

WORLD PIPELINES[®]

Volume 18 Number 2 - February 2018



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Comment

EAST MEDITERRANEAN PROMISE

Italy, Greece, Cyprus and Israel agreed in December to pursue the construction of the €6 billion, 2000 km EastMed gas pipeline from the Levantine Basin to Europe (transporting gas from Israel to Italy via Cyprus and Greece). This costly project seeks to secure a route to market for the untapped reserves currently residing in the Mediterranean Sea. The four countries announced in a statement that they will co-operate to bring about the necessary permits and plans for the proposed pipeline, working towards signing an intergovernmental agreement on the project later this year. The project owner will be IGI Poseidon, a JV between DEPA (Greece) and Edison (Italy).

The creation of an eastern Mediterranean pipeline corridor is attractive to European markets, as North Sea reserves dwindle and many question Europe's reliance on Russian gas. Any pipeline coming from the east Mediterranean to feed European markets would be a technical challenge, travelling some 2000 km, at sea depths of up to 3 km.

Feeding such a pipeline would be gas from significant recent discoveries in the Levantine Basin, situated off the coasts of Egypt, Israel, Lebanon, Syria, Turkey and Cyprus.

The EastMed pipeline would be fed by Israel's Leviathan and Cyprus' Aphrodite gas fields (which are estimated to hold 620 billion m³ and 140 billion m³ of gas respectively). Israel's only commercial gas field in the region to date is Tamar, which is close to a disputed border with Lebanon (more on that later). Leviathan has been a long time in the making but holds great potential. Noble Energy operates both fields and hopes to deliver first gas from Leviathan by the end of 2019.


The Zohr field (Egypt) is the most recent of the gas field discoveries to be brought online, with first gas flow heading to Port Said in Egypt in December. Zohr, which sits 150 miles off the coast of Egypt, is the largest discovery made in the area, holding an anticipated 850 billion m³ of gas. Eni and BP will help Zohr to meet domestic demand in Egypt within the next couple of years. Egypt was a net exporter of gas for 10 years before an energy crisis in 2013, when the government failed to pay foreign companies and mass unrest saw President Morsi removed from power.

Lebanon finally began to do some exploration at the beginning of 2017 but progress following a lacklustre licensing round has been hampered by several setbacks, including the resignation of Lebanon's Prime Minister and a new law from Israel that means it can unilaterally impose sovereignty over disputed territory at maritime borders (Israel and Lebanon have overlapping exclusive economic zones). Israel has amicably demarcated its maritime border with Cyprus, but the border with Lebanon remains in dispute.

Both Israel and Cyprus will be keen to export their newfound gas, as domestic need in both countries is relatively small. Jordan has allocated an initial US\$2 million for a joint pipeline project with Israel in order to import gas from Leviathan; effectively buying in to the local gas boom.

The ambition of Israel and Cyprus to become big time exporters hinges on either the successful implementation of a large diameter pipeline such as the EastMed pipeline, or on utilising Egypt as an energy hub for the

region, either by existing pipelines, through a new subsea pipeline or by conversion into LNG in Egypt.

Anyone watching season two of Netflix's *The Crown* will have been reminded about the Suez Crisis in 1956. Egypt's Colonel Gamal Abdel Nasser and his soldiers seized control of the canal, which had historically been under the control of the British army. Israeli troops (in conspiracy with, and alongside, those of Britain and France) attacked in retaliation but were swiftly rebuked by US President Eisenhower, who threatened economic sanctions if the trio of forces didn't pull back. This proved a crushing humiliation for British Prime Minister Anthony Eden, who resigned. The episode showed the importance of the canal to the various nations it served, directly or indirectly. Today, it remains a key (if somewhat vulnerable) trade route for oil and gas. Egypt's LNG facilities at Idku and Damietta are served by the canal, and a new LNG wharf is being built on the Gulf of Suez. If Zohr production means that Egypt achieves gas self-sufficiency, the nation will have gone from an exporter of gas, to importer and back again in less than 10 years. Such is the power of the mighty Levantine Basin. 

ENI AND BP WILL HELP ZOHR TO MEET DOMESTIC DEMAND IN EGYPT WITHIN THE NEXT COUPLE OF YEARS

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World News

Nord Stream 2 environmentally feasible and compliant

The expert commission for state environmental expert review (SEER) under the Russian Federal Service for Supervision of Natural Resource Use (Rosprirodnadzor) has issued a positive conclusion on the project documentation for the Nord Stream 2 pipeline in Russia. The commission concluded that implementation of the project in Russia is feasible and compliant with the country's environmental requirements.

Nord Stream 2 AG submitted the environmental impact assessment (EIA) report and project documentation to Rosprirodnadzor in November 2017 for SEER.

The project documentation comprises 138 volumes, including the EIA and a comprehensive programme of mitigation and compensation measures. The materials are based on comprehensive environmental surveys along the proposed pipeline route for a period of over five years. These surveys are the most detailed and complete ever conducted in this area. Given the environmental sensitivity of the shore crossing area, the company developed an innovative construction method that relies on trench boxes to reduce the construction corridor width and related impacts by some 50%. The final EIA report was prepared with due consideration of the feedback received as a result of a broad public discussion.

Upon its analysis of the Nord Stream 2 project documentation, the SEER commission concluded that both the envisaged technical solutions and mitigation and compensation measures will ensure compliance with the Russian rules and regulations. In addition, the conclusion confirmed a range of mitigation and compensation measures to ensure environmentally sustainable project implementation, along with monitoring, construction schedule adjustment and other aspects.

The positive SEER conclusion is a pre-condition for submitting permit applications in Russia. 

PennEast pipeline approved by FERC

After incorporating feedback from landowners, public officials, regulators and other stakeholders over the last three years as part of a concerted effort to include community input and reduce environmental impacts, the Federal Energy Regulatory Commission (FERC) recognised the clear need for, and public benefit of, the PennEast pipeline and issued an order under section 7(c) of the Natural Gas Act approving its construction.

The approval comes just weeks after a severe regional cold spell that forced natural gas prices in New Jersey to skyrocket 31 times above the low cost gas supplies that PennEast will access.

"Approval of the PennEast pipeline is a major victory for New Jersey and Pennsylvania families and businesses," said Anthony Cox, Chair of the PennEast Pipeline Company LLC Board of Managers. "They will reap the benefits of accessing one of the most affordable and abundant supplies of natural gas in all of North America. PennEast will lower gas and electricity costs, increase reliability, improve air quality, and make the region more competitive for jobs in the coming decades."

The approximately 120 mile pipeline route begins in the Marcellus Shale production area near Dallas (Pennsylvania), and connects with the existing underground Transcontinental pipeline near Pennington (New Jersey). The route includes 24 municipalities in

TransCanada confirms commercial support for KXL


TransCanada Corp. has concluded the Keystone XL open season, securing approximately 500 000 bpd of firm, 20 year commitments, positioning the proposed project to proceed.

Interest in the project remains strong and TransCanada will look to continue to secure additional long-term contracted volumes.

The announcement builds on the decision by the Nebraska Public Service Commission on 20 November 2017 to approve the Keystone XL route through the state. The approved route was based on a comprehensive review of the evidence submitted by all parties in the hearing process as well as state agencies to ensure it has a minimal impact to the public and to Nebraska's natural resources.

"Over the past 12 months, Keystone XL has achieved several milestones that move us significantly closer to constructing this critical energy infrastructure for North America," said TransCanada's President and CEO Russ Girling. "We thank President Donald Trump and his administration for their continued support and appreciate the ongoing efforts of Nebraska Governor Pete Ricketts, the Nebraska legislative and congressional delegation, Omaha Federation of Labor, Nebraska State AFL-CIO, our customers and various stakeholders to advance this project. Furthermore, we appreciate Alberta Premier Rachel Notley for her government's commitment to the project, which was instrumental to achieving the commercial support needed to proceed."

TransCanada is continuing outreach in the communities where the pipeline will be constructed, and is working collaboratively with landowners to obtain the necessary easements for the approved route. Construction preparation has commenced and will increase as the permitting process advances throughout 2018, with primary construction expected to begin in 2019.

The project is expected to generate millions of dollars in local tax revenues, supporting first responders, schools and hospitals, as well as roads and other local infrastructure. 

Pennsylvania and six in New Jersey.

"We appreciate the dedication, time and work of FERC staff and the Commissioners to collect extensive public input and ensure the project met a clear public need while minimising environmental impacts," added Cox. "We also thank the countless business and labour organisations from across two states, as well as dozens of bipartisan elected officials. Together, they understand the importance of the PennEast pipeline, which will spur job growth, aid business retention and provide a dedicated and reliable fuel supply for the future."

The PennEast Pipeline Company updated its estimated in-service date to 2019, with construction still beginning in 2018. The original project timeline allowed for many variables, though did not anticipate the many months without a voting quorum at FERC.

"In the coming days, we will work to finalise fair and positive compensation agreements with landowners," added Cox. "In the weeks ahead, survey crews will collect remaining field data in support of our permit applications to ensure minimal environmental and community impact. We look forward to continuing our work with state, bi-state and regional permitting agencies and expect those permit reviews to be conducted on the merits of the application, without outside interference." 



World News

IN BRIEF

UK

Inmarsat has launched a new set of Fleet Xpress plans designed specifically to meet the technical and commercial requirements of offshore support vessels.

Gulf of Finland

Nord Stream 2 AG, the developer of a new pipeline to supply Russian natural gas to the EU market through the Baltic Sea, is supporting a programme of telemetry studies of the Baltic ringed seal in the Gulf of Finland.

Colombia

Pumping on the Transandino pipeline was halted on 14 January after a bomb attack by the the National Liberation Army (ELN) rebels spilled crude into a river.

Germany

The Brandenburg State Office for the Environment has started the approval procedure for the Radeland 2 compressor station in Baruth/Mark. The station is part of the infrastructure for the European gas pipeline link. The compressor station will be applied for and approved in a separate procedure.

USA

Constitution Pipeline said it will seek a rehearing or appeal FERC's decision (on 11 January), in which the commission declined to overturn the permit decision by New York State's Department of Environmental Conservation.

Canada

Kinder Morgan Canada Limited is pleased with the National Energy Board's decision of setting down a generic process to hear any future motions as they relate to provincial and municipal permitting issues.

Nigeria

Two Chinese companies have held a groundbreaking ceremony to start the construction of a subsea pipeline installation for Dangote Oil Refining Company Limited in Lagos, Nigeria's economic hub.

China and India pipeline analysis


Analysis of global planned trunk/transmission oil and gas pipelines for the period 2018 - 2022, shows that the Xinjiang-Guangdong-Zhejiang SNG gas pipeline in China is the longest planned pipeline globally with a length of 8972 km, according to GlobalData.

The onshore pipeline is expected to start operations in 2022. China Petrochemical Corp has 100% equity stake in the pipeline while China Petroleum & Chemical Corp is the operator. The pipeline has a CAPEX of US\$30.1 billion.

The second longest planned pipeline, the Chinese section of the Power of Siberia, has a length of 3968 km. The onshore pipeline is expected to start operations in 2019. China National Petroleum Corp (CNPC) has 100% equity stake while China National Petroleum Corp is the operator. The pipeline has a total CAPEX of US\$5.2 billion.

The Russian section of the Power of Siberia is the third longest pipeline for the period of 2018 - 2022, with a length of 3200 km. The onshore pipeline is expected to start operations in 2019. Gazprom has 100% equity stake and is also the operator. The pipeline has a total CAPEX spending of US\$20.1 billion.

The fourth longest planned pipeline is the Jagdishpur-Haldia gas pipeline in India, with a length of 2655 km. The onshore pipeline is expected to start operations in 2019. GAIL (India) Ltd has 100% equity stake and is the operator. The pipeline has total CAPEX of US\$1.9 billion.

The Surat-Paradip gas pipeline, also in India, is the fifth longest planned pipeline globally, with a length of 1990 km. The onshore pipeline is expected to start operations in 2020. GAIL (India) Ltd holds 100% equity stake and is also the operator. The pipeline has total CAPEX spending of US\$1.5 billion. 

Granite blamed for Forties crack

Scottish granite has been blamed for the closure of the Forties pipeline.

Ineos has explained that its contractors found the crack where the pipeline system runs over land near Netherley, south of Aberdeen.

"The precise point of the transverse weld of the pipeline was resting on a sharp ridge of granite rock and over time vibration of the pipeline led to the hairline crack," said Ineos Director Tom Crotty. "It was a failure that BP hadn't seen before and we don't expect to see again."

The 234 mile long Forties pipeline was closed for three weeks in December after inspections by Ineos discovered a hairline crack.

Over 80 oil and gas platforms and facilities connected to the mainland by the UK's largest pipeline had to suspend production.

The Health and Safety Executive is carrying out an investigation into the circumstances surrounding the incident.

Crotty described the condition of the pipeline post-purchase saying: "It was more of a Ford Mondeo than a Mercedes but that is a reflection of the age of the system. We knew that a robust maintenance programme would be essential. We will probably spend more on maintenance than the previous owners, reflecting the fact that this is an older asset."

The company bought the pipeline from oil major BP in October 2017 for a sum of US\$250 million. 

Atlantic Coast pipeline receives final approval


Dominion Energy Spokesperson Aaron Ruby addresses the West Virginia Department of Environmental Protection's approval of the state's erosion and sediment control permit for the Atlantic Coast pipeline.

"This is a very significant milestone for the project and one of only a few remaining approvals needed to begin construction. It brings West Virginia one step closer to the thousands of jobs and hundreds of millions of dollars in economic activity the project will bring to communities across the state.

"We commend the agency's staff for the years of hard work and careful study they've dedicated to reviewing the project. For over three years, the agency carefully reviewed the project and considered extensive public input. The agency followed a rigorous process and left no stone unturned. The approval includes numerous conditions to strengthen protections

for water quality and other natural resources.

"At every stage of the project we've taken great care to meet the highest water quality standards. In many cases, we've gone above and beyond regulatory requirements and adopted some of the most protective measures ever used by the industry. This should assure all West Virginians that the pipeline will be built safely and in a way that protects the state's water quality.

"With federal authorisation, upland tree felling and vegetation clearing [is] underway in West Virginia and will continue through the end of March. Once we receive a few remaining approvals from other state and federal agencies, we'll take the final step of requesting a Notice to Proceed with full construction from FERC. We expect to receive these remaining approvals in time to begin full construction activity by the early spring." 

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World News

Events DIARY

27 February - 1 March 2018

Offshore Pipeline Technology Conference 2018

Amsterdam, the Netherlands

<https://energy.knect365.com/offshore-pipeline-technology/>

12 - 14 March 2018

13th Pipeline Technology Conference

Berlin, Germany

<https://www.pipeline-conference.com/>

25 - 29 March 2018

NASTT's 2018 No-Dig Show

Palm Springs, USA

<http://nodigshow.com/future-no-digs/>

26 - 27 March 2018

Midstream Oil and Gas Congress (MOGC)

Copenhagen, Denmark

<http://mogc.eu/>

15 - 19 April 2018

NACE Corrosion Conference and Expo

Phoenix, USA

<http://nacecorrosion.org/>

16 - 20 April 2018

TUBE Düsseldorf

Düsseldorf, Germany

<https://www.tube-tradefair.com/>

17 - 19 April 2018

MOC 2018

Alexandria, Egypt

<http://www.moc-egypt.com/>

22 - 26 April 2018

PLCAC 2018 Convention

Nashville, USA

<https://www.worldpipelines.com/events/plcac-2018-convention/>

30 April - 3 May 2018

OTC 2018

Houston, USA

<http://2018.otcnet.org/>


TurkStream pipeline underway

Gazprom received, through diplomatic channels, a construction permit from the authorities of the Turkish Republic for the second string of the TurkStream gas pipeline's offshore section stretching to the Turkish coast.

"The TurkStream project is well underway.

In accordance with the plan, it is carried out simultaneously at three sections: onshore in Russia and Turkey and offshore in the Black Sea. Over 760 km of the two strings are already built at the offshore section.

Construction of the landfall in Russia is nearly completed. In Turkey, work started at the construction site of the receiving terminal.


Today, we received a permit to lay the second string in the exclusive economic zone and territorial waters of Turkey. We now have all of the required permits from the Turkish Government to lay the TurkStream gas pipeline in the offshore area. It is therefore a certainty that both strings of the gas pipeline will be put into operation right on time, before the end of 2019," said Alexey Miller, Chairman of the Gazprom Management Committee. 

M&NP pipeline application rejected by NEB

The National Energy Board (NEB) has denied an application from Maritimes & Northeast Pipeline (M&NP) for approval of a new pipeline service and toll.

M&NP had offered a 'load retention' service and discounted rate to Irving Oil in exchange for a 13 year commitment to use the M&NP pipeline to ship up to 68 579 GJ/d of natural gas from the Canadian/US border in St. Stephen, to the Irving oil refinery and cogeneration facility in Saint John. M&NP said it offered the service to Irving Oil in response to a competing offer from the Emera Brunswick pipeline.

In a letter decision, released on 22 January, the NEB turned down the application saying that the application was premature. The NEB noted that the natural gas market in the Maritimes is facing a period of future uncertainty around current and future natural gas supply and markets.


The NEB did not make any determination as to whether the load retention service toll would be just and reasonable, and not unjustly discriminatory under the National Energy Act. 

Operations begin for Utopia pipeline

Kinder Morgan, Inc. is pleased to announce that the Utopia pipeline has been placed into service, and product delivery of ethane from Harrison County (Ohio, USA) to Windsor (Ontario, Canada) has commenced operation.

The pipeline system extends approximately 270 miles and has an initial capacity of 50 000 bpd and can be expanded to more than 75 000 bpd.

"We are extremely pleased to have placed the Utopia pipeline into service," said Don Lindley, President of Natural Gas Liquids, Products Pipelines for Kinder Morgan, Inc.

"The project team, in co-ordination with local, state and federal agencies, has done a tremendous job developing a project that provides ethane takeaway capacity from the Utica shale to the growing petrochemical industry while also maintaining an open dialogue with the local communities to support their needs and consider alternatives. This interaction and creativity developed a project that worked for multiple stakeholders." 

News Highlights

- ▶ North Montney Mainline hearings begin
- ▶ Kurgalsky biodiversity conservation proposal from Nord Stream 2
- ▶ 21st century approach needed for FERC gas pipeline review process
- ▶ Research forecasts oil and gas capex and R&D spending boosts in 2018



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Contract News

Kenya invites companies to bid for pipeline

The Ministry of Energy and Petroleum has started the search for a firm to design the planned 892 km crude oil pipeline between Turkana and Lamu in Kenya.

The Ministry said it has invited eight firms to bid for the FEED work, which comprises feasibility studies and an initial design.

The proposed pipeline would transport oil from oilfields in Lokichar to Lamu Port for export.


Andrew Kamau, Principal Secretary for Petroleum said the Ministry last week invited eight companies to bid for the design contract. The companies were selected from a pool of contractors that had submitted applications to be prequalified to undertake the FEED after the Ministry sent out a request for Expression of Interest (EOI) in 2016.

The pipeline is expected to have a capacity of 80 000 - 120 000 bpd.

"The firms who made it through the expression of interest were invited to tender and these were a total of eight companies. They will be awarded the contract by end of April and take about eight to nine months to complete the FEED," he said. The Ministry had expected to award contract for the FEED mid 2017, which would have paved way for the development of the pipeline later this year and scheduled for completion in 2020. Delay in securing a firm to design the pipeline could delay the commencement of building the pipeline, which could in turn delay the commercial oil export phase of the Turkana oil project.

Tullow Oil has reported "significant progress" on the field-development plan that would lead to oil exports from the Lake Turkana region.

In an 11 January operational update, Tullow said some US\$80 million of its US\$460 million total CAPEX associated with operating activities in 2018 would be allocated to predevelopment spending in Kenya. The focus is on developing already discovered resources in the South Lokichar Basin on the southern side of Lake Turkana.

The company estimates that South Lokichar holds approximately 0.75 billion bbls of oil. 

Halfwave secures contract for Nord Stream 2

Halfwave has been awarded a contract to design and build 48 in. ART Scan® inline inspection tools for Nord Stream 2.

The ART Scan tools will be used to inspect the 48 in. twin gas pipelines in the Nord Stream 2 project.

The length of each of the twin lines will be over 1200 km, representing a challenge well-suited to acoustic resonance technology (ART).


The pipeline wall thickness, long range and high accuracy capabilities of the ART Scan tools were key factors for selecting this technology solution for the inspection.

The ART Scan tools will have the capability to inspect an entire pipeline in one single run and provide high resolution inspection results.

"This is one of the largest and most exciting contracts that we have been awarded, and we are pleased that Nord Stream 2 AG has recognised the added value the ART technology provides," said Halfwave CEO Paul Cooper.

He believes this contract shows the value that ART provides and new market opportunities for the technology.

"After a very diligent technology evaluation process, it is very rewarding to be recognised by Nord Stream 2 AG as their leading technology provider and preferred supplier of pipeline inspection services," said Cooper.


Halfwave uses patented ART to perform inline inspections and external subsea pipeline inspections for operators. 

Trafigura commits to Cactus II pipeline

Trafigura has committed to transport 300 000 bpd of US crude oil from the Permian Basin to the port of Corpus Christi via the Cactus II pipeline, which is targeted for service in 3Q19.

This commitment will enable Trafigura to transport crude bought from producers in the Permian basin, and deliver it to American and international refining customers via the company's splitters and export terminal in Corpus Christi. The export terminal is co-owned with Buckeye Partners L.P., with Trafigura retaining exclusive throughput rights.

"This is one of the largest commitments of its kind to be signed in the US and solidifies Trafigura's position as a leading US exporter of crude oil and refined products," said Corey Prologo, Head of Oil Trading and Director for Trafigura North America. "As demand for American crude continues to grow we'll be able to bring our significant logistics infrastructure, global customer base and marketing skills to producers in the Permian Basin."

The announcement builds from an agreement signed with Plains in July 2017 for Trafigura to receive up to 100 000 bpd of crude oil and condensate from the Permian Basin to Corpus Christi. 

Working commission agreement signed for TAPI pipeline

The President of Turkmenistan Gurbanguly Berdimuhamedov has signed a decree on the establishment of a working commission to co-ordinate the implementation of the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline project.

The document was signed in order to facilitate the TAPI gas pipeline and other related projects along the Turkmenistan-Afghanistan-Pakistan route.

Turkmenistan started to construct its TAPI section in December 2015. The foundation laying ceremony for the Afghan section of the TAPI gas pipeline is due to be held in the second half of February 2018.

Currently, the Turkmen section of the gas pipeline is being laid in line with the schedule. Completion of the construction of this site is planned for the end of 2018.

The main problems for the project's implementation are largely considered to be financing and security issues as the pipeline passes through the territory of Afghanistan. 



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Image provided by Transneft Media.



Safely does it

Valery Degtev, Chief Engineer, Transneft Diascan JSC, Russia, explains how to operate pipelines safely, with a particular focus on Russian pipeline systems.

The media has recently been reporting on oil leakages due to accidents on platforms or pipelines, which pose serious threat to the global ecology. While oil companies calculate financial losses from such catastrophes and consulting firms bring disappointing statistics, others develop solutions for the safe operation of oil and gas pipelines, and make real steps towards

efficient and more environmentally friendly oil transportation. For example, a highly specialised enterprise for inline inspection (ILI), Transneft Diascan JSC, has been present in Russia for 27 years. As a subsidiary of the world's largest oil pipeline company Transneft PJSC, Transneft Diascan JSC was created to ensure accident free operation of the Russian pipeline system.

From design to reality: production of inspection tools

The first step oil transport companies must take to ensure safe pipeline operation is the selection of a reliable inspection service provider. Ideally, one which develops its own tools for ILI and is responsible for each stage of their assembly and further operation. Thus, Transneft Diascan JSC has set up its own design and production cluster, which performs the entire range of related works: from research and development to software design, assembly of inspection tools and production of components for repair.

Creation of inspection tools begins with the elaboration of a detailed technical task, based on which the design documentation, including 3D models of future tools, is developed. During the design and before commissioning of the ILI tool, the company is able to amend the design documentation, which ultimately allows for the creation of a technically advanced product. Transneft Diascan JSC produces all the mechanical



Figure 1. Launching of the combined tool on the client's pipeline system, Russia.



Figure 2. Inspection tools testing facility in Lukhovitsy, Moscow region, Russia.

parts and components of its inspection tools at its own facilities or by high tech Russian partner manufacturers.

Patents protect inspection solutions. Thus, during 2017, Transneft Diascan JSC became the owner of 12 patents of the Russian Federation, as well as one European patent for inventions. The technical solutions protected by these patents are applied in the field of ILI and interpretation of inspection data.

Equipment testing

Before inspecting the customers' pipelines, inspection tools undergo thorough testing at Transneft Diascan JSC's unique testing facility, which has no analogue in the international practice. To ensure that all defects are identified and evaluated accurately, the tool moves through pipes in a fluid flow simulating oil and scans the surface of the pipeline. The testing facility is equipped with both artificial and real defects from existing pipelines, and creates conditions very close to the real ones for inspection tools operation.

Advanced inspection capabilities

To date, Transneft Diascan JSC has a large selection of inspection tools with a diameter ranging from 6 - 48 in. Its equipment fleet comprises over 90 inspection tools, including ultrasonic and magnetic inspection tools, as well as unique developments such as the combined magnetic ultrasonic tool (magnetic flux leakage [MFL] + wall measurement [WM] + plus crack detection [CD]) and ultrasonic tool for multi-angle examination of the pipeline wall.

A combined magnetic ultrasonic tool (MFL+WM+CD) is the best-in-class of Transneft Diascan JSC's inspection tools. In just one run, this tool is able to perform both magnetic (MFL) and ultrasonic (WM and CD) pipeline inspection for metal loss and the presence of longitudinal and transverse cracks. Maximum sensitivity of the inspection tool is achieved by combining these two methods. It also helps to identify dangerous combined defects such as dents and buckles that can often be combined with pipe wall defects, such as metal loss and scratches.

As well as successfully applying existing technologies, Transneft Diascan JSC continues its engineering practice and is actively engaged in the creation of new generation ILI tools. The latest developments include an ultrasonic tool for multi-angle examination of the pipeline wall. This tool is designed to detect randomly oriented scratches and crack-like defects in the pipe wall and welds (longitudinal, transverse and spiral).

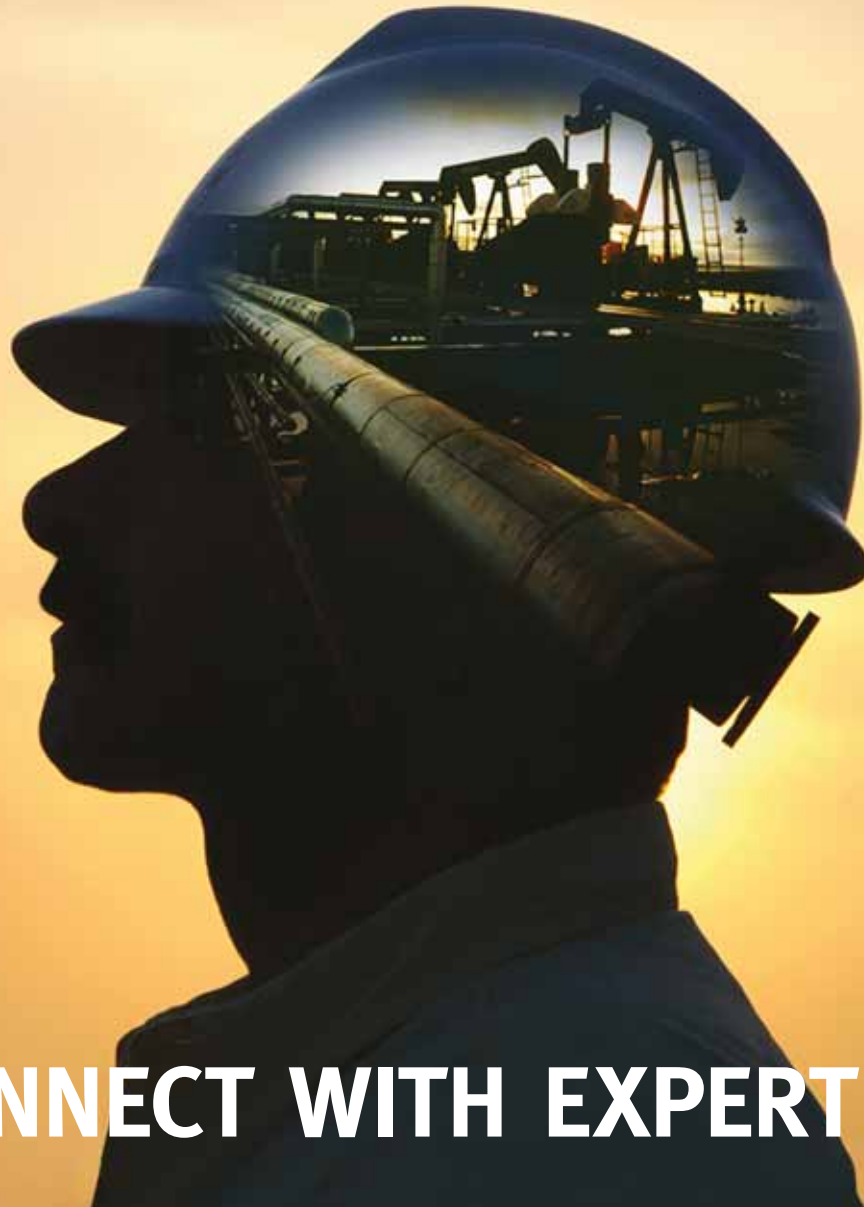
Another recently developed inspection tool is designed to detect



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Pipeline Integrity

the disbonding of the insulation coating of pipelines using the electromagnetic acoustic technology (EMAT).

What does the data hide?

After the inspection tool has inspected the pipeline, one of the most critical steps in the whole process is data analysis. The effectiveness of the ILI wholly depends on data competent interpretation. Transneft Diascan JSC has its own data processing centre with high tech equipment. It is responsible for analysing the results of ILI and providing technical reports and recommendations on pipelines' further operation. These reports fully comply with the international standards and recommendations of the Pipeline Operators Forum (POF) document.

The processing of information, obtained by the ILI tool, is divided into three stages. First, the recorded data is transferred into a format suitable for processing in specialised graphics programs.

Then the data is interpreted and electronic spreadsheets are generated: pipeline tally, defects and features, as well as its reference points. Based on this, the company produces spreadsheets with inspection results for each run of the inspection tool, which are then inserted in the appropriate database.

Transneft Diascan JSC owns a database called 'Defect', which contains all the data of the inspection surveys of the company since 1997 in a unified format. In fact, it is a powerful information core, which forms the basis of the successful analytical work of the company. Professionals have access to the whole volume of data on previously performed inspections, including the parameters of the detected defects, fitness-for-purpose calculations of these defects, as well as repairs performed and other information.

After that, a comprehensive technical report on the survey of the pipeline is completed. In addition to the general information on all detected defects and design features of the pipeline, the technical reports show the fitness-for-purpose calculation results for the sections with indication of the allowable pressures, service life limits and recommended repair methods. It is important that when a dangerous defect is detected, the information on it is forwarded to the customer promptly, pending the completion of the technical report. Timely inspection of pipelines enables not only to prolong their service life due to scheduled maintenance, but also to avoid an environmental catastrophe.

Testing of pipes and prediction of defects growth

In order to accurately predict the development of a defect in real operating conditions of the pipeline over time, a special testing laboratory was established by Transneft Diascan JSC 17 years ago to conduct research on real pipe sections with defects. These inspections allow experts to assess the dynamics of a defect growth, the recommended operational period of the pipeline and possible repair methods.

Typically, laboratory specialists use steel pipes up to 48 in. dia. and up to 7 m in length for testing. The pressures that the pipe undergoes during its operation are artificially increased several-fold. The pipe is loaded with internal pressure and two transverse forces create a bending moment (four point bending). During the check, the liquid is conveyed through the pipe under cyclically variable pressure, which simulates the pumping of petroleum products, and the bending moments reproduce the possible ground pressure, the effects of construction

works and the impact of extreme temperatures. Within a few days of tests, the pipe is exposed to loads equal to tens of years of operation under real conditions. This allows for tracking its changes from continuous use in dynamic mode, identifying weaknesses and preventing potential problems.

To date, the oil and gas industry has to search for answers to the growing number of challenges in order to develop successfully. Every year, Transneft Diascan JSC sets new goals and develops its technological and manufacturing potential. Responding to the ever-increasing demands of customers, inspection providers solve missions that were previously considered impossible, bringing the future of completely accident-free operation of pipelines closer. 



Figure 3. Pipelines testing laboratory in Lukhovitsy, Moscow region, Russia.

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DATA: A MISSION CRITICAL ASSET

In June 2014, oil was averaging US\$120/bbl. Over the last two years, until very recently, it has not been above US\$60/bbl.


There is what you can control, and there is what you cannot. Wisdom, as the saying goes, is knowing the difference, and in the world of midstream oil and gas, wisdom is making and breaking companies.

'Wise' midstream oil companies have recognised that, in the digital era, operational data has become a mission critical asset. When collected and made available in context, this data can reduce their 'controllable margins', guarantee their social license to operate and ensure their survival amid a wave of mergers and acquisitions.

Midstream oil and gas under pressure

The cost per barrel is down and shale oil production rose by almost 10% in 2017. This increase in realised production is forcing midstream companies to operate on razor thin margins. On any given day, the difference between operating profitably and running at a loss is operational efficiency.

The good news: midstream companies can, and have, successfully reduced their controllable margin in logistics by 1 - 5% year-over-year through aggregating, normalising and adding context to their operational data and applying 'layers of analytics' that reduce operational and maintenance (O&M), energy and compliance reporting costs.

A hand holding a pen pointing to a bar chart with data values like 12195.37 and 14834. The background is a blue and red gradient with a grid pattern.

Craig Harclerode, OSIsoft, USA, focuses on the role of data infrastructure as an asset to midstream companies looking to survive the current economic pressures and maintain a social license to operate.

TransCanada, for example, transports roughly one fifth of US demand on a network of 31 000 miles of pipeline. Along its network, it manages 800 compression units across 36 states. The compressor fleet is as varied as it is large – they operate three different types of compressors: some dating back to the 1950s, others state-of-the-art recent models.

These diverse compression units dotting the TransCanada network are essential to operations. They compress natural gas to a specified pressure so it can flow on. The best-case scenario if a compressor breaks: TransCanada’s ability to move and deliver natural gas is compromised resulting in disruptions in supply. The worst case scenario: a rupture, explosion or fire due to the compressor failure.

The critical nature of compression units led TransCanada to implement a programme of Enterprise Analytics, which the company describes as “a real time monitoring system that detects and prevents functional failures on large rotating equipment.” Run by just three

people, Enterprise Analytics handles over 16 000 streams of data and provides an executive level dashboard for critical anomalies, as well as email and text notifications of operations deviating from the norm. This system saved TransCanada an estimated US\$10.6 million through the first three quarters of 2017, based only on reduced parts and repair costs (Figure 2).

These savings result largely from early detection and cost avoidant intervention. In one instance, Enterprise Analytics alerted TransCanada to a discharge temperature in a ‘Tier 1’ compressor – which represent the most commercially valuable components of operations – that was rising above its set parameter. With the alert, TransCanada was able to schedule maintenance on the valve before a catastrophic failure and costly unplanned downtime. In another case, Enterprise Analytics notified operators of a rising temperature that turned out to be a cracked main shaft bearing. They intervened early and replaced the bearing, sparing them a larger US\$4 - 5 million expenditure had the crack gone undetected.

Social license to operate

The benefits of a digital infrastructure go beyond cost reduction. The rise of unconventional drilling, especially shale production, has increased the supply of oil and gas flowing through North America’s midstream infrastructure. The pressure for more capacity to flow through the same pipeline has increased the risk of oil and gas spills and increased public concern around the environmental impact of midstream pipelines.

The rise in risk and public visibility is pressuring midstream companies to verify well and pipeline integrity if they want to maintain their social license to operate. This social license to operate is conditional on public trust and government permission, both of which depend on asset integrity and protection of the public and the environment. In short, the social license to operate mandates operational excellence, and a reliable data

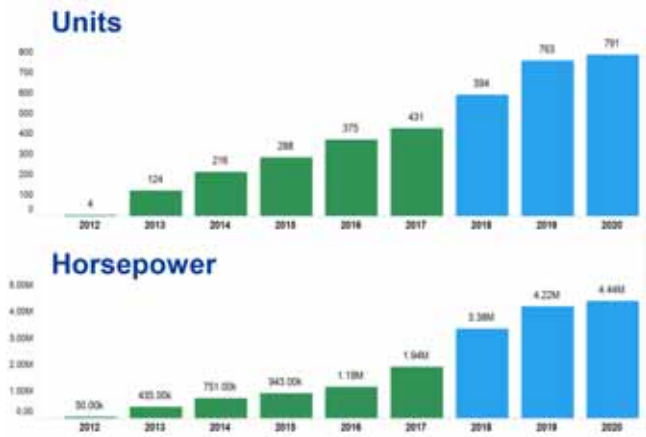


Figure 1. TransCanada continues to rapidly expand its capacity.



Figure 2. Failure avoidance costs for TransCanada’s Enterprise Analytics anomaly detection. Estimates were calculated conservatively on the basis of a commercial impact of 30% the current parts and labour.

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utilising real time information to understand the state of the network and make operational decisions.

Survival of the fittest

The rise in unconventional oil and gas exploration upstream has fuelled mergers and acquisitions across the North American midstream industry. Operational data plays a key role in these mergers in two ways. First, companies who treat operational data as an asset lower their total cost of ownership, giving them a healthier balance sheet and enough cash flow to want to go shopping.

In addition, a sound operational data infrastructure makes it easier and less expensive to absorb another entity. When it comes to the data used for operational decisions, mergers and acquisitions can be extra messy.

For example, Kinder Morgan is currently the largest publicly traded midstream company. The company, which started 20 years ago with an initial value of US\$325 million, has grown to manage 69 000 miles of pipeline primarily through acquisition. In 2005, the company acquired Terasen for US\$5.6 billion; in 2012, El Paso Cooperation for US\$38 billion; in 2013, Copano for US\$5 billion. Each of these acquisitions came with its own data solutions and software, as well as a taxonomy and lexicon for assets.

The digital value chain

What does the future look like for midstream oil and gas? The industry is likely to see a surge of capital lite business models as more smart equipment comes to market. Rather than buying assets, midstream companies will lease from equipment vendors who will own and monitor the assets, leaving midstream companies to focus on logistics with less overhead.



Figure 3. Hydrogen production plants: corrosion occurred because hydrogen bonded with carbon in the steel. Through fault detection analysis, MOL was able to get uptime back to 97%.

Data from midstream assets will also become increasingly valuable to the entire digital value chain from downstream to upstream. In one recent example, a US midstream company is working with two upstream companies to set up data and analytics sharing. These companies are forming a complete digital value chain, opening the possibility for a data and analytics strategy that can track oil and gas supply from initial exploration to market consumption.

Digital transformation – where to start?

MOL Downstream, one of central Europe's largest downstream companies, operates across 13 countries. Over the past five years, the company has realised an estimated US\$1 billion in increased earnings before EBITDA through data initiatives. Its approach provides important lessons for successfully embarking on digital transformation within large oil and gas enterprises.

MOL's story begins in 2012 when the business recognised that it would need to transform its operations if it were to survive in the competitive European market. MOL worked to establish a digital twin of its operations, and treated data as an asset that could catalyse smarter and more predictable operations. The company focused on concrete initiatives, such as predicting corrosion to reduce high temperature hydrogen attacks. As the first initiatives delivered concrete return on investment, MOL moved from predictive operations to management by exception, using data to automate decision making. Currently, MOL generates 80 billion data points per year. The company has also had its first successes with Big Data and machine learning on Microsoft Azure to predict the impact of sulfur levels in various desulfurisation units and increase its DCU yields by 2%.

MOL's success provides important principles to launching a data initiative:

- Build out a digital infrastructure that mirrors the physical infrastructure.
- Treat operational data as an asset.
- Start with concrete initiatives that address business problems with clear value and return on investments.
- Learn from each initiative, iterate and extend the infrastructure to more advanced analytics, including the edge and cloud.

Conclusion

Data is an asset few are using, but it holds the key for threading the many competing interests and succeeding in the future. How well a company controls their 'controllable margin' comes down to how well they manage their data.

For midstream oil and gas, and many other traditional industries, if you want to control your destiny in the digital age then you have to control your data. 📊



MAKING THE MOST OF BIG DATA

Combining machine learning with the Industrial Internet of Things and engineering models will revolutionise asset management in the oil and gas industry, explains **Richard Irwin, Bentley Systems, UK.**

The industrial world is awash with data and new information from sensors, applications, equipment and people. But the data is worthless if it is left untouched or not used to its full potential to gain insights and make improved decisions. To make the most of Big Data, oil and gas leaders should implement machine learning alongside accurate engineering models linked to the Industrial Internet of Things (IIoT), to leverage the digital DNA of the asset and take advantage of the increased insight that engineering information can bring to the operation regarding performance and reliability. Using reality modelling technologies to capture existing asset conditions, applied together and working in tandem with the IIoT and machine

learning, you can reap the rewards of cost savings and improved uptime.

Demystifying machine learning

We have all experienced some form of machine learning, from streaming movie recommendations, to banks that monitor spending patterns to detect fraudulent activity. Now, the industrial arena is moving quickly toward using a type of artificial intelligence to leverage the IIoT.

As the velocity and variety of data becomes available through advancements in sensor technology to monitor just about anything, machine learning is being applied to efficiently manage increasingly large and fast moving data

sets. Previously, organisations with predictive analytics could use Big Data (current and historic) to try and predict the future with reasonable results. What it brings is a more accurate prediction using algorithmic models to deliver more insight. Machine learning can handle large and complex information, from sensors, mobile devices and computer networks, to discover hidden patterns or trends in the data. It can then learn these patterns and apply it to new, real time data to detect similar patterns in the future. An example would be to model the performance of a piece of equipment, such as a pipe, in relation to the temperature of its surroundings. Machine learning can be taught to see what normal and abnormal behaviour looks like, and by applying the model to current data, it can identify events, such as when the pressure within the pipe increases while the temperature remains the same. The system can then predict from existing knowledge that something is not right, and can send out notifications and prescribe actions. The more data that is analysed, the more accurate the predictive model.

Machine learning techniques – two paths to choose

Part of the implementation process is understanding how it works and the number of techniques involved. Your software service provider or machine learning expert will recommend which techniques to use and when. The most common techniques are:

- **Supervised machine learning:** the program is trained on a pre-defined set of 'test' data comprised of historical or similar data to the real thing, which then facilitates its ability to reach an accurate conclusion when given new data.
- **Unsupervised machine learning:** the program is given a mix of data and must find patterns and relationships therein with no training whatsoever, without any specific target or outcome.

So, what it comes down to is knowing what it is that you want your data to tell you and understanding the data you have available.

Machine learning strategy – questions to consider

When implementing machine learning within your operation, certain considerations need to be considered regarding the data, the insights you are looking for and how they can be applied within your business. Five questions to ask are:

- **Question your data** – what are you not seeing that you hope the data can provide?
- **Clean your data** – is your data validated and can it be labelled easily?
- **Choose a platform** – have you considered interoperability?
- **Hire a data scientist** – do you have a machine learning engineer, and can that person couple with a subject matter expert?

- **Share the learning** – plan ahead to leverage the technology across the enterprise.

To stay competitive, we need machine learning and more

Unlike business intelligence and predictive analytics methods that require a significant amount of manual labour and time, machine learning automatically produces insights at a consistent and accurate rate. It can then apply the learning to new, real time data for future predictions, and easier and more reliable decision making.

In the oil and gas industry, the ability to recognise equipment failure and avoid unplanned downtime, repair costs and potential environmental damage, is critical to success across all areas of the business, from well reservoir identification and drilling strategy, to production and processing. This is even more relevant in today's turbulent times. With machine learning, there are numerous opportunities to improve the situation. The following details some of the main forms of predictive analysis machine learning that can be delivered to the oil and gas industry.

Predictive maintenance

One of the most applicable areas where machine learning can be applied within the industrial sector is predictive maintenance. Predictive maintenance is the failure inspection strategy that uses data and models to predict when an asset or piece of equipment will fail so that maintenance can be planned well ahead of time to minimise disruption. Predictive maintenance can cover a large area of topics, from failure prediction and failure diagnosis, to recommending mitigation or maintenance actions after failure. The best maintenance is advanced forms of proactive condition-based maintenance. With the combination of machine learning and maintenance applications leveraging IIoT data to deliver more accurate estimates of equipment failure, the range of positive outcomes and reductions in costs, downtime and risk are worth the investment.

Reservoir modelling

There is some question as to how reliable estimations are when calculating how a reservoir reacts to fracture treatments. Machine learning makes the process more reliable, with decisions made more quickly by providing the reservoir with data that recognises patterns for history matching. The models used will then be robust enough to help improve the accuracy of the predictions of reservoir properties.

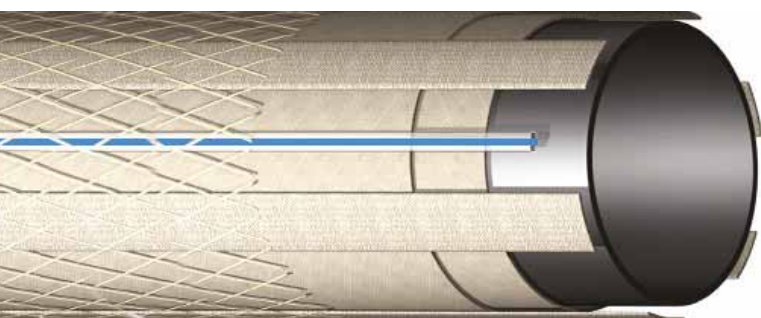
Video interpretation

As well as the many sensors that are part of the continuous monitoring process of a platform or plant, video technology used in the down hole drilling environment can benefit from machine learning. Machine learning can be applied to interpret video data through anomaly detection to provide accurate assessment wherever video technology is applied for sensing tasks, therefore, improving safety, costs and efficiency.

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Case-based reasoning

Frequent operational and reliability problems are still common within the oil and gas process, with well blow outs, leakages and production issues being some of the serial offenders. The reason they are common is the number of complex parameters that can cause many outcomes. With case-based reasoning, a current problem or case is compared to historical cases to look for similarities that could provide clues to help identify the actions or behaviours to take that could help overcome the current situation. This could include analysing data, such as weather condition, depth, equipment used, costs and more. Case-based reasoning is not a new approach in the oil and gas sector, but the process can be significantly sped up with the aid of machine learning.

Other examples of where machine learning can be used within the oil and gas industry – particularly within down hole drilling – is optimising the rate of penetration, path and angle correction to determine the best drilling pattern for the terrain and conditions that will minimise equipment failure. Accurately forecasting natural gas/oil markets to predict the supply and demand price would give operators the competitive edge they need to maximise the supply demand price. It would provide them with the information they need to meet customer demand by anticipating future demand or consumption.

Visualisation will bridge the gap between the real asset and the virtual asset

As already seen, machine learning capabilities will help you to realise insights from the large amounts of data provided by sensors and the IIoT. Bringing it all together is visualisation through engineering models for structures, such as offshore platforms and onshore processing plants. An engineering model, or digital twin, is the computerised 3D version of the physical asset, which maps everything associated to the physical asset using sensors to represent near real time status, such as condition, performance and location. Where 3D models do not exist, one can quickly and easily create 3D models with technology such as ContextCapture – Bentley's 3D reality modelling software. Here, using high resolution photographs, drones aid in the creation of digital engineering models for offshore structures, refineries and more. Photographs are transformed into detailed, comprehensive 3D models of all infrastructure data, in a less labour-intensive, cheaper and more efficient manner when compared to traditional methods.

IT/OT convergence has become an accepted practice, with operators gaining new insight from known information. But misalignment in corporate strategy still results in silo building across many areas, especially within engineering technologies where engineering models often remain stranded, inhibiting the ability to leverage this information to optimise operations. They should be included with the existing IT/OT conversation, driven by the IIoT in addition to machine learning. Designing and testing new products, systems and even plants in a virtual environment makes a compelling case, particularly from a cost perspective. Virtual


models can tie these domains together over the whole lifecycle of an asset using its embedded digital DNA. From an asset management perspective, it is about predicting a problem before it occurs and enabling maintenance to be performed at optimum rates and costs. This will be accelerated with the application of machine learning to make the decision-making process smarter, faster and, more importantly, in context.

Continually modelling an oilfield or installation means that personnel can survey the asset throughout its lifecycle, from initial design to current condition, applying the difference in data to maintain up to date information on the equipment's condition along the way. These models become the context within which oil and gas operators can design, build and operate their infrastructure projects. Reality modelling can link engineers in the field directly to the office, sharing information and data collaboratively. With the use of IIoT data provided by the images in the construction of the 3D models, the machine learning algorithms will provide even greater context, a predictive capability and deliver more informed business insight to the user, resulting in faster and more reliable decision making.

Digitalisation and machine learning

While machine learning gives the impression that human involvement is minimal, this is not the case. It gives the user more intelligence, context and insight to make the decision making process easier and improve productivity. For those adding machine learning to their asset management journey, the next logical step is to go model-centric by adding visualisation dashboards, cloud-based IIoT data, analytics and reality models to machine learning. With a machine learning strategy in place, it will give you unprecedented insight into your operation and lead to significant benefits in efficiency, safety and optimisation, as well as the speed in which decisions can be made.

Conclusion

With the arrival of the IIoT, data is growing and becoming more accessible. With the ability to acquire more data, more advanced technologies are required to scrutinise and filter out the important information and the value held within. But, it can only be exploited by identifying what works well and what does not. Machine learning features complex algorithms to sort through large amounts of data, identifying patterns and trends within it to make predictions. The use of machine learning in the oil and gas industry does not have to stop at just exploration and production, but can be applied across the whole operation, where algorithms are used to continually improve the overall performance across the whole facility and the equipment within it. By combining these machine learning practices with the IIoT and visual operations, they will bring, as it matures, significant benefits. The IIoT, engineering models and machine learning should no longer be considered just buzzwords. Instead, combined, they should be your number one priority for achieving operational excellence. 

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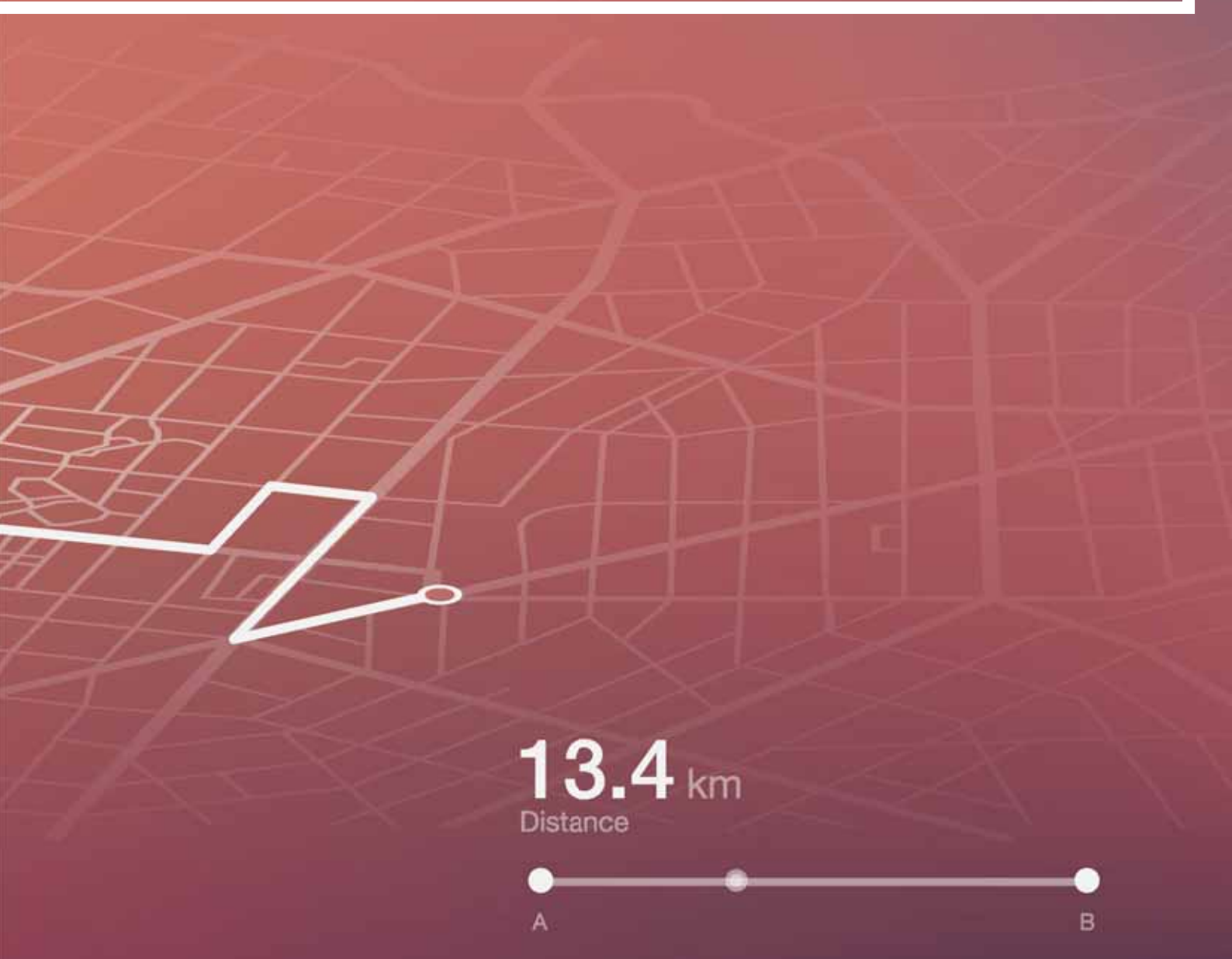
TRACKING PIPELINE ASSETS



Greg Edds, JPL RFID, USA, discusses a pipeline project where the company's asset tracking solution was required.

JPL RFID was founded with the ultimate goal of assisting companies in improving their operations by sharing its resources of experience and expertise. The company's team possesses a wealth of intellectual property in the IT, logistics, and oil and gas industry. As such, JPL RFID provides innovative RFID solutions for the implementation of asset and warehouse management systems in the oil and gas industry, serving both the domestic and international sectors.

The company was contacted by oil and gas pipeline contractor RSH Energy, which was looking for a solution to improve the method by which they tracked the movement of pipe. RSH Energy wanted a solution that could track pipe joints, beginning from receiving it from the mill, all the way to the right-of-way (ROW). As



construction of the pipeline that they needed to track was already underway, RSH Energy had an immediate need to track the pipe joints being installed at the ROW. Due to the fact that most pipeline ROWs are located in remote areas, the WiFi access in that area was not reliable.

JPL RFID's Get a Grip on your Assets®, a combined cloud web service and handheld solution, was able to provide all of the elements needed to satisfy the client. This implementation was the runner up for 'Best use of RFID to enhance a product or service' in the 2015 RFID Journal Live Conference.



Figure 1. JPL RFID's Get a Grip on your Assets solution.

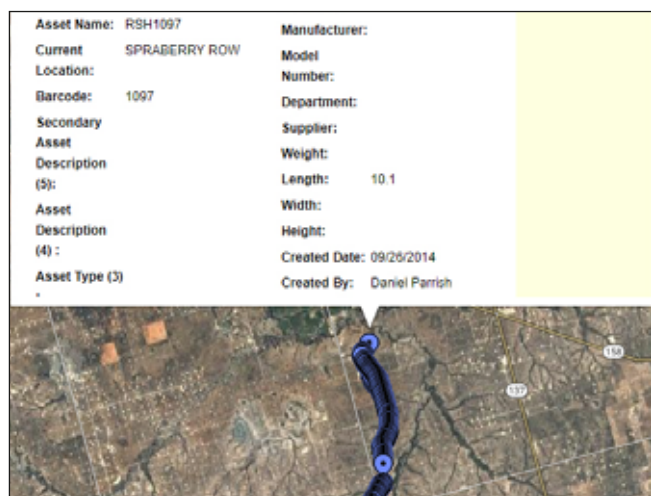


Figure 2. JPL RFID map view report displaying a string of RSH Energy pipe and attributes of an individual pipe.

RFID technology

JPL RFID specialises in asset tracking and management using RFID technology. A simple method for relating how RFID is different than barcodes is to think of an RFID tag as a barcode tag that uses radio waves to transmit information. The major difference between the two is that barcode labels require direct line of sight to the label in order to scan the barcode. On the other hand, RFID uses radio waves to provide data, from 15 - 20 ft away at a minimum in most cases. You can read the data stored on an RFID tag through almost any material, except water and metal. For example, you can read RFID tags on material that is tagged and packed inside boxes even though you cannot see them. In turn, this offers more flexible opportunities and a higher level of automation than with barcodes.

Solution

JPL RFID's Get a Grip on your Assets asset tracking solution allowed RSH Energy to automate importing pipe attributes, print and programme RFID labels to uniquely identify each joint of pipe, and track each joint location by GPS co-ordinates.

Pipe attribute data

The company's asset tracking solution enabled RSH Energy to automate capturing pipe attributes, such as heat number, OD, length etc., by importing data currently received from the mill in an Excel spreadsheet. The spreadsheet data was easily uploaded and imported into JPL RFID's cloud web service solution. Previously, engineers had to manually cut and paste this information into separate reports. This proved especially important since the job was already underway, and an onsite solution was needed immediately.

JPL RFID was able to upload, store and generate labels quickly to match all the necessary pipe joints for the job. The pipe already had labels with barcode identifiers that were uploaded with the other attribute data. At the ROW, the pipe barcode was scanned which confirmed the pipe. The operator then attached a new label to that pipe, which was generated from the JPL RFID system. The label is then scanned and the tag ID is associated to the existing pipe.

Remote operation

JPL RFID's handheld software is designed to operate with WiFi connectivity to the cloud web service. This allows real time verification and storage of all data collected.

For RSH Energy, the handhelds needed to operate at the ROW without a WiFi connection and still collect location data. JPL RFID's handheld software solution was capable of being configured to allow for updating individual pipe information offline to deliver this solution. The entire pipe asset database was downloaded and stored on the handheld for remote operation.

Each pipe was scanned and location updated on the handheld. When the operator moved the handheld within a WiFi signal it could use, the handheld remotely connected



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CHALLENGE CONVENTION

to the cloud service and uploaded all the data that was collected during the time it was operating offline.

GPS location tracking

Besides being able to automatically upload the pipe attributes, RSH Energy required each pipe joint to be tracked by GPS co-ordinates when moved to the ROW.

The handhelds that were used are fully GPS capable. When the pipe tag is scanned and the pipe is confirmed to be identified, the pipe location is saved. The location is then stored with GPS co-ordinates and associated to that unique pipe joint.

Map view report

Once the data is uploaded to the cloud web service, RSH Energy used the Map View Report, which uses Google Maps to display the pipe’s geographic location.

They were able to visually verify each piece of pipe joint that was laid at the ROW by seeing its geographic location and how each pipe maps together with the other pipe joints to form the entire pipeline. They could also select a map pin representing a joint of pipe and see the individual attribute data.

Benefits for the RSH Energy pipeline project

Increased efficiency, decreased labour, improved data accuracy

Before using JPL RFID’s system, capturing data on the movement of pipe joints was two totally separate processes for RSH Energy.

The JPL RFID asset tracking solution was able to increase efficiency and decrease labour by 100%. Additionally, the company improved the accuracy and efficiency of records by having each pipe automatically recorded.

Capturing the joint location by using GPS co-ordinates and identifying the pipe joint at the same time meant that

the company was able to increase efficiency in capturing location data, as well as improve the accuracy of the data.

Simplified data import

The ability to upload spreadsheet data directly into the JPL RFID asset tracking system eliminated previous errors that were made by RSH Energy trying to copy and paste information between separate spreadsheets. This also resulted in occasionally missing data altogether.

GPS co-ordinate location capture

Through the use of a GPS attachment coupled with JPL RFID’s software, the location of each individual pipe joint was captured with GPS co-ordinates.

Visual location display

The location of each pipe joint is displayed in the Map View Report using Google Maps. As a result, daily progress of the pipeline’s construction was able to be easily monitored at RSH Energy’s home office, while the work took place hundreds of miles away.

Easy access to individual pipe data

RSH Energy can select an individual pipe joint in the Map View and see all the attribute data associated with that specific joint. The main dashboard also allows them to select a location to get a comprehensive list of all pipe joints in that named location. Or, if the pipe is mapped only by GPS co-ordinates, then they can get a full list of those pipe joints as well. Simply select a specific joint and get a screen with all the data associated with that joint, including the entire move history and any documents, photos or video attachments.


JPL RFID is extending its innovation by launching a new portable offering that uses a smartphone/tablet-based app for device control and logic. It supports both barcode and RFID scanning, easily switching between the two inside any function. 



Figure 3. JPL RFID web service general pipe asset information entry screen.



Figure 4. JPL RFID web service pipe dimension details entry screen.



Heavy equipment review

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Heavy equipment review

In *World Pipelines'* first ever Heavy Equipment Review, 10 companies present a selection of heavy equipment for oil and gas pipeline construction projects. Showcasing trenchers, land clearing equipment, vacuum lifters, pipelayers and more, the companies offer details on the product specifications and capabilities of large scale heavy equipment designed to tackle the biggest of production, site and environmental needs.



Cedar Eaters[®] of Texas, USA


Cedar Eaters[®] of Texas is the industry leader in environmentally friendly land restoration, and specialises mainly in cedar and brush mulching services. The company's primary focus is on pipeline and right-of-way (ROW) clearing, as well as clearing for residential and commercial developments across Texas (USA).

The company is a HUB-certified, woman-owned contractor, whose owners worked in the pipeline and industrial construction field in Louisiana (USA) for over 15 years prior to founding Cedar Eaters in 2001. Because of this vast experience in managing a large industrial construction company, the owners have learned the value of safety and to place great importance on ongoing safety training. All operators are carefully screened in the hiring process, and the commitment to safety is ingrained into every member of the Cedar Eater team from day one.

The mulching process, which Cedar Eaters has perfected over its 17 years in business, is the ideal method for

clearing and maintaining pipelines and ROWs because there are no piles left behind to be burned or hauled off later. It is an all in one process wherein standing vegetation is shredded down to ground level with little to no soil disturbance. The layer of mulch left behind is all that remains of the unwanted vegetation and is beneficial in preventing soil erosion, as well as sealing in moisture and nutrients beneath the surface. As an ecofriendly land restoration contractor, the company hopes to remove the stigma associated with clearing trees for pipelines and ROWs.

Cedar Eaters clears pipelines and ROWs using only 300 hp Tiger Cat mulchers with 8 ft wide cutting heads, which the company has found to be the best forestry equipment available for the task. It believes strongly in machine maintenance and all operators spend an average of two hours per day cleaning and maintaining their equipment. This results in fewer breakdowns and fewer delays for repairs. Because all the machines are of the same type, the company has streamlined its repair processes and, therefore, have minimal downtime in the unlikely event that there is a major mechanical issue. The company also rotates machines out of commission well before they hit 10 000 hr, to ensure that all the equipment is relatively new and functioning at top capacity.

Unlike the average clearing contractor, Cedar Eaters has the ability to deploy multiple machines at one time to help speed up the clearing process, as it knows that time is of the essence when it comes to pipeline and ROW clearing. When the company cleared an 82 mile pipeline in the Midland/Odessa, Texas area in 2016, it mobilised three Tiger Cat mulchers to expedite that project's completion. Cedar Eaters is also set up to provide grubbing services for mesquite and other types of vegetation that grow back from the root using patented grubbing attachments, including the Root-N-All[®] universal attachment. Hand crew and skid steer raking/grappling services are also available to aid the heavy equipment, as needed. The company's vast experience in multiple clearing techniques is one of the many things that sets Cedar Eaters apart from its competitors. 



The 300 hp Cedar Eater mulchers are equipped with an 8 ft wide Fecon cutting head that rotates at 1800 rpm.



The track-mounted mulchers are powerful but agile in any terrain, from hillsides to swamplands.


DMI International, Inc., USA

DMI International, Inc. is a world class company dedicated to engineering, manufacturing and supplying construction and maintenance equipment for the oil and gas pipeline industry since 1977. The company recently increased the size of its manufacturing facility and corporate headquarters in Tulsa, Oklahoma (USA), and built a state-of-the-art paint facility to streamline product finishing.

These upgrades mean improved quality control, decreased turnaround times, and have expedited the production and shipping of pipeline products in the US and worldwide.

The equipment the company offers is designed, engineered and manufactured in its state-of-the-art facility. Its broad range of pipe bending machines, mandrels, facers and lineup clamps is second to none. DMI International currently manufactures a standard line of nine different hydraulic bending machines to accommodate pipe sizes from 6 - 60 in., conforming to the highest technological standards. The company's Standard 6 - 20 in. machine has been the pipeline construction go-to hydraulic bender for over 30 years. Constructed from TI steel and powered by a Caterpillar C 4.4 99 hp diesel engine, the bender features a removable 3/8 in. steel liner built into the stiff back and pin-up. When removed and replaced with a urethane liner, it can be used for bending 20 in. thin film coated pipes. A lined bending die would ordinarily be required. A hydraulically driven Ramsey winch with free wheeling drum feature moves the pipe through the machine. The Standard 6 - 20 in. includes a 3000 psi hydraulic system with a 50 gal.

hydraulic tank. The company has designed the bender with an indicator rod, calibrated so that the operator can consistently make uniform bends. In 2010, DMI International redesigned the Standard 6 - 20 in. to include a 'peek-a-boo' window in the side of the body for visual access to the pipe as it is being bent.

In 2007, DMI International engineers developed the Super 6 - 20 in., which quickly became a best selling hydraulic bender in its category. Powered by a Caterpillar C 4.4 99 hp diesel engine, it features two 8 in. x 6 in. inboard cylinders and two 8 in. x 14 in. outboard cylinders. The Super 6 - 20 in. is designed with a four point die nest for stronger support of the die, and can bend all grades of currently available API-5L pipe within its range. The company has attached the towing eye on the bending machine to the stiffback so that it can be conveniently raised and lowered by actuating the stiffback control when connecting to a towing tractor. The Super 6 - 20 in. bender can be mounted on dual tyres, 10 t tracks or stationary base. 



Innovative 'peek-a-boo' window in the Standard 6 - 20 in. bender.



The DMI International Super 6 - 20 in. machine.

John Deere, USA

Purpose-built in Iowa (USA), John Deere has designed and manufactured the 1050K pipelayer-ready crawlers. The 1050K pipelayer is available in two configurations: one with a 170 000 lb (PL170) maximum lift capacity and the other with a 220 000 lb (PL220) maximum lift capacity.

The 350 hp 1050K pipelayer models present a dual path hydrostatic transmission, which provides more precise movement and control along the trench. The electrohydraulic controls also allow for advanced metering when placing the pipe.




The John Deere-designed and manufactured 1050K PL crawler is available in two configurations for 170 000 lb (PL170) and 220 000 lb (PL220) of maximum lift capacity.

When the pipelayer-ready crawlers leave the factory, they are prepared for the customer's choice of an approved supplier boom. The machines feature a bolt-on/pin-up design, which is able to simplify sideboom installation and, consequently, improve reliability and reduce set-up times.

A purpose-built pipelayer cab integrates an electrohydraulic joystick for precise one-handed control of the load line, boom and counterweight. A roof-mounted skylight provides the operator with a clear view of the boom. To simplify set-up even further, the cab is factory equipped for simple installation of the sideboom supplier's load moment indicator.

The cab tilts with the sideboom installed for increased uptime, and the front grille is hinged to provide easy access to the coolers. Toolless access is provided to the dipstick, sight gauges, fill tubes, batteries, master electrical shutoff, engine, transmission and all filters. Eco mode and auto-idle are standard on all John Deere crawlers, which can provide significant fuel savings in many pipeline applications. Eco mode automatically adjusts the engine speed and transmission settings based on the load, and also has the ability to reduce fuel consumption up to 25%, without a loss in productivity.

Fleet managers looking to achieve the greatest output of their 1050K pipelayer-ready crawlers can rely on John Deere dealers to provide the Ultimate Uptime solution, featuring John Deere WorkSight™. With this solution, owners receive predelivery and follow-up inspections that include five years of JDLink™ telematics, machine health prognostics, remote diagnostics, programming capabilities and the ability to add dealer-provided uptime solutions to create a customised package. 

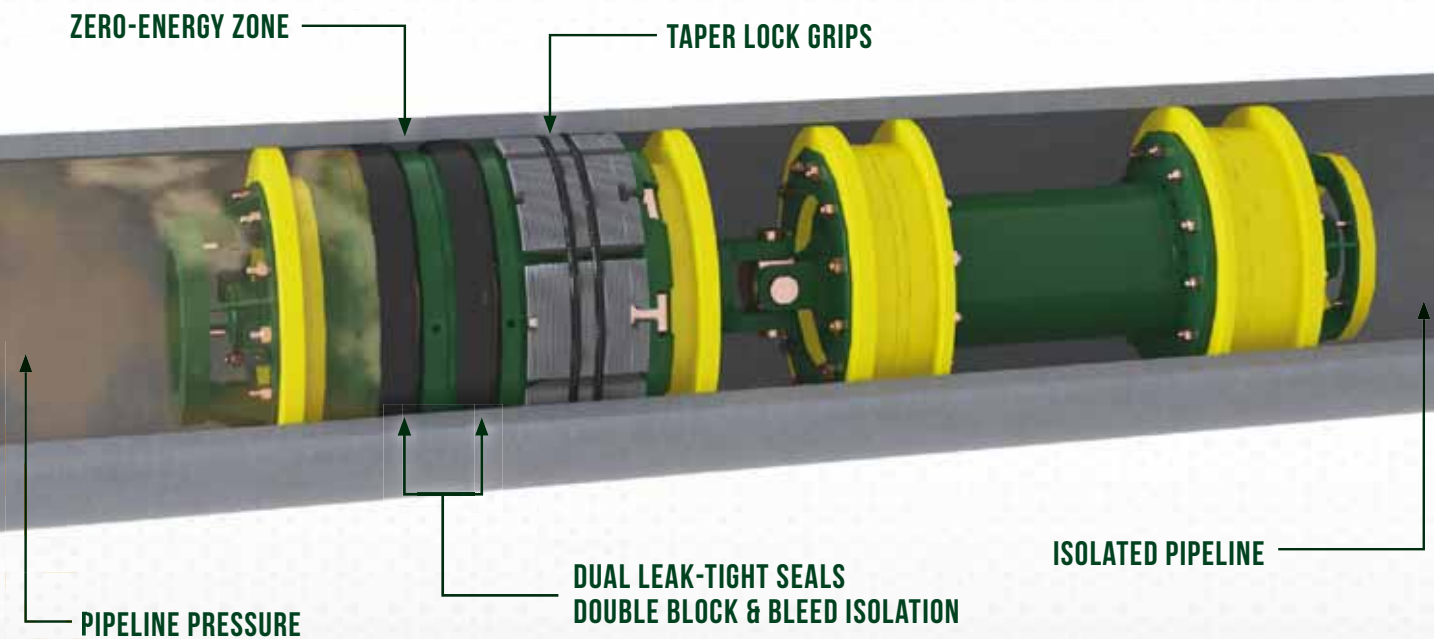


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PipeLine Machinery International, USA

Cat® pipelayers have been the standard of the pipeline industry for decades. The Cat PL series model pipelayers are the latest innovation in pipelaying equipment, maintaining their reputation for powerful performance, reliability and durability. Designed to meet the unique demands of the pipeline industry, Cat PL series pipelayers feature increased lift capacity, enhanced slope capability, ease of operation, performance and transportability. All PL series pipelayers incorporate a Cat ACERT™ engine that puts maximum power at your disposal, meeting US EPA Tier 4 Final/EU Stage IV or US EPA Tier 3/EU Stage IIIA equivalent emissions technology, depending on regional requirements.

The largest size pipelayer in the Cat PL series line-up is the PL87 pipelayer with a lift capacity of 216 000 lb (97 976 kg), followed by the PL83 pipelayer that has a lift capacity of 170 000 lb (77 111 kg). For big inch pipework, the



The PL87 pipelayer has been specifically designed to address slope capability and increased lift capacity.




The PL83 pipelayer has a lift capacity of 170 000 lb (77 111 kg) and, like the PL87, meets the unique demands for big inch pipework in varied climates.

PL83 and PL87 pipelayers both specifically address slope capability with a lengthened track roller frame and re-positioned rear idler, which puts more track on the ground along with a new counterweight profile that adds more weight, providing increased lift capacity.

The PL72 is a medium range pipelayer with a lift capacity of 90 000 lb (40 823 kg). Where the smaller inch pipework is being carried out but the wall thickness adds additional weight, the PL72 pipelayer provides a safe and efficient solution. Some of the features include improved manoeuvrability and steering, enhanced stability, improved machine controls for greater operator comfort and productivity, and improved visibility to help customers get pipe in the ground faster, more efficiently and safely.

Engineered for reliable production on the most challenging jobsites, the PL61 pipelayer is designed for tough and varied working conditions. The lift capacity of the PL61 pipelayer is 40 000 lb (18 145 kg). The PL61 pipelayer features electronically independent power and control of each track for fast acceleration, infinitely variable speed control and on the go direction changes for each track. When soil conditions are sandy or muddy, the pipelayer maintains proper track tension, extending the system life of the pipelayer and reducing operating costs at the same time. The purpose-built undercarriage gives added stability on uneven ground.

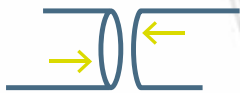
New in 2018, all PL series model pipelayers include a rear view camera mounted to the roll over protection structure (ROPS), with the ability to add additional cameras for increased visibility. The Cranesmart Load Monitoring Indicator (LMI) is now standard with a pipelayer purchase. This safety innovation allows for the operator to wirelessly receive load management information, which can significantly reduce the potential for costly and dangerous overloading.

All PL series pipelayers are built on the Caterpillar® legacy of offering customers high value machines that are purpose-built for pipeline work. The PL series pipelayers are designed for long life, serviceability and rebuild capability to help keep owning and operating costs low. 

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NEW 2018

360° bevel measurement with laser profilometry, ideal for onsite welding, providing customers with optimal fit-up and guaranteeing that all bevels are approved before welding.

This new solution reinforces the reliability and accuracy of quality controls for the most demanding requests, namely Clad Pipelines and Steel Catenary Risers, where root pass welding is highly impacted by the quality of the bevel itself.



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A VALLOUREC COMPANY

PRINOTH GmbH, Germany

PRINOTH GmbH – formerly AHWI Maschinenbau GmbH, located in Herdwangen (Germany) – constitutes the vegetation management division of PRINOTH; a manufacturer of snow groomers and tracked utility vehicles based in South Tyrol (Italy). PRINOTH GmbH holds the latest developments and innovations in agriculture and forest management as its top priority.

The company's carrier vehicles RAPTOR 300r and RAPTOR 800 are specially developed for the most challenging works, such as heavy clearing in preparation for pipelines, vegetation management around pipelines and power lines, and for the creation of firebreaks and re-cultivation tasks. The product ranges combine low ground pressure, productivity and reliability.

The RAPTOR 300r is a unique machine for pipeline and/or right-of-way maintenance, as well as mulching operations on rough or swampy terrain where low ground pressure is important. Its exceptional undercarriage with rubber tracks adapts to all types of grounds or obstacles, and allows you to easily cross roads.

The CAT- C7.1/275 hp – Tier4 Final Engine output is mechanically attached to the rotor of the mulcher (no hydraulic power losses compared to hydraulic driven mulchers). It is a reliable and highly efficient low ground pressure machine with all modern features. Additionally, the 3-point linkage allows flexibility on the attachments.

The main features of the RAPTOR 300r include:

- Rubber tracks – low ground pressure of 3.77 psi.
- Excellent all terrain mobility – can be used in all soil conditions, even up to 4 ft in water.
- Cabin – maximum comfort and safety standards.



RAPTOR 300r at work.



Land clearing with the RAPTOR 800.

- CAT- C7.1/275 hp – Tier4 Final Engine – average fuel consumption of 6 gal./hr.
- Maximum power to the mulching head; no hydraulic or cooling losses.

The RAPTOR 800 Heavy Duty Drive Line (HDDL) is the biggest machine of the new generation of carriers. The unit combines productivity, heavy duty and reliability. Everything is designed for durability, ease of maintenance and a high level of efficiency. The high performance, electronically controlled 6-cylinder Caterpillar C18 – TIER4F engine generates 640 hp and a maximum torque of 26 119 lb/in.


The optimum weight distribution and low centre of gravity make the RAPTOR 800 an ideal low ground pressure tracked vehicle for all terrain conditions. The safety frames for roll over protection structures and falling object protective structures run around the outside of the cabin and provide protection from falling objects for both the driver and the cabin itself during heavy work.

The new, patented Power Belt system that drives the mulcher head increases the amount of power transferred from the engine to the mulcher head, resulting in productivity increases and cost savings.

The main features of the RAPTOR 800 include:

- Steel tracks (32 in.) – ground pressure of 5.9 psi.
- Excellent all terrain mobility.
- Cabin – 'best in class' cab with ergonomic position of all controls.
- Low fuel consumption with strong CAT 6 Cylinder turbo diesel engine – 640 hp, Tier4F.
- Efficient power transfer provided by the new patented Power Belt system (HDDL).

With the company's high performance mulchers and robust carrier vehicles ranging from 200 - 640 hp, PRINOTH GmbH provides sustainable solutions for clearing and recultivating forest areas, clearing streets for power lines, and transforming unused scrubland into areas that can be used for agriculture or forest management.

PRINOTH is part of the High Technology Industries (HTI Group). 

Sharewell HDD, USA

For years, operators, contractors and owners alike have been sharing ideas in an effort to make vacuum lifting systems a better and more efficient tool. The need for smart, cost-effective technology is never ending, and Pipeline Equipment Solutions (PES), along with Sharewell™ HDD, are two companies delivering on that need. PES has designed and engineered the next generation in vacuum lifting systems. The PipeVac™ lifting system is manufactured in the US and distributed by Sharewell HDD.


One lifting system is all you need for virtually any size project, big or small. The HLS-26t has a lightweight frame, yet still safely delivers a maximum lifting power of 57 200 lb (26 t). The vacuum system is driven by the auxiliary hydraulics of the host machine so the need for an onboard power source – most commonly, a diesel engine – is no longer required. The hydraulic-driven system delivers a significant cost savings compared to diesel and gas engines. Fuel costs can easily reach US\$400/month, and with the PipeVac, that is just the start in the savings department. The highest maintenance and weakest link in a traditional vacuum lifting system is the diesel engine. PipeVac has successfully eliminated the diesel engine, delivering the user a quiet, smooth and maintenance-free power supply. Simply install the system and go to work. No need to rent or purchase a spare lifting system just in case your primary one fails – those days are in the past.

The PipeVac has a new vacuum pad design that sets the bar. Safely achieving a variable range design was the initial goal, and the PES design team delivered.

Eight vacuum pads will safely lift steel pipe diameters ranging from 4 - 48 in. OD (custom vacuum pad applications are also available).

The same exotic steel used to fabricate the PipeVac is used to manufacture the vacuum pads. Extreme temperatures are commonplace in the world of pipelines and, not only is the PipeVac safe to operate in temperatures ranging from -40°F to 140°F, the vacuum

pads are as well. Some manufactures claim to be safe to operate in frigid environments, yet use inferior materials and components. All PipeVac products are designed and engineered to perform in some of the world's nastiest environments; a failure or the need for a spare system is not an option.

The additional features on the PipeVac are all standard to the system, requiring no add-ons. GPS with productivity data tracking, a 125 mm adapter, liquid-filled gauges, aluminium push-lock vacuum fittings, stainless steel bolts and fasteners, a lightweight and portable shipping and storage system, and cutting edge wireless technology are just a few of PipeVac's standard features. The lifting system is CE certified, OSHA compliant and proven in the field. 



Contractor stringing 36 in. OD x 40 ft long steel coated pipe with the PipeVac in Venus, Texas.



Contractor unloading and racking 20 in. OD x 40 ft long steel coated pipe with the PipeVac in Cushing, Oklahoma.

Suxxesion, the Netherlands

Pipeliners are in action all over the world in the most remote locations. The lifetime of a pipeline is typically 30 years. Damages caused by logistics, choice of material, choice of coating, internal corrosion, external corrosion and tension corrosion are all factors that influence a pipeline's lifetime.

Steel pipes are used in the construction of onshore and offshore pipelines. The pipe used for onshore pipelines are stored at temporary storage yards along the line's stretch.

Corrosion starts when the external coating on the pipeline is damaged, and this damage commonly occurs when handling and storing the pipe before stringing.

Steel pipe is used for long distance pipelines transporting oil and gas. Consequently, the pipes can become susceptible to magnetisation. A frequent cause of magnetisation on steel pipelines is 'residual magnetism', whereby magnetic fields are created during the manufacturing and/or coating processes. To prevent residual magnetism in the pipe, vacuum lifting equipment is utilised. Vacuum lifting enables the steel sheet

to be offloaded from the truck/wagon and stacked. Magnetic handling is a primary cause of residual magnetism, creating problems when welding the pipes together when the welding plasma is pulled or pushed in one direction.


At the end of the production line, the pipes need to be stored before shipment to the coating plant. In some cases, the pipe coating yard is situated directly after the pipe production plant.

Pipes can be handled by bridge or gantry cranes equipped with dedicated vacuum lifting equipment, which is able to handle one or more pipes per cycle. It is also possible to handle the pipes with pay loaders, reach trucks or knuckle boom cranes.

When the pipe leaves the production plant it is either transported by rail, road or vessel. With dedicated vacuum lifting devices, rough coated pipes can also be handled.

With vacuum lifting devices, the coating and bevelled ends of the pipe will not be damaged.

For offshore application, in waters to a depth of 400 m, the pipes require a concrete lining for ballasting and protection of the pipeline. Here, it is no longer possible to handle the pipe with a vacuum lifter due to the porosity of the concrete lining and the specific weight per metre of the pipe. Instead, dedicated pipe spreaders are used to handle the pipes. They use a soft touch system when hooking in the pipe ends so that they are not damaged. Additionally, the hooks are covered with plastic caps to prevent internal damage of the pipe.

A good example of total logistic operation is the recently finished Nord Stream project, where vacuum lifting operations took place at EUROPIPE's production plant in Germany, Mülheim Pipecoatings GmbH's plant in Mülheim (Germany) and OMK's plant in Vyksa (Russia). Here, the pipes were handled with vacuum lifters at the storage yard and in the factory halls, in order to load the trains and trucks that travelled to Kotka (Finland) and Mukran at the Isle of Rügen (Germany). The rough coated pipes went to the concrete lining yards. After the concrete lining, the pipes were loaded into the supply boats with dedicated double pipe spreaders. 



15 t Suxxesion pipe handler RHKV 180 integrated in a Sennebogen materials handler.



60 t Suxxesion type DEHK 600 hydraulic pipe lifter loading a supply boat with concrete lined Nord Stream pipes suspended from a Liebherr HMC 550.



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FOR CORROSION PREVENTION



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Tesmec Group, Italy

Tesmec Group has been working in the pipeline sector worldwide for over 30 years. The company's digging technologies provide efficient operations on the worksite, high quality excavation and is able to complete the job faster than with an excavator, always keeping environmental sustainability in mind.

Currently, in Kuwait, the chainsaw trenching machine model TRS 1150 CS is working on the Lowers Fars Heavy Oil Development project to connect two pipelines and one fibre optic line:

- 163 km export oil pipeline of 24 in. pipe.
- 83 km fuel gas pipeline of 24 in. pipe.
- 350 km fibre optic line cable.

The Tesmec chainsaw trencher ensures minimal over-excavation, as well as regular trench walls and floor.



Tesmec 1150 chainsaw digging in Kuwait.

In particular, the Tesmec machine involved in this project is the TRS 1150 CS with a 440 hp CAT C13 ACERT engine, which is equipped with a double configuration: one single chain boom of 5 ft x 16 in. and another 10 ft x 36 in. sectional boom that can reach up to 3 m depth.

The machine is equipped with the TrenchTronic: an electronic system that makes the trenching machine easier to use and increases productivity, making it less dependent on operator skills. The machine is also equipped with the remote monitoring system (Re.M.) that provides operating, maintenance and troubleshooting information to improve machine's performance. All the operating parameters, diagnostic data, engine and hydraulic system data are transmitted by the GPRS system, and can be accessed from a remote PC anywhere at any time, with the sole need of an Internet connection so the customer can monitor the machine from his laptop.

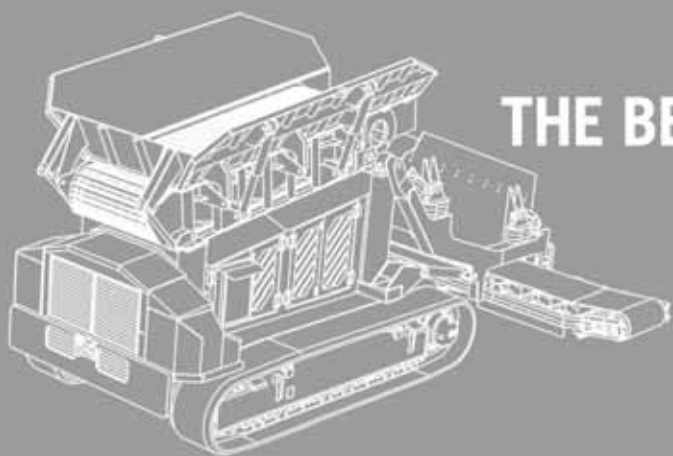
This machine is the bestselling Tesmec trencher for mid-size pipelines and underground utilities, and provides the best cost-efficiency and productivity for excavation in hard rock as well.

Tesmec Group is extremely focused on technical services activities to support its customers, and to improve productivity, efficiency and quality of the work. Actually, for the Lowers Fars Heavy Oil Development project, Tesmec not only supplied the machine, but also proposed a service contract with site survey and a feasibility study, offering all its technological support providing a full training package with a professional engineer onsite for six months to train the customer's mechanics and operators, as well as to supervise the jobsite. The company can rely on a team of experts having knowledge at a worldwide level. Tesmec engineers and technicians are always available to provide commissioning activities and support for machine operation. In addition, Tesmec is able to provide support with feasibility studies, work time evaluations and estimation to help the customer to perform the planned work. 

CONSTANT INNOVATION IS THE FIRST STEP TO SUCCESS.



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Vacuworx Global, USA

Jones Logistics recently completed a large diameter pipe handling job for Enbridge's Valley Crossing, a US\$1.5 billion intrastate natural gas pipeline project extending 168 miles to Brownville, Texas from the Agua Dulce hub west of Corpus Christi (USA).

Jones secured a contract with Bolt Logistics-Express to transport lengths of welded steel pipe with diameters of 42 in. (1066 mm) and 48 in. (1219 mm), weighing between 25 000 lb (11 t) and 35 000 lb (16 t), and with wall thicknesses of up to 1.20 in. (30 mm). The pipe was initially hauled to laydown yards in Robstown, San Benito and Brownsville, then subsequently loaded back on the contractor's trailers and set for delivery to the right-of-way.

Robert Helmer, Site Supervisor for Jones, said safety and efficiency are what originally drove the Mississippi-based company to adopt Vacuworx vacuum lifting systems as its primary method of handling pipe more than seven years ago.

For this job, the contractor employed three RC 25 vacuum lifters to handle loading and unloading the heavy pipe at all three of its storage areas. With a lift capacity of 55 000 lb (25 t), the RC 25 is the newest and largest model in the RC Series, designed specifically to work with large diameter pipe for energy and infrastructure projects, as well as material handling at port facilities, pipe mills and storage yards. Jones chose to work with the standard diesel powered RC 25, but there is also a hydraulic 'H' model available.

All RC Series vacuum lifting systems feature wireless remote operation from the cab of the host machine and 360° rotation to position materials without the need for tag line operators on the ground. In addition, vacuum lifting allows faster load and unload cycles with less downtime than conventional methods since there are no slings and chains to hook and unhook, and the technology virtually eliminates damage to materials and coatings without having to take extra precautions.


The principal components of the RC Series vacuum lifting systems are a vacuum pump driven by a diesel engine or hydraulically powered by the host machine; a vacuum reservoir

and valve to provide vacuum even in the event of a power failure; interchangeable pads designed to handle different materials; and visible and audible vacuum alerts.

The vacuum pump maintains a constant vacuum in the pressure reservoir. When activated, the system pulls a vacuum between the pad and the pipe or material to be lifted, providing a powerful positive seal. Specially engineered Tough Seal™ pad seal is used on the vacuum pad to cover the object to be lifted and create the necessary suction. The vacuum seal will hold until the operator activates the release.

Helmer said that removing the need for tagline operators or additional flaggers automatically equates to safer and more productive worksites, comparing the system to less contemporary methods of pipe handling that are dependent on hooks, straps or cables. Ease of maintenance, quick turnaround times on service calls and access to overnight shipping on parts 365 days a year all factor into Jones' pipe handling strategy, which revolves around the assurance of maximum uptime and keeping workers out of harm's way.

Versatility, Helmer said, keeps the company coming back for more, as the Vacuworx machinery frees workers to perform other high priority tasks while blunting the hard cost of material handling in the field.

Enbridge's Valley Crossing project by the Comisión Federal de Electricidad includes the construction of a header system of more than 5 billion ft³/d near Agua Dulce in Nueces County. The 168 mile cross-border pipeline is slated to intersect with the Sur de Texas-Tuxpan pipeline, which will extend into Mexico. The project, set to come online in late 2018, is intended to provide natural gas transportation services to help meet the growing electric generation needs in Mexico. 



A Vacuworx RC 25 vacuum lifting system joined with a CAT 385 excavator handles 42 in. and 48 in. dia. natural gas pipe in south Texas.



Vacuworx vacuum lifting technology offers a safer method of handling large diameter pipe in the field.

Vermeer Corporation, USA

Pipeline right-of-way work is demanding. Before installation work can begin, land clearing crews must clear the way using the most productive methods possible. To conquer these challenging projects that are often rushed for time, contractors need quality land clearing machinery that can get the job done. And at the heart of most land clearing operations is a self-propelled track horizontal grinder for processing wood waste from trees.

Vermeer offer three sizes of self-propelled track grinders, including the feature-packed new HG6800TX horizontal grinder.

The HG6800TX horizontal grinder is engineered to produce large volumes of ground materials. With a 950 hp (708 kW) engine. This 92 000 lb (41 730.5 kg) class grinder is powerful, compact and manoeuvrable with 26 in. wide double grouser track pads and travel speeds of 2.8 mph (4.5 km/hr). An optional DT6 integrated dolly transport system is available to eliminate the need for trailering the grinder when moving locations.

“The HG6800TX grinder is designed to help large scale land clearing contractors maximise productivity and efficiency,” said Jeff Bradley, Product Manager for Recycling and Forestry equipment at Vermeer. “The feed roller on this machine can climb up to 50 in. (127 cm) to help tackle the tough material elements that land clearing contractors often come across.”

The new infeed on the HG6800TX grinder was designed with low sidewalls to help the operator more easily load material into the machine. This feature allows larger loads to be dropped on the infeed with less interaction and manipulation of the material, so the operator can drop the load and focus on the next one.


The Vermeer HG6800TX grinder features the patented Series III duplex hard faced drum. In addition to providing long lasting durability, maintenance time is decreased with the ability to remove and flip or replace single hammers, as well as being able to externally balance the drum.

The grinder is equipped with Vermeer SmartFeed and thrown object deflector (TOD) technology.

SmartFeed optimises machine performance and production

electronically, and also allows the operator to focus on loading raw product and move finished product about the jobsite. This function stops and reverses material from feeding into the hammermill when the engine’s rpm drops below efficient operating range. Vermeer TOD decreases the quantity and distance of thrown objects, which allows the machine to be operated in a smaller ‘safe’ work zone. The TOD is hinged and can be raised or lowered with the remote control depending upon grinding applications.

Remote operation allows the operator to engage tracks for onsite manoeuvrability, and view and change a variety of settings during operation while monitoring various engine parameters from inside the loader cab or in a remote location.

The Vermeer HG6800TX grinder can be outfitted with the Vermeer Damage Defence system, which reduces the likelihood of major machine damage caused by certain metal contaminants entering the hammermill. If the mill comes in contact with metal while grinding, the Damage Defence system will alert the grinder control and automatically initiate the shutdown process. The system idles the engine down, reverses the infeed and disengages the clutch. Once the contaminant is cleared, normal operation can then resume. 




HG6800TX land clearing.



HG6800TX clearing neighbourhood.

Plasma use on the line





Michelle Avila, Hypertherm Inc., USA, discusses safety, speed and quality aspects of plasma arc cutting for pipelines.

With natural gas responsible for fulfilling nearly a third of US power needs and heating half of all US homes, the need for efficient delivery is critical. Owners of the nearly 3 million miles of pipe that crisscross the US are constantly working to maintain the flow by upgrading, expanding and, in some cases, building new lines aimed at linking natural gas production areas and storage facilities with consumers.

As anyone in the pipeline business knows, it is a never-ending process. To keep up and, at the same time, continuously improve the network, pipeline owners are constantly looking at better and faster ways of getting the job done. This includes replacing

oxyacetylene cutting and carbon arc gouging with plasma arc cutting.

Mark Marshall, a Welding Engineer at Energy Transfer Partners – one of the country's largest energy companies – is among those impressed with plasma. He explains: "It's an excellent process. It doesn't matter if you're cutting or gouging. There's no soot, very little mill scale. You can cut pipe through the coating with no problem whatsoever, and it doesn't disturb the coating or mechanical properties of the pipe [...]. It's a very clean process compared to oxy and, not to mention, with oxy you have a potential for back injuries from lifting the bottles and stuff. You don't have that problem with plasma. It reduces back injuries from not having to handle the bottles."

For those reasons and more, Marshall notes that several major contractors for Energy Transfer Partners now use plasma. Those contractors include some of the most recognisable names in the industry, such as Associated Pipeline, MPG, U.S. Pipe and Willbros.

Plasma cutting

James Wingo, a Welding Manager for Willbros, believes that the time and cost savings from plasma cutting are substantial. "For every day of plasma cutting, you are looking at three days of oxyacetylene cutting," Wingo states.

Figure 1. Welders prefer gouging with plasma rather than carbon arc on the pipeline for the control it provides.

To demonstrate, Wingo talked about a recent job he carried out. Working on two lines — one with 6 miles of 24 in., 375 wall pipe and the other with 7 miles of 30 in., 406 wall pipe — Wingo used two plasma torches mounted on a Mathey Dearman pipe cutter to bevel 57 pups in 6.5 hr. While one torch bevelled, the other back bevelled. Wingo is certain that number of cuts would have easily taken three times as long using oxyacetylene. Wingo says no one in the pipeline industry ever dreamed this was possible.

Wingo's work was made easier by his selection of two Freedom 38 PPA units from Hypertherm. The units are self-contained, combining a 38 kW generator and air compressor, in addition to a 125 amp Powermax125 plasma system. The unit is small enough to fit on the back of a welding rig, trailer or Marooka buggy, making it easy for pipeline crews to move the plasma quickly along the right-of-way.

The Powermax125 that comes with the Freedom is capable of piercing 1 in. thick material. It is also able to



Figure 2. Major pipeline contractors like Willbros use an all in one unit like the Freedom 398 PPA unit from Hypertherm.



Figure 3. The greater control offered by the use of plasma rather the carbon arc to remove welds provides piece of mind for welders who no longer have to worry about blowing a hole through the pipe.

cut 1.5 in. thick material at a speed of 18 in./min. The availability of several torch options allows the crew to cut by hand when needed, or use a machine torch as Wingo did.

In addition to bevelling pipe, pipeline contractors are using plasma to cut pipe to size and gouge out welds needing repair. Wingo says he has even used the Freedom units to cut pad eyes, making it a great investment. Before the arrival of the Freedom, these crew members would have used three different processes to do that work: oxyfuel, air carbon arc gouging and grinding.

Oxyfuel

Oxyfuel — a process that uses a fuel gas and oxygen to burn through metal — has several drawbacks, including the fact that it is slow. While great for cutting 2 in. and thicker slabs of metal, oxyfuel is not the best choice for pipe used to construct pipelines since the thicknesses are typically well below 2 in. Another drawback to oxyfuel is that preheating is required. An operator will need to heat up the pipe before attempting the cut, and then burn back the coating found on nearly all pipes.

All of this takes time. As a result, a dozen people (an entire crew) might spend half an hour waiting for one person to cut a section of pipe that is needed somewhere down the line. As one pipeline worker explained: “A pipeline is like an assembly line. One slow down affects everyone on the line.”

Then there is the use of fuel, whether acetylene or something else, and large pressurised containers of oxygen, which welders need to keep close at hand. These cylinders are heavy, weighing upwards of 150 lb apiece and are hazardous. Department of Transportation regulations state that an operator can only transport one or two cylinders at a time. When he runs out, which is sure to happen in the middle of the day, he has to stop what he is doing, hop in his truck and make an often long, roundtrip



Figure 4. Automated pipe cutting machines like this one from Mathey Dearman are making it easy for pipeline contractors to make smooth and accurate bevelled edges using plasma.

journey back to the main staging yard for another couple of cylinders. The crew on the line? They just keep waiting.

On the line, crews have found that when using the plasma for tie-ins, cutting the pipe can be completed in 7.5 min. With oxyfuel, the same job takes 27 min., nearly 20 min. longer, assuming everything goes smoothly with no unexpected trips back to the yard for additional cylinders.

The speed with which cuts are made is just the beginning though. The quality of the cuts also counts. The cuts need to be formed with just the right amount of bevel so a welder can come in and properly join the pipe to the line. The Powermax plasma found on the Freedom unit excels here, making accurate and smooth cuts that eliminate secondary work for the crews on the line.

Repairing welds


Perhaps the toughest job for any welder on a pipeline though is weld repair. When a weld does not pass inspection because of a defect picked up during radiographic or ultrasonic testing, a welder needs to come in to remove the old weld before creating a new stronger weld. Ask any welder to name their biggest fear while doing this and they will tell you it is accidentally burning a hole in the pipe. If that happens, the pipe is history. It cannot be repaired. A crew of people will need to come in and replace it completely.

Before the Freedom, welders would have used air carbon arc gouging: an electric arc at the end of a

carbon rod melts the metal, while a continuous blast of compressed air blows it all away. The arc is bright and intense like a small ball of fire; the compressed air violent and powerful making it difficult for any welder to see past the molten metal flying at him. Fumes and an extremely loud noise fill the air. Even with earplugs – mandatory if the welder wants to keep his hearing – and a mask, he is still exposed.

However, with the Freedom's plasma unit, welders can carefully gouge out the weld. Molten metal is pushed out of the groove less violently than with air carbon arc gouging. Less molten metal vaporises and fewer sparks fly through the air. The welder can see what he is doing, giving him more control. More control means the chances of accidentally melting a hole in the pipe are much lower. Fewer sparks flying through the air means there is less risk of a fire breaking out. Air carbon arc gouging will shoot flames at least 15 ft away from the source. If it is windy, even further.

Conclusion

Take the safety attributes of plasma, along with the speed with which cuts are made, the quality of the cuts and greater control when gouging, and it is easy to understand why pipeline companies are sold on plasma. Gas companies are also excited by the use of plasma as it results in about half the heat input going into their gas pipelines. 

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Figure 1. The stringer bead brush is ideally suited for cleaning of weld passes.

A competitive edge

Maria Cartier, PFERD INC., USA, explains how demands on the pipeline industry for efficiency and high quality of work have never been greater.

Supplying tools to the North American pipeline industry has never been more crucial. Growth in the oil and gas production industry has created a need for new pipelines. Intense scrutiny resulting from an increase in regulatory and political pressure means that every foot of every pipeline has to be as flawless as it possibly can be during construction. Abrasives are one of the most important tools in the building and laying of today's pipelines projects. Those working in the pipeline industry demand tools that meet the highest standards of functionality and quality.

Challenges

The pipeline industry poses some unique demands for specific solutions in order to meet these challenges head on. PFERD INC. – a US subsidiary (based in Milwaukee) of August Rüggeberg

GmbH & Co. KG – is a leading manufacturer of abrasives, brushes and power tools. PFERD has invested not only in products that meet the requirements of this market, but also in being the dedicated resource to support pipeline construction workers from an applications perspective. Michael Roche is the National Pipeline Accounts Manager for PFERD, and brings extensive experience and a long history of serving the pipeline industry. The combination of PFERD's experience and expertise, along with Roche's 50 plus years focused in the pipeline market, means that pipeline workers get the products and support they need to meet the day to day challenges they face.

“We have leveraged our experience and know-how to produce tailor-made solutions for specific applications in pipeline construction. These are a few of the reasons why the pipeline contractors who build many of the major oil and gas

(midstream) pipeline projects turn to PFERD for solutions,” says Roche.

Pipeline replacement projects

In addition to a number of new projects in the works, there is also a need to replace some existing lines that are over 50 years old and are that not able to supply the needed products based on today’s demands. Some of the major US projects set for the coming year include: the Dakota Access project, consisting of 1168 miles of 36 in. pipe through North and South Dakota, Iowa and into Illinois; the Sabal Trail project, consisting of 465 miles of 36 in. pipe from Alabama through Georgia and into Orlando; and the Rover project



Figure 2. POLIFAN®-CURVE radial flap disc easily reaches into fillet welds for a smooth finish.



Figure 3. PFERD’s ECAP® brush gets into tight bevels, even on heavy wall pipe.

consisting of 713 miles of 24 in. and 36 in. pipe through Michigan, Ohio, Pennsylvania and West Virginia. Additionally, the Nexus pipeline project is just getting underway. It will consist of 225 miles of 36 in. and 42 in. pipe, starting in Michigan and extending into Pennsylvania.

PFERD tools are developed with quality and focus on optimising productivity and cost-effectiveness. No matter which processing tasks need solving – whether it be pipe cutting, grinding the hot pass weld, cleaning the fill passes or buffing pipe bevels to remove rust and deburring the bevel – users can be confident that these abrasive tools will stand up to the job. They are guaranteed to have the best products for the most optimised process possible. Given PFERD’s portfolio breadth, the company offers a wide range of products and solutions that can be used throughout the various stages in pipeline construction. Whether it is a standard or reinforced grinding wheel or flap disc to reform or clean a damaged bevel, stringer bead knot wheel to clean weld passes, scratch brushes to remove rust or scale, or even files to get at hard to reach bevels, PFERD is a reliable partner in this industry.

Files

“Files are an important tool in this industry. They are an everyday tool in pipeline construction and, as such, reflect the importance that they are well designed and well made,” states Roche. “PFERD offers the choice of files with or without handles. The ergonomic file handles from PFERD guarantee maximum working safety. The shape and design principle protect hands from sharp edges and corners. These files have reduced injuries on more than a few occasions and are vital to every contractor’s construction supply list,” he explains. PFERD has manufactured files for over 200 years, and are global experts in this field.

Roche continues: “Obtaining end user input, coupled with monitoring industry trends, is part of PFERD’s product design process. The results of this can be seen in some of the new products developed for key applications, such as weld cleaning and slag removal.”



Figure 4. PFERD’s COMBITWIST® knot construction provides aggressive and effective brushing action for cleaning and deburring.

Brushes

An important offering in the PFERD portfolio are power and maintenance brushes. As an industry leader in this category, the company not only offers a standard range of products, but also designs and manufacturers specials based on specific customer requirements. Imre Karetka, PFERD Product Manager, Brushes, states: "Stringer bead knot wheel brushes are the bread and butter of the pipeline construction business. Everyone's using them, largely for weld cleaning, typically in 6 7/8 in., 6 in. and 4 in. dia. sizes on an angle grinder. They're a real workhorse."

Why? Because of their design. The knots of these brushes are tightly twisted for low flex, high impact brushing action and longer service life. They are ideal for root and hot pass weld clean up during the pipe joining applications. Though closely identified with pipeline work, the stringer bead knot wheel brush is also employed effectively in general use, including any time there is a need for a narrow face, aggressive brush in a controlled, confined surface area.

PFERD also offers knot wheel and cup brushes with the unique COMBITWIST construction, widely employed in the pipeline business. COMBITWIST is a variation on existing knot styles, in which the knots are alternately twisted to offer a number of advantages during operation. "This distinctive orientation of the knot is something that none of our major competitors do," says Karetka. "This helps to ensure that this brush will cut faster in many applications, because every knot is oriented in a different direction. It also means that the brush is better balanced, reducing vibration for greater operator comfort and reduced fatigue for the long haul."

This construction style offers a more aggressive and effective brushing solution for cleaning and deburring applications. Aside from more aggressive brushing, it also delivers longer brush life, faster stock removal and a better surface finish, in addition to the aforesaid superior rotational balance.

Additionally, PFERD's patented TWIN-NUT variation of the

stringer bead wheel (also available in the COMBITWIST knot style) is playing an increasing role in pipeline construction. That is because its unique patented nut design solves the problem of brush interference with the guard when changing the mounting position of the brush on the grinder, resulting in a greater degree of operator safety.

Karetka notes: "Reversing the mounting position of the brush takes advantage of the self-sharpening effect of the wire. This results in longer service life and improved brush performance."



KNOWLEDGE SHARING

“ I have worked in the corrosion industry for 20 years. NACE training and certification helped me get a major promotion as a QC manager. It's given me the chance to exchange knowledge with other third-party inspectors and most importantly, our fellow workers—blasters, painters, and inspectors. Being certified is a statement of recognition.”

— Alexandre Racine, NACE CIP Level 3 Certified, Quality Control Manager/EHS Coordinator at Drytec Trans-Canada

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He stresses that COMBITWIST and TWIN-NUT stringer bead brushes have an aggressive knot twist, which is a significant advantage for the user in removing heavy scale and contaminants.


Recent experience is also showing that encapsulated brushes are gaining some traction among the pipeline contractors. The reason for this is that the bristle encapsulation material gradually wears away to consistently maintain a short trim length for more aggressive brushing and longer service life. The elastomer provides precision control of the contact area on the workpiece. PFERD's 5 in. dia. ECAP encapsulated stringer bead wheel, known as the J-BEVEL brush, is ideally suited for cleaning welds and bevels created by automatic orbital welding equipment. It features an extra long 1 1/4 in. trim length, allowing the brush to reach into the tight bevels used by automatic welders, even on heavy wall pipe.

"Pipe is delivered and stacked in a pipe yard until the right-of-way is cleared, at which point the pipe is then strung," explains Roche. It can take a year before actual pipeline construction begins due to a variety of legal challenges that today's projects typically encounter. All this time, sitting in the open intensifies the need for cleaning rust and debris from the bevels of the pipes, even before any welding begins. PFERD's power tools and brushes meet the demands of this critical operation. Once the actual construction begins, the need for well designed, high quality tools and abrasives intensifies. This is where products such as COMBITWIST comes in. Its innovative design means it can remove scale, rust and slag from pipe surfaces.

Reducing rework and getting the job done quickly are always important considerations in welding. PFERD's POLIFAN-CURVE radial flap disc enables pipeline workers to do just that. Designed for work on fillet welds, this disc's innovative flap design leaves a perfect radius in the fillet, distributing stress evenly for structural stability. In addition, the POLIFAN-CURVE yields a smooth, consistent finish and works faster than grinding wheels without the risk of undercutting the workpiece. A key benefit to this is that the resulting smooth finish allows easy visual inspection for defects, such as porosity and inclusions. Another added benefit is the available abrasive both above and underneath the disc, allowing it to be used as a conventional flap disc with extended life.

"The finish that it provides makes weld inspections easier and far more efficient. It is ideal for repair applications to remove weld defects without damage to adjacent areas and it leaves ample room for a new weld bead," states Roche. He continues, noting that the POLIFAN-CURVE's ability to save time (and, thus, money) can be a significant contribution to the overall success of a pipeline construction or repair project.

Conclusion

Demands on the pipeline industry for efficiency and high quality work have never been greater. PFERD has the range and expertise to help the industry meet those demands with proven tools that can reduce costs and increase productivity on the pipeline jobsite. 

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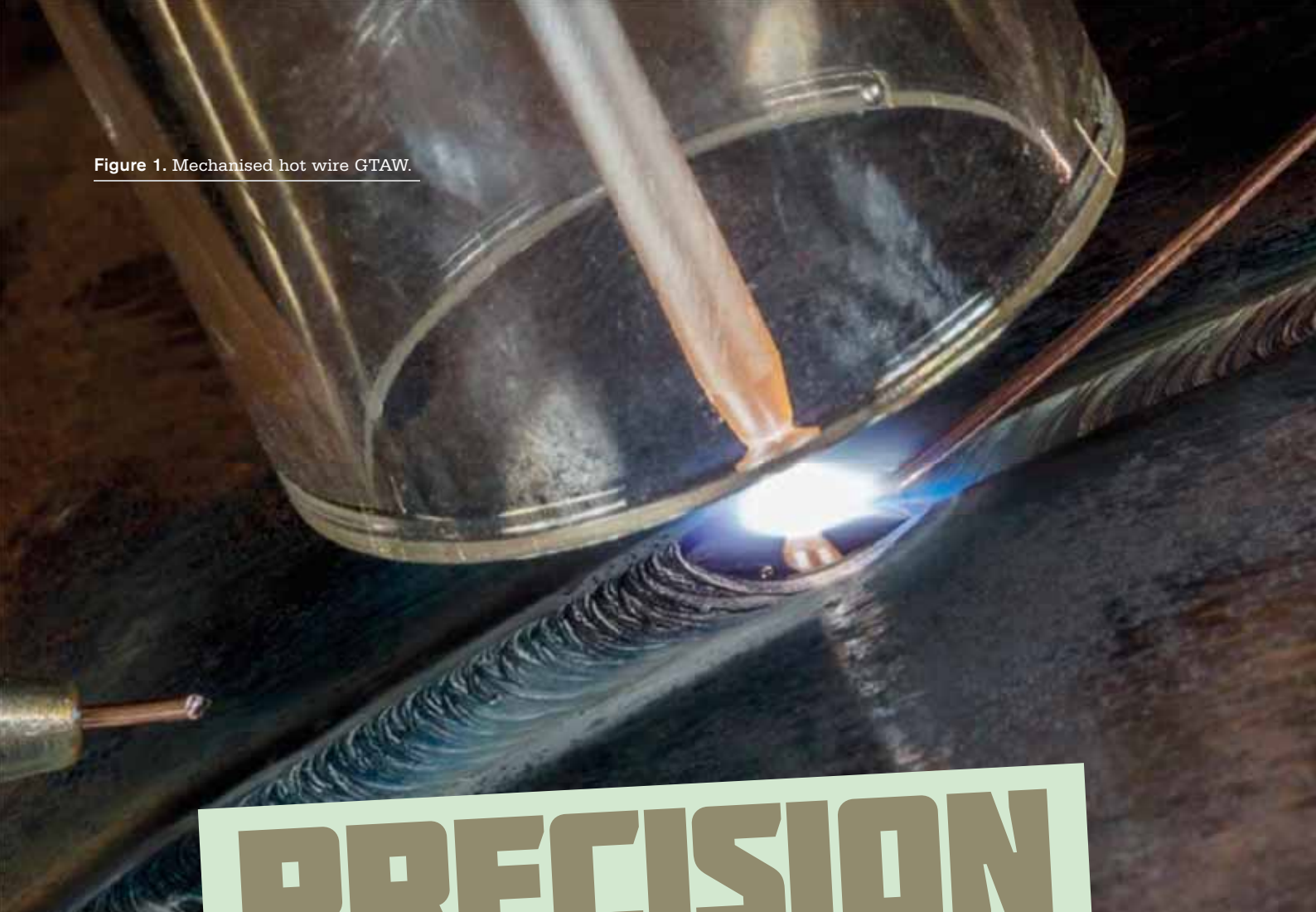


Figure 1. Mechanised hot wire GTAW.

PRECISION WELDING IN MOTION

**David Freeman (USA)
and Steve Peters (USA),
Lincoln Electric Company,**
discuss the benefits of active
arc suppression and its role in
weld critical applications.

Lincoln Electric has been synonymous with pipeline construction for more than a century, ever since the introduction of the first variable voltage, single operator, portable welding machine in 1911. By the 1920s, the company had introduced the Fleetweld®5 coated electrode, which produced up to 50% higher tensile strength and 100% greater ductility than the bare electrodes used at that time. In subsequent decades, World War II and the post-war boom in the US auto industry boosted demand for petroleum products. This, in turn, made welding a critical process in pipeline construction in the US oil industry for the remainder of the 20th century and beyond.

Strictly in terms of pipeline construction methodology, little has actually changed. But, as with all industries, forward progress in technology is inevitable. The successful pipeline contractor understands the importance of staying current

and adopting advanced welding technologies to remain viable in a fiercely competitive market.

As little as 10 years ago, pipe materials such as X80, X90 and even X100 were expected to become the standard within the pipeline industry. The belief at the time was that these higher strength steels would drive welding technology to new levels by offering considerable advantages to the pipeline owner. Among these anticipated advantages were thinner wall thicknesses reducing material and construction costs, and higher operating pressures improving operating efficiencies and reducing operating costs.

But the reality played out differently. The scenario of higher pressure pipelines running through cities and towns was poorly received on the political front. Regional regulations mandated minimum wall thickness to mitigate risk against external mechanical damage. The number of pipe mills capable of consistently manufacturing these high strength materials was limited. These were just a few of the obstacles that stifled the adoption of higher strength pipe industry-wide.

Since those days, the industry has settled on X65 and X70 as the standard for mainline pipelines. So, why should we consider alternative and more advanced welding technologies? The answer lies in the high strength materials being used in manufacturing X65/X70 pipe. The pipe mills cannot be expected to manufacture an X65 pipe with exactly 65 300 psi yield strength, but instead API5L-PSL2 allows a range with the minimum yield being 65 300 psi up to a maximum of 87 000 psi. Similarly, an X70 pipe has a range of 70 300 - 92 100 psi. Along with these parameters is an increasing number of specifications for girth welds extending beyond the

typical specified minimum tensile strength (SMTS) and specified minimum yield strength (SMYS), instead placing specific levels of overmatch and 'at no time should a tensile test fail in the weld' irrespective of the measurement. So, the fact remains: the choice of welding consumable and, more importantly, the welding process has never been more important.

In response to industry trends, Lincoln Electric – or more specifically the Power Wave® platform and its latest 450 amp advanced process power source addition, Power Wave R450 – is a critical pillar in the girth weld as a solution to the higher strength steels requiring low hydrogen processes. In recent years, successful pipeline projects both onshore and offshore have proven many times over that a competitive edge is not derived from a single welding consumable or a specific power source. Instead, it results from the proper combination of consumable, power source (weld process) and motion. The Power Wave R450 provides the intelligence in delivering that balance through the leverage derived from the world's fastest welding communication platform, ArcLink®.

This single platform power source supports the end user by accommodating a broad spectrum of processes, including metal inert gas (MIG), tungsten inert gas (TIG), hybrid welding TIG (HW-TIG) and HW laser. These options allow for more customisation and automation, which improve quality and in consistency on the more technical applications like root pass and out of position tie-ins.

Root pass

Most would agree that the root pass is the most critical weld on the pipe. The R450, used with the advanced module, supports a range of solutions for open and closed root applications, including the gold standard root pass processes: surface tension transfer (STT) and, more recently, the AC hot wire gas tungsten arc welding (GTAW) with active arc suppression for weld critical applications. But, as mentioned earlier, the weld process alone is not enough. The other important factor is the speed at which the power source can manage the arc characteristics and change processes as needed without any detrimental effects to the weld puddle anywhere on the pipe.

As an example, consider a 5G gas metal arc welding (GMAW) root pass in a narrow groove J-prep joint starting at the 12 o'clock position, starboard vertical down. At the moment of arc initiation, the weld strikes a 'relatively' cold pipe and, until the puddle becomes established, any motion (travel) will have varying degrees

of weld indications. These indications will ultimately require grinding to prepare for the port side pass tie-in.

Now, consider the port side weld on the same pipe. Not only is the arc initiating on a relatively cold pipe, but it also has the added challenge of starting on a much greater mass – the starboard weld bead – which acts as a heatsink to the arc.

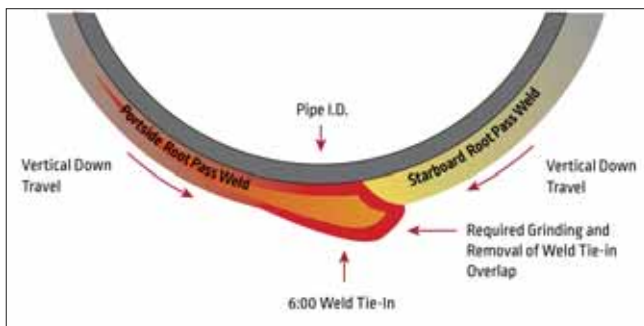


Figure 2. Typical port side tie-in weld at 6 o'clock overlapping the previously ground starboard side weld. In all, four manual grinding processes for each single 360° weld pass.

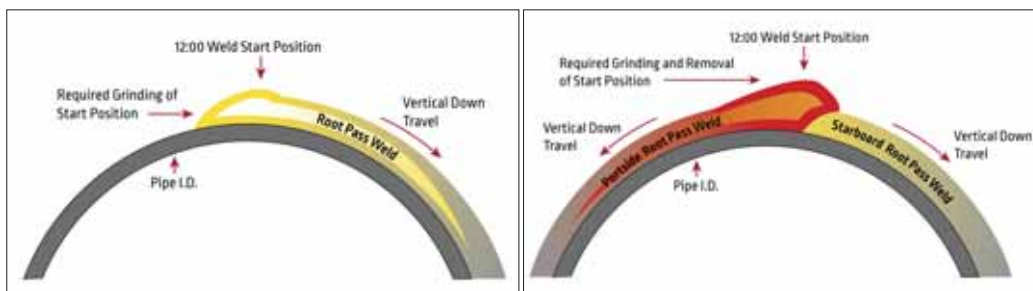


Figure 3. Left: typical starboard side weld starting routine and resulting weld topography requiring secondary grinding process. Right: typical port side weld starting routine beginning at manually ground starboard weld – resulting topography requires a manual grinding process before subsequent passes can be made.



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Finally, consider the port side ending routine at the 6 o'clock position with an established weld puddle travelling vertical down. At 6 o'clock, the operator encounters a change in mass as the root pass topography changes. At the tie-in position, heat is effectively removed from the weld, which increases the risk of weld defects.

The integration of Power Wave and ArcLink communication speeds has changed the way one can approach these challenges. Managing energy, travel and wire feed speeds – a process that was once unreliable and only marginally productive – is now as simple and precise as selecting a waveform that is in sync with weld motion, delivering the highest level of quality.

Pushing technology further

Pushing the pipeline joining technology further with Power Wave, the industry is entering the realm of 5G hot wire GTAW. Lincoln Electric's hot wire waveforms and active arc suppression

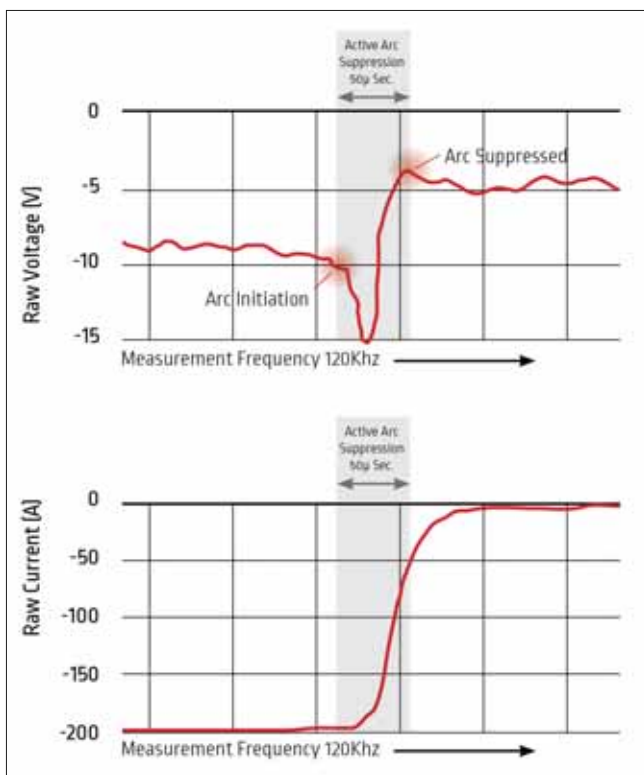


Figure 4. Active arc suppression reducing current from 200 amps to zero in a little over 50 µsec.

TIG (GTAW) is a process of choice when weld metal quality is the primary goal. TIG is one of the few arc processes where the heat input is independent of the filler wire added. The user has the freedom to manipulate the size of the puddle, control the penetration into the base plate and add filler as needed. Starting the TIG arc, establishing a puddle and then adding wire ensure high quality starts and stops.

Hot wire TIG is not a new idea. It has been an established process for the better part of 50 years. But the phrase 'hot wire' is a bit of a misnomer. A more accurate name would be 'warm wire' TIG, since most users operate at a 'comfortable' hot wire current because of complexities in process stability. If at any moment during the weld the hot wire breaks into an arc – even if only briefly – the combination of excessive heat, turbulence and spatter often creates a defect and outweighs the reward of potential faster speeds. This results in reduced productivity in joining applications.

Using Power Wave and patented hot wire modes, Lincoln Electric developed a process that incorporates an active element of the STT module circuitry. In the event that an arc begins to establish, the STT circuitry kicks in to stifle current flow, thus suppressing the arc faster than conventional hot wire power supplies. This allows joining deposition rates to achieve three times that of traditional TIG process.

Figure 4 shows a high speed trace from an arc event. The voltage was dropped to zero in 50 µsec. Inductance in conventional welding leads will keep current flowing into an arc for a much longer time frame – about 500 µsec.

There are three benefits to active arc suppression:

- Reduced puddle agitation: as an arc forms, its force pushes on the puddle, causing it to undulate. The faster an arc is suppressed, the less the puddle jumps around.
- Faster recovery: as an arc is created, it melts wire further back away from the puddle. The quicker the arc is suppressed, the less the gap widens. Only then can the wire feeder push the wire back into the puddle. The result is a faster recovery back to normal hot wire operation.
- Improved AVC operation: high voltage arcing events interact with the TIG arc, affecting automatic voltage control (AVC) units. Active arc suppression reduces the interaction time, thus reducing the adverse effects on AVC units.

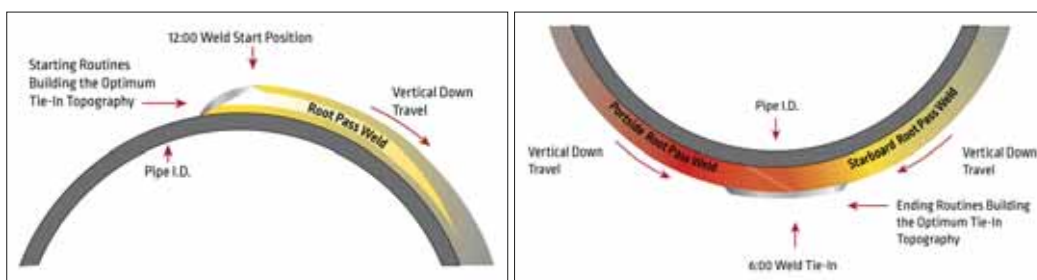



Figure 5. Left: Power Wave and precision welding in motion creating a tie-in friendly topography as part of the automated starting routine with no requirement for a manual grinding process. Right: Power Wave and precision welding in motion with a finishing routine optimised to the ending routine of the previous weld with no additional grinding required.

Lincoln Electric not only understands the challenges facing the industry, but also develops solutions to provide its partners with a competitive edge. Part of that edge is the Power Wave R450, which provides the highest levels of process flexibility and customisation, and real time traceability and connectivity in a single platform, addressing industry requirements from pipeline primes to the right-of-way. 

OPENING THE DOOR TO GREATER PRODUCTIVITY

Scott McDonald, Senior HDPE & Frac Specialist, Victaulic, reveals how a lightweight launcher can simplify the pigging process for layflat hose frac lines.

Pigging lines for maintenance and flow assurance is a necessary exercise and a practical way to reduce the risk of line failure. But, it can be time consuming and costly when using conventional equipment.

The pigging process facilitates line integrity management, allowing buildup and blockages caused by scale, paraffin, asphaltenes, iron oxides and gas hydrates to be reduced to alleviate their impact on production. It also enables corroded areas to be identified and addressed before damage escalates to a point that safety could be jeopardised.

Lines used for hydraulic fracturing operations present particular pigging challenges because low elevation areas in the gathering system can allow liquids to accumulate, causing slugging. Proppants, chlorides and aged chemicals can collect in the line as well, restricting flow and reducing production. The utilisation of layflat hoses in frac lines



offer many advantage – for example, in terms of transport and storage volumes, handling and usage – but they are still subject to common issues such as ice and debris.



Figure 1. Victaulic pig launcher: a lighter union at every joint for easy disassembly and transportation.



Figure 2. Grooved assemblies: easy transition to HDPE.

A line that is not pigged frequently is at risk. Inline inspection delivers better understanding of line integrity, so operators can avoid unplanned downtime for repairing or replacing damaged channels. Routine pigging helps make sure lines are clear, which makes it possible to exercise more control over production.

On projects where many lines need to be pigged frequently, it is possible for a site to require the installation of multiple pig launchers. In remote areas and where extreme weather conditions are a factor, the difficulty of getting pigging equipment to the site poses a significant challenge.

The devil you know

A typical field pig launcher for layflat hose consists of a flanged Y lateral, a wafer valve with a flanged adapter nipple, a flanged gate valve, a blind flange and the bolts that secure the tapped blind flange to the assembly.

Getting equipment of this size and weight to a worksite requires co-ordination and co-operation that often must take into account weather conditions. This is particularly true in many parts of Canada and other cold regions where truck weight is restricted when the roads are not frozen. A complete 8 in. flanged system weighs approximately 730 lb, while a 10 in. flanged system weighs more than half a tonne.

The cumbersome components of traditional launching systems not only introduce logistical challenges in remote areas, they pose operational challenges as well. The flanged valves are difficult and time consuming to install, and require significant force to operate.

Maintenance also can be arduous for pig launchers with flanged valves because the units are difficult to disassemble and reassemble. When flanged valves are incorporated in a system, there is a large amount of force placed on the bottom of the flange. As soon as a wafer butterfly valve comes into contact with any medium, such as water, oil or gas, it immediately swells by a minimum of 5%. Rubber on the inside of the valve pushes back, so any time a valve is being opened, there is an immense force pushing against the liner of the butterfly valve. And, because a special tool is required to remove or install these valves, they are complicated to maintain. Additionally, opening and closing valves multiple times a week can increase the risk of valve seat failure, which increases maintenance costs.

Another issue with many pig launchers is the difficulty in sourcing parts in remote locations. Some companies have turned to local suppliers to purchase Y laterals, colloquially referred to as 'farmer fittings'. In many cases, these components are fabricated by uncertified welders working in facilities that are not CWS listed, which means the shops are not certified for welding under the pressure code. The parts these shops produce in many cases are not well made because they have not undergone appropriate quality assurance and have not been produced with engineering oversight. Welds need to be pickled and passivated to prevent oxidation, and if those processes are not properly controlled, the welds can fail, placing operations and the pipeline at risk.

Breaking tradition

A different way of thinking has led to the development of a pig launcher that addresses all of the shortcomings of the traditional equipment and introduces additional advantages. The primary differentiator is the grooved assemblies that take the place of flanged configurations.

Replacing flanged equipment with comparable grooved components delivers enormous weight savings. The Y lateral, butterfly valve, gate valve and connectors for an 8 in. grooved system weigh only 356 lb compared to the 730 lb weight of a unit made up of flanged parts, while a 10 in. system weighs in at 576 - 522 lb lighter than its flanged counterpart. If a worksite needs 10 pig launchers sized at 10 in., a truck transporting traditional units would weigh 5000 lb more than a truck carrying 10 units made with grooved components.

The lighter weight not only allows for an expanded window for transporting the equipment to the site, but means more payload on each truck when road restrictions are not in place. Fewer trips translates into fuel savings and less wear on the transporting equipment and infrastructure.

Pig launchers made with grooved components also are much easier to operate. Enormous force is required to open and close a flanged valve. Manipulating the hand valve not only requires considerable strength and exertion, it also slows down operations because of the time it takes to execute the process. And, in some cases, applying the extreme torque required to manipulate the valve ends up breaking the stem. These are not considerations for a pig launcher built with grooved valves, which offer better breakaway torque. The grooved valves have an elongated stem instead of the square stems of the valves used in traditional designs, so there is a sort of cheater bar or 'snipe' built in, making it much easier to open and close the valves.

Because of the way the grooved pig launchers are constructed, they can be disassembled easily so the individual parts can be used for day to day operations. Instead of having a unit sitting idle on the site when it is not in use, workers can use the components in other applications. For example, contractors use

grooved couplings to connect layflat hoses, which are commonly attached to pumps, valves, fittings, bypasses and, of course, pig launchers. This allows contractors to simply redeploy grooved couplings and components anywhere in the system much easier than flanged systems.

The ease of assembly and disassembly make the alternative pig launcher a much more versatile and functional tool than its more commonly used counterpart, as it is not possible to repurpose the components of flanged assemblies for other applications.

Simple assembly and disassembly make maintenance of pig launchers using grooved components easier as



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well. The grooved pig launcher has only two bolts per component, while the flanged units generally have 12 or 16 per component. Simplicity in design means fewer safety concerns. For winter operations when the temperature is at -31°F (-35°C) and there is a 24 mph (40 km) wind blowing snow, workers have no choice but to work wearing bulky gloves that compromise dexterity. While field teams are struggling to open flanged valves, they are exposed to the elements. Bolts on a grooved system are removed with an impact gun, which quickly loosens the bolt so a coupling can be taken off to remove a valve and replace it with a new one, or to move the valve to another area on the site.

A grooved, single source pig launcher has a union at every joint. Rugged ductile iron provides greater longevity in the field than is achievable using units constructed of aluminium. From construction to operability, this alternative unit offers advantages over traditional systems.

Putting the new pig launcher to work

In recent applications on a project in northern Alberta and British Columbia, the grooved pig launcher proved its value in the field in the course of a full year of operation.


10 in. assemblies that take 2 hr each on traditional equipment took only 10 min. per assembly using the grooved unit. And the versatility of the grooved pig launcher delivered considerable value on site, with field crews using the components of the system to build layflat assemblies and pump bypasses. During normal operations,

the grooved valves could be operated using less torque and at higher pressure than flanged valves and functioned better than flanged gate valves because of the grooved valve construction, which exerts no force at the bottom of the valve. Because the units are easy to repair in the field or at an onsite shop, crews were able to carry out routine maintenance quickly and efficiently.

The ease of operability, functionality and flexibility have led to the owner's decision to use the grooved pig launcher on additional company worksites.

Challenging the status quo

The persisting lower for longer oil price scenario has had a profound impact on industry, pushing operators to find ways to streamline operations without compromising safety, leading to an increased focus on managing and maintaining assets and improving efficiencies. There is a pronounced need to find ways to do things better and, in many cases, that means doing things differently.

The ability to think about problems from a different perspective is leading to design changes that can disrupt the status quo. Grooved assemblies that take the place of flanged valves have been introduced as an alternative to traditional pig launching systems, making installation, operation and maintenance faster and easier, and allowing system components to be used in other applications. This new pig launcher design is one example of how innovation is opening the door to greater productivity. 



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GIRTH WELD JOINTS AND CORROSION: A SIMPLE SOLUTION

H. Peters, CHLOR RID International, Inc., USA, discusses a simple field solution for pipe joints and other common corrosion problems.

The pipe coating industry currently implements numerous steps for meeting stringent requirements that are meant to prolong protective coating service life for new pipe in pipe coating plants. These preventative measures against corrosion are especially necessary when pipes will be used in immersion or buried service.

It is, however, challenging to translate these deliberate and purposeful steps from the pipe coating plant to the field, especially for weld joints.

New pipe entering the pipe coating yard is tested for surface salt contamination and generally treated with a displacing phosphoric acid solution after an abrasive profiling step. It is then rinsed, dried and coated as a last step.



It is common to coat to within 3 - 5 in. of the end of the pipe section to facilitate welding and coating in the field as completion steps before being placed in service.

The issue of translating the steps from pipe coating plant to the field is also relevant to the remainder of pipe surface areas where coating damage or premature corrosion has occurred, for example. The joint areas, which are purposely left uncoated, are especially vulnerable to protective coating failures, which can start very easily with blister formation from incomplete surface preparation in the field. This, in part, is due to the impracticality of using the same environmentally sensitive chemical products in the field as those traditionally used in the pipe coating shop. In pipe coating plants, entire systems are in place to deal with collection, neutralisation and proper hazardous waste handling of spent chemical waste solutions.

There is a relatively lengthy period of time from coating new pipe to the time it is placed in service in the



Figure 1. Yard storage of recently coated pipe.



Figure 2. Pipe sections being transported.

field. After coating, the pipe sits in the yard and is then transported to the field site. It can have an extended open storage period in the field before it is aligned for welding. Its exposure continues until some cursory surface preparation is done prior to the application of a specified field joint coating, all before burial.

In all this time, the girth weld joint areas are subjected to the corrosive environment of salts, whether simple atmospheric acid rain deposition, the salt from the ocean air and/or salt spray during transportation to its destination. Damaged coating areas, in storage or transportation, are also vulnerable to the same sources of salt contamination (Figure 2).

Note also in Figure 2, the covers placed at each end of pipe sections to protect against internal contamination by salts during shipping and storage: a good practice considering the susceptibility that pipe can experience during these steps.

Relatively speaking, protective coating application at a pipe coating plant has the controlled process environment and conditions, all of which is totally lacking in the field. The issue of time availability to properly prepare the joints after welding is an important factor, as the process in the field needs to move smoothly from welding to burial.

It is commonplace to dry abrasive blast joints after welding pipe sections together to deoxidise the surface of accumulated corrosion products, in order to achieve a specified visual appearance requirement.

The visual appearance specification or reference industry standard prior to coating is insufficient, especially when the pipe is to enter the severe buried service environment.

Any further steps to decontaminate and clean the surface can be overlooked because the pipe coating plant steps are unsuitable for surface preparation in the field. Use of a phosphoric acid wash in the field is much too

cumbersome due to the remote nature of field operations. Furthermore, the need to collect the chemical wash and rinse as hazardous wastes for proper disposal is costly. As such, the important final steps – which would duplicate or emulate surface preparation specifications in pipe coating plants – are not taken.

A good number of pipe failures due to corrosion are located at, or in proximity to, the weld joint. Thus, the lack of attention to this area should be remedied if long-term service and liabilities issues are part of the important risk assessment analysis.

Removing deficiencies

Taking into account issues of time constraint, practical work environment issues and the remote nature of most



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Figure 3. A simple standardised visual appearance is insufficient.



Figure 4. Was this area tested for residual salts?



Figure 5. Vapour blasting with the approved acid salt remover.

pipe projects in the field, a duplication of what transpires on successful tank relining projects have proven to extend life of linings to over 25 years. These measures can be used to remove the deficiencies recognised in completing pipe protective coating projects.

The process starts with the understanding and acceptance that residual surface salts not removed during the surface preparation steps prior to protective coating application are a leading cause of premature coating failure. One would expect this to be well recognised and intuitive, especially with the pipe owner's commitment to make a significant financial investment in the protective coating application at the pipe coating plant to achieve long-term corrosion protection. Furthermore, the recognition that there are tremendous costs associated with recoating and field repair projects because failures can lead to catastrophic outcomes, all which means that the entire process is neither consistent nor seamless.

All coatings are semipermeable membranes, allowing moisture through to the substrate. The presence of residual soluble salts result in the retention of that moisture and, with all the ingredients now available, a corrosion cell can form and the coating blisters. Blisters are the result of cathodic delamination, which occurs not at the anodic defect, but rather the small area around the metal loss pit area where the salt is concentrated and a very acidic environment dissolves the metal. This is manifested as pitting from the metal loss.

The elimination of any soluble salts on the surface prevent the entire mechanism from occurring, so surface preparation has the important requirement of a non-visible specification as well.

Once pipe girth welds are found acceptable, and immediately after the abrasive blasting takes place to deoxidise the metal surface and create the required anchor profile, the pipe should be tested for the presence of residual anionic salt species. NACE SP 0716 addresses the locations and number of tests that should be made. Various documents list numeric limits recommended to prevent premature coating failures. More recent documents – such as the CSA Group (Canada) pipeline standard – gravitate around the limit of $2 \mu\text{g}/\text{cm}^2$ for chloride, as does the NORSOK specification. Soluble sulfate and nitrate levels should be targeted to be less than $7 \mu\text{g}/\text{cm}^2$, to replicate the recommended limits and the success of coating lifecycle performance for linings in immersion.

Salt test kits

Testing with accurate, easy to use, ion specific test kits can be expected to generate the actual anionic salt levels of concern. The CHLOR*TEST kit provides the components available to make an accurate field determination of residual chloride (sulfate and nitrate as well in the expanded series test kit), and is accomplished without confusing arithmetic calculations (or miscalculations). For example, if a single digit limit of chloride is specified, the CHLOR*TEST measures that level with precision and without the need of extrapolation values surrounded

with assumptions that are required with conductivity. Realistically, the measurement of surface conductivity for total extracted conductive species may be indicative of surface condition but cannot, nor is intended to, measure specific anionic limits found in pipeline specifications.

Surface salt decontamination

Once determined that salt levels exceed the specified limit, an environmentally friendly acidic solution can be applied to decontaminate and flush adsorbed salts from the surface. The simple application in a diluted solution with potable water using a pressure washer will achieve the required specified limit. CHLOR*RID is a one time application product that is easy to use, environmentally friendly and has no need for collection and special disposal. There are no adverse effects since the product has proven itself as an effective surface salt decontaminant. And, the steps of washing and retesting to ensure the operator has applied the approved acidic soluble salt remover do not inconvenience or delay the timely process required for final preparation prior to being buried and/or placed in service.


Water and pressure washers are most generally available for field projects as they are commonly used for water washing of new and in-service pipe prior to coating.

Though the recommended measures are intended to address the deficiencies of surface preparation at and around pipe joints, the suggested steps of testing and

environmentally friendly acidic pressure washing also apply to all areas of the pipe. Where damage, coating degradation or corrosion of the pipe coating has occurred during a field recoating project, the process recommended can be used. Reblasting those areas, where the coating has delaminated or where the continuous coating has been broken, can then be treated with the named soluble salt remover to eliminate reoccurrence when placed back in service. As the soil around buried pipelines unearths the pipe for inspection, there is no coating or wrapping system that has not been susceptible and affected by the intrusive and damaging effects of residual salts left on the surface prior to coating or recoating.

Prejudices against an industry transporting hydrocarbons and gas to provide competitively priced products for the market or for value added processing can be quelled with the completion of a corrosion mitigation and prevention process, which starts at the steel forming plant and can be seamlessly consistent all the way through to the in-service step.

Conclusion

To summarise, addressing corrosive salts on pipe surfaces can be achieved in the field, not just in the service yard. Prolonging the service life of protective coatings is achievable by removing surface salts, which will result in many more years of use, extending the considerable investment by the pipe owners. 

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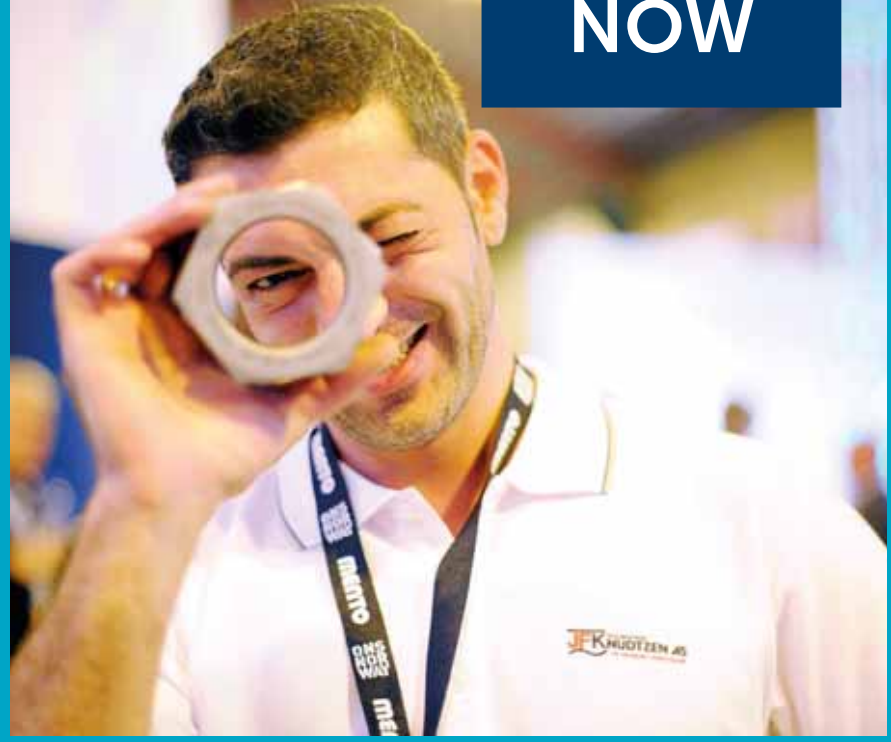


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TESTING FOR HOLIDAYS

David J. Barnes, Elcometer Limited, UK, reviews a pulsed DC holiday detector for anti-corrosion pipeline coatings.

Inspecting a pipeline coating can often be compromised by the climatic conditions in which the pipeline is located, especially when testing the porosity of the coating.

Elcometer Limited has a pulsed DC holiday detector in its product range, which has been designed to make testing with a 'stick type' holiday detector safer, easier and more reliable than ever before. The Elcometer 280 Pulsed DC Holiday Detector uses the latest electronic design principles to generate the pulsed DC voltages required for detecting flaws and defects (holidays) in coatings on metal surfaces, such as pipelines and tanks, even if the coating is damp, dirty or slightly conductive.

It is only one of a range of holiday detectors from the company, alongside the Elcometer 266 DC Holiday Detector and the Elcometer 270 Low Voltage (Wet Sponge) Pinhole Detector,

that offer a comprehensive selection of porosity detectors for coatings applied to conductive substrates.

The pulsed DC holiday detector

Designed particularly for use on coated pipes, the Elcometer 280 Pulsed DC Holiday Detector has a voltage output that can be adjusted by the user in the range from 0.5 - 35 kV, making it possible to detect flaws or holidays in coatings up to 25 mm thick.

The Elcometer 280 sets the standard for high voltage holiday detection safety, from the two-stage safety switch in the handle, through the bright LED's and screen icons signifying when the high voltage is on, to the extended ribbing on the nose cone to protect the operator from spark creep.

The key features of the Elcometer 280 include:

- A rugged, shock-proof and water resistant design to ensure a long service life, even in harsh environments.
- Internal voltage check (jeep tester) to ensure that the selected voltage is equal to the applied test voltage.
- Three indicators of the presence of a flaw – flashing detector display, a bright LED indicator and a user adjustable audible alarm.
- A safety trigger integrated in to the handle cuts the high voltage when released for safe operation. The detector is switched on using a separate power switch on the top of the handle. To maintain the high voltage at the probe the safety trigger must be held closed by the operator. If the trigger is released the voltage is disconnected.



Figure 1. The Elcometer 280 Pulsed DC Holiday Detector with a band brush electrode fitted.



Figure 2. Drips.

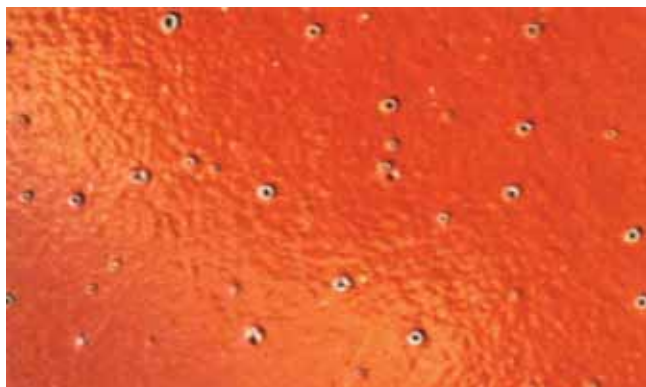


Figure 3. Cratering.

- A balanced, ergonomic design, complete with a shoulder strap to allow long periods of continuous use without operator fatigue. The unit is operated using large waterproof buttons that can be operated by gloved hands.
- A voltage calculator option to set the test voltage to the correct value from the coating thickness value, using well known test standards.
- A wide range of interchangeable probe accessories that are compatible with all Elcometer high voltage holiday detectors.

The Elcometer 280 is available in two user options.

The 'Standard Detector' package has a 5 m trailing signal return cable; a single rechargeable battery pack and universal charger with UK, Europe and US plug options; a rolling spring connection shaft; shoulder strap; and a calibration certificate.

The 'Top' package has all the items supplied with the Standard package, but with an additional battery pack for continuous operation (one battery pack in use while the other is charged) and an additional 250 mm probe extension shaft. In the Top package, all these items are packed in a light weight, rugged, wheeled transit case for transportation to site for remote working.

Coating defects

There are many causes of coating defects and some of the more frequently encountered flaws – which result in discontinuities in the coating – include pinholes, runs and sags, cratering, cissing and incorrect coating thickness. Runs and sags are caused by excessive coating thickness, while pinholes are caused by either air or blast media entrapment. Cratering is the result of air released from the surface of the coating at the point where the coating is partially cured and the coating does not flow back to cover the void created by the air release. Cissing is characterised by surface breaks in the film revealing the substrate and often results from substrates being contaminated by grease or oil. Cissing is also known as 'crawling' or 'fisheyes'. Incorrect coating thickness can also be detrimental to the service life of the coating

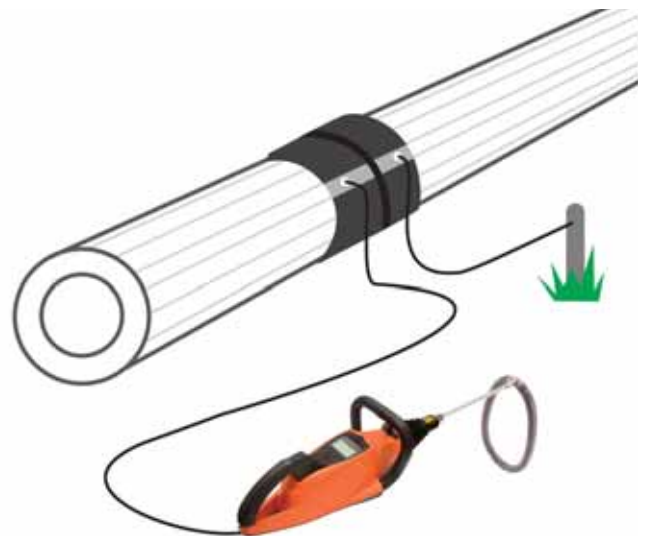


Figure 4. Ground mat diagram.

when other defects are not present, be it that the coating is too thick or too thin.

Test standards

The Elcometer 280 can be used in accordance with many national and international test standards for high voltage holiday detection: AS 3894.1; ASTM D5162; NACE SP0188; ANSI/AWWA C203; JIS G 3491; NACE SP0490; ANSI/AWWA C214; JIS G 3492; NACE TM0186; ASTM D4787; NACE RP0274; NACE TM0384; and ISO 29601.

Operation

As the Elcometer 280 operates with a pulsed DC voltage output there are significant differences between the Elcometer 280 and DC high voltage holiday detectors, such as the Elcometer 266.

The pulsed DC detector can be operated with a trailing signal return cable and, therefore, does not need a direct metal to metal ground contact that the DC high voltage system requires. As the Elcometer 280 generates a pulsed output voltage, a capacitive signal return is all that is required to ensure that any flow of current in the substrate due to the flow of current through a flaw will be maintained and will flow back to the detector causing the alarms to signal that a flaw has been detected. This is an easier and more practical test set-up in many situations, particularly where the coating process is complete and no access is possible to the uncoated substrate. This capacitive signal return can also be achieved using a grounding mat. A conductive rubber mat is wrapped around the coated pipe and connected to both the grounding pin that is driven in to the earth and the signal return cable. This completes the circuit when a flaw is detected via the capacitive effect of the area of the conductive mat over the coating. A range of mat sizes is available for pipes from 229 - 1067 mm dia.

Pulsed systems are also able to better withstand slightly conductive paths, which lead to false alarms with DC systems. With a pulsed DC system, the energy is all contained within the very short pulses, so within each pulse there is more energy than for the equivalent DC system. The pulsed system can, therefore, maintain the test voltage on a slightly conductive coating and is less easily overloaded.

The pulsed DC system is looking for a significant release of energy to signify a flaw that is allowing current to flow from the probe to the substrate. A small release of energy to a slightly conductive coating will not trigger the alarms.

The voltage can be set either by the operator when working to a test specification that gives the test voltage required, or by using the internal voltage calculator. This calculator requires the test method to be selected from the list of national and international test methods programmed into the detector and the thickness of the coating. The internal calculator will then determine the correct test voltage for that thickness using the detail contained in the published test method.

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Once set, the test voltage can be applied to the coated surface using a wide range of probe accessories. If the coating is defect free the high voltage will not cause any current to flow, no flaws will be detected and no alarms triggered. If, however, the probe passes over a defect, current will flow and the alarms will be triggered. It is normal with pipeline coatings that any defect is located and marked for repair after the test has been completed.

Accessories

There are a full set of accessories available for testing coatings on a wide variety of surfaces. Band brush and phosphor bronze

probes are used for local testing to identify the precise location of flaws, and for coatings on structural steel fasteners and other key components. Right angle brush probes up to 1 m wide are used for large flat areas, and similar right angled conductive rubber probes are available in widths up to 1 m. Such brushes can also be used for testing around the circumference of a pipe by aligning the brush along the axis of the pipe. However, this is less convenient than using probes that have been specially designed for external pipe coatings.

Circular wire brushes are used for internal pipe coatings and are available from 38 - 305 mm (1.5 - 12 in.) ID pipes.


For external pipes, 'C-type' wire brushes are available in several diameter ranges from 150 - 250 mm (6 - 9 in.) up to 650 - 750 mm (24 - 28 in.) OD, and complete rolling spring assemblies in either stainless steel or phosphor bronze material are available for nominal pipe diameters from 48 - 1425 mm.

Conclusion

Testing cured coatings for flaws and defects is often a crucial part of the acceptance process for a coating assessed against its specification. This is particularly the case for pipeline and storage tank coatings, as well as for coatings applied for corrosion protection, where discontinuities in the coating can lead to premature failure of the coating.

Flaws and defects in coatings will lead to premature failure of the coating in service, and result in corrosion damage due to the effects of the surrounding environment, particularly if the coating is immersed or partially immersed. Pipelines and storage tanks, for example, must have pinhole free coatings to either protect the contents from the substrate to prevent contamination, or to protect the substrate from the contents to prevent chemical damage.

Discontinuities, flaws and defects (holidays) in coatings can take many forms, but they all have one common property in that they reduce the effective strength of the coating and, hence, its durability. One measure of the strength of an organic coating is the insulating property of the coating: its ability to resist the flow of current when a voltage is applied.

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A COMPRESSOR CONSTRUCTION CHECKLIST

Arnold Eisenstein, UniversalPegasus
International, USA, provides a step by step
approach to planning an electric powered gas
compressor station.

Electric motor driven gas compressor stations have become the default recommendation when planning a new or expanded station in an environmentally sensitive area. Gas pipeline transmission operators have always maintained that they wanted to be responsible for their fate. Being responsible means controlling the fuel that is powering their compression. When there was no other option due to regulatory or other considerations, the industry turned to electric motor drive (EMD) compression.

With the advent of relatively 'cheap' gas prices, any financial advantage of a fuel switch to electricity is negated

other than engine emissions. In a past era when natural gas was trading at two to four times the current costs, under the right circumstances, electricity offered a competitive fuel-operating advantage over self-powered engine/turbine drive units in both fuel and operating expense costs. Depending on the electric contract terms, a large block of horsepower could generate significant fuel cost savings as well as other operational advantages of enhanced reliability, reduced maintenance costs and equipment longevity. A typical well designed electric motor is replaced every 20 - 30 years, whereas a typical turbine is overhauled every 30 000 running hours (four to six years) and an

engine has a minor overhaul every 3000 - 5000 running hours (six months to two years).

Step one: verify power availability

Actually, this is step four or five after deciding that an EMD is in your future and the horsepower requirements of the pipeline are quantified. Making sure that the utility has the power to sell in your area is important. If the power is too far from your location, the cost to bring the power in is as costly and time consuming as rerouting the pipeline; a high voltage transmission line can take as long to permit as a pipeline, with all the same restrictions. Try to co-locate near a power corridor. The power company will typically try to tie your project into the lowest voltage in the area that can handle the load – the higher voltage (up to a point) is actually more reliable and better for capability. The power availability and ‘strength’ of the power line will make a difference on how the equipment will be allowed to start due to voltage drop of the main transmission line. As a general rule, the higher the voltage



Figure 1. Dedicated compressor station electric substation.



Figure 2. Reciprocating compressor installation.

of the power tie-in, the less effect your facility will have on the utility. Most pipeline transmission projects of 5000 hp and above will want to connect to a 69 KV transmission line or higher. At 10 000 hp a 138 KV line is preferable, and at 20 000 hp and above a 230 KV line would be desirable. Each increment in power line voltage increases the cost of the connection for breakers and substation transformer; and also enhances the reliability of the power line.

For large blocks of power, a dual feed of the power is desirable for power reliability. A four breaker ring or system isolation switch nearby can increase availability of power during a planned or unplanned outage by having an alternate power source available. The ring configuration manages incoming power from several generating plant locations; the isolation switch can segregate the power from a power line to keep a segment energised while maintenance is performed on the downstream segment.

Step two: decide on equipment type

On a strong power line, life is good and an ‘across the line’ start is possible. Across the line starting is the simplest and best method for reliability and longevity of the equipment. Costs for special electrical, electronic or mechanical start systems are avoided, as well as a complex design. There are different methods of starting an electric motor, including capacitive, reduced voltage, electronic soft start and variable frequency drive (VFD). Older technologies include the pony motor assist start, which uses a smaller motor (typically rated at 10% of main motor rating) to accelerate the main motor to synchronous speed. Reciprocating compression is typically limited to 10 000 hp due to compressor frame limitation; centrifugal compression horsepower rating is limited only by operating and turndown limitations of the equipment, with a practical limit in the 30 000 hp range for a gas pipeline.

Gas pipeline compression equipment will have varying load to follow pipeline flow conditions, as such a method for capacity control is required. For control of a reciprocating compressor, the options are volume bottles/clearance pockets and/or speed control. Based on current available technology and economic factors, a VFD is normally utilised for starting and speed control of EMD compression units below 10 000 hp.

Centrifugal gas compressors rely on speed changes for capacity control, and a method of controlling compressor speed is normally required. Speed control is accomplished by either a VFD with a speed increasing gear, which varies the motor speed by varying the input frequency, or by a hydrodynamic gear, which acts like a car transmission adjusting the compressor speed. Advantages of the VFD is the ability to start the motor with little in-rush current (less strain on the utility). Motor horsepower is reduced as a ratio to the speed of the motor, which could result in a larger motor frame to handle low speed operating requirements. The hydrodynamic gear requires a starting method that may be limited by the electrical system. The advantage of the hydrodynamic gear is that the motor runs at full speed all the time. Hence, full power is available even at reduced compressor speed and the motor is less likely to have issues

Step three: system configuration

There are several compressor options to consider with EMD powered compression packages for the gas transmission industry.

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Figure 3. Aerial view electric powered compressor station.



Figure 4. Typical centrifugal compressor cutaway.

Compressor evaluations include total flow, minimum flow, total horsepower required, pressure rating and differential pressure. Large flows can be accomplished by one very large machine or many smaller machines running in parallel.

Small flow/small horsepower machines are typically specified as reciprocating compressors based largely on economic issues of initial capital cost. Compressors up to 5000 hp tend to be reciprocating packages based on economics. The cost of a 'small' centrifugal package is often much more costly than a like sized reciprocating unit. Other compression alternatives exist based on specific operating conditions.

Reciprocating compression is typically chosen for low flow/high pressure differential machines or low horsepower machines. Reciprocating machines have higher operating and maintenance costs based on the number of moving parts vs a centrifugal machine. Capacity control of a reciprocating machine may be accomplished by pockets and unloaders.

Centrifugal compression is typically chosen for larger flows and lower pressure ratios. There are fewer moving parts and less

vibration in a centrifugal machine than a reciprocating machine. Initial cost is typically higher for a centrifugal machine, but operating and maintenance is typically lower over the operating life of the machine. Reliability of the centrifugal machine is typically better than a reciprocating machine although, when there is an event, the cost per event is much higher.

VFD start/control is used almost exclusively on compression units 1200 hp and smaller. Larger VFD frames are available and are competitive with other methods of starting and control. VFDs smaller than 5000 hp are air cooled, and larger than 7000 hp are generally water cooled. As electronic switchgear, the units are subject to obsolescence after several years based on improvements in the topology/technology. A speed increasing gear is also required for centrifugal compression units.


Hydrodynamic drive trains are available for horsepower blocks in excess of 5000 hp economically; typically for centrifugal compression. These drives require additional space inside the compressor train line-up and a larger lube oil cooling system. System efficiencies are comparable to the VFD drives that include the speed increasing gear. There are fewer operational issues and high reliability with the hydrodynamic drive.

Step four: number of operational units

The amount of operational units is a decision made by system planning, based on the operational requirements of the facility. A single unit station is simplistic in design and typically affords good reliability and best cost-effectiveness, but is limited in turndown and has no redundancy. A multi-unit station increases control complexity and cost for the same total installation, but offers advantages in flexibility and limited redundancy. The smaller unit blocks are easier to obtain sufficient power from the utility for starting. A two unit station is sometimes configured for 50% flow capacity of each unit. Reciprocating systems, being positive displacement machines, will limit flows to 50% if a unit is out of service, whereas a centrifugal system is capable of flowing significantly more than 50% at a reduced differential pressure (hydraulic head).

In cases where contracted volumes require all units operational, all units may be forced to be completely offline at a station due to flow restrictions until a unit is restored in a multi-unit station. Three smaller units (and etc.) will have a lesser effect on total flow if one unit is not operational. In a centrifugal system, three units might be able to flow full contracted volumes with less impact to the overall capability of the system.

Step five: site location

The site location is a decision made by system planning based on the operational requirements of the facility. Fuel employed by the facility is determined by location of the pipeline in relation to the power line. A suitable power line 20 miles away is little use for an electric station as the costs to bring in the power to the station will exceed the financial benefit of having an electric powered station. A typical rule of thumb is anything over 5 miles exceeds the financial threshold for incoming power. Moving the facility closer to the power can be a solution, but is normally limited to 1 mile by system hydraulics and horsepower requirements. 

ON THE SPREAD FROM START TO FINISH



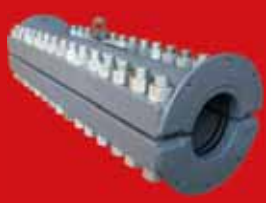
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A change from gas to oil

Dana Vilsack, Sulzer, USA, recalls the design, construction and installation of 15 pump skids for a pipeline conversion project.

Large scale projects typically involve many stakeholders, contractors and suppliers, which can lead to increased complexity and more challenging situations. Delivering such projects on time and within budget requires considerable co-ordination and management skills; traits that one US energy company needed in order to complete its most recent expansion project.

The locations of oil deposits are rarely close to a refinery, so it is necessary to use a series of pumping stations to transport the oil from its source to the facility. The objective of this project was to convert an existing gas pipeline into a crude oil pipeline, with a pumping capacity of 320 000 bpd of light crude oil.

Although this is a huge undertaking, the conversion is more cost-efficient and environmentally friendly than constructing an entirely new pipeline. However, the project required all new pumping equipment to be installed – a task that would demand considerable expertise.

Braving the elements

The challenge to design, manufacture, install and commission 15 pump skids in just 10 months was awarded to Sulzer. Spanning three states, working through the cold, winter months and co-ordinating with seven different internal and external partners, this project had potential challenges throughout its duration.

The whole project took years of planning and involved the local authorities and the power companies that, in many cases, needed to upgrade the electrical supplies to the pumping stations. These supplies dictate the size of the electric motors that can be used to power the pumps and, as such, form the starting point for Sulzer, which supplied this equipment.

The logistics required to expand the pumping stations and increase capacity are enormous, but any such project also needs expert design and management skills to be successful.



Figure 1. Detailed project planning and co-ordination ensured each aspect of the installation was completed on time.



Figure 2. The project presented several challenges, including working through the winter months.



Figure 3. The completed installation will have a pumping capacity of 320 000 bpd of light crude.

Sulzer understands the requirements of such projects and the expectations of the client were very high, having experienced less than favourable results with a different supplier on a previous project. One of the most important steps was the appointment of the project manager, who would be the single point of contact for the client, as well as collaborating with the other stakeholders and contractors.

Delivering the best design

As part of the project, new contracts had to be signed with the energy providers in each state, in order to receive the necessary electrical supplies in line with the feasibility study that was undertaken at the very beginning of the project. These supplies affected the design of the electric motor that was installed with each pump, as well as the performance of the pump.

The pumps for each pumping station were designed based on the data provided by the customer. For each location, there would be information relating to the increase in head, pressure, flow, fluid viscosity and temperature that would dictate the design of each pump.

As a pump manufacturer, Sulzer has a wide range of designs that can be tailored to suit each application. In this case, the pumps were based on the HSB horizontal axially split single stage double suction pump. This has a proven record of both reliability and efficiency in crude oil pipelines around the world.

Capable of pumping up to 45 000 gal./min. (10 200 m³/hr) at a head up to 1800 ft (550 m) and able operate with temperatures up to 400°F (200°C) and pressures up to 2200 psi (150 bar), the HSB pump is extremely versatile. This is matched by its precision design that ensures smooth running and durability, as well as ease of operation and maintenance.

Tailored to suit each application

The pump skids were designed to a typical pipeline configuration but tailored to the customer's specific requirements, including figures for energy efficiency. In projects of this scale, pump efficiency can be the deciding factor in the operational profit of the pipeline. Every manufacturer that bids for these contracts must be able to deliver excellent performance in terms of reliability and efficiency.

Dana Vilsack, Project Engineer for Sulzer, comments: "Every pump will have its own performance curve and each one must meet the minimum requirements presented by the customer. Even small improvements in this figure can have a very significant impact on the running costs of a pumping station. Multiplying this across 15 units will offer substantial savings in annual running costs."

A typical pump in this project might require 2800 hp (2100 kW) input to deliver a flow of 9300 gal./min. (2100 m³/hr) with a head of 825 ft (250 m), depending on the specifications for the pumping station. In each case, the design was scaled and fine-tuned to meet the exact requirements of each location. In this way, the optimum pumping conditions and efficiency could be maintained throughout the pipeline.

Keeping on track

The customer fully understood the complexity of this project and the logistical challenges that it presented. Therefore, to minimise the management burden, the major contractors on the project were chosen for their expertise and their ability to deliver large sections of the work in-house. In Sulzer's case, the pump expertise was already proven, but as a turnkey solution provider, it could also manage the transport and installation of the pumps, as well as the supply of the electric motors.

The delivery of such a complex project required in depth planning to ensure it would be both cost-effective and delivered on time. Careful co-ordination of both internal and external suppliers was essential to keep the work on track. Above all, it was the flexibility of the team that would enable the successful completion of this crucial project.

Vilsack continues: "This was one of the most organised and co-operative projects I have been a part of. The collaboration between the divisions of Sulzer along with the external partners, the supportive leadership and the display of outstanding teamwork, resulted in a synergy few can match and made for a very happy customer."

Hard work, dedication and the ability to adapt to an ever-changing schedule were just a few of the many traits that the Sulzer team exhibited throughout the duration of the project. In fact, the collaboration between the Sulzer team and the client's many representatives proved to be successful, allowing everyone to concentrate on their core responsibilities. This included Sulzer's onsite teams helping with the alignment of both the skids and the associated pipework, ensuring that it was installed with minimal strain on the pipes.


Turnkey delivery

The success of the project started at the top, with the decision by Sulzer's project manager to work onsite rather than in one of the remote company offices. In this way, he was able to deal directly with all the interested parties and provide a more hands on management of the project. This also helped to maintain momentum within the project and ensured that all the milestones were met.

The greatest challenge in a project of this scale is the logistical effort required to build and install all the pumps in a way that is carefully co-ordinated with the build schedule of the pumping stations themselves. With so many other contractors

involved with the construction of the buildings and the installation of the pipework, effective project management was essential for the timely completion of the scheme.

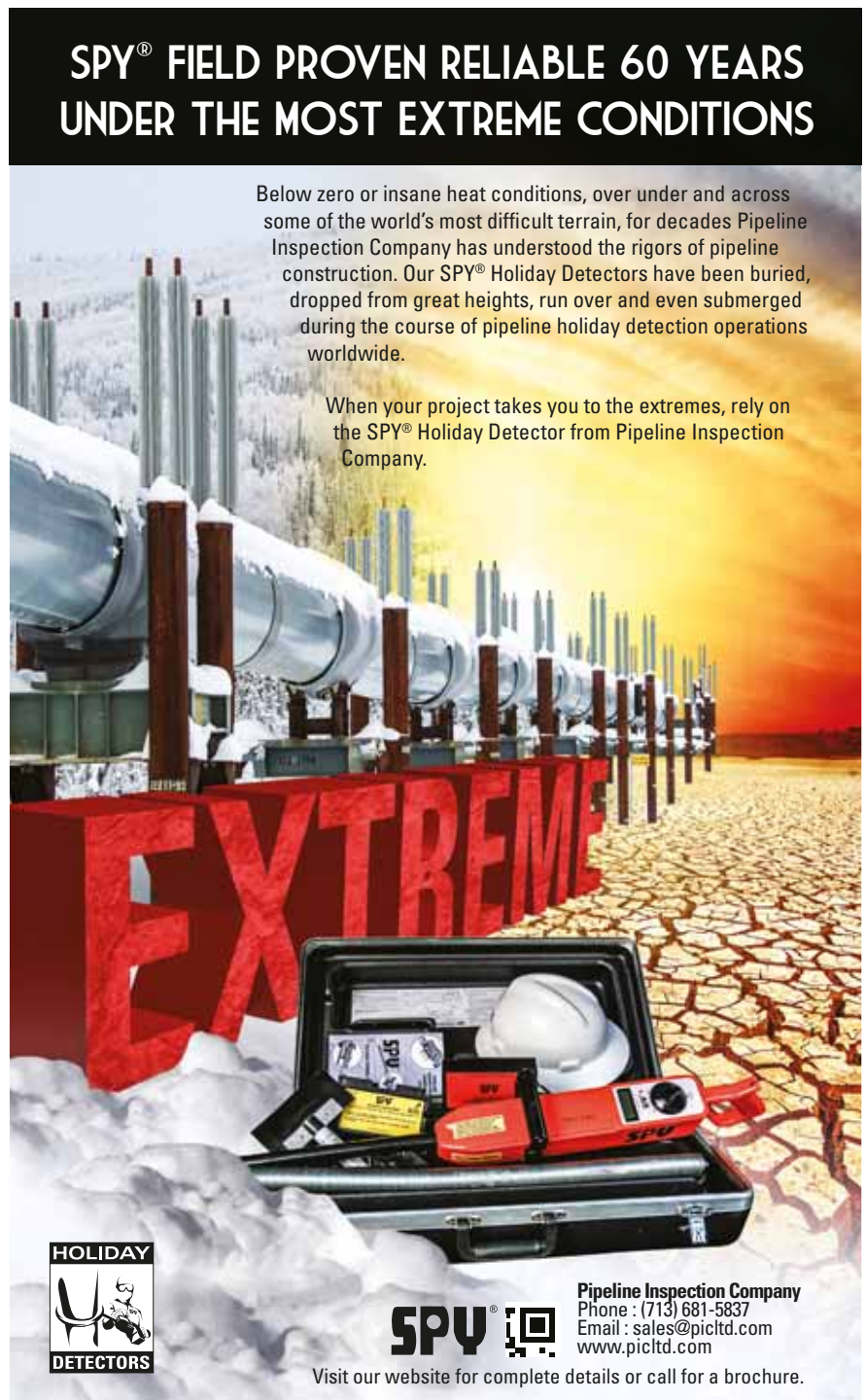
As a project for Sulzer, it involved almost every aspect of its business. From the engineers who designed the new pumps, to the manufacturing sites that produced and tested every pump, to the field service teams and electromechanical engineers who provided support to the installation teams.


Thanks to Sulzer's collaborative approach and proactive management, the project was delivered on time and within budget, with all of the pump skids commissioned and operating successfully. The client was very grateful to find that it was possible to deliver such a demanding project successfully. 


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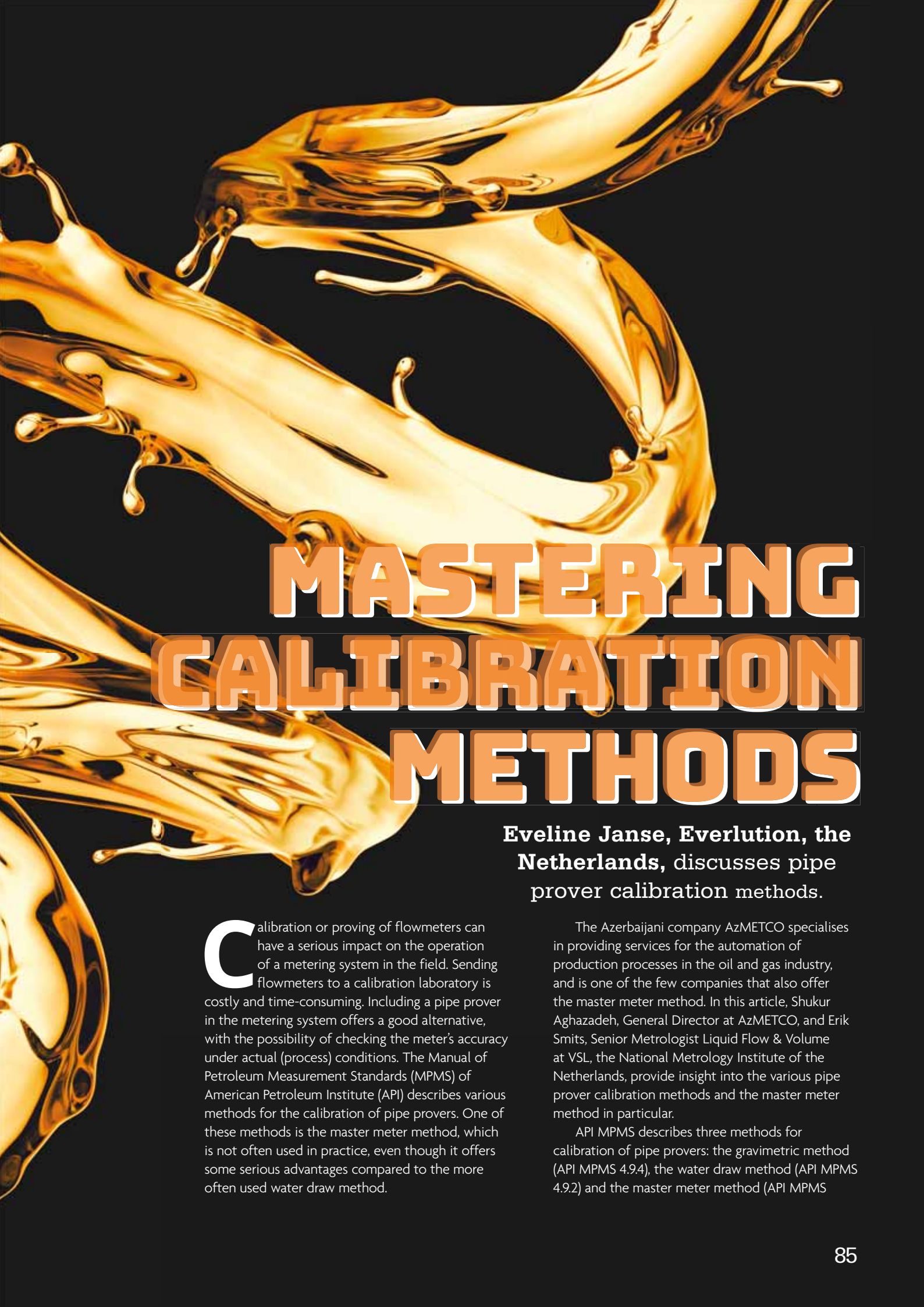
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MASTERING CALIBRATION METHODS

Eveline Janse, Everlution, the Netherlands, discusses pipe prover calibration methods.

Calibration or proving of flowmeters can have a serious impact on the operation of a metering system in the field. Sending flowmeters to a calibration laboratory is costly and time-consuming. Including a pipe prover in the metering system offers a good alternative, with the possibility of checking the meter's accuracy under actual (process) conditions. The Manual of Petroleum Measurement Standards (MPMS) of American Petroleum Institute (API) describes various methods for the calibration of pipe provers. One of these methods is the master meter method, which is not often used in practice, even though it offers some serious advantages compared to the more often used water draw method.

The Azerbaijani company AzMETCO specialises in providing services for the automation of production processes in the oil and gas industry, and is one of the few companies that also offer the master meter method. In this article, Shukur Aghazadeh, General Director at AzMETCO, and Erik Smits, Senior Metrologist Liquid Flow & Volume at VSL, the National Metrology Institute of the Netherlands, provide insight into the various pipe prover calibration methods and the master meter method in particular.

API MPMS describes three methods for calibration of pipe provers: the gravimetric method (API MPMS 4.9.4), the water draw method (API MPMS 4.9.2) and the master meter method (API MPMS

4.9.3). In his work, Smits has seen the pros and cons of these calibration methods. At the most recent meeting of the European Flow Measurement Workshop, he held a presentation about the various calibration methods of pipe provers and the considerations for choosing one or the other.

The most commonly used method for calibration of a pipe prover in a flow metering systems in the field is the water draw method; the gravimetric method is not very often used. Smits explains: "It is only possible to use the gravimetric method for small volumes at low flowrates, and the required conditions can only be met by bringing a mobile laboratory to the site."

The master meter method is not applied as often as the water draw method but, according to Smits, this is due to the fact that the master meter method is not very well known and not many suppliers offer this option. He notes that "in the terms of contracts for custody transfer, the water draw method as a rule is explicitly mentioned, and I think that in most cases this is only because this method is offered more often, and not necessarily because it is the best option."

Aghazadeh adds to that, explaining how the calibration procedure using the water draw method is more complex, time-consuming and requires extensive material costs.

Uncertainty of metering systems

Calibration is all about staying in control of measurements, thus assuring a high level of confidence in the results. Traceability of measurements is essential to achieve this. For almost all flow measurement systems, traceability starts with the standards of mass that are maintained by National Metrology Institutes, such as VSL (the Netherlands) and NIST (USA). Directly traceable to these standards – only one uncertainty level down from these standards – are the weighing balances and test measures used at these institutes. Both the gravimetric method (which is traceable to mass) and the water draw method (which is traceable to volume) are found on this level, securing low measurement uncertainties. The master meter method is found one level further down.

Table 1. Uncertainty contributions to the overall measurement uncertainty (root sum squared) of the metering system. Note: this data is estimated with no actual field data

	Low* (%)	Average* (%)	High* (%)
Pipe prover calibration uncertainty (base line)	0.02	0.05	0.07
Stability of pipe prover calibration volume(s)	0.04		
Flowmeter calibration/proving	0.05		
Stability of flowmeter between proving	0.05		
Design errors	0.02		
Stability due to changing conditions (in and outside of pipe)	0.10		
Others	0.07		
Overall measurement uncertainty of metering system	0.149	0.156	0.164
*Measurement uncertainties for the pipe prover (low, average or high)			

Immediately before and after the calibration runs the master meter is calibrated with a master prover or proving tank.

Smits believes this might suggest that the gravimetric and water draw method are better – in other words, have a better uncertainty. However, this is not necessarily the case. He reveals that, in fact, many more factors impact the measurement uncertainty of a field unit, and that the calibration method is only one of them. Fundamentally, this holds for all fluids, but particularly when working with a complex liquid such as crude oil, other factors will add considerably to the uncertainty budget.

This is illustrated in Table 1, which shows typical values of uncertainty contributions to the overall measurement uncertainty of the metering system. Clearly, the impact of the calibration uncertainty to the overall measurement uncertainty in the field is limited. The measurement uncertainties are determined by various parameters, such as the design (geometry, flowrate/profile, upstream pipes etc.), fluid properties (viscosity, density, temperature, pressure, homogeneity etc.), instrumentation (temperature and pressure transmitters, flow computer etc.), calculations and the use of standards (fluid property data etc.).

Smits notes: "Before choosing the calibration method, it is important to check the achievable accuracy of the metering system. When the measurement uncertainty for the metering system is large in itself, there is no need for a pipe prover calibration with low measurement uncertainty, as in that case the calibration method is not the determining factor of the overall measurement uncertainty."

Field conditions

Taking this into account, the most suitable calibration condition for the pipe prover volume is the one that comes as close as possible to the actual field conditions. After all, using a model liquid (such as water) or conditions differing from those in the field, lead to an extra translation step, with a corresponding added uncertainty to the performance and stability of the pipe prover in the field. The gravimetric method and the water draw method can only be applied at low flowrates, and the calibration is done only with water. These are two big differences with the actual process conditions. The use of water also has a practical implication, in that the process liquid should be drained from the metering system and the system should be filled with water and after the calibration this should be done in reverse. This not only means a lot of work and cleaning (for obtaining the required purity of water), but also causes serious risk in terms of corrosion of the system.

For example, Smits considers how replacing or repairing a four-way valve of a pipe prover means a huge unaccounted-for investment. This is a serious risk. Moreover, the pipe prover might be out of service for a period of time, during which the meter factors of the flowmeter(s) in the system could shift and cause tangible commercial losses due to incorrect measurement of the liquid passing through the system.

Aghazadeh agrees, stating: "Our customers experience difficulties because of the inability to use the field prover for calibration of flowmeters with process liquid, while rinsing and

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Figure 1. Inspection and measurement of the sphere of the piston prover is part of the calibration procedure.



Figure 2. Reading of a test measure.

cleaning of the field prover for calibration by the water draw method.”

Smits continues, explaining that, in most cases, the master meter method uses the process liquid of the system. This means that the results directly relate to the field situation and, therefore, a much better determination of the performance of the metering system is obtained. Furthermore, the system does not have to be drained, cleaned and filled twice, and there is no risk of corrosion. Additionally, even though the flowrate is not the same as the flowrate in use, the master meter method allows for higher flowrates than the other calibration methods.

The master method in practice

“The essence of the method is comparing the known volume of the calibrated section of the master prover with the unknown volume of the calibrated section of the field prover, using a comparator – the master meter. The master prover and field prover are simply connected in series along the flow of the process liquid, and there is no need to assemble a special calibration loop. Preparations of the onsite calibration include

inspection of the sphere of the field prover and connecting the field prover to the master prover,” details Aghazadeh.

Since the process liquid is used, there is no need to clean the total volume of the field prover. This means that, after checking the connections, the sensors and detectors are connected to the master prover and the calibration system is filled with the process liquid.

Aghazadeh reveals that, before calibration begins, at least three test measurements are performed by the field prover and the master prover, in order to verify the correct operation of the system and to remove remnants of air or vapours. Additionally, if the calibration system equipment allows for it, field prover calibration is performed at several flowrates, in accordance with API MPMS 4.9.3. Corresponding with this standard, operational conditions are continuously checked, including flowrates, temperature, pressure and density.

Counting pulses

While the water draw and gravimetric methods measure the volume or mass between start and stop switches by collecting water in predefined field volume or by weighing measures, the master meter method counts pulses between the switches.


Smits explains that this makes the measurement more dynamic and allows for the use of more than one pair of detectors per calibration run. The detectors are turned on and off by the prover’s sphere passing the switches, which comes much closer to field conditions.

Which method to choose?

Considering the benefits of the master meter method brings us back to the question: which of the methods is the best one? When the impact is small, one can select the calibration method that suits the location of the pipe prover best, and select a service company that can perform the calibration in the desired way.

“We use the water draw method in the AzMETCO laboratory only for calibration of our master prover, in order to ensure low uncertainty in its volume. Taking into account the earlier mentioned circumstances, the complexity, the time it takes and the expenses involved, AzMETCO calibrates the field provers in the Azerbaijan-Georgia-Turkey region using the master meter method. We have over 20 years of experience using this method in accordance with API standards. The master prover allows us to calibrate several field provers in a short time and with lower expenses. Therefore, we consider our master meter method, using our mobile master prover and process fluid, the most suitable for calibration of pipe provers,” states Aghazadeh.

Smits concludes: “When the required measurement uncertainty of the metering system is medium to high, there is no need for a pipe prover calibration with low measurement uncertainty. I always advise to choose a calibration method that meets your needs and not the needs of the service provider.”

The topics addressed in this article are amongst the many that will be discussed at the 6th European Flow Measurement Workshop, which will take place in Barcelona from 16 - 19 April 2018. 



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REDUCING DRAG TO BOOST CAPACITY

Ted McKeehan and Bill Ma, Optum Energy Solutions, USA, present an innovative and versatile DRA technology that is enabling pipelines to increase capacity and boost profitability for operators across the US.

Traditionally, in order to increase the throughput of an existing pipeline, operators have been required to lay an additional, parallel pipeline at a potentially huge economic and environmental cost. With decades of experience in the global flow improver industry, Optum Energy Solutions' team works closely with operators to solve this longstanding industry problem – helping them to instantly increase the value and capacity of their pipeline asset with minimal expenditure and surface disruption.

DRA: the pipeline capacity solution

The primary use of flow improvers is to increase pipeline capacity. For hydrocarbon liquids in turbulent flow, a flow improver streamlines the chaotic movement that originates at the pipeline wall. 'Drag reduction' is the increase in pumpability

of a fluid, caused by the addition of small amounts of an additive to the fluid. Its effectiveness is normally expressed in terms of percent drag reduction. Without a drag reducing agent (DRA) the chaotic movement leads to turbulent bursts that increase the drag or energy required to move the fluid. When DRA is dissolved in the fluid it inhibits the production and propagation of the turbulent bursts, resulting in a more streamlined flow with reduced loss of energy. The streamlining effect means more movement in the direction desired instead of the random motion of turbulence. The flow improvement results in drag reductions of up to 80% and flow increases of more than 100%.

During the recent peak in the price of oil, production worldwide increased as well as the need to move the ever-increasing quantities of crude oil. As a result, drag reducer became in short supply, prices

escalated for those customers that could buy it and others simply had to go back to the traditional solution of installing a parallel pipeline or 'loop'. This expensive, disruptive process can take up to two years, exposing the pipeline company to changing market forces and embroiling them in local, state and federal permitting processes. Conversely, the benefits of the use of DRA is instantaneous. As an unobtrusive solution that creates no surface impact, the use of DRA eliminates the need for permitting requirements and saves the operator a huge amount of capital expenditure in the process.

The company offers turnkey solutions, including full field support and onsite services fully customised to clients' individual needs. Optum's aim is to deliver the most reliable, stable and easy to handle pipeline drag reduction solutions to ensure maximum efficiency. A new DRA technology that frequently features in client solutions offered is Optum's Flow Optimizer™: a non-hazardous, versatile tool allowing pipeline companies to increase profitability or defer capital expenditures normally required to expand capacity.

Water-based DRA to optimise flow

Flow Optimizer is Optum's new water-based DRA technology, designed for broad-spectrum applications in crude oil pipelines. The technology's active ingredient is an ultra high molecular weight hydrocarbon polymer, chemically similar to the major components of crude oil, which dissolves into the hydrocarbon stream and does not deposit on the pipeline walls. A proprietary process includes cutting-edge methods for controlling polymer production and blending, resulting in a stable suspension that is easy to maintain and resuspend with mild agitation.

The product is separately formulated for temperate climate, winter applications and for environments

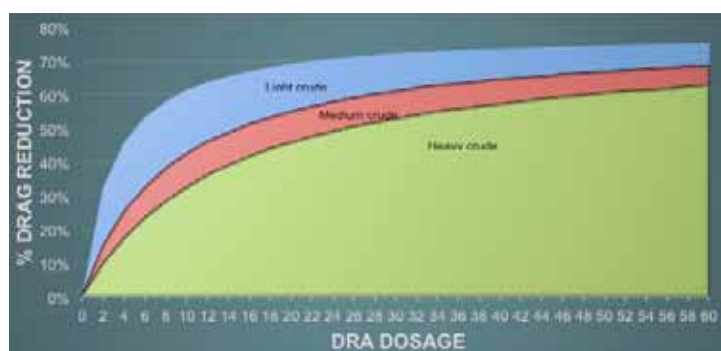


Figure 1. Typical performance for DRA in various crude types.

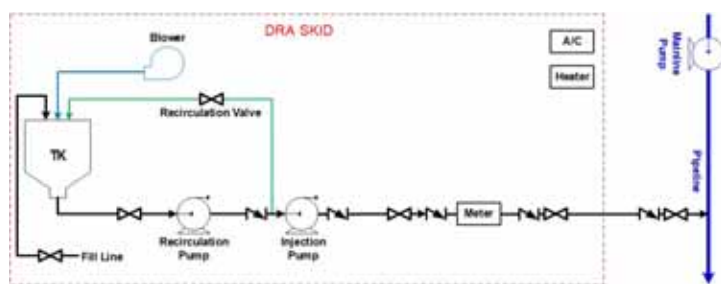


Figure 2. DRA skid.

continuously well below freezing. The pipeline operator's crude oil can be analysed and the pipeline modelled under different scenarios to identify ways to maximise each particular system's capability at the lowest possible operating cost. Different hydrocarbons react differently depending on their properties (Figure 1).

In the field, commissioning a site to inject DRA is a simple but important process that has evolved over decades. Today's DRA is a suspension, or slurry, that requires specialised injection skids to maintain the suspension as homogenous and to inject the chemical into the flowing pipeline at high pressure. The skids are portable and customised to each site. Consideration for weather extremes may call for completely enclosed units and insulated tanks to ensure reliable injection. Typically, a site inspection takes place to determine space and power requirements. The DRA is a polymer that can be damaged by valves or ancillary pipeline equipment, so the injection point is chosen where the line exits the station, downstream of the pigging traps.

Case studies

Case study: Delaware Basin, west Texas

Flow Optimizer in combination with Optum's simulation technologies solved takeaway capacity limitation for a midstream company transporting light crude (API >35) from the Delaware Basin.

Challenge

The midstream company had upgraded its takeaway capacity over a 12 mile, 10 in. interconnection of two trunk systems. As is common in the region, producers in the Delaware Basin announced increases calling for higher takeaway commitments through the 12 mile tie in, soon after the upgrade. For this operator, any investment in pumping capacity and storage was easily justified. However, an interim solution was needed to maximise capacity while installing the upgrades. The capacity was restricted by line operating pressure and insufficient horsepower.

Solution

DRA technology was selected because of its ability to be deployed quickly, and Optum was selected because of its proven technology for light crude oil and in-house hydraulics modelling expertise. Transient pressure surges at the higher expected flowrates were a significant safety concern. Optum proposed a field trial to establish the behaviour of the system while using DRA. The particularly short line length of only 12 miles meant that fast dissolution of the DRA was essential. The trial protocol called for three dosages at constant flowrate, then – depending on the results of the first three dosages – a fourth dosage would be selected to pinpoint the current system's maximum sustainable flowrate. The injection module had a DRA precision metering pump injection capable of up to 9 gal./hr and was fully instrumented for remote monitoring and control.



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Figure 3. Standalone skid.

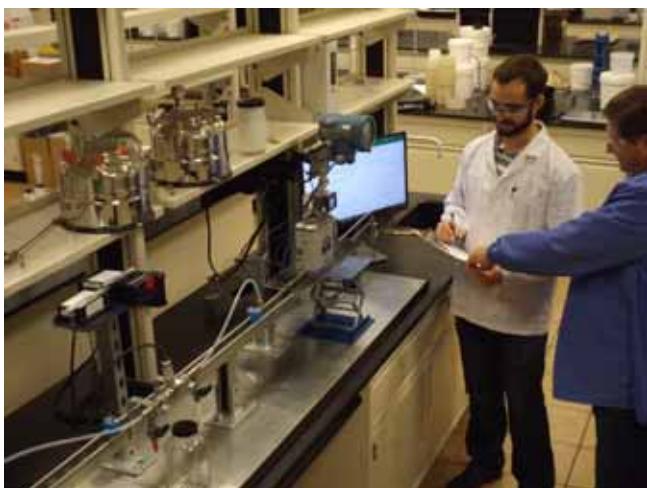


Figure 4. Quality control drag reduction test loop.



Figure 5. Injection point exiting pump station.

Results

Flow Optimizer's rapid dissolution easily met the challenge posed by the short line length. The maximum drag reduction, an indicator of the DRA's polymer quality, was calculated to be 84%. The first dosage of 15 ppm produced such high drag reduction that lower dosages were required to develop the shape of the performance curve.

Case study: North Dakota

Flow Optimizer polar blend expanded vital pipeline capacity for a North Dakota operator concerned about the surface impact of installing a new parallel pipeline.

Challenge

An operator in the Williston Basin (North Dakota) faced an increase in production that required significant additional pipeline capacity. The projected increase in production required looping a 19 mile section at an estimated cost of US\$15 million. Costs were expected to rise due to the permitting required for the construction to begin immediately in order to meet commitments to the producing operators in the Basin. However, due to the sensitive nature of the surrounding land in the region, including the presence of Native American communities, the operator sought out an alternative solution that could be less disruptive to the local community and environment.

Solution

Flow Optimizer proved to be a winning alternative due to its quick and unobtrusive deployment capability, at a fraction of the cost of installing a parallel pipeline. An additional challenge that the technology helped to overcome was that of the local climate. The freezing temperatures in North Dakota can drop to -25°C in winter time, and can cause wax to precipitate and for the oil to become more viscous, obstructing flow. Despite a 15% wax content, the DRA delivered the required 60% drag reduction to produce the flow increase needed to meet the production growth. With minor modifications for this weather, the equipment was quickly deployed, installed and ready for continuous operation.

Results

Flow Optimizer instantly enabled the operator to expand pipeline capacity, while preserving the surrounding terrain and safeguarding relations with the local community of residents. Capital expenditure was avoided and, instead, a variable cost of US\$0.03 per additional barrel moved was experienced. The costs are expected to significantly improve during the summer as the temperature increases and the wax content is maintained in solution. During the trial, the temperatures dropped to -25°C without any adverse effects to the product or equipment performance.

Case study: Eagle Ford, west Texas

Flow Optimizer more than doubled production capacity for a midstream pipeline company transporting crude from the Eagle Ford to Corpus Christi (Texas) in a short, partially obstructed, pipeline.

Challenge

The hydraulic fracturing and directional drilling revolution in the Eagle Ford shale basin led to huge gains in production of light crude (API >40) beyond the pipeline capacity available in the region. Traditional solutions, such as additional lines or pumping equipment, required long lead times and significant

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capital investment. A midstream pipeline company in the region required a more immediate solution.

Solution

DRA technology was considered to be an excellent solution as it could be deployed within days, and Optum was selected because of the company's new advanced technology for light crude oil. However, the presence of a pig launcher at the 40 mile marker presented a point of shear degradation that could limit the viability of the DRA solution. Working with the midstream operator, Optum designed an evaluation protocol requiring three dosages to determine Flow Optimizer's effectiveness increasing the capacity and to measure the effects of the pig launcher on overall performance. Additionally, a maximum flowrate evaluation was included in the protocol to estimate the maximum drag reduction capability of Flow Optimizer. Optum brought to the site a mobile, wholly enclosed tank and injection system, fully instrumented for local or remote operation.


Results

During the three day evaluation, Flow Optimizer required no mixing and the various dosages were carried out safely and with minimal disruption to the pipeline's normal operations. Flow Optimizer's rapid dissolution properties were evident and expectations were exceeded for each dosage. The product demonstrated it could reliably enable greater than 100% increase in capacity for the light crude system, with as little as 15 ppm. No serious performance losses were measured passing through the pig launcher site, and the field data demonstrated a high drag reduction of 77%. With this performance information, the pipeline operator was able to design injection schemes that minimise the cost of the overall operation, while increasing profits with the additional throughput they could now accept using DRA.

Investing in innovation

While Optum has invested significant capital into a state-of-the-art DRA plant, to take advantage of the latest manufacturing technologies available, innovation must be a continuous and ongoing activity.

Through various recognition and reward programmes, employees are incentivised to practice the core values of innovation, safety, integrity, reliability and partnership in their everyday tasks. Current innovation efforts encompass everything from product chemistry, order fulfilment, delivery and remote tank level monitoring, with the goal of maximising the overall value chain. Customers benefit from higher performing DRA products, consistent and reliable DRA performance and lower product costs. Optum's focus on innovation has resulted in some game-changing molecular tuning capabilities.

These capabilities can be leveraged to customise DRA molecules to suit specific customer needs in terms of drag reduction performance in pipelines of short, medium or long length. In addition, total manufacturing flexibility provides for rapid changes in product mix to produce products for various temperature conditions, temperate, winterised or extremely low polar conditions. 

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