# Strain Assessment

## Concerned about ground instability?

A bending strain assessment is conducted on the data collected by an Inertial Mapping Unit (IMU) inspection tool. The IMU provides curvature data which can be used for identification of areas of pipeline deformations and movements.

Deformations and movements can be caused by environmental and third-party interference events, such as:

- Landslips, subsidence
- Construction activities
- Thermal loadings
- Frost heave
- Scour
- Seabed movements
- Ships dragging their anchors or from trawl boards

Almost any pipeline can be affected by one or more of the above events but pipelines that are offshore, or in mountainous or geologically unstable areas are at particularly high risk. Pipeline curvature causes bending strain in the pipe wall which can lead to buckles or wrinkles, can exacerbate the significance of other defects especially cracks or even lead to global collapse in severe cases.

The bending strain assessment will assess the curvature throughout the pipeline and identify areas of pipeline movement, assess the bending strain associated with the changes in curvature and align the curvature data with ILI anomaly data to identify coincident geometric features and other anomalies.

A bending strain comparison (StrainCom™) study will compare bending strain features using two IMU data sets and identify where changes are occurring thus identifying where pipeline movement is taking place.

Standard resolution and high-resolution reporting levels are available for both the single IMU bending strain assessment and the strain comparison assessments.

## Features and benefits

- Provide early warning of instability problems enabling proactive mitigation and remediation measures to be implemented.
- Apply advanced engineering techniques to locate high curvature and potentially high strain events resulting from ground instability events, e.g., landslide, earthquake, flooding, frost heave, construction damage, anchor drag, etc.
- Assess the extent of pipeline movement between IMU runs and of the resulting applied strains.
- Identify the pipeline anomalies, i.e., dents, buckles, ovalities, girth weld anomalies, corrosion, cracks etc., coincident with the strain event from available ILI data.
- Determine where strain events exceed industry guidelines.

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The following additional strain related services are also available for ONSHORE ONLY pipelines:

## Total Strain Demand Report

The Total Strain Demand Report provides the total longitudinal strain (from IMU & AXISS™ combined) at:

- Each reportable bending strain and axial strain event
- All pipeline girth welds
- All reported metal loss & geometric anomalies.

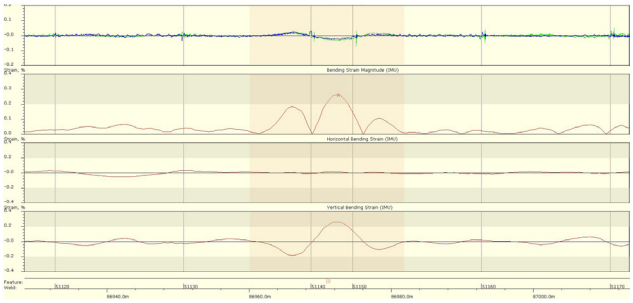
The AXISS EPS Axial Strain Inspection Technology is a non-contact electromagnetic technology, combined with the traditional magnetic flux leakage (MFL) inspection tool, which can be used to measure longitudinal strain in a pipeline.

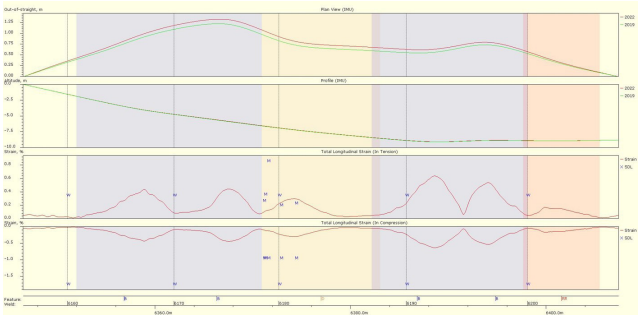
The strain demand comprises of both the longitudinal bending strain component (derived from the IMU data) and the pure axial strain component (measured using the AXISS EPS technology).

Strain demand is defined as the magnitude of strain acting on the pipeline and will vary along its length depending on the loads acting on the pipeline and the pipe geometry. The strain demand information is a required input into a strain-based integrity assessment of a pipeline section that is subject to a strain from external loads.

The Total Strain Demand Report is delivered through an Excel report and can be viewed interactively through the accompanying Strain viewer tool.

### Strain viewer tool





## Strain-based Integrity Assessment

The Strain-based Integrity Assessment is an engineering assessment of the severity of reported strain events. The assessment involves the calculation of the strain capacity at girth welds and at reported corrosion and geometry features that are within reported strain events and comparison against the strain demand.

Pipelines experiencing elevated longitudinal strains can potentially fail by tensile leak or rupture or by compressive buckling. The strain capacity is defined as the strain level a pipe segment can sustain without experiencing negative consequences. The negative consequences could be a leak, a rupture, or any other unacceptable change of the physical characteristics of the pipeline e.g., buckle or wrinkle. The tensile strain capacity (TSC) represents the pipe segment strain capacity under tensile loading conditions and the compressive strain capacity (CSC) under compressive loads.

- Under tensile longitudinal strain, the main integrity concern is a leak or rupture at an affected girth weld or other weakened location.
- Compressive longitudinal strain may cause the formation of wrinkles or buckles in the affected pipe segment leading to a structural integrity concern. The presence of girth weld anomalies, metal loss defects and dents can also affect capability of the pipe to sustain longitudinal loading.

The Strain-based Integrity Assessment applies industry accepted models for calculating strain capacity and the corresponding strain demand limit. The assessment can be provided following IMU+AXISS EPS surveys or just following an IMU Bending Strain Assessment and is delivered through a written engineering assessment report with accompanying Excel listings and interactive Strain viewer software tool.

## Features and benefits

- Supports compliance with regulatory safety notices regarding girth weld integrity concerns.
- Comparison of strain demand (loading) vs strain demand limit (strength) is needed for making pipeline integrity decisions.
- Enables differentiation between “real” strain events and intentional construction related bending.
- Reduces spend on unnecessary geotechnical work by filtering out strain events where pipeline has enough strain capacity to withstand the deformation.



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