GAZPROM
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Implementation of Dry Seal Technology in Gazprom System

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Parameters of the Gazprom Unified Gas Supply System

Parameters	2008
Total number of compressor stations, (CS), units including	*281*
linear CS	*219*
booster station	45
CS UGS	17
Total install capacity of CS and booster stations, thousand MW	47,238
Gas pumping aggregates (GPA) at CSs and booster stations, units	4242
including	
gas turbine and gas motor compressors	3559
electric	683

Relevance of the Problem

- modernization of the gas pumping aggregates operating at Gazprom facilities

- obligations of Russia under the international agreements on the stabilization and reduction of greenhouse gas emissions including methane

- corporate interests in implementation of market mechanisms under the Kyoto Protocol

Researches in methane leakages reduction

Purposes

– efficiency increase of the Russian gas complex,
– reduction of methane emissions into the atmosphere,
– obtaining of adequate estimates and trends on the amount of leakages,
– scientific substantiation of Gazprom necessary corporate decisions on the methane emission reduction;
– expert estimate of commercial benefits, based on the project of oil seals replacement with the dry seals.

Objectives

- study the economic and environmental advantages of the compressor oil seals replacement with the dry seals;
- estimate the amount of the natural gas leakages into the atmosphere under the wet seal and dry seal systems;
- set the selection criteria for the compressor oil seals to be replaced with the dry seals.

Methodology Applied

Methodology

- Collection and analysis of statistical data of the exploitation performance for the seal systems of GPA superchargers
- Detection of the natural gas leakages from the emission sources whilst implementing the wet seal technology on GPA superchargers
- Measuring of the methane leakage amount as detected from the seal systems

Techniques

The amount of the natural gas leakages was estimated by means of contact control media based on the practical recommendations and technical equipment certified under the normative documents of OAO Gazprom.

Disadvantages of the supercharger wet seals

The most considering disadvantages

- exploitation complexity;
- complexity of the provision system, which is not fully safe;
- high probability of the operation failure;
- high service and maintenance costs;
- high energy consumption;
- hazard of inflammability and non-compliance of the production ecological safety;
- probability of the pumped gas contamination with the oil (the longer the seal in operation is, the more likely the contamination gets).

Gazprom acknowledges the advantages of dry seals

GAZPROM

acquires new GPAs with dry seals

implements an ambitious corporate program of compressors modernization involving the dry seal technology

cooperates with leading suppliers of dry seal equipment and services:

«JSC Sumy Frunze NPO» «BURGMANN»

«John Crane» and «John Crane - Iskra».

«Grace Engineering»; PTP «SGER»;

Standard scheme of a dry seal

Main nodes:

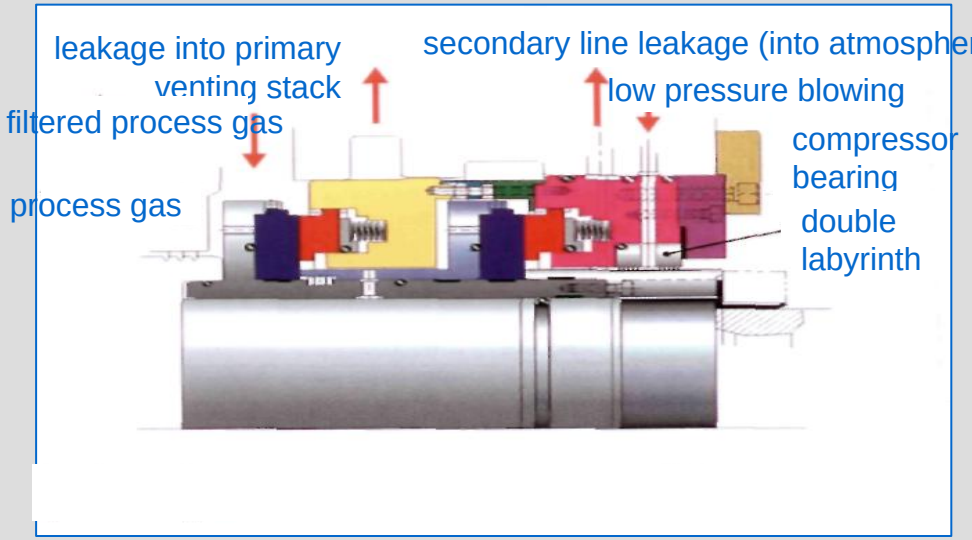
-I step of sealing, which normally takes the main load;

- II step of sealing, which operates as the reserve system

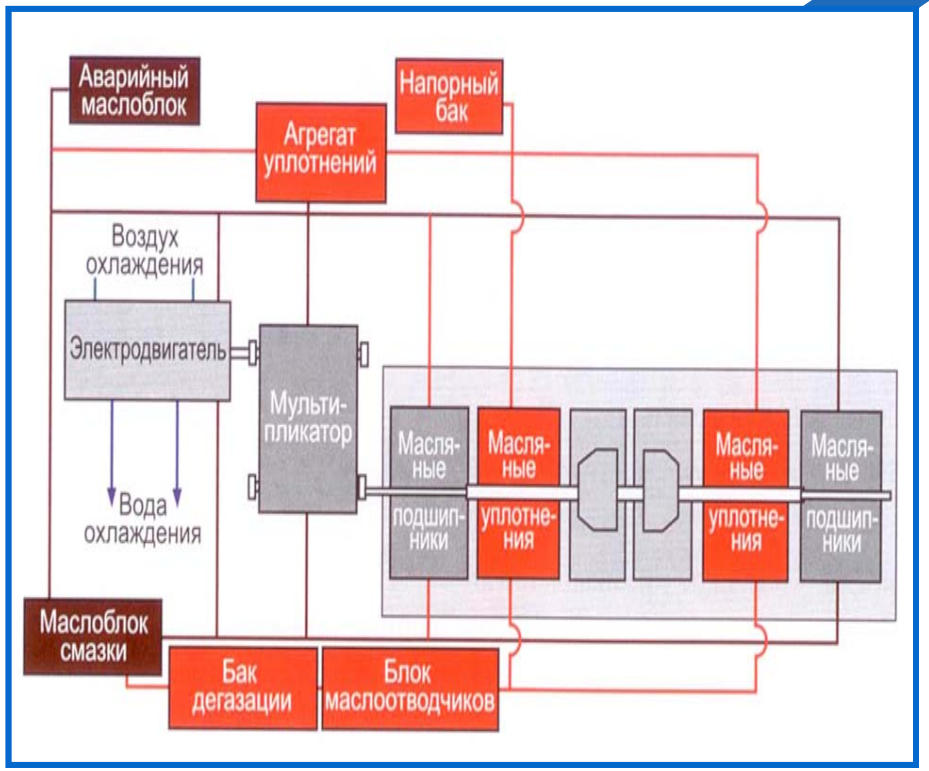
- bore protector, which prevents the bearing oil contamination of the dry seal, gas leakage and its penetration into the bearing
(it also operates as an additional barrier, when the I and II step of sealing is not enough)

Operation parameters:

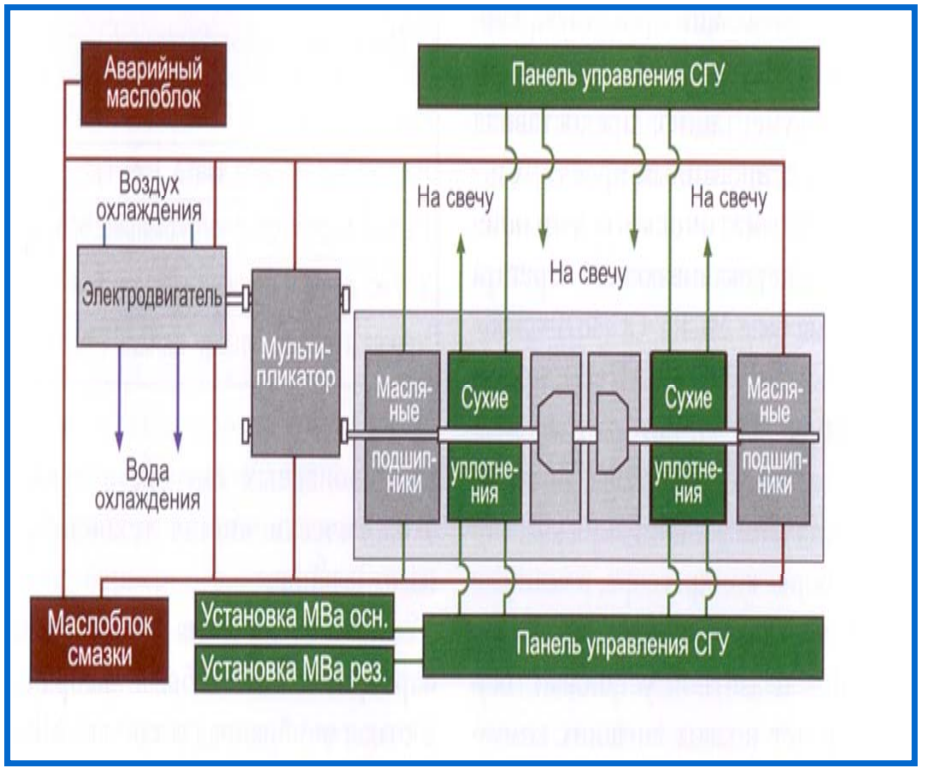
- T = 140 – 315 ^{0}C
- P ≤450 bar
- n ≤200 m/sec
- d ≤350 mm



Modernization of GPA sealing systems



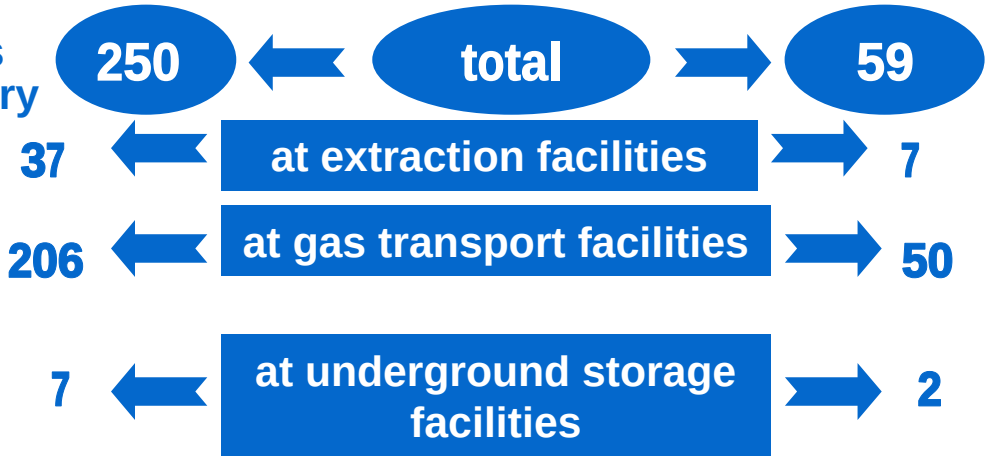
Scheme of a compressor unit with oil seal capping



Scheme of the compressor unit after the modernization

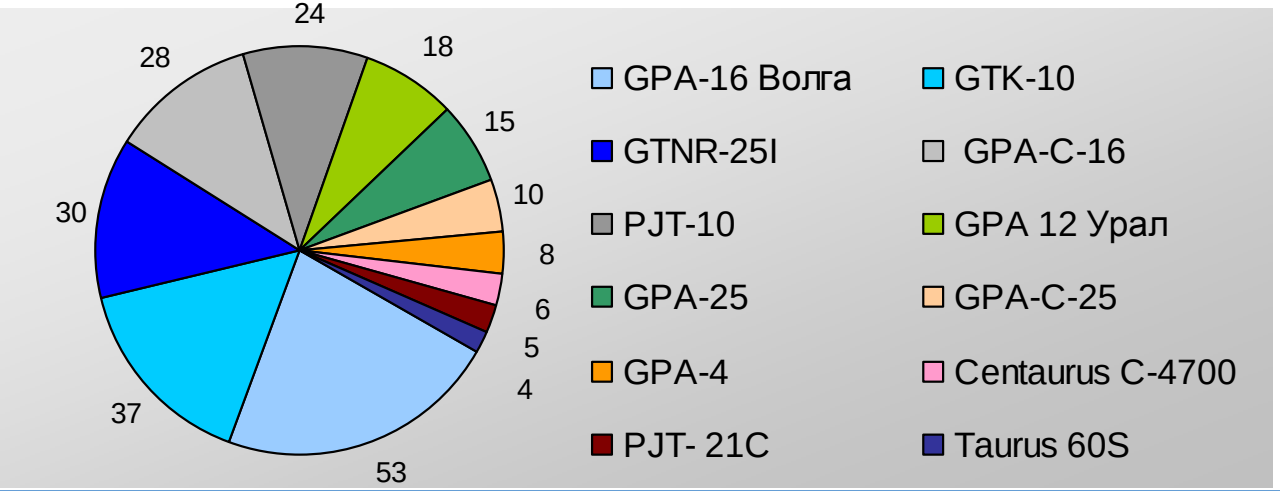
Implementation of seal system technology among Gazprom compressor stations

GPA superchargers equipped with dry seals



Number of compressor stations (GPAs with dry seals)

Implementation of dry seal technology by GPA types, units



Methane fugitive emissions into the atmosphere

Potential sources of the natural leakages from the on-shore equipment:

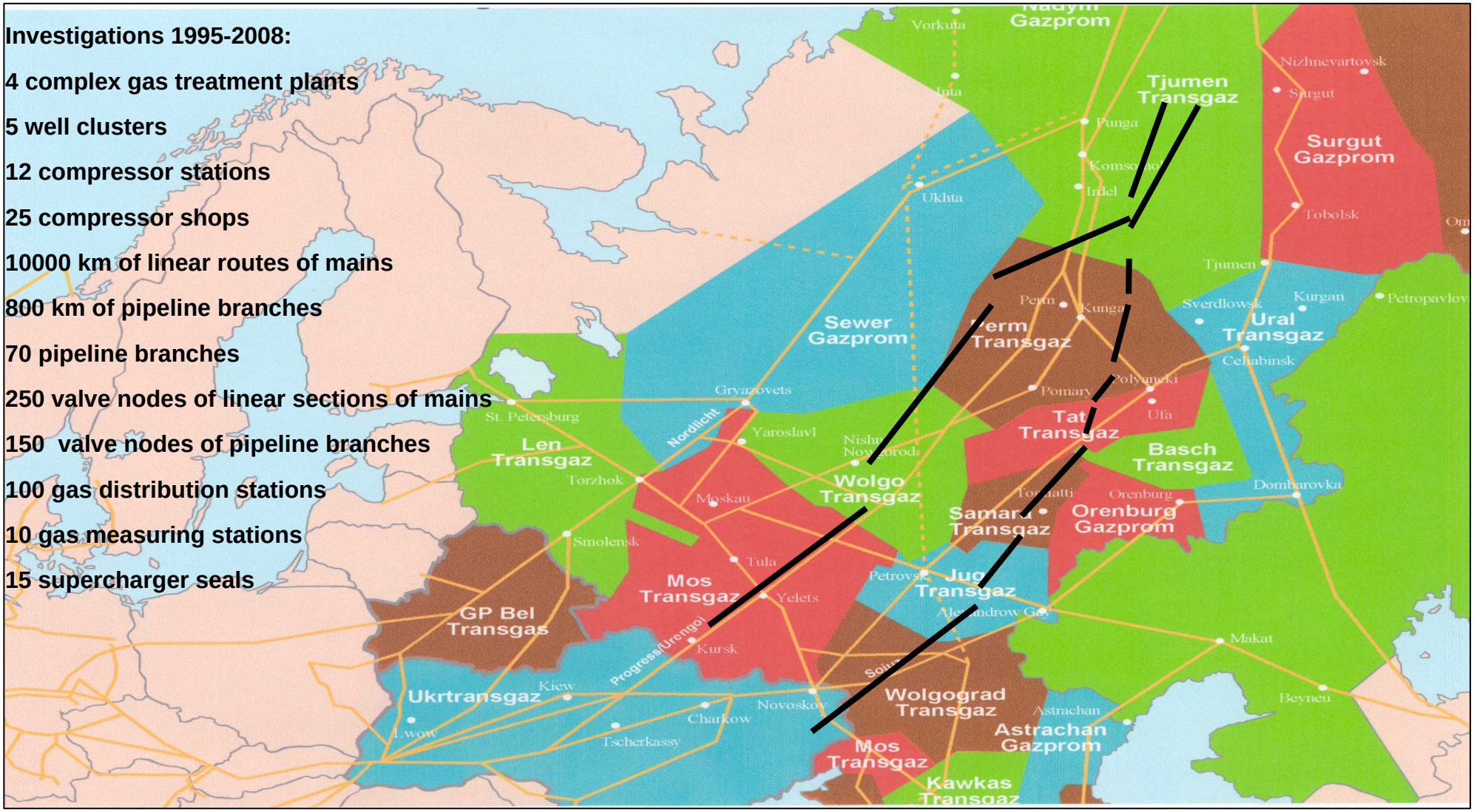
1. **Pipeline and technological equipment**
2. Vent stacks **(when the stack valves are "locked")**

Leakage factors	Leakage locations
• Leakages caused by the unsealing of the equipment in operation	• Welding joints • Flange and thread joints • Flange and thread joints
• Blocking valves gaps of pumping units and measuring devices regulations system	• Tap pistons • Pulse tube
• Leakages as a result of the equipment (fittings, pipelines) accident damage	• Blowholes • Scratches • Cracks • Rust-through damage

Export and transmission pipeline routes

Investigations 1995-2008:

- 4 complex gas treatment plants
- 5 well clusters
- 12 compressor stations
- 25 compressor shops
- 10000 km of linear routes of mains
- 800 km of pipeline branches
- 70 pipeline branches
- 250 valve nodes of linear sections of mains
- 150 valve nodes of pipeline branches
- 100 gas distribution stations
- 10 gas measuring stations
- 15 supercharger seals



METHODS OF METHANE LEAKAGES REMOVAL VIA MODERN CONTROL MEDIA

TOOL DETECTION OF METHANE FUGITIVE EMISSIONS FROM DIFFERENT SOURCES IS CARRIED OUT VIA CONTACT SENSING AND DISTANT EXPLORATION OF THE EQUIPMENT SURFACE (ASSUMED SOURCE OF A LEAKAGE) INVOLVING INTERNATIONALLY CERTIFIED MEASURING MEDIA

Leakage detectors, methane concentration meters

Portable gas meter

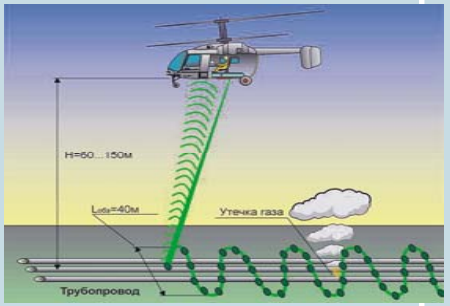
Multifunctional IrDA gas analyzer

Sampler unit

Volumetric emissions measuring and detection device

Gas detector

METHODS OF LEAKAGE CONTACT DETECTION



Helicopter distant laser gas analyzer for pipelines

Laser system of the methane spatial concentration

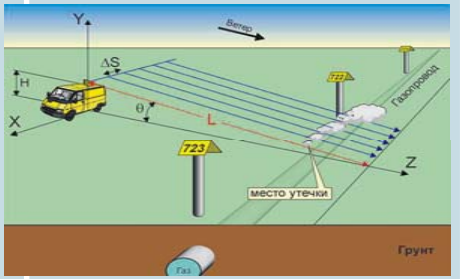
Laser measuring system of the methane local concentration

Board passive distant gas meter for methane concentration “Tomsk-1”

Portable passive gas analyzer for methane “Proryv”

DGA of methane concentration based on an IrDA sound and optical spectrometer and projector

Distant measuring system of methane concentration



Vehicle distant laser gas analyzer for pipelines

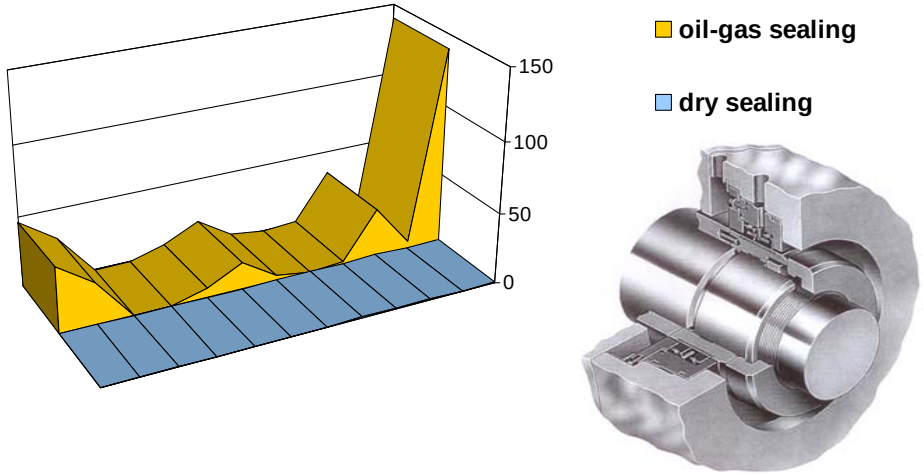
Показатели эмиссии CH_4

Methane emissions source	ОАО «Gazprom» data for 1999, 2005-2008		Data of the Wuppertal Institute, 2004 г.
Gas extraction and preparation, % of the extraction			
Emissions	0,04	0,10	0,09
Leakages	0,02	0,02	0,03
Total	0,06	0,12	0,11
Compressor stations, м³/year / MW CS			
Emissions	-	4500-5500	5227
Leakages	-	40000-60000	44191
Total	75000	45500-64500	49418
Linear gas main pipeline, м³/year / km of route			
Emissions	700	250-900	284
Leakages	2700	1600-3000	2425
Total	3400	2500-3250	2709
Gas distribution stations, м³/year			
Emissions	-	50-300	-
Leakages	-	300-1000	
Total	-		
Gas measuring stations, м³/year			
Emissions	-	30-50	-
Leakages	-	90-150	
Total	-		

Measuring results of methane emissions into the atmosphere resultant from seal systems of gas pumping aggregates

Type of GPA/supercharger	Methane emission source from oil-gas seal system	Methane emissions, m^3/hour
GTNR-25I/PCL-804/36	oil degasser vent stack	4,3-140,0
	bearing crankcase venting	3,0-5,0
GPA-C-16/NC-16-76	oil degasser vent stack	5,8-34,5
GTK-10-4/ N-235-21-1	oil degasser vent stack	0,07-1,7
	bearing crankcase venting	0,01-0,06
N-370-18-1	oil chamber stack	0,5-46,5
N-520-12-1	oil degasser vent stack	1,7-3,6
GTN-16/ 2N-16-76	oil degasser vent stack	15,4-19,1
	oil chamber stack	10,4
	bearing crankcase stack	5,4 -7,0
	oil chamber stack	1,8-2,3
GT-750-6/N-370-17-1	oil degasser vent stack	0,15-0,22
GPU-10 / N-370-18-1	oil degasser vent stack	0,007
	oil chamber stack	0,003
GT-6-750 / N-300	bearing crankcase stack	4,4-29,5
	oil degasser vent stack	0,6-46,5

Type of GPA/supercharger	Methane emission source from dry seal system	Methane emissions, m^3/hour
GTNR-25I/PCL-804/36	stack of the 1 step	0,05-1,26
	stack of the 2 step	0,04-0,38
ГПА-Ц-16 / НЦ-16-76	stack of the 2 step	0,07-1,2
ГТК-10-4 /Н-370-18-1	stack of the 2 step	0,03-0,6
ГПА-25 Днепр / Н-650-22-2-1,35	stack of the 1 step	0,08-0,8
	stack of the 2 step	0,03-0,42



Conclusion

Gazprom practical experience proves

- evident economic, operational and environmental benefits of dry seals;
- necessity to boost the implementation of the dry seal technology on oil seal GPAs;
- demand for further studies to give a quantitative assessment of particular methane emissions and achieved emission reduction resultant from the shift to the dry seals.

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