Off-piste pigging

René Landstorfer, Gottsberg Leak Detection GmbH & Co. KG, Germany, shares a case study of leak detection pigging in the Alps.

In a way, pipelines are like the lifelines of modern society. Almost all aspects of life are dependent on fossil fuels in one way or another and in order to guarantee crude oil delivery, for example, the product must be distributed via pipeline networks.

Avoiding supply shortfalls along with economic loss and also environmental protection are top priorities in pipeline operation. This translates to, in the case of a leaking pipeline, not only the search for the spilled liquid, but also the costs involved in its disposal. After the leak is located, the pipeline must be repaired and the contaminated soil has to be removed over a wide area and disposed of. Not least of the problems is the resulting loss of reputation for the operator – a great disadvantage when it comes to acceptance by society.

Figure 1. Gottsberg Engineers working on one of the test rigs in Hamburg.

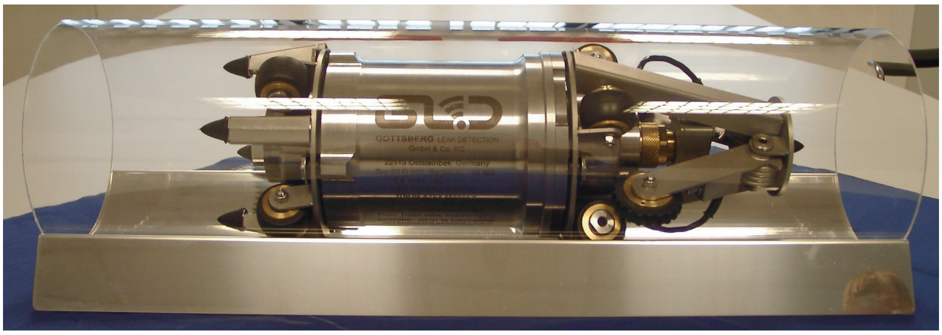


Figure 2. A design of the 8 in. GLD leak detection pig.

Leak detection through pigging

There are several options for ensuring the security of these transit routes. One such option – one that is almost indispensable – is the use of leak detecting pigs (pipeline inspection gauges). Online systems, for example, which make calculations based on model processes and external measurements of the operating parameters along the pipeline, offer good opportunities for continual monitoring but have the disadvantage that they cannot capture small, subtle leaks of the magnitude of a few litres per hour and that, when it comes to the detection of larger defects, they have difficulty locating the defects in question. As described already, this is ultimately a mathematical model process where, unlike the use of pigs, one arrives at precisely measured values at all points along the pipeline. In contrast, pigs can save the actual parameters for each relevant point in the pipeline network, thereby allowing more accurate statements to be made about the leak-tightness of pipelines.

Gottsberg Leak Detection (GLD) from Germany has developed a particularly precise system for this purpose. The company has created a leak detector based on ultrasound technology that takes records in the pipeline, which are then analysed later by the operators. The devices are easy to use, for example, analysis by the largely automated system is so simple that the operators can have it carried out by their own staff, which means that most leak detecting pigs sold by GLD can be used as often as needed and – unlike other pigging services – are inexpensive to install as well. The pig only has to stop its inspections to charge its batteries and to read out the data it has collected.

In addition, thanks to its approval for Ex zone 0 from the TÜV Nord standards organisation – something that is unique among intelligent pigs – the device can be used without restricting operations in the pipeline. It can perform its runs during normal operation and parameters such as pressure and speed or flowrate can vary without affecting the recording, which means no shutdown of the pipeline and very straightforward handling. One other advantage of the leak identification system is the way it reliably avoids false alarms. These are eliminated by the fact that noises and, especially, their origins can be appropriated through an exact frequency analysis.

So, unlike before, any harmonics from a noise typically found in the frequency range of a leak will not be classed as potentially dangerous. Instead, the new multi-channel technology can accurately determine the causes of these harmonics and thereby determine their origin. In fact, the device is so accurate that it is no problem to distinguish between for example a truck driving on a road next to the pipeline and a passenger car on the same road, because the noises of the engines would produce different results in the frequency analysis.

Challenges of terrain

On flat land, pipeline operators will not be confronted with any major problems concerning for example high speed or pressure variations, either during the construction phase or during operation. If, however, the pipeline passes through difficult terrain such as mountains and valleys, the operator will face new challenges.

These challenges begin during the construction phase, when questions including “should the pipeline go over the top of the mountain or perhaps even through a tunnel, so that we won’t have to overcome big altitude differences?” or “how much energy will be required to traverse a mountain or entire mountain ranges?” arise.

It is not only upward slopes that give planners headaches; descents, where the medium being carried in

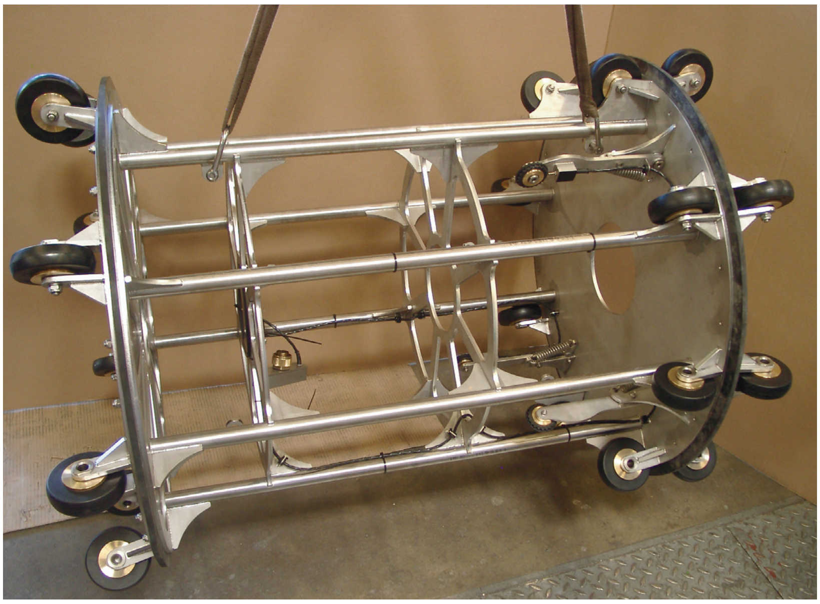


Figure 3. 40 in. chassis without electronics for test runs in the TAL Pipeline.

the pipeline can accelerate in speed to the point where it is almost in free-fall, must be borne in mind too.

All these considerations are not only of immense importance during the construction phase; they must also be remembered during operation and, especially, when it comes to maintenance.

And what better way to encounter and discuss all these challenges than with an Alpine crossing case study?

Case study

Gottsberg Leak Detection has, in collaboration with the operating company Transalpine Pipeline (TAL), recently commissioned a new generation of leak detecting pigs, the aim of which is to defy the above-mentioned odds.

From the oil port in the Italian city of Trieste, the pipeline crosses the Alps to supply refineries in Germany and Austria. Over the course of the pipeline's trajectory, altitude differences of several hundred metres at a time, rising to over 2000 m in total, must be overcome.

Furthermore, there are several sections where the pipeline faces such steep descents that both the medium being transported and the pig found in the pipeline are almost in free-fall. It is precisely in these areas that the durability of the pig and of the carrier is of huge importance, which meant that new structures were required at different locations. Complex calculations and computer simulations had to be made, not only to provide a solid construction for the carrier, but also to record usable data for the analysis after the run. The carrier had to be fitted with braces and other completely new structures which had been developed, while the odometer devices were also changed in order to achieve reliable measurement of the distance already covered and the speed.

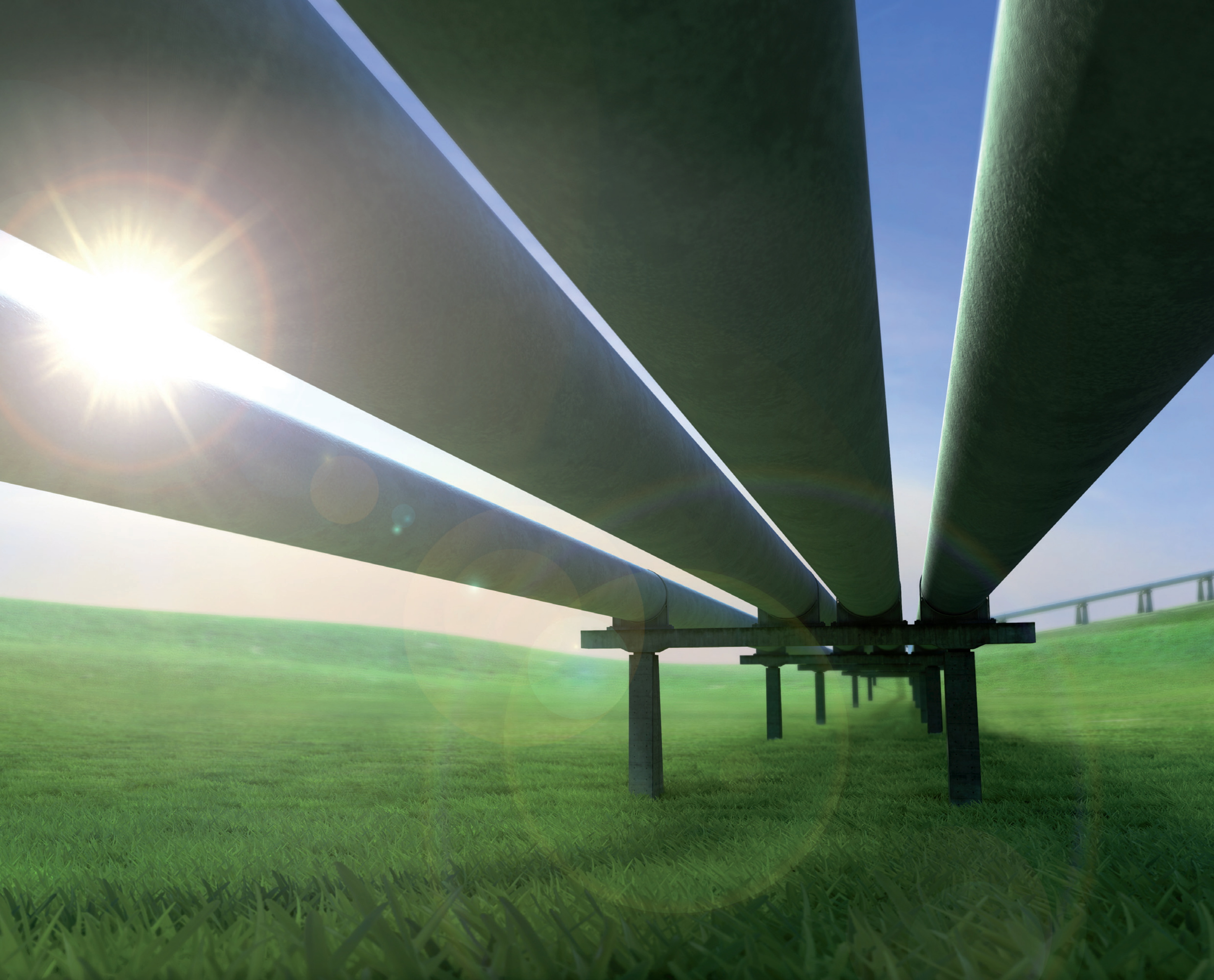
To ensure that the anticipated forces would not damage the devices and that the devices would, in turn, not damage the pipeline, test runs were carried out first using dummies and not until many modifications (developed in close collaboration with the operators) had been made could regular operation of the pigs finally commence.

Not only that, the measurement data and records taken also had to be reliably delivered under these challenging conditions, so as to allow the operators to assess the leak-tightness and other parameters. Uncontrollable speeds along with huge pressure variations make it difficult to calculate reliable values and presented the developers with issues that they had never faced before. For example, the sensitivity of the hydrophones was raised to allow enough data to be received even under unfavourable conditions and thereby allow an accurate assessment of the pipeline's leak-tightness to be made. The smallest leaks of 6.8 l/hr, unable to be detected in the past, can now be found and even other information on the condition of the pipeline can be made.

For example, wax disposals in the line can be detected and statements about the degree of pollution in the pipeline can be made. Also, valves that are not fully opened or closed can be detected. As they produce very significant noises it is no problem to detect these installations. This all adds up to an additional benefit for the operators, because they do not only know about the leak-tightness of their pipeline but also where energy can be saved in the transportation process, and saving energy means saving money.

Other added values to the leak detection are that the device also records parameters such as temperature, pressure and distance, which can be helpful for online systems that are used for monitoring. As some of these systems use mathematical models for their calculation, several of GLD's customers provide the data recorded from the whole pipeline to make, for example, their SCADA systems more accurate.

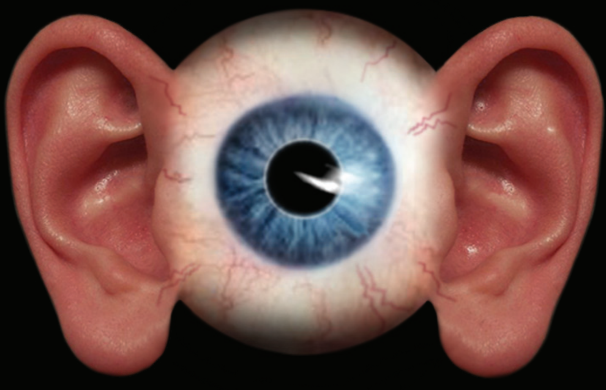
In the end, the Gottsberg engineers were successful and by now the pigs have made many investigative journeys between Trieste and Ingolstadt, helping to ensure even more secure operation of the transalpine oil pipeline. One of these journeys, representing a complete traversal of the Alps, takes around five days. During this time, the pig must process huge amounts of data. Since this must all be carried out in such a small casing, the company's engineers have managed, via a compression rate of around 1:300, to shrink the amount of data collected, which means that for a 200 hr run, a low energy, error-resistant 1 GB memory card is sufficient. This means no relevant information or measurement data is lost and any leaks present in the pipeline can be accurately detected.



LISTEN WITH YOUR EYES

A NEW GENERATION OF LEAK DETECTION PIGS

Reliable performance
- easy to use.



GOTTSBERG Leak Detection GmbH & Co. KG · Am Knick 20 · 22113 Oststeinbek · Germany
www.leak-detection.de · info@leak-detection.de · Fon +49 40 71 48 66 99 · Fax +49 40 71 48 66 77