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2015001

A Comprehensive Approach To Integrity Of Non-Piggable Pipelines Based On Combined DCVG/CIPS/MTM Survey

应用 DCVG/CIPS/MTM 综合检测方法确定不能清管的管道的完整性

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Abstract

Integrity management of non-piggable pipelines up to now remains as an essential challenge for all Operators. For instance in Gazprom, due to diverse causes ILI technology cannot be applied for 47% of 164.7 thousand kilometers of pipelines. In addition, for half of those pipelines to run ILI is not economically reasonable. These pipelines are primarily branch pipelines, as well as part of transmission pipelines, which were commissioned more than 30 years ago. These assets have significant value, since they deliver gas to industrial consumers and population. Widely applicable aboveground survey techniques such as DCVG and CIPS alone, targeted at evaluation of pipeline coating integrity and CP effectiveness, do not entirely determine the integrity of non-piggable pipelines. Furthermore, these methods have limitation – they are not intrinsically sensitive to coating disbondment, which is considered as one of the significant threats to integrity. In the meantime, over the last years Magnetic Tomography Method went through extensive industrial validation. Based on the converse magnetostrictive effect, MTM defines stress characteristics of pipe sections by registering changes in the magnetic field of the pipeline. But MTM results in low accuracy for detecting pipe features with stress level less than 5% of the SMYS (e.g., pitting corrosion). As an effective instrument for comprehensive integrity assessment of non-piggable pipelines, authors propose to perform combined DCVG/CIPS/___ survey, which allows to evaluate coating and pipe integrity in one-pass and compensate limitations of each method. This paper is based on DCVG/CIPS/MTM survey results of Gazprom pipelines and describes methodological approach to develop an effective pipeline integrity management plans.

2015002

Case History in Optimization of Crude Oil Pumping Through an Accessed Point on a Strategic Pipeline

通过战略管道优化原油泵输的事例

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Abstract:

Crude oil is pumped through the Strategic Pipeline (SP); [406.4 mm outside diameter (O.D) & 387.35 mm inside diameter (I.D)] x 166 km. SP was operated by two pumping stations; one at First Point (FP) and the other station is located at SP mid, 83 km far from FP. Crude oil produced from Aghar Field (AF) was pumped at the rate of 6,300 barrels during 17 hours daily, through a pipeline; (254 mm O.D & 238.76 mm I.D) x 46 km, to an Access Point (AP), 111 km from FP at 800 psi initial pumping pressure. There was necessity for upgrading SP transportation capacity by 80 % to reach 180 thousand bbl/d which of course was accomplished by increase in operating pressure so that pressure at AP was increased and reflected in the form of back pressure on the pump at AF which created a problem for the crude oil coming from it to AP. This was requiring an optimized solution, either by replacing the existing pumping system at AF with another one of higher pumping pressure (which was excluded due to high cost)

or reducing pressure at the AP, which was achieved by using Drag Reducing Agent (DRA) to reduce hydraulic friction losses through SP. This paper contributes for a practical case history for using DRA as an optimized solution, by which could make pumping from AF to AP at the same initial pumping pressure without need for changing pumping system. Also, all such stated events are presented in addition to the economic analysis for calculation of the realized gains with using DRA.

2015003

Assessment and treatment of earthquake-related geohazards threatening offshore gas pipelines in the Mediterranean sea

地震相关的地质灾害对地中海的海底天然气管道威胁的评估和处理

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ABSTRACT

The transportation of hydrocarbons to Central and Northern Europe is currently being performed by high-pressure onshore pipelines coming mainly from Central Asia. Undoubtedly, in the following decades the increased demand for energy in European countries will require the smooth and safe transfer of hydrocarbons from East Mediterranean, Middle East, and North Africa. This process is expected to be performed via offshore pipeline networks and seaside facilities connecting various countries in the wider Mediterranean region (i.e., Tunisia, Italy, Greece, Cyprus, Turkey, Lebanon, Israel, etc). However, since this region is characterized by moderate to high seismicity, the seismic design of any offshore pipeline should aim to eliminate the probability of occurrence of potential accidents such as explosion, fire, leakage, etc., and their devastating consequences (deaths/injuries, economic loss, environmental pollution, etc). This goal may be achieved through: (a) the identification and the quantification of the potential geohazards, and (b) the realistic estimation and, if needed, the effective improvement of the integrity of offshore pipelines. The potential earthquake-related geohazards, apart from strong ground motion, include mainly coastal or submarine landslides, active faults, soil liquefaction phenomena, and in some cases tsunamis.

Since the accumulated experience worldwide related to the design of offshore pipelines exists mainly in low-seismicity regions (such as North Sea, Gulf of Mexico, etc), the objective of the current work is to shed some light to the very challenging issue of seismic design of offshore gas pipelines. After a short presentation of the geology, the bathymetry and the seismicity that characterizes the Mediterranean region, the main earthquake-related geohazards are briefly described. Finally, the paper conceptually proposes certain technically and economically feasible mitigation/protection measures.

2015004

Achieving Traceability of Material and Construction Quality in Real Time on Pipeline Construction Projects

管道施工项目材料与建设质量的实时跟踪

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Abstract

Pipeline construction projects that typically feature large diameter pipelines passing through various types of terrain are complex and challenging initiatives. At times, being in the thousand kilometer ranges, these lines could go from the plains into the mountains, dry land to offshore environments and from unpopulated stretches to dense urban areas. The design might involve different grades of steel pipe, different types of coating and multiple wall thickness sizes with possible diameter changes too. In projects of such magnitude, one of the key challenges is in tracking material and its installation from production to quality of construction. Taking an example of such a project, we will view how material and construction traceability can be achieved in such complex situations. We

will see that effective solutions built around modern day technologies such as mobile devices, the Internet and geo-spatial technologies can help us achieve a high level of material, manpower and quality management in real time. Adopting the following case scenario, in which a pipeline has both onshore and offshore sections and multiple points of pipe production and fabrication (possibly in different geographies) and supply of this material to different delivery points (construction spreads) on a project, the paper will examine the entire data management and reporting process.

2015005

Cathodic Protection Guaranteed with Anodeflex linear anodes.

用柔性线性阳极实施阴极保护

Erik Broesder / Dinko Cudic, Anodeflex – Seal For Life Industries

Seal For Life Anodeflex linear anodes provide cathodic protection current in the right amount and where it is needed. The installation is simple and there is virtually no risk of interference to adjacent structures. Anodeflex works especially well in the presence of AC influence and DC stray current interference. Cathodic protection is almost universally applied to buried and immersed structures in the oil and gas industry. Amongst other things it is applied to pipelines, above ground storage tanks, buried storage tanks, and buried pipe works in above ground installations. The amount of cathodic protection current required to stop external corrosion is provided in the various standards. The actual amount of current required is determined by the coating condition (if any) and the environment that the structure is buried or immersed in. The standards provide guidelines for the design of cathodic protection systems by advising the cathodic protection current density required for bare steel and the efficiency of the applied coatings over the design lifetime of the structure. This is all well and good, but the problem is to get the current to where it is needed i.e. at the coating defect.

2015006

Building the Fluid Highways™ of the future- Long Pipes “Fluid Highway”™; the development program so far.

建设未来长距离管道的“流体高速公路”

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Abstract:

The world needs a new lower cost more efficient means of fluid transportation for oil, gas, water etc. Like almost all new technologies that we are working with today from rockets, to fighter jets, to cars and now pipelines the answer appears to be composites. These materials are many times stronger and lighter than steel. They are inherently corrosion resistant or immune to corrosion. They can be made to sense fell alert the operator or defend the pipe. Yet any one material on its own cannot do the job so we are pioneering a new pipeline technology that combines many composite materials and promises to produce a completely new technology in pipelines that are made continuously in the field at high speed. We call it the Fluid Highway™. This is the story of; the history, the development to date, the trials, the tribulations and the successes on the development road, to produce the Long Pipes; Fluid Highway™.

2015007

An Integrated Approach to Integrity for the Un-Piggable Pipe: New Inline and External Techniques

确保不能清管的管道完整性的总和和方法：新的在线与外部技术

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Abstract:

New techniques and technologies in the industry are markedly improving a pipeline owner’s ability to establish

fitness for service for un-piggable pipe. By combining new, innovative techniques for non-intrusive external line inspection with free-swimming, inline tools, owners can now better understand the condition of these critical assets. New external techniques include an indirect inspection platform that combines all the standard indirect inspection technologies into a single platform, and all performed on a single inspection. Inspection techniques include depth of cover, GPS centreline, ROW inventory, Coating Survey (ACVG/DCVG/ACCA), and close interval potential surveys for evaluating cathodic protection. Inherent in the term “un-piggable” is the idea that traditional ILI inspection tools are not able to inspect such pipe due to limiting factors like tight-radius bends, lack of pigging facilities and internal coatings. A containment verification tool with the ability to inspect such un-piggable for the presence of pinhole leaks has been used extensively over the last three years, and case studies will be presented. Sized smaller than the ID of the pipeline, the tool rolls through the pipeline while being pushed by the fluid flow in the pipe, so tight radius bends are not a concern and the tool does not require the presence of pig launch and receive facilities. New capabilities just added to the platform allow for a pipe wall assessment inspection capability to be performed concurrently with the containment survey. This new capability is designed to detect stress on a metallic pipe. While not providing the defect resolution of MFL or UT tools, the assessment data provides an effective means of screening a pipeline for issues of concern. In concert, the containment verification and the new external assessment capabilities allow pipeline owners and operators to establish a reasonably comprehensive baseline condition assessment of their un-piggable pipeline inventory.

2015008

Application of 3D Laser Method for Corrosion Assessment on a Spherical Pressure Vessel

3D 腐蚀评价方法在球形压力容器上的应用

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Abstract

Oil & Gas pressure components found on power plants and refineries must be inspected on a regular basis to ensure fitness-for-service. Corrosion is one of the most critical and recurrent degradation that must be inspected under API-579 code. Various non-destructive methods have been used to measure corrosion. A contact method is always problematic due to the deteriorated external surface. Encoding a scan is also a challenge, requiring mechanical scanners or fixture to fit the specific component geometry for referencing the defect position. 3D laser scanning is emerging as an efficient alternative for accurate surface degradation and offers the versatility needed to inspect various geometries with a same system. The analysis is performed using post-treatment software to generate all required measurements for assessment. This paper describes how metal loss can be measured from a 3D laser mesh file compared to a reference surface. Case study of a corroded spherical pressure vessel will be discussed.

2015009

COMBINED ULTRASONIC TETHERED TOOL FOR INSPECTION OF WELD CRACKS IN OFFSHORE PIPELINES: TOOL QUALIFICATION AND FIRST RESULTS FROM OFFSHORE INSPECTION

检查海底管道焊缝开裂的组合超声波系链工具

Thor-Ståle Kristiansen, KTN, Norway

ABSTRACT

Typically inline inspection is carried out for geometry-, corrosion- and cracking defects. Regarding cracking, most of the time axial cracking (SCC, seam weld cracks....) is observed. Ultrasonic crack inspection tools are available for the reliable detection of such cracks using conventional ultrasonic shear wave technique suitable for detection but with limited depth sizing capabilities. Under special conditions (bending forces, poor welding) cracking can

also appear in circumferential direction. For this type of cracks, the same type of tool can be used with a modified sensor carrier providing similar detection and sizing performance as for axial cracking. In offshore applications, however, accurate sizing in particular of crack depth is an important requirement as offshore verification and repair work is usually very cost-intensive. In order to provide a high POD together with good sizing performance a tethered 10" tool was developed for inspection of circumferential cracks. It contains a pulse - echo (PE) unit for reliable detection and a TOFD (time of-flight-diffraction) unit for accurate sizing of circumferential cracks. The PE technique is used for fast screening during the forward inspection. The TOFD measurement which is basically stationary is performed on the backward inspection by stopping at every location where a crack indication was detected by the PE inspection. Extensive blind testing of the new tool was performed. The comparison of the results from ILI inspection and destructive testing showed that the ILI tethered tool fully met the specification with regard to detection and sizing. After successful validation the tool was used for a tethered inspection of a 10" offshore pipeline (length 8 km). In the paper the inspection concept and the setup of the new tool are described. Results from the qualification tests as well as from the first inspection run performed with the new tool are presented.

2015010

Comparative study of different fluids flowing in a Supersonic separator used in Subsea Gas Pipeline systems

海底天然气管道系统用的超音速分离器中不同流体流动状态的综合研究

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ABSTRACT

The supersonic separator is unique technology which gained market acceptance. The usage in subsea systems have been increasing extensively. The conversion of kinetic energy into pressure energy at the diffuser makes this device more special. The pressure recovery technique helps the system to use near the well head where the pressure is drastically reduced to limited range. In this paper the Numerical study of supersonic separator is done using the computational Fluid Dynamics package FLUENT. The simulations are run using three different fluids, air, methane and natural gas given the same boundary conditions and initial physical parameters. The Redlich – Kwong real gas equation and standard k- ϵ turbulence model is employed. The result shows that the shock formed in the nozzle of the supersonic separator is depending on the density of the fluids, the lighter the fluid the closer the shock position to inlet. The Pressure and temperature variation is also high in low density fluids.

2015011

Compliance kit for easy retrofitting to TRFL and API

按照 TRFL 和 API 标准容易修复管道的适宜方案

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Abstract

In the world news as well as generally throughout the public domain we commonly find large, transnational pipeline projects – Northstream, Southstream, Bluestream, etc. – that are planned and discussed over years and therefore the object of widespread attention. But the major part of pipelines transporting the various types of liquids and gasses is far from the global spotlight, buried in the ground and methodically fulfilling its purpose for more than 50 years. The risk of an explosion caused by external damage or simply by corrosion is much higher at these installations than at newly built pipelines, which are usually equipped with modern control and monitoring technology. For more aged pipelines comprehensive oversight should be a top priority. An ideal combination for retrofitting pipelines without reconstruction is a periodical inspection using intelligent PIGs – preventive and sensitive but with reaction periods of years – together with computational pipeline monitoring – quick reaction,

robust and easy installation. The advanced version “LEO-Pipe Compliance Kit” of MAGNUM’s monitoring solution was especially designed for retrofitting existing pipelines to meet compliance with TRFL and API-1130. The presentation briefly describes the principals of model-based pipeline monitoring. In practical applications at old and existing pipeline systems several obstacles will be found that stem from the broad range of involved technologies: installed sensors, control solutions, weak or missing data links, operation modes, etc. To prevent huge engineering costs caused by special solutions a set of standard components is defined and described. Main units besides the central monitoring station are specialized remote stations (RT-Stations) providing modularized sensor interfaces, robust communication, and GPS based synchronization. Pre-processing and buffering of measured data is the solution to cope with weak, slow, and unreliable communication links.

2015012

Considerations on the Risk of Hydrogen Embrittlement of Pipeline Steel due to Cathodic Overprotection

过度阴极保护导致管道钢材氢脆的风险研究

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Abstract

The risk of hydrogen embrittlement of pipeline steel due to cathodic overprotection has frequently been described in literature. ISO 15589-1 mentions this risk for pipeline steels with specified minimum yield strength exceeding 550MPa (N/mm²) and requires to investigate the limiting cp-potential (at the steel/soil phase boundary). Furthermore there is some evidence from literature that a combination of mechanical damage and cathodic overprotection can lead to rapid failure due to hydrogen embrittlement. On the other hand, however, the operation of a cathodic protection system requires the adjustment of a fairly negative on-potential, e.g. in order to compensate local anodic potential gradients that cause an anodic interference. Furthermore in case of risks due to alternating current corrosion EN 15280 recommends adjusting the cp on-potential to a sufficiently low level in order to establish a current ratio $J_{ac}/J_{dc} < 5$ (e.g. measured on probes). Following this it has been found that even at low ac voltage $U_{ac} \approx 5V$ cathodic dc-current densities (J_{dc}) of some 10A/m² may be needed to reduce ac-corrosion rate thus causing the formation of hydrogen on the steel surface. The paper considers the state of the art regarding the operation of cp-systems of buried pipelines and presents a case history of mechanically damaged pipe surfaces. Results are summarized from different laboratory and full scale investigations that have been performed to study the hydrogen induced cracking of pipeline steel considering (simulated) different soil conditions, different mechanically damaged/deformed and non-damaged pipeline steel grades and a range of cathodic protection current densities.

2015013

Continuous Monitoring of Pipe Coating During Pulling Operation in a Horizontal Directional Drilling (HDD)

水平定向钻进牵引作业过程中管道涂层的连续监测

Kamyar Darbandi, Steffel

Abstract:

When pipeline routes have to cross traffic infrastructure, rivers, biotopes such as mountains and so on, the choice nowadays is almost exclusively trenchless pipe laying, and for trenchless pipe laying over longer distances it has been horizontal directional drilling that has become the proven method. As stated, for example, in the federal government’s pipeline provision, cathodic protection in line with the German Industrial Standard EN 12954 is normally required for the metal pipeline that is then pulled into place. Despite the precaution of additional coating, the mechanical stress involved, such the destroying effect of sharp-edged stones, as the pipeline is pulled into the borehole often leads to coating damage. Depending on the size of the resulting coating defects and the electrolyte’s

electrical conductivity in the bedding zone, it may no longer be possible to achieve the cathodic polarization required for cathodic corrosion protection. The Pull & Check test procedure involves continuously testing the pipe coating while the pipe is being pulled into the horizontally drilled bore hole. From a procedural point of view, this method of testing is tied to the overall time taken to pull the pipe into position. The main advantage of this method is that any coating defect occurring during pipe pullback shows up straight away. This allows immediate measures to be taken to pull the pipe back, repair the coating damage and continue the operation, thus achieving the desired – undamaged or technically acceptable – coating quality and also avoids the situation in which a pipe run that is already damaged is pulled all the way into position before those responsible can be informed that the coating requires patching

2015014

Decision Making Matrix for Emergency Pipeline Repairs

事故管道修理的决策方案

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Abstract:

Pipelines are one of the most efficient and safe means of hydrocarbon distribution and account for more than 50% of energy transportation in the world. Hence, any pipeline damage that may lead to an unplanned shutdown of the pipeline network may result in substantial loss of revenue to the Operator and a severe dent to its reputation. It is therefore in the Operator's interest to rectify the damage and resume full operation in the shortest possible time. Existence of a pre-analyzed, approved decision making matrix, repair equipment/ inventory and trained manpower is vital in facilitating a quick and cost-efficient resumption of full operation. Even though resources like the Pipeline Defect Assessment Manual exist, such literature sources provide generic guidelines and might not be detailed and specific to the issues faced by the Operator. Operators need an in-depth, pre-analyzed, approved decision making matrix customized to their pipeline network and incorporating credible damage scenarios, local conditions, ready-to-use repair equipment/ inventory and available marine/ vessel resources. This enables quick identification of the type and extent of damage and the most appropriate repair to be exercised. A thorough understanding of the Operator's pipeline network and field architecture, marine traffic in the area, possible damage scenarios, damage assessment methods, software, latest survey tools, pre-evaluation of repair options, inventory, available marine resources and installation issues is a prerequisite to develop an effective and customized decision making matrix. Active collaboration between entities representing above issues is important so that the matrix developed is technically robust, financially optimized yet easily understood and approved by all stake holders within the Operator's organization. This paper identifies all critical technical/ operational elements, available tools/resources, multi-disciplinary activities and repair methods that need to be considered for development of an effective decision making matrix for emergency pipeline repairs.

2015015

DEEP SEA - HIGH TECH, COLLAPSE RESISTANT PIPES FOR THE SOUTH STREAM OFFSHORE PROJECT

南溪深水管道抗压瘪高科技钢管

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ABSTRACT

The South Stream offshore pipeline for the supply of natural gas across the Black Sea to southern Europe is an extremely challenging project from a technical perspective. The challenges in engineering and design are resulting from a water depth up to 2200 m in combination with a large pipeline diameter, geo-hazardous risks and a

corrosive subsea environment. As a leading pipe manufacturer EUROPIPE GmbH was contracted to deliver line pipe material and related components for the first offshore pipeline. The paper describes EUROPIPE's activities from a project-related and technical point of view: In the beginning a general overview of the project organization with all relevant sub-sections is given. Due to the fact that all required components of the pipeline can be delivered by a single supplier the contractual partner profits from a centralized and experienced project management. Together with its sub-contractors, EUROPIPE GmbH covers all business activities from line pipe material, buckle arrestor assemblies, bends, 3-layer PP / CWC coating to transportation and logistics. Subsequently, the pipe manufacturer provides an insight into material selection, -testing and quality control to achieve the advanced mechanical properties for that project. The exceptional demand for collapse resistance in the as-coated condition can be named as an example in that context. As the collapse resistance of the pipes is mainly influenced by compression strength and ovality it is explained how EUROPIPE GmbH ensures to guarantee these desired requirements. The development of a new approach for the inline heat treatment of pipe ring segments before coating is introduced. It is presented which efforts were made and how traceability and quality control over the complete production are ensured. Afterwards production results from both, mechanical and dimensional tests are shown. The latter are determined by laser devices which highlight the importance of high measurement accuracy for deep water offshore pipelines.

2015016

Deformation behaviour of HFI-welded pipes– some examples of present applications

高频感应加热焊接管的变形特征

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Introduction

HFI welded steel pipe has been used successfully for decades in technically demanding applications and severe service conditions. Line pipe designed for high operating pressures ensures reliable transportation and distribution of gas, oil, water and other media. And without welded steel pipe, the exploration and extraction of essential resources would be impossible. Even in machinery and plant construction, welded steel pipe has established itself as an indispensable structural element. In the last years requirements for laying and operation of pipelines have become more and more challenging. On the one hand this is related to national regulations and complex laying situations, such as pipeline installation in high density residential areas. On the other hand the pipe material and coating itself are exposed to multiple loads during laying activities and the use of pipelines, for example because of the geological conditions. The paper shows the behaviour and applicability of high-frequency induction (HFI) welded pipes of Salzgitter Mannesmann Line Pipe GmbH on three different stress and strain demanding applications.

2015017

Perfection in Pipe-end Protection: Certification Program for optimal Pipe Closure

尽善尽美的管端保护

Bernadet Gijsbers, Marketing Manager, Dhatec Line

The supply chain of pipeline projects is global nowadays. Pipes can be manufactured in Japan, coated in the Middle East and installed onshore or offshore in Europe. In this global supply chain quality loss to the pipe and coating can occur easily. The pipes are lifted, stored and transported multiple times before they are welded together to form a pipeline. Dutch company Dhatec Line pipe Logistic Solutions is a manufacturer and supplier of high quality products to arrange for flawless deliveries of pipes from its production mill to construction site.

2015018

Disrupt, Collapse, Transform – Future of NDT from Periodic Testing to Continuous Monitoring

无损探伤从定期测试到连续监测

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ABSTRACT

Traditionally, monitoring of static equipment always involved periodic testing. There are various names for it but generally, the technologies used for this purpose can be clubbed under nondestructive testing (NDT). Recent research from Frost & Sullivan has found that especially in the oil and gas industry, periodic testing of static equipment is just not good enough. End users have realized that for static equipment the typical time frame for failure is reducing. Assets can fail catastrophically, not only within a few months but also within weeks from being commissioned. Hence, there has been a trend towards moving from periodic testing to continuous monitoring. We at Frost & Sullivan believe this is a paradigm shift in the inspection industry, especially the NDT industry, disrupting the way these industries function, maybe collapsing a few business models and transforming all existing products, technologies and business models. This trend can also be looked at as convergence of the condition monitoring, industrial automation and the NDT industries. Within this exciting development, business model innovation is of particular interest. Very often companies focus their entire innovation efforts on new technologies or products. Research however suggests that it is business model innovation that provides a higher rate of return and enables differentiation on a sustained basis. This paper will provide an overview of this trend that we are currently witnessing and cover the transformational growth potential of the NDT industry from disruption to collapse and then transformation.

2015019

Ensuring safety of compressor and pump stations through comprehensive robotic inspection of underground piping

埋地管道应用机器人检查确保压缩机和泵站的安全

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Abstract

Piping at compressor and pump stations is exposed to extreme pressure and vibration levels within transmission pipelines. Accidents on compressor stations are reported in many countries worldwide. The main operational threats that lead to these accidents are corrosion, cracking, and geometry violations. These threats are diagnosed in main transmission lines using traditional smart pigs; however, compressor and pump stations contain piping systems with complex geometries that such pigs cannot navigate. In recent years, significant industry developments have made remotely-operated in-line inspection (ILI) tools available that could inspect the unpiggable piping found in compressor and pump stations. Gas and oil transmission companies started performing robotic ILI operations to investigate real pipe conditions of all facility piping and connection lines with the following goals: Safety – ensure zero incidents at compressor and pump stations; Cost savings – inspect rather than replace. Today, Diakont has performed more than 200 inspections in compressor and pump station piping using proprietary robotic ILI tools. This paper describes Diakont's robotic ILI process and provides results from two case studies.

2015020

Experimental and numerical investigations on the fracture behavior of an API 5L X100M base material and weldings

API 5L X100M 钢管焊缝的断裂实验与数值模拟

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Abstract

Pipelines are the most efficient and safest gas transportation systems. Due to the increased use of high strength steels, the fracture mechanics assessments complementing the classical stress and strain-based design computations have gained remarkable importance. The mechanical properties and microstructure of API 5L X100M steel and weldments were investigated. The mechanical properties were characterized by tensile tests, Charpy-V impact test and quasi-static fracture mechanics tests. Numerical calculations of a pipe, compact tension (CT), single edge notched bend (SENB) and single edge notched tension (SENT) specimens from the base material were performed with the finite element package Abaqus to compare the stress and strain distributions in front of a crack. The difference in the stress state was evaluated by means of a constraint parameter such as the Q-value. Using this constraint parameter it is possible to correct the crack growth resistance curve (J-R-curve) determined on laboratory specimens in order to obtain the J-R-curve of the pipe. With these results a crack driving force diagram was calculated and used for assessing the pipe integrity.

2015021

Finite element simulation of guided waves to detect product theft from pipelines

导波检测管道产品泄漏的有限元模拟

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Abstract

The huge economic and environmental costs, as well as the injuries and fatalities associated with pipeline failures are daunting. Product theft (hot tap) and intentional attack (vandalism) are major causes of pipeline failure in addition to failures resulting from corrosion and aging. The existing pipeline monitoring/inspection techniques mainly serve as reactive measures to detect leakage resulting from such damage. Guided waves (GWs) are finding more applications for the real time structural health monitoring (SHM) of pipelines and other long, slender structures, particularly in the areas of corrosion and crack detection. The use of GW offers advantages, such as long range examination of a structure from a single location and rapid detection of damage. As an example stress wave signals generated through physical attack on a pipeline propagates along the pipeline in the form of GW. These signals can be detected by a GW sensor to provide information about the source and location of the interference. Deliberately excited GWs can be used to detect the presence of additional features such as small branch introduced to initiate a product theft. FE analysis is conducted on a typical 12 in (305 mm) diameter steel pipe with 12 mm wall thickness. A frequency sweep was conducted for fundamental longitudinal L(0,1) and torsional T(0,1) GW modes propagating along a pipeline. It was observed that a low frequency (below 5 kHz) tone burst excitation modified by a Hanning window produces a GW with low attenuation and dispersion. For example, at 2.5 kHz centre frequency, a phase velocity of 5100 m/s and attenuation of 0.00034 m⁻¹ were obtained from the simulation results. At this attenuation rate, the GW signal would theoretically retain more than 10 % of its original energy after propagation through a distance of 8 km. The sensitivity of the signals at this frequency was tested with simulation of 2 in (50 mm) branch pipe attached along the 12 in pipeline. The reflection coefficient of the branch was obtained and cross correlation signal processing was used to locate the position of the branch. Future work will use laboratory tests to validate the FE results.

2015022

Flaw Acceptance Criteria for Thin Walled Offshore Pipelines

薄壁海底管道瑕疵的验收标准

Cosmas Vlattas, Konstantinos Katsounis and Paul Breckon, Saipem Ltd

ABSTRACT

During S-lay pipelay operations offshore, pipe joints are welded on the lay-barge firing line. On completion of the girth weld, Non-Destructive Testing (NDT) is performed to locate the existence of any welding flaws. Automated Ultrasonic Testing (AUT) technique is normally the principal NDT method, providing high Probability Of Detection (POD) and accuracy. Empirical limits for welding flaws used during production offshore are frequently classified as too conservative. Hence, they are often replaced by criteria derived from an Engineering Critical Assessment (ECA). The approach is particularly effective for EPIC projects, since all aspects are considered in a complete “fit-for-purpose” approach and limiting conditions for failure are avoided. The benefits from performing an ECA however decrease with thinner pipelines. It is therefore paramount that all installation and design parameters for thin walled pipelines during detailed design are carefully optimised so the benefits are maintained. The optimisation process is presented in this paper for two thin wall export pipelines. Maximum loads are extracted from a range of analyses performed for the two pipelines. The stress ranges are calculated for the installation condition, the temporary on-bottom condition and the operation condition. Geometrical effects at the welded joint (axial joint misalignment) along with corrosion allowance (where appropriate) are considered in the calculations. Peak and variable loadings for the design life are established. Both pipelines were designed and subsequently installed by Saipem Ltd. The flaw acceptance criteria for welding had been developed in-house. All limiting loads were considered, including operational data supplied by Company. This led to a highly successful installation campaign with minimisation of repairs offshore.

2015023

Advances in Damage Resistant Epoxy Coating Technology

抗损伤环氧涂料技术进展

Dr. Jennifer K. Pratt, 3M Company

ABSTRACT

Fusion bonded epoxy (FBE) coatings have been used on pipelines as protection against corrosion for more than 50 years. They have been used as a stand-alone product in single layer systems and as a primer in dual layer FBE and three layer polyolefin systems. Pipeline coating systems require physical properties that minimize damage during transit, installation and operation. The two part liquid epoxy systems that are often used for field joint coatings also require superior mechanical properties like gouge, impact, and flexibility. While the field joint coatings do not experience all the same transport issues as plant applied coatings, the field applied coatings still experience flexing as the welded pipe is lowered into the ditch post joint welding and coating. The handling of pipes with un-loaders or horizontal directional drilling may also result in significant gouging of the existing coatings whether they are field or plant applied. As a result, both the plant and field applied coatings need to be very flexible, yet maintain a high degree of toughness to resist the mechanical abrasive forces that could result in a damaged coating. Damage to the coating system leads to higher potential corrosion sites on the metallic surface and could ultimately lead to a decrease in service life. This paper will present a novel plant applied coating system that incorporates both damage resistance and flexibility into an FBE system that is not subject to cathodic shielding. This paper will also present a new two part liquid Abrasion Resistant Epoxy Coating (AREC) that is extremely tough and rugged. The AREC coating system meets all the standard requirements for a field applied liquid epoxy yet is significantly more flexible than traditional two part liquid epoxy systems. Mechanical and chemical properties as well as application methodologies for both coating systems will be presented.

2015024

Fully automated gluing station for continuous pipeline deformation monitoring and 3-D positioning

管道变形全自动三维定位监测站

Aldo Minardo, Second University of Naples - Department of Industrial and Information Engineering, Via Roma 29, Aversa - Italy

Abstract

We have developed a fully automated gluing station for the simultaneous installation of three optical fibers on a pipeline at the 9, 12 and 3 o'clock positions. The three sensing cables retrieve the pipeline dislocation based on stimulated Brillouin scattering, providing the operator with a graphical 3D view of pipeline movements. The automatic gluing system allows reducing the cost of installation, while at the same time minimizing positioning errors of the fibers along the pipe. While advancing along the pipe, the station does the following:

- A. cleanses the surface of the pipeline, to remove grease marks or anything that may affect the quality of the bonding between the pipe and the fibers,
- B. applies a layer of adhesive along the surface of the pipeline,
- C. disposes, with controllable tension, the three optical fibers along the pipeline.
- D. applies a protective coating.

The fibers are unwind from three separate spools, each one including an optoelectronic circuit for optical continuity assessment. In case of break of the fiber, the operator is immediately warned by the alarm system. While advancing along the pipe, the station keeps the horizontal asset thanks to an automatic balance system composed by two servomotors and an electronics platform including two gyroscopes for pitch and roll stabilization. In this paper, we report the results of tests performed along a 12 m length of straight 6" pipeline, featuring three optical fibers glued using the developed station. After application of controlled bends to the instrumented pipe, the optical interrogator OSD-1 manufactured by Optosensing provides the strains for the computation of pipeline displacement, on the assumption that the pipeline is free of sectional and torsional strains. Comparison between imposed and measured displacements allowed us to assess the accuracy of the pipeline monitoring approach.

2015025

Impact of Advances in Seam Weld Assessment to Integrity Management: A Series of Case Studies

焊缝评价技术进步对完整性管理的影响事例研究

Ian Smith P.Eng. and Dr. Ted Anderson P.E.

Abstract

Recent advances in seam weld assessment allow us to more effectively manage risk related to seam failures due to pressure cycle fatigue. To illustrate the impact of the advances, four case studies have been developed that will both highlight best practice assessment procedures and show how the correct assessment procedures improve decision making.

1. It has been recognized that some of the accepted fracture models are insensitive to fracture toughness. Using a model that is insensitive to toughness can overestimate critical flaw size and lead to a false sense of security. The Modified NG 18 method will be compared to the API 579 FAD method to highlight the improvements to the accuracy of fracture models.
2. The bending that occurs during the pipe forming process of seam welded pipe will introduce significant residual stress. Residual stress can be relieved through normalization, cold expansion or high-stress pressure tests. In cases where residual stress has not been relieved, failing to include its impact in assessment can lead to non-conservative results.
3. Using a lower bound toughness estimate when calculating a re-inspection interval based upon a pressure test leads to an underestimation of the maximum flaw size that survives the test, which in turn leads to an underestimate in remaining life.
4. The results of a pressure cycle fatigue analysis have been historically viewed in a deterministic fashion: the

calculated remaining life is simply that of the flaw with the shortest fatigue life. Viewing the results of analysis in a probabilistic rather than deterministic fashion leads to a more complete understanding of failure times. An analysis is performed using a Monte Carlo simulation that accounts for variation in inputs such as yield strength, fracture toughness, and flaw size measurement error.

2015026

In-service Relocation of 24 inch Wet Acid Flare Line Header

24 英寸湿酸性火炬管汇在役重新安置

R. Moradifar, F. Ahmadi Abkenar, A.R. Shariati

Abstract

One of the major problems in the South Pars Gas Complex is dislocation and abnormal movement of bi-phase fluid lines, the major problem happened during gas plant overhaul 2007 in 24 inch wet acid gas flare line header. The middle of the last loop, had a 356mm deviation from original position and fallen from the pipe-rack structure and its support caught by beam wedge. Therefore, pipeline was distorted and was under stress in bends and supports. In this paper, our method of safe in-service relocation of this pipeline and the reason of dislocation is presented. For ascertaining the nature of the failure, two assumptions were examined, thermal shock and differential shock. The result shown it should be the aftermath of differential shock. To avoid unnecessary rehabilitation, the significance of defects detected in the pipeline was assessed. For this purpose operating condition and also induced stresses and deflection profiles of dislocation were applied in the finite element model, the result shown max available stress is nearly closed to the yield stress, but it might exceed beyond the elasticity limit of pipe material. It could have resulted in not only decrease pipeline stability and plant reliability, but also possible injury to plant personnel. Thus, relocation was urgent. After job risk assessment Executive procedure was performed in the three steps; first, preparation, the internal operating pressure of the pipeline reduced, the loop was restrained in three dimensions by forces extracted from FEM, to prevent sudden movement; Second was removing the source of stress by cutting the caught part of support. Third, removing forces by releasing chain-block slowly, consequently line was returning slowly to its original place, safe, cost-effective without loss of service. NDT was done for girth welds and supports weld connected to the pipeline.

2015027

不能清管的管道检验技术的挑战

Inspection of Challenging Pipelines

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Abstract

Nearly half of the world's oil or gas pipelines have until recently been considered "un-piggable". This term is used when a pipeline cannot be inspected with a free-swimming in-line inspection tool without a need to modify the tool or the line to be inspected. Typical examples are for instance missing launching and receiving facilities, diameter variations, tight bends, low pressure and flow conditions or high pressure and high temperature environments, onshore or offshore. In this paper a new concept is introduced, the so-called "toolbox approach". The driving idea behind the concept is based on having a large variety of services with all the required technologies, including magnetic flux leakage (MFL), eddy current (EC) or ultrasound (UT), enabling tailor made solutions to be packaged utilizing exactly the right technical resources for a specific inspection and integrity challenge. But it is not limited to a technology perspective. It also uses market information to identify mid- and long term market needs as well as special operational procedures. The resulting combination of understanding market needs, requisite know-how regarding optimized methods for service execution and the right set of

inspection technologies and transportation means results in utmost flexibility and optimal solutions for operators faced with managing the integrity of their challenging pipelines. In addition it must be stated that this type of work relies heavily on the expertise and experience of the crew involved, because of the often extremely complex boundary conditions and operational parameters encountered during the job performance. Several case studies will be presented to illustrate this approach, including special solutions for very difficult access, the need for bi-directional inspection solutions as well as special applications where robotic solutions were required.

2015028

Installation and Design of Large Diameter of HDPE Pipeline for Intake Water

引水工程设计安装大口径高密度聚乙烯管道

Youngtae Kim, Daewoo Engineering & Construction

Abstract:

Increased power demand over the world have been driving many developing countries with planning the construction of the power plant. The lack of water in the world are requiring facilities which could convert seawater into drinking water. The key facilities used for these power plant and desalination systems are intake and outfall pipelines, which provide crucial functions of supplying and discharging seawater. And the diameter of the pipe should be enlarged to supply affordable amounts of seawater into these facilities. Recently, for water intake pipeline systems High Density Polyethylene Pipe (HDPE) have been preferred candidate material compared to other possible materials such as steel and Glass Fiber reinforced epoxy based on the development of HDPE manufacturing technologies and its numerous advantages. Daewoo Engineering & Construction (Daewoo E&C) have been performing construction of Ras Djinet Combined Cycle Power Plant (RDPP) Project and HDPE pipeline was adopted for providing seawater into the onshore cooling water system. HDPE pipes have many beneficial features, such as light weight, flexibility and ductility, and well-suited for marine applications. But design and installation of the HDPE should be done carefully so that excessive bending stress and sudden sink may not be happened. The float-and-sink installation method was adopted to laying the pipeline with 2500mm diameter into the seabed in the project. The ballast weight are clamped along with the pipeline as designed space. The aims of the paper are to present the design procedure of the large HDPE pipeline and show the float-and-sink installation.

2015029

"Integrated Solution of SCADA and Modular Technology Packages to Support the Operators during the Lifecycle of Pipelines"

应用一体化的 SCADA 与模块技术支持管道寿命期操作

Klaus-Peter Fischer, Andreas Wolters, Actemium Cegelec GmbH, Germany

The implementation time for a SCADA system is insignificantly short compared to the lifetime of a pipeline. During the design and construction phase of a pipeline, neither the SCADA engineering nor the basic engineering can cover all tasks, opportunities and risks that operators will face during the life cycle. Therefore, it is extremely important during the entire pipeline lifecycle to provide the operating and maintenance personnel with tools which enable the continuous optimization of the pipeline process - against the background of changing conditions and a changing piping system. The control room is the heart, the nerve centre, the cockpit of a pipeline: In the control room decisions are made daily concerning safety, performance (maximize throughput) and economy (minimize costs). Systems that accompany all phases of the life cycle and adapt to the changing demands therefore belong to the control room. And they must be SCADA integrated. Moreover, for the continuous analysis and improvement of the pipeline process a software solution must be able to be combined flexibly and expanded with intermeshing

modules. In this way for each plant a tailor-made PipelineCockpit® is created, which naturally complements the existing SCADA system. SCADA integrated modular technology packages for the construction of a PipelineCockpit® are presented below.

2015030

Integration of the Pipelines in the Urban Infrastructure

城市基础设施中管道的一体化

Aloisio Pereira da Silva, Federal University of Santa Catarina

Abstract

This study aims to propose a model of joint trench for designing facilities of urban infrastructure, using concepts related to planning and urban cadastre, sustainability and resource utilization, especially with focus on safety during construction, maintenance, operation and expansion thereof. The model proposes to replace the individualized construction of natural gas pipeline, potable water, firefighting system, telephone, cable TV, data, power - low and medium voltage and public illumination systems that encompasses all of these facilities in an only trench in the sidewalk, and the deployment of these may also occur in the same period, or if necessary, at different times, thus creating flexibility to the proposed system. The model also proposes the use of bike lane to implementation of sewage facilities, high-pressure pipelines and main water, and attachment a system for collecting rainwater aligned with the sustainability criteria, since that collects, stores and filters the water from the rains. The security and integrity of facilities due to the operational interface between the dealers and third parties is ensured by the design of bay in reinforced concrete, designed by the concept of "fail-safe device", derived from the Toyota Production System. The joint trench model was designed in a perspective of sustainability and technological innovation for your future use in the new design of power supply, through the concept of "Smart Grid Systems" with the use of transmission and distribution electricity in order bidirectional model for decentralized power generation through cogeneration systems to natural gas. This model is an effective tool for implementing the concept of sustainability in the design of infrastructure facilities, because beyond the planning and urban cadastre and effective management for operation and maintenance these, also uses rationally the natural resources. Whereas the concept of the joint trench model is division the multiple facilities into a single trench, the costs listed above are fractionated between the various participating concessionaires, making deployment lower values when compared to the installation located in an individualized form. The implementation of facilities in an only time shortens the interdiction of the road and its surroundings and reduces the amount of rework, commonly visualized in our cities. It is not uncommon to observe a street that was recently restored reopened being for the installation of a new service. The construction of all these facilities in a centralized form contributes beyond cost reduction of the work, deployment time and inconvenience to the surroundings, also for the management and supervision of this work, which is in line with the new molds governance, management and transparency in public accounts in the construction of infrastructure facilities. Another fact is the need for acquisition of land use, which in some cases is necessary for the deployment of infrastructure services. The sharing of these costs among utilities is reduction factor of the final price of a project. Beyond the advantages initially described, as security, sustainability, planning and urban cadaster, the study began with the quantification of deployment services for natural gas pipeline in six blocks in the joint trench, presenting the following simulated result in deployment: Reducing costs in the deployment of natural gas mainline of order 32,30% compared to non-destructive method and 26,50% a destructive method and 70,30% in implantation a new derivation.

2015031

Intelligent Pipeline Solution: Leveraging breakthrough Industrial Internet technologies and Big Data analytics for

safer, more efficient oil and gas pipeline operations

智能化油气管道运行方案：突破工业英特网技术和大数据分析

Axel Hochstein, Senior Data Scientist, GE Global Research Center, GE Oil & Gas

Abstract

Current global transportation pipeline infrastructure stretches across more than three million kilometers. Pipeline companies invest up to \$40 billion per year¹ to expand networks and maintain their assets, but they are increasingly challenged by aging infrastructure, IT systems complexity and capabilities to leverage growing amounts of data. It is estimated that less than 25 percent of the data generated for any given pipeline is used to formulate data-driven decisions. This paper looks at the challenges facing the industry and explores how new technologies connecting assets, data and people can help address specific pipeline issues, such as:

- Asset safety and reliability
- Limited and siloed data
- Processes highly dependent on people and an aging workforce
- Increased regulation & public scrutiny

In this paper we will draw on research and development conducted by GE and Accenture in collaboration with one of the largest pipeline operators in the United States, providing examples that demonstrate the benefits new digital technologies and data analytics can bring to pipeline management. We will identify new technology and analytics applications that now help pipeline companies take advantage of the massive amounts of data generated through business operations, including secure data integration and modern visualization technologies, risk management capabilities, and decision support tools. Finally, we will discuss innovations in inspection, sensing and remote monitoring capabilities that can be leveraged by the Intelligent Pipeline Solution to deliver enhanced outcomes to operators. With the adoption of the Intelligent Pipeline Solution, operators can unlock quantitative benefits in asset maintenance, productivity and throughput optimization, as well as qualitative benefits in risk management, safety and knowledge transfer. As a result, they will be able to better identify and mitigate risk while optimizing their operations and efficiently allocating valuable resources when and where needed.

2015032

Lateral Buckling Capacity of Surface Laid Subsea Pipeline

水面铺设的海底管道的横向翘曲能力

I. Obele; D. Karunakaran; D. Achani, Subsea 7 AS Norway

ABSTRACT

Surface laid subsea pipelines under high temperature and pressure (HT/HP) induce compressive effective axial force which had over the years been the driving factor that initiates lateral buckling of subsea pipelines. This could lead to failure of the pipeline if lateral buckling and the resultant walking phenomenon at the buckle crown are not properly controlled or mitigated. Over the years, flowline engineers have addressed issues of lateral buckling of exposed subsea pipelines by adopting approach that allows pipeline to buckle provided it is demonstrated that the high thermal axial forces and consequent deformations are acceptable. This paper presents a study of the lateral buckling capacity of surface laid flowline under varying lay amplitudes and a uniform curvature. It addresses the utilization of the buckling capacity with regard to uncertainties in lateral soil friction, shape and/or dimensions of initial imperfection affecting pipe-lay curvature at seabed with respect to maximizing the feed-in into a buckle. Snake-lay configuration has been considered as the expansion control/sharing mechanism in this paper. The post buckling force is shown as one of the defining parameter for determining the acceptable lay amplitude that maximise the pipeline capacity during lateral buckling design. The paper further differentiate with finite element analyses (FEA) the acceptability of axial feed-in in design for load control condition (moment-based) and

displacement control condition (strain-based) with respect to DNV-RP-F110 and the need for ECA strain limit for plastically deformed pipeline.

2015033

Leak Detection – The necessity for pinhole leak detection – ways and means to a professional approach.

泄漏检测：针孔泄漏检测的必要性

Rene Landstorfer, Senior Product Manager, GOTTSBERG Leak Detection GmbH & Co. KG, Germany

Abstract

Pinhole leaks in pipelines can be a big problem for operators. Especially because they cannot be detected with conventional methods like SCADA or other online systems. These pinhole leaks can lead to spills that possibly will not be detected over a long time, because too many operators underestimate the risks of these spills and necessities of leak detection for leaks with a spill rate down to a few liters per hour. Conventional methods will detect leaks of several hundred liters per hour in best case and also complex wall thickness inspections with US or MFL tools cannot find every defect that may cause a leak at some day. For example defects that have a size too small to be detected with these devices can grow and lead to a small leak from which nobody knows and which cannot be expected. This leak can then spill over weeks or months and will not be recognized with the conventional leak detection systems. Gottsberg leak detection, a developer and manufacturer of one of the world's leading products in the field of leak detection for smallest leaks has again improved the safety for pipelines. The already pioneering technology was optimized for any disturbance events to be eliminated. For example, new filtering algorithms have been developed which are better adjusted together with the next-generation amplifier for the new, even more sensitive, hydrophones. This is mainly used for better noise detection of relevant processes within the line and for clear recognition and evaluation of noise after the run. In addition, a new generation of significantly improved pig detectors has been developed that work reliably and simultaneously improve safety. The presentation will give an overview about available technologies for leak detection and focus on the technical improvements of the new pig generation.

2015034

Magnetic Eddy Current In-Line Inspection Tool Development for CRA Pipelines

用于耐蚀合金管道的磁性涡流在线检测工具的发展

Stefanie Asher, ExxonMobil Upstream Research Company

Abstract:

Conventional In-Line Inspection (ILI) technology is based on ultrasonic (UT) or magnetic flux leakage (MFL) sensors, both of which are unable to inspect pipelines mechanically lined with Corrosion Resistant Alloy (CRA). UT sensors cannot transmit the sound wave through the interface between the CRA liner and carbon steel base pipe. MFL cannot inspect the carbon steel pipe because of the inability to permeate the magnetic field through the CRA liner. To address this gap in commercial ILI technology, ExxonMobil and Innospection Ltd. are working to develop a new ILI sensor technology based on a combination of Magnetic Eddy Current (MEC) and multi-differential eddy current. Initial feasibility trials were conducted with a prototype ILI MEC tool. Tests were conducted on an 8.625" (219 mm) X65 carbon steel pipe lined with 0.118" (3 mm) of Inconel 825 pipe. Four types of defects were introduced in the pipe to represent natural defects anticipated in service: Metal loss of features 3 to 24 mm in diameter on the external surface of the carbon steel base pipe; Erosion on the internal layer of the CRA liner; Internal girth weld crack-like defects; Metal loss defects at the interface of the CRA and carbon steel. Over 80 pull tests were conducted to determine the detection capabilities and speed sensitivities of the tool. All defects were detected by the sensors including the very small (<10 mm) pinhole-type features. Detection performance was not

affected at speeds up to 0.75 m/s. Since detection capabilities exceeded expectations, future development will continue based on the current prototype.

2015035

MARV™ Multi-Analytic Risk Visualization tool

多功能分析风险可视化工具

Francois Ayello and Asle Venas, DNV GL, NORWAY

Abstract

DNV GL Strategic Research and Innovation has been working several years to develop the future risk assessment method for pipelines that can give better, more correct and real time risk that can be visualized on a GIS system. The development has resulted in a new method including a new tool that is named MARV™ – Multi-Analytic Risk Visualization tool. The system has been tested out on several clients globally with very good result. MARV™ is a risk assessment methodology based on Bayesian networks. MARV™ uses Bayesian Models Forward Projection Plus Backward Correction. More importantly, uncertainty in the calculations is quantified too. This uncertainty is driving the data collection, when the uncertainty is acceptable, expensive data gathering can stop. MARV™ allows sensitivity analysis on the results that helps decide between data gathering and/or mitigation. Bayesian inference is used to update the probability of an event through observations/monitoring improving the initial “guess/assumption” through real data. Bayes' equation allows the probabilities of various outcomes to be updated based upon the relationships between models and evidences. After inference, the updated probabilities reflect the new levels of belief of all possible outcomes. Why is MARV™ different from current risk assessment methods? • Can use single deterministic values, even distribution, but also a probability density functions; • Links all models no matter origin, complexity, or programming language in one single frame work. • Understand where the risk comes from.

2015036

Modular Risk Assessment

模块风险评价

Mark Wright, MACAW Engineering Ltd

ABSTRACT

Pipelines are recognised as one of the safest methods of transporting hazardous products, yet they pose an inherent and constant risk to the local population, infrastructure and environment. It is therefore incumbent upon an operator to demonstrate that they have strategies in place that maintain this risk as a low as reasonably practical. To accomplish this, the operator should complete an appropriate risk assessment to identify any significant threats and then apply sufficient measures to mitigate them. What constitutes an appropriate risk assessment is a matter of much debate across the industry. In any risk assessment there is a balance to be struck between data availability & acquisition costs; model complexity and transparency; practicality and regulatory compliance. This balancing process has resulted in a multitude of different risk assessment methodologies, each having its own strengths and weaknesses. One size most certainly does not fit all applications, for example out-of-the-box software solutions are often inappropriate through their reliance on extensive and complete data sets, opaque decision processes and conservative assumptions that can disguise results or mislead the risk analyst. This paper describes the development of a pipeline risk assessment methodology, incorporating a combination of mathematical logic and statistical elements into a modular framework. A customised risk model is constructed from these modules depending on the pipeline location (onshore / offshore), fluid type, availability of information, data quality and required level of model complexity. Whatever level is chosen, the risk model provides an operator with consistent

and quantifiable results that are fully transparent. The methodology is integrated into the Rosen integrity management software suite (ROAIMS) and has been successfully implemented by a number of major oil and gas operators around the globe. Some of these applications will be illustrated in the paper.

2015037

Modularization and Standardisation of Pump Station Design

泵站模块化标准化设计

Carles Giro, ILF Beratende Ingenieure GmbH, Germany

Abstract

ILF was requested to design a pump station which should be optimized for its intended purpose within the transport system and at the same time suitable for standardisation /repetition. Standardizing the design does not only reduce engineering and (potentially) construction costs but also maintenance cost and capital spares. The solution is a modular concept in terms of process design and construction approach. Through a truly construction driven design, it was possible to find a solution where the benefits increase with the number of times the design is repeated. The design of the piping is such that adding additional pumps does not impact the design of the header for the other pumps. The electrical system and cabling concept is such that its position in the station plot can be easily swapped. The design of the pump suction and discharge areas are made such that it can be grouped in pre-fabricated skids, where all components (piping, valves, instruments, wiring and cables, steel structures, lights, etc.) are assembled and shipped to site where it is almost literally just put in place on the foundations. Last but not least, the pump and driver are placed on pre-cast foundations and transported to site fully assembled. The benefits of the skid concept are higher in areas with bad weather (complicated site construction activities) and high labour costs. Further, it is better the bigger the skid is (more components can be placed on it). Although the size is limited by transportability, the approach is applicable almost everywhere. One must keep in mind the example of pump and driver, which are also normally mounted on a skid and transported to site. The described solution is currently in development and will be applied in the near future.

2015038

Multi Method Leak Detection on a 120km 10" ethylene gas pipeline

在 120 km 10 英寸乙烯气体管道上采用多种方法检测泄漏

Daniel Vogt, Krohne Messtechnik

Introduction:

Demand for pipeline leak detection and location systems is increasing rapidly. Unfortunately general knowledge about these systems is still limited and the view that these systems 'will only detect catastrophic leaks' or 'give false alarms all the time' is still heard regularly. This view may be the result of bad experience in the past, unrealistic expectations, or a combination of the two. Leak detection in pipelines can be performed in various ways, from simple visual controls during inspections to computer-supported systems that monitor conditions, even for underground and undersea pipelines.

2015039

New Approach to the Results of Internal Inspection

内部检测结果的新方法

Aleš Brynych Alexandrs Jelinskis

The most efficient way to ensure the integrity of aging pipelines is a sequence consisting of internal inspection, elimination of major defects, and subsequent pressure testing. This has been proven on a crude oil pipeline DN 700

that was shut down, emptied, chemically cleaned and conserved by nitrogen as the crude oil transport through this pipeline was no more needed. The pipeline owner then considered the option of commission of this 45-year-old oil pipeline after long shutdown period for transportation of another media. A revalidation of a section of this pipeline was therefore carried out. As part of the revalidation a targeted combination of off-line internal inspection and subsequent integrity test was used. This enabled the operator to use a fundamentally different approach to the results of the internal inspection.

2015040

ON THE CARBON FOOTPRINT OF COMPRESSOR STATIONS

Pierre Brousse, Solar Turbines Incorporated, San Diego, CA, USA

ABSTRACT

One of the foremost topics of discussion for the energy industry is the amount of CO₂ and other greenhouse gases that are generated as a result of their activity. We will discuss methods to reduce the amount of CO₂ emitted by increasing the efficiency of drivers and driven equipment. Another key area for improvement is to make the overall operation more efficient. The operational effectiveness of a pipeline or a pipeline system will not be measured only by the cost of transporting a certain amount of gas to the end user, but also by the carbon footprint related to this effort. Natural gas is the most environmentally friendly fossil fuel. All forecasts indicate the leading role of natural gas in the effort to provide the world with energy, while reducing the environmental impact. While natural gas is abundant in some regions, the transport of natural gas is receiving scrutiny regarding its environmental impact. One of the key theses of this paper is the requirement of a system level view, rather than the level of individual units. This is particularly true for operational issues to be considered, such as the discussion of the carbon footprint of electric motor driven compression versus gas turbine driven compression. Topics like this require an evaluation including the carbon footprint related to the generation and the transport of electric power.

2015041

Polyamide 12 – Multi - Talent in Oil and Gas Industry

尼龙 12 在石油工业的多种用途

In the automobile industry, the high - performance plastic polyamide 12 (PA 12) has already been established for decades. In the areas of sports, aviation, and medical technology, PA 12 is also used frequently. For some years now, the semicrystalline polyamide has also been conquering the oil and gas industry – on land and under water. For nearly 50 years, Evonik has been operating a fully back - integrated production process for polyamide 12 at the Marl Chemistry Park, starting with butadiene and running through all precursor steps to the polymer. Over the course of the years, the capacities have been adjusted steadily to market requirements. Since then the high - performance plastic has been exposed day - in day - out to extreme environmental conditions, such as high temperatures, extreme weather conditions, and direct contact with hydrocarbons.

2015042

Pipeline Bending Strain Assessment using ILI Tools: Case Studies

用在线检测工具进行管道弯曲应变的评价事例研究

Ian Murray CEng IMechE, Jane Dawson, Lautaro Ganim, PII Pipeline Solutions, UK

Abstract

Mapping the position of a pipeline using pipeline location coordinates (x, y, z) collected from an in-line inspection (ILI) survey has become routine practice for many pipeline operators over recent years. When an IMU (Inertial Mapping Unit) tool is included as part of an ILI survey it provides a synchronized stream of x, y, z mapping

information which aligned with the ILI data provides the means to accurately and easily locate pipeline anomalies, features and fittings. Indeed, regulations in some regions require that the precise location of pipeline assets are documented as part of managing the integrity of a pipeline and certainly this is considered to be good practice. The x, y, z mapping information collected by an IMU tool has an additional use which is less widely understood. The mapping data can be used in the determination of sections of a pipeline indicating potential deviation from the pipelines' original position. Specialized assessment of the IMU data can be performed to calculate curvature and to derive the consequential bending strain levels throughout the pipeline. The use of data from repeat runs can identify where even small changes to pipeline shape changes are occurring. However, the use of the IMU mapping data is less known for this purpose and has not yet been widely adopted across the industry. There is no requirement in pipeline regulations to conduct this type of study and furthermore little guidance in industry codes on what level of movement or bending strain should be considered actionable. This paper presents case studies describing the rupture failure of a 10 inch natural gas pipeline caused by a spontaneous and localised landslide event. The metallurgical failure investigations carried out on the pipe material taken from the failure site did not find any evidence of sub-standard pipe material or of any pre-existing pipeline defects, this was further confirmed from ILI and IMU data collected from the failed pipe several months prior to the event. Hence, it can be concluded that the rupture was caused solely by the catastrophic external loading on the pipeline resulting from the sudden landslide. The paper goes on to discuss the specialized assessment of IMU mapping data to derive the magnitude of sub-critical bending strains present on the pipeline prior to the landslide event and whether such assessment could be used to indicate the pipeline segments in unstable ground conditions and potentially at risk from environmental outside force events. Taking experience from these case studies and from other known pipeline events, the level of bending strain that may be considered actionable is also discussed.

2015043

Pipeline Corrosion in a 24" dia Crude Oil Pipeline due to Interference from High Voltage Transmission Line: A Case Study

高压输电线路干扰导致 24 英寸原油管道腐蚀的事例研究

Yadav, B.D.; Indian Oil Corporation Limited, Pipelines Division, Viramgam, INDIA

Abstract

In early years, when pipeline industry and HT transmission system were not so developed in India, AC interference for underground pipelines did not receive adequate attention. In recent years, due to paucity of land and lack of clear policy on utility corridors have led a situation, wherein cross country Oil & Gas pipelines are running parallel to HT transmission lines. AC interference on pipelines is a real and serious problem which can place both operator safety and pipeline integrity at risk. When a long-term induced AC voltage exists on a pipeline, it can be dangerous and potentially Life-threatening for operations personnel to touch the pipeline or appurtenances as well as it can lead to pipe corrosion resulting from discharge of current. Indian Oil Corporation Limited is India's largest company by sales with a turnover of over \$76,250 million for year 2013-14. Indian Oil is also the highest ranked Indian company in Fortune 'Global 500' listing, ranked at 96th position. Indian Oil is an integrated energy company, with significant presence in refining, transportation, marketing and petrochemicals business. It also operates about 12000 km of petroleum pipelines, crude oil pipeline, multi product pipelines, dedicated LPG pipelines, Naphtha pipelines, Gas pipelines etc. The paper presents a case study of about 100% metal loss in a 24" dia crude oil pipeline, having 6.4 mm wall thickness, apparent due to interference from HT AC transmission line is presented in the context of pipeline industry in India and also brought out the constraints pipeline industry face while mitigating different type of interference.

2015044

Pipeline Integrated Management Systems - An Integrated Model

管道一体化管理系统

Malcolm Toft, Dennis Keen and Andy Fuller, Penspen, UK

Abstract:

Integrity management is not a piece of software, or documentation, but an organised method for structuring pipeline integrity activity in order to optimise safe, reliable and profitable asset performance. The range of international pipeline integrity management standards such as IS CEN TS 15173 & 15174, BS PD 8010, ISO 12747 and 13623 etc. have many features in common, and Penspen has distilled these into a single, integrated model of integrity management. We have harmonised the key aspects of all the relevant standards into one model, covering pipeline integrity policies and objectives, management and organisation, risk and quality assurance, design, procurement, construction and commissioning, operations, inspection and maintenance, emergency response, recovery and repair, incident investigation and reporting, document and data management, change control, legal and code compliance, review and audit. We present this integrated model, and share lessons learnt from our experiences in successfully applying it through audit, gap analysis and system development with numerous operators around with world.

2015045

Pipeline Integrity Analysis (PIA²) - A Survey Concept for Non-Piggable Gas Transport Pipelines with Spigot-and-Socket Connections

管道完整性分析 – 不能清管的承插接口燃气管道检测理念

Dr. Carmen Acht, Open Grid Europe GmbH, Gladbecker Str. 404, 45326 Essen

Abstract

The German High Pressure Gas Pipeline Ordinance [1] and the technical regulations published by the DVGW [2] place the operators of high pressure gas pipelines under an obligation to carry out regular monitoring and tests and to guarantee their technical safety. Surveying the condition of high-pressure gas pipelines is an important part of ensuring their engineering integrity, with intelligent pigging being the preferred option for pipelines of more recent design. The pipeline network of Open Grid Europe has around 2000 km of lines that are more than 50 years old (some 15 % of the total stock). The construction of these pipelines reflects the changing state of the art from about 1910 to 1960. Unlike the butt-welded pipe joints in common use today, these older pipes were connected using a variety of spigot-and-socket designs. However the specific characteristics of these pipelines rule out the use of intelligent pigging as part of a condition survey exercise. In order to demonstrate the integrity of these so-called ‘old lines’ Open Grid Europe monitors and surveys the condition of their corrosion protection and also conducts a pipeline strength assessment (PIA² = Pipeline Integrity Analysis) which makes it possible to identify potential weaknesses.

2015046

PIPELINE INTEGRITY MANAGEMENT USING ADVANCED SOFTWARE APPLICATIONS

应用先进软件的管道完整性管理

This paper will address the current challenges faced in pipeline integrity management and the solutions available to address these challenges. We will explore maximizing the return on investment on solutions used to address integrity management by integrating multiple systems. Finally, we will discuss using advanced software applications to enable pro-active pipeline integrity management.

2015047

POSSIBLE REASONS WHY CALCULATIONS OF INDUCTIVE INTERFERENCE PIPELINE VOLTAGES ARE HIGHER THAN CONDUCTED MEASUREMENTS

管道感应干扰电压计算值高于实测值的可能原因

Christian WAHL, Ernst SCHMAUTZER

Abstract: Due to bundled energy routes, high voltage energy systems (e.g. overhead lines) are often located near buried isolated metallic pipelines. Thus, a possible high inductive interference from energy systems may produce hazardous AC pipeline voltages. High induced voltage levels can cause dangerous high touch voltages and AC material corrosion. Therefore, European standards limit the allowed maximum voltages for long and short term interference. Consequently, pipeline interference calculations are necessary to survey if given limits are exceeded. Unfortunately, the results of these – standardized – calculations are often higher than conducted measurements on pipelines, despite using state of the art calculation parameters. Investigations on this discrepancy are needed to bring calculations and measurement data closer together to avoid excessive measures which are often cost-intensive. Even with experience, it is difficult to identify the very well hidden, but crucial factors for the discrepancy on specific calculated and measuring positions. The following factors are suspected to have different degrees of impact on induced pipeline voltages and have to be considered individually and with each other: Load current instead of using the maximum operational currents; Reduction effect of global earthing systems; Reduction effect of local earthing systems; Reduction effect of practically achievable pipeline earthing systems; Reduction effect of pipelines, running in parallel; Reduction effect of parallel high voltage power systems with grounding conductors; Incorrect or inadequate pipeline coating parameter; The influence of the model-conform specific soil resistivity.

2015048

Pipeline Repair or Modification Enabled by Double Block and Bleed Isolation Tools

用双重阻断渗流隔离工具进行管道修理或改造

Dale Millward, STATS Group, Scotland

The following paper will describe pipeline isolation tooling and techniques that enable safe repair or modification of pressurised pipelines. Double block and bleed pipeline isolation methods will be explained for piggable and unpiggable pipeline systems. Examples will be presented highlighting the benefits of double block and bleed pipeline isolation and how they are applicable to scenarios such as: Emergency pipeline repair; Retrospective installation of pigging facilities – making unpiggable pipelines piggable; Removal and replacement of a pipeline section, or a deadleg installation, repair or replacement of pipeline valves (Subsea Isolation Valves, Emergency Shutdown Valves, PLR isolation Valves) ; Pipeline infrastructure development - new pipeline tie-ins into existing pipelines; Decommissioning, disconnection or retirement of pipeline sections or deadlegs. Concluding with recent case studies where double block and bleed isolation has facilitated repair or modification of major subsea pipelines in the North Sea. In one case 40% of UK oil production was dependent on a successful isolation.

2015049

Protecting onshore pipelines from the geohazard of seismic slope instability

保护管道免受地震边坡不稳定性地质灾害

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ABSTRACT

Undoubtedly, during the next decades many onshore pipelines are expected to be constructed worldwide.

Depending on the local site conditions, the hazard of slope instability and the associated risk to a pipeline are certainly very important issues of pipeline design. Nevertheless, in areas characterized by moderate or high seismicity slope instability assessment and treatment are much more demanding and challenging as many issues are directly or indirectly associated to a potential earthquake. Strong ground shaking during a seismic event and nonlinear ground response may cause a slope failure that will certainly impose permanent ground deformations (PGDs) to the pipeline, and consequently additional pipeline distress. The current paper aims to illustrate the main topics of seismic slope instability that have to be coped with for the optimum design of onshore pipelines. The first part of the paper is devoted to seismic slope instability assessment. After a short overview of some basic concepts, the available methods of seismic slope stability assessment are briefly described. The second part of the paper refers to the possible mitigation measures that may be analyzed and designed for slope stabilization and minimization of PGDs, while the third part deals with the issue of “soil-pipeline interaction” due to the PGDs potentially caused by an earthquake (without - or even with - the stabilization measures) and the concept of “strain-based design”. Finally, the paper deals with the provisions of European seismic norm (i.e. EN1998) related to slope stability, retaining structures, and onshore pipelines, which are rather insufficient to cover fully the aforementioned issues. Through characteristic case studies, it is shown that, apart from reliable data and advanced numerical modelling, engineering judgment is also required to obtain a realistic quantitative assessment and to design the optimum (i.e. safe and cost-effective) mitigation measures.

2015050

Protecting Pipeline Management System Investment

保护管道管理系统投资

Martin te Lintelo, Eduard van Loenen, Yokogawa, The Netherlands

Abstract

Requirements for Pipeline Management Systems (PMS) are becoming more demanding because of the business environment in which the pipelines have to be operated, but also the stricter regulations and expectations as far as HSE aspects are concerned. This means that there is a drive towards more and wider functionality that is required while at the same time the margins are under pressure because of the increasing costs and competition. Smaller numbers of panel operators are expected to have the pipeline perform better with less human errors. This means that the supporting systems have to perform routine tasks and should provide the operators with the right information and insight at the right moment in order to enable them to perform as required or expected. Pipeline operators are increasingly struggling to keep pace with cost effective maintenance and upgrades of their PMS to ensure compliance with today's demanding application requirements and the requirements related to the IT environment in which the PMS is operating. Lagging behind in this endeavor not only potentially exposes their systems to emerging (cyber) security flaws and safety risks, but also may mean that customers cannot be served the way they expect to be served. A typical PMS in operation today has been largely tailored to the specific job it is deployed for. It lacks a standardized system foundation, in which applications can be plugged into in a modular way, as well as the design to ensure interoperability with the IT environment and the related policies. This poses increasing challenges for pipeline operators to maintain and upgrade their often complex system architecture and bespoke applications to prevent the system from breaches and security compromises. This paper provides a vision on how to tackle the associated issues and address the challenges to improve the situation.

2015051

realSens™ Remote Leak Detection, Performance Analysis based on a 4-Year Operations Record

远程泄漏检测仪四年运行记录的性能分析

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ABSTRACT

In a number of papers previously presented at the Pipeline Technology Conference, Synodon discussed the science behind its proprietary realSens™ technology and how it can remotely detect both simple hydrocarbon molecules such as methane (found predominantly in natural gas) as well as complex ones such as butanes or pentane which evaporate from various products such as condensates, gasoline, crude oil, etc.. The realSens™ system and its corresponding services have been commercially available since 2010 and the system has participated in a number of blind tests conducted by natural gas and oil pipeline operators or related research organizations. The technology has also been used to survey nearly 60,000 km of operational underground natural gas pipelines in North America and it has detected and accurately located 100's of leaks and emission sources with virtually no false positives. This paper will discuss briefly the operational principle behind the technology, present the results from a number of blind tests organized by pipeline operators and a geologic research organization (showing strikingly consistent results from the very different test setups) as well as an oil producer and outline a number of real-life leak detection case studies from live, operational pipeline systems. The paper will conclude with a summary of the demonstrated leak detection capabilities and their importance to pipeline operators.

2015052

RECOMMENDED PRACTICES FOR THE MECHANICAL INTEGRITY AND RISK MANAGEMENT IN PIPELINES USING THE CODES ASME AND ANSI API

按照 ASME、ANSI 和 API 标准实施管道机械完整性和风险管理的推荐做法

M. E. Leonardo Espinosa Cortes, Corporación Mexicana de Investigación en Materiales, Mexico.

Abstract

The demand for oil and gas transport leads to new challenges for the inspection and maintenance activities in Pipelines as the requirement of compliance with optimum operating conditions. Nowadays, we have norms and codes applicable for these activities and various countries around the world have internal procedures to highlight these activities necessary for Pipelines. In this paper, the principal objective is to provide guidance necessary to create a “Plan of Pipeline Integrity Management” using the recommendations and criteria of the codes ASME and ANSI API for Pipelines that collect and transport gas and liquids, providing the adequate steps from inspections maintenance, repair and mitigation, as the various technologies that exist for better results and greater reliability in the mechanical integrity of Pipelines, providing programs and intervals to attend the activities and if it is required, the repair through the assessments made to the Pipeline in the past. The steps to apply a correct activity of inspection and maintenance for any Pipeline is according to the type of Flaw or Damage Mechanism detected and supported by the Codes ASME and ANSI API and the internal procedures of the Company that control the operation in the Pipeline and in this case, exists different options to attend the correct activity.

2015053

Relining Techniques in Domestic Waste Water Pipeline in Sweden

瑞典民用废水管内衬技术

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Abstract

Rehabilitation of the sewage system by relining materials and techniques is a solution towards degradation problem of the old pipeline. This paper gives a summary of the advances in technology, methods and materials of relining techniques and the important considerations such as cleaning, inspection and working environment in

Sweden which is very similar to the methods and considerations in other Nordic countries. The paper also includes result from a survey conducted by KTH Royal Institute of Technology regarding client's point of view in 15000 apartments with relined pipe. The main conclusion of the interview survey was that relining has worked satisfactory in most of the cases and majority of the clients in the study have been satisfied and are willing to use relining again.

2015054

Remote Gas Leak Detection - By Infrared Spectroscopy and Laser Technology - Benefits of Active and Passive Remote Gas Leak Detection

远程气体泄漏检测用红外光谱和激光技术的优势

Sebastian Wilkens, Esders GmbH, Germany

Abstract

Installations and pipelines which contain or convey natural gas must be checked regularly to ensure safe and environment-friendly operation. Checking with hand-held gas detectors is safe and reliable only if the lines and equipment checked are easily accessible and if other site conditions permit. Conventional hand-held detectors quickly reach their limits, particularly in large-scale and difficult-to-access gas facilities. A real need exists for testers which recognize methane at great distances, therefore making leak detection much easier. Two technologies are available which offer substantial benefits in these areas: active laser absorption and passive infrared spectroscopy. Active Laser Detection Technology This technology senses gas leakage at specific locations. Gas leakage plumes up to a distance of 50 metres are indicated by a visual display and an acoustic signal. The signal becomes higher-pitched as gas concentration increases - making for easy, operator-friendly gas detection. Passive Infrared Spectroscopy This technology visualizes leakage plumes at distances up to 100 metres, even against non-reflective backgrounds such as the sky. The gas plume is shown by colour highlighting on a video display screen. Advantages and Limitations of Both Technologies: Passive infrared detectors (also known in the industry as gas cameras) are much higher in price than active laser methane detectors. When comparing the two technologies with hand-held instruments and deciding on a solution for a specific application, decision-makers must keep 3 main considerations in mind: 1. Maximization of safety and detection reliability, 2. Economics, including purchase investment, costs of labour and auxiliary equipment such as access cranes (required for hand-held devices) and minimization of potential damages as well as downtime, 3. Special circumstances or conditions in the intended application which may favour or rule out a specific solution.

2015055

REQUIREMENTS FOR REAL-TIME OIL AND GAS PIPELINE SURVEILLANCE WITH WIRELESS SENSORS FOR THEFT AND SABOTAGE MITIGATION

用无线传感器实时监测油气管道防盗的要求

Johnson Eze, University of Wolverhampton, United Kingdom.

Abstract

The security of oil and gas pipelines is a great challenge to the global oil and gas industry and government. In countries such as Nigeria, USA and those in Europe, oil theft and other incidents through pipeline sabotage are increasing. In Nigeria this sabotage amounts to \$12 billion annually. Consequently, affected countries now seek other means of transporting these resources beside the pipeline based supply chain. This underscores the urgent need to develop robust pipeline surveillance systems to mitigate pipeline sabotage and third party interference. Statistics show that in the last decade, over 95% of pipeline leakages were due to artificial (human) damages. This paper categorises pipeline detection systems into external interference and leak detection systems. Thereafter, it

reviews the causes of pipeline adverse incidents. From this it presents an analysis of the fundamental characteristics of the state-of-the-art pipeline monitoring techniques with strengths, weaknesses, opportunity and threat (SWOT) analysis. This analysis indicates that techniques employing Wireless Sensor Networks (WSN) are generally of low cost, more secure, reliable and responsive. Having carried out the SWOT and then identifies the urgent need for “smart” pipeline surveillance technology, a system specification for integrated real-time technique based on Wireless Sensor Network is presented. The paper recommends the integration of a range of surveillance techniques that provide maximum surveillance coverage for oil and gas pipelines.

2015056

Safety and Security: Integrated Solution Concepts for High-threat Areas

高风险地区一体化安全解决方案

Kevin Tardif – System engineer, Rheinmetall Canada Inc.

ABSTRACT

A safe, secure, and peaceful environment, is something most organizations will strive for, but the reality may at times be different. The same reality applies to the Oil and Gas sector operating in regions where terrorist and criminal activities pose a serious threat. This presentation is meant for an audience in the Oil & Gas industry with activities in high-risk areas. When operating in these difficult conditions, whether during construction or operations, the adequate protection of people, equipment, and infrastructures is paramount. The question is not should we protect, but how we should protect? The answer is not obvious and there may be many answers to that question. In today’s security market, many suppliers offer a wide range of products; some being great, others somewhat good, and the remainder in great need of improvement. So how can we ensure the selection of the right security equipment fit while ensuring that it will be efficient? You may only know this after several years of trials and errors, large amounts of money invested, and the unfortunate possible outcome of loss of lives, material, and production. We believe the key is a fully integrated solution. We, as experts in Security solutions, know that it can only be initiated through a rigorous design process, assisted by a knowledgeable integrator, and the use of powerful state-of-the-art software. The goal of this paper is to demonstrate that it is possible to significantly improve the process of designing, implementing, and operating a fully integrated security solution by choosing the right people, the right tools, the right equipment, and mostly, the proper product match. We will present this concept and explain the different steps to reach an effective integrated security solution that will allow an enhanced protection for your people, your equipment, and your infrastructures, while keeping operations running whether in downstream, midstream, or upstream sectors.

2015057

Safety in building and routing of high-pressure pipelines

高压天然气管道沿线建筑物的安全

Ulrich Hoffmann, ONTRAS Gastransport GmbH; Germany

Abstract

An increasing demand for safety among the public frequently leads to criticism with regard to pipe routing and the construction of electrical and high-pressure gas pipelines. Although the decision by the Higher Administrative Court (OVG) of Lüneburg to provide for a safety clearance of 350 metres between a high-pressure gas pipeline route and building development is not a generally legally valid specification, it has sparked discussion. In the Netherlands and Switzerland, this discussion has changed course as in both countries, probabilistic evidence of pipeline safety must be provided for the construction and operation of high-pressure gas pipelines where, specifically, a Structural Reliability Analysis (SRA) establishes the pipeline safety and the individual risk for

residents affected is determined by means of a Quantitative Risk Analysis (QRA). The results of these analyses are compared with specified limit values and the final results revealed to the public. In addition to the legally and according to technical regulations required analyses, ONTRAS has acquired experience in an initial project based on this procedure, and optimised the approach as follows: 1. The Structural Risk Analysis is determined for the entire pipeline within the framework of the Pipeline Integrity Management System (PIMS). 2. For all areas in the vicinity of building development, busy traffic junctions etc., additionally a QRA is drawn up and compared with the Dutch limit values. The result shows that these limit values have not been exceeded in any case. By combining the PIMS-based Structural Risk Analysis and the QRA, a tool has been created at reasonable expense for providing evidence of the high safety of a high-pressure gas pipeline.

2015058

SEISMIC ANALYSIS OF BURIED STEEL PIPELINE SUBJECTED TO GROUND DEFORMATION WITH EMPHASIS ON THE NUMERICAL MODELLING OPTIMIZATION

应用数值模型优化对受到地表变化影响的埋地钢管的地震分析

G. BANUSHI, Technische Universität Braunschweig, Germany

Abstract

Steel pipeline systems traverse large geographical areas characterized by a wide variety of soil conditions and environmental hazards such as earthquakes which can threaten the pipeline integrity undergoing large deformations associated with widespread yielding, leading to fracture with consequent material leakage. Buried pipelines installed in seismic regions are susceptible to the effects of transient ground deformation (TGD) due to seismic wave propagation and permanent ground deformation (PGD) resulting from earthquake induced soil liquefaction, surface faulting and landslides [1]. Post-earthquake investigations have shown that almost all seismic damages to buried pipelines were due to permanent ground deformation and there were very few reported cases of pipelines damaged only by wave propagation [2]. In fact, buried pipelines are primarily affected by large permanent ground deformations (PGD) which may produce pipe wall rupture due to excessive tension as well as buckling by either excessive imposed bending or uniaxial compression loading. Therefore it is necessary to perform accurate finite element analysis taking into account the nonlinear soil and pipe interaction as well as the constitutive behavior of the pipe material subjected to extreme seismic loading. At the state of art, detailed finite element analysis of the soil-pipeline system subjected to large ground deformations are computationally expensive resulting in extremely large numerical models that may require days to run using the normally available computational resources [3]. Within the present work, in order to reduce the needed memory and computation time of the calculator, the part of the soil-pipe system away from the fault is suitably modeled as a single equivalent axial spring, connected to the pipe shell elements through appropriate constraints. Furthermore, the seismic performance of the buried pipeline has been investigated through a series of parametric studies that permit to assess the structural response of the pipe components in function of various configurations of the soil-pipeline system. The obtained numerical analysis results allow to evaluate accurately the limit ground displacement inducing global failure on the pipeline components due to loss of strength capacity following large scale seismic loading, with the advantage of being computationally efficient.

2015059

Selection Guide for Pipeline Leak Detection Systems

管道泄漏检测系统选择指南

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Introduction

Apart from regulatory and statutory requirements, the motivation to run a Leak Detection System (LDS) on a pipeline or piping system is continuous monitoring of system integrity and preparedness for fast initiation of countermeasures in case of a detected and confirmed leakage. Fast and effective mitigation measures can reduce adverse impact on the environment and will substantially reduce the cost for restoration. Under normal operating conditions the LDS is permanently confirming the tightness of the pipeline or piping system. In case a leakage occurs, the LDS notifies the operating personnel through messages and alarms about the leak rate and its location, so that fast and effective mitigation measures can be initiated. It is important to realise that a LDS cannot prevent leaks. It is part of the emergency response in case all measures for leak prevention failed. There are various methods for leak detection, each of them with specific strengths and weaknesses. And not all methods suit all pipeline or piping systems equally. Besides conventional so-called Internal Leak Detection (ILD) methods, including Computational Pipeline Monitoring (CPM), there are new promising developments with so-called External Leak Detection (ELD) systems. This article gives a brief overview and comparison between ILD and ELD methods, and how they could complement each other. The selection of the optimum set of leak detection methods for an individual pipeline system is a non-trivial engineering task. This article is intended to serve as a guideline for preliminary considerations on LDS selection. It is intended to support all those who are planning to establish a new LDS or to revamp an existing LDS. Most of the statements in this article can be used for piping systems in general. This article, however, is focusing on long-haul underground pipelines for transportation of oil, gas and other fluids.

2015060

Strain Rate Effect on Strength and Orientation Effect on Toughness of Modern High-Strength Pipe Steels

应变速率对强度的影响以及顺向效应对现代高强度管子钢材韧性的影响

S. Xu* and W.R. Tyson, CanmetMATERIALS, Natural Resources Canada

Abstract

Tensile properties (stress-strain curve) including effects of strain rate and temperature as well as fracture resistance curves are required for advanced engineering critical assessment (ECA) of imperfections discovered during construction or service, and for modelling dynamic fracture. However, these fundamental mechanical properties do not appear to be widely available for modern high-strength pipe steels. In this experimental investigation, seven modern high-strength pipe steels including X70, X80, X100 and X120 grades were tested. Tensile tests were performed using cylindrical specimens over a range of strain rate (0.00075 to 1 s⁻¹) and temperature (23 to -150°C). For ferritic steels, the thermal component of flow strength $\Delta\sigma = \sigma - \sigma_0$ where σ_0 is the flow stress at room temperature and quasi-static rate follows a “master curve” constitutive equation,

i.e., $\Delta\sigma = \sigma_{\text{thermal}} = \left[27.86 - 0.00393T \ln \left(\frac{10^8}{\dot{\epsilon}} \right) \right]^2$, where T is the temperature in Kelvin and

$\dot{\epsilon}$ is the strain rate in s⁻¹. Standard Charpy absorbed energies, and J-resistance and crack-tip opening displacement (CTOD) resistance curves using single-edge bend, SE(B), specimens, were determined with different specimen orientations. The initiation fracture toughness values ($J_{0.2 \text{ mm}}$ and $CTOD_{0.2 \text{ mm}}$) were also determined. Generally, toughness was higher for longitudinal than for transverse specimens for the same notch configuration, and for surface-notched than for through-thickness-notched specimens for the same specimen orientation. These results provide historical perspective on trends in the evolution of strength and toughness.

2015061

COMPARISON PERFORMANCES BETWEEN POLYMERIC BACKED MESH COATINGS (PBM) AND

COLD APPLIED TAPES (CAT) AND HEAT SHRINKABLE SLEEVES (HSS)

聚合材料背材网状补口材料与冷缠带及热缩套的性能比较

Luc Perrd, Polyguard Products

Abstract:

The topic of our paper consists of a technical performances comparison between heat shrinkable sleeves, cold applied tapes and polymeric backed mesh coatings. The comparison is conducted according to the requirements from the international standards EN12068 & ISO21809-3. The comparison is concluding that Polymeric Backed Mesh coating, a one layer, non-shielding coating system, simple and very fast to apply has similar or better performances compared with the requirements for shrinkable sleeves and cold applied tapes from EN12068 & ISO21809-3. Petrojet from Egypt is one of the most important contractor operating in North Africa and the Middle East. Petrojet conducts its own corrosion protection strategies depending on the equilibrium between all variables including: materials performances, coating conditions, total cost, applicability and the cathodic protection system level. According to Petrojet integrated engineering process, Polymeric Backed Mesh coating system has been recently selected for number of projects (pipeline / piping rehabilitation) and also recommended for future projects as field joint coating.

2015062

Safety and welding evaluation of welding work on in-service high-pressure gas pipelines by means of numerical simulation

应用数值模拟评价在役高压天然气管道安全性和焊接质量

Andreas Raschke, Felix Koch

Abstract

In accordance with § 1 (1) of the German Energy Act (EnWG), operators of long-distance gas pipeline networks are encouraged to design pipeline-bound supplies of gas to the general public in a way which is as safe, inexpensive, user-friendly, efficient and environmentally-compatible as possible. The generally recognised rules of technology must be observed in complying with these demanding supply tasks (see § 49 (2)). This can be assumed when the technical rules of the Deutsche Vereinigung des Gas- und Wasserfaches e. V. (DVGW – German Technical and Scientific Association for Gas and Water) are applied. This article concerns "welding on gas pipelines under pressure" maintenance technology outlined in the DVGW worksheet G 466-1, Maintaining high-pressure gas pipelines made of tubular steel for operating pressure > 5 bar. Apart from the DVGW worksheet G 466-1, the DVGW worksheet GW 350 "Welded joints on steel pipelines in gas and water supply – Manufacturing, testing and evaluation" is also of relevance for this maintenance technology. Welding on high-pressure gas pipelines under pressure or even in operation represents one of the most demanding and risky maintenance technologies. In accordance with DVGW worksheets G 466-1 and GW 350, only sufficient competence on the part of the operator and/or pipeline construction company as well as preparatory tests and plans can ensure that work is carried out safely and the welded joints display mechanical properties in line with the respective requirements. As a result of an 8-year research project conducted by ONTRAS Gastransport GmbH (ONTRAS) in collaboration with renowned universities and institutes, this article shows how safety can be evaluated in advance by means of technical welding simulation of welding work on high-pressure gas pipelines in operation and what mechanical properties are displayed by the weld seams. ONTRAS therefore avails of a tool for carrying out this maintenance technology with maximum safety and quality.

2015063

The analysis of the impact of falling objects on buried pipelines

跌落物体对埋地管道冲击力的分析

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Abstract:

Pipelines are the lifelines of our modern society, but they can also lead to risks in case the pipelines are used for transportation of potentially dangerous chemical substances. The damage of such pipelines may then affect the safety of the surrounding area. Depending on the area where the pipeline is located potentially falling objects may be a serious risk for damage to the pipeline. There are numerous possibilities in which a falling object might have an effect on a buried pipeline in which dangerous chemical substances are transported. The impact of a falling object on a buried pipeline was for long time difficult to model. In the past, the calculations for falling objects on pipelines have been carried out in sequential steps. The disadvantage of this stepwise analysis is the summation of worst case assumptions and the summation of safety factors in each analysis. Nowadays, analysis methods using finite element packages in which the falling object, the soil and the pipeline are modelled are available for a dynamic analysis. This paper describes how the impact of a falling electricity pylon on an adjacent buried gas pipeline can be modelled using a coupled model based on Abaqus software.

2015064

THE APPLICATION OF A HYBRID WAVE AND FINITE ELEMENT TECHNIQUE TO INVESTIGATE REFLECTED/TRANSMITTED POWER THROUGH BENDS IN PIPEWORK

应用混合波和有限元技术研究通过管道弯头产生的反射和传输功率

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ABSTRACT

The knowledge of how piping systems respond to dynamic loads is important for many viewpoints: integrity and reliability during operational conditions depend on how well the characteristics of a network can be designed in the modelling stages. However, considering both that low induced vibration due to internal/external presence of uid and/or excitations produced by waves (i.e. low control valves) cover a broadband noise over a large range of frequencies (1-20 kHz), Finite Elements models, generally used in the design process, are computationally very expensive and cannot always cover the whole frequency band. The hybrid method known as WFE (Wave and Finite Element) was developed to investigate structural and mechanical vibration of periodic structures and aims to extend the prediction capabilities of standard Finite Element software by reducing the size of the models which are involved in the numerical computations. The case study presented investigates reflection/transmission characteristics of a bend in a standard pipe network. The WFE formulation presents a major advantage compared to Finite Element Analysis (FEA) in that the pipe models are obtained by just meshing a strip of the structure along the circumference. Any FE software could be employed in this process. Results are obtained using periodicity considerations and wave propagation analysis and are presented in terms of reflected/transmitted powers due to a unit amplitude point force. To fully understand the versatility and the power of the method it should also be noted that the characteristics for the curved elements are obtained from the same straight FE model with mathematical artifices. The WFE formulation, reducing the model size involved in the numerical computations, aims to expand the limits of standard FE software and makes the technique appealing features for future applications in estimating vibrational stress levels in piping systems.

2015065

The application of ILI and PIM in Iraqi national oil companies and the reflect on reducing oil spills and improvement exporting

伊拉克国立石油公司应用在线检测和管道完整性管理减少溢油改善出口

Prof. Alaa M. Abdullah Alassady, Executive director of EFCODB, Kirkuk – Iraq

Abstract :

This research paper related to a new theory of operation techniques called PIM, the pipeline integrity management which is not applied yet in Iraq and many petroleum countries is very important step in the way of increasing pumping systems efficiency and improving the pumps operation methods leading to increasing the virtual life of the whole pumping system and pipeline also. With the application of PIM rules and programs we will be able to detect any leaking in the pipeline system whatever its quantity will be as we know that the ordinary leak detection systems LDS cannot discover or detect the small rate of leaking < 500 bbl. With this integrity system we will be able to detect any amount of spills or leaking due to sabotage, corrosion leaking, operation failures or any other reasons. Also the paper will give a brave case study of the application of PIM on the Iraqi pipeline of crude oil pumping systems (especially in north oil company – Iraq) and will give us a simulation of the rate of increasing in pumping quantities with the same power consumption approximately about 20% of the total crude oil pumping quantity. The PIM effect also in saving the nature and the environment of the operation areas by the quick and high response to leaking accidents by the using of the integrity system of SCADA,ALDS,PLD and else.

2015066

The Nord Stream Offshore Pipeline Repair Strategy - Preparing for Contingencies

北溪海底管道修补方案

Andrey Voronov, Nord Stream

Abstract:

Nord Stream owns and operates a strategic infrastructure that links Russia to the EU for long term supply of natural gas. Nord Stream is committed to the best in terms of safety and reliability of gas transportation, and wants to comply with the highest professional standards related to its activity. Within this framework a comprehensive pipeline integrity management system has been developed in the early years of operation and is being implemented. One of the most advanced elements of the system is Offshore Repair Strategy. Nord Stream Offshore Repair Strategy aims at providing optimal repair preparedness. A significant damage to the Nord Stream pipelines is very unlikely since most of it is offshore and the design is very robust. However in the event damages to the pipeline would jeopardize integrity and threaten gas transportation capability, the consequences would be quite substantial and it was decided to invest into a contingency setup. The Nord Stream Repair Strategy consists of following elements: • Proper organizational structure including internal organization and agreements with appropriate contractors; • Availability of necessary spares; • Long-lead items of repair equipment to be procured, stored and maintained; • Upfront development of procedures for all possible repair cases; • Availability of qualified and trained personnel in accordance with the procedures. The presentation describes the process of development of Nord Stream Repair Strategy and reports on its current status.

2015067

The Proven Efficiency of Epoxy Flow Coats for the Protection of Gas Transmission Pipelines

输气管道环氧减阻涂层确实有效

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Introduction

The concept of internally lining gas pipelines – known as internal flow coating – was first developed in the 1950s to counter the adverse effects on pipeline capacity, operation and pumping costs caused by the rough internal surface of steel pipes and the build-up of deposits and corrosion products. This paper reviews the benefits of considering an internal lining for gas transmission pipelines, and the relationship between the internal surface

roughness, the pressure drop across the pipeline and the maximum flow rate of gas through the pipeline. This paper also outlines the benefits of internal flow coatings and the developments that have been made over recent decades in terms of coating materials, taking into account new challenges associated with gas production and transmission, and how they meet the current requirements of international standards and specifications.

2015068

Transportation of Heavy Crude Oils through Heated Pipeline - Assessment of Relative Economics

管道加热输送重质原油相对经济性评价

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Abstract

After stagnation of domestic crude oil production for many years, findings of crude oil in Rajasthan oil fields provided a new source of crude oil for Indian Refining companies. However, crude oil from Rajasthan Oil Fields is having high wax content, with pour point in 40°C-45°C range and viscosity in the range of 93.5-288 Cp (centipoise) at 42°C temperature. It poses challenges not only for processing such crude oils in old refineries, but, also in transportation of such crude oils to refineries situated far away from Rajasthan oil fields through conventional pipelines. Transportation of Rajasthan crude oil is feasible, without any quantity restrictions, through heated oil pipeline; however, such pipelines require higher capital as well as operating costs. An attempt has been made in this paper to compare economics of heated oil pipeline vis-à-vis regular pipelines, so as to estimate additional margins for processing heavy crudes to account for higher transportation costs.

2015069

Use of Acoustic Waves for Non-Invasive Buckle Detection in Offshore Pipelines

海底管道应用声波技术非侵入式皮带扣检测

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Abstract

During laying operations from a pipelay vessel, the pipeline integrity shall be guaranteed until complete deployment onto the seabed. Harsh environmental conditions, pipeline transit in load bearing structures (e.g. S-Lay stinger) and vessel motion can induce local deformations that may develop into major damages (e.g. local buckling) with possible critical consequences both during and after laying operations. Hence, online monitoring of the pipeline can be crucial for early detection of anomalies. Currently, the offshore industry uses circular mechanical gauges positioned inside the pipe at the touchdown point and connected to the vessel via wire cable. The management of the wire cable is cumbersome in deep waters on long pipeline projects. Saipem has developed a novel tool (IAU: Integrated Acoustic Unit) based on a noninvasive acoustic technology, with the aim at detecting deformations of the internal section of pipes. The IAU is based on the EAR (Extended Acoustic Radar) technology. The tool can remotely investigate long stretches (up to some km) of the line, classifying and quantifying the measured anomalies. It is also able to localize solid unexpected objects and obstacles (e.g. pigs, inline items). Further it can detect and track any water intrusion. It is basically composed of loudspeakers, microphones and dedicated acquisition and control units. This paper gives an overview of recent developments on buckle detection, and it describes the IAU structure, its basic working principle and the expected benefits of this novel technology. The prototyping and validation phases are described and results are presented specifically referring to recent and near to come projects.

2015070

TOWARDS INDUSTRIAL BY-PRODUCTS IN PIPELINE CONCRETE COATINGS

用工业副产品制造管道混凝土层

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ABSTRACT

Some of the major problems encountered during pipeline construction are countering buoyancy in hostile wet environments and protecting the pipe in dry environments. A different field condition obligates different protection methodology for the same. Though, several methodologies are used to counter buoyancy, concrete with a density of 2200 to 2400 kg/m³, high strength and durability properties is the perfect material for protecting the pipe and imparting weight. However, production of the constituents of concrete is detrimental to the environment. An environmentally and economically conducive alternate is the use of mineral admixtures as replacements in the cement. Mineral admixtures have been widely and successfully used in building construction projects worldwide and have always bettered their qualities in one way or another. However, their application in pipeline industry is limited. The paper discusses the possibility of the use of such mineral admixtures like fly ash, rice husk ash, blast furnace slag and metakaolin as binary (one admixture with cement) and ternary (two admixtures with cement) replacements in pipeline concrete coatings. The paper presents the results of laboratory experiments for such ternary blended concrete specimens where; the relative proportions for different mixtures were varied to determine the optimum mix proportions. In the investigation, the mixtures were tested to determine the mechanical properties (compressive, flexural and tensile strengths) after 28 days of casting. The use of metallurgical slag based aggregates (instead of natural heavy weight aggregates) is also discussed, thereby entertaining the prospect of imparting strength to the pipe section in addition to weight for countering buoyancy. Being cost effective and environmentally friendly, these replacements could warrant the betterment of not only the overall strength and durability of the pipeline but also the economic viability of such change at a large scale.

2015071

What are the differences between composite pipeline repairs, and what should a pipeline operator be aware of when choosing a composite repair?

复合管道修补材料的差别以及如何选择复合材料?

James Knights, Andrew Patrick, Clock Spring Company, L.P.

Abstract:

Composites repairs are regularly used to reinforce weakened areas of high pressure transmission pipelines, including the repair of mechanical and corrosion defects. Composites are a prudent choice for operators as they require no hot-work and enable the pipeline to operate while the repair is being installed. There are many different options for composite pipeline repair available on the market, making choosing the correct one particularly challenging for pipeline operators, to add to this option there are also numerous guidelines all offering different repair lifetimes. This paper highlights some of the key choices to make when considering the correct composite repair for pipelines including fibre choice, composite architecture and repair lifetime. The repair also looks at the different guidelines with regards to pipeline and pipework repair, highlighting their strengths and weaknesses enabling the operator to make an informed choice as to which composite repair is best for the pipeline.