

# SATELLITE SERVICES FOR GAS PIPELINE MONITORING

The distribution of gas energy in the UK and the island of Ireland faces challenges from natural and anthropogenic activities within distribution networks and the speed in which asset managers can identify and respond to pipeline threats. Telespazio UK (TPZ UK) have built a service definition for a leading Gas Network operator that tackles these challenges, using satellite Synthetic Aperture Radar (SAR) imaging to detect ground deformation and specific encroachment features.

## THE PROBLEM

UK and Irish gas energy is distributed through a high-pressure transmission system, then through subsequent medium and low-pressure distribution networks before reaching consumers. The highest-pressure system in the UK (Local Transmission System) operates up to approximately 70 bar, beneath which there are eight high-pressure distribution systems operating up to approximately 32 bar.

At 32 bar, strikes to the pipeline network can result in:

- › A pressure release deadly to proximal humans and animals in adjacent areas;
- › Friction with the local landscape resulting in self-ignition of the escaping gas;
- › Fireball explosion and associated thermal radiation.

## AREAS OF CONCERN



### › Stress Activities

Industrial activities over pipeline corridors, e.g. construction, agriculture.



### › Asset Management Complexity

Where natural processes go on unchecked by human intervention e.g. river migration across floodplains.



### › Threat Response Time

Environmental conditions bring challenges to aerial monitoring surveys, posing delays to pipeline threat detection and response.

## PROPOSED SOLUTION

The status quo may be enhanced in two ways, both of which would reduce the overall risk to the high-pressure pipeline infrastructure and so deliver enhanced value to network customers:

- › **The nature of threat detections.** SAR satellites can be used for remote monitoring to improve the overall detection process across the asset network.
- › **The timeliness of threat detections.** The satellite sensors of today have much improved revisit rates over what was achievable just a few years ago. This coupled with: wide-area acquisition in a single overpass; cloud penetrating properties of SAR imaging; sophisticated change detection algorithms; and, high performance automated processing environments, which translates to an improved temporal window between threat initiation and threat detection.

## SERVICE DEFINITION

Telespazio UK service definition is built around the establishment of automated / semi-automated routines that use existing satellite InSAR technology to detect ground deformation, and modified SAR change detection routines to detect specific encroachment features.

## GROUND MOVEMENT MONITORING

- › InSAR processing provides information on ground deformation (subsidence and uplift) over time.
- › Provides understanding of historical movement.
- › Monitors future movement along the pipeline and surrounding area.
- › Triggers alerts to asset managers if user-defined thresholds are breached.



## ENCROACHMENT DETECTION

- › Supports mapping and tracking of changes along the pipeline route and surroundings, which represent potential encroachments from both human and natural activity.
- › Provides understanding of historical encroachment.
- › Monitors future encroachment along the pipeline and surrounding area.
- › Triggers alerts to asset managers if user-defined thresholds are breached.

## ADVANTAGES

Telespazio UK services aim to improve the timeliness and reliability of gas pipeline monitoring:

- › **Appropriate safety margin for threat detection and response.** Satellite tasking of the COSMO Sky-Med constellation coupled with a streamlined processing workflow to improve threat detection and response time.
- › **Viable long-term monitoring solution.** The longevity of the COSMO-SkyMed radar constellation and the recent launch of the Second Generation of satellites is ideally placed to support long-term monitoring through SAR.
- › **Reliability through weather independence.** Reliance on SAR data, as oppose to optical, ensures that weather conditions (such as cloud cover) do not affect data acquisitions.
- › **Reduced environmental impact.** Satellite monitoring techniques can reduce carbon footprint from traditional helicopter surveys, capturing larger areas in the process.

## FUTURE RESEARCH

Future research seeks to enhance encroachment detection using deep learning models on satellite data to ensure pipeline integrity and support for the early identification of potential maintenance issues.