IRIS: In-service Riser Inspection System

First of its kind to allow deployment and operation of several nondestructive technologies simultaneously to ascertain the integrity of subsea riser systems and extend the facility life of the field.
A breakthrough technology to ascertain the integrity of riser systems.

Overview

Building on its strong inspection experience acquired through flexible pipe manufacturing operations, TechnipFMC launched the development of IRIS three years ago. This versatile subsea inspection tool has the ability to deploy and operate two nondestructive inspection techniques (ultrasonic and electromagnetic) simultaneously to detect damages within the riser structure.

The solution focuses on identifying faults such as corrosion, breaks, and cracks in multi-layered products (such as flexible pipe or umbilical) as well as issues related to annulus flooding.

IRIS is the result of a development program involving internal and external nondestructive testing (NDT) experts in coordination with flexible riser and robotics experts. Technologies were developed in the frame of a technology development partnership with the CEA(1) Technology Research Division.

Several entities such as Cybernetix, a TechnipFMC company, have been involved in this breakthrough project.

Underwater nondestructive testing laboratory

In the majority of cases, a single inspection technology is not able to provide robust detailed integrity information while different NDT technologies are complementary and prove to be much more effective when used in combination.

- **Electromagnetic Testing Integrity (ETI)**
  Electromagnetic Testing is the process of inducing electric currents inside the riser structure and measuring their repartition in the metallic layers. Properly set up, measurable response allows the identification of a defect inside the predefined riser layer.

- **Ultrasonic Testing (UT)**
  Ultrasonic Testing is a nondestructive technology based on the propagation of mechanical waves in the tested material. When coupling condition are satisfied, the analysis of the propagation of high frequency mechanical waves in the riser (time of flight, signal attenuation) allows the identification of defects in predefined layers.

- **Electromagnetic Testing Flooding (ETF)**
  This component aims to detect flooding of the annulus section of flexible pipes. The principle is based on a measure of the impedance between metallic electrodes. This impedance varies upon relative permittivity and conductivity of the environment between both electrodes and allows the detection of water inside the annulus.

(1) CEA: French Atomic and Renewable Energies Commission

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A real-time underwater nondestructive testing laboratory.
A dedicated inspection strategy for each riser

Before starting the offshore inspection campaign, a dedicated inspection strategy will be defined based on the inspection objectives set.

Dedicated NDT modeling softwares can be used to simulate the different potential defects detection response on the specific flexible CAD(2) model. This allows to fine tune NDT inspection parameters (acquisition and post-processing) and create a database of targeted potentials defects for each riser.

So, according to the objectives of the inspection campaign on one side and the modelling results in the other one, various inspection strategies can be established (selection of inspection method, inspection scanning method...).

TechnipFMC can propose a dedicated robust inspection strategy for each flexible pipe thanks to its in-depth knowledge of flexible pipe and specific NDT modelling tools.

IRIS Customer Value Proposition

» Allows to deploy and operate different NDT technologies in parallel
» Versatile inspection tool
» Able to propose dedicated inspection strategy for each riser
» In depth inspection strategy preparation before the inspection campaign thanks to our TechnipFMC flexible pipe knowledge combined with our inspection technological edge
» Non-intrusive equipment deployed externally to the riser.
» Increases up-time: Inspects and cleans the riser without compromising production
» Able to move to the flexible riser independently thanks to the crawler function
» Enable inspection subsea, in the “splash zone” and above the water line
» Operated and controlled in real-time from the deck of a supply vessel, via an umbilical and dedicated offshore spread

Technical specification

IRIS also addresses the accessibility challenge of the inspection area. Given its architecture, the tool enables riser inspection and cleaning without stopping production subsea, in the splash zone and in its aerial part.

Main distinctive features:
» IRIS work area: aerial /splash zone /subsea
» -200m water depth to + 20m above seawater
» Riser departing angle comprised between 0° to 20°
» External diameter between 7” and 18”
» Real time control 360 degrees

Real time armor wire corrosion and defect detection

The complex structure of flexible pipes combined with their installed configuration makes inspection challenging. One of the most difficult aspects of flexible pipe inspection lies in the multilayer structure design. Various materials, profiles and thicknesses in a single product generate difficulties for the efficient implementation of inspection technologies when not using a NDT system such as IRIS.

Main distinctive features:
» An efficient detection system from the outer sheath to the first and second layers
» Wide range of riser OD(3) compatibility
» Pre-defined inspection based on defect library and in-house riser expertise

A new generation of in-service subsea inspection

IRIS is a robust modular mechanical solution designed to withstand hostile offshore and subsea environmental conditions. Main distinctive features:
» Continuous and reliable umbilical based transmission

Versatile inspection tool

IRIS is remotely controlled and operated in real-time via an umbilical from a control room located aboard a support vessel. All inspected results are displayed and analyzed in real-time using dedicated software routines. Main distinctive features:
» Inspection preparation
» Implementation of dedicated inspection strategy
» Offshore inspection procedure preparation

Robust amphibious system

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Integrating engineering

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››› IRIS allows autonomous inspection of multiple riser sizes, with different NDT technologies (UT, ET) based on pre-defined inspection campaigns resulting in a dedicated riser inspection report and subsequent riser integrity diagnostic report, established based on TechnipFMC in depth knowledge of flexible pipe and umbilical products.

Performances

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 ››› Compact and autonomous offshore spread

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A unique non-intrusive and stand alone device

Inspecting, repairing and maintaining subsea equipment for clients required divers or ROV® interventions, depending on the working depth or type of subsea structures. Thanks to its launch and recovery system and its crawler function, IRIS offers advanced subsea inspection services and solutions adapted to offshore facilities. Once launched, IRIS will be locked and unlocked on the riser and will also be able to move independently along the flexible underwater, in the splash zone and even in the air.

- Inspection preparation based on riser and offshore expertise
- Efficient international logistic and in country mobilization onboard Light Construction Vessel
- Offshore operation staff composed by Project engineers, operators and NDT engineers
- Immediate identification of riser defect
- In-house post-processing and riser analysis with robust health diagnostic for possible Life Extension

(5) ROV: Remotely Operated Vehicle

A device which is permanently evolving to better suit clients’ needs.

More technology
High energy X-Ray Computed Tomography: by using custom-made penetrating radiation generator and state-of-the-art detection technology, this NDT technique will make inspection of all layers (metallic and thermoplastic) possible.

X-ray tomography is a non-destructive technique that allows “cross section” image reconstruction of a three-dimensional object. Tomography is based on complex mathematics and numerical analysis as well as physics and engineering. It allows rebuilding internal structure of a body using external radiography measurements. It can also locate any identifying faults such as corrosion, breaks, and cracks in an object, and verify the geometry and positioning of complex mechanical assemblies.

X-Ray Computed Tomography overcome the limits of the 2 other inspection methods (UT & ET) enabling to access all the layers even the most inner ones.

Associated with ultrasonic and electromagnetic testing technologies, High energy X-Ray Computed Tomography will complete perfectly the portfolio of inspection technologies needed to establish a reliable riser diagnostic.

Several applications
The tool has been developed primarily for complex flexible pipe structures, but will also be suitable in the near future for other kind of pipes such as rigid pipe, pipe-in-pipe and umbilical.

Technical specification
The water depth scope will also be increased to reach thousands of meters to allow inspection in very deep water ranges.

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