

PIPELINE MONITORING SYSTEMS (PLDS & IDS)

Contents

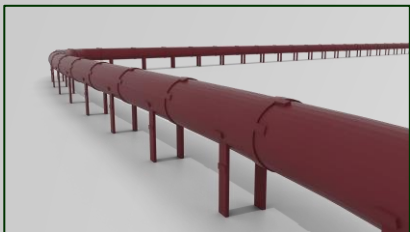
- Our Background
- Our Completed Projects
- Our Monitoring Components & Specifications
- Pipeline Leak Detection Function
- Activity Detection Function
- Operational Display Examples
- Integration
- Redundancy & Information Protection
- Installation & Operational Requirements
- Main benefits of system use
- Competitive advantage
- Contact Us

Our Background

- ▶ **“Petrofibre” LTD**, our Russian Parent Company, was formed in 2008, specializing in the design, development and production of fibre optic leak detection and monitoring systems.
- ▶ Our systems successfully gained recognition on the Russian market and were applied to a variety of infrastructures across various sectors:
 - Oil and Gas Pipelines
 - Oil and Gas wells (conventional, horizontal and injection)
 - Refineries
 - Airports
 - Railroads
- ▶ Currently, our company group is targeting opportunities on the Algerian market through our subsidiary – **Petrofibre Algerie**, located in Algeria.



Our Completed Projects

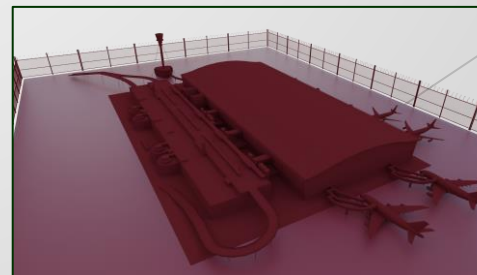


- Transneft. Eastern Siberian - Pacific Gas Line 2 - 2050km
- Transneft. Baltic Transportation Gas Line - 1001km
- Transneft. Samotlor Gas Line - 429km
- Transneft. Tupase Gas Line 2 - 350km
- Transneft. Tikhoretsk Gas Line - 325km
- Transneft. Obvodnoi Pipeline - 250km
- Transneft. Irkutsk Gas Line - 250km
- Transneft. Purpe Gas Line - 200km
- Transneft. Tichoretsk Gas Line- 250km

- Tatneft Shashin, Republic of Tartarstan, 205 wells
- Lukoil, Western Siberia, 25 wells
- Gazprom, Western Siberia, 6 wells
- Rosneft, Sakhalin, 5 wells
- Rosneft, Eastern Siberia, 2 wells



- Rosaviatsia - Pulkovo Airport, St Petersburg - Perimeter
- Rosaviatsia - Magas Airport, Ingushetia - Perimeter
- Russian Rail, central Russia, 140km of Railway



- Sibur, Tobolskii gas and chemical complex product line - 417km
- Novatek - Total. Pyreinoe Gas Line - 250km
- Novatek - Total. Termokarstvov field gas lines - 300km
- Novatek - Total. Yarudeiskii field gas line - 350km
- Novatek - Total. Yakhinskii field gas lines - 180km
- Novatek - Total. Norther Khichinskii field gas lines - 100km

Our Monitoring Components & Specifications



VOSK – A

- Acoustic monitoring unit
- Real time acoustic monitoring
- Primary designation is the monitoring of activity, however, can perform leak detection tasks on oil and gas pipelines
- Is able to identify and distinguish following activity in real time mode: human traffic, vehicle traffic, animal traffic, attempted work with tools/excavation attempts
- Linear range is on 100km, can be programmed into zones and adjusted
- Accuracy of location of impact is +/- 5 meters
- Is able to detect human up to 3 meters away from the cable, SUV up to 15 meters and heavy digging machinery up to 50 meters
- Spatial resolution +/- 5 meters



VOSK – L

- Temperature monitoring unit
- Real time monitoring of temperature changes
- Primary designation is monitoring of leaks
- Can be applied to oil and gas pipelines
- Linear range is of 50km
- Temperature measurement range - 60°C-300°C
- Sensitivity of 0.1°C
- Spatial resolution +/- 5 meters
- Leak is detected instantly once oil/gas comes into contact with the FOC

Our Monitoring Components & Specifications



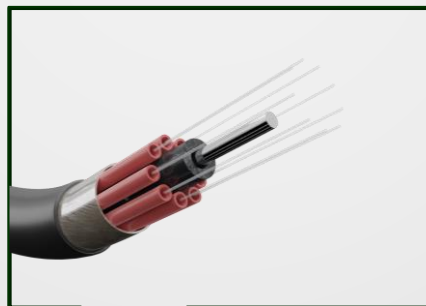
Both VOSK-A and VOSK-L form part of our FOSM Complex. The VOSK units can be interchanged to fit the client's requirements. However, we recommend the use of both units simultaneously, this enables dual verification of leaks and activity, providing the most accurate and reliable results possible. Additionally, reserve VOSK units can be added as a redundancy measure. The units and accessories are enclosed in our All Weather Field Cabinet (AWFC) which can tolerate temperatures of up to 80°C. An indefinite amount of VOSK units can be connected in linear chain fashion, allowing the system to monitor and infinite length of pipeline

VOSK SERVER
UNIT

Information received from the VOSK units is transferred to the VOSK-S Server for output, it is a closed server which minimizes risk of hacking. Connected can be established via cable route, or wirelessly, with the use information encryption devices, providing wireless safety

AWP DISPLAY
UNIT

An operator's display is present on site, typically we locate these in control rooms on site. However, monitoring can be done remotely through methods mentioned above



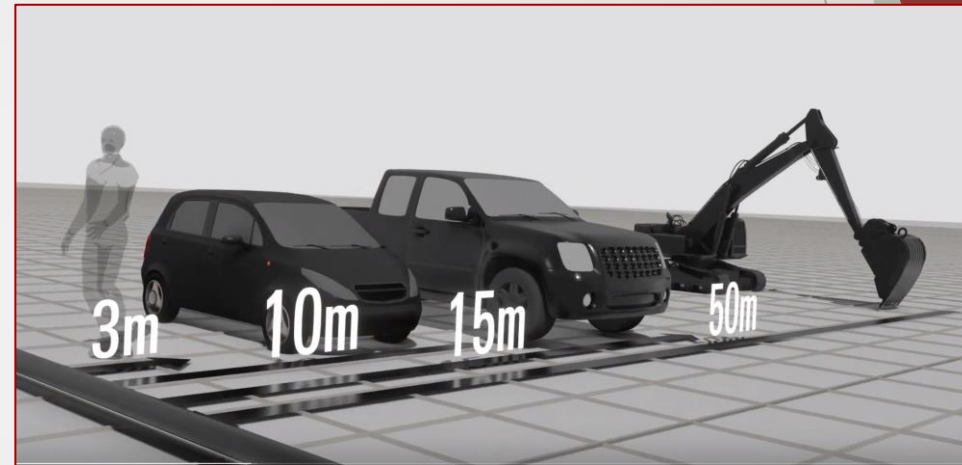
Our system uses an armoured fibre optic cable, single mode and preferably with 8 fibre cores available (minimum 4). Already existing on site cable can be used

Pipeline Leak Detection Function

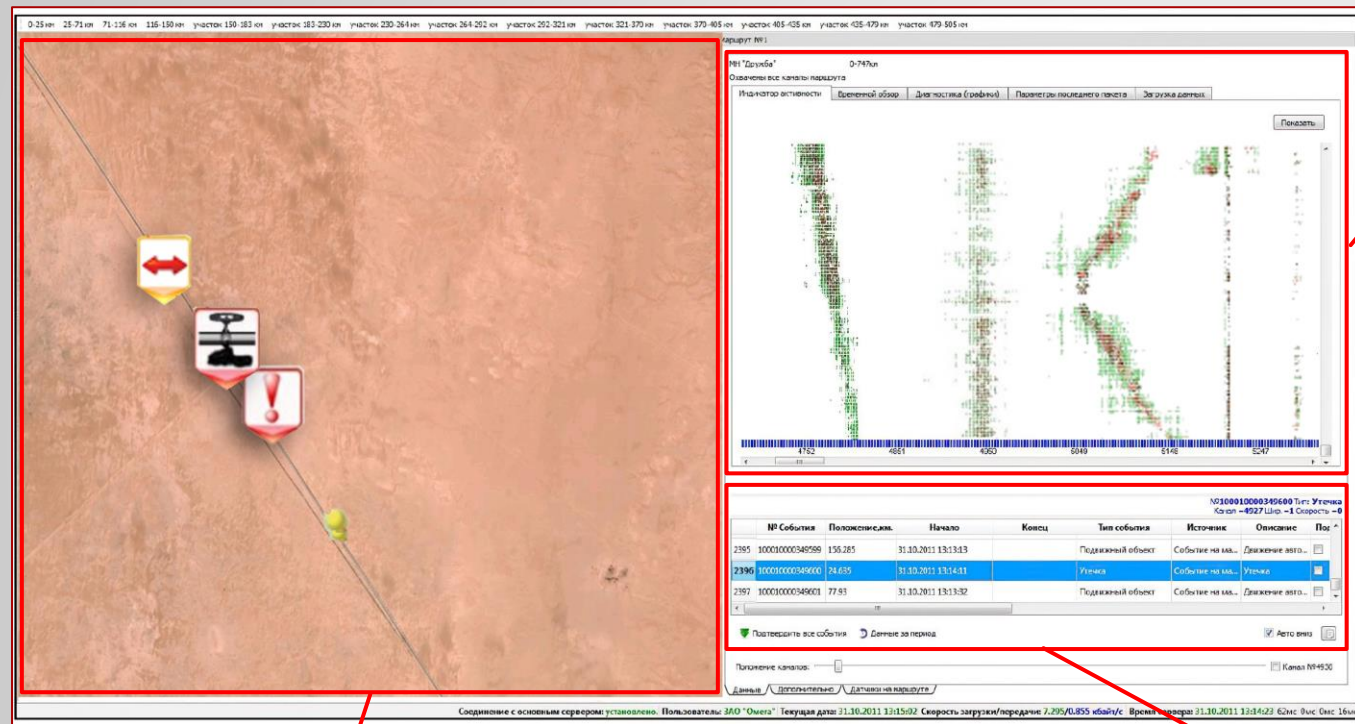
- ▶ VOSK-L uses changes in the temperature properties of the cable (Distributed Temperature Sensing – DTS) to accurately and reliably detect pipeline leaks (both oil and gas). As soon as a perforation occurs, either oil or gas comes into direct contact in the cable, which rapidly changes its temperature properties. For oil leaks the temperature rapidly increases, whereas for gas it rapidly decreases. The light signals, which are constantly sent down the FOC, are changed once the temperature properties of the cable are changed. Upon return, these signals are analysed and a leak alert is displayed. This process occurs in real time mode, allowing the operator to take quick action and avoid the leak from deteriorating. The system is adjusted for rapid temperature changes, therefore it does not produce false alarms due to change weather conditions
- ▶ VOSK-A uses distributed vibro-acoustic (DAS) monitoring to register the vibrations caused when a substance leaks through a perforation at high pressures. Much like with the explanation above, the light signals are altered, analysed and classified to display a leak alert. Although DAS is competent in registering leaks, DTS provides more reliable and accurate results
- ▶ We recommend the use of both DTS and DAS modules for the monitoring of pipelines. This allows us to implement the dual verification method, which involves the verification of activity through both VOSK units, providing the most accurate and reliable results possible, with a practical nullification of false alarm incidents

Activity Detection Function

- ▶ For security monitoring of pipelines, we use exclusively our Distributed Acoustic Sensing (DAS) block VOSK-A. VOSK-A provides real time acoustic data along the entire length of the pipeline and is able to reliably detect the following activity:
 - Human traffic – detectable up to 3 meters away from the cable
 - Light vehicle traffic – detectable up to 10 meters away from the cable
 - Heavy vehicle traffic - detectable up to 15 meters away from the cable
 - Earth digging machinery - detectable up to 50 meters away from the cable
- ▶ The system is able to distinguish between different activity via the different acoustic profiles exerted. The sensitivity can also be adjusted and programmed to ignore certain types of activity. For example the system can be programmed to detect vehicle traffic, yet ignore human traffic. The system can also be programmed into different zones and each zone's sensitivity adjusted accordingly



Operational Display Examples



Map showing positioning of FOC. Once an event occurs, it is classified and displayed on the map with an accuracy of 50 meters +/- . In the given example the right icon represents activity with tools, the centre icon represents a leak and the left icon represents vehicle movement detection. The icon will follow the detected intruder on the GPS Map.

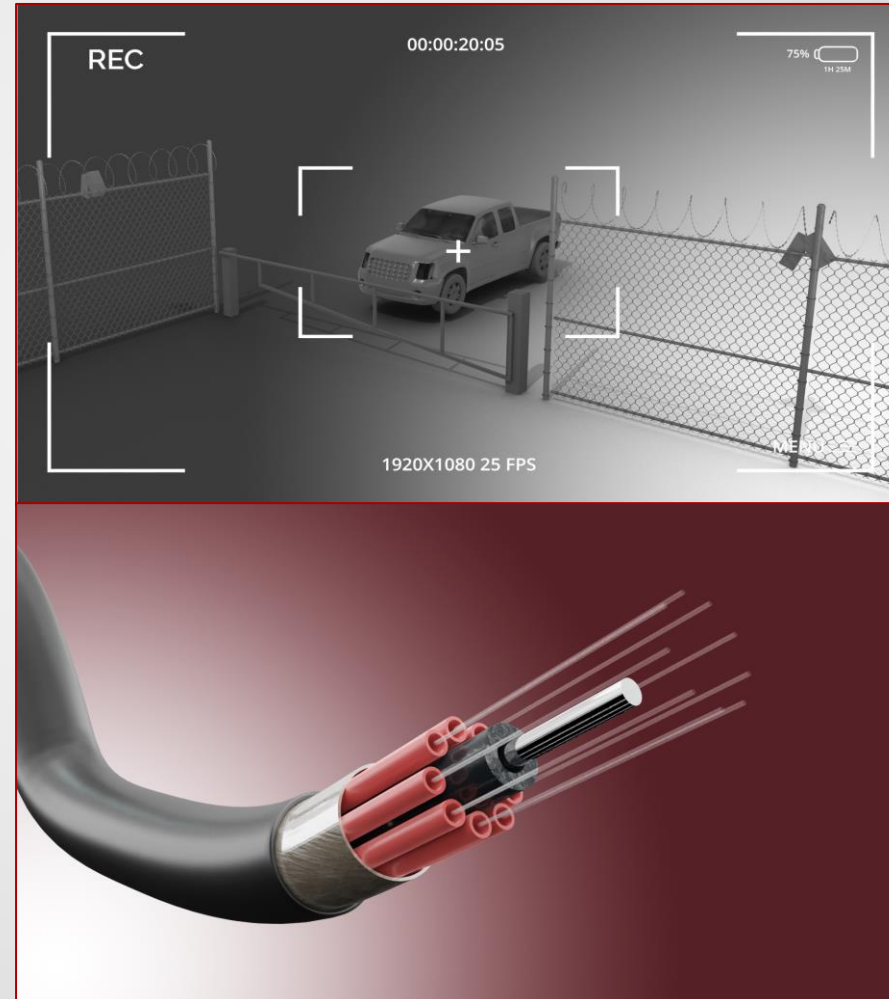
The entire display is fully customizable to the user's preference

Events Log – each activity is registered and stored for a minimum of 2 years. The operator is required to enter the decisions made when an event has occurred, leading to an increase in accountability

Activity Graph – each microevent is registered with a mark on the graph. The X Axis shows the location along the FOC route, the Y Axis shows the duration of the event. In the given example, the left column of activity shows attempted work with tools (minor positional change and heavy vibro-acoustic activity), the central column shows a leak in progress (no change to position of activity, constant activity) and the right column shows a vehicle approaching the FOC and moving away (change in activity position in relation to time). The system will classify the activity and provide a reliable output on activity type

Integration

- ▶ Our system uses OPC as its base protocol system. This allows for the system to be integrated into existing monitoring systems such as CCTV or Infrared Sensors and existing SCADA programs
- ▶ The software used by our VOSK modules is designed and produced by Petrofibre. If the client requests the protocol to be changed to suit their needs and requirements, this possibility exists
- ▶ Moreover, since our system uses a limited amount of strands in the FOC, the remaining strands are at the disposal of our client for transmitting communications, or to integrate additional monitoring instruments

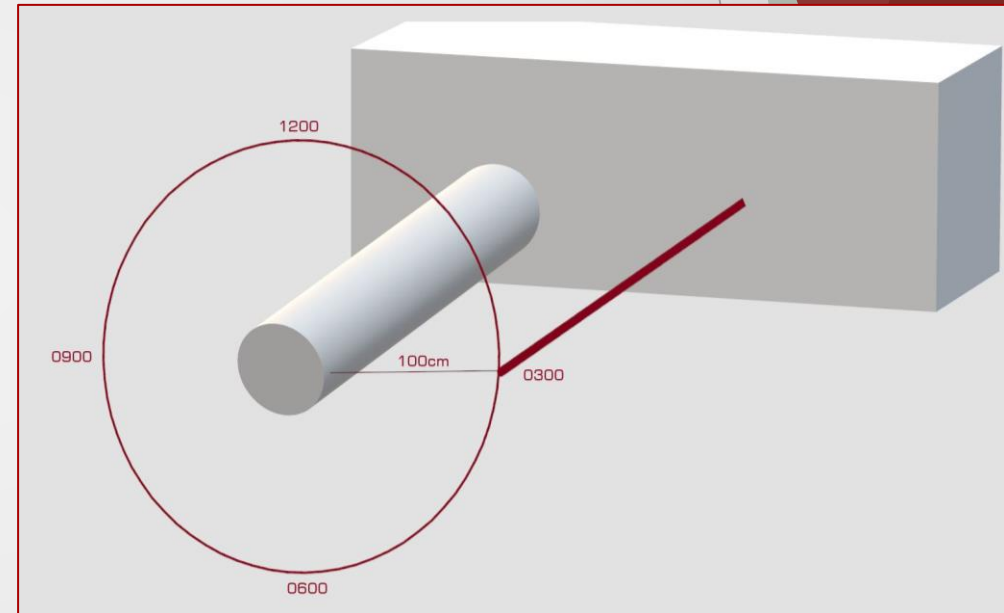


Redundancy & Information Protection

- ▶ Our FOSM features the possibility of the additional of reserve VOSK units. These units would be programmed to take over operations instantly if the main units were to suffer critical failure. The information from the original units is constantly backed up, therefore no loss of data would occur
- ▶ Our system features a redundancy solution for the FOC as well. In its original design, if the FOC suffers a cable break, the system will continue to monitor up to the point of the cable break. However, we do feature a design option which closes the distance between the VOSK units, allowing light signals to be sent and received from both sides of the cable. In this instance, even if a cable break occurs, the system would not be compromised
- ▶ As previously mentioned, our system uses a closed VOSK Server without an open connection to the net, meaning sensitive files cannot be compromised by hacking, unless there is physical access to the VOSK units. For remote monitoring, we offer the option of cable connected monitoring, however, if this is not available, we offer encryption devices, which would encrypt sent data and decrypt the data on the receiving end

Installation & Operational Requirements

- ▶ For the monitoring of pipelines, our FOC can be installed up to 1 meter away from the pipeline wall for our system to operate competently. However, for quicker leak detection results, a distance of 50cm is recommended
- ▶ The o'clock positioning of our cable in relation to the pipeline is not relevant. In previous tests, we have identified that our systems performs equally well at 12, 3, 6 and 9 o'clock positioning
- ▶ The system can tolerate up to 80°C thanks to our All Weather Field Cabinet (AWFC). The system also requires minimal maintenance – a simple dust off twice a year is sufficient
- ▶ Our FOC cable requires no power to operate, consequently it is electrically passive. The VOSK unit required a power source of 200VA (Maximum)



Main Benefits of System Use

- ▶ Increase in the safety and awareness of the pipeline by providing reliable data in real time
- ▶ Increased response time and effectiveness due to system's accuracy and by being able to classify incidents, reacting with precision and stopping leaks at the earliest possible stage
- ▶ Monitoring method not based on flow rate and dual verification of incidents nullifies false alarm incidents, results in a more efficient flow of operations with minimal shutdown time
- ▶ Ability to integrate – provides the opportunity to incorporate into existing SCADA & Monitoring units and monitor thousands of kilometres of pipeline, from one location
- ▶ Electrically passive and will not be deterred by electrical equipment on site
- ▶ Functional with both oil & gas pipelines without the need of modification
- ▶ Adaptable to any pipeline layout
- ▶ Provides safeguarding for collected data and immune to hacking attempts
- ▶ Multifunctional – provides PLDS & IDS in one package
- ▶ Low maintenance and operational costs
- ▶ A redundant and innovative solution

Competitive Advantage

Technological Advantages

- ▶ More accurate and precise data
- ▶ Redundancy and reliability
- ▶ Significant reduction in false alarm incidents
- ▶ Multifunctionality
- ▶ Integration and connectivity
- ▶ Flexibility and adaptability
- ▶ Low operational costs and maintenance
- ▶ Informational safety

Service Advantages

- ▶ We build to customer specification – unique and custom fitted design, engineering and technical solutions for any of our client's needs
- ▶ We offer a 2 year warranty period for any damaged or malfunctioning units
- ▶ Our aftersales services include full technical installation and training sessions for system operators
- ▶ Quick and effective tech-support and spare parts package