

*Infrasonic leaks detection systems for products pipeline  
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*Orenburg oil, gas and condensate field (Orenburg field) has been operating continuously since 1974. It is one of the largest fields where pipelines transporting H<sub>2</sub>S containing gas and condensate are used. H<sub>2</sub>S and CO<sub>2</sub>, which produced and transported products contain, raise their corrosive characteristics, what causes Orenburg field's pipelines and shutoff valves' damage and destruction. Even minor damage and destruction may result in sufficient ecological and economic consequences, sometimes even people's death. Even more, such damages and destructions may affect accidents, which are followed by gas emission or soil contamination by liquid hydrocarbons.*

*Gas production and processing are core activity of OOO "Gazprom dobycha Orenburg", at that the Company pays much attention to ecological safety of pipeline, transporting hydrocarbons. So, the Company assumed a commitment to arrange all nature conservative activities in accordance with international ISO 14000, which provide for regular faithful discharge of all requirements of ecological legislation as well as maximum transparency and cooperation with all interested parties.*

*Reliability of products pipelines is one of the main criteria of ecological safety. Production activity of the Company, as for rational nature management is concerned, is subject to environmental legislation of the Russian Federation, license agreements, ecological programs and plans, developed in accordance with obligations, stated in OAO Gazprom's ecological policy.*

*From technical point of view, pipelines are complicated engineering facilities which, beside the pipe itself, include protection units, cathodic protection stations, pumping stations, aerial, automotive and railway crossings; the pipelines, located near to settlements and industrial facilities, need even more serious attention in order to be run safely.*

*That is why one should solve such challenges as safe pipelines' exploitation, control over technological parameters of transporting regime and leakages detection in complex and in proper time. Technical and ecological aspects of safe hydrocarbons transportation are to be solved simultaneously.*

*So, the pipelines which have worked out rated resource need to be reconstructed and equipped with leaks detection systems (LDS).*

*The linear part of the pipelines is the most trouble one; especially it concerns pipelines, located far from production facilities. Pipelines' threats are:*

- technological regime's failure;*
- terrorist act;*
- natural occurrences, such as lightning, storms;*
- outside interference.*

*The main threats are low intensity leakages, which cannot be detected by linear remote control devices after pressure drop. Such leaks may result in technical and ecological subsequences and create risk of anthropogenic catastrophe.*

*There have been 3 accidents and 2 breakdowns at the Company's pipelines within 2005-2007. Breakdowns which took place in 2005 (condensate spill in Salmysh river) and in 2007 (unstable condensate pipeline) resulted in sufficient ecological and economic loss and had wide public response.*

*Equipping pipelines with leaks detection systems will help to solve the following problems:*

- to increase emergency protection rate of linear part of the pipelines, thanks to timely detected emergency situations by fault section remote disconnection;*
- to register low intensity leaks, less than 1% from transported products volume;*
- to decrease loss of raw material and products due to decrease of fault sections shutdown time;*
- to decrease possible ecological damage due to timely detected emergency situations;*
- to decrease costs for linear part maintenance and control.*

*Leaks detection systems are being developed both, in Russia and abroad. They differ by physical working principles and characteristics – sensitivity and positional accuracy.*

*The Company's specialists determined technical requirements to such systems, such as:*

- *threshold of sensitivity – no more 1-2% from transportation volume;*
- *detection period – up to 5 min;*
- *accuracy of the leakage location – no more 200 m;*
- *ability to detect mechanical effect;*
- *protection and diagnostics of system's modules.*

*Taking into consideration the results of the field trials of infrasonic pipeline monitoring system (IPMS) made by OOO "NPF "TORY" (Novosibirsk) was acknowledged as highly efficient.*

*IPMS can be used along with pigs as well as to monitor oil and products pipelines; it detects leaks, performs pipeline surveillance and a number of other works.*

*When the System is used to detect leaks and to perform surveillance, it determines mechanical damages, position and intensity of leaks.*

*If used along with diagnostic and scraping pigs, it continuously monitors position, rate of motion and determines estimated and actual time when the pigs pass reference points.*

*Data accumulated by the system are displayed on the computer monitor in real time and the pipeline operator can see information about all events with references to geographical position, flowchart and maps of pipeline altitude above sea level.*

*Noise, generated by pumping (compressor) stations is the main source of noise in pipelines. Additional noise can be generated by traffic along field roads or farm works as the condensate pipeline passes through agricultural lands.*

*The novelty of the System is the applied method of infrasonic vibration detection. Such vibrations are generated by leaks and then travel inside pipelines through liquid hydrocarbons for hundreds of miles. As infrasound attenuates slowly the System can detect very distant leaks of low intensity.*

*The "desired signal" is the infrasound signal with frequency equal to 20Hz which is generated by a leak or a mechanical impact on the pipeline created by a pig or any other device.*

*IPMS is a pipeline complex monitoring and leak detection system. It secures:*

- *leak detection, including long branch pipes with small diameter;*
- *locating of internal devices;*
- *detection of mechanical effects;*
- *detection of damages (without pigging);*
- *pressure measurement;*
- *guarding and diagnostics;*
- *easy sensors setting, near to existent automatic remote control points up to 30 km. from each other. No additional cable is needed along with pipeline; sensors don't prevent pigs to pass by;*
- *low amount of false response;*
- *message log.*

*Sensitivity of IPMS makes it possible to keep working even if equipment in one of the controlled points has been failed.*

*IPMS system includes the following:*

- *modules of preliminary data collection and processing which are installed on the pipeline;*
- *controllers located in existing remote-control points;*
- *data transfer system;*
- *software, installed on IPMS server, which provides data on dispatcher's workstation.*

*At that, such interface includes network of pipelines and indicates checking parameters. In case of parameters change the dispatcher is informed by light or sound signal.*

*In 2008 the pipeline "Orenburg-Salavat-Ufa" was equipped with IPMS system; in July 2012 it was trialed by OAO Gazprom's commission. As a result, a conclusion was made that IPMS technical and operational performance in field conditions confirms its reliability in ensuring of safe operation of the equipped condensate pipeline.*

*Thanks to timely detection of pre-emergencies and emergencies, the Company could raise safety of the pipeline and decreased man's impact to environment.*

*Annual saving rate from IPMS implementation is 14.8 million rubles.*

*Safety of pipelines is so large-scale financial, ecological and social problem that it goes beyond responsibility of the separate companies and becomes a state problem which needs urgent solving.*

*IPMS introduction demonstrated that requirements to the equipment that is installed on pipelines, which operate far from operator and technical support devices, are very high. Hardware and software, applied in IPMS, ensure stable and autonomous work of the system. Technical maintenance costs are minimal due to function of automatic remote self-diagnostics, which includes prognosis of the equipment technical condition and 3-months archiving of diagnostics' results.*

*Gazprom dobycha Orenburg is planning to continue IPMS introduction and field trials on the pipelines, transporting H<sub>2</sub>S-containing media.*