COMPLEX CONTACTLESS PIPELINES INSPECTION

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**MAIN ACTIVITIES:**

- Providing environmental safety
- Industrial construction
- Industrial safety expertise

**Scientific and Technical Base:**

- 7 doctors of sciences
- Up to 200 professional employees
- Own scientific and industrial equipment
- Own scientific labs
- Headquarter in Saint-Petersburg (Russia)

**Our Customers:**

- NKK Corporation, Japan; «Total», «Halliburton», USA; Unilever SNG, Great Britain; «Total Fina Elf», France; «Mahrukat», Syria; Beijing Gas, China; Dragon Oil (UAE)
- "Lukoil" Oil Company; "Transneft"; "Diamonds of Russia -Sakha" Co. Ltd; "TNK-BP"; "Moscow Oil Refinery"; "Rosneft" Corp; ROS "United Power Systems of Russia"; "Russian Railways"; Ministry of Defense; Ministry of the Natural Resources.
PROBLEM

Pipeline monitoring is a **matter of safety**

Existing inspection methods are costly and labor-intensive

No current effective solution for inspection of underwater pipelines
WHAT IF PIPELINE IS NOT PIGGABLE?

○ Non piggable pipeline:
  ▪ Multi-diameters
  ▪ Small diameters and tight bends
  ▪ Over and under sized valves
  ▪ Low or no flow
  ▪ Cleanliness of the pipe
  ▪ Non availability of launcher and receiver

○ Not able to perform in-line inspection (intelligent pigging)

○ Unnecessary excavations might be required

○ A better method is needed
CONTACTLESS MAGNETOMETRIC DIAGNOSTIC SYSTEM

- Non contact diagnostics of steel pipelines
- From the surface of ground or water
- Detects flaw from stress, tension or corrosion
- No excavation required
- No disruption of operations
- Diver-operated non contact inspection
- Up to 40 m depth
- Instrumental detecting of flaw
KMD-01M TECHNOLOGY

• KMD-01M detects changes in the pipelines magnetic field caused by various flaws, including stress, tension or corrosion, isolation state (Villari Effect)

• From the surface, without excavation

• Received data is visualized as magnetograms showing the location of anomalies with links to a digital map
NON CONTACT AND REMOTE INSPECTION METHOD

- Remote diagnostics at a distance of up to 10 diameters of the pipe
- Stopping or changing the operating mode is not required – No lost production
- No preparation needed
- High speed - up to 20 km daily per 1 crew
- Detects anomalies in real time
- Reliability reaching 90 %
KMD PRODUCT LINE

- The system for underground pipelines inspection designed for using at a moto vehicle
- The mobile system for underground pipelines inspection
- The system the sub-contact (without insulation removing) location of the stress concentrators, connected with flaws, designed for inspection of pipelines in pits and tanks walls
- Underwater diver-operated trace founder
- The system for underwater pipelines inspection at the depth of 20 – 60 m
NON CONTACT & REMOTE INSPECTION METHOD

KMD-01M provides remote non-contact inspection of above ground, underground and underwater steel pipelines of any type without any interruptions of the operation or any preparations.

Non Contact and Remote Inspection with NMC

Express-analysis of the contactless data (magnetograms)

Marking of the magnetic anomaly's center at the site

Additional control measuring in the test pit
ADDITIONAL SENSORS: ELECTROMETRIC TOOL

- Accurately find buried pipes
- Establish center-line depth
- Troubleshoot coating defects
- Minimizes unnecessary excavations
## STAGES OF WORK

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<th>Stage</th>
<th>Description</th>
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<td><strong>I. PREPARATION</strong></td>
<td>Collecting all necessary information about the pipeline and preparing the measuring equipment</td>
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<td><strong>II. FIELD DEPLOYMENT</strong></td>
<td>Field inspection with KMD-01M system – magnetometric contactless measuring with the simultaneous data visualization and GPS coordinates linking and electrometric inspection</td>
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<td><strong>III. EXPRESS ANALYSIS</strong></td>
<td>Express analysis of the magnetograms, choosing the places for control pits</td>
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<td><strong>IV. ADDITIONAL CONTROL</strong></td>
<td>By the customers request the opening of the pipeline can be made for the NDT - additional control by non-destructive methods (measuring of thickness and hardness)</td>
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<td><strong>V. DATA PROCESSING</strong></td>
<td>The processing and interpretation of the received data is held in the Analytic Center</td>
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<td><strong>VI. REPORT</strong></td>
<td>The report and the final condition conclusion on the technical state of the pipeline including the digital maps of the discovered anomalies is made</td>
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Magnetogram of the damaged sections of the pipeline

Magnetogram of undamaged part of the pipeline
DETECTABLE DEFECTS

KMD-01M detects anomalies of the magnetic field caused by various types of defects:

- Stress-deformed state - SDS
- Corrosion fatigue
- Defects related with loss of metal and failure of metal's solidity, changes the pipelines geometry, unauthorized inserts as well as repair locations – “local damage”
The magnetogram of changing of the full vector of magnetic induction shows significant stress (bending moment), caused by curving of the pipeline due to the pressure of sand. ILI made a few months before defined the pipeline as “no problems”.
The magnetogram shows the changing of the full vector of magnetic induction of the pipeline, covered by the sand dune. At 118 meters long section the high of the dune is more than 10 diameters of the pipe, so the data of the pipeline can not be read.

At places where the pipeline enters and exits the dune the stressed-deformed state of high level are detected, caused by the pressure of large amount of sand. No local defects associated with the loss of metal were detected at the inspected area.
EXAMPLE OF CORROSION (1)

Saudi Arabia Project
• Corrosion of underground pipeline was detected and marked
• Excavation confirmed precise location of the anomaly within ± 0.5 m
EXAMPLE OF CORROSION (2)

Siberia Project – The damaged part of the pipeline and corresponding magnetogram. The loss of metal - over 50%

Example of magnetogram of the pipeline section in emergency state
EXAMPLE OF LOST OF METAL

The fragment of the magnetogram at the part of the pipeline that has metal loss

Open pit №7, Loss of metal 100%

The loss of metal 100% - hole
EXAMPLE OF LOCAL DAMAGE – THE DENT

The fragment of the magnetogram

The dent 350 x 280 x 35 mm
EXAMPLE OF LOCAL DAMAGE

The pit at the anomaly location. Additional Flaw Detecting Tests (AFDT) – ultrasonic thickness measuring

Zone of stress-corrosion cracking
200x400 mm
EXAMPLE OF TENSION CONCENTRATOR

Dragon Oil Project
The excavated clamp located at the point, marked according to the results of the contactless inspection

The excavated pit, made at the location of the magnetic anomaly, the concentrator of the tensions (repair construction) was found
EXAMPLE OF INSULATION DAMAGE

The excavated pit made at the location of the isolation cover damage, detected according to the results of the contactless inspection
Examples of maps of anomalies caused by various defects with the geographical coordinates.
WORK EXPERIENCE: SURVEY UNDER EXTREME WEATHER

Executing diagnostics on ski and snow-shoes

Using snowmobile for diagnostic
The speed - 20 km/h
THE UNDERWATER MODEL OF KMD-01

The device operated by a diver allows inspection at the depth of up to 40 m. The received data is written to the flash memory for further processing.

Waterproof display allows the operator to monitor anomalies in real time.
SUBCONTACT INSPECTION OF TANKS

Sub-contact (without insulation removing) inspection system allows location of the stress concentrators, appeared due to various flaw.

The system allows inspection of tanks even without a pressure.
Received data is visualized as colored magnetograms showing the places of anomaly (flaw) as red spots and normal area as colored green and blue.

- Spots of corrosion
- Not-stressed (normal) welding joint
OBJECT: field pipeline (diameter 273 mm) Oil Company «PetroChina» (China), 2012

Scope of work:
Diagnostics of the pipeline with the help of magnetometric system KMD-01M

OBJECT: field and gas gathering pipelines (φ 159 - 600 mm) of Oil Company «Lukoil - West Siberia», 2010

Scope of work:
Inspection of pipelines via nondestructive testing methods by means of magnetometric system KMD-01M

OBJECT: filed oil pipeline of «Langepasneftegaz», (φ 159-420 мм), of Oil Company «Lukoil - West Siberia», 2011

Scope of work:
Inspection of the pipeline with the system of magnetometric diagnostics system KMD-01M

OBJECT: main water pipeline and oil pipeline (φ 1220 mm and φ1020 mm), OA "KazTransoil" (Kazakhstan), 2012

Scope of work:
Diagnostics of pipelines with the system of magnetometric diagnostics system KMD-01M
The diagnostics using the system KMD-01M was carried out on the pipelines of different types, destinations and level of readiness for operating:

«Lukoil - West Siberia», Russia
- gas collecting pipeline «Yamalneftegaz», ø 260-400 mm
- field oil pipelines «Kogalymneftegaz»,
  «Pokachineftegaz», «Langepasneftegaz»,
  «Urajneftegaz», ø 159-400 mm

«Bashneft», Russia
- field pipeline, ø 159-420 mm

«Rosneft», Russia
- field pipeline «RN-Uganskneftegaz», ø 530 mm

«KazMunayGaz», Kazakhstan
- main gas pipeline «Middle Asia - Center», ø 1220 mm

«KazTransOil», Kazakhstan
- main oil pipeline, ø 1020 mm
- main water pipeline, ø 1220 mm

«Saudi Aramco», Saudi Arabia
- main pipeline, ø 31”

«CNPC», China
- main gas pipeline, ø 600 mm

«PetroChina», China
- field oil pipelines «Shi Xi Oil Field»,
  ø 273 mm

«Sinopec», China
- main oil pipeline, ø 426 mm

Dragon Oil (UAE) in Turkmenistan
- trunk oil pipeline, ø 30”

PT Chevron Pacific Indonesia
- gas pipeline, ø 12”
SCIENCE AND TECHNICAL APPROVAL

- New design, technological solutions and software developed for the diagnostic equipment are protected by 11 patents
- Application for PCT #PCT/RU2014/000227 "Device for inspection of the technical state of steel pipelines"
- The company processes the License on the activity on executing of expertise of industrial safety.
Besides successful commercial projects KMD-01M system successfully passed through the arbitrage tests at the objects of "LUKOIL-West Siberia", "Sibur neftehim", «Bashneft-Dobycha» PetroChina (China), Dragon Oil (UAE) and received positive expert conclusions from State Corporation "Rosnano" and "Skolkovo" Fund