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Safely does it

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

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

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

From design to reality: production of inspection tools

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

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



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



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

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

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

Equipment testing

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

Advanced inspection capabilities

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

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

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

Another recently developed inspection tool is designed to detect

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

What does the data hide?

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

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

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

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



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

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

Testing of pipes and prediction of defects growth

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

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

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

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