TRANSKOR INTERNATIONAL (UK) LTD

NON CONTACT MAGNETIC TOMOGRAPHY

PIPELINE SURVEY

Work from the ground surface

Detects and measures levels of stress

Defines features causing stress

Detects all metal defects in all orientations in a single pass

Detects defective insulation

Correlates the magnitude of stress raisers with operating pressure and defines the degree of danger

Principle features of MTM Magnetic Tomography Surveys

- **No interruption to the pipeline operation**
- **No minimum or maximum operating pressure required**
- **No need for special pipeline equipment or preparation**
- **No contact with or change to mode of the pipeline**

- **No limit to length of pipeline inspected**
- **Identifies all metal defects irrespective of orientation**
- **Identifies defective insulation coatings**
- **Suitable for all ferromagnetic pipelines including tight turns and small diameters**
- **Lower cost and more accurate than traditional survey methods**

Improve Efficiency with MTM

Magnetic tomography charts the attributes and characteristics of pipe sections by registering and analysing changes in the magnetic field of the pipeline. These changes are related to stress which in turn are related to defects in the metal and insulation.

Magnetic data is collected from the ground surface and anomalies detected are a function of stress, mechanical loading and structural changes in the metal. Magnetic tomography does not measure the dimensions of geometric defects alone but instead it measures the stress caused by these defects and identifies their character, location and orientation in accordance with the location and orientation of the area of stress. Linear and angular co-ordinates of flaws in the metal and coating are defined within a tolerance of +/-0,25m

Measure Stress Not Geometry.
MTM determines the comparative degree of danger of defects by a direct quantitative assessment of the stress-deformed condition of the metal. Conventional surveys only measure the geometrical parameters of a defect. Their subsequent calculations to assess the impact of the defect on the safe operation of the pipe do not take into consideration the stress caused by the defect. Therefore conventional surveys may fail to detect dangerously stressed areas of the pipe or, conversely, classify a defect as one which requires urgent attention when, in reality, the stress level may be low and the defect presents no immediate threat to the operation of the pipe. Since MTM directly measures the stress caused by defects it is an inherently more accurate guide to the safe operation of the pipeline than conventional survey methods.

Monitor Defect Growth
Because MTM allows any section of any length of a pipeline to be surveyed while the pipe remains in operation it can be used to monitor the evolution of defects and the increase in stress caused by such growth. These measurements may be taken at any interval of time and can be compiled into a database. Excavation and repair with its subsequent disruption to service is therefore more easily controlled and maintenance can be planned with confidence at convenient times.

Reduce Unnecessary Excavations

MTM is inherently more accurate than in line pig surveys both in its ability to determine the nature of a defect and in defining its position. Consequently the number of unnecessary excavations caused by spurious data and inaccurate positioning of detected defects are considerably reduced compared with in line PIG surveys.

Reduce Reporting Timescale
Preliminary reports identifying the position and degree of danger of defects located in the pipe is usually presented within three days of the magnetic data survey. Immediate remedial attention can therefore be applied to pipe sections if necessary.

Predict Deterioration
The final report includes a corrosion forecast and an assessment of the stress-deformed condition level.

Reduce Costs with MTM

Operational costs of MTM are considerably lower than in line inspection costs. Therefore not only are MTM surveys more accurate but they also cost significantly less than in line surveys. With MTM there is

No need to equip the pipeline with a pig launch or trap,
No need for a pipeline cleanout
No need for inner surface preparation,
No need to open a section of pipeline to recover a trapped Pig

and therefore

NO LOST PRODUCTION.

Improve Accuracy

Considerable savings are made from the greater accuracy of MTM defect definition and location. For example consider the following data which has been taken from a recent case study where a total of 6.6km of pipelines varying in diameter from 219 – 720mm were surveyed by both MTM and in line methods

	Stage of works	PIG $USk	MTM $USk
1	Excavation (15 pits, 3m long and 2m deep)	75.85	10.1
2	Insulation coating repair following additional NDT	61.94	8.25
3	Highway repairs following excavation	26.49	3.53
4	Total direct expenses	164.28	21.88

This table shows the costs of unnecessary excavations, repairs to insulation damaged during confirmatory NDT and making good to damaged road surfaces - all incurred because of false indications reported by the in line survey. The costs of MTM were incurred by verification works which subsequently confirmed that the MTM report was correct. In this example, then, the use of MTM would have saved US$142.4k in unnecessary works. The cost of such works vary in different locations but the proportionate increase in costs incurred by the lower accuracy of in line surveys serves as a useful guide to the savings that can be made by using MTM. And this does not include the lower cost of the survey itself.

Detect Pipeline Defects with MTM

Geometrical (corrugations, dents, ovality

Corrosive structural and mechanical changes

Metal loss (defines internal and external corrosion)

Discontinuities (delamination, non-metallic inclusions)

Crack-like defects (linear defects in all orientations

Stress corrosion cracks

Weld defects

Stress deformation caused by sag, flexure, landslip

Defective insulation

Technical Data

Magnetometer dimensions	200mm x 200mm x 750mm
Connection to an IBM PC	via RS232 interface
Casing protection category	IP-66
Weight	4.5kg
Power supply	PS1212 storage batteries or similar. 9 - 24 V DC external source
Continuous operating duration	> 8 hrs

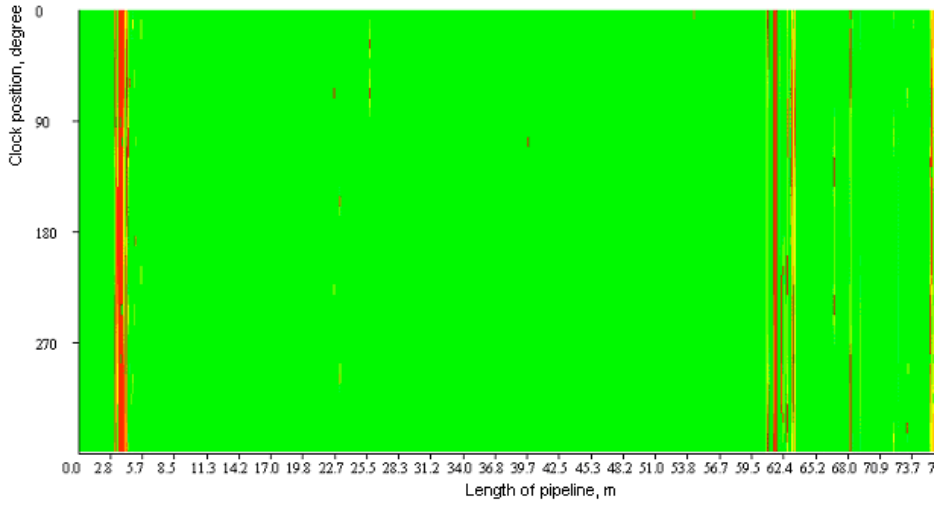
Detectable metal flaws	Crack-like defects in any orientation (laps, scabs, scratches, cracking and exfoliation)
	Stress corrosion
	Weld defects (laps, pores, cracks, lack of fusion, lack of penetration, displacement, metal flakes, residual thermal stress within the heat affected zone)
	Compression marks, corrugations, scores, out of roundness and changes in wall thickness caused by corrosion pits and filiform corrosion
	Loss of metal – including internal and external corrosion defects of any nature
	Delamination
	Sections with deviations of a level of stress deformed conditions caused by, sagging, landslip, washouts or transitions under roads.
	Local corrosion under scaled insulating coating
	Indents and buckles
	Deviation from the specified laying axis
Minimum length of detectable flaws	> 10mm
Opening of detectable flaws	300 microns
Depth of detectable flaws	> 5% of the pipe wall thickness
Measurement tolerance	< 20% of crack length
	< 30% of surface crack depth
	< 25% of wall thickness loss
Features of surface examined	Flaw detection and cross-section metal loss for any ferro-magnetic underground or subaqueous pipe with any type of insu lation provided it has operated under pressure

Detection rate	Up to 2m/sec
Distance from pipe	15 pipe diameters maximum depending upon operating pressure
Data logging	Initial data is fed to the display and re corded in memory at 0,25m intervals. In strument memory span is sufficient to con tinuously record data over a 30km stretch of pipeline
Initial data processing	On line
Operating temperature range	-25 - +45 deg C
Pipe diameter range	56mm - 1420mm
Pipe wall thickness range	2.8mm - 22mm

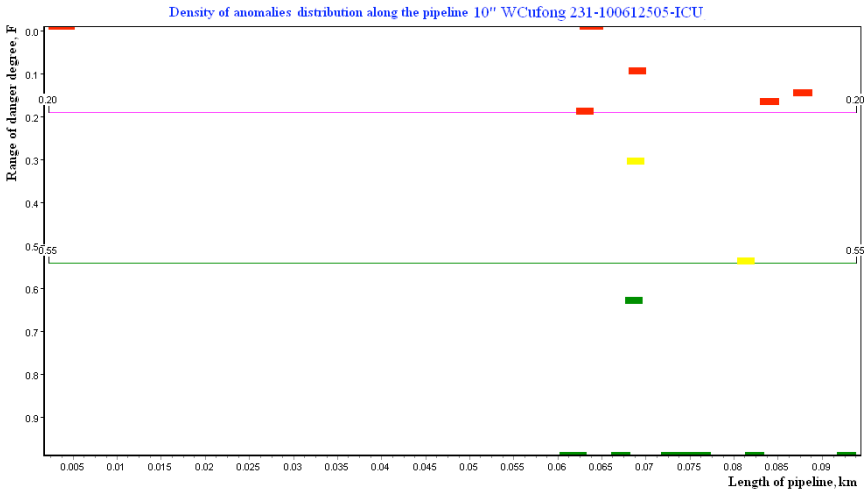
DIAGRAM OF MAGNETIC TOMOGRAPHY RESULTS
(Stress concentration distribution along the pipeline)

10” WCufong 231-100612505-ICU

Magnetic field strength data is collected by the magnetometer and fed into a petented to-mographic reconstruction software algorithm. The chart shows the distribution of stress concentration and degree of danger along a section of pipeline taken from detected anomalies in its magnetic field.



The second shows how this information can be represented to show the density of anomalies (and therefore defects) in the axial plane and a more quantified representation of the degree of danger (ref y axis). Note that F (y axis) is an integral index of the degree



of hazard that takes into account the extent of magnetic anomalies, their amplitude and the shape of the distribution of magnetic intensity vectors over background values.

TRANSKOR INTERNATIONAL (UK) LTD

Tudor House Mews, Westgate,
Grantham NG31 6LU, UK
Tel. +44 1400 283523
Fax. +44 1400 282648
Email: enquiries@transkor-intl.com
Web: www.transkor-intl.com