PIPELINE

Case Study

Pipeline integrity monitoring Transandean route

PERU

> Leak > Soil Stability > Seabed Migration

The challenge

The operators of a liquid natural gas (LNG) pipeline comprising a new 408 kilometer (km), high-pressure gas pipeline system required a long-range monitoring system. The route runs over the Peruvian Andes to a new LNG facility constructed approximately 170 km south of Lima on the coast of Peru.

The pipeline passes east to west across the Andean mountains at altitudes of 4,000-6,000 metres, in a geologically unstable region involving steep slopes, high peaks and deep valleys. The climate ranges from warm and humid to cold, with heavy seasonal rain. In the Andes, more than 50 % of pipeline failures are caused by geohazards, so real-time monitoring is essential for maintaining pipeline integrity.

Cases where the ground has been washed away by heavy rain resulting in long unsupported and exposed pipeline spans have been observed in Latin America and have been the cause of repeated pipeline failures. The monitoring has so far been restricted to visual inspection that is difficult in remote mountain areas. Traditional tiltmeters and inclinometers only offer data from the location of the sensors and are incompatible with long-distance monitoring.

A pipeline integrity monitoring system was required that would help the operator maintain pipeline operations, detect leaks and ground movement, prevent major failures and accidents and preserve the natural environment over this rugged terrain.

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The solution

Omnisens recommended a combination of two optical fibre cables to be laid in the trench above the pipeline throughout its length. The first 60km section was equipped with a **DITEST-AIM dedicated fibre-optic-based monitoring system**. This enables geotechnical monitoring including detection and localization of ground movement and leakages.

The DITEST-AIM system uses Brillouin-based sensing technology, a technique enabling a distributed measurement of temperature and strain over long distance. It was selected for its high monitoring performance combined with its ability to detect real-time temperature events within one metre, where they occur.

For leak detection, a Temperature Measurement Cable (TMC) consisting of multiple singlemode fibers integrated in an armored cable was installed to sense temperature difference in the soil. In compressed gas pipelines leaks show up as a cold spot due to local pressure release, the so-called Joule-Thomson effect. This leak detection system enables the detection and precise localization of very small leaks compared to conventional mass/volume balance techniques. This cable also carried the telecommunications fibers used to communicate between the leak interrogator and the control stations.

For ground movement detection a Strain Measurement Cable (SMC) was chosen. Designed to measure lateral and longitudinal ground movement around the pipeline and anticipate events that could trigger pipeline strain, this dedicated cable responds to landslide or other geohazards by measuring the amount of deformation from the original position. It is able to detect from small to large ground displacements and identify landslide boundaries precisely, with metre localization along the whole monitoring distance. The SMC cable is simply installed in the trench in the backfill material without affecting the pipeline installation work progress.

The complete monitoring system includes a strain and temperature interrogator, an optical switch, an SMC for geotechnical monitoring and a TMC for leakage detection, which is part of the telecom optical fibre cable.

The telecommunication cable runs along the whole pipeline length, whereas the SMC cable application is restricted to the exposed mountain area.

The results

The DITEST-AIM fibre-optic monitoring system has been used to monitor onshore and offshore pipelines over the last seven years and has consistently demonstrated unmatched pipeline integrity monitoring performance.

Omnisens' unique application of the most advanced fibre-optic Brillouin-based sensing technology is able to maintain system performance over exceptional distances without loss of accuracy.

The monitoring is non-intrusive and therefore not affected by operational changes of the pipeline, such as flow or pressure changes and even operation when the pipeline is in standstill mode. Other monitoring techniques are not able to detect leaks smaller than 2-3% of total throughput in the pipeline.

> **"Over the last seven years this system has consistently demonstrated unmatched pipeline integrity monitoring performance."**

Only advanced fibre-optic-based systems can offer high sensitivity (leakage much smaller than 0.1% of total pipeline throughput), guaranteeing the detection of small leaks before they develop into significant leaks; precise localization with no dead zones and continuous detection without false alarm.

This can result in reduction in maintenance, surveillance costs and health, safety and environmental risks.

About Omnisens

Omnisens is the leader in long-range continuous monitoring for industries including subsea, pipeline, civil engineering and power. We are delivering state-of-the-art solutions across five continents, working with teams of specialist providers and resellers in the Far East, Europe, Latin America, Russia and North America.

We provide our customers with the best, most precise technology on the market. We use pioneering fibre-optic Brillouin-based sensing to deliver pinpoint-accurate monitoring to help protect the structural and operational integrity of critical resources 24/7, 365 days a year.

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Securing asset integrity