DIFFERENT SOLUTIONS TO INSPECT PLATFORM RISERS

By R van Agthoven and H Quakkelsteijn, ApplusRTD, Rotterdam, The Netherlands

SUMMARY

The need for the inspection of pipelines and risers is growing, as the worldwide infrastructure related to pipelines and platforms is ageing. Moreover, regulations today require periodical inspections.

Today, many pipelines and the connecting risers are piggable and with the intelligent In-line inspection (ILI) tools flaws can be detected to monitor integrity and fitness-for-purpose. Different types of tools are needed to cover all possible flaws, such as metal loss, cracks, geometric anomalies and leaks. Nevertheless, despite all kind of measures, the riser is still a difficult section for inspection as it may have a very thick wall thickness or other obstructions, thereby reducing the effectiveness of such ILI tools, also their speed in risers is difficult to control.

This presentation focuses on the “unpiggable” risers where free swimming ILI tools cannot be used or are of limited use. Application of internal tethered ultrasonic tools is discussed for inspection of both crude oil and gas risers. Besides that, in the second part of this paper, also non-intrusive methods will be shown as a valid alternative to inspect risers and pipelines from the outside, even without removing marine growth. Today this can be done even at -200 m using ROV’s.

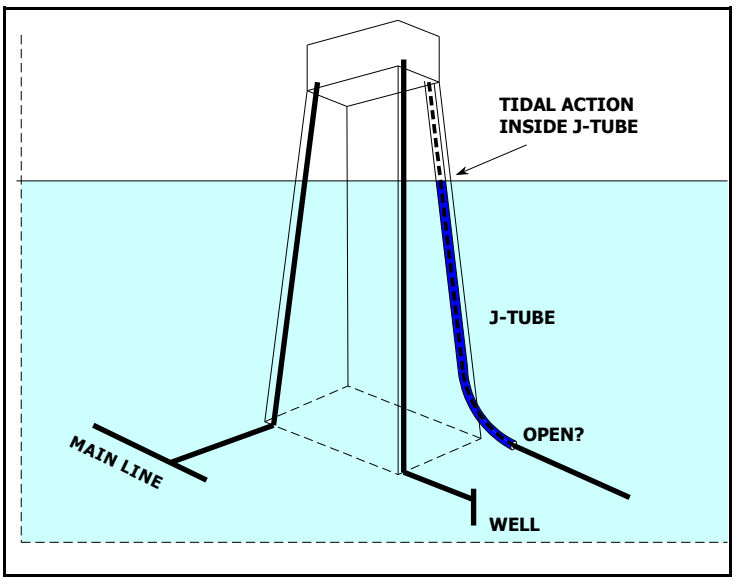
The presentation shows that each tool has a dedicated field of application. Operational aspects as well as expected results will be discussed, they are of benefit for all operators of platform risers in the oil and gas-industry operated in the North Sea and world-wide.

INTRODUCTION

The platforms in the North Sea are ageing, some are in place for over 25 years and although they were initially designed for a 30 year life time operators are now looking for ways to extend this period. This means that there is even more emphasis on inspections and NDT to guarantee the integrity and safety of the installation. In this paper we focus on the risers, in particular those that cannot be inspected with regular intelligent pigs.

PART I: INSIDE RISER INSPECTION TOOLS, by R van Agthoven

There may be various reasons why risers cannot be inspected with free-swimming ILI tools.



A riser may:

- Connect to a main pipeline (branch-line)
- Connect to a well
- Contain internal diameter changes
- Have a very heavy wall thickness

Have insufficient flow to drive an ILI tool

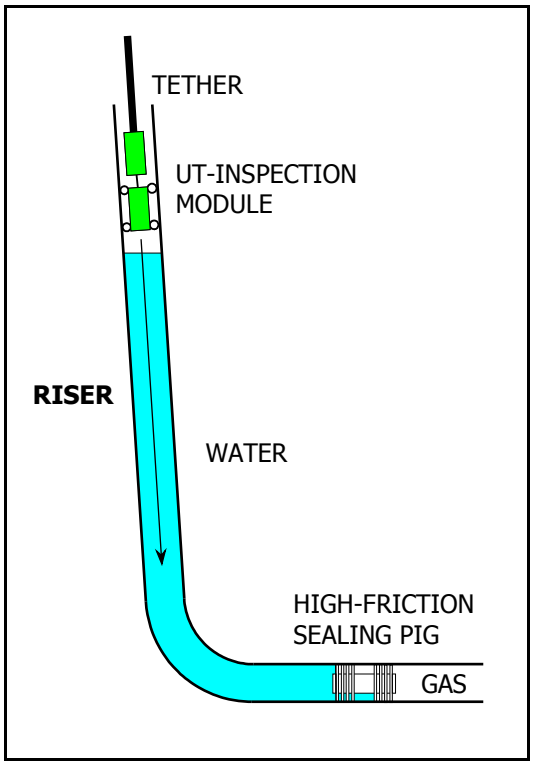
Tethered inspection tools can be adapted to cope with the above conditions. To deploy a tethered inspection tool open access must be made to insert the inspection vehicle in the riser. This requires shutting down and depressurization in order to safely open the riser. The tethered tools discussed in this presentation are equipped with ultrasonic sensors.

A tethered ultrasonic tool has several advantages:

- It is safe to operate, the tool can always be retrieved,
- The tether allows on-line presentation of the inspection results
- Ultrasonics provide quantitative results, no verification is needed
- No flow is needed to drive the tool

To allow an ultrasonic inspection the riser must be filled with a liquid. This liquid acts as an acoustic couplant, there is no need for the ultrasonic probes to be in contact with the ID pipe wall, this is called “immersion technique”. As there can be a large distance between probes and ID pipe surface it is capable of passing diameter restrictions, dents, ovalities without problems.

In most cases, crude oil or condensate can remain in the riser. This requires proper safety measures when opening the riser, sometimes the platform operator may choose to fill the riser with water.

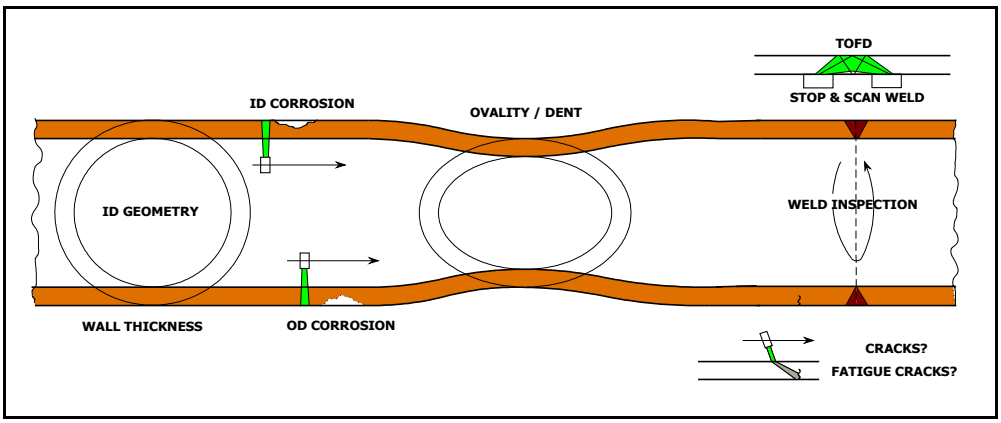


In order to inspect gas-risers with such a system a procedure must be followed to fill the riser with a liquid, often water. Obviously the pipeline will be shut down and depressurized. A high friction sealing pig is introduced, either through an existing pig-trap, or a temporary trap, and by pumping a metered amount of water behind the sealing pig it can be pumped to a location just after the bottom bend of the riser. The sealing pig has enough friction to hold the head of water in the riser and the riser can then be opened to deploy and lower a riser inspection tool.

Upon completion of the inspection the riser shall be closed. By increasing the gas-pressure on the other side of the sealing pig it will be pushed back to the (temporary) pig trap and this also displaces the water and can be drained.

Detection capabilities:

Ultrasonics allows the detection and quantification of various defects and parameters:



- The stand-off (immersion) technique allows mapping of the ID geometry, any dents and/or ovalities can be detected, to 0.2 mm accurate
- Internal corrosion can be mapped and quantified, to 0.2 mm accurate with a minimum diameter of 10 mm
- External corrosion can be mapped and quantified, to 0.2 mm accurate with a minimum size of 5 mm,

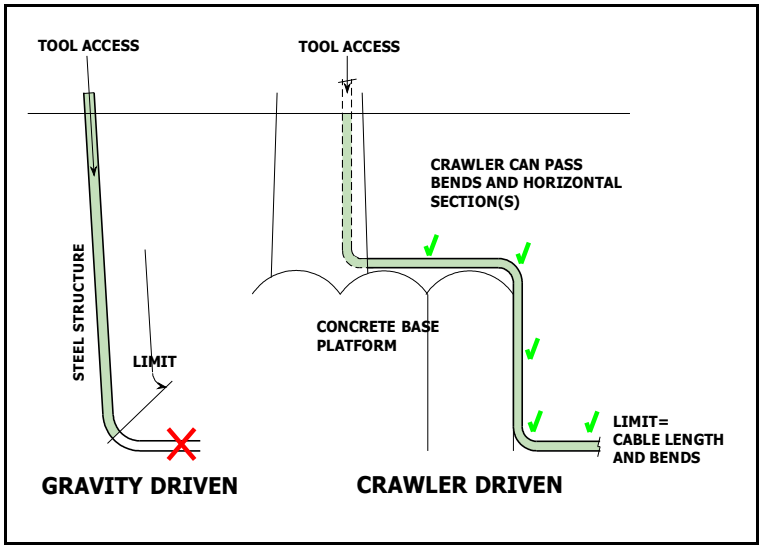
The location, along the pipeline length, can be determined to 0.1% accurate and all data can be recorded while the tool moves at a rate of 500-1000 m/hr.

To detect cracks or to inspect welds the transducer array can be adapted. Generally this will be done after a geometry/corrosion survey, by then the location of welds or other phenomena is known.

Circumferential fatigue cracks can be detected using the same probes as used for the corrosion survey but mounted under an angle or to produce an ultrasonic beam of e.g. 45°. Also such inspections can be performed while to tool is moving. This technique has limited capabilities to size the defects in depth.

For more accurate sizing a TOFD (Time Of Flight Diffraction) technique can be used. Both contact or immersion transducers can be used. This can be done when the inspection vehicle stops at the weld or other area of interest and with an extra mechanism on the vehicle the TOFD transducers can be moved along the circumference. Also these inspection results can be shown in real time.

Tool versions:



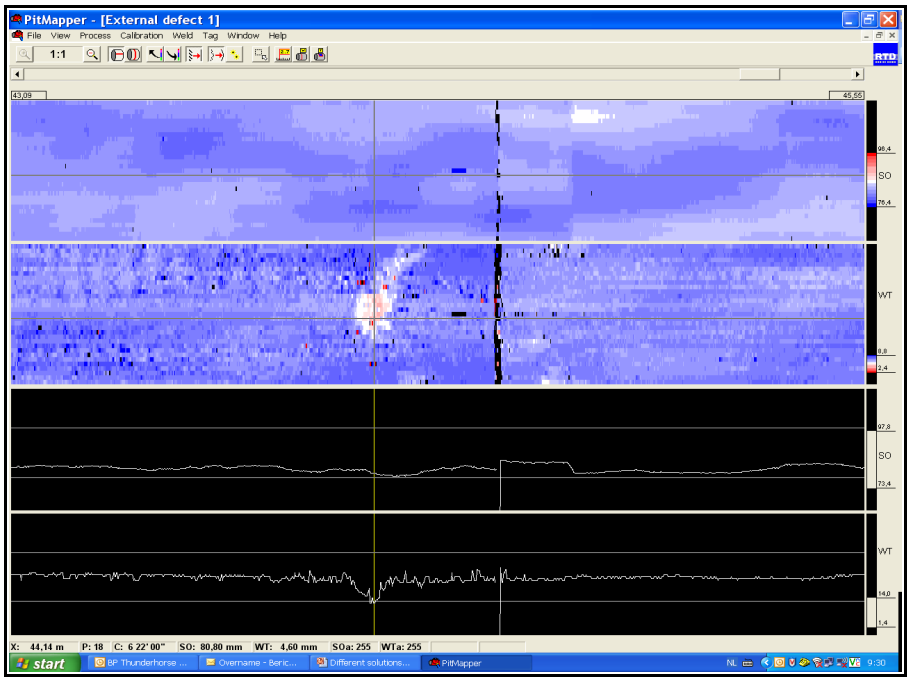
Various versions of tethered tools exist. Basically, they can be divided in two groups, these being:

- Gravity drive tools to inspect straight vertical riser parts only,
- Tools with their own traction module, they can pass through horizontal pipe sections also.

Systems exist for inspection of risers of 4” diameter and over, for water depths of 200 m. Umbilicals (tethers) are available with lengths up to 10 km but in most cases only short distances are to be inspected. Specially adapted versions for even deeper risers, or casings do exist, they have travelled 750 m deep.

For tools that must pass bends it is important to know how many bends must be passed as there will be friction between the cable and the inside of each bend. It is safe to state that most tools can pass at least 4 off 90° bends.

For the inspection of risers it is of paramount importance that the full circumference is inspected. Unlike in horizontal pipes, where ID corrosion often occurs at the 6 o ‘clock position only, corrosion in risers may occur at random locations on the circumference. Hence, the UT system must provide 100% circumferential coverage. This can be achieved by using a multiple of transducers equidistantly divided over the circumference or by using one rotating transducer.



In both cases the data is recorded with a dedicated data recording and acquisition system called PITMAPPER for instant display of the results.
This allows our clients to take immediate action if needed.

The oil- and gas-industry moves into deeper water, think of areas like the Gulf of Mexico, offshore Angola or Brazil to name a few. For water deeper than 200-300 m now floating platforms are in use and today installations are coming on stream in 2000 m of water and even deeper to come. Here we see no more risers fixed to jacket-structure (there is none) but SCR's (Steel Catenery Risers) are hanging free to the sea-bed or tensioned, such as TTR's (Top Tensioned Risers).

These risers are subject to movements in sea-currents, tidal differences and other loads, this may result in fatigue crack damage in time.
This is recognized by the industry and tools are under development to detect such fatigue damage under the difficult conditions present, think of high hydrostatic pressures, temperatures, product velocities etc. A real challenge!

CONCLUSION, PART I, INTERNAL UT RISER TOOLS:

For many risers, especially in the shallow water areas, solutions exist to perform inside inspections.

They have proven to be a reliable alternative or addition to ILI pigging for areas where such tools cannot be used or have limited performance for different reasons.

The down-time is short, sometimes hours, and the application of ultrasonics means that no verification is needed as the results are quantitative. Last but not least the umbilical is an important safety aspect for the client as the tool can always be retrieved.

PART II: NON INTRUSIVE MEANS TO INSPECT RISERS, CAISSONS AND SUB SEA PIPING, by: H. Quakkelsteijn

RTD-INCOTEST is an acronym for INsulated COmponent TESTing and it was originally designed and developed for corrosion detection under insulation on objects made of low alloyed carbon steel.

RTD-INCOTEST is a Pulsed Eddy Current inspection technology which is a cost-effective alternative to traditional NDT inspection approach both above and below water: it is fast, it guarantees high production rate, it is suitable for RBI and Integrity Inspection, it is not affected by fouling and marine growth, and therefore no expensive cleaning is needed. It does not need any contact with the object to be inspected; it may inspect through paint, coating and concrete.RTD-INCOTEST system measures the decay time of the eddy current induced in the object under examination. This eddy current is induced in the material by means of a DC current circulating through the sending coil circuitry of the RTD-INCOTEST sensor. This DC current generates a magnetic field that takes a while before getting uniform and stable. The magnetic field lines generated are closed lines and move through the insulation and the ferromagnetic object under examination. At the moment the current is cut off, the sending coil stops generating the magnetic field. During this transient, Eddy Current is induced in the ferromagnetic object under examination. This Eddy Current migrates through the object wall and rapidly extinguish when it reaches the opposite object side. Eddy current is a circulating current and it generates during its decay a variable magnetic field. Its field lines move through the sensor receiving coils inducing a current. The RTD-INCOTEST system measures the resulting voltage. This voltage is function of the object thickness and of the material electromagnetic properties. RTD-INCOTEST is designed for generalised corrosion detection and it will not perform with localised corrosion type such as small pits.

To monitor risers, caissons or sub sea piping at any given moment an on-stream measurement can be taken with INCOTEST. In the splash zone the probe can be handled with a riser tool, rope access operators or even a diver. The sub sea part obviously is the territory for (saturated) divers or for ROV's. On forehand the number of measurements or grid is agreed with the client. One cycle of a measurement will take a few seconds although ROV use will slow down the inspection speed.

A recent INCOTEST inspection carried out in the North Sea at 90 and 140 meters depth at a transport pipe and some small piping in a manifold showed that more than 700 measurement points in just 8 hours was possible. The same exercise with conventional UT would have cost much more time due to the fact removal of epoxy coating is a time consuming.

Another Non Intrusive technique is Guided Wave piping Inspection. The principle of Guided Waves Piping Inspection (GWPI) is based on an ultrasonic pulse being sent through the pipe around the whole circumference. Because of the excitation around the whole circumference, there is no geometric spreading of the wave and thus low attenuation of the sound travelling along the pipe. The technology functions by sending a pulse through the pipe and receiving the echoes from geometric features. In this way, examination ranges can be achieved from 5 to 40 meters along the pipe from a single probe location, in both directions. Practically, the range is usually around 20 meters, in both directions.

Corrosion damage is always a loss of the cross-section. Because this guided waves technique is a screening tool, an indication is sized in percentage Estimated Cross-sectional Loss (ECL).

Both techniques are rapid screening techniques that have advantages above traditional UT wall thickness inspection. When they are applied with common sense they can save time, reduce risk and can be a major financial cost saver.