High Performance Subsea Inspection Techniques for Oil and Gas Operations

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Andreas Boenisch, Innospection Limited

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Foreword

At every stage and at every level, offshore, subsea oil and gas exploration and production is hazardous as well as very expensive. Whether it's the efficiency of the drilling equipment or the quality with which structures and equipment are built, a lot depends on how well those early stages are carried out. As importantly during production, the efficiency and reliability of equipment is critically important not only for commercial purposes but also because regulation now sets parameters and standards at every stage in the process. Failure can be costly in terms of lost production and the price of repair, replacement and renewal; but also, if the failure causes damage to the environment, the cost of cleaning up, regulatory fines, compensating any who have been adversely affected and reputational damage, can be immense. Little wonder that most operators would say that prevention of failure is better policy than trying to deal with its consequences. And inspection is a very important element in any prevention strategy.

The opening article in this Special Report looks at Innospection, a specialist provider of advanced and innovative services and solutions, with particular emphasis on the inspection of subsea and splash zone infrastructures such as pipelines, platform legs, caissons and rigid and flexible risers. The article goes on to describe a number of the techniques developed and used by Innospection including the MEC (Magnetic Eddy Current) technique and subsequent further developments. Since 1998, they have been providing Non-Destructive Testing (NDT) services and solutions to worldwide process industries, including the onshore and offshore oil and gas industries, refining and petrochemical and power plants.

In the second piece we look at the global drivers that are making it necessary to find and exploit oil and gas reserves in ever more difficult places including offshore and subsea. The article also considers how changing attitudes towards the environment are adding a new dimension to operators’ worldview.

High Performance Subsea Inspection Techniques

Andreas Boenisch, Innospection Limited

The mature and ageing North Sea assets have led the operators to focus increasingly on the integrity management of the offshore installations. The splash zone and subsea components in particular become subjects of increasing inspection demand and extensive condition assessment with the target for lifetime extension and to demonstrate fitness-for-service. As a result, the industry encourages the development of advanced subsea inspection solutions.

Andreas Boenisch, Group Managing Director of Innospection Ltd, a specialist provider of innovative inspection services and solutions, explains how the next generation of high performance subsea inspection techniques and tools developed by Innospection could help Operators to solve longstanding and niche subsea inspection challenges.

With a reputation for expertise in advanced NDT solutions, Innospection is frequently tasked by oil and gas Operators and integrity management suppliers to provide customised solutions and equipment to longstanding inspection challenges. Since 2006, market demands have driven Innospection to develop dedicated inspection solutions to solve niche inspection challenges for subsea infrastructures such as rigid and flexible risers, caissons, subsea pipelines and structures, mooring lines, ship hulls, etc.

High Performance Subsea Inspection Techniques

Amongst the various inspection techniques offered by Innospection, two high performance subsea inspection techniques are explained in this article. The electromagnetic testing technique “MEC” (Magnetic Eddy Current) is the main inspection technique and is applied to most of Innospection’s next generation of topside and subsea inspection tools to support integrity assurance. The “MEC-FIT™” technique is developed by Innospection to provide a reliable and technically advanced solution for the inspection of flexible risers and flexible pipes operated from offshore installations.

MEC – Next Generation of SLOFEC

MEC is the next generation of the fast corrosion mapping technique based on the...
With a reputation for expertise in advanced NDT solutions, Innospection is frequently tasked by oil and gas Operators and integrity management suppliers to provide customised solutions and equipment to longstanding inspection challenges.

The MEC technique is a dynamic corrosion mapping technique. By superimposing the direct current magnetisation with an Eddy Current field, the depth of penetration is increased to such an extent that the internal defects such as corrosion, cracks and pitting can be detected from the external surface. While the defects affect the direct current magnetic field lines inside the remaining wall of the inspection object, a change in the relative permeability consequently affects the Eddy Current field. This is displayed as impedance disorganisation and defects such as metal loss or crack, but without the risk of damaging the integrity of the flexible riser. By combining magnetic field lines with Eddy Current field lines, the MEC-FIT™ technique not only allows the deeper penetration into the various armour layers for defect detection in the inner layers, but also enables the optimisation of inspection for a specific layer from which a detect signal is received. The specifically developed sensors and magnetic system has demonstrated sensitivity in the detection of single or multiple wire cracks and corrosion (pitting areas or individual pits) in the first and second transient armour layers and, to some extent, damage and interlocking failures in the third pressure armour layer. Being an electromagnetic technique, no annulus flooding is required for the inspection, which minimises damage to the flexible risers.

In addition to the MEC technique, the MEC-Combi Crawlers and Pipescanners can also be equipped with an advanced integrated cleaning system to enable a simultaneous cleaning and inspection operation. Deployed by ROV or divers from the support vessel or from the installation by rope access personnel, they are designed to be self-driving and enable the fast scanning in axial and/or circumferential orientation. An overview of the next generation MEC-Combi Crawlers & Pipescanners is shown above.

To deploy the high performance subsea inspection techniques, a range of sophisticated next generation MEC-Combi Crawlers and Pipescanners has been designed and built to provide comprehensive inspection data within a single deployment for the inspection of the following subsea assets:
- Risers, caissons and conductor pipes
- Flexible risers
- Subsea structures and ship hulls
- Subsea pipelines
- Mooring lines
- Other inspection challenges

Subsea Inspection Applications with MEC-Combi Crawlers & Pipescanners

Originally used for the detection of metal loss and cracking in flexible pipes with armour layers having a 30°-45° wire angle setup, the MEC-FIT™ technique has been further developed and successfully verified to be sensitive also in the detection of defects in flexible pipes having a tighter armour wire setup at 15° angle. With a signal to background ratio of >6dB, a 90% Probability of Detection was achieved for defect types such as single and multiple wire gap in the outer layer, multiple wire gap in the inner layer as well as extra wire on top outer layer at 15° and 35° wire angle.

The MEC-FIT™ technique has been successfully deployed for the inspection of flexible risers and flexible pipes in the North Sea.
The MEC-Hug Crawler
is a self-driving scanner developed not only to deploy the MECFIT™ inspection technique but also to address the specific challenges of accessing and inspecting flexible and rigid risers at their working locations.

Flexible Riser Inspection

The MEC-Hug Crawler is a self-driving scanner developed not only to deploy the MECFIT™ inspection technique but also to address the specific challenges of accessing and inspecting flexible and rigid risers at their working locations. After deployment by divers or ROV, the MEC-Hug Crawler embraces the flexible riser and moves along the pipe to perform the external inspection. A change over occurs, the sensor system enables the MEC-Hug Crawler to be used for the inspection of rigid risers.

The capabilities of the MEC-Hug crawler include:
- Inspection of flexible risers with OD ranging from 4” to 12”
- Wall loss, crack and corrosion detection at first and second tensile layers or third zeta layer with wire gap display
- Deployed by divers or ROV

Subsea Pipeline Inspection

Subsea Pipeline inspection techniques combined with the generation of sophisticated MEC-Combi Crawlers and Pipescanners provide our clients with optimum and unique inspection solutions to meet the new challenges presented in the deep water operations in the worldwide oil and gas industry.

Supported by an internal R&D team consisting of highly qualified engineers and development technologists with expertise and knowledge in advanced NDT technologies and application development to inspection tasks, the advanced and innovative inspection solutions and services provided by Innospection are unlimited. Whatever your subsea inspection challenges, Innospection is your solution provider.

The MEC-Combi PipeCrawlers include:
- Inspection of coated pipelines
- External and internal wall loss detection
- Mapping of external and internal pipe surface condition
- Corrosion mapping with matrix data
- Diver or ROV deployed

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Subsea Pipeline Inspection

The MEC-Combi PipeCrawlers are used for the external fast scanning of non-piggable subsea pipelines. They are self-driving scanners with hydraulic driven wheels to enable the inspection of subsea pipelines and flexible pipes in the axial and circumferential direction.

The MEC-Combi PipeCrawler is equipped with an Ultrasonic sensor array, Pulsed Eddy Current and laser system to provide matrix wall inspection data in terms of defect size, severity of wall loss and locations for the fitness for service analysis.

The capabilities of MEC-Combi PipeCrawlers include:
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Mooring Line Inspection

The MEC-Wire Scan with flexible Eddy Current sensor array system is capable of penetrating through 35mm stand-off for the detection of cracks, localised defects and galvanization removal from wires of the mooring lines. The flexible Eddy Current sensor array system enables larger circumferential area coverage to accommodate the thickness of the mooring line’s polyethylene outer sheath as well as a change in the diameter in case of a repair patch.

Your Inspection Solution Provider

The high performance subsea inspection techniques combined with the next generation of sophisticated MEC-Combi Crawlers and Pipescanners provide our clients with optimum and unique inspection solutions to meet the niche challenges presented in the deep water operations in the worldwide oil and gas industry.

Supported by an internal R&D team consisting of highly qualified engineers and development technologists with expertise and knowledge in advanced NDT technologies and application development to inspection tasks, the advanced and innovative inspection solutions and services provided by Innospection are unlimited. Whatever your subsea inspection challenges, Innospection is your solution provider.

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Flexible Eddy Current sensor array system

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What Drives Inspection?

John Hancock, Editor

A growing market means a growing sector which means a growing demand for safe and responsible operations.

EXCEPTING SAFETY, any overview of offshore oil and gas operations will start with the money because that’s what business is about: bringing investment, time and capabilities together to generate value. Investments in this sector are colossal while the time over which any return might be realised spans decades rather than years and capabilities come from across the engineering spectrum and beyond. Over and above the ability to locate, access and produce oil and gas, there is the need to keep all of the expensive equipment and infrastructure involved in the process running smoothly.

The process to which this task is entrusted is inspection, repair and maintenance (IRM) and it is with the first stage of the IRM process, inspection, that this paper will be concerned. But first, to understand why such an expensive undertaking is worthwhile, we need to take a step back and look at the underlying driver of demand: powering growth for the whole energy sector and, in this case, offshore oil and gas.

Demand Drives Development

Global demand for energy continues to grow with little prospect that sustainable or renewable resources will be sufficiently developed to fill that appetite in the near future. That reality generates the incentive to find further reserves of carbon-based fuels. Much of the world’s hydrocarbon reserves have been located but not all are yet exploited. There are several reasons for this but the most frequently cited is that, as yet, unexploited reserves tend to be in inaccessible or inhospitable environments… or both. There are few environments more inaccessible or hostile than the oceans but there are significant reserves of oil and gas to be found at ever increasing distances from land, far beneath sea beds that are themselves deep below the ocean’s surface. It adds up to a significant challenge.

All that said, demand growth will not be equal across the sector so that while, as BP Energy Outlook 2030 explained, “global energy consumption is expected to rise by only 1.6% from 2013 to 2035,” the rate of demand growth might only grow at 0.8% a year during the period in question, demand for natural gas will rise at 1.9% a year – more than twice as fast.

Developments Becoming Worthwhile at the Right Price

Notwithstanding all of the above, the underlying driver of demand continues to grow. In June 2013 the United Nations calculated that the current world population of 7.2 billion was likely to increase by 1 billion over the next 12 years and to reach 9.6 billion by 2050. So even if the population stabilises at that level, the mannequin level of demand will be maintained. In the years ahead as it has been in the recent past, demand will continue to grow and prices, although falling at the time of writing, will rise in the long-term, unless supply can be increased at a rate to match demand growth.

This is important because a rising price for the product will render once uneconomic reserves now viable. Also, to meet today’s energy demands, producers will consider and test the most economical and efficient technologies to access those reserves. That is the incentive that drives innovation. And it isn’t just the locations that are challenging – the engineering is being stretched in every possible way, extending the life, reach and capability of current installations.

Responsibility and the Environment

But with all of these extensions, the regulatory authorities are making sure that appropriate support regimes are in place to ensure safe and environmentally responsible as well as efficient and profitable processes. For instance, the UK Health and Safety Executive (HSE) ‘Agreeing and Life Extension Inspection Program, 2010-2013’ was designed to, “ensure that the risks associated with ageing and life extension are controlled effectively by the offshore industry… to develop a common approach to the management of ageing installations and life extension [and] ensure the continued safe operation of all ageing offshore installations.”

One further consideration in any engineering extension programme is that, as part of an operator’s environmental responsibility, any changes, upgrades or maintenance have to be carried out in accordance with, as Dr Brian Twomey put it in his June 2012 presentation ‘Life Cycle of an Oil & Gas Installation’; “full consideration of future decommissioning, disposal and operating pollution.”

In any of the developments outlined above, there will be a need for operators to know as much as possible about the condition and resilience of their equipment and structures and that will require sound inspection techniques.

Oil and gas operators and consultants are becoming increasingly aware of the rate in which conventional wells are drying out… As a result, oil and gas firms are looking to squeeze every last drop of reserves from the nooks and crannies of the ocean, in hard-to-reach, ultra-deep places.

The days of cheap and easy-to-drill oil are over. Now comes the hard work of finding and producing oil from more challenging environments. Those were the words of ExxonMobil in 2005 and seven years later, oil and gas operators and consultants are becoming increasingly aware of the rate in which conventional wells are drying out… As a result, oil and gas firms are looking to squeeze every last drop of reserves from the nooks and crannies of the ocean, in hard-to-reach, ultra-deep places.”

And it isn’t just the locations that are challenging – the engineering is being stretched in every possible way, extending the life, reach and capability of current installations.

Inspection solutions feature:

- Advanced inspection tools with cleaning
- Magnetic Eddy Current (MEC) technique with multiple UT sensor system
- ROV & installation deployment
- High corrosion defect detection capabilities
- Axial & circumferential orientation
- No coating removal
The offshore sector puts engineering and inspection to the test at every turn.

The engineering employed in offshore oil and gas production is both costly and expensive, and if it fails, has the potential to seriously damage the environment as well as the finances and reputation of the operator. Thorough and routine inspection using the best equipment available will significantly reduce the risk.

**Expensive Equipment**

We cannot talk about the offshore subsea energy sector without talking about equipment and very expensive equipment at that. There is a reason for that enormous cost. Given the tremendous demands of the environment in which the sector operates, the enclosed nature and isolation of most installations, everything has to be built to the highest structural, safety and operational integrity levels. But if something does go wrong, there aren’t many places to go to and if something ceases to function, the cost in lost production and/or environmental damage can be enormous.

It is, therefore, no surprise that a significant part of any development and operational package would include scheduled inspection and maintenance programs. Equipment in these conditions must be reliable enough to safeguard the environment, and make the exploitation of subsea hydrocarbons economically feasible; operators must have the means to monitor the equipment to ensure that it continues to deliver on all of these attributes.

**Platforms**

Perhaps the best-known offshore engineering achievements are the enormous platforms and associated structures from which the drilling and production processes are achieved and managed. In the first place, there are two types of offshore structure, fixed and floating. There are also man-made islands but, for the purposes of this paper, we will stick to the familiar structures of a platform, a wellhead, associated equipment and the pipe work that joins it all up and connects the complex to a loading facility or the mainland.

While we need not go into details of the various types of fixed and floating platforms, one thing common to all of them is that significant parts of their structures are underwater and that poses particular problems when it comes to inspecting them in order to monitor their condition and resilience.

But even these platforms include an array of different engineering solutions to the challenges of winning oil and gas product from wells located under water and tapping reserves far beneath the seabed. And subsea production systems can range in complexity from a single satellite well with a flow line linked to a fixed platform, FPSO or an onshore installation, to several wells on a template or clustered around a manlift, and transferring to a fixed or floating facility, or directly to an onshore installation. A manifold, and transferring to a fixed or floating facility, or directly to an onshore installation.

The engineering and infrastructure

**Francis Slade, Staff Writer**

**Pipelines**

Platforms are not the only structures on or in the sea. Pipelines are also candidates for the most important, if largely invisible, components in any offshore energy complex. After all, they transport the product to where its value can be realised. But pipelines are vulnerable and can be subject to considerable stresses if not properly managed. And stresses can eventually lead to joints separating which, in turn, can lead to the worst nightmare of any offshore operator – a pipe leaking into the ocean. Only a robust inspection regime will alert an operator to changes and/or deterioration in the fabric or condition of a pipe and thereby possibly avoid the incalculable cost of a failure.

**Equipment at the Wellhead**

The pipe, of course, transports product away from the wellhead and accompanying Christmas tree. Oilfield Wiki describes the Christmas tree as: “In petroleum and natural gas extraction, a Christmas tree, or ‘tree’ is an assembly of valves, spools, and fittings used for an oil well, gas well and other types of wells. It was named for its crude resemblance to a decorated tree.”

Tree complexity has increased over the last few decades… This is especially true in subsea applications where the resemblance to Christmas trees no longer exists given the frame and support systems into which the main valve block is integrated… The primary function of a tree is to control the flow into or out of the well, usually oil or gas. A tree often provides numerous additional functions… and well-monitoring points.” Again, the need for a sound inspection process is clear.

**Subsea Processing**

And then of course there is the latest development for offshore oil and gas production – subsea processing, moving processing and the paraphernalia that accompanies it, down to the seabed. It is development that has been dubbed ‘The Game changer’, as in the Offshore Magazine article of the name which explains, “…the short-term future for subsea processing is most likely to involve equipment being installed on fields to de-bottleneck topsides facilities. These fields are less likely to be long-distance tie-backs or low-pressure reservoirs and more likely to be deepwater fields or fields with high water content.”

The article continues to add that, while the range of areas where subsea processing is likely to be used has decreased, the likelihood of operators using the technology has increased, with nearly all of them expecting to install some subsea processing equipment within the next five years. In the terms of this paper, that means more equipment to inspect.

The engineering employed in offshore oil and gas production is both costly and expensive and, if it fails, has the potential to seriously damage the environment as well as the finances and reputation of the operator. Thorough and routine inspection using the best equipment available will significantly reduce the risk of failure and increase the efficiency of processes, and that must be worth pursuing.
An Eye on the Future

Peter Dunwell, Correspondent

Inspection and maintenance can add long-term value to structures and equipment.

A Growing Market

The challenges facing inspection as part of an IRM programme are certainly growing with increasingly challenging environments, complex engineering, life extension and ever tightening regulations to be considered (see previous articles). But as well as these qualitative requirements, there is also a more traditional quantitative growth as the amount of equipment and infrastructure also grows. Following a period in which the 2009 financial crisis and the Gulf of Mexico oil spill limited growth in subsea hardware spend, “Douglas-Westwood (DW) forecasts global subsea hardware Capex will total $117 billion (bn) between 2014 and 2018. This represents growth of more than 80% compared with the preceding five-year period. In 2013, subsea tree installations were lower than expected with delays in crucial projects off Brazil and West Africa. However, DW predicts an increase through to 2018, with major manufacturers reporting strong backlogs.””

In an earlier report last year, DW6 noted that the IRM market is seeing huge growth thanks to the sheer magnitude and age of global subsea infrastructure. Also, unlike field development and production, IRM is largely unaffected by the oil price: it is a burgeoning subsector. Underlying this growth, as well as the sheer size of the sector, is the fact that, in any process where costly and complex equipment is used, a key priority will be to avoid failure. Put simply, equipment that isn’t working isn’t generating revenue. As importantly, in a process, when one piece of equipment fails, the whole process fails. This is one of a number of reasons why access to a reliable and effective inspection to ascertain current condition and identify flaws before they become failures, is critical to the management of any offshore subsea energy installation. And these days, no management program can ignore the environmental dimension. Dr Brian Twomey has explained this as:”7: “Maintenance [should be] carried out with full consideration of future decommissioning, disposal and operating pollution.”

Reasons to be Careful

While there are many reasons why investment in a sound inspection and maintenance regime is money well spent, there are some particular business reasons why inspection and maintenance are desirable. Right at the top of that list, for any responsible company, will be safety. It is the first duty of any business operating in any environment, let alone an environment as hazardous as that where offshore oil and gas operate, to ensure the safety of its workforce. Safety is also a key focus of regulators around the world typical of which would be the 2013 EU Directive 2013/30/EU8 on the safety of offshore oil and gas operations, which followed the April 2010 Gulf of Mexico spillage and has the objective to reduce as far as possible the occurrence of major accidents related to offshore oil and gas operations and to limit their consequences.

After safety, any inspection regime should contribute information to an overall asset integrity management programme, described by Robbie Williamson of Celso Raposo as “a continuous process of ‘Knowledge and Experience Management’ applied throughout the lifecycle to assure that the equipment is used, a key priority will be to avoid failure. Put simply, equipment that isn’t working isn’t generating revenue. As importantly, in a process, when one piece of equipment fails, the whole process fails. This is one of a number of reasons why access to a reliable and effective inspection to ascertain current condition and identify flaws before they become failures, is critical to the management of any offshore subsea energy installation. And these days, no management program can ignore the environmental dimension. Dr Brian Twomey has explained this as:”7: “Maintenance [should be] carried out with full consideration of future decommissioning, disposal and operating pollution.”

A Longer Useful Life

Throughout this paper, we have alluded to the practice of extending the operational life, reach and capability of structures and equipment in offshore oil and gas. These concepts are interlinked. All equipment has a ‘design life’, the period of operation or number of operations for which the designer and manufacturer anticipated the equipment having to function. Today, with operators seeking to extend the working life of equipment to further exploit a reserve or to exploit a new technology that can extract more product from a given reserve, a lot of equipment is being operated well beyond its design life. That is absolutely fine; but there are conditions that will need to be met before the end of design life.

The Journal of Petroleum Technology article ‘Offshore Oil and Gas and Life Extension – Ageing and Life Extension’10 explains, “In the end-of-life stage, the safe operating limits for the equipment are approaching, advanced inspection techniques are required...” However, the article continues to say that the key to longer-term reliability and safety is to establish effective management systems early on, so as to prolong the mature stage, because leaving life extension programmes until later stages requires considerably more effort and cost. The sensible thing is to monitor and maintain equipment properly throughout its operational life to ensure that, if required, it will remain efficient and usable for longer.

There are many safety and operational reasons to avoid failure but perhaps the one that should most exercise the minds of operators is the reputational risk which might not only have an adverse effect on revenue but could also affect the share price and ultimately make a business vulnerable to takeover.

Given the financial, reputational and operational costs that can result from any failure, for the offshore oil and gas sector, prevention is definitely better than cure. And in this respect, along with a robust program of risk assessment, risk management, maintenance and renewal, inspection is an absolutely critical component in the overall running of an operation.
Challenges to Inspection Techniques

John Hancock, Editor

The variables that inspection has to monitor and the need to keep up with progress in engineering and regulation.

Aging is not about how old the equipment is; it is about what is known about its condition, how that is changing over time, and how effectively the associated risks are being managed.

Most variables that determine the nature and frequency of an inspection programme will be situational (such as environment and geology) or event driven (such as weather, and equipment wear and tear). One variable, however, is linear and that is the life stages through which any offshore oil and gas field and installation will pass. Because the anticipated life of installations is measured over decades, it could be easy to neglect situations that might be seen as too far ahead in time to warrant consideration today. However that would be wrong because consideration of the long-term future will usually mean that inspection and maintenance processes today will not only add value to current operations but will make more feasible and cost-effective any extended operations beyond the end of design life.

Asset Life and Aging

The life stages of an offshore oil and gas field are well documented but can be summarised. In simple terms the offshore oil and gas life-cycle goes from exploration and evaluation of the reserves to developing the field, building the subsea structures, production and ultimate dismantling. But the management of life extended structures and equipment is a specialist process in its own right. Engineer Live, in an article “Repairing and strengthening of ageing offshore structures” confirms that “Structural integrity management is an increasingly important element of the oil operator’s offshore engineer’s role… Should any significant change of the structural integrity of the structure be suspect then… an appropriate repair strengthening plan must be implemented sooner rather than later.” Of course, the best way to monitor for change in structural integrity is through an effective inspection programme. As The Journal of Petroleum Technology, February 2012 edition explains, “Aging is not about how old the equipment is; it is about what is known about its condition, how that is changing over time, and how effectively the associated risks are being managed.”

Regulators also take especially seriously the management of aging and life extended assets. In the UK, the HSE’s (Health & Safety Executive) KP4 inspection programme seeks to ensure that risks to asset integrity arising from aging and life extension are adequately controlled.

Access Challenges

All of these requirements and the environmental and engineering factors already discussed, inspection techniques have to overcome a number of challenges and constraints which make visual inspections difficult and, as importantly, unable to deliver the quality of conditional information required by either operators or regulators today. Access is often the first challenge. As Robert Lamb writing in How Stuff Works put it, not only is “… most of the world’s petroleum trapped between 500 and 25,000 feet (152 and 7,620 meters) under dirt and rock… [but also]… not all oil deposits are conveniently located under land or water.”

The Deepwater Challenge

Depth can be a challenge in its own right. In a May 2013 interview with O&G Next Generation, Dr Neil Thompson, Ex-President of the National Association of Corrosion Engineers (NACE) explained that hostile environments are often associated with offshore pipelines and facilities. As production goes deeper, the environments of production almost always become more hostile (temperature and pressure) and often with higher concentrations of aggressive substances (e.g. H2S, CO2, solids, water). Words like ‘hostile’ and ‘aggressive’ suggest that the challenges facing deep sea facilities and inspection are more than simply intellectual. In these conditions, equipment will be under greater levels of stress and the consequences associated with failure will be ever more daunting. Not only does the equipment used require more frequent and thorough inspection, but the inspection techniques themselves have to be sufficiently robust to cope with the harsh conditions. Yet the challenge of depth cannot be avoided. Total has calculated that “More than 5% of the world’s liquid hydrocarbon resources are believed to lie in deep water reservoirs. Estimated at some 300 billion barrels those resources could make a major contribution…”

Other challenges to high-quality inspection can include the weather and sea conditions, the topography of the seabed and, of course, the usual commercial constraints of time and cost.

Inspection Techniques

Have to Keep Up

To meet these various and significant challenges, inspection techniques have to be developed to high-degree. As Julian Turner puts it in the opening lines of his article on cutting-edge offshore inspection techniques, “New technologies that minimise revenue loss and protect both personnel and the environment are transforming offshore inspection best practice.” However even the best inspection techniques cannot identify every possibility of failure. In her presentation on risk-based inspection, Susannah Turner of Ponapen Integrity explains that while inspection is good at identifying damage or the onset of deterioration, it cannot predict instantaneous failure, although a good inspection regime will reduce levels of uncertainty and indicate possible failure triggers. She advocates a process of risk based inspection to ensure that the latest inspection techniques are applied in a structured regime that takes account of likely threats and deterioration.

Even the best asset management regime using the latest technology and methodology will not guarantee against failure but, in a world where costs in general and the costs of failure in particular are so high, operators will wish to reduce any risk they can to minimise the risk of failure and maximise the likelihood of pre-empting failure through deterioration or wear and tear. High quality inspection remains the best weapon in an operator’s monitoring and management regime.
References:


5. Dr Brian Twomey http://www.ccop.or.th/eppm/projects/40/docs/3%20BT%20Life%20cycle%20of%20an%20oil%20field%20&%20decommissioning%2013June12%20issued.pdf


15. Oil & Gas UK http://www.oilandgasuk.co.uk/ageing_and_life_extension.cfm


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