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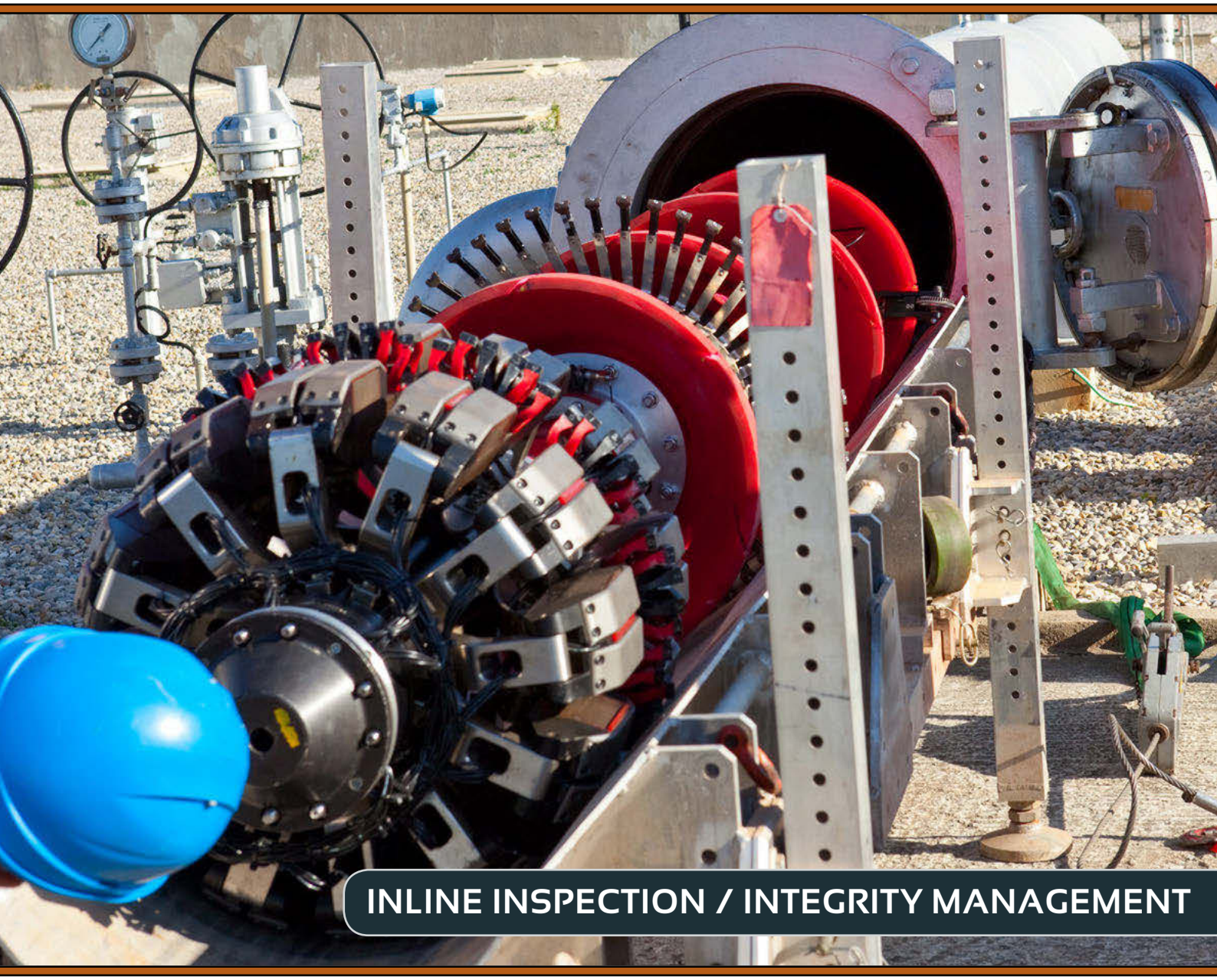

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We face many challenges – together we must find solutions

Admir Celovic
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Oil and gas pipelines around the world are facing a number of challenges that will shape our industry in a severe way and require us to work even more closely together than ever before in order to develop innovative solutions to these challenges.

At the annual Pipeline Technology Conference (ptc) in Berlin and in the Pipeline Technology Journal (prj), we regularly cover topics, lead them into international discussion and thus support pipeline developers and operators around the world to make their pipelines safer, more reliable and more economical.

In addition to some 80 presentations on the further development of material, technology, construction and operation of pipelines, the 14th ptc will also include the two new side conferences Public Perception / Qualification & Recruitment, as well as panel discussions and plenary sessions about a number of current pipeline topics:

Illegal Tapping
Just a short while ago, a devastating pipeline explosion killed about 100 people in Mexico. The explosion was caused by illegal tapping of a fuel pipeline. This problem may be extreme in Mexico, but it certainly is not limited to this county. Even in western countries, the numbers of illegal tappings are raising.

Eurasia
Large TSOs from Asia and Eastern Europa and their technology subsidiaries are pushing their way into the markets in North America and Europe. This increases the competition in these markets, but also opens up new business opportunities in their home regions. However, there are still many hurdles to overcome in order to connect East and West.

From fossil to renewable fuels
In 2018, the European Commission adopted a strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by 2050. The decline in the cost of renewable energies has opened the prospect of large-scale production of green hydrogen and liquid e-fuels. Pipelines could play an important role in this process.

Digital Transformation
As the energy industry is already preparing for a consistent digital transformation, another big development for improving the integrity of the systems by big data analytics will be expected. Furthermore, as manufacturers and service providers will make use of IoT tools and products, the energy industry as a critical infrastructure must also gradually improve cyber security.

Don't waste this chance and participate in the upcoming ptc. Together we can increase the pipeline industry's safety, reliability, and profitability.

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Yours,

A. Celovic

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JANUARY 2019 / ISSUE 1

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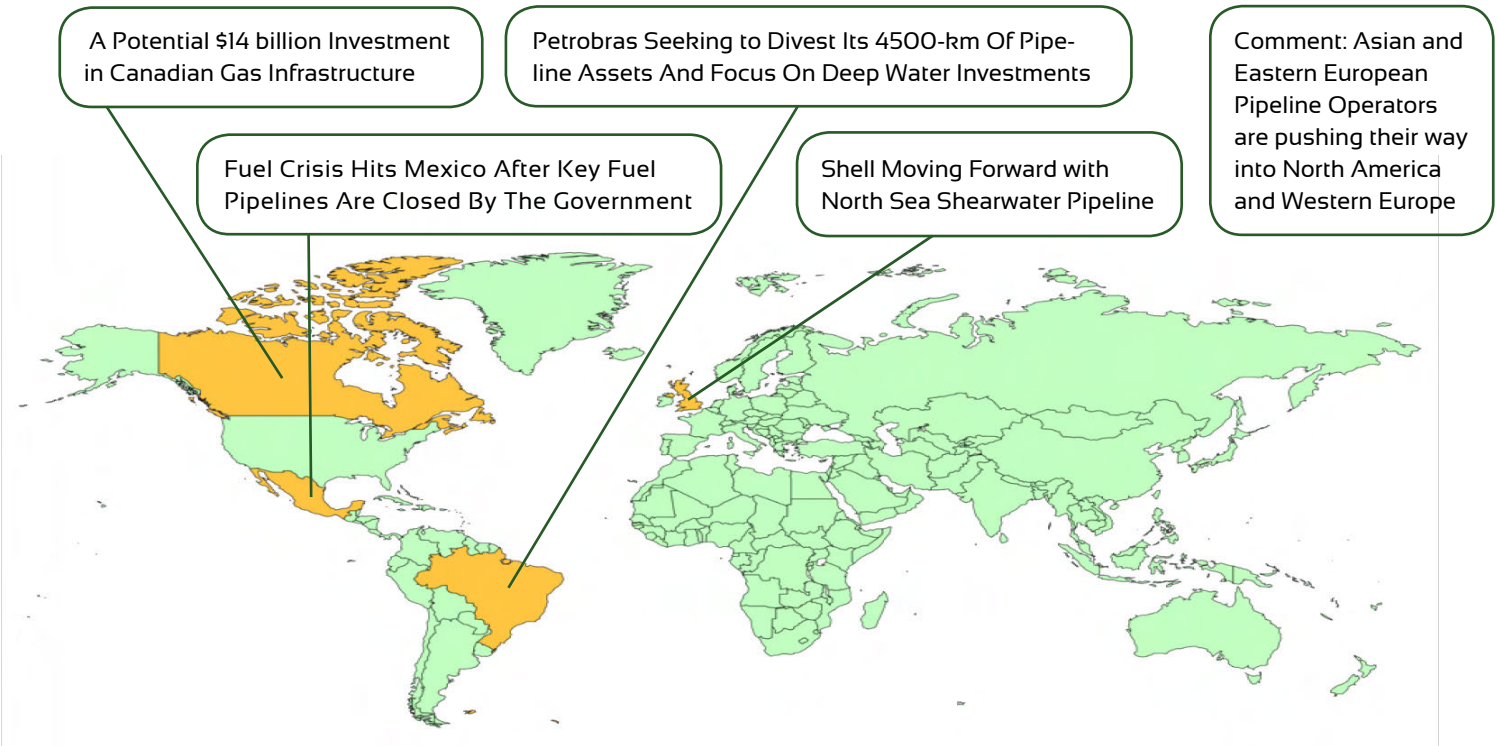
WORLD NEWS



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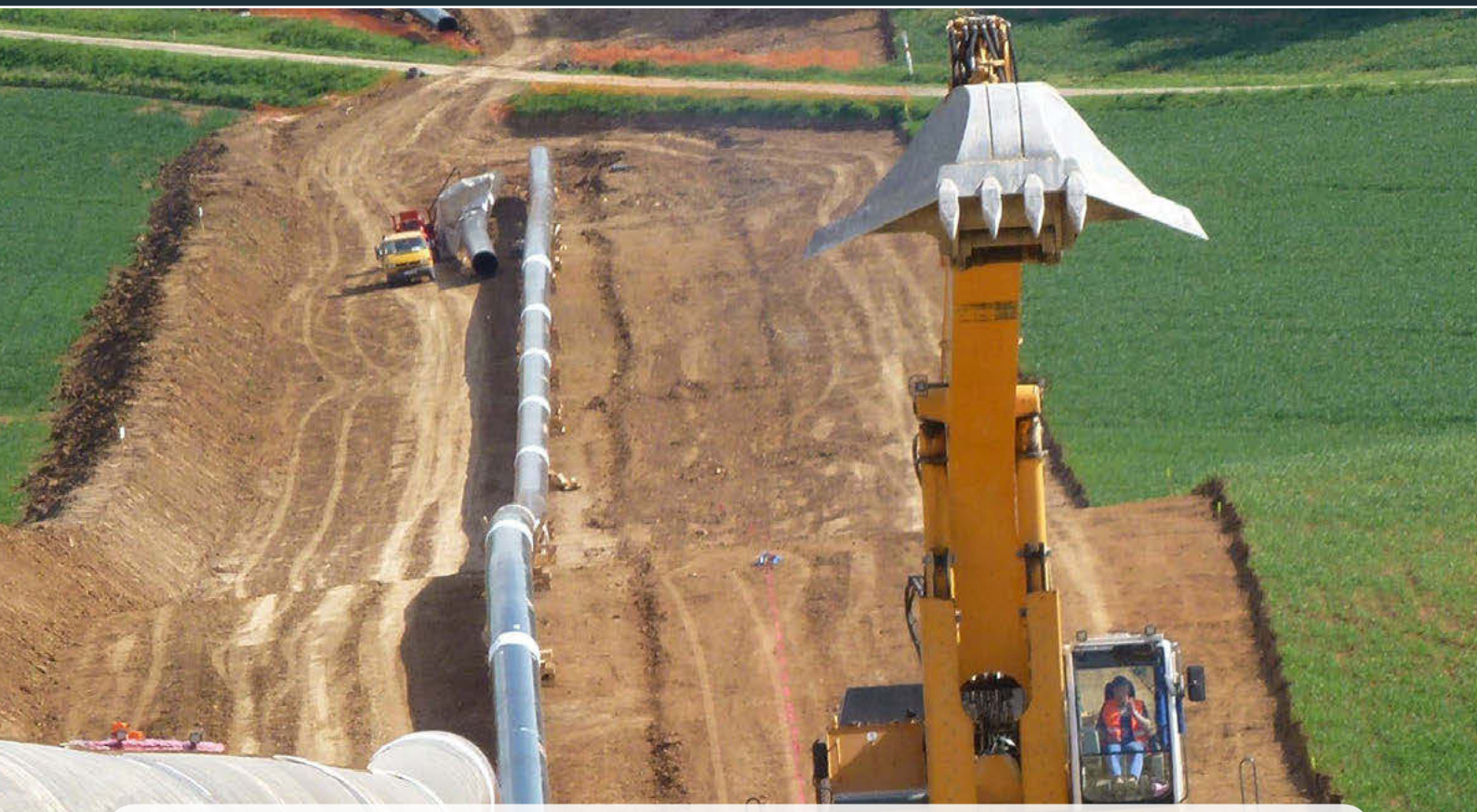
Construction on Enbridge's Line 3 Replacement Program progresses in Alberta and Saskatchewan in 2017. The L3RP, with a targeted completion date of 2019, will fully replace 1,660 kilometres (1,031 miles) of Line 3, one of the primary conduits in Enbridge's Mainline crude oil network, between Hardisty and Superior, Wisconsin.

QUALITY CONTROL IN THE PASSIVE CORROSION PROTECTION – THE COATING INSPECTOR

Dr. Thomas Löffler > DENSO;
Andre Graßmann; Hilmar Jansen > Open Grid Europe



Abstract

A highly sophisticated and well coordinated active and passive corrosion protection is mandatory for a long-lasting integrity and an error-free operation of a new pipeline. Furthermore, importance from an economic point of view it is of essential importance for the achievement of the target lifetime.

The passive corrosion protection includes all activities shielding the steel from corrosive media. This can be realized for instance either by a suited plating or coating or by constructional features. With respect of the construction of buried pipelines there is a detailed technical regulation for all relevant applications.

Beside the choice of the correct material and its quality a high-grade workmanship is of crucial significance, especially in the course of field joint coatings. After successful implementation of the tools of error prevention like product training or optimal material usage, according to the Poka Yoke principle, coming from the automotive industry, only the possibility of inspection of sources of error remains. Applied to the pipeline construction this means quality control of the used components and materials as well of the coating works in the field.

For this reason coating inspectors have been established for the first time in 2012 within the framework of the pipeline project Loop Sannerz-Rimpar of the Open Grid Europe GmbH, in order to execute the mentioned tasks of inspection of sources of errors / quality control. Since then the acceptance of this specifically skilled expert in the pipeline industry is backed by a draft technical standard prepared in a DVGW committee. It describes the qualification as well as the duties and responsibilities of the coating experts.

1. INTRODUCTION

1.1. Passive corrosion protection

The world corrosion organization estimates the costs caused by corrosion at about 3.300 billion US$ per year [1]. In most of the industrialized countries the costs caused by corrosion are around 3 % of the gross domestic product gdp and come up to 5 % in some cases. Furthermore, if one takes into account, that by the use of available technology cost savings of annual 990 billion US$ could be reached, it is obvious that the coating of a buried steel pipeline is a substantial condition for a technical reliable and an economical corrosion protection.

From a technological but also from an economical point of view usually a combination of active and passive corrosion protection is implemented. Theoretically a sufficient corrosion protection could be achieved solely by the use of cathodic protection, but for financial and technical reasons this is not an option. The use of a coating allows a low current demand paralleled by an optimal distribution of the protective current. There is a quantity of requirements the coating has to fulfill, arising from the mentioned properties that it is necessary for a functional corrosion protection (see Table 1). A principle distinction can be made concerning the feature of the corrosion protection and third-party interference affecting the integrity.

	influencing parameter	requirement
corrosion protection effect	Water	low water vapor permeability
	Oxygen	low oxygen permeability
	Electrolyte	impermeable for ions
	stray current	high electric resistivity
third-party influences affecting the integrity	loading / transport / storage / handling and installation: • hit • point load • shear forces • sun light • compaction of the bedding/the soil	impact resistance indentation resistance peel strength shear strength UV-resistance
	Operation • movement in the soil • high operation temperature • aggressive soil • bacteria in the soil	adhesion and shear strength persistent versus thermal and oxidative aging chemical persistence microbiological persistence

Table 1: coating requirements

Coatings are classified into mill coatings that are applied in the plant, and field joint coatings or field-applied coatings, that are applied on-site. The distinction is not only reasoned by the place of the application but also the different technical capabilities as well as different environmental conditions during the application. This causes various compositions of the coatings and leads in general to a less resistant field joint coating or field applied coating with respect of mechanical and thermal influences.

1.2. Mill coating

Depending on the thermal and mechanical requirements as well as the geometry of the components, nowadays the following mill coatings are used nearly exclusively in Germany

- 3 layer polyethylene (mainly HD-PE) according to DIN EN ISO 21809-1 or DIN 30670
- 3 layer polypropylen according to DIN EN ISO 21809-1 or DIN 30678
- Polyurethane according to DIN EN 10290 (pipes, pipe fittings and valves) and DIN 30677-2 respectively

In some cases, e.g. trenchless pipe laying, an additional mechanical protection made of fiber cement or glass fiber reinforced plastic (grp) could be mandatory. The three mill coating systems are accompanied by an increased number of field joint coating (fjc) or field-applied systems. This can be explained by the fact, that there must be compatible field-applied systems for all mill coatings being used during the last 100 years. For example, bituminous systems have been used till the mid of the seventies as standard. Therefore, an estimated 50 % of the German pipelines are coated with bitumen.

1.3. Field joint coatings fjc and field applied coatings respectively

The classification oft he field-applied coatings is usually based upon the application process and results in cold-applied and hot-applied systems as well as spray applied or painted systems, e.g. polyurethane or epoxy resin (see Figure 1).

In the case of the cold applied and hot applied materials the requirements are described in the DIN 30672 and DIN EN 12068. The normative PUR requirements for field joints or field-applied coatings do not differ from those for mill coatings, i.e. DIN EN 10290 (pipes, pipe fittings and valves) and DIN 30677-2 respectively (fittings).

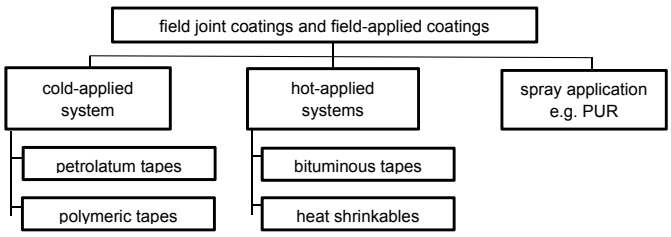


Figure 1: classification of field joint coatings fjc and field applied coatings respectively

In the past field-applied coatings were considered to be the "weak points" of the whole corrosion protection system. In the case of the cold-applied polymeric tapes, that has been used by the Ruhrgas AG as fjc for more than 30 years successfully, this point of view was disproved impressively [2]. The detailed analysis of the internal inspection results of ca. 2.000 km pipeline displayed, proper application assumed, no indications of a higher corrosion probability when using cold applied polymeric tapes as fjc compared to the mill coating.

1.4. Quality Control – historical development

Although a quality philosophy was linked to production of goods in the middle age the situation drastically changed with the beginning of the industrialization. From now on a lack of well qualified workers limited the productivity. In the context of industrial processes a separation of production and control of the products was established. Later on the consciousness became accepted, to generate quality, not to control it. In this age such famous names as Bosch, Krupp, Daimler, Siemens or Ford set the benchmarks. After world war II the Japanese industry developed an enhanced way together with the famous US Deming and Juran such that quality became an essential task of the management. One highlight of this development is the undoubted impressive way of Toyota, see The Toyota way [3], to the world´s largest car manufacturer. Incited by this also in Europe the realization enters that quality starts in the marketing, draft as well as the construction phase.

Today, it is generally accepted, that a consequent quality strategy is a determining factor of the success of a company [4]. Or in other words, a wrong planning, an inefficient control and communication, a lack motivation and responsibility as well as nonobservance of the requirements lead to a flop.

2. ASPECTS OF QUALITY CONTROL OF COATINGS IN PIPELINE CONSTRUCTION

2.1. Historical background

Coating systems of buried steel pipelines are at risk to damage from time of fabrication to transport, site-storage, pipe laying, backfilling and during operation of the pipeline. This implies transport- and distribution pipelines as well as compressor-, pumping- and metering stations.

These coating deficiencies are of different character and may occur during different phases of the application process.

The key failures are:

- Improper mixture of two component systems (epoxy, polyurethane)
- Incorrect manually operated surface cleaning basically in the field
- Deviation of coating material use from specification
- Inaccurate application (minor thickness, wrong system setup)
- Irregular application parameters (temperature, humidity, dust, dirt)
- Damage during transport and pipe handling

For several years, it has been observed that anomalies in coating systems affect the long life quality expectance for a pipeline system and may lead in the worst case to pipeline integrity-relevant impacts. As part of the pipeline operation and maintenance work, coating defects are generally detected using over the line techniques (e.g. close holiday detection). Investments for excavation and repair of previously detected coating defects are cost-effective and measures to reduce these costs have been discussed widely.

Health, Safety, environmental protection and quality are for Open Grid Europe GmbH, the former Ruhrgas AG, of significant importance and pari passu part of corporate policy and corporate objectives. In recent years, and also continuously extensive efforts have been made the subject of health, safety, environmental protection and quality of Open Grid Europe GmbH to improve steadily. Open Grid Europe GmbH has a fully integrated management system in the area of health, safety, environmental protection, quality and technical safety. There is also a special focus placed on new pipeline projects.

In order to implement a further improvement in the quality assurance of the passive corrosion protection on new pipeline projects, a monitoring concept for pipeline projects has been developed within Open Grid Europe, comprising the steps of material manufacturing, delivery and installation. The example of the implementation of the new pipeline Loop Sannerz-Rimpar (LSR) and the advanced quality assurance of the passive corrosion protection by coating inspectors are presented in the following.

2.2. Conception – coating inspector and quality benchmark

The two key aspects of the conception are firstly quality benchmark/thresholds that are to be fulfilled and secondly exclusively trained personnel – coating inspectors CI's-, experts that control, test and document all coating quality relevant parameters.

Referring to the 1st conception part, the coating quality is checked by several test methods during pipeline construction. A widely used and technically easy applicable testing of coating quality is the high-voltage test "holiday test", which is carried out before the pipeline stretches are lifted into the trench.

After backfilling is completed and sufficient ground contact has been achieved, current drainage tests were

executed sectionwise, the current demand was recorded and the average coating resistance r_{co} in [Ωxm²] was calculated. A threshold value[1] of 10^8 Ωxm² has to be fulfilled to demonstrate a coating defect free pipeline section [5][6][7]. These drainage tests were carried out on all water pressure test sections and additionally on trenchless laid pipeline parts. For those sections the criterion could not be met, defects were searched using the close holiday detection technique.

The 2nd part of quality method is the elaboration of coating inspectors that focus their supervision activities exclusively on the coating quality.

Raising the question how these personnel is selected, it was considered that they could be either contracted as external consultants especially for the pipeline construction or are 'trained on the job' for the specific work by Open Grid Europe itself.

Open Grid Europe decided to educate for this specific field the CI's 'in-house' because a subcontracted expert from the pipelaying contractor was not found to be independent enough in his ability of judgments.

The in-house training of the CI's has been executed by the Competence Center of Corrosion Protection at Open Grid Europe, comprising classroom- and practical exercises and was started such early, that factory coating expediting could be implemented.

Detailed checklists for the coating quality tests have been developed and test equipment has been supplied (e.g. holiday tester, thickness- and hardness gauges).

The main working tasks that have been in the responsibility of CI's were the following:

- Planning and executing preproduction and expediting activities of any coated or painted pipes, pipe fittings and valves in factory
- Planning, executing, supervising and documenting the personnel prequalification of contracted field applied coating companies prior to start of pipeline construction.
- Checking quality, ability and specification conformity of all field coatings/paintings and accordance with purchase documents
- Performing any quality income inspection on pipes, pipe fittings and valves that came from factory and are stored on site
- Random testing and documenting of factory- and field coatings/paintings of pipes, pipe fittings and valves (on site and factory)

- Planning, executing, supervising and documenting the coatings/paintings quality on pipes, pipe fittings and valves in the field. This also implies carrying out destructive and nondestructive testing on a random basis. Quality checks and testing cover all pipe parts but especially trenchless laid sections like thrust- or auger bored, micro-tunneling, horizontal direct drilling or pipes that are laid inside metallic casings
- Checking and approving the documentation prepared by coating/painting contractors
- Checking and approving the documentation of any current drainage tests carried out on pipeline sections
- Claiming any occurring deficiency, flaws an defects towards the involved contractor

3. EXAMPLE FROM PRACTICE – COATING INSPECTOR ON LOOP SANNERZ-RIMPAR

3.1. Pipeline project - Loop Sannerz-Rimpar

In order to provide additional transport capacity or the expansion of existing capacity, the natural gas transmission pipeline from Sannerz in Hessen to Rimpar in Bavaria was built in 2012.

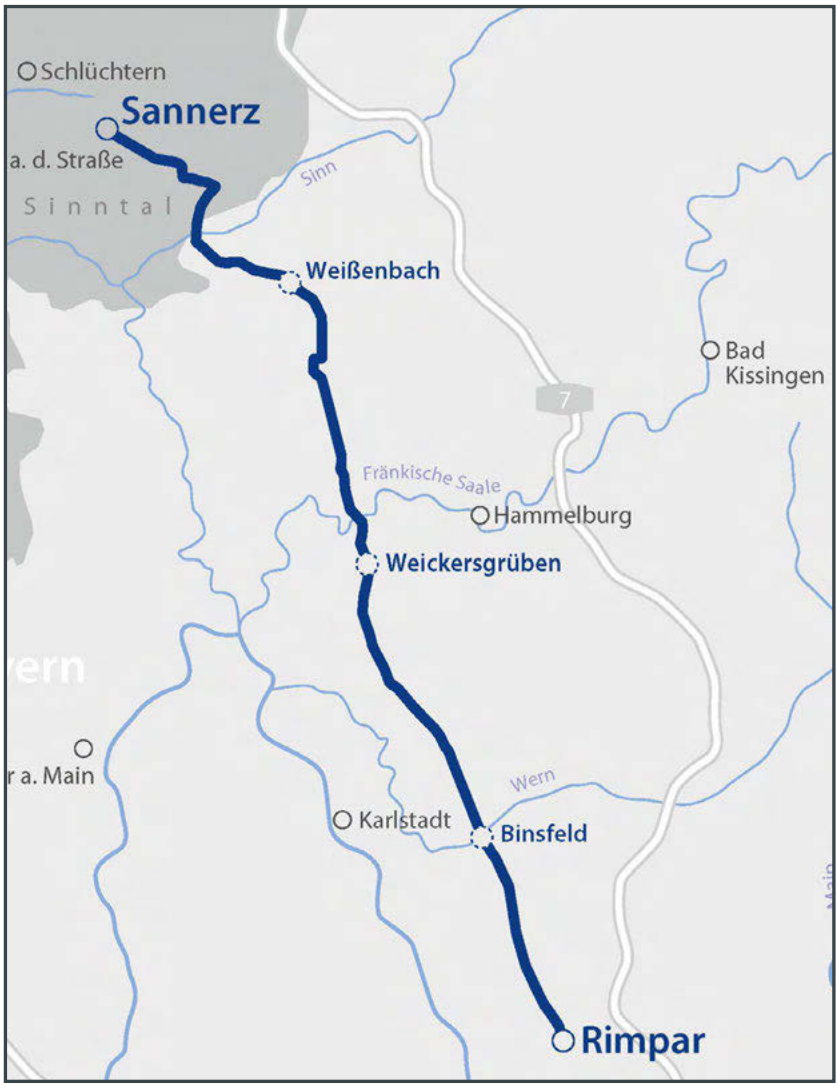


Figure 2: line course LSR pipeline

Figure 3: working strip and welded pipeline section

The construction of this line is based on the Open Season process 2008/2009 carried out by Open Grid Europe in which by querying market participants in the future transport requirements have been identified.

The route has been widely published as so-called "Loop" parallel to an existing natural gas transmission pipeline of Open Grid Europe.

The natural gas transmission LSR has a transport capacity of around 1.5 million cubic meters of natural gas per hour.

It is about 67 kilometers long, running from Sannerz about 10 km in Hessen and 57 km in Bavaria to Rimpar (see Figure 2 and Figure 3).

For this purpose, a total of over 3800 pipes, each with a 40'' diameter (DN 1000), about 18 m in length and about 7.5 t weight were moved. The total weight of the tubes is about 28000 tons.

The pipeline is designed for an operating pressure of up to 100 bar and protected against corrosion by polyethylene (PE) coating.

The 67 km long loop pipeline system Sannerz-Rimpar was divided into 2 lots. Coating works for each lot were supervised by a CI (see Figure 4 and Figure 5). All CI's verifications and supervision activities have been accompanied by the Competence Center Corrosion Protection and by the main pipeline supervisor.

Figure 4: destructive testing –peel resistance on cold applied PE/butyl rubber fjc

3.2. Results and conclusion

All observation and quality control activities have been reported. A total number of 122 reports have been written (see Table 2). 66% have shown positive results with no claimable outcome.

The coating quality statistic on 42 inspected faults/defects can be summarized as follows:

- 16% of observed discrepancies were due to mechanical damage whereas 42% of these defects are caused during grid welding due to inaccurate deposition of welding equipment on the adjacent factory coating of the pipe ends
- 14% were poor or non-specification conform paintings / coatings. 94% belong to faults and non-conform mixing ratios of polyurethane coating of pipe fittings and valves
- 5% refer to damage caused during transport and 90% have been detected on transported valves and pipe fittings

Figure 5: coating damage during transport at valve support

Number of Inspection Reports	122	100%
No observation	80	66%
Mechanical damage	19	16%
Poor painting / coating application	17	14%
Transport damage	6	5%

Table 2: Number of reports and percentile distribution of findings

A very good impression of the general effectiveness of quality control established by the CI's work could be derived when the drainage tests carried out on pressure tested pipeline sections (DPA) of loop Sannerz-Rimpar compared to a second loop pipeline, which has been constructed at the same period in the South of Germany.

Both pipelines have the same diameter but the loop benchmark was not supervised by CI's.

Loop Sannerz-Rimpar	r_{co} [Ωxm²]	Loop benchmark	r_{co} [Ωxm²]
DPA 1	1,8 x10⁸	DPA 1	5 x10⁸
DPA 2	2,3 x10⁸	DPA 2	0,2 x10⁸
DPA 3	3,1 x10⁸	DPA 3,4,5,6,7	0,8 x10⁸
DPA 4	1,6 x10⁸	DPA 8	0,2 x10⁸
DPA 5	1,6 x10⁸	DPA 9	0,06 x10⁸
DPA 8-1	2,2 x10⁸	DPA 10	0,2 x10⁸
		DPA 11	0,2 x10⁸

Table 3: summary of drainage tests carried out on pressure test pipelines sections (DPA = water pressure test section)

Table 3 summarizes the results of drainage tests performed on both loop pipelines which allow a quality related assessment of the CI work effectiveness. Drainage tests on the supervised pipeline all fulfilled the criterion for r_{co}. No further coating quality measures were necessary.

For the benchmark loop pipeline the result is completely different. With the exception of one test section, the threshold criterion of the drainage test readings was not met. All pressure test sections (excluding DPA 1) with a length of 60 km had to be checked for defects using laborious close holiday detection.

From this outcome, it can be concluded, that the CI work has a general significant effect on increasing the coating quality for the pipeline supervised. Open Grid Europe has decided in this way to supervise all larger pipeline projects by CI's. Following this decision, Open Grid Europe started training CI's especially for quality control activities of coatings / paintings in buried / aboveground structures of compressor- and metering stations.

The schedule and quality guaranteeing work of the inspectors became an integral part of Open Grid Europe's overall expediting strategy for plant and mill coating industry.

The developing necessity to contract professional CI's expertise and implement them in projects, expanded in Germany since then so vigorous, that a standard is drafted and published shortly by a DVGW (the German Gas and Water Association) committee. Its general scope is to describe in detail the skills and qualification as well as the duties and responsibilities of coating inspectors, working in future for the pipeline industry. With this normative acceptance the relevance and importance of the coating inspector is highly increased.

Footnotes

1 A criterion of rco ≥ 108 Ωxm² was added to the DVGW worksheets No. 12, 20 and 28 to verify a defect free pipeline coating system.

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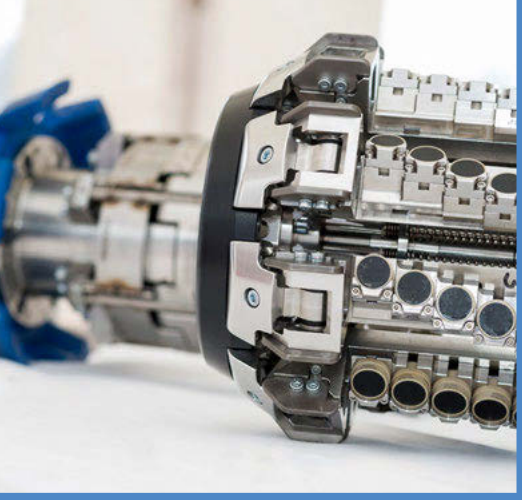

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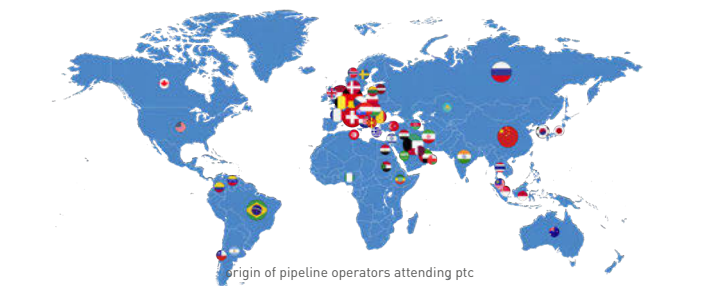

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THE KEY OF SAFETY AND RELIABLE OPERATION IS THE PIPELINE INTEGRITY - MAIN ELEMENTS AND IMPORTANCE OF PIPELINE INTEGRITY

Ferenc Peterfalvi > MOL

ABSTRACT

In the recent years, the "integrity" issue has become a popular topic with pipeline operators and the development companies.

Generally, it means the use of more advanced diagnostics tools, the corrective interventions that are based on the results and advanced SCADA (Supervisory Control and Data Acquisition) application. The advanced technical aspect is indispensable. Nevertheless, effective pipeline integrity has further "soft" elements: operational knowledge and capabilities (including the competencies of the staff, emergency drills and other traditional surveillance and safety methods.

This article outlines the relevance and importance of the topic and presents the main elements of pipeline integrity, highlighting the social expectations on MOL Hungary (Hungarian Oil and Gas Co) and its high-pressure liquid pipeline operational area.

> *"Where is the balance – if exist at all without risk – between "Safety First" and the fact that operation is driven by financial outcomes?*
>
> *Ferenc Peterfalvi*

INTRODUCTION

MOL Hungary is operating 805 km of crude oil pipelines and 1250 km product (different types of fuels, special products – virgin naphtha, aromatics, FAME) pipelines. The diameter ranges between 6"-24", permitted pressure is 63 bar for the total system. The average age is over 40 years, so the operator has to face the issue of aging pipelines. Intelligent tools for diagnostics have been applied from the mid 1990s, and the procedure is periodically repeated every 5-6 years.

The rehabilitation plans are made based on the diagnostics results. The number of defect spots increases with age. So far two pipelines had to be replaced; one of them was the oldest pipeline built in 1962 for crude. The other was a virgin naphtha pipeline, whose replacement was due to the corrosive effects of the transported fluid.

The first generation of leak detection system (LDS) was in use from the end of 1990s along the product pipelines. In the previous years, the situation was critical due to the high number of 3rd party interventions. Since then, LDS has been developed on both (product and crude) systems so the number of external interventions gradually decreased.

Striving for excellence currently a special software solution for Pipeline Integrity Management System (PIMS) is being implemented.

In parallel with the developments, it is necessary to increase the organizational skills and capabilities of personnel as well.

In Hungary, there are no harsh environmental conditions, so there is no need to calculate for natural disasters. Still the operator has been faced with formidable challenges.

Figure 1 provide a map of MOL high-pressure liquid hydrocarbon pipelines.

WHY IS IT IMPORTANT?

There can be more approaches to evaluate the role of pipeline integrity; here the relevance and importance of this issue are highlighted from operational and business aspects.

Finally, yet significantly, it has regard for the higher expectations and sensibilities of society.

OPERATIONAL RELEVANCY

The expectation of business management is the high availability rate of the pipelines and calculable, scheduled transportation. By using advanced SCADA systems, surprises can be avoided during operation. The applied SCADA consists of four modules; process control, LDS, excise product accounting and batch tracking. The latter two are part of the product pipeline system, as fuels are under Excise Duty Law and the system has to meet the legal criteria. The basic method of Leak Detection System is PWM (pressure wave method), complemented with PDM (pressure drop method), VBM (volume balance method) and RTTM (real time transient method). Details: [1].

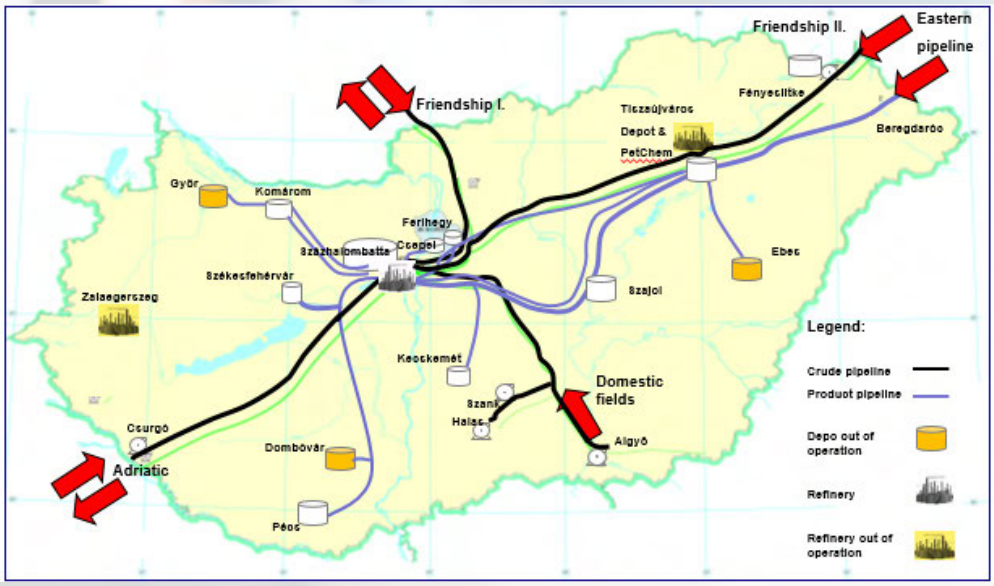

Figure 1: Crude oil and product pipelines in Hungary

The actual breaks-offs in the operation are during the reconstruction works (based on the pigging results), which are well planned also for the scheduler and stock management team. It is nearly 1-1.5 % of the total yearly operation time together with some 3rd party interventions (1-2 cases/year in the last 10 years) which can be intentional or unintentional (for example, an attempt to steal product or backhoe activity). In these situations we should consider other integrity elements: the emergency response preparedness (see later).

In certain business circumstances, another business expectation is the capacity flexibility.

Generally, the operator uses DRA (Drag Reducing Agent) which can lead up to 30 % capacity increase, and/or uses more pumps. The latter are mainly characteristics of the crude transportation.

Naturally, DRA additivation systems in different locations are also part of SCADA.

BUSINESS AS USUAL?

The smooth and reliable pipeline operation is the major part of business expectations. In a balanced logistics system, each mode of transportation has its own, well-defined role; pipeline, barge, rail and road transportation. (As Hungary is a land-lock country, barge means river navigation along the Danube.)

The final goal is to serve the "the customers", whether internal or external customers both in the requested time and in the quantity ordered.

In general, with a decrease in the quantity delivered the sharing of end-users increases. Practically all the receivers are accessible by road, so product transported by road has the most end-users (Retail and Wholesale customers).

Nevertheless, the specific cost (EUR/tons/km) of road transport is app 7-8 times of the pipeline specific cost. The next important aspects are the HSE (Health, Safety and Environment) risks (including fatalities); the order is similar to the specific cost: pipeline<barge<rail<road with essential differences.

From sustainability aspect (including greenhouse gases), the greatest possible part of the transportation demand is to be transported by pipe (and barge), which is possible, the remaining demand is to be transported by rail, which is also possible, and finally just what remains from the demand should be transported by road. In many cases, this is not implemented in such places/receivers where the technical conditions are not available. This issue at first glance seems complicated, but behind the scenes there is usually some kind of organizational sub-optimum, or short-term financial interest. The next sensitive area, which partly leads to the social topic as well, is a real trap.

Because of social "pressure", all companies have, beyond definition of mission and vision, public declarations about HSE policy, social responsibility, including social effects, commitment to sustainable development, etc., and the annual reports are accompanied by these relevant reports. However, certain effects, either external or internal circumstances: economic crisis, change of business environment, short-term financial interest, change of company priorities etc., can make the declarations appear shallow unless continuous efforts are made to maintain the pipeline integrity.

CASE STUDY

The described accident is not unique and is not directed against anybody or any legal entity. All related information was public and available by anybody.

On May 19, 2015, Plains All-American (PAA) pipeline ruptured and an estimated 2934 barrels of crude oil was released on land and beaches, and into the Pacific Ocean, in Santa Barbara County, California.

The PHMSA (Pipeline and Hazardous Materials Safety Administration) Failure Investigation Report (May 2016) [2] found that the integrity elements were violated in several points. Just to recite the entries:

- Ineffective protection against external corrosion of the pipeline
- Failure by Plains to detect and mitigate the corrosion
- Lack of timely detection of and response to the rupture

Figure 2: Spill location in Santa Barbara County

Figure 2 shows the location of spillage, Figure 3 is one of the first photos of the release location after removal from the ditch. [2].

Just the immediate cost for PAA of damage compensation and control — typically clean-up of oil on beaches — was $69 million within 3 weeks after the event. In addition, there was the cost of the extended diagnostics examinations, pipeline reconstruction works, etc.

A PAA spokesman said to the public: We are committed to the thorough clean-up of this accident.

But let us look at what this "commitment" was on declaration level.

Figure 3: The failed pipe and surrounding insulation and coating

"Plains All American Pipeline and its affiliates adhere to high standards of environmental quality and are committed to providing a workplace that protects the health and safety of our employees and the communities surrounding our facilities. In order to achieve this objective, Plains strives to integrate safety into its business planning and decision-making process. We believe this will enhance and promote the protection of our employees, the people who live, work and play in the vicinity of our assets, and the environment while increasing value for our stakeholders.
...
In fulfillment of this commitment, Plains strives to:
...
Assess potential environmental, health or safety concern prior to the sale, lease, transfer or purchase of property. Establish appropriate design, construction, operating, and, maintenance program and practices to minimize risks, reduce releases and waste, increase energy efficiency, and conserve natural resources. Establish programs to analyse and mitigate risks, investigate significant environmental and safety incidents, and prepare for and respond to emergencies" [3].

What does "business as usual" mean?

It is a good question, in general; what is the match or overlap between the declaration level and the daily practice at the pipeline operators?

Where is the balance – if it exists at all without risk - between "Safety First" and the fact that operation is driven by financial outcomes?

Summarizing the losses at an extraordinary event:

- Direct fluid loss (crude, product, etc.)
- Cost of damage control, repairing and rehabilitation works, extraordinary and unplanned examinations
- Punishment, indemnification and compensation, procedural and regulatory costs
- Lost business opportunities
- Reputational losses, immediate and long-term effects

SOCIETAL EXPECTATIONS

In the last 10 years, there has been paradigm shift in thinking about energy in the developed countries and especially in Europe.

After protracted discussion, there is now abundant evidence that climate change is a one-way process. The alternative or renewable energy sources - mainly solar and wind energy -are explosively spreading.

The Paris climate convention's objectives are challenging, but as was pointed out, the consequences of continuing the "business as usual" scenario in the world economy are catastrophic in the foreseeable future.

Figure 4 shows the current primary energy world consumption [5].

It can be seen that the dominating energy source is fossil in origin and within this nomenclature crude is the major one.

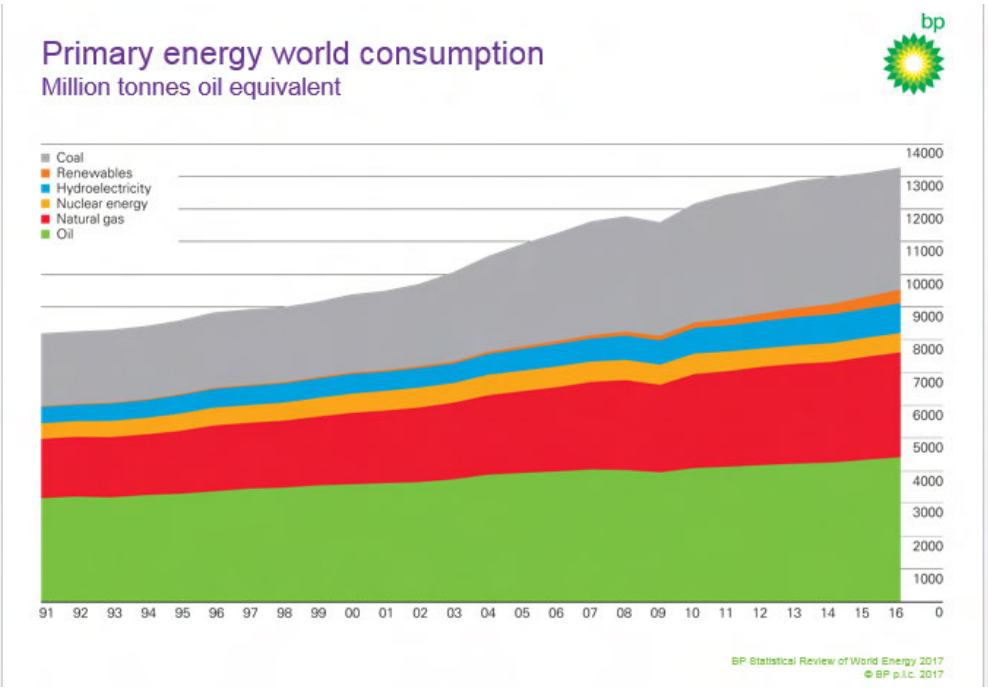

Figure 4: Primary energy world consumption

The EU's long term policy target is a low carbon economy by 2050, and it means, among other things, decreasing liquid fossil fuel consumption. Nevertheless, at present liquid fossil fuel consumption is still growing worldwide. As the oil price has moved upwards after Y2017, the investment interests of oil companies have also increased. At present, less than 20 % of the world runs on renewable energy. It is conceivable that transport can work without carbon-based fuels but the petrochemical industry cannot. Approximately 95 % of our everyday products/objects contain carbon. Nevertheless, the EU has made a strong commitment to reduce the quantity of different petrochemical products, the first sign of which is the ban of plastics bags and straws.

The other essential issue is the penetration rate of electricity-based mobilization in the future.

The predictions of highly appreciated national and international organizations and scientific institutions are fairly diverse. It is sure that long years will be required to change the transport vehicles; in addition, further technical development is necessary to increase the electricity storage, to build the electricity network and to secure energy supply. On one hand the penetration rate is essential for the future of oil industry, on the other hand let us not forget the adaptability of the oil industry, which has been highly proven in the last 100 years.

Nevertheless, such high expectations, sometimes exaggerated, to change fossil fuels into renewable ones have never been met. The European general public considers the traditional fuels as "dirty" energy. Big cities make decisions to ban diesel cars (as a consequence of VW scandal) or to ban diesel and gasoline cars (Oslo) after middle term periods. Unfortunately, there is less focus on other significant sources of carbon-dioxide and particulate matters, including the most dangerous PM 2.5 and PM 10; such as industry, non-road transport, agriculture, commerce, households, waste, etc.

Anyway, now it seems that only higher electric car penetration and more sustainable energy production can ensure compliance with emission targets.

In these circumstances the oil companies are demonstrating that their activities are environmentally friendly during the total supply chain, there are no or minimal risks in the operation of upstream, downstream, the logistics and distribution processes.

Demonstrating their transformation into low carbon world, they highlight their investments in and development of the renewable sector, typically participating in building recharging stations for electric cars and renewable energy farms.

Also part of the politics of social responsibility are their sponsorships and many volunteering contributions to "sensitive" social areas.

Without the current and extensive hydrocarbon pipeline systems, it is impossible to maintain the current standard of living in the developed countries. We as pipeline operators know this very well. At the same time we must acknowledge that the general public is much more responsive and sensitive to all types of havaria/extraordinary events than a few years ago.

Maintaining pipeline integrity is the indispensable operational philosophy and "tool" for minimizing the operational risks. All elements of integrity are important since we know that the weakest part determines the strength of the entire system.

Potential threats to pipelines [4]

- Stable threats
  - Manufacturing-related defects (defective pipe seam, defective pipe).
  - Welding/fabrication-related (defective pipe girth weld, defective fabrication weld, wrinkle bend or buckle, stripped threads/broken pipe/coupling failure).
  - Equipment (gasket, O-ring failure, control/relief equipment malfunction, seal/pump packing failure, miscellaneous).
- Time-dependent threats
  - External corrosion.
  - Internal corrosion.
  - Stress corrosion cracking.
- Time-independent threats
  - Third party/mechanical damage (damage inflicted by first, second, or third parties (instantaneous/immediate failure), previously damaged pipe (delayed failure mode), vandalism).
  - Incorrect operation (incorrect operational procedure).
  - Weather-related and external force (cold weather, lightning, heavy rain or flood, earth movements).

For all elements of this list there is by now detailed professional literature available in many resolutions within the issues.

Just to mention one of them, the most relevant manufacturing - related defects are the following [6].

- Plate defects
  - Segregation is concentration of non-metallic material in the mid-wall position
  - Indentation is depression on the pipe surface
  - Laminations are internal metal separation creating layers
  - Silvers are thin, elongated flaps of metal rolled onto the plate surface
  - Inclusions are non-metallic inclusions in the plate wall
- Seamless pipe defects
  - Typical seamless pipe defects are laps, silvers and rolling marks. Furthermore, linear surface defects

(e.g. quench cracks) can occur on the inner and outer surface as single events or in group.

- ERW pipe defects
  - ERW (Electric Resistance Welded) pipe defects are often related to the longitudinal ERW weld.
  - Seam overtrim, seam undertrim, seam misplaced trim
  - Aligned inclusion
  - Lack of fusion
- SAW (Submerged Arc Welding)/Spiral pipe defects
  - Hot cracks are solidification cracks in the centre line of the weld bead. They tend to occur around the end of pipe in the last metal solidity.
- Grindings
  - Pipes can be repaired by grinding within the wall thickness tolerances.
- Mechanical damage
  - Mechanical damages are typically gouges and dents. They are irregular scores and gouging of the metal surface, which may be occur within a dent.

The category of stable threats contains lot of traps. Unfortunately, only one part of them can be investigated with diagnostics tools, the other part comes decades later into a critical state that causes havaria (as the system is known in Hungary)/emergency situations. This could be, for example, due to the existing non-metallic intrusion in the weld caused by leaks and spills.

Keeping the equipment in good and reliable condition can be ensured by preventive maintenance.

The category of time-dependent threats is the typical area of the increasingly developed and constantly developing diagnostics tools (ILI tools).

Figure 5 shows the technologies of inline inspection, and Figure 6 shows the grouping of different defects [6].

Recently the category of time-independent threats has been the biggest challenge for the pipeline operators. In some regions of the world the 3rd party interventions cause significant environmental damage and often involve fires and fatalities as well (Mexico, Brazil, Nigeria).

Only the joint and coordinated actions of the legislature, authorities and operators could improve the situation, but the willingness to do so is rather different [8].

In Europe, over the last couple of years the number of 3rd party interventions has risen sharply, mainly in Western-European countries [7]. It seems the Eastern-European countries are "more quiet" in this regard, at least the members of the EU. The reaction is not the same, but the common trend is tightening of law, more effective authority support, more sensitive and reliable (also more expensive) leak detection systems, more and more effective supervision.

The aim is faster response to sensibly increase the risk for the perpetrators; moreover, the later a leak is discovered, the more money is lost.

As one can see, the threats to pipelines are important. There are a relatively high number of accidental, typically incidental damages but still far fewer cases than intentional damages (theft or theft attempt). Most of these events are caused by direct damage from some form of digging and earth moving activities (digging, trenching, bulldozing, drilling, agricultural activities, etc.).

Generally, when better communication has been established between the pipeline operator and a 3rd party company, it does help but not always enough. Sometimes the necessary communication chain is broken. When the actual work begins, the actual machinery operator may

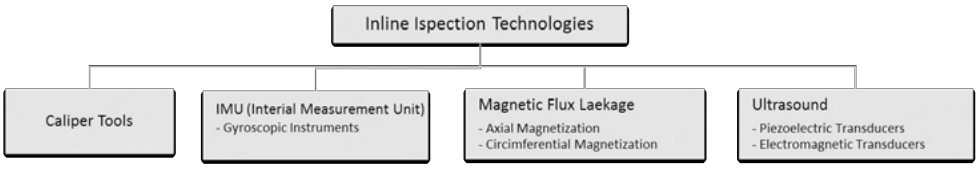

Figure 5: Inline Inspection technologies

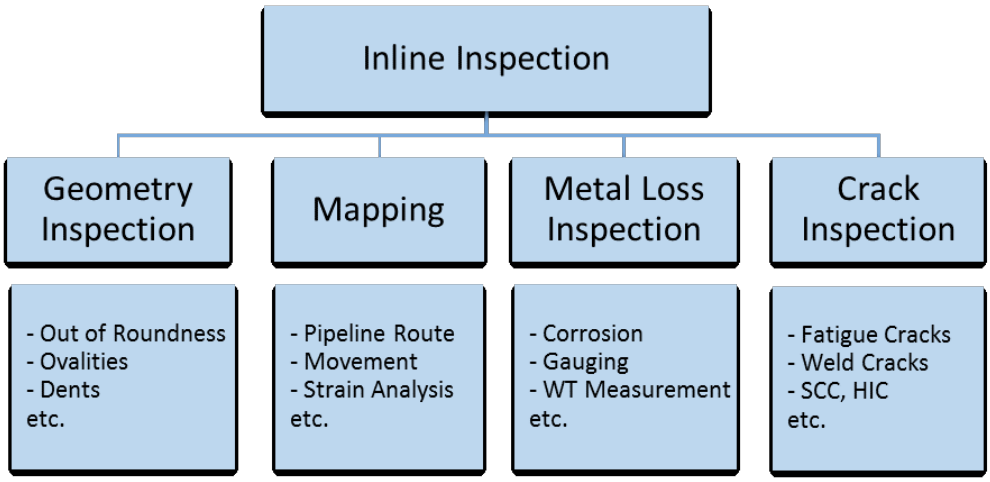

Figure 6: ILI grouping for different defects

not be aware of the pipeline at all, or the pipeline's track. In the majority of the countries, based on high-level state rule, the 3rd party company has to notify the pipeline operator about these works in advance. In Hungary, MOL supports and gives continuous technical supervision to these high-risk works (road, highway, rail crossing, etc.).

Figure 7 shows the consequences of serious damage to crude pipeline caused by agricultural activity. (It has been the biggest damage in the last 20 years.)

Further special attention needs to be paid to aging pipelines. Most of the world's pipelines are over 40 years old. In Europe 64 % are over 40 years and only 4 % of the total is 10 years old or less. [7]. The situation is the same in Hungary.

Naturally, along the aging pipelines, as time passes corrosion accelerates.

But the old status does not necessarily mean that there is significant deterioration or damage. It is increasingly important to define bespoke integrity level for these pipelines and to operate with those principles.

In Europe, based on the Concawe 1971-2016 incident database, there is no evidence that the aging of the pipeline system implies a greater risk of spillage [7]. It means that responsible thinking and operation is a long-term practice with European operators. Continuous monitoring and diagnostics examination (ILI tools) with predefined frequency ensure failures can be prevented, i.e., it the weaknesses can be spotted before they lead to errors. These inspection methods together with bespoke integrity management system are able to prevent any increase of age-related spillages.

Figure 7: Consequence of crude pipeline damage in Hungary, 2002

Based on Concawe grouping [7] the following factors can lead to faulty performance —beyond corrosion (internal, external, stress) and external interventions.

- Mechanical
  - Construction
    - Faulty weld
    - Construction damage
    - Incorrect installation
  - Design and materials
    - Incorrect design
    - Faulty material
    - Incorrect material specification
    - Age or fatigue
- Operational
  - System
    - Equipment
    - Instrument and control system
  - Human
    - Not depressurized or drained
    - Incorrect operation
    - Incorrect maintenance or construction
    - Incorrect procedure

The industry should strive to transfer the vast experiences and knowledge of the pipeline operation area through generations. It is not inconceivable that we will operate 100-year-old pipelines.

TECHNICAL ELEMENTS OF INTEGRITY

Field operation devices and instruments

It is important that the condition of all types of these devices and instruments including IT-related infrastructure and measuring system must be continuously monitored and reliably maintained so that their functions be kept (transmitter, switch detector, fitting, etc.). Reliability, sensitivity, accuracy and robustness are the most important aspects in their selection besides price, implementation and maintenance costs. It is also indispensable in today's world, that the data transfer system is put into operation after a successful cyber security audit, which should be repeated on a regular basis.

SCADA (Supervisory Control and Data Acquisition system) Generally, a SCADA system has four functions

- Data acquisition
- Network data communication

- Data presentation
- Control (automatic intervention is also possible)

The main components that provide the functions

- Sensors and control relays
- Remote telemetry units (RTU) serve as local collection points for gathering data from sensors and delivering command to control relays
- SCADA master units provide a human interface to the system and automatically regulate the system in response to sensor inputs
- Communication network provides the connection between SCADA master unit and RTUs in the fields

Figure 8: MOL Product pipeline dispatcher centre

In the selection and construction processes reliability, sensitivity, accuracy and robustness are also important criteria.

MOL product pipeline SCADA system consists of four main modules with many sub functions.

- Technological process control and monitoring
- Batch tracking application (MOL system is used to transport batches of various semi-finished and finished products sequentially without the use of segregation elements by so-called "direct contacting".
- Excise product accounting application (Transported products/fuels are under Excise Duty Law.)
- Leak detection system

MOL crude pipeline SCADA is similar but without batch tracking and excise product application.

At the present time, our industry should prepare for the fourth generation SCADA architecture IoT (Internet of Things, Industry 4.0).

Figure 8 shows MOL product pipeline dispatcher centre with the SCADA surface which was put into operation in 2016.

INTEGRITY SYSTEM (PIMS-PIPELINE INTEGRITY MANAGEMENT SYSTEM)

Generally, the primary concern of pipeline operators is to ensure continuous, safe and reliable operation while improving asset integrity and operational efficiency. Operation is taking place amid increasing demand, higher energy costs, potential security threats, and both regulatory and environmental pressures.

Integrity is the application of selected engineering and management disciplines to ensure that a pipeline performs in accordance with its appropriate and intended functions.

Today there are a lot of integrity software solutions available on the market.

The primary goal of MOL Pipeline Operation was to implement an integrated management system, able to support Hungarian product and crude pipeline maintenance-related planning, simulation, risk assessment along with the help of more advanced modeling methods and by using a more complex set of information as the basis of the calculations. Further aims were that the system should be subject to audit (either external, by the authorities, or internal), well structured, should have good visualization capability and support the operator in day-to-day work. Finally, by the end of the implementation it was also important to eliminate all paper-based documentations and digitally integrate them into the system (including P&ID or right of way contracts, etc.).

In the pilot phase MOL experts worked together with the contractor (approximately 10 % of the total system), and thereafter they have continued the work independently (with remote support if it was needed).

In Figure 9 MOL integrity system architecture can be seen.

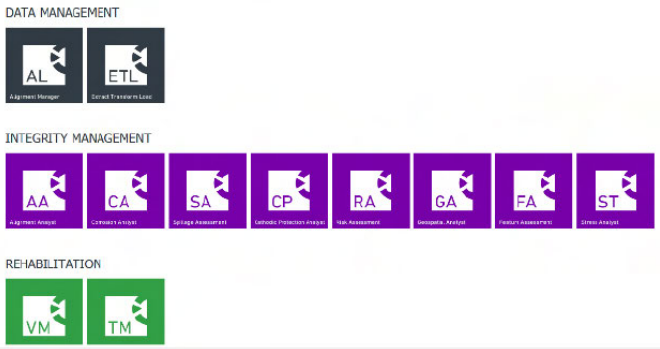

Figure 9: System architecture

A short summary of the modules' functions

Data management

Alignment Manager
Loading, alignment and management integrity related data, which can be displayed in map views and as band along the length of the pipeline.

Extract, Transform and Load (ETL)
It integrates data from various MOL sources into the centralized PODS (Pipeline Open Data Standard) database.

Integrity management

Risk Assessment
It evaluates threats and consequences along the entire pipeline network, compares risk outcomes to optimize and prioritize maintenance and inspection spending, and identifies areas of potential and immediate concern.

Feature Assessment
It rapidly assesses the criticality of features identified during in-line inspections regardless of the inspection vendor used. This module also applies corrosion growth rates as a basis to develop term repair plans.

Geospatial Analysis
It visualizes and analyses all the integrity related data in a geographical context.

Alignment Analysis
All distance based data, whether external or from another module, can be viewed and aligned allowing further analysis and determination of possible root causes.

Corrosion Analyst
It calculates corrosion rates by comparing two ILI runs.

Cathodic Protection Analyst
All CP data can be viewed and analyzed giving insight into the actual condition of system performance along a pipeline.

Stress Analyst
The module calculates bending strain perspectives using GPS/GYRO/trajectory data to detect bends, which could have been created by earthquake, thermal expansion, etc.

Spillage Assessment
This module supports the process of estimated spill amount after a pipeline rupture.

Rehabilitation

Task Manager
The entire repair process can be managed within this module. TM combines risk-based actions, immediate repair tasks and planned maintenance schedule into a single integrity plan.

Verification Manager
It helps operators in the collection and analysis of field measurements, making it easy to compare these against the reported defect sizes reported by the inspection vendor.

In addition, a part of the system is the Management Dashboard - such a tool designed to summarize and display key data (e.g. KPIs) from the software.

Figure 10 shows an example of the system visualization capability.

TRACK SURVEILLANCE

MOL operates more than 2000 km high-pressure liquid pipeline with numerous road, rail, river and utility crossings. We have more than 26000 properties' right-of-way contracts. Hungarian state regulation describes exactly what the owners can do and what they can not do on the easement areas. Naturally, on such an extended network, something always happens. The majority of those who intend to work notify us and ask for our contribution, work condition or surveillance of the crossing work. Nevertheless, many owners tend to make irregular working attempts, for example, planting trees, making construction initiatives or various materials' deposits.

MOL's track surveillance consists of two parts. The main goal is prevention; timely detection and intervention.

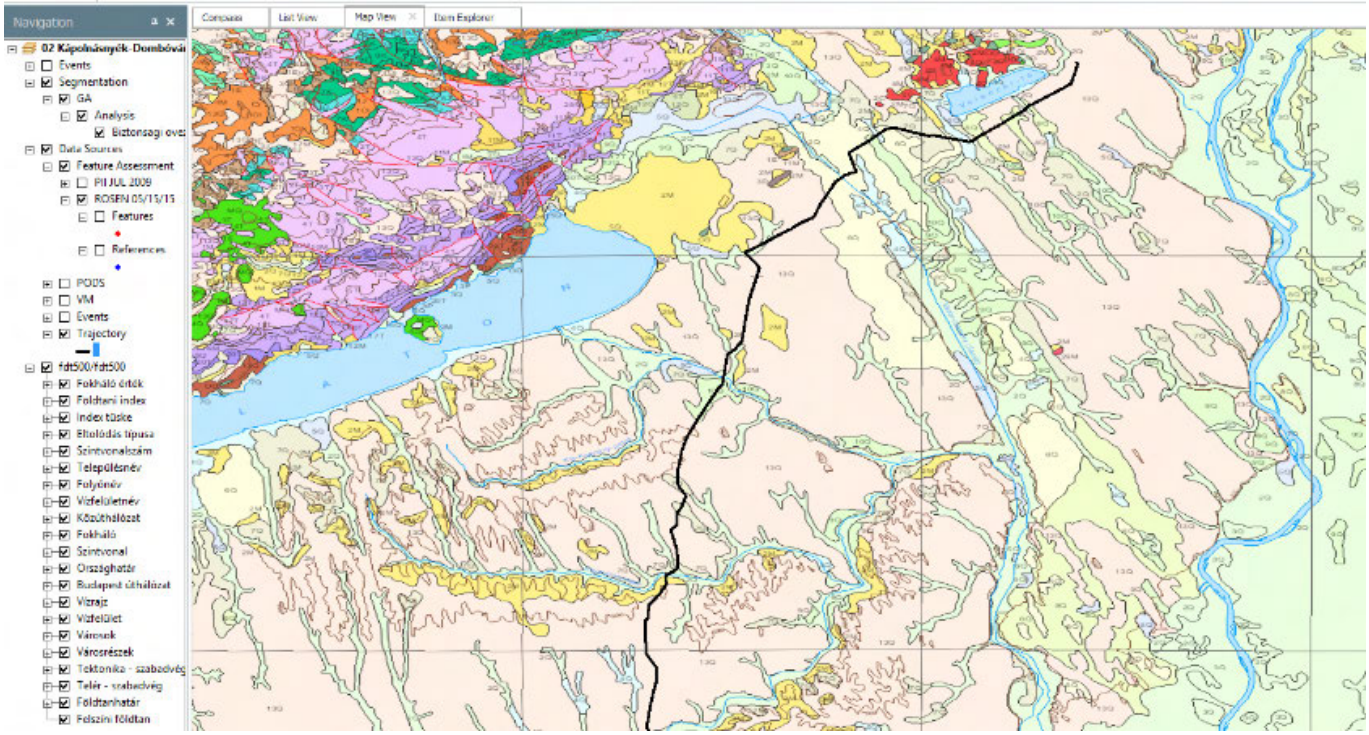

Figure 10: Track of Adria pipeline near Lake Balafon with the soil types

- Flight control twice a month.
  Our experienced colleagues fly and the following report with photos clearly shows where to intervene. (It should be noted here that in the recent years there have been two attempts to use drones. Unfortunately, this technique does not seem to be mature enough to change the traditional flight. It is a more complicated, involving a longer process and financially unmatchable with the traditional flight.)
- Walking control for all pipelines biweekly but with different time periods completed by external contractor. Tasks are to detect subtle changes along the track, for example, theft preparation, such changes that are undetectable from the air. Correct and appropriate application of track surveillance methods is also a part of the integrated operation and spares the operator much annoyance.

ORGANIZATION AND PROCESS RELATED ELEMENTS

Safety management system framework

The safety management system follows the well-known principles of the PDCA cycle.

Main elements

- Plan
  - Leadership, Policies
  - Organizational structure, rolls and responsibilities
  - Hazard identification and risk assessment
  - Regulatory requirements
- Do
  - Goals and targets
  - Operational control
  - Management of change
  - Training, competence and evaluation
- Check
  - Communication
  - Measurement and monitoring
  - Incident investigation system/reporting
- Act
  - Records, management activity
  - Management review and audits

A more detailed breakdown of the subject is beyond the scope of this article; just some typical topics are mentioned.

MOL is strongly committed to continue the steady improvement of HSE (Health, Safety, and Environment) performance and process safety.

There are many long-term HSE programs, actions and bespoke internal regulations, which are also part of the pipeline operation organization.

The two most important long-term programs are the following.

PROGRAM ZERO is a project to achieve our vision zero, which means

- ZERO fatalities
- ZERO personal injuries
- ZERO process safety events
- ZERO serious road accidents
- ZERO harm on environment
- ZERO tolerance for unsafe behavior and practices

To ensure strong, solid and safe processes, MOL implemented the DuPont model of Process Safety Management System (PSM). Figure 11 shows the elements of PSM.

Some further programs that MOL has implemented in headlines: Log Out Tag Out (LOTO), Fall, Slip & Trip (FST). To increase the contractor safety for all critical works/processes it is mandatory to set up an approved HSE plan. The Job Safety Analysis (JSA) and the Last Minute Risk Analysis (LMRA) are also mandatory before the works start.

Organization structure and competency development

There are different approaches to creating organizational structure. Some companies, like to keep everything in one hand beyond the operation (planning, certain types of construction, maintenance or IT system operation, guarding, etc.). The position of MOL in this question is on the opposite side. It is focusing on the operational area (except for a small group who are involved in the daily businesses of external stakeholders, typically related to right-of-way affairs).

All other activities that are indispensable for the operation from the organizational perspective are supply from external resources; all maintenance works are in SSC (Single Service Company) construction, planning and investment implementation are services provided by (MOL) Group, while the others are bought from the market typically after periodical tendering procedures.

Under such operational conditions, the professional competence of company personnel is particularly important. Without high-level competencies a cost - effective but reliable operational practice would be impossible.

The most simple definition of competency is the ability to do something well.

This is a true and self-determined statement, but the next one says a little bit more; competency is a combination of thinking skills, knowledge and experience. It means the personal professional value consists of skills, knowledge and experience.

This article is not about competency development, it only intends to emphasize the key role of competency development in the integrated approaches of operation.

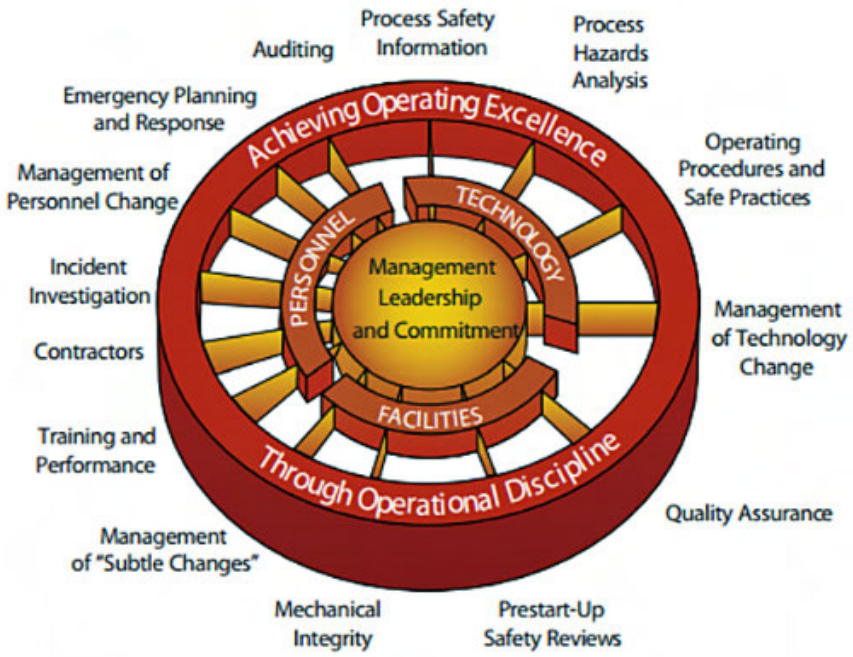

Figure 11: Elements of Process Safety Management System

Naturally, these elements can be developed with different methods; training for skill, mentoring, tutoring to increase knowledge and spending long time in practice to get experience. Within MOL there are many different types of training sessions and practices (focusing on HSE and process safety), but the pipeline organization has two bespoke and long-term training courses.

- Pipeline operators' training course involves a high number of hours and periodically repeated. It contains basic operational knowledge and practice with additional professional background. The blue collar workers

are the main focus group but it can be attended by white collars as well. The lecturers and task managers are our own senior experts together with lecturers from authorities and universities. The course ends with an exam before the course committee.

- For a couple of years, MOL has also been a member of the PetroSkills Alliance. PetroSkills is a competency based training provider for the Oil and Gas Industry. We have adapted the methodology, which begins with the individual competency map. The "measured" knowledge has four levels; awareness, fundamental, skilled and mastery. Based on the gap between the current and the required competency, the individual development plan is set up. The white collar high - level technicians are the main focus group. This way not only the competence level increases but also the career development that depends on it.

A special challenge for the oil industry (the pipeline industry a major subset of this) is that we are operating aging pipelines with aging personnel, i.e., "aging" competency owners (at least in Europe and North-America).

At present, that high-level competency is at the older generations (baby boomers and generation x). The large number of baby boomers are slowly retiring on pension; the issue is there is no one to pass their knowledge to. The knowledge transfer, which was successful in the previous years, now does not work suitably. Oil industry is not too attractive for fresh graduates because of social expectations, low reputation, "dirty energy" approach. (See in chapter "Societal expectations".)

A possible way to change is represented by the fresh example of Statoil. Statoil changed its name after 46 years to Equinor. Statoil / Equinor is strongly motivated to become a broadly-based energy firm, investing more and more in "new energy solutions". It is also emphasized that they want to attract more young talented technicians from the universities [9].

Drills

The next issue is preparing for different disaster situations. Inappropriate reaction can worsen the situation very much, significantly increasing the financial losses, while quick and professional intervention can significantly mitigate the consequences.

Based on the Hungarian state regulation the operator (MOL Pipeline Operation) has had to make (and regularly update) the Incident Emergency Response Plan (IERP) approved by the dedicated authority. For the IERP detailed analysis MOL used the methodology of British Standard PD 8010, and for authority request we did not use our own database for modeling events but we used UKOPA (United Kingdom Onshore Pipeline Operators Association) Pipeline Product Loss Incident and Fault Report (1962-2015) database.

(As a reminder, PIMS, in chapter "Integrity system" also has a subtle risk assessment module (RA) highlighting high consequence areas, - with potential serious consequences.)

IERP describes in a nut shell the different devices we use during the defense procedure and also the personnel structure, the likelihood of pipeline defects, hydrocarbon leakage at different rates and via different holes (6 mm, 50 mm and at total diameter), and fault tree analysis (FTA).

From a practical aspect, we have two types of drills. One of them is the overall IERP drill, once a year, involvement of the majority of the pipeline organization is obligatory based on the state regulation and it is supervised by the authority (National Emergency Response Directorate). The other one is voluntary, also once a year, relating to every individual unit and focusing on the reaction to an extraordinary event, for example current outage.

The IERP drill is based on a difficult incident scenario (a new one in every year) somewhere in the country. The action starts with an alarm to the dispatcher centre of the pipeline organization. The participants beyond the pipeline organization are a professional refinery fire brigade with special capabilities, vehicles and instruments, excavating unit (contractor), mechanical (including welding) and technician units (contractor). After fulfillment, the drill is evaluated in every detail.

It also bears mentioning that the pipeline organization sustains a continuous preparedness unit from its own personnel who can be called from home in case of an extraordinary event.

REGULATION AND SOCIAL BACKGROUND

In Hungary a number of state regulations (or part of them) apply to pipeline operation but two of them have decisive effect on high-pressure pipelines.

Act No. XLVIII of 1993 on Mining defines the legal framework of establishment, licensing, authorization, obligations and operation.

The other one is GKM decree No. 79/2005 (X.11) on the Safety Requirements for Hydrocarbon Transmission Pipelines and the Publication of the Related Safety Regulations.

It contains detailed, but normative requirements, and it does not specify the precise technical solutions.

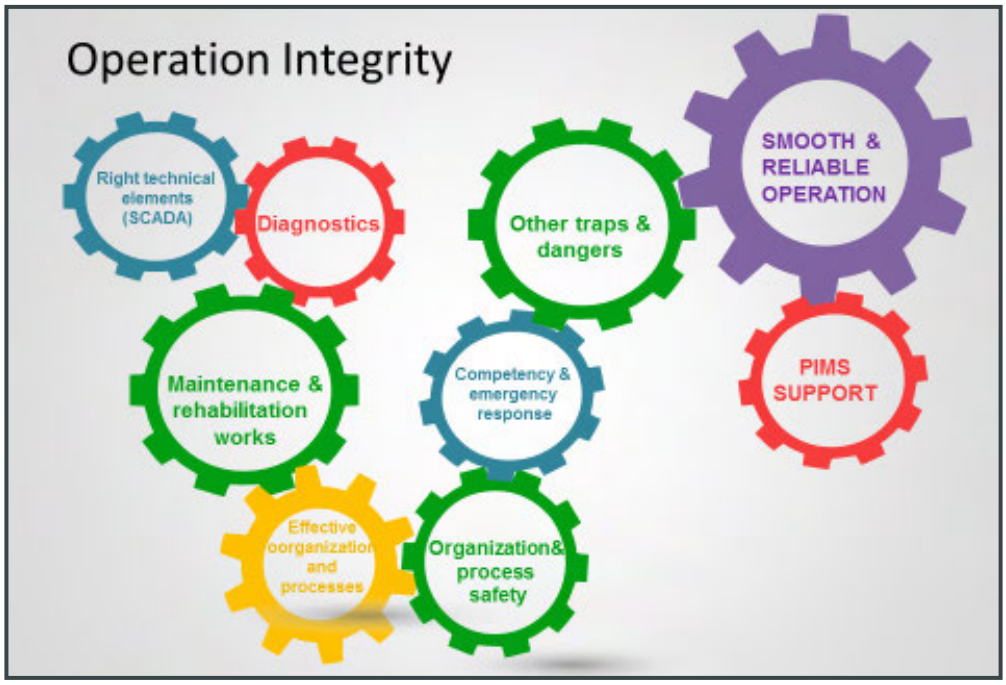

Figure 12: Operation integrity model

The regulations distinguish between the owner and the operator, and determine the criterion system of becoming an operator.

The official supervision and control is divided into national (as the main one) and regional levels.

It is also has to be mentioned that more than a decade ago there were many attacks against the pipelines (thefts and theft attempts) but in the last few years only 1-2 cases have occurred, more precisely theft attempts — hopefully, at least partly thanks to the new generation leak detection system. Since these are crimes, in each case, the police try to investigate the perpetrators, unfortunately, not with very good results. The general result after a few months is "perpetrator unknown". A further disadvantage in the Hungarian practice is if the perpetrator(s), are caught, the court proceeding lasts either for five to ten years.

OTHER RISKS AND TRAPS

All economic organizations, irrespective of the form of association, have to "produce" profit on middle and long term to reach sustainability. Unfortunately, the profit expectations beat the integrity requirements. Although the pipeline transportation is one of the safest and cheapest means to transport crude and crude oil products, it poses a great potential threats to the environment because of the large volume of hazardous liquids that could be released. However, there is a price of compliance with the integrity requirements, which can be managed at the expense of profit. In many cases, the "appetite" for profit is greater than the pursuit of security. If this is accompanied by a profit-oriented managerial incentive system, the safety "margin" is getting smaller and smaller during the operation. The first idea of the management almost always the cost reduction. Lacking better options the technical professionals must trust the "fortune factor", which eventually makes them become losers.

It can be another risky situation for the pipeline operator when the organization is a part of a big (multi-divisional) company. The top management is mainly responsible for the yearly profit and may not see the details. The strategic goals change, depending on business environment there are new developing areas, which need money. The result is again cost reduction as a consequence of the financial source transfer. In case of aging means, it is extremely dangerous if the integrity requirements are not aligned with business cycles due to not mature enough corporate culture.

> *"There is a price of compliance with the integrity requirements, which can be managed at the expense of profit. In many cases, the "appetite" for profit is greater than the pursuit of security.*
> *Ferenc Peterfalvi*

Nobody should forget that in the background, the sensibility of the society is high and the tolerance level for error is lower and lower for the oil industry.

CONCLUSION

This paper, due to limits on length, does not cover the defense against natural disasters (landslide, subsidence, earthquake, flooding) and cyberattacks; although the latter can be a major challenge for the future.

It summarizes the essential elements of integrated pipeline operation, which have a significant impact beside stricter social expectations.

In the case study, we have an example when public declarations are sharply in contrast with the real situation.

It also reviews the potential dangers to pipelines, and in another way of grouping, the other causes of malfunctioning; furthermore it shows the available in line inspection techniques.

For the right application of diagnostics tools, which are the bases of the maintenance and rehabilitation works, there is an indispensable need for technical systems, such as SCADA, within which reliable leak detection systems has a prominent role. Now the pipeline operators have such software tools that can effectively handle a wide range of functionalities in a single system (Pipeline Integrity Management System).

The successful operation also includes the appropriate organization- and process-related elements. The best technical conditions though can only be exploited with well-trained and continuously developing professionals. At the high competency level, the operator's task is to quickly and professionally react to an emergency, which can only be achieved by regular trainings/preparation and drills, with a continuous preparedness team in the background.

In today's busy world, in order to avoid surprises, it is important to maintain track surveillance services with different capabilities. In addition, there may be "external" traps and dangers, which derive from the priority of profit or from other centralized prioritization processes.

The operation integrity model can be compared to a gear system; failure of any gears, as a weakest link, results in incorrect output. (Figure 12)

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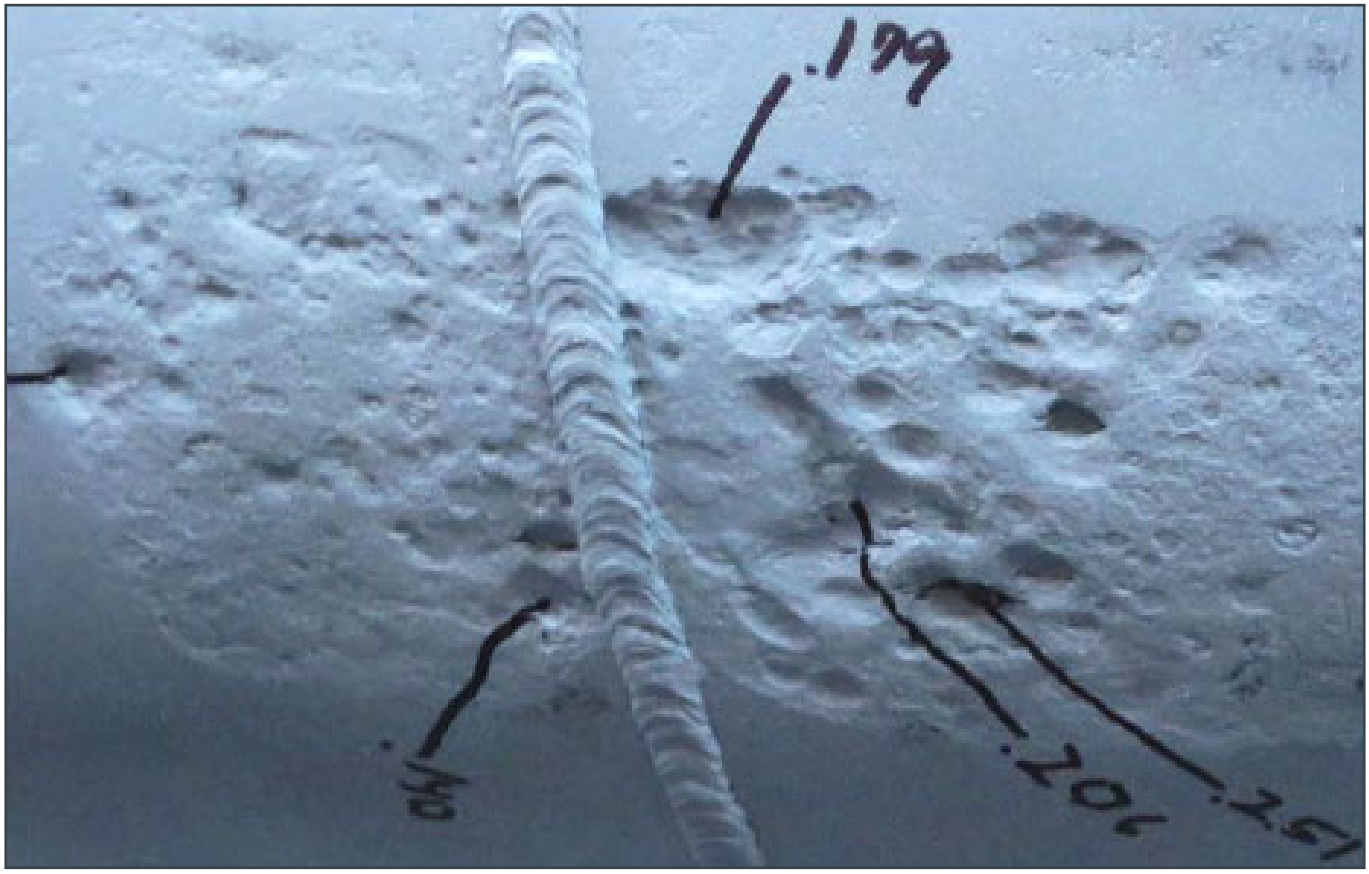
PREDICTING THE FUTURE
- Applying corrosion growth rates from in-line inspections

Abstract

There are various approaches that can be used firstly to estimate corrosion growth rates from repeat in-line inspection (ILI) data and secondly for applying growth rates in pipeline integrity assessments. With the goal of producing realistic and targeted repair schedules that avoid unnecessary repairs whilst ensuring safety, this article shares experiences gained via two integrity assessment case studies.

Jane Dawson > Baker Hughes, a GE company

Corrosion is still one of the major threats to the integrity of onshore and offshore pipelines. Realistic corrosion growth rates are essential inputs to safe and effective pipeline integrity management decisions. For example, corrosion rates are needed to predict pipeline reliability as a function of time, to identify the need for and timing of field investigations and/or repairs and to determine optimum re-inspection intervals. The consequences associated with using wrong corrosion growth rates range from the inefficient use of resources (time, people and money) on unnecessary repairs and/or inspections to in the worst case, unexpected pipeline releases. The identification of where corrosion is active on a pipeline and how fast it is growing is a complex process which is understood in the general sense but is highly variable. Corrosion is therefore difficult to predict due to the very localised nature of its behaviour and the many parameters that influence the corrosion reaction.



Running an in-line inspection (ILI) tool in a pipeline identifies the internal and/or external corrosion located along the full length of the pipeline.

The ILI inspection also determines the depth, length and width measurements for each corrosion site and for the overall feature. The use of repeat ILI data to match and compare metal loss sites in order to estimate the corrosion growth rates at individual defects along a pipeline is a well-used and established practice in the industry.

The use of such corrosion rates to make predictions of the future integrity of a pipeline started almost 20 years ago and over that time considerable experience has been gained. Now that we are starting to collect 3, 4 or even 5 or more ILI data sets for the same pipelines, Baker Hughes, a GE company (BHGE) is able to test and validate our earlier ILI based growth rate predictions versus what actually occurred in the pipeline over time.

With the benefit of this hindsight, the predictive analytics employed for evaluating and applying ILI based corrosion rates can be further improved and refined to give more accurate predictions of the future pipeline condition, the response schedule and for setting the optimum timing of re-inspections.

The next section of this article illustrates how corrosion growth rates derived from repeat ILI runs can be applied in pipeline integrity assessments. In particular, the application of fixed corrosion rates vs location specific rates is investigated using case studies on real BHGE ILI data sets.

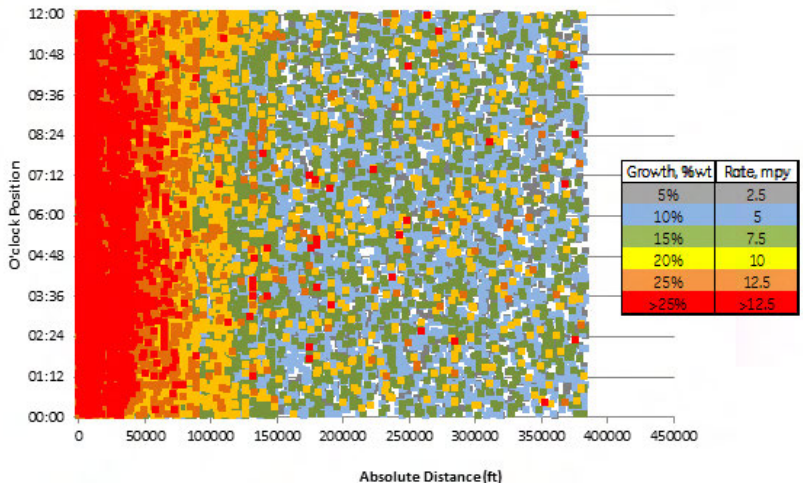


Figure 1: Distribution of Box Growth Rates along Pipeline (External)

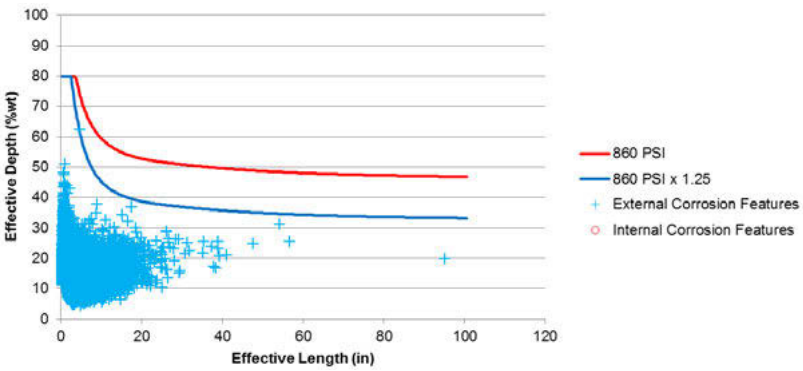


Figure 2: Severity Assessment of External Corrosion Anomalies

Case Study 1 - The first case study is a 36" diameter gas pipeline that was constructed during the 1980's. The pipeline has an extensive external corrosion population (approximately 80,000 external metal loss clusters) with a maximum reported depth of 70% of the wall thickness from the latest ILI.

A BHGE ILI signal matching corrosion growth assessment was conducted between the last two ILI surveys and localised growth rates were determined for every pipe joint along the full length of the pipeline. The growth rates were observed to be higher in the first 10 miles of the pipeline with the corrosion growth rates in that section estimated to be as high as 32 mpy (0.8mm/yr) as shown here in Figure 1.

Figure 2 shows the severity assessment of the external corrosion anomalies reported in the latest ILI survey in relation to the maximum operating pressure (MOP) and MOP x 1.25 safety factor (SF) using the RSTRENG assessment criteria. One anomaly exceeds the allowable dimensions at 1.25 x MOP.

The time before a repair is required (the scheduled response time) was predicted on the basis of the following three scenarios:

i. Fixed rate of 32mpy (maximum ILI based growth rate observed in the pipeline).
ii. Fixed rate of 16mpy (maximum pitting rate suggested in NACE RP0502).
iii. Variable rate (location specific rate) taken from the maximum rate reported per pipe joint across the full pipeline.

As shown in Figures 3 and 4 the choice of fixed growth rate has a huge effect on the number of responses scheduled year on year.

At a fixed rate of 32mpy, over 9000 defects (in 1123 pipe joints) require repair over the next 5 years. Clearly, predicting the time to repair using this high rate results in a very high number of repairs. In comparison, applying a fixed rate of 16mpy results in 510 repairs (in 162 pipe joints) over 5 years. This is clearly a more manageable plan, however for any corrosion growing at > 16mpy it is not a safe plan and we know from the ILI run comparison assessment that growth rates up to 32 mpy were observed in the first 10 miles of the line. So, without the knowledge of this critical information on the localised rates choosing this repair plan would be non-conservative and could result in unexpected failure.

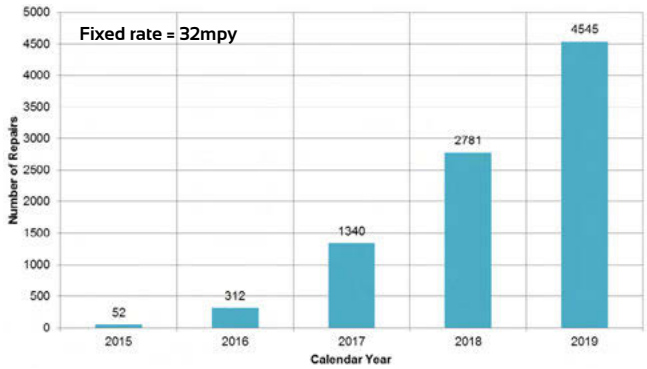


Figure 3: Number of Scheduled Response per Year, Fixed Rate

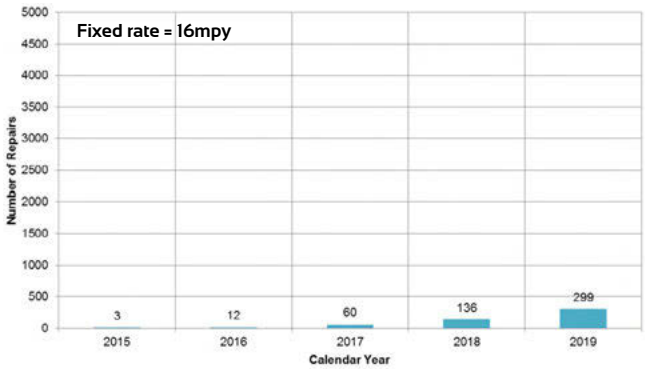


Figure 4: Number of Scheduled Response per Year, Fixed Rate

SPECIAL CONTENT:

NEW OPPORTUNITIES FOR PIPELINE DIAGNOSTICS: TRANSNEFT DIASCAN CASE STUDY

Abstract

For many years, operational safety and reliability of trunk pipelines had been ensured by scheduled preventive repair works and major overhaul, generally accompanied with a total replacement of pipes or insulation coating. However, this method proved to be inefficient and cost-intensive given the ageing pipeline systems. The modern maintenance strategy is based on the selective repair of defective sections following the in-line inspection (ILI) results.

Established in 1991, Diascan Technical Diagnostics Center (later renamed to Transneft Diascan), has been handling all tasks of acquiring initial data and assessing the pipeline's technical condition, as well as identifying safe operating modes and repair procedures. Transneft Diascan also provides all methods, regulations, tools and processes for ILI.

The Company's core business is carrying out in-line inspection of pipelines with the diameter range from 6 to 48 inches using ILI tools manufactured by Transneft Diascan itself. The tool fleet includes geometry tools with a navigation system, ultrasonic, combined magnetic and combined magnetic-ultrasonic units. All ILI tools manufactured by Transneft Diascan are high-precision ones, capable of both detecting a defect and measuring its parameters and type. This data is fundamental to calculations of pipe strength and durability, as well as limit pressure and operational life.

Transneft Diascan has achieved its full potential in Russia, being the largest Russian ILI services provider. Today, the Company is promoting its services based on its 27-year-long experience, to the international markets. Transneft Diascan cooperates with companies from Kazakhstan, Belarus, Mexico, the United Arab Emirates, Kuwait, the Czech Republic and Latvia. Scheduled projects include Saudi Arabia, Algeria, India, Malaysia, Indonesia and South America.

An alternative approach to using fixed rates is for BHGE to apply localised growth rates to the corrosion anomalies based on their specific location in the pipeline. This approach is far better suited to this pipeline given the high variability in the observed growth behavior along the pipeline length as shown in the chart on the previous page.

In this case the maximum growth rate reported per pipe joint is applied to all the reported anomalies within that entire pipe joint (pipe spool). Figure 6 shows the number of scheduled responses predicted by year since the last ILI run using these location specific rates. On this basis 1241 corrosion defects (in 145 pipe joints) are predicted to require repair over the next 5 years.

In this response plan the highest growth rates have been applied at the locations where they have previously been observed in the pipeline. This results in a more targeted and optimised response plan than simply applying a fixed rate across all defects.

Case Study 2 - The second case study is a 24" diameter gas pipeline constructed in 1980. The most recent BHGE ILI survey reported an external corrosion population of just over 35,000 anomalies; the maximum depth was reported as 88% of the wall thickness. The case study is based on the last two ILI surveys which were conducted 5 years apart.

An ILI signal matching corrosion growth assessment was conducted between the last two BHGE ILI surveys and individual defect growth rates were determined within each corrosion anomaly (cluster) across the full pipeline.

The maximum corrosion growth rates associated with every pipe joint were also calculated. The highest growth rate observed was 40 mpy (1mm/yr) with the average rate being 8 mpy (0.2mm/yr).

The scheduled response time (time to repair) was predicted on the basis of the following three scenarios:

i. A fixed corrosion growth rate of 16mpy (maximum pitting rate suggested in NACE RP0502).
ii. The maximum pipe joint growth rates were applied to corrosion within each individual pipe joint*.
iii. The defect individual rates were applied across the corrosion depth profile for each reported anomaly*.

*A lower bound limit was applied to the corrosion rate representing the rate equivalent to the repeatability error associated with the ILI data comparison (of 6mpy (0.15mm/yr) in this case).

The results are summarised in Table 1 below:

Scenario	No. of Repairs over next 5 years
i. Fixed rate of 16mpy (0.4mm/yr)	544
ii. Maximum rate per joint	112
iii. Individual defect rates	15

Table 1: Number of Repairs Over Next 5 Years at Different Rates

- The fixed rate of 16 mpy results in the highest number of repairs in this case even though rates as high as 40 mpy were observed from several corrosion anomalies in the pipeline.

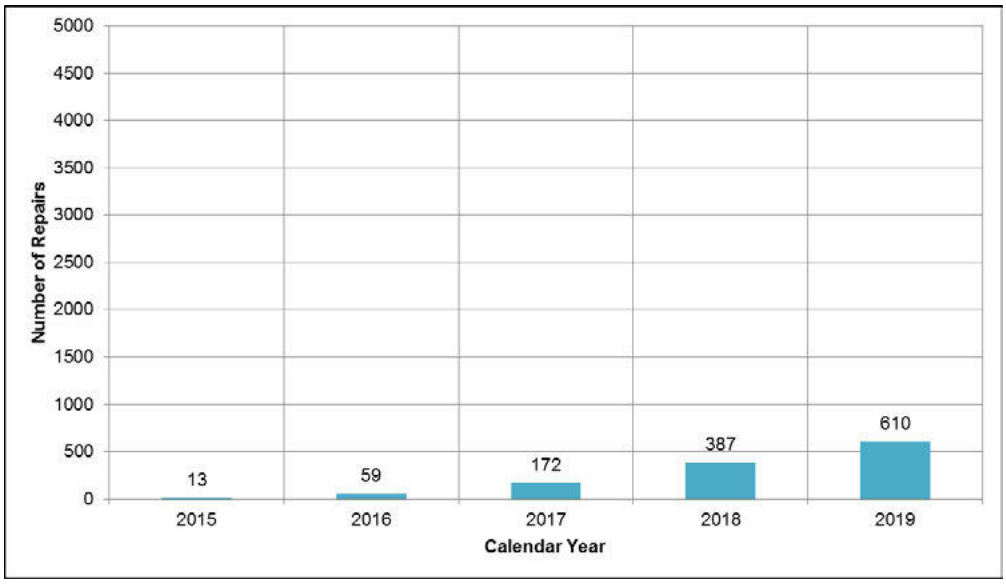


Figure 5: Number of Scheduled Response per Year, Location Specific

- Both scenarios ii. and iii. result in targeted response plans with significantly lower number of repairs than with the fixed rate.
- The maximum rate per joint results in approximately 5 times fewer repairs than the fixed rate scenario.
- The individual defect rates applied to the corrosion profile results in even fewer repairs, over 30 times fewer than the fixed rate and 7 times fewer than the joint rates.

The above results demonstrate that increasing levels of repair refinement can be achieved by using more detailed corrosion rate data. These findings have been validated by comparing the predicted repair plans with actual ILI findings when there are more than 2 ILI survey results available.

In one such scenario a pipeline that had been inspected 3 times (in 2006, 2012 and again in 2015) was used to compare the predicted corrosion severity with the actual ILI findings in 2015.

Localised corrosion rates were derived from comparing the 2012 and 2006 BHGE ILI data sets and were applied to the reported 2012 corrosion dimensions to predict the future corrosion severity. BHGE concluded that growing the 2012 ILI results using the 2006 to 2012 localised growth rates very closely represented the actual severity of the corrosion anomalies reported in the 2015 ILI survey.

CONCLUSIONS

There are various approaches that can be used to define corrosion growth rates for use in pipeline integrity assessments. The major advantage of using repeat ILI data to derive corrosion rates over other methods is that the ILI can provide growth rate information on the whole detectable corrosion population giving visibility of what is happening along the entire pipeline.

Depending on the number of corrosion defects to be compared, the ILI based corrosion growth assessment can demand significant effort and expertise to ensure accurate and meaningful matches between often very large ILI data sets. Specialist ILI comparison software facilitates efficient and accurate defect-to-defect matching and the depth comparison to determine defect specific growth between the two runs across the large ILI defect populations.

The corrosion growth rates obtained from a comparison of two ILI data sets can, depending on the proportion of sites being compared, result in a fixed growth rate estimate (e.g., a maximum or average rate) or location specific growth rates (e.g., pipe joint rates or defect specific rates). Two case studies have been used to demonstrate how both fixed and variable growth rates can be applied in pipeline integrity assessments and to compare the results obtained.

The application of fixed rates can be very conservative and will lead in many cases to unnecessary repairs or if the rates are too low to an unsafe assessment of the future integrity of a pipeline. Using location specific (variable) growth rates (both scenarios of applying the maximum rate per pipe joint and defect specific rates were presented in the case studies) has been found by BHGE to provide more realistic and targeted predictions of repair needs. The location specific growth rates were shown to give accurate predictions of the corrosion severity over time, thus resulting in realistic scheduling of future repair needs & setting of appropriate ILI intervals.

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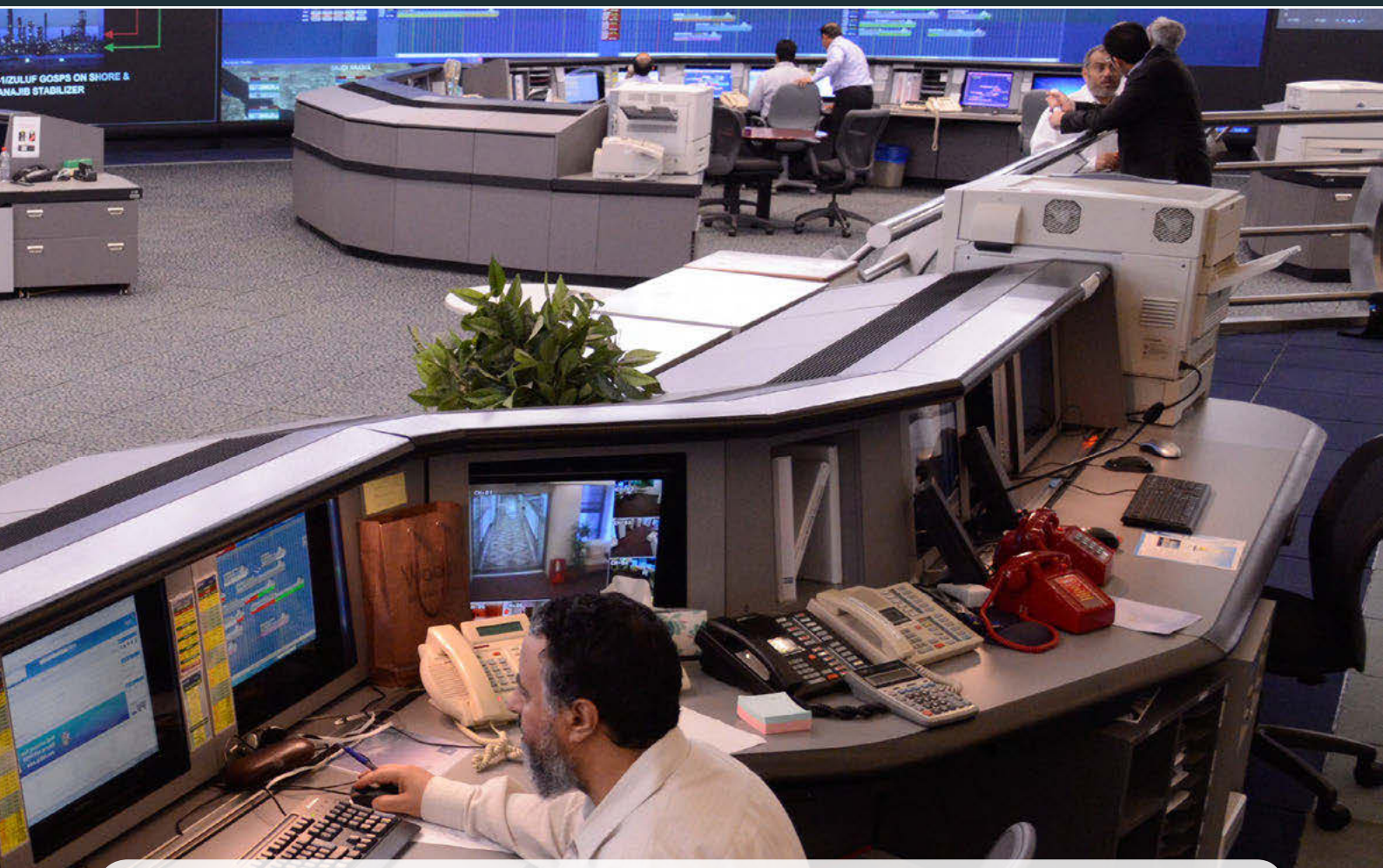
IMPROVING PIPELINE SCRAPING OPERATION – A SYSTEMATIC APPROACH AND CASE STUDY

Husain Al-Muslim, Mousa Al-Harbi > Saudi Aramco



Abstract

A critical step in ensuring that a pipeline is fit and healthy for operations is continuous scraping "cleaning" and frequent scraping inspection. If scraping activities are not properly performed, pipeline integrity can be at risk. In a case study, numerous networks of pipelines were found to be operated with different experiences and internal guidelines. This variation led to impact on pipeline integrity in terms of metal loss as well as several other issues such as leaking doors, scraping tools being stuck or damaged, valves passing, and signal passage indicators "SPIs" failures. Therefore, a systematic approach was initiated to review the different practices, procedures in an internal comparison with various experiences, and benchmarking with international users. The objective was to adopt best practices and develop consistent guidelines for scraping operation by focusing on the major areas such as standard piping layout of scraping facility, valve selection strategy, operation instruction of scraping activity, operation and maintenance of scraper doors, deployment of non-intrusive scraper passage indicator, and scraper tool design selection. A success criterion was also developed by defining the scraping efficiencies, which is the percentage of actual versus planned scraper runs.

BACKGROUND

On-stream scraping is essential to pipeline operations in terms of maintaining both pipeline efficiency, as well as integrity. Running effective brush cleaning scrapers through pipelines will remove accumulated solid debris and leftover liquids as well as smoothen the pipe wall. This will reduce pipeline pressure, increase product flow as well as meet the product specs. A scraper with sealing discs will push out accumulated condensates in gas pipelines and will prevent internal corrosion. The concept is simple, but the implementation is challenging for a complex pipeline network. Although scraping is largely based on experience and it is more of an art than a defined science, the complexity of the network needed a systematic approach to develop meaningful and useful guidelines.

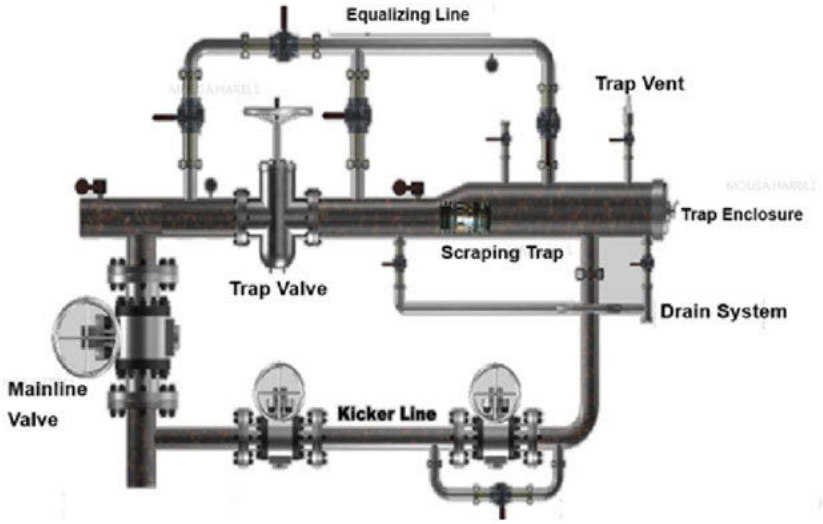


Figure 1: Main components of scraping station

Each pipeline shall be equipped with a scraping facility in order to enable scraping operations. The scraping facility consists of main components shown in Figure 1.

The scraping station is required in order to facilitate the launching and receiving of scrapers tools. Thus, each pipeline must be equipped with one launching scraping facility, and at the end of the pipeline another facility for receiving the scrapers.

The operation is performed by closing the trap valve and kicker valves. Once the system is completely isolated, the barrel is fully drained and purged to insure it is safe for field personnel to open the door. Once the door is opened, the scraper is loaded inside the trap, and the door is then closed. Then, the trap valve is opened, and mainline valve is closed, or partially closed, and the kicker lines are opened to divert the flow to launch the scraper.

Nonetheless, scraping operations usually involve several challenges that hinder its regular scheduled operations. The challenges may include any mechanical issues with the scraping facility components such as trap valves, kicker valves, vent/drain systems, scraper enclosers.

A SYSTEMATIC APPROACH TO IMPROVE PIPELINE SCRAPING OPERATIONS – CASE STUDY

In a case study as part of efforts to enhance reliability and integrity of pipeline networks, a systematic approach to identify and tackle top challenges hindering scraping operations was developed (Figure 2).

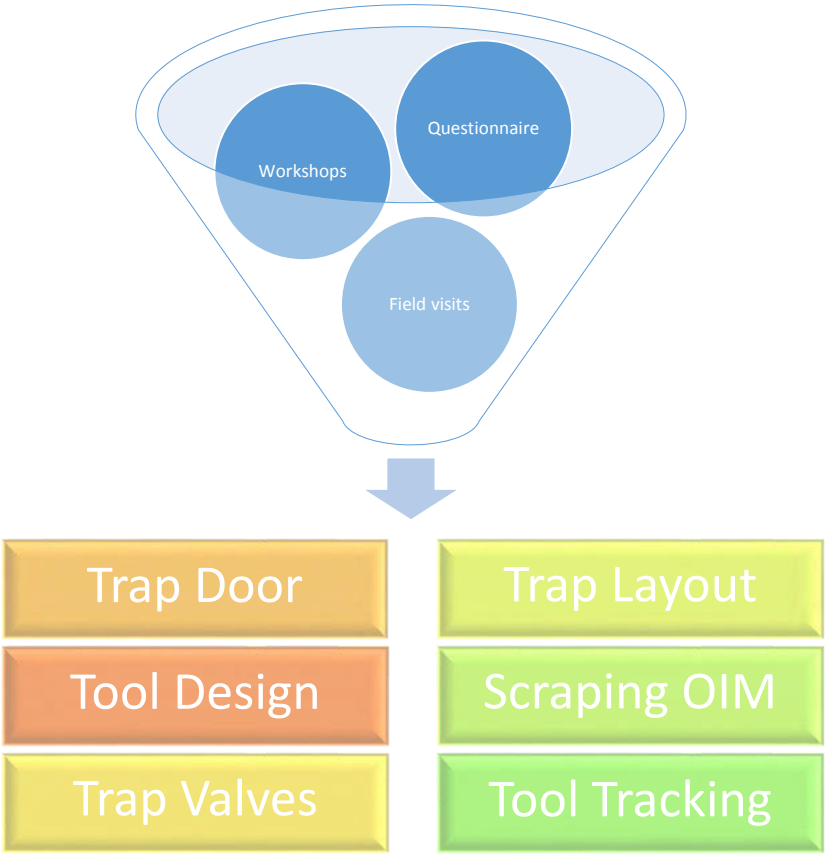


Figure 2: Systematic approach to improve pipeline scraping operations

Figure 3: Leaking scraper trap door which is hindering the planned scraping run

The network consists of different types of services both upstream and downstream including water injection, oil, gas, and refined products. The pipeline sizes range from 6" to 60". The age of pipes vary from 50 years old to new installations and accordingly, their conditions and cleanliness vary. The approach was developed to solve persisting field challenges related to pipeline scraping including many delays in scraping operations due to valve passing or scraper door leakage (Figure 3), scraper tools being stuck inside pipelines, increase in pipeline corrosion rate, and impact on downstream equipment and facilities (Figure 4). The approach includes data collection through three sources: questionnaire to operators, workshops between operators and subject matter experts, and field visits. More than 60 gaps were highlighted, and subsequently categorized in six focus areas: scraping barrel closure door, scraping facility layout design, scraper tool design, scraping operation and instruction (OIM), trap area valves, and scraper tool tracking.

A team was formed from operators and subject matter experts to fully understand the challenges identified based on the available data, and work with several vendors and service providers to bridge the identified gaps.

The following summarizes the challenges and recommendations in the six categories identified as focus areas.

1 - Trap Door;

A comprehensive review was conducted on the different door design methods as well as the recommended practices for operating and maintaining the doors versus the current operators' experiences. Through failure history, field visits, and vendor consultation, failures were found to be mainly due to poor preventive maintenance practices like improper seal area cleaning as well as using inappropriate spare parts like the sealing O-rings. The field

> *"Although scraping is largely based on experience and it is more of an art than a defined science, the complexity of the network needed a systematic approach to develop meaningful and useful guidelines.*
> *Husain Al-Muslim*

personnel lacked the training and did not have access to the maintenance instruction manuals. Several improvements have been implemented:

- Establish training for field personnel
- Build digital database for all relevant drawings and spare parts
- Conduct periodical maintenance

2 - Trap Layout:

The trap layout was reviewed in terms of numbers of isolation valves and valve type. Field challenges indicated that gas pipelines are more susceptible to the challenge of passing valves. Benchmarking was conducted with international oil and gas companies to identify their practices. Utilizing double isolation and bleed was found to be the best practice in gas pipelines and NGL, with ball valve being the most common. This was incorporated in the internal guidelines to be used during project design and development.

3 - Tool Design:

The main gaps related to tool design include selecting the right dimensions of the mandrel as well as sealing discs and guide discs. Moreover, improper selection of the hardness of the polyurethane discs lead to ineffective scarping operations, the discs being worn out partially

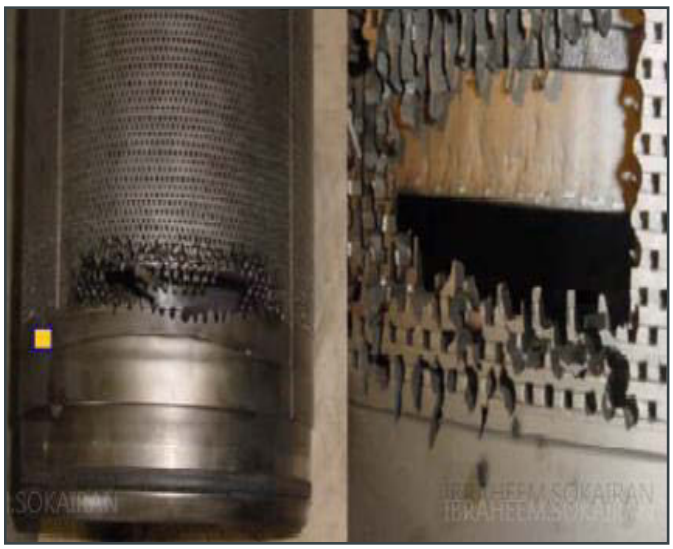


Figure 4: Control valve damaged by black powder accumulated due to ineffective scraping

Figure 5: Worn-out scraper seals due to improper material selection

or completely (Figure 5) lead to the scrapers being stuck in the middle of the pipeline. A detailed document was developed on how to select the right material, select the right dimensions (Figure 6) and recommend the additional appurtenances like brushes and magnets.

4 - Scraping Operation Instruction Manual (OIM):

The review identified significant variations on conducting the scraping operations between different operators. Some practices were found to be subpar leading to ineffective scraping runs. Various techniques and best practices adopted by all department were carefully reviewed to generate a common OIM accessible to all internal operators.

5 - Trap Valves:

Valve failures are always related to proper operation and maintenance. Several field surveys were conducted to evaluate the field valves performances for recently installed valves (in operation for less than five years) in different services (oil vs. gas, corrosive vs. non-corrosive). The reported failures were grouped in terms of size, pressure rating, service, and body seal design. A comprehensive report was prepared to address common failure causes and solutions such as the online and periodical maintenance for API-6D Ball and TC gate valves as well as the pressure balanced plug valves.

6 - Tool Tracking:

Major concerns were highlighted with regards to the conventional intrusive scraper passage indicators (SPIs) vs. the new technologies of the non-intrusive SPIs. A thorough comparison was conducted on the types of non-intrusive SPIs. Three types where identified; passive acoustic, active ultrasonic and magnetic detection devices. Clear guidelines about the use, the specifications and the limitations of each type were developed.

SCRAPING PROGRAM CURRENT REALITY AND DESIRED OUTCOME

The overall scraping program was also evaluated to understand the challenges in addition to challenges that were evaluated for the individual scraping runs. The main

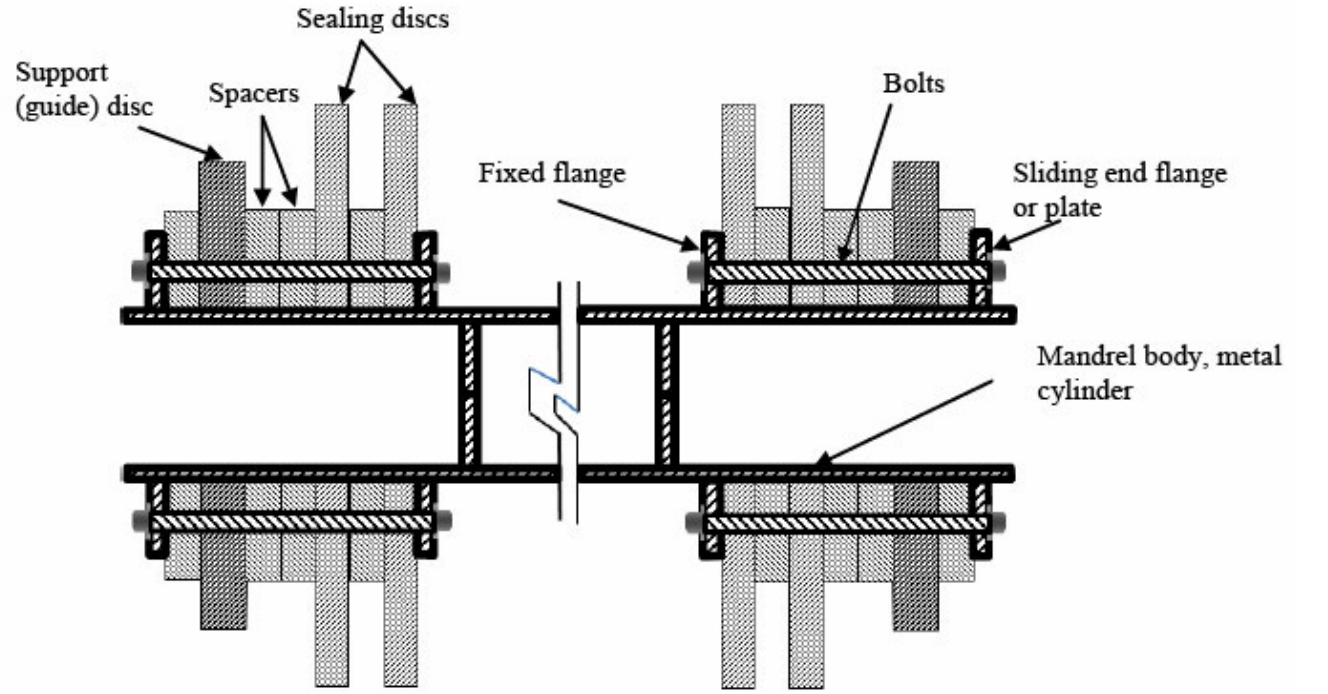


Figure 6: Schematic of properly design scraper tool

gaps identified in the scraping program are determining the cleaning frequency and the scraping runs records.

Cleaning Frequency

The most important aspect of an effective cleaning program is the cleaning frequency. There is inconsistency in determining the cleaning frequency as it is only relying on the experience of the responsible engineer. The annual cleaning plan for each scrapeable section of the network is mainly defined based on the type of fluid running in the line. In some instants, some pipeline sections receive special attention (i.e., through increasing cleaning frequencies) driven by the ILI inspection date. On the other hand, a standardized approach to decide upon the cleaning frequency and when it shall be changed does not exist. Some pipelines are being cleaned on a constant frequency without assessing the need to increase the frequency due to changing operational parameters (such as water ingress) or reported corrosion growth.

Guidelines for cleaning frequency were partially developed for some crude oil pipelines. However, this was not generalized to cover a wider range of the hydrocarbon services such as sales gas that experiences black powder.

In brief, the current cleaning frequency has the following shortcomings:

> *"Developing the guidelines is a very important milestone in having a successful and effective scraping program, but is not the ultimate goal.*
> *Husain Al-Muslim*

1. Fixed frequency for each pipeline decided by service.
2. Plans are not dynamic enough to address pipeline upset and cleanness issues to minimize the associated impact on pipelines integrity on a timely basis.

Scraping runs records

The scraper cleaning plans are set one time at the beginning of the year. However, there is no controlled procedure for updating the plan. In many instances, the changes in the plan during the year are not updated. Even in case of updates taken place, the updated plan is not easily retrievable as it is not available in a centralized database. Run performance and cleaning jobs quantifiable measures do not exist. Reporting the results of scraping runs is not practiced. The current Key Performance Index (KPI) which measures the percentage of total scraping runs to the planned run could be misleading. While some pipeline segments get more than planned scraping runs due to ILI inspection period or recorded upsets, others are not adequately scraped.

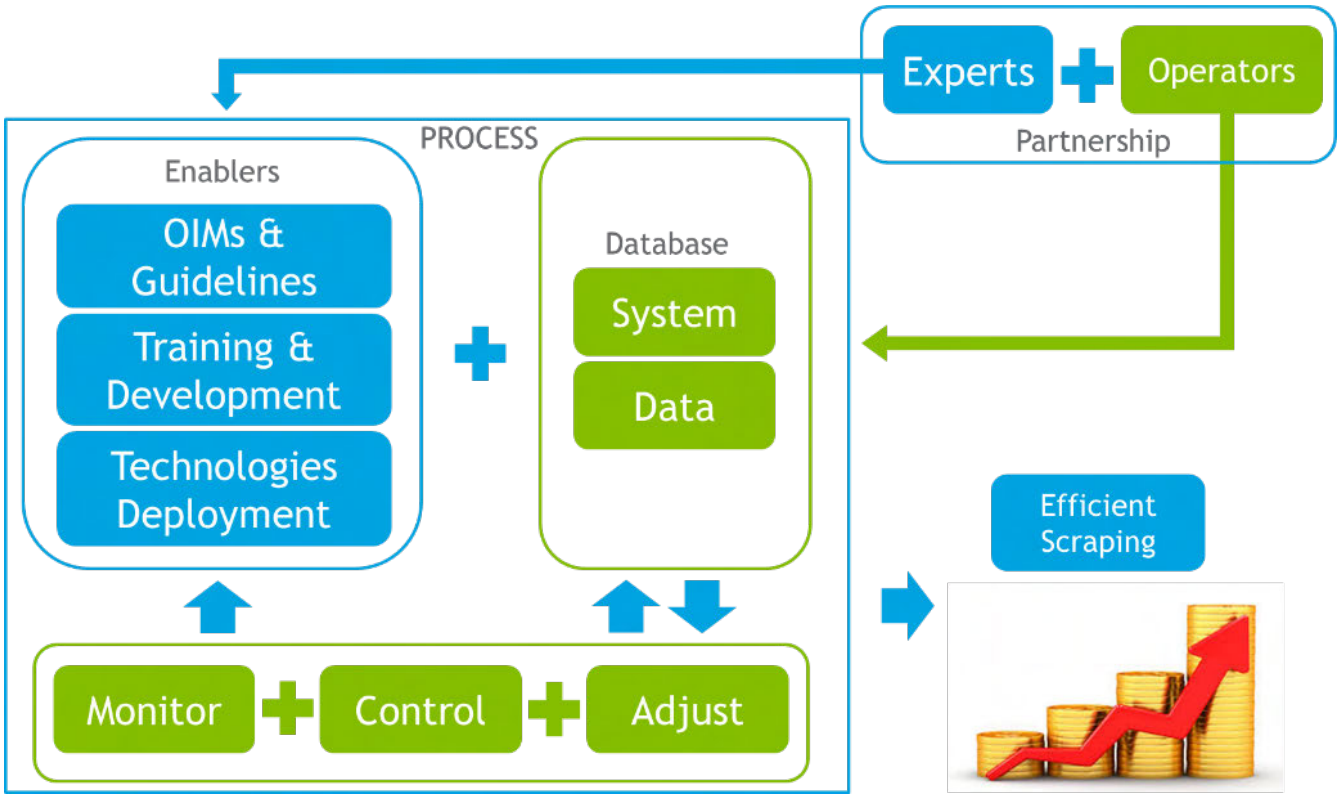


Figure 6: Collaboration model to implement recommendations to improve pipeline scraping operations

Figure 7: Dashboard of scraping performance for several operators

The guidelines established do clearify definitions for measuring the effectiveness of a single scraping run as well as the scraping program.

A scraping run is considered successful if:

- The objective of the scraping run has been met (liquids removed, debris cleaned, increase of flow rate, reduction in pump or compressor power, improved product quality, etc.).
- The scraper is received in good conditions.

A cumulative database of scraping run post-reports must be available to measure effectivness of the scraping program. The effectiveness of the scraping program may be measured by:

- The amount of liquid or debris received at each scraper run.
- The cleanliness of the scraper after each run.
- The reduction of corrosion rate measured by corrosion monitoring devices or successive runs of in-line inspection.
- The compliance percentage of the actual performed scraper runs compared to the planned scraper runs.
- The optimized scraping cost by optimizing scraper frequency per pipeline specifics.

WAY FORWARD

Comprehensive scraping guidelines were developed for a large pipeline network through a systematic approach that was described in this paper. Developing the guidelines is a very important milestone in having a successful and effective scraping program, but is not the ultimate goal. The next steps are implementation and continuous improvement. A collaboration model was developed for the implementation with specific processes and enablers (Figure 7). Moreover, a monitored dashboard will be created to measure the performance of scraping operations. This will be key in reviewing trends and performance as well benchmark the internal operators to ensure success of the program.

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SPECIAL CONTENT:

NEW OPPORTUNITIES FOR PIPELINE DIAGNOSTICS: TRANSNEFT DIASCAN CASE STUDY

Abstract

For many years, operational safety and reliability of trunk pipelines had been ensured by scheduled preventive repair works and major overhaul, generally accompanied with a total replacement of pipes or insulation coating. However, this method proved to be inefficient and cost-intensive given the ageing pipeline systems. The modern maintenance strategy is based on the selective repair of defective sections following the in-line inspection (ILI) results.

Established in 1991, Diascan Technical Diagnostics Center (later renamed to Transneft Diascan), has been handling all tasks of acquiring initial data and assessing the pipeline's technical condition, as well as identifying safe operating modes and repair procedures. Transneft Diascan also provides all methods, regulations, tools and processes for ILI.

The Company's core business is carrying out in-line inspection of pipelines with the diameter range from 6 to 48 inches using ILI tools manufactured by Transneft Diascan itself. The tool fleet includes geometry tools with a navigation system, ultrasonic, combined magnetic and combined magnetic-ultrasonic units. All ILI tools manufactured by Transneft Diascan are high-precision ones, capable of both detecting a defect and measuring its parameters and type. This data is fundamental to calculations of pipe strength and durability, as well as limit pressure and operational life.

Transneft Diascan has achieved its full potential in Russia, being the largest Russian ILI services provider. Today, the Company is promoting its services based on its 27-year-long experience, to the international markets. Transneft Diascan cooperates with companies from Kazakhstan, Belarus, Mexico, the United Arab Emirates, Kuwait, the Czech Republic and Latvia. Scheduled projects include Saudi Arabia, Algeria, India, Malaysia, Indonesia and South America.

NEW OPPORTUNITIES FOR PIPELINE DIAGNOSTICS: TRANSNEFT DIASCAN CASE STUDY

The difficulty in acquiring reliable data on the condition of a trunk pipeline section is immanent to the nature of the facility itself.

The pipeline network is stretched across a long distance and sometimes is hard to reach, so the methods of non-destructive control traditional for other industries don't work well enough here. At the same time, transportation of such environmentally aggressive product as crude oil under high pressure and in big amounts requires utmost attention to the pipeline integrity.

Before 1990s, the main method of estimating the pipeline condition was regular hydraulic testing with high pressure, while the fault prevention procedures were limited to major overhaul and total replacement of pipes or coating at a given section.

Annual replacement covered some 1.5 % of the total length of trunk oil pipelines, As the general infrastructure grew older, this method kept falling behind the industry's actual need to maintain reliable operations of the oil pipeline system.

The time had come for a transit from the major overhaul to the selective repair of sections that had hazardous defects. However, such transit depended on the new method development for acquiring information about the actual technical condition of a pipeline.

That is why the new strategic approach to ensuring operational safety of oil trunk pipelines in Russia was focused on timely prevention of their technical degradation by conducting in-line inspection and consequent selective repair. In the follow-up of this strategy, a center of technical diagnostics, or Diascan, was established in 1991. The company name combined two meanings: diagnostics and scanning.

Since its inception and until now, Diascan (later renamed to Transneft Diascan), has been handling all tasks of acquiring initial data and assessing the pipeline's technical condition, as well as identifying safe operating modes and both necessity for and methods of repair. Transneft Diascan together with the Pipeline Transport Institute also provide all methods, regulations, tools and processes for ILI.

ILI TOOL ZEROING IN

Today, Transneft Diascan is a hi-tech, knowledge-intensive enterprise with an advanced production capacity and high innovation potential. Its tool fleet includes over 90 ILI tools, manufactured by Transneft Diascan itself, and capable of inspecting pipes with the diameter range from 6 to 48 inches. These are multichannel geometry tools with a navigation system, pipeline positioning tools, ultrasonic, magnetic, combined magnetic and magnetic-ultrasonic inspection tools.

Apart from the oil pipeline inspection, Transneft Diascan also carries out the inspection of gas pipelines, remodeling its geometry and magnetic inspection tools so that they can work in a gaseous environment. The tool's speed in oil does not exceed 4 m/s, while in gas it can accelerate up to 10–15 m/s. To avoid any negative impact of this peculiarity on the quality of inspection results, a special device regulating the tool's speed in gas pipelines was developed.

All ILI tools manufactured by Transneft Diascan are hardware and software of high-precision, capable of both detecting a defect and measuring its parameters and type. This data is fundamental to calculations of pipe and welded joints strength and durability. Let's take a glimpse of some inspection tools used at different stages of the control procedure.

Multichannel geometry tools (Figure 1) are used to detect and measure geometric anomalies in a pipeline (dents, buckles or ovality), as well as measuring its internal clear opening and bend radii. The tools are equipped with inertial navigation systems determining the

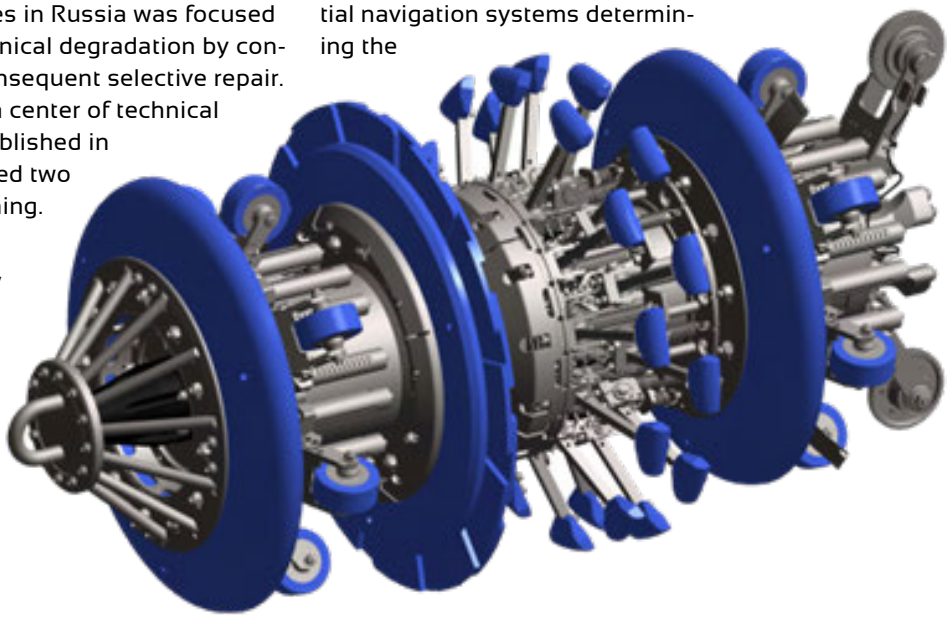

Figure 1: Multichannel geometry tool. Source: Transneft Diascan, JSC

pipeline's spatial position with high accuracy and tracking its change during monitoring.

MFL magnetic tools (Figure 2) with axial magnetization are capable of detecting and measuring defects in pipe walls and circumferential joints (poor penetration, undercuts, cracks or padding), as well as transverse cracks and pitting corrosion in walls.

These tools deliver a high degree of pipe wall magnetization and are equipped with high-resolution magnetic field sen-sors with additional eddy current measuring channels.

WM and CD ultrasonic tools (Figure 3) are used to detect and measure corrosion, mechanical and technological defects in pipes, such as lamination, notches, geometry defects, welded joints misalignment, as well as crack-like defects inside pipe and joint metal.

Transneft Diascan developed combined ILI tools to decrease the inspection time and eliminate the reduction of pipeline performance during the inspection.

MFL+TFI combined magnetic tools with longitudinal and transverse magnetization (Figure 4) are used to detect cracks and crack-like defects (irrespective of their orientation) in longitudinal, transverse and spiral joints, areal and pitting corrosion in pipe walls and connecting structures.

Combined magnetic-ultrasonic tools have both a CD+WM ultrasonic and MFL

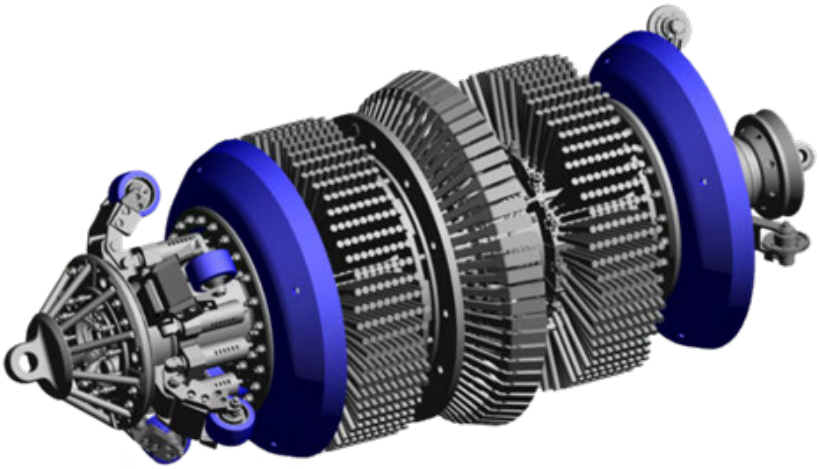

Figure 2: MFL magnetic tool Source: Transneft Diascan, JSC

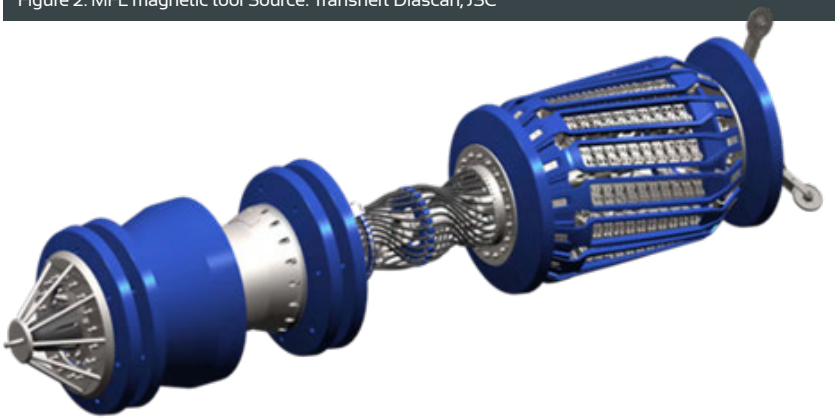

Figure 3: WM ultrasonic tool Source: Transneft Diascan, JSC

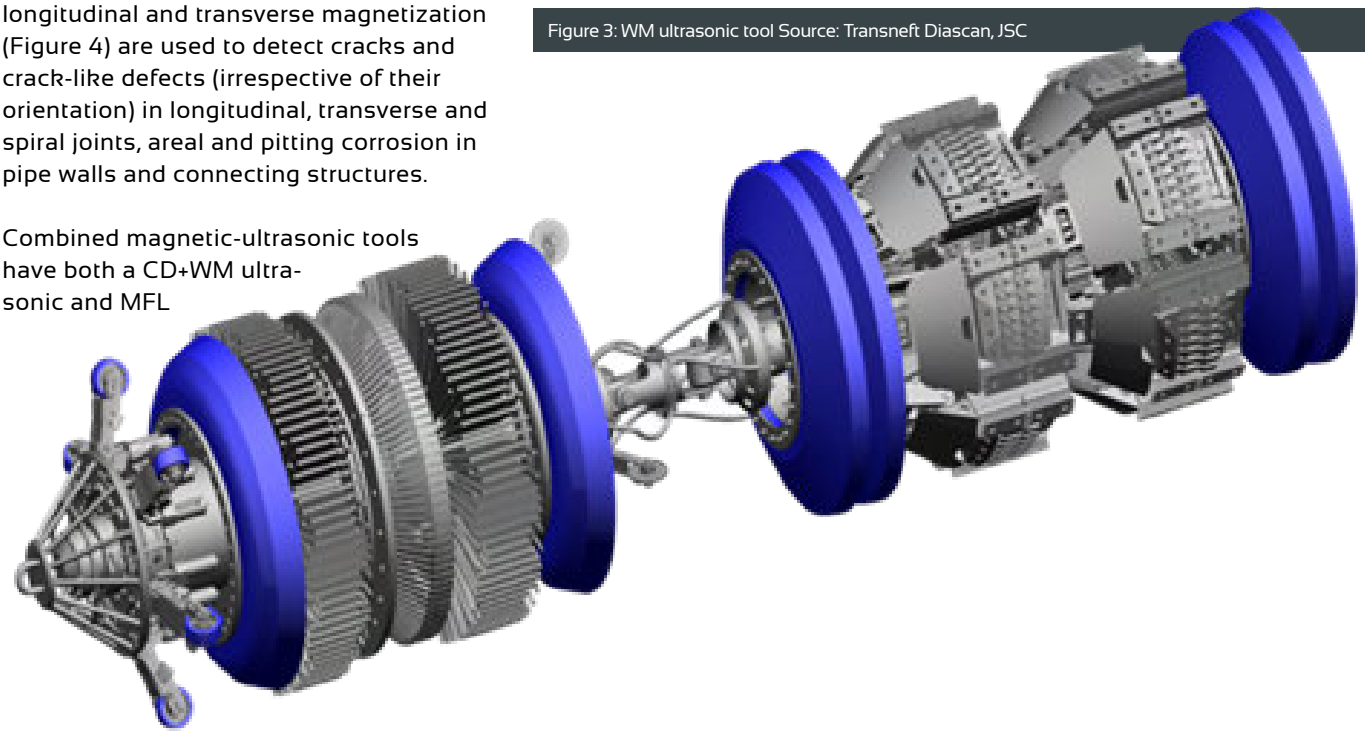

Figure 4: Combined magnetic tool (MFL+TFI) Source: Transneft Diascan, JSC

magnetic sections (Figure 5), and are capable to detect different types of pipe defects within one inspection run, thus optimizing diagnostics time. Such simultaneous combination of several inspection methods also provides a much higher accuracy than several single-section tools.

ILI TOOLS: NEXT GENERATION

Transneft Diascan is permanently upgrading its technology and equipment, by inventing and adopting new inspection tools, software and data processing systems. The company now holds more than 140 intellectual property titles, including Russian and foreign patents for some of its useful inventions and models.

There is another invention of Transneft Diascan put into operation in 2018: an inspection tool detecting lamination in pipe coating by applying the technology of non-contact electromagnetic-acoustic (EMA) excitation and reception of ultrasonic waves (Figure 6). The tool is equipped with a measuring system with electromagnetic-acoustic converters. It applies the method of ultrasonic inspection without an immersion fluid based on the principle of direct and reverse electromagnetic-acoustic conversion. This method detects minimal-size coating defects.

Another novelty is a high-resolution multichannel geometry tool with a 40-PRN.02 navigation system. The number of sensor channels has more than doubled as compared to the tools of earlier generations, and the sensors' design has been improved. This allowed to reduce the inertial effect of the measuring rods during the tool running at a high speed natural for gas pipelines. It also features a 2.5 times higher accuracy than the previous models, which significantly enhances the inspection data. Reduced error in measuring geometry defects' widths allowed more accurate calculation of their hazard degree.

The developed line of ILI tools perfectly negotiate most difficult pipeline sections with a flow passage up to 0.6–0.85 of the pipe's diameter and a minimal turning radius, min. 1.5 of the pipe's diameter. Depending on the version, the tool is operational under temperature from –15 °C to 70 °C, pressure 8–14 MPa and speed up to 6 m/s.

When magnetic inspection tools are run at a high speed (for example, in gas pipelines), they are also equipped with speed control units to acquire as much data as possible.

Experiments for improving ILI tools and data processing methods are run at the test ground of Transneft Diascan (Figure 7).

The test ground is an absolutely unique structure. It has circular, semi-circular above-ground and buried pipelines as well as straight sections of different diameters and the total length about 2 km. It also stores a collection of some 12,500 artificial and real-life defects, enriched regularly as the research and development work goes on.

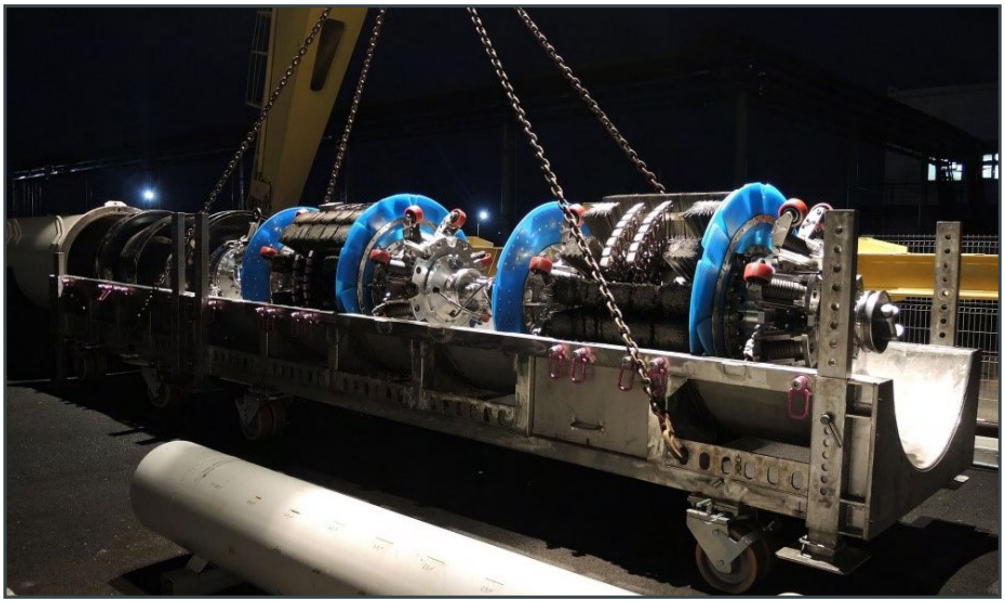

Figure 6: Tool for the detection of pipeline coating lamination using the EMA technology Source: Transneft Diascan, JSC

Figure 5: Combined magnetic-ultrasonic tool (MFL+WM+CD) Source: Transneft Diascan, JSC

Figure 7: Transneft Diascan test ground Source: Transneft Diascan, JSC

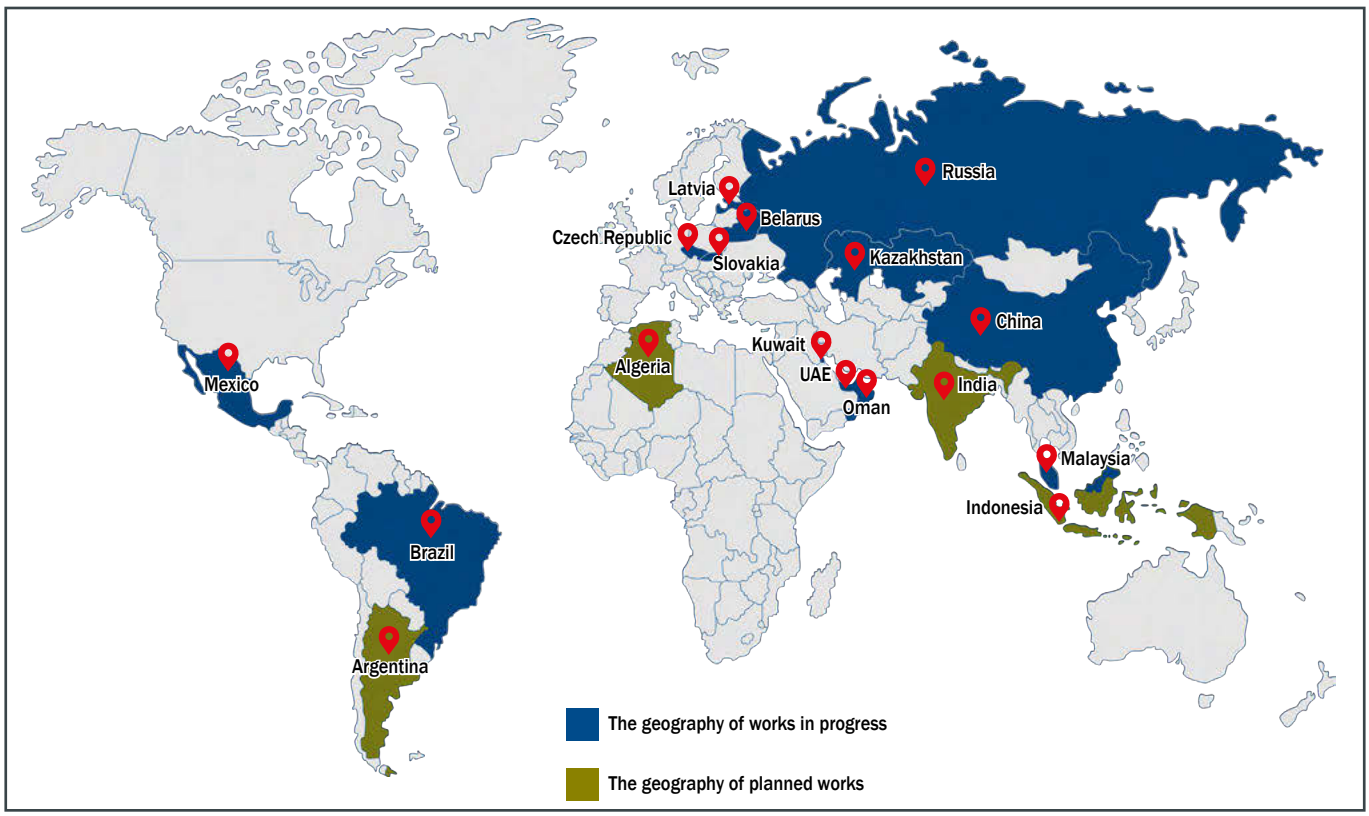

Figure 8: Transneft Diascan: operations' geography Source: Transneft Diascan, JSC

RUSSIAN DIAGNOSTICS GOING GLOBAL

Transneft Diascan is one of the biggest ILI service providers in the world. Last year tools mileage amounted to more than 61,000 km including 54,000 km of Transneft pipelines and 7,300 km of third-party pipeline companies. The geographic expanse of Transneft Diascan operations is presented at Figure 8.

Seeking new production opportunities, Transneft Diascan has renewed its line of tools, increased the fleet and adopted new technologies. Cooperation with foreign clients also includes the analysis of related legislation and adaptation of technical reports in accordance with specific requirements, including terms and definitions used by the client.

At present, the company is working in accordance with the international quality standard ISO 9001-2015. It operates in 13 countries and has a boundless potential for the expansion of its overseas portfolio.

CONCLUSION

Transneft Diascan is one the biggest ILI services provider in the world. The company's fleet has more than 90 ILI tools manufactured by Transneft Diascan itself and based on different physical principles of non-destructive control. The most advanced inventions of Transneft Diascan, such as combined ILI tools, use a comprehensive approach to pipeline diagnostics, when all possible defects are detected within one inspection run.

Using sophisticated software for processing diagnostic data from different types of equipment allows to analyze the condition of a facility more effectively, while discovering more actual defects including ones of small size.

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Crondall Energy Appoints New Managing Director To Its Consulting Division

Crondall Energy, the floating production and subsea engineering specialists, has announced changes to its board to enable it to capitalise on the increasing level of opportunities within the sector.

The move follows the creation last year of two distinct service offerings: consulting, provided by Crondall Energy Consultants and its affiliate Crondall Energy Subsea, and its technology arm Buoyant Production Technologies Ltd. which is focused on projects including work on unmanned production facilities and new FPSO designs. The two offerings are part of the Crondall Energy Group.

With immediate effect, Anna-Louise Peters, Crondall Energy Consultants' Finance Director, has been promoted to the role of Managing Director. Her predecessor, Duncan Peace, will continue to oversee Crondall Energy's group activity as Group Managing Director. He will also lead the technology business as Managing Director of Buoyant Production Technologies. Anna-Louise will retain her group finance responsibilities.

In addition, Gary Doyle, previously Crondall Energy Consultants' Director for SE Asia and Norway, has stepped down from the Board and has sold his shares in the group. Anna-Louise joins Duncan as a shareholder in the newly established holding company Crondall Energy Ltd., with Duncan remaining the majority shareholder. Gary remains with Crondall Energy as a key member of the management team, retaining his responsibility for SE Asia and Norway. Stephen Booth continues as Managing Director of Crondall Energy Subsea.

Duncan Peace, Crondall Energy's Group Managing Director, said: "These changes will allow us to capitalise on the rapidly expanding opportunities in the market and grow both our consulting and technology businesses." and "Anna-Louise has shown outstanding leadership during what has been a turbulent period throughout the industry and she has demonstrated that she has the necessary strategic vision and drive to grow the consulting business in the future.

Crondall Energy provides engineering, business advisory, project support and training services from its offices in the UK, Singapore, Norway and the US. Buoyant Production Technologies is currently part of a multi-partner study supported by the Oil and Gas Technology Centre to prove its concept for a reusable production buoy.

Many casualties in pipeline explosion in Mexico

Unknown individuals tried to tap gasoline from a fuel pipeline. The attempt led to the explosion of the pipeline, killing at least 89 people and wounding over 50.

Local media reported that several hundred people were in the vicinity of the pipeline at the time of the explosion. The pipeline in the city of Tlahuelilpan had previously leaked, and local residents were approaching it to take the gasoline with them in buckets or canisters.

The cause of the explosion is still unknown. Video footage showed how panic prevailed at the scene after the explosion. People ran away from the burning fuel line. At the pipeline, flames were blowing up and the fire spread at the scene of the accident. Emergency personnel cordoned off the zone. Mexico's President Andrés Manuel López Obrador called on the government to support the people in the affected region.

Fuel theft is a big problem in Mexico. According to the operating petroleum company Pemex, there is an attempt to illegally tap one of the pipelines every 30 minutes.

Recently ptj reported on the difficulties surrounding the fuel theft problem. Some vital pipelines in Mexico were shut down due to this challenge, leading to the increased use of guarded fuel tanks.

Comment:
Illegal tapping is a serious and rising problem. Together we can fight it.

MARCELINO GUEDES F. M. GOMES
SENIOR PIPELINE ENGINEER PETROBRAS
FELLOW OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

The recent accident in Mexico is a source of great disappointment and sadness among all of us in the international pipeline community. The illegal tapping problem has been growing uncontrollably for the last 15 years throughout the world. Some countries recognize this, whereas others do not. The methodology used by illegal tappers varies considerably from sophisticated systems, which measure the fuel stolen and replace it with water, to a simple spike to allow the fuel under pressure to gush out like a geyser.

The Mexico case was probably caused by a lack of awareness of the dangers allied to extreme poverty. To break the pipe wall with a metal spike is the most unsafe methodology used to tap pipelines by criminals, because they are not concerned with the quality of the installation or safety. This method would never be utilized in the developed world.

In Mexico last weekend however, the criminals must have used a simple spike to perforate the pipe wall. This caused the geyser effect, establishing an atmosphere with gasoline fumes, which subsequently exploded. Before the explosion, the local population was collecting the fuel, which literally rained down, in saucepans, buckets, big cans or in some cases with trucks. Their behavior was like looters. In this case the poor population was clearly helping the bandits. There have been other cases of huge accidents in the world, where hundreds of people have died.

In Brazil, we are developing a Daisy Methodology. We have noticed that in several countries this methodology has been put into use to some extent. Each petal in our daisy represents a different approach, which, when taken together, help to resolve the problem. The petals may be classified into three separate groups:

a) Security, Intelligence and Official/External Relationships
b) Engineering-Technology, Operational Procedures, Risk Analysis and HSE matters, and
c) Legal, Social and Communication Actions.

There is a weighting given to each petal in the daisy. Some of these are applicable in certain situations but not others. So, we must measure our efforts for each parameter, as we would use a control panel. An action that is good for France or the UK may not work in Spain, Brazil or Mexico. For example, a change of law may be necessary in one country but not necessarily in all. Social initiatives will work in some countries but are totally inapplicable in others.

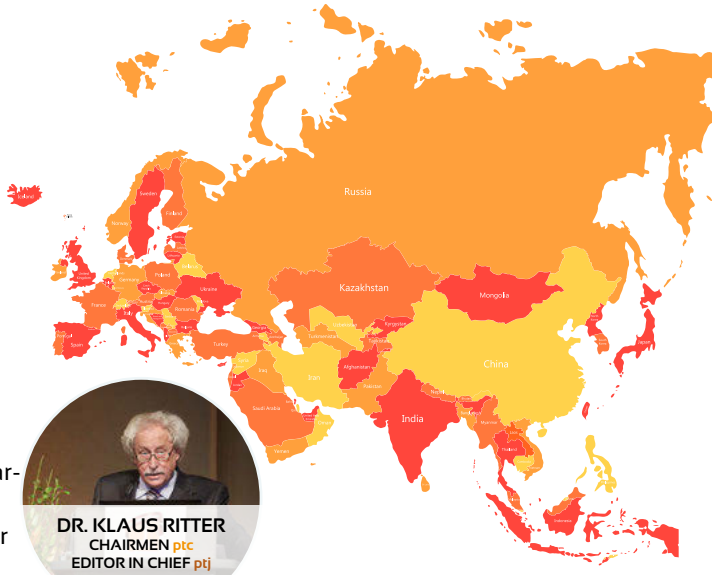
My perception of this Mexico case is that the Government needs to:

1. Instruct the population as to the potential dangers of pipelines;
2. Change the mindset of the population from supporting the gangs to opposing them and supporting PEMEX;
3. Invest heavily in productive social programs to discourage the collaboration with criminal cartels.

There are also several other appropriate action that can be taken.

It is the duty of the rest of us in the international pipeline community to help Mexico and all others resolve this problem. The Pipeline Technology Conference – 2019 will take place in Berlin in March and all pipeline experts should be present, because a special panel on illegal tapping will be held.

Comment:
Asian and Eastern European Pipeline Operators are pushing their way into North America and Western Europe



DR. KLAUS RITTER
CHAIRMEN ptc
EDITOR IN CHIEF ptj

Large Transport System Operator with their technology subsidiaries from Asia and Eastern Europe (e.g. Transneft, Sinopec and others) are pushing their way into the markets in North America and Western Europe, says Dr. Klaus Ritter in his Editorial for Pipeline Technology Journal.

On the one hand, they bring with them specific experience that require the companies that have dominated the technology and the market to adapt their technology. On the other hand, their step into the international markets also enables these companies to compare their technology with their competitors and adapt it to the requirements.

However, both opportunities can only be exploited if they can take place on the basis of an open market. This means that technology and service providers also gain access to the markets where their new competitors are at home.

Technical journals as well as conferences and exhibitions are the right channel to foster such an expansion. However, entrants to new markets must consider that they are expected to convince potential customers that their technology can compete in terms of safety, reliability and profitability.

The next Pipeline Technology Conference will feature an array of interesting panel session in regards of this development. One of them will focus on Eurasia and the regions significance for the pipeline industry. Currently confirmed for this panel session are Nord Stream 2, TANAP and Turkstream, offering interesting insights into the tradition of cooperation between European and Asian energy companies.

The upcoming 14th ptc will feature additional panel sessions and plenary discussions about a variety of important pipeline issues. Take your chance and participate in this outstanding international event by registering for the offer most suitable to you.

Shell Moving Forward with North Sea Shearwater Pipeline

Shell has made its Final Investment Decision (FID) concerning the construction of a 37-km underwater gas pipeline from the Fulmar Gas Line to Shearwater which will be jointly constructed with Exxon Mobil and BP. The construction will include a modification of the Shearwater platform to allow production and processing of wet gas. The hub is expected to produce as much as 400 million cu ft. per day.

The construction of this pipeline also opens up other options in the area - if the pipelines are subsequently linked into the Jackdaw field to ensure maximum recovery from the North Sea. Getting operators to keep investing in the pipeline network is a vital way of ensuring smaller deposits don't get stranded and rendered uneconomic.

Steve Phimister, Shell's vice president for upstream in the UK, said: „This is part of our strategy to grow our gas production from around the Shearwater platform and it underscores Shell's commitment to maximising the economic recovery of oil and gas from the North Sea. „Through close collaboration with our partners and suppliers, we have been able to reduce costs, simplify the production process and create an important production hub at Shearwater. Fifty years after Shell began working in the North Sea, we continue to invest in projects to deliver more gas to UK consumers for years to come."

Petrobras Seeking to Divest Its 4500-km Of Pipeline Assets And Focus On Deep Water Investments

Brazil's state-controlled oil company Petróleo Brasileiro, or Petrobras, could introduce a new sale and purchase agreement (SPA) for the sale of the Transportadora Associada de Gás (TAG) pipeline, after a Brazilian Supreme Court injunction this past July stalled the sale.

Petrobras aspires to fetch some $7 billion through the sale of its 4500-km natural gas pipeline infrastructure and invest the proceeds in deep water plays in the Atlantic, which are considered more profitable investments. Before the injunction Petrobras negotiated with a consortium of France's Engie and Canada's Caisse de dépôt et placement du Québec (CDPQ).

Earlier last month, Petrobras' board approved a five-year investment plan comprising proposed investments worth around $84bn by 2023. These mainly focused on deepwater oil and gas exploration and production assets.

The Supreme Court injunction has cost Petrobras an estimated $10 billion. The French-Canadian consortium mentioned above will now have to present a new SPA to the market and allow time for counter offers from any other parties interested in buying TAG from Petrobras, the sources said.

The Pipeline Transport Institute and Transneft Diascan Sign Agreements with Algeria-Based Sonatrach

The Pipeline Transport Institute and Transneft Diascan have signed contracts for diagnostics (inspection) with Sonatrach, an Algerian state oil and gas company. The documents were signed on December 12, 2018 in the city of Algiers within the framework of the development of the provisions of the memorandum of Cooperation signed between Transneft and Sonatrach.

The contract signed by Transneft Diascan considers in-line inspection of several sections of the Algerian company's pipelines. The Transneft R&D signed another contract with Sonatrach for integrated diagnostics of lightning protection and earthing system for a loading terminal's hydrocarbon storage farm.

The documents were signed in the presence of Sonatrach President Abdelmoumen Ould Kaddour and Vice-President of Transneft Mikhail Margelov.

For reference:
Sonatrach is an Algerian state oil and gas company. In terms of economic performance it is the biggest company of the African continent (across all industries). Sonatrach is engaged in oil and gas production, refining, sale and transportation, also investing in power engineering. The Memorandum of Cooperation between Transneft and Sonatrach was signed in October 2017 during the meeting of Russian Prime Minister Dmitry Medvedev and Prime Minister of Algeria Ahmed Ouyahia.

Pictured (left to right): General Director of the Pipeline Transport Institute Yakov Fridlyand; General Director of Transneft Diascan Sergey Ermish; Vice President of Sonatrach Slimane Arbi-Bey; President of Sonatrach Abdelmoumen Ould Kaddour; Vice-President of Transneft Mikhail Margelov; Ambassador of The Russian Federation to Algeria Igor Belyayev

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EVENT PREVIEW

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- 80+ EXHIBITORS
- 100+ PRESENTATIONS
- 25 TECHNICAL SESSIONS
- ACCOMPANYING SCIENTIFIC POSTER SHOW

THEMATIC FOCUSES:

CONSTRUCTION
CORROSION PROTECTION
DIGITALIZATION
ENVIRONMENTAL IMPACT
ILLEGAL TAPPING
INLINE INSPECTION
INTEGRITY MANAGEMENT
LEAK DETECTION
MAINTENANCE & REPAIR
MATERIALS
OFFSHORE TECHNOLOGIES
PLANNING & DESIGN
PUMP & COMPRESSOR STATIONS
STRESS CORROSION CRACKING
THIRD PARTY IMPACT
TRENCHLESS TECHNOLOGIES
VALVES & FITTINGS

14TH PIPELINE TECHNOLOGY CONFERENCE

18-21 MARCH 2019, BERLIN, GERMANY

EUROPE'S LEADING PIPELINE CONFERENCE & EXHIBITION

www.pipeline-conference.com

ptc

MONDAY, 18 MARCH 2019

PTC SIDE CONFERENCE	PTC SIDE CONFERENCE	PTC SEMINARS
Qualification & Recruitment	**Public Perception**	**4 Technical Seminars**

ptc Reception (for invited speakers, exhibitors, comittee members, session chairs and side conference delegates only)

PTC CONFERENCE

TUESDAY, 19 MARCH 2019

Opening / Welcome

Keynote Speech
"Learning from Failures: Moving from 'Failure' Cause to 'Root' Cause"

Plenary Session
"Eurasian Pipeline Forum - Linking East and West"

Panel Discussion
"Digital Transformation and Cyber Security in the Pipeline Industry"

1.1 Inline Inspection	**2.1 Digitalization**	**3.1 Materials**	**4.1 Trenchless Technolgies**	**5.1 Coating**

ptc Get-together party within the exhibition

PTC EXHIBITION

WEDNESDAY, 20 MARCH 2019

1.2 Inline Inspection	**2.2 Pump & Compressor Stations**	**3.2 Leak Detection**	**4.2 Environmental Impact**	**5.2 Coating**
1.3 Stress Corrosion Cracking	**2.3 Case Study "TAL Pipeline"**	**3.3 Leak Detection**	**4.3 Construction**	**5.3 Corrosion**
1.4 Integrity Management	**2.4 Offshore Technologies**	**3.4 Third Party Impact**	**4.4 Planning & Design**	**5.4 Valves & Fittings**
1.5 Integrity Management	**2.5 Offshore Technologies**	**3.5 Illegal Tapping**	**4.5 Planning & Design**	**5.5 Maintenance & Repair**

ptc Dinner Invitation "Classic Remise Berlin: A center for vintage cars" (separate registration required)

PTC EXHIBITION

THURSDAY, 21 MARCH 2019

Plenary Session
"Pipelines 2050: From Fossil Fuels to Renewable Fuels?"

Panel Discussion
"Illegal Tapping - Focus Regions, Monitoring and Counter Measures"

Closing Remarks

PTC EXHIBITION

PTC WORKSHOPS	PTC ROUND TABLES
(free access for all delegates)	(free access for pipeline operators only)

This year's PLENARIES

Plenary Session

„Eurasian Pipeline Forum - Linking East and West“

There is a long tradition of energy cooperation between Europe and Asia. For decades, Russia has been a reliable partner for the supply of crude oil and natural gas. A number of other initiatives are currently being developed.

Keywords: Europe, Russia, Central Asia, China.

Panel Discussion

“Digital Transformation and Cyber Security in the Pipeline Industry”

As the energy industry is already preparing for a consistent digital transformation, another big development for improving the integrity of the systems by big data analytics will be expected. Furthermore, as manufacturers and service providers will make use of IoT tools and products, the energy industry as a critical infrastructure must also gradually improve cyber security and relevant mechanism and processes.

Keywords: Digitalization, Industry 4.0, IoT, AI, Critical Infrastructure, Cyber Security, Big Data Analytics.

Plenary Session

“Pipelines 2050: From Fossil Fuels to Renewable Fuels?”

In 2018 the European Commission adopted a strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by 2050. The decline in the cost of renewable energies has opened the prospect of large-scale production of green hydrogen and liquid e-fuels. Pipelines can play an important role in this process. The existing infrastructure can be used to transport the hydrogen and e-fuels, with limited adjustments and costs.

Keywords: Hydrogen, E-Fuels, Power-to-Gas, Power-to-Liquid.

Panel Discussion

“Illegal Tapping - Focus Regions, Monitoring and Counter Measures”

Illegal tapping and product theft are severe problems not only regarding economic aspects but also in terms of safety and integrity of the pipeline. According to recent studies, these problems exist not only in emerging markets but currently also in regions like Europe.

Keywords: Product Theft, Third Party Impact, Monitoring, Socioeconomics, Counter Measures, Repair.

ptc Dinner Invitation:

CLASSIC REMISE

For our dinner invitation on the second night of the ptc conference & exhibition we could again find a very special place: The Classic Remise Berlin, a center for vintage cars. It was opened in 2003 in a historic tram depot, originally built in imperial times, construction starting in 1899. Now there are garages, services and dealers for classic cars, shops for spare parts, clothing, model cars, accessories and restaurants in this landmark building. The old industrial architecture

in combination with historic and classic vehicles will guarantee a unique automotive experience in the first classic car center of this kind worldwide. The participants of this exclusive gathering can learn more about the various vehicle models during guided tours and prove their driving skills on a slot car race track.

Interested?
Register for this Years Pipeline Technology Conference.

JOB & CAREER MARKET

YOUR OPPORTUNITY TO ATTRACT PROFESSIONALS AND HIGH POTENTIALS

The international pipeline community is in need of additional personnel.

We need more experienced professionals, but we also need young graduates to join our ranks. Despite attractive working conditions, many companies encounter problems while they are reaching out to potential recruits. There are many competing industry sectors who are also in need of high potentials. This results in many vacant jobs in the pipeline community, for operators, technology providers and service providers alike.

This necessity has driven us to develop a new service for the global pipeline industry. For this reason, we organize the first ptc side conference on Qualification and Recruitment.

ptc side conference on

Qualification and Recruitment

18 March 2019

Estrel Convention Center Berlin, Germany

In the frame of ptc

ONE SERVICE - MULTIPLE CHANNELS

International Universities

Offensive approach: We push forward and generate attention to our career market directly at the universities. We also collect CVs from international graduates and experts and forward it directly to you.

Website

Continuous promotion : Your vacancies are published on the Pipeline Technology Journal (ptj) website. In Addition, the ptj contains your vacancies too.

Biweekly Newsletter

Dead on target: We send your vacancies or your company profile to our database of 50,000 international pipeline professionals.

International Events

Physical appearance: The job & career market has an individual booth during all EITEP events.

Questions?

Please contact Mr. Admir Celovic for further information and booking requests.

celovic@eitep.de
+49 / 511 / 90992-20

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Association

IAOT - International Association of Oil Transporters
Czech Republic
www.iaot.eu/

DVGW - German Technical and Scientific Association for Gas and Water
Germany
www.dvgw.de

Automation

Siemens
Germany
www.siemens.com

Yokogawa
Japan
www.yokogawa.com

Certification

Bureau Veritas
Germany
www.bureauveritas.de

DNV GL
Norway
www.dnvgl.com

TÜV SÜD Indutrie Service
Germany
www.tuev-sued.de/is

Cleaning

Reinhart Hydrocleaning
Switzerland
www.rhc-sa.ch/rhc/

Coating 1/2

Denso
Germany
www.denso.de

Kebulin-gesellschaft Kettler
Germany
www.kebu.de

Polyguard Products
United States
www.polyguard.com

Coating 2/2

Premier Coatings
United Kingdom
www.premiercoatings.com/

RPR Technologies
Norway
www.rprtech.com/

Shawcor
United States
www.shawcor.com

TDC International
Switzerland
www.tdc-int.com

TIAL
Russia
www.tial.ru

TIB Chemicals
Germany
www.tib-chemicals.com

Construction 1/2

BIL - Federal German Construction Enquiry Portal
Germany
www.bil-leitungsauskunft.de

Herrenknecht
Germany
www.herrenknecht.com

IPLOCA - International Pipe Line & Offshore Contractors Association
Switzerland
www.iploca.com

Liderroll
Brasil
www.liderroll.com.br

LogIC
France
www.logic-sas.com

MAX STREICHER
Germany
www.streicher.de/en

Petro IT
Ireland
www.petroit.com

Construction 2/2

VACUWORX
Netherlands
www.vacuworx.com

Vlentec
Netherlands
www.vlentec.com

Construction Machinery

Maats
Netherlands
www.maats.com

Worldwide Group
Germany
www.worldwidemachinery.com

VIETZ
Germany
www.vietz.de

Engineering

ILF Consulting Engineers
Germany
www.ilf.com

KÖTTER Consulting Engineers
Germany
www.koetter-consulting.com

Inline Inspection 1/2

3P Services
Germany
www.3p-services.com

A.Hak Industrial Services
Netherlands
www.a-hak-is.com

Baker Hughes, a GE company
United States
www.bakerhughes.com

Intero Integrity Services
Netherlands
www.intero-integrity.com/

Inline Inspection 2/2

KTN AS
Norway
www.ktn.no

LIN SCAN
United Arab Emirates
www.linscaninspection.com

NDT Global
Germany
www.ndt-global.com

Pipesurvey International
Netherlands
www.pipesurveyinternational.com

PPSA - Pigging Products and Services Association
United Kingdom
www.ppsa-online.com

Romstar
Malaysia
www.romstargroup.com

Rosen
Switzerland
www.rosen-group.com

Inspection

Ametek – Division Creaform
Germany
www.creaform3d.com

Applus RTD
Germany
www.applusrtd.com

EMPIT
Germany
www.empit.com

Integrity Management

Metegrity
Canada
www.metegrity.com

Pipeline Innovations
United Kingdom
www.pipeline-innovations.com

Leak Detection

Asel-Tech
Brazil
www.asel-tech.com

Atmos International
United Kingdom
www.atmosi.com

Direct-C
Canada
www.direct-c.ca

Entegra
United States
www.entegrasolutions.com

Fotech Solutions
United Kingdom
www.fotech.com

GOTTSBERG Leak Detection
Germany
www.leak-detection.de

MSA
Germany
www.MSAsafety.com/detection

OptaSense
United Kingdom
www.optasense.com

Pergam Suisse
Switzerland
www.pergam-suisse.ch

PSI Software
Germany
www.psioilandgas.com

sebaKMT
Germany
www.sebakmt.com

SolAres (Solgeo / Aresys)
Italy
www.solaresweb.com

Monitoring 1/2

Airborne Technologies
Austria
www.airbornetechnologies.at

Monitoring 2/2

Krohne Messtechnik
Germany
www.krohne.com

SolSpec
United States
www.solspec.solutions

Operators

Transneft
Russia
www.en.transneft.ru/

TRAPIL
France
www.trapil.com/en/

Pump and Compressor Stations

TNO
The Netherlands
www.pulsim.tno.nl

Repair

CITADEL TECHNOLOGIES
United States
www.cittech.com

Clock Spring
United States
www.clockspring.com

RAM-100
United States
www.ram100intl.com

T.D. Williamson
United States
www.tdwilliamson.com

Research & Development

Pipeline Transport Institute (PTI LLC)
Russia
www.en.niitn.transneft.ru

Safety

DEHN & SÖHNE
Germany
www.dehn-international.com/en

HIMA
Germany
www.hima.de

Signage

Franken Plastik
Germany
www.frankenplastik.de/en

Surface Preparation

MONTI - Werkzeuge GmbH
Germany
www.monti.de

Trenchless Technologies

GSTT - German Society for Trenchless Technology
Germany
www.gstt.de

Rädlinger Primus Line
Germany
www.primusline.com

Valves & Fittings

AUMA
Germany
www.auma.com

Zwick Armaturen
Germany
www.zwick-armaturen.de

March 2019

In the next Edition of **ptj**:

Pipeline Safety & Operation

The next issue of Pipeline Technology Journal (ptj) will address Pipeline Safety & Operation.

This is a great opportunity for skilled authors to submit insightful papers and to contribute to the global pipeline industry's constant professional exchange.

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Event Calendar		
14th Pipeline Technology Conference (ptc)	**19 - 21 March 2019**	**Berlin, Germany**
ptc Side Conferences:		
on Qualification & Recruitment	**18 March 2019**	**Berlin, Germany**
on Public Perception	**18 March 2019**	**Berlin, Germany**
Commercial UAV Expo Europe	08 April 2019	Amsterdam, Netherlands
34th International Scientific & Expert Meeting of Gas Professionals	8 - 10 May 2019	Opatija, Croatia
UESI Pipelines 2019 Conference	21 July 2019	Nashville, Tennessee, USA

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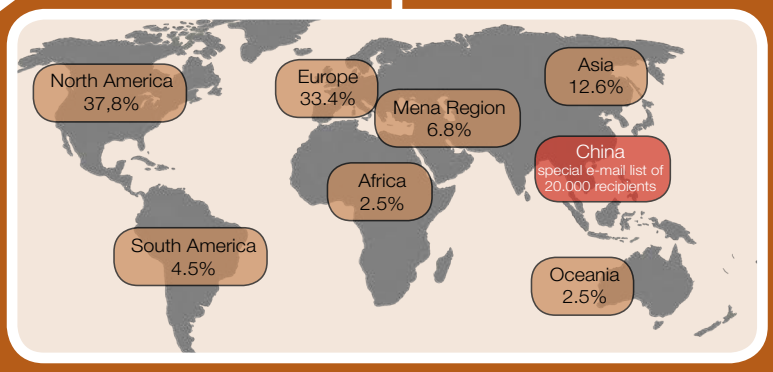

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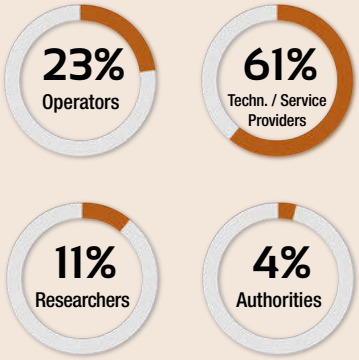
Audience Job Levels

Company types



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