Product Theft on Pipelines: How to Detect and Locate Illegal Tapings

All over the world, pipeline operators and oil companies are facing the problem of illegal tapings in their lines where product is stolen, and ever since pipelines have also been subject to vandalism and theft.

In some regions it is an increasing challenge, not only, but also due to the current Covid19 crisis, which costs a lot of jobs and pushes people into illegality. That brings some people to look for other ways to generate money, so pipeline theft becomes a rising issue for operators. With oil and product prices at levels never seen before it becomes an even more lucrative business for criminals.

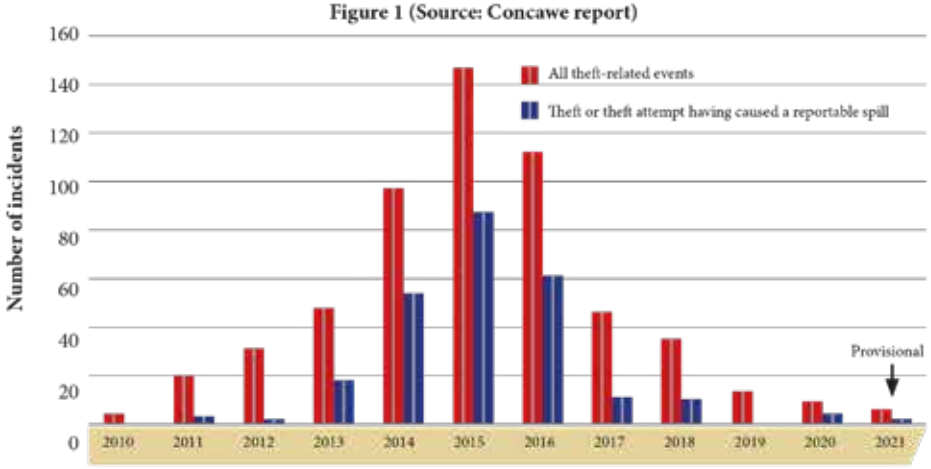
On the other hand, in Europe the cases of product theft had been going down due to the awareness of operators faced with this serious new threat. They reacted promptly, enhancing surveillance, improving leak detection system capabilities and increasing awareness of the problem with own staff, contractors and law enforcement authorities. Therefore since a peak in 2015 the numbers are going down significantly, although the problem is far away from being solved, as many of the hot tapings are not detected. (Figure 1 numbers for Europe).

In the last years, a lot of different technical options had been developed to cope with this problem. One of them is using leak detection pigs that are able to detect even the smallest product losses by means of acoustic data evaluation. This technology can find even the smallest amounts of product loss you could not find with other technologies.

The devices run during normal operations and do not need a lot of manpower or work to be launched or received. After processing the recorded acoustic data the analysis starts and leaks can clearly be identified and distinguished from all other noises. Also, locating is done with a very high accuracy of 1-5 m within the first run and without any external tracking or localization devices needed.

In a cooperation with the pipeline service company Integ from Slovakia, GLD could gain the pipeline operator Slovnaft to provide a line and test setups for a trial that shall show the abilities of the tools to detect and locate product theft.

Figure 1 (Source: Concawe report)



The leakages / tapping spots had been installed in different ways that had been found in illegal theft points along the lines in the past. In all three cases valves hat been attached to the line and a hole had been drilled into the pipe wall. Then different fittings had been used which consisted of different smaller pipes and valves mounted behind the valve on the line. Attaching long hoses to the installation is also a common practice. This helps to siphon the product far away from the line at a place where it can easily be loaded to tanks or trucks.

In the past, GOTTSBERG Leak Detection has detected illegal tapings with hoses installed that had been up to 600 m long leading to a place in the woods far away from the actual line.

For the trial a GLD 202 leak detector with standard configuration had been used. (Figure 2) The tool is working on an acoustic basis, recording all noises during the pipeline run. The sound data is processed and a frequency analysis is performed to make statements about the origin of a signal.

The chassis for the electronics had been slightly modified to suit for that special pipeline and guarantee a safe and quiet locomotion for best run results.

Figure 2: tool setup

The Different Leak Setups Had Been the Following:

Leakage 1 setup: (Figure 3)

Fully opened sampling branch DN80 with a ball valve DN80. Leak simulated via 2m long pipe DN50 mounted to the DN80 valve with a DN15 valve mounted on the other end where the leak flow was controlled, leak flow: 1,38 m3/hr, 16,7 l/min

With accumulated frequencies around 10, 30 and 40 kHz and also a very distinct signal geometry of the noise signal as well as the frequencies, the leak could be verified. Also the overall loudness and the clear signal to noise ration lead to the leak alarm. The location accuracy was around +/- 5 m. The installation was placed in the small valve station right next to the located position of the tool.

Figure 3

Leakage 2 setup: (Figure 4)

An already existing construction pit had been used to setup leak 2. A ball valve DN25 and drilled with a 6 mm drill to the main pipeline. Leak flow reduction done via ball valve DN25 partly opened, leak flow was 0,57 m3/hr, 9,5 l/min

Again the leak could be verified by sound frequencies that, compared to leak one have shifted a little bit to lower frequencies around 10 to 20 kHz and with lower amounts at the higher ranges. Additional verification could be done through signal geometry. Location accuracy was again just a few meters +/-.

Figure 4

Leakage 3 setup:

Another construction pit was used to access the line and set up the leak installation. Leak was simulated via newly welded branch DN25, with ball valve DN25 and drilled with 6 mm drill to the main pipeline. Additional pressure hose DN25 ca 20m long was installed with a DN 15 valve to regulate the leak flow. Leak flow was 1,38 m3/hr, 23,0 l/min.

Compared to the two other leaks this one was not as distinct. It could not be detected through the first data evaluation on site and needed a deeper data analysis performed for the final report.

The overall loudness of the signal is way more quiet which was caused by the much lower pressure of only 9 bar compared to 23 and 36 bar at the other installations.

Nevertheless it was possible to identify the noise as a leak that was also located at the right place with a high accuracy. Again there was a shift in frequencies to lower levels with only one major peak besides at 25 kHz. Still the frequency range and the clear signal geometry of the sound gave the ability to flawlessly state a leak.

With some filter algorithm and frequency analysis it is possible to make precise statements about the origin of a noise recorded during the run. That not only helps to reliably avoid false alarms but also to know what is happening in the line during every minute of the run.

Only difference from one setup to the others was that, depending on the installation and the kind of turbulent flow at the extraction point, different frequencies had been produced.

In the past Gottsberg Leak Detection tools have detected many locations where criminals had been stealing product and the treatment of the pipe wall differs a lot from big holes of 2 cm to plenty of small holes of less than 5 mm to avoid being detected with intelligent pigging by staying below the threshold of these tools.

Figure 5:

Concluding it should be mentioned that there still isn't the one for all technology to detect illegal tapings and product theft. Especially because the criminals are in many cases very sophisticated and can pretty quickly react on the counteractive measures of the operators by adapting their installations. Another big issue still is that they are very well informed about the pipeline operation. In many cases they already know when and how the operator reacts to their attacks and can then respond accordingly. It is already known that the

Figure 5

criminals have connections to the inside of the operating companies in many cases. That all doesn't make it easy to find the right solution to address the problem and in the end it probably leads to a solution of combining different technologies and approaches and of course to sensitize the own personnel as well as the public to be attentive towards these offenses. •

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