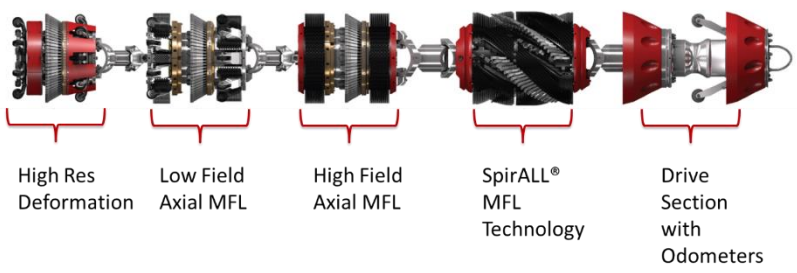
Fact Sheet 3: Facts of technologies on a smart inspection PIG



Magnetic Flux Tools: There are two types of tools commonly used for inspections of hazardous liquid pipelines based on magnetic flux measurements. A Magnetic Flux Leakage (MFL) tool is an electronic tool that identifies and measures metal loss (corrosion, gouges, etc.) through the use of a temporarily applied magnetic field. As it passes through the pipe this tool induces a magnetic flux into the pipe wall between the north and south magnetic poles of onboard magnets. A homogeneous steel wall – one without defects – creates a homogeneous distribution of magnetic flux. Anomalies (i.e., metal loss (or gain) associated with the steel wall) result in a change in distribution of the magnetic flux, which, in a magnetically saturated pipe wall, leaks out of the pipe wall. Sensors onboard the tool detect and measure the amount and distribution of the flux leakage. The flux leakage signals are processed, and resulting data is stored onboard the MFL tool for later analysis and reporting. A Transverse MFL/Transverse Flux Inspection tool (TFI) identifies and measures metal loss through the use of a temporarily-applied magnetic field that is oriented circumferentially, wrapping completely around the circumference of the pipe. It uses the same principal as other MFL tools except that the orientation of the magnetic field is different (turned 90 degrees). The TFI tool is used to determine the location and extent of longitudinally-oriented corrosion. This makes TFI useful for detecting seam-related corrosion. Cracks and other defects can be detected also, though not with the same level of reliability. A TFI tool may be able to detect axial pipe wall defects – such as cracks, lack of fusion in the longitudinal weld seam, and stress corrosion cracking – that are not detectable with conventional MFL and ultrasonic tools.

Ultrasonic Tools: There are two types of tools commonly used for inspections of hazardous liquid pipelines based on ultrasonic measurements. The Compression Wave Ultrasonic Testing (UT) tools measure pipe wall thickness and metal loss using compression waves. These tools are equipped with transducers that emit ultrasonic signals perpendicular to the surface of the pipe. An echo is received from both the internal and external surfaces of the pipe and, by timing these return signals and comparing them to the speed of ultrasound in pipe steel, the wall thickness can be determined. Of particular importance to successful deployment of a UT tool is pipe cleanliness, specifically the removal of paraffin build-up within the pipe. The Shear Wave Ultrasonic Testing (also known as Circumferential Ultrasonic Testing, or C-UT) is the nondestructive examination technique that most reliably detects longitudinal cracks, longitudinal weld defects, and crack-like defects (such as stress corrosion cracking). Because most crack-like defects are perpendicular to the main stress component (i.e., the hoop stress), UT pulses are injected in a circumferential direction to obtain maximum acoustic response. Shear Wave UT is categorized as a liquid coupled tool. It uses shear waves generated in the pipe wall by the angular transmission of UT pulses through a liquid coupling medium (oil, water, etc). The angle of incidence is adjusted such that a propagation angle of 45 degrees is obtained in pipeline steel. This technique is appropriate for longitudinal crack inspection.

Geometry Tools: Geometry tools use mechanical arms or electro-mechanical means to measure the bore of pipe. In doing so, it identifies dents, deformations, and other ovality changes. It can also sense changes in girth welds and wall thickness. In some cases, these tools can also detect bends in pipelines. The remediation criteria depend on both the depth and orientation of dents, so geometry tools that are used to detect deformation anomalies such as dents, should be the type that provide both the orientation, location and depth measurement of each dent.