINE
100% OF TESTS WERE DETECTED & ALARMED

High pressure gas pipeline, India
Example: Prevention of Product Theft
Detected 26 hot tapping attempts in 6 months!

The majority of tapping attempts were prevented before the potential thieves could reach the pipeline, as digging in the proximity of the pipeline was detected and an alarm was raised, providing timely, actionable information.

- Security team dispatched to a precise location.
- Intervention made before the thieves reached the pipeline.
- A number of arrests made.
- Evidence acquired for prosecution.
Example: Prevention of Product Theft

1 particularly sophisticated hot tapping attempt

In one particularly sophisticated attempt to steal product a tunnel was dug from a building about 20m from the buried pipeline.

In this instance, data from a mass-balance system and DAS system combined to identify tunnellers digging and then operating the valve of their bleed-off pipeline.

- DAS identified and located sporadic and quiet activity associated with tunnelling activity over several nights, but security team were unable to find the tunnel on the first site visits.
- Mass Balance recognised lost product and located the event to a region of 500m.
- DAS reduced the search area to a region of 10m.
- Tunnel found and hot tap discovered and removed.
Example: Prevention of Product Theft

1 particularly sophisticated hot tapping attempt
Distributed Acoustic Sensing

LivePIPE® Composition

LivePIPE comprises of,

- Helios DAS (Sensing)
- Panoptes Server (Processing and Alarm Handling)
- Single mode fibre optic cable

Generating continuous detection & location of events,

- At a resolution of up to 1 metre
- Along up to 100km of fibre
- Frequency content <5Hz to 20kHz
A single Helios® DAS unit monitors up to 40km of fibre optic cable (FOC), turning it into tens of thousands of highly sensitive vibrational sensors.

- Simple to install
- Low development cost
- Low maintenance costs
- Immune to EM and RF interference
- User friendly system configuration
Distributed Acoustic Sensing
LivePIPE® Integration: Helios DAS

LivePIPE® integrates multiple Helios systems,
- for unlimited distance monitoring
- from any location.

Complementing traditional solutions,
- PTZ CCTV
- Security lighting
- Drones UAV
- GIS mapping systems

Providing audio visual corroboration and another layer of intelligence and analysis.
Distributed Acoustic Sensing
LivePIPE® Integration: Panoptes

A single Panoptes processing server unit can manage all the information acquired from the networked Helios units.

It will generate alarms to inform the end-user to pipeline threats and integrity issues, in real-time, along the entire pipeline.

- The alerts are high confidence and actionable.
- The events are intelligently characterised.
- Operators can react to pre-deciphered data.
Example
Mechanical Digging
Panoptes includes the ‘Accumulator Functionality’.

Confidence levels escalate based determined by pre-set time and location based parameters, and the client is able to select the level of alert received.

In addition to alarm generation, Panoptes provides:
- An alarm management portal,
- Complete with alarm handling controls,
- Historical alarm storage
- User management controls
Distributed Acoustic Sensing

Fibre Deployment

Deployable using pre-existing fibre, retrofitted to existing assets or installed alongside during construction.

- Standard single Mode telecoms grade optical fibre, (15xx ITU G652 series) clad in polyimide or acrylate materials
- Fibre end terminations require a clean end profile (minimal point optical reflection)

Automated 'Fibre Break' Alarm algorithm may be installed to ensure warning of any fibre integrity issues
Alert Generation
Accumulator Functionality: Excavation Demo

A demonstration of the growing confidence as a threat event escalates through GREEN, AMBER and RED phases.

Demo is playing at 2 x speed
Pipeline Integrity Management
LivePIPE® Components

The Monitoring & Sensing Station - *Helios and Panoptes*
Both Helios and Panoptes are co-located during normal operation. Often the hub to process all sensory data

The Sensing Station - *Helios Sensor*
A single long-range monitoring solution. This station is used for a layout requiring multiple Helios units networked together.

The Monitoring Station - *Panoptes Server*
A data processing station used to integrate the Sensing Stations output.
Pipeline Integrity Management
LivePIPE® Interface & Control

1. **Installer Interface (HWI)**
   Real-time monitoring & control software installed on Helios.

2. **Operator Interface**
   Fotech’s proprietary server Panoptes & alarm handing GUI.

3. **Interface, client integration**
   Integration with multiple platforms including SCADA.
Pipeline Integrity Management

Network Integration

LivePIPE is configured and tested before deployment

- Supports remote monitoring and tuning.
- All IP and network settings can be set and tested pre-FAT.
- Alarms are sent using XML over HTTP, Binary, Email or SMS
- Integration into control rooms with SCADA over Modbus, websites, CCTV, security management systems or GIS systems
- System incorporates information security components for configuration and connection to client network infrastructure
The system’s capabilities are not limited to monitoring for malicious or accidental threats.

DAS is a significant value add for wider pipeline monitoring and management systems, rather than just a standalone tool.

Working alongside complementary technologies:
- DTS
- Electrical current
- Corrosion sensors

Adds another layer of intelligence and analysis, particularly when it comes to leak detection.
Pipeline Integrity Monitoring
LivePIPE® Leak Detection Application

Understanding that a leak is not a simple event is the core of leak detection. LivePIPE harnesses a multitude of acoustic and thermal data from a leak incident and distils it into a confident alarm.

**Rupture events**
An immediate acoustic burst as integrity of the pipe fails.

**Turbulent flow**
A persistent acoustic signal, generated from flow through the point of rupture.

**Thermal gradient (DTGS)**
Temperature disturbance caused by the product cooling or warming the environment around the leak.

**Negative pressure pulse (NPP)**
NPP travels up and downstream of the leak, identified by velocity tracking algorithms.

The detection and identification of leak events depends on the acoustic energy of the event reaching and causing strain on the fibre. Coupling of the fibre to the pipeline is recommended.
Fotech Solutions
Our Clients

[Logos of various companies]

www.fotechsolutions.com
What is FOSA?

- The Fiber Optic Sensing Association ("FOSA") is a non-profit industry association formed in 2017 in Washington D.C.
- Provides North American education on the benefits of distributed fiber optic sensing technology, including through:
  - Webinars
  - Videos
  - White papers
  - Developing standardized industry practices
  - Public policy advocacy
- Membership is open to companies globally who make, install, support and use distributed/quasi-distributed fiber optic sensors.