INTRODUCTION

Inspecting a deepwater pipeline is extremely challenging. One problem might be that it lies more than 2,000 m (6,500 ft.) subsea, giving rise to issues commonly associated with working in this remote environment, such as high pressure and accessibility. Another is that the pipeline was probably not designed with a view to making it piggable and easy to inspect. As a result, inspection is often problematic, time-consuming and expensive. To address these issues, a customized inline inspection (ILI) tool that employs ultrasonic technology has proven to be a very effective, field-proven solution.

This White Paper will discuss how using bespoke inspection technology, combined with greater involvement of pipeline inspection engineers early in the pipeline design process, helps to reduce the complexity and costs of inspecting deepwater pipelines.
THE COMPLEXITIES OF DEEPWATER INSPECTION

Inspecting a pipeline is a complex operation, as it must be completed safely, with minimal disruption to production. It is often fraught with complications due to the varying dimensions that the pipeline exhibits, in order to operate in a deepwater environment. Designing the line with future inspections in mind is the exception, not the rule. As a result, a deepwater line usually features at least one of the following characteristics that complicate inspection:

- thick pipe wall
- internal CRA cladding
- high-pressure and temperature
- nonconstant internal diameter
- small internal diameter, especially in production and service lines
- challenging launching and receiving conditions (e.g. short traps, subsea launching, restricted work space on deck)
- flexible pipe

Each of these characteristics makes inspection difficult, in very different ways. Because each one must be addressed individually, the process of inspection is often long and arduous. As pipeline maintenance managers come under increasing pressure to cut costs and speed up maintenance and repair programs, they struggle with these obstacles.

Apart from ILI, traditional methods of assessing the condition of a deepwater pipeline are limited and costly. Typically, ROV and support vessels are required to verify by external measurement.

Despite the high cost of such operations, the quality of information gathered from scanning pipe surfaces is very limited. This is extremely frustrating, especially as the need to identify even the smallest anomalies in the pipe wall has increased, in an effort to control corrosion, schedule inspection intervals and minimize risk.

Against this backdrop, pipeline maintenance managers want to execute inspections at a lower cost without compromising safety or incurring extended downtime. They are keen to embrace a field proven, economical inspection solution that provides high-resolution inspection data.

"AS MOST DEEPWATER PIPELINES ARE NOT DESIGNED WITH ILI EXPERTS INVOLVED EARLY IN THE DESIGN PROCESS, THEY ARE FREQUENTLY NOT CONDUCTIVE TO EASY INSPECTION."

TECHNOLOGY + EXPERIENCE + INNOVATION = SOLUTION

In response to market demand, NDT Global developed a range of inspection tools and strategies to address these complications and to simplify the deepwater pipeline inspection process. In 2006, the company produced its first high-pressure tool for small diameter deepwater pipelines. Since then, it has extended its range of deepwater inspection options to include a line of ultrasonic technology (UT) inspection tools that have been used to inspect many deepwater pipelines around the world. These crack and metal loss UT tools provide extremely
high-measurement resolution data. They reliably detect flaws as small as 5.0 mm (0.2 in) diameter and 0.8 mm (0.03 in) depth, so that even the smallest anomaly, such as pinhole corrosion, is accurately identified.

The following illustrates how NDT Global uses its UT tools and expertise to address some of the primary obstacles encountered when inspecting a deepwater pipeline.

**Overcoming thick pipe walls**
With regard to the problem of thick pipe walls, when inspecting a line with a wall thickness of up to 50 mm (1.96 in.), magnetic flux leakage (MFL) tools are not suitable because the magnets they employ are not strong enough to fully magnetize the pipe wall. This is where UT technology provides an optimum solution. UT provides quantitative, not qualitative – hence absolute - measurements and requires no calibration. It is also extremely versatile, which means that it is suitable not only for internally clad pipe, but also for flexible pipe. UT tools also deliver accurate results that provide operators with a high-level of certainty with regard to probability of detection (POD).

**Internal CRA cladding? No problem**
UT technology is also useful for inspecting pipe that features internal CRA cladding, which can pose inspection problems for other ILI methods. With CRA cladded pipe made of metallurgical bonded plates with a seam weld, the internal surface is typically quite smooth, so that it poses no limitations with regard to UT measurements. In addition, pipe constructed with an internal CRA surface produced by orbital or longitudinal welding can also be inspected by UT tools, with minimal impact on measurement accuracy.

**Inspection tools designed to perform in high-pressure environment**
As pipelines are built in ever deeper water, pressure increases. In many cases, temperatures also rise. Consequently, deepwater pipelines have special pressure requirements that must be borne in mind when inspecting them. Due to water depth and operating conditions, a deepwater pipeline must be able to withstand static pressure and pump pressure of up to 500 bar (7,250 psi). This means that inspection tools must be designed and rated accordingly to operate in this environment; for example, by using high-strength materials. NDT Global uses a range of such tools to cope with these unique pressure and temperature challenges.

**Tackling variable internal diameters**
When designing ILI tools, non-constant internal pipe diameter is often the greatest challenge. There are a number of reasons for this lack of constancy. For example, there might be different wall thicknesses for risers, flow lines, topsides piping and subsea structures. Or, manufacturing tolerances on seamless pipe can cause variations in thickness, as can dual-diameter design (e.g. 6" risers and 8" flow lines). To tackle these problems posed by nonconstant internal pipe diameter, NDT Global employs its field-proven multi-diameter inspection tools to navigate through these unpredictable environments to provide critical inspection data.

“THE ROOT CAUSE OF MANY DEEPWATER PIPELINE INSPECTION DIFFICULTIES LIES IN THE DESIGN OF THE PIPELINE ITSELF.”

**A TRUSTED, EXPERIENCED INSPECTION PARTNER**
Field-proven technology isn’t all that’s required to collect high-quality inspection data from a deepwater pipeline. It’s critical that the inspection is planned and executed by an experienced team; one that has the ability to design a custom ILI tool that will address every nuance of the individual pipeline. With its extensive knowledge, gleaned from many successful deepwater pipeline inspections, NDT Global has been providing this essential service for years.

In fact, as its expertise in designing bespoke ILI tools and inspections has grown, NDT Global has come to the conclusion that the root cause of many deepwater pipeline inspection difficulties lies in the design of the pipeline itself. This realization led the company to a simple solution: involving ILI experts in the initial stages of designing the pipeline greatly simplifies
future inspections, delivering dramatic time and cost savings throughout its lifetime. By collaborating with ILI experts in the pre-FEED phase of pipeline design or early stages of developing an asset, it's possible to change the design of the pipeline and subsea or topsides structures to reduce pigging-related risks, thereby avoiding associated complications and costs. Experience has proven that tackling pigging challenges early on significantly reduces risk probability and the potential impact on project schedules and costs.

A case in point
The importance of early consultation and cooperation is borne out by NDT Global’s experience in the Gulf of Mexico, offshore West Africa and the North Sea, where the company has used its UT tools to inspect approximately 20 difficult to pig deepwater pipelines.

To illustrate, in the Gulf of Mexico, NDT Global is adapting a UT tool to requirements specific to a pipeline that is part of a project to extend an existing 12" deepwater oil production pipeline with a new 10" line to tie-back a new field to the host platform. The maximum water depth is 1,830 m (6,000 ft). Previously, NDT Global supplied a customized high-pressure metal loss UT tool for the 12" pipeline. The changes to the pipeline required that the design of the ILI tool be reviewed.

The operator approached NDT Global during the design phase of the pipeline extension to seek advice on specific design options, and how these would affect pigging and inspection of the new system. Following completion of the design work, NDT Global then created a modification kit for the existing 12" UT tool. The new metal loss UT tool is now capable of measuring the entire 10" to 12" diameter range with the same accuracy as the previous 12" tool, making it possible to determine corrosion growth by comparing data from current inspection runs with previous ones. Clearly, early involvement of ILI experts in the pipeline design phase facilitates future inspections.

"WHEN DESIGNING ILI TOOLS, NONCONSTANT INTERNAL PIPE DIAMETER IS OFTEN THE GREATEST CHALLENGE."

SUMMARY
Inspecting deepwater pipelines is complicated. Not only do they lie thousands of feet below the surface, but the nature of the deep sea environment means that they are designed with certain characteristics that make inspection difficult. As most deepwater pipelines are not designed with ILI experts involved early in the design process, they are frequently not conducive to easy inspection.

As a result, inspections are often lengthy and costly. When investigating potential defects, pipeline maintenance managers struggle to collect the high-quality inspection data needed to make accurate assessments. The common methods of inspection, which can be costly and time-consuming, often do not generate the high-resolution data necessary for proper assessment of the pipeline.

An effective, field proven solution lies in retaining an experienced NDT Global team of ILI experts to inspect the pipeline with a bespoke UT inspection tool to gather high-resolution data. This system employs ultrasonic technology to detect the smallest anomalies, and provides high-resolution inspection data that is used to assess the condition of the pipeline. This
means that informed decisions can be made during the maintenance and repair planning process. When inspection experts are involved in the initial phases of the pipeline design process, their input ensures that the pipeline will be much easier to inspect in future.

The combination of these two strategies, namely involving ILI specialists when designing a pipeline and employing a team experienced in UT to gather high-resolution data, means that the time and money required to inspect and maintain the pipeline throughout its lifetime will be significantly reduced.

**LEARN MORE**

- **Internal Axial Corrosion in Offshore Pipelines: Inspection and Assessment**  
  by Dr. C. Jäger and A. Abdullahi of NDT Global. Presented in 2014 at the PPSA in Aberdeen, UK.

- **Advanced Ultrasonic ILI in Support of Pipeline Integrity Management**  

- **Tailored-Solution Tools - Configured For Every Application**  
  by NDT Global.