SAKHALIN-1 PROJECT

SUMMARY
OF ENVIRONMENTAL MONITORING AND INDUSTRIAL CONTROL RESULTS FOR 2017

Chayvo Well Site
Sakhalin-1 Project

EXXON NEFTEGAS LIMITED

Moscow

2017

Table of Content

Abbreviations

ANO – Autonomous Non-Profit Organization

AS – anionic surfactants

BOD_5 – biological oxygen demand, 5-day

BODfull – biological oxygen demand, 20-day

WS – well site

TPL – tentative permissible levels

GN – Hygienic Standards

GOST (R) – State Standard (directive)

H – hardness unit

PL – pollutant

CFU – colony-forming unit

LPB – lactose-positive Bacillus coli

MM – measurement methodology

MU – Guidelines

MUK – Guidelines for Control

TC – total coliforms

TMC – total microbial count

MPE – maximum permissible emission

MPC – maximum permissible concentration

$MPC_{o.t.}$ – maximum permissible concentration, one-time

MPL – maximum permissible level

PND F – environment protection regulatory documents, federal

RD – directive document

DN – distribution network

CWT – clean water tank

SanPiN – Sanitary Codes and Standards

SPZ – sanitary-protection zone

SP – Sanitary Regulations

TTCB – thermotolerant coliform bacteria

GWL – ground water level

FSFHI TsGiE – Federal State-Funded Healthcare Institution Sanitary and Epidemiological Center

ENL – Exxon Neftegas Limited

1 Introduction

This report presents the results of the field and laboratory studies performed in accordance with the existing Program of Environmental Monitoring and Industrial Control for Chayvo Well Site located on the east coast of Sakhalin Island, on a sand spit between Chayvo Bay and the Sea of Okhotsk. The Chayvo WS location map is shown in Fig. 1.

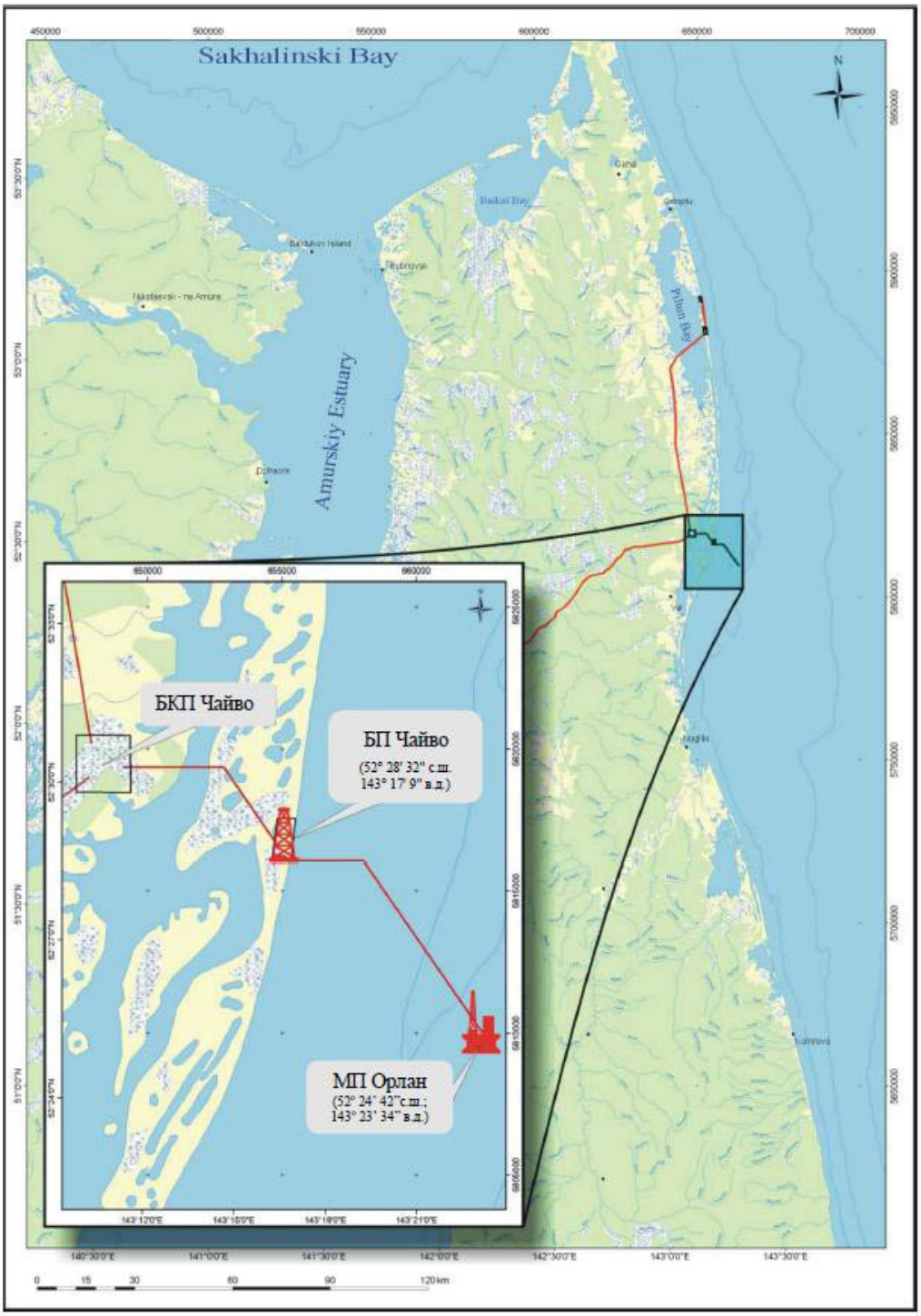


Fig. 1. Chayvo WS location map

The main goal of the industrial environmental control is to timely obtain and provide to the persons concerned the reliable information on the ecological and sanitary-and-hygienic conditions of the components of the environment at the facility and within its impact zone for information support and decision making in the sphere of environmental protection and operating conditions safety.

The main objectives of the industrial environmental control are as follows:

- Monitoring and subsequent assessment of conditions of the components of the environment in the facility impact zone in operations period vs the background indicators and the established regulatory requirements;
- Assessment of effectiveness of the environmental and sanitary-hygienic measures, if any;
- Obtaining information that allows taking timely measures to ensure safety and health of the company's employees.

The following activities have been implemented at Chayvo WS:

- monitoring of ground water level;
- monitoring of ground water quality;
- monitoring of air quality in the work and residential zones;
- monitoring of atmospheric air quality;
- monitoring of drinking water and wastewater quality;
- monitoring of physical impact factors;
- monitoring of the sanitary protection zone.

The laboratory analyses have been done by the accredited laboratories of Sakhalin Hydrometeorological Agency, of Sanitary and Epidemiological Center in Sakhalin Oblast, of Sanitary and Epidemiological Center in Aleksandrovsk-Sakhalinsky, Tym and Nogliki Districts, the Okha Branch of Sanitary and Epidemiological Center in Sakhalin Oblast.

2 RF Legislative Framework in the Sphere of Environmental Monitoring

2.1 Protection of Environment (in general)

Requirements for environmental monitoring are provided for by the RF laws and regulations as well as by regulatory-technical documents of the federal architecture and urban development bodies, federal bodies for protection of natural environment, for sanitary and epidemiological oversight, for civil defense, prevention of and response to emergency situations, for land resources and management, for protection of subsoil, waters, atmospheric air, soils; by regulatory-technical documents of other federal bodies of state control and oversight; by laws and regulations of the constituent entities of the Russian Federation.

The principal provisions for environmental monitoring in the Russian Federation are set forth in the RF Law #7-FZ "On Protection of Environment" of 10 January 2002, Art. 34:

- Placement, designing, construction, upgrades, commissioning, operation, mothballing and abandonment of buildings, structures and other facilities causing direct or indirect negative effects on environment shall be implemented in accordance with the environment protection requirements. These activities shall include measures for protection of environment, restoration of natural environment, prudent use and reproduction of natural resources, ensuring ecological safety;
- Violation of the environmental protection requirements shall entail suspension, under the court decision, of the placement, designing, construction, upgrades, commissioning, operation, mothballing and abandonment of buildings, structures and other facilities.

The principal objectives of environmental monitoring are as follows:

- Assessment of condition of different components of the environment that can be impacted by the man-made effects of the facility operation;
- Forecast of the negative impact on the ecosystems and prompt development of measures for control and stabilization of the ecological setting.

2.2 Monitoring of Atmospheric Air

Protection and monitoring of atmospheric air pollution are regulated by Federal Law #96-FZ *On Protection of Atmospheric Air* of 04 May 1999.

Article 25 reads: “Industrial control of atmospheric air protection shall be implemented by legal entities, individual entrepreneurs that have sources of harmful chemical, biological and physical impacts on atmospheric air, and who shall appoint persons responsible for industrial control of atmospheric air protection and/or establish environmental services.

In performing the control, legal entities should comply with RF law, rules and regulations established by authorized governmental atmospheric air protection oversight bodies.

2.3 Sanitary-Hygienic Control (Monitoring)

Sanitary-hygienic monitoring is governed by RF Law No. 52-FZ *On Sanitary-Epidemiological Welfare of Population* (amended and supplemented).

Responsibilities of companies and organizations are set out in Article 11, which says that companies and organizations are required to:

- comply with requirements of health legislation, as well as orders and citations issued by federal state sanitary and epidemiologic oversight officials;
- develop and implement sanitary and epidemic control measures;
- conduct in-process control (i.e. by means of laboratory tests and studies) of compliance with sanitary and epidemiological requirements and sanitary and epidemic control (preventive) measures during the execution of work and provision of services, as well as transportation, storage and sale of goods.

2.4 Goals and Objectives of Environmental Monitoring

The purpose of environmental monitoring is control over environment pollution sources, as well as condition of geosystems and components thereof.

Objectives of the monitoring are as follows:

- timely identification of sources and focal points of disturbance, pollution and degradation of environment resulting from operations;
- assessment of identified changes in environment and forecast of possible adverse effects;
- acquisition of data on entry of various wastes into the environment during construction activities and operation;
- identification of emissions and discharges of pollutants that exceed regulatory limits, identification of pre-emergency situations, prediction of potential situations in order to apply appropriate environment protection measures;
- evaluation of consequences of emergencies and incidents;
- efficiency check of environmentally sound design solutions and environment protection measures based on monitoring results;
- information support of government bodies controlling the condition of environment; check of compliance with environmental legislation, regulatory and other documents that cover the condition of natural sites.

3 Work Types and Scope

Types and scope of work performed in 2017 are listed in Table 3-1.

Table 3-1: Work types and scope

Work type	Number of control points	Frequency
Ground water level measurements	3	Once a month
Ground water quality control	3	Once a quarter
Work environment air quality control	3	Once a quarter
Residental area air quality control	2	Once a quarter
Atmospheric air quality control	1	Once a quarter
Physical impact factors (noise, electromagnetic field)	1	Once a quarter
Physical impact factors (electromagnetic emission)	11	Once a year
Physical impact factors (microclimate)	12	Twice a year (during the warm and cold periods)
Physical impact factors (illuminance)	4	Once a year
Physical impact factors (ionizing radiation)	10	Once a year
Waste water quality monitoring	2	Twice a month

4 Field and Laboratory Work Methods

4.1 Field Work Methods

List of equipment used for industrial environmental control is included in Attachment A hereto.

4.1.1 Ground Water Level and Quality Monitoring

Ground water level was measured using EU-100 downhole level gage and tape measurer.

Downhole level measurements were taken in compliance with *RF MNR Guidelines for the Arrangement and Performance of Ground Water Monitoring in Shallow Batch Water Intakes and Individual Development Wells* of July 25, 2000.

4.1.2 Work Area Air Monitoring

Work area air studies were conducted in compliance with RD 52.04.186-89 *Atmosphere Pollution Control Guidelines*. *Methods of Mass Pollutant Concentration Measurements in Atmospheric Air using GANK-4 Gas Analyzer*, RD 52.04.792-2014, RD 52.04.831-2015, RD 52.04.822-2015, KPGU 413322002 PS.

4.1.3 Atmospheric Air Quality Monitoring

Measurements were taken in compliance with RD 52.04.186-89 *Atmosphere Pollution Control Guidelines*, RD 52.04.792-2014 *Mass Concentration of Nitrogen Oxide and Dioxide in Atmospheric Air Samples*. *Methods of Photometric Measurements Using Sulfanilic Acid and I-Naphtylamine*, MVI 4215-002-565914009-2009 *Methods of Mass Pollutant Concentration Measurement in Atmospheric Air Using GANK-4 Gas Analyzer*, RD 52.04.831-2015, RD 52.04.822-2015, PND F 13.1:2:3.23-98.

Meteorological parameters were determined during instrumental measurements (wind direction, temperature, pressure).

Atmospheric air and residential and work area air quality measurements were taken in 2017 by ANO Sakhalin Meteoagency laboratory.

4.1.4 Potable Water Quality Monitoring

Potable water samples were collected, stored and transported to an accredited laboratory in compliance with GOST 31861-2012 *Potable Water. Sampling*, GOST 31861-2012 *Water. General Requirements to Sampling*, GOST 31942-2012 *Water. Sampling for Microbial Analysis*.

4.1.5 Wastewater Quality Monitoring

Water samples were taken in compliance with general requirements for sample taking and storage per GOST 31861-2012 *Water. General Requirements to Sampling*, GOST 31942-2012 *Water. Sampling for Microbial Analysis*, NVN 33.5.3.01-85 *Instructions for Sampling for the Purpose of Wastewater Analysis*.

4.1.6 Physical Impact Factors

Measurements were taken in compliance with GOST 23337-14 *Noise. Methods of Noise Measurement in Residential Areas and in Premises of Residential and Public Buildings*, SanPiN 2.1.2.2645-10 *Sanitary-Epidemiological Requirements for Housing Conditions in Residential Buildings and Premises*. *Sanitary-Epidemiological Regulations and Standards*, MUK 4.3.2194-07 *Noise Level Control in Urban Development Areas, in Residential and Public Buildings and Premises*.

Regulatory and technical documents based on which microclimate measurements were taken: SanPiN 2.2.4.548-96 *Hygienic Requirements to Microclimate in Production Facilities*, GOST 30494-2011 *Residential and Public Buildings. Microclimate Parameters in Premises*, SanPiN 2.1.2.2645-10 *Sanitary-Epidemiological Requirements for Housing Conditions in Residential Buildings and Premises*, MUK 4.3.2756-10.4.3. *Control Methods. Physical Factors. Guidelines for Measurement and Assessment of Microclimate in Production Premises. Guidelines*.

Non-ionizing radiation was measured in compliance with SanPiN 2.2.4.1191-03 *Electromagnetic Fields in Production Conditions*, SanPiN 2.1.8/2.2.4.1383-03 *Hygienic Requirements to Location and Operation of Transmitting Radiotechnical Facilities*; GOST 12.1.006-84 SSBT *Electromagnetic Fields of Radio Frequencies. Permissible Levels at Work Places and Requirements to Control*, GN 2.1.8/2.2.4.2262-07 *Maximum Permissible Levels of Magnetic Fields with a Frequency of 50 Hz in the Residential and Public Building Premises and in Residential Areas*, GOST 12.1.002-84 SSBT *Electric Fields of Industrial Frequency. Permissible Levels of Intensity and Requirements to Control at Work Places*, MUK 4.3.2491-09 *Hygienic Assessment of Electric and Magnetic Fields of Industrial Frequency (50 Hz) in Production Conditions*.

Ionizing radiation was measured in compliance with SanPiN 2.6.1.2523-09 *Radiation Safety Standards* (NRB-99/2009) and in observance of MKS-01SA1M dosimeter-radiometer operation manual.

Illuminance was measured in compliance with the following regulatory and technical documents: GOST R 54944-2012 *National Standard of the Russian Federation – Buildings and Structures. Illuminance Measurement Methods,* Guidelines: MU OT RM 01-98 / MU 2.2.4.706-98 *Work Place Illuminance*, SP 52.13330.2011 *Regulations. Natural and Artificial Lighting*. *Updated Version of SNiP 23-05-95*, SanPiN 2.2.1/2.1.1.1278-03 *Hygienic Requirements to Natural, Artificial and Combined Illumination of Residential and Public Buildings*.

4.2 Methods of Laboratory Work

All laboratory work was conducted in compliance with the current regulations and based on certified methodologies that are included in RD 52.18.595-96 *Federal Inventory of Measurement Methodologies Approved for Use in Environment Pollution Monitoring Activities*.

Measurement devices used for laboratory research activities have timely passed state calibration and calibration certificates have been issued.

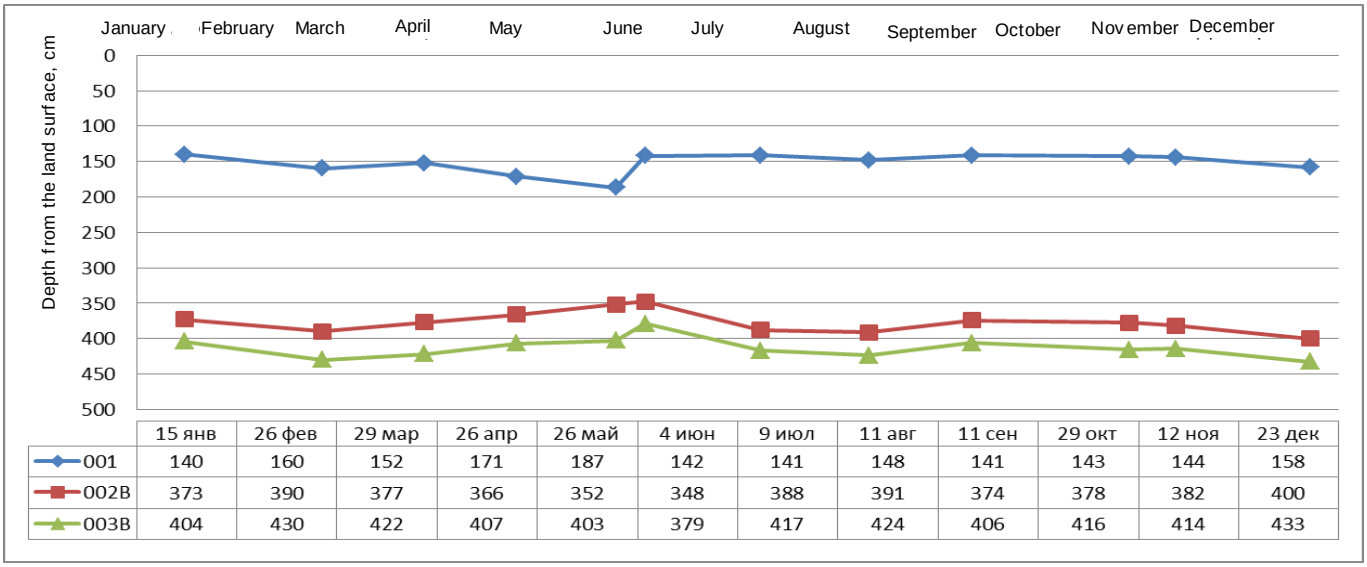
5 Laboratory Study Results

5.1 Ground Water Levels

The level of ground waters was determined by the depth of occurrence below the surface.

Observations were held monthly in three wells at Chayvo WS using EU-100 electric level gage.

Results of level measurements taken in wells over the reported period are indicated in figure (Fig. 5.1-1).



	15 янв	26 фев	29 мар	26 апр	26 май	4 июн	9 июл	11 авг	11 сен	29 окт	12 ноя	23 дек
001	140	160	152	171	187	142	141	148	141	143	144	158
002B	373	390	377	366	352	348	388	391	374	378	382	400
003B	404	430	422	407	403	379	417	424	406	416	414	433

Fig. 5.1-1: Ground Water Occurrence Depth Variation Chart

The depth of ground water occurrence below the surface measured in Chayvo WS observation wells varies over the entire observation period.

Variations of ground water depth at the territory of Chayvo WS stayed within the natural seasonal variation ranges during the entire observation period.

5.2 Ground Water Quality Monitoring

Chemical parameters of ground water quality were monitored quarterly in the same wells where ground water levels were measured.

In the second, third and fourth quarters, samples were taken before and after the well washing in compliance with GOST 17.1.5.04-81. Samples were stored and preserved in compliance with GOST 31861-2012.

The measured parameters and methods of ground water quality measurements in observation wells at Chayvo WS are set out in Table 5.2-1.

Table 5.2-1: Measured parameters and methods of ground water quality measurements in observation wells

Item	List of measured parameters	Measurement unit	Contractor laboratory	Measurement methodology
1	Synthetic surfactants	mg/dm³	ANO Sakhalin Meteoagency	RD 52.24.368-2006
2	pH	pH unit		RD 52.24.495-2005
3	Mercury	mg/dm³		RD 52.24.479-2008
4	Petroleum products	mg/dm³		PNDF 14.1:2:4.168-2000
5	Specific electric conductivity	µS/cm		RD 52.24.495-2005
6	Phenols	mg/dm³		PNDF 14.1:2:4.182-02

The measured pH values (6.0 to 7.8) are common for natural waters. In terms of pH values ground waters were characterized primarily as neutral (pH = 6.5-7.5), except samples taken in June (prior to well washing) and August in well 001 and in February in well 003B, where ground waters are weakly alkaline (pH = 7.5-8.5), as well as samples taken in June after the hole washing and in August in well 001, and samples taken in June after the well washing and in August in well 002B, where ground waters are weakly acidic (pH = 5.0-6.6).

Ground water quality monitoring results indicate that concentration of petroleum products in samples varied from values below the detection limit (below 0.02 mg/dm³) to 0.88 mg/dm³. Since the waters are not used for potable water supply, these concentrations are acceptable.

Mercury was not found in any of the samples (mercury content was below the detection limit (<0.00001 mg/dm³)).

Synthetic (anionic) surfactant concentrations in the ground water varied from values below the detection limit (below 0.01 mg/dm³) to 0.1 mg/dm³, and phenol concentrations varied from values below the detection limit (below 0.0005 mg/dm³) to 1.03 mg/dm³.

Specific electric conductivity of samples was within the range of 121-588 µS/cm.

It should be noted that presently there are no standards in the Russian Federation for maximum permissible concentrations of pollutants in ground waters.

5.3 Work Zone Air Quality Monitoring

In 2017, work zone air quality studies were conducted quarterly in Parker Drilling camp office premises and at the work place 1 of Module 40. The measured parameters and methods of work zone air measurements are indicated in Table 5.3-1.

Table 5.3-1: Measured parameters and methods of work zone air measurements

Item	List of measured parameters	Measurement unit	Contractor laboratory	Measurement methodology
Work zone air				
1	Nitrogen dioxide	mg/m³	ANO Sakhalin Meteoagency	RD 52.04.792-2014
2	Nitrogen oxide	mg/m³		RD 52.04.792-2014
3	Benzapyrene	mg/m³		RD 52.04.186-89
4	Soot	mg/m³		RD 52.04.831-2015
5	Sulfur dioxide	mg/m³		RD 52.04.822-2015
6	Carbon monoxide	mg/m³		KPGU 413322002 PS
7	Kerosene	mg/m³		M-01-05

Results of work zone air quality instrumental measurements are set out in Table 5.3-2.

Table 5.3-2: Work zone air quality study results

Measured parameters	Measurement results				MPC*
	Feb 22, 2017	Apr 16, 2017	Aug 19, 2017	Oct 18, 2017	
Module 40 (work place No.1)					
Nitrogen dioxide, mg/m³	0.084	0.163	0.050	0.031	**2**
Nitrogen oxide, mg/m³	0.050	0.089	<0.028	<0.028	**5**
Sulfur dioxide, mg/m³	0.016	0.012	0.012	0.009	**10**
Carbon monoxide, mg/m³	0.8	3.0	1.8	2.0	**20**
Soot, mg/m³	0.053	0.103	0.085	0.042	**4**
Benzapyrene, mg/m³	0.2×10^{-6}	0.3×10^{-6}	0.2×10^{-6}	$<0.2\times10^{-6}$	**0.00015**
Kerosene, mg/m³	<0.8	<0.8	1.3	<0.8	**600**

**GN 2.2.5.1313-03 Maximum Permissible Concentrations (MPC) of Harmful Substances in Work Zone Air.*

The measured mass concentrations of pollutants in the work zone air meet the requirements of GOST 12.1.005-88 *General Sanitary and Hygiene Requirements to Work Zone Air* and GN 2.2.5.1313-03 *Maximum Permissible Concentrations (MPC) of Pollutants in Work Zone Air*.

5.4 Sanitary Protection Zone

5.4.1 Atmospheric Air Quality Monitoring at Sanitary Protection Zone (SPZ) Boundary

In the report period, atmospheric air quality was monitored at the boundary of the sanitary protection zone, 1000 m away from the Chayvo WS work area boundaries. The measured parameters and methods of atmospheric air measurement at the boundary of the sanitary protection zone are set out in the table below (Table 5.4-1).

Table 5.4-1: Measured parameters and methods of atmospheric air measurement at the boundary of the sanitary protection zone

Item	List of measured parameters	Measurement unit	Contractor laboratory	Measurement methodology
1	Nitrogen dioxide	mg/m³	ANO Sakhalin Meteoagency	RD 52.04.792-2014
2	Soot	mg/m³		RD 52.04.831-2015
3	Sulfur dioxide	mg/m³		RD 52.04.822-2015
4	C_1-C_5 hydrocarbons	mg/m³		KPGU 41 3322002 PS
5	C_{12}-C_{19} hydrocarbons	mg/m³		KPGU 41 3322002 PS
6	Carbon monoxide	mg/m³		KPGU 41 3322002 PS

Results of instrumental measurements of atmospheric air quality at the sanitary protection zone boundary are set out in Table 5.4-2.

Table 5.4-2: Results of instrumental measurements of pollutants in the atmospheric air at the sanitary protection zone boundary.

Measured parameters	Measurement results				MPC*
	Feb 19, 2017	Apr 16, 2017	Aug 19, 2017	Oct 18, 2017	
Nitrogen dioxide, mg/m³	0.061	0.068	0.034	0.025	**0.2**
Sulfur dioxide, mg/m³	0.004	0.009	0.011	0.005	**0.5**
Carbon monoxide, mg/m³	1.0	1.8	1.9	2.1	**5**
Soot, mg/m³	0.027	0.030	0.050	<0.030	**0.15**
C_1-C_5 hydrocarbons, mg/m³	1.6	<25	<25	<25	**50****
C_{12}-C_{19} hydrocarbons, mg/m³	<0.8	<0.1	0.1	<0.1	**1**

**MPC per GN 2.1.6.1338-03, GN 2.1.6.1983-05.*
***SRLI standard (per GN 2.1.6.2309-07).*

During the entire observation period, mass concentrations of pollutants in the atmospheric air at the Chayvo WS sanitary protection zone boundary fully met the requirements of GN 2.1.6.1338-03 *Maximum Permissible Concentrations (MPC) of Pollutants in Atmospheric Air within Populated Areas,* GN 2.1.6.1983-05 *Maximum Permissible Concentrations (MPC) of Pollutants in Atmospheric Air within Populated Areas. Addendum and Supplement No. 2 to GN 2.1.6.1338-03*, and Safe Reference Levels of Impact (SRLI) (per GN 2.1.6.2309-07 *Safe Reference Levels of Impact (SRLI) of Pollutants in Atmospheric Air within Populated Areas*) for atmospheric air.

5.4.2 Noise Levels at SPZ Boundary

In 2017, noise measurements were taken, 1000 m away from the Chayvo WS work area boundaries, at point 1, to check conformity of noise and noise pressure levels with regulatory standard values in the daytime.

The measured parameters and methods of measurement are set out in the table below (Table 5.4-3).

Measurement results are indicated in Table 5.4-4.

Table 5.4-3: Measured parameters and methods of noise measurement at the SPZ boundary

Item	List of measured parameters	Measurement unit	Contractor laboratory	Measurement methodology
1	Noise level and noise pressure	dBA	ANO Sakhalin Meteoagency	GOST 23337-78; MUK 4.3.2194-07

Table 5.4-4: Equivalent sound level measurement results

Date of measurement	L_A sound level and equivalent sound levels $L_{Aequiv.}$, dBA
February 19, 2017	58.9
April 16, 2017	50.9
August 19, 2017	41.2
October 18, 2017	46.8

Results of non-continuous noise impact monitoring at the SPZ boundary show that the measured values of equivalent sound level meet the requirements of SN 2.2.4/2.1.8.562-96 *Noise at Work Places, in Premises of Residential and Public Facilities and in Housing Development Areas* for the daytime.

5.4.3 Electromagnetic Emissions at SPZ Boundary

Measurements were taken at Point 1, 1000 m away from the Chayvo WS work area boundaries, on the north-west side. The purpose of those measurements was to assess conformity of electromagnetic fields with the requirements of SanPiN 2.1.2.2645-10 *Sanitary-Epidemiological Requirements for Housing Conditions in Residential Buildings and Premises*, GN 2.1.8/2.2.2.4.4.2262-07 *Maximum Permissible Levels of Magnetic Fields with a Frequency of 50 Hz in the Residential and Public Building Premises and in Residential Areas*, and SanPiN 2.2.1/2.1.1.1200-03 *Sanitary Protection Zones and Sanitary Classification of Plants, Structures and Other Facilities*.

The measured parameters and measurement methods are set out in Table 5.4-5.

Results of non-ionizing electromagnetic emission measurements are indicated in Table 5.4-6.

Table 5.4-5: Measured parameters and methods of electromagnetic emission measurement at the boundary of SPZ

Item	List of measured parameters	Measurement unit	Contractor laboratory	Measurement methodology
1	Intensity of electromagnetic field's electric component	kV/m	ANO Sakhalin Meteoagency	SanPiN 2.2.4.1191-03
2	Magnetic field intensity	A/m		

Table 5.4-6: Results of instrumental measurements of non-ionizing electromagnetic emission

Measured parameters	Maximum permissible level (MPL)*	Measurement results			
		Feb 19, 2017	Apr 16, 2017	Aug 19, 2017	Oct 18, 2017
Electric field intensity, kV/m	**1**	<0.01	<0.01	<0.01	<0.01
Magnetic field intensity, A/m	**8****	<0.1	<0.1	<0.1	<0.1

** SanPiN 2.1.2.2645-10 Sanitary-Epidemiological Requirements for Housing Conditions in Residential Buildings and Premises.*
*** MPL per GN 2.1.8/2.2.2.4.4.2262-07 Maximum Permissible Levels of Magnetic Fields with a Frequency of 50 Hz in the Residential and Public Building Premises and in Residential Areas.*

Values of electromagnetic field electric component intensity measured at Point 1 on the north-west side, 1000 m away from the Chayvo WS work area boundary, meet the requirements of SanPiN 2.1.2.2645-10 *Sanitary-Epidemiological Requirements for Housing Conditions in Residential Buildings and Premises.*

Values of magnetic field intensity measured at Point 1 on the north-west side, 1000 m away from the Chayvo WS work area boundary, meet the requirements of SanPiN 2.1.2.2645-10 *Sanitary-Epidemiological Requirements for Housing Conditions in Residential Buildings and Premises* and GN 2.1.8/2.2.2.4.4.2262-07 *Maximum Permissible Levels of Magnetic Fields with a Frequency of 50 Hz in the Residential and Public Building Premises and in Residential Areas.*

5.5 Waste Water Quality Monitoring

In January 2017, wastewater samples were taken at the Parker Drilling camp treatment facilities to evaluate chemical, microbial and parasitological parameters.

Domestic wastewater full-scale biological treatment stations E-100 BPF are used at Chayvo WS for the treatment of domestic wastewater. The treated wastewater is transferred to leach fields.

Table 5.5-1 contains process specifications (including design performance capability) of treatment facilities.

Table 5.5-1: Specifications of treatment facilities used at Chayvo WS

Item	Parameters	Measurement units	Value
Requirements to initial waste liquid			
1	BODfull	mg O_2/dm³	250
2	Suspended solids	mg/dm³	220
3	Ammonium nitrogen, N/NH_4	mg/dm³	30
4	Nitrite nitrogen, $N/N0_2$	mg/dm³	-
5	Nitrate nitrogen, N/NO_3	mg/dm³	
6	Phosphates, P_20_5	mg/dm³	10
Stage of treatment. Treated effluent water			
1	BODfull	mg O_2/dm³	6
2	Suspended solids	mg/dm³	6
3	Ammonium nitrogen, N/NH_4	mg/dm³	0.5
4	Nitrite nitrogen, $N/N0_2$	mg/dm³	0.08
5	Nitrate nitrogen, N/NO_3	mg/dm³	9.1
6	Phosphates, P_20_5	mg/dm³	2
Design treatment efficiency*			
1	BODfull	%	≥97
2	Suspended solids	%	≥97
3	Ammonium nitrogen, N/NH_4	%	≥98
4	Phosphates, P_20_5	%	≥80

** Design treatment efficiency based on the quality of the initial waste liquid and treated effluent water.*

In-process monitoring was conducted at different treatment stages in line with the treatment facility operation procedures, in order to assess treatment efficiency.

Samples were taken in compliance with requirements of NVN 33.5.3.01-85 *Instruction for the Collection of Samples for Subsequent Wastewater Analysis*:

- Upstream of treatment facilities;
- Downstream of treatment facilities, prior to discharge to leaching fields.

The measured parameters and methods of wastewater quality measurement are indicated in Table 5.5-2.

Table 5.5-2: Measured parameters and methods of wastewater quality measurement

Item	List of measured parameters	Measurement unit	Measurement methodology
1	Ammonium ion	mg/dm³	PNDF 14.1:2.1-95
2	Phenols	mg/dm³	PNDF 14.1:2:4.182-02
3	Petroleum products	mg/dm³	PNDF 14.1:2:4.128-98
4	BOD_{20}	mgO_2/dm³	MVI 253.01.17.197.2004
5	Nitrates	mg/dm³	PNDF 14.1:2:4.157-99
6	Phosphates	mg/dm³	PNDF 14.1.2:4.112-97
7	COD	mg/dm³	PNDF 14.1:2:4.190-2003
8	Chlorides	mg/dm³	PNDF 14.1:2:4.157-99
9	Anionic surfactants	mg/dm³	PNDF 14.1:2:4.158-00
10	Nitrites	mg/dm³	PNDF 14.1:2:4.157-99

Item	List of measured parameters	Measurement unit	Measurement methodology
11	Lead	mg/dm³	PNDF 14.1.2:4.149-99
12	Cadmium	mg/dm³	PNDF 14.1.2:4.149-99
13	Copper	mg/dm³	PNDF 14.1.2:4.149-99
14	Zinc	mg/dm³	PNDF 14.1.2:4.149-99
15	Arsenic	mg/dm³	PNDF 14.1:2:4.223-06
16	Iron	mg/dm³	PNDF 14.1.2:4.139-98
17	Suspended solids	mg/dm³	PNDF 14.1:2.110-97
18	Chrome	mg/dm³	PNDF 14.1.2:4.139-98
19	Viable helminth eggs and pathogenic protozoan cysts	in 10 L	MUK 4.2.2661-10
20	Coliphages	PFU in 100 mL	MU 2.1.5.800-99
21	Infectious agents (Shigella, Salmonella)	-	MU 2260-80
22	Total coliforms	CFU/100 mL	MU 2.1.5.800-99
23	Thermotolerant coliform bacteria	CFU in 100 mL	MU 2.1.5.800-99
24	Lactose-positive Bacillus coli, MPN	CFU/100 mL	MU 2260-80

Laboratory study results are indicated in Table 5.5-3.

Table 5.5-3: Measured parameters and results of wastewater quality measurements prior to wastewater discharge to leaching fields

Item	List of measured parameters	Measurement unit	Measurement methodology
1	Ammonium ion	mg/dm³	26.47
2	Phenols	mg/dm³	0.011
3	Petroleum products	mg/dm³	0.052
4	BOD_{20}	mgO_2/dm^3	10
5	Nitrates	mg/dm³	23
6	Phosphates	mg/dm³	11
7	COD	mg/dm³	45
8	Chlorides	mg/dm³	75
9	Anionic surfactants	mg/dm³	0.43
10	Nitrites	mg/dm³	< 0.2
11	Lead	mg/dm³	< 0.0003
12	Cadmium	mg/dm³	< 0.003
13	Copper	mg/dm³	0.018
14	Zinc	mg/dm³	0.053
15	Arsenic	mg/dm³	< 0.002
16	Iron	mg/dm³	0.10
17	Suspended solids	mg/dm³	20
18	Chrome	mg/dm³	< 0.025
20	Viable helminth eggs and pathogenic protozoan cysts	in 10 L	N/D
21	Coliphages	PFU in 100 mL	N/D
22	Infectious agents (Shigella, Salmonella)	-	N/D

Item	List of measured parameters	Measurement unit	Measurement methodology
23	Total coliforms	CFU/100 mL	< 50
24	Thermotolerant coliform bacteria	CFU in 100 mL	< 50
25	Lactose-positive Bacillus coli, MPN	CFU/100 mL	N/D

In February-December 2017, minimum equipment maintenance activities were conducted at Chayvo WS by personnel delivered from Chayvo OPF. Wastewater was collected in a holding tank and transported to the treatment facilities at Chayvo OPF.

5.6 Potable Water Quality Monitoring

Potable water samples were collected at the Parker Drilling camp in 2017 from the potable water tank, and another set of water samples were collected in January 2017 from the distribution network water tap at two points (in the distribution network and catering facilities).

The measured parameters and methods of potable water quality measurement are indicated in Table 5.6-1.

Table 5.6-1: Measured parameters and methods potable water quality measurement

Item	List of measured parameters	Measurement unit	Laboratory engaged	Measurement methodology
1	Chemical oxygen demand with permanganate as the oxidant	mgO_2/dm^3	FSFHI Sanitary and Epidemiological Center in Yuzhno-Sakhalinsk	PND F 14.1:2:4.154-99
2	Manganese	mg/dm^3		PND F 14.1.2:4.139-98
3	pH	pH unit		PND F 14.1:2:3:4.121-97
4	Anionic surfactants	mg/dm^3		PND F 14.1:2:4.158-00
5	Total phenols	mg/dm^3		PND F 14.1:2:4.182-02
6	Total hardness	Hardness degrees		GOST 31954-12
7	Dry residue	mg/dm^3		GOST 18164-72
8	Petroleum products	mg/dm^3		PND F 14.1:2:4.128-98
9	Iron	mg/dm^3		GOST 4011-72
10	Odor	Points	FSFHI Sanitary and Epidemiological Center in Aleksandrovsk-Sakhalinsky, Tym and Nogliki Districts	GOST 3351-74
11	Turbidity	TU/dm^3		GOST 3351-74
12	Flavour	Points		GOST 3351-74
13	Color value	Degrees		GOST 31868-2012
14	Total microbial count	CFU/ml		MUK 4.2.1018-01
15	Total coliforms	CFU/100 ml		MUK 4.2.1018-01
16	Thermotolerant coliform bacteria	CFU/100 ml		MUK 4.2.1018-01
17	Sulphite-reducing clostridia	CFU/20 ml		MUK 4.2.1018-01

Iron concentrations were observed to have slightly exceeded the permissible levels (1.03-1.067 MPC) in the clean water tank on January 13, 14 and 24, and at the distribution network and catering facilities on January 13 and 14.

All other chemical parameters of potable water samples meet the requirements of SanPiN 2.1.4.1074-01, GN 2.1.5.1315-03.

In terms of organoleptic, microbial and composite index, all potable water samples meet the requirements of SanPiN 2.1.4.1074-01, GN 2.1.5.1315-03.

5.7 Monitoring of Physical Factors

Physical factor study was conducted in July. These studies are conducted once a year. In addition, microclimate measurements were taken in July and December. Such measurements are normally performed twice a year, during a warm and a cold month.

Methods of measurements and a list of measured parameters are indicated in Table 5.7-1.

Table 5.7-1: List of measured parameters and methods of physical impact factor measurements

Item	List of measured parameters	Measurement unit	Contractor laboratory	Measurement methodology
1	Microclimate parameters	°C, %, m/s	Sakhalin Expert Center LLC	SanPiN 2.2.4.548-96; GOST 30494-2011
2	Ionizing radiation	µSv/h, mSv		OSPORB-99/2010; SP 2.6.1.2612-10; SanPiN 2.6.1.2523-09
3	Electromagnetic field measurement	µW/cm2, V/m, nT, kW/m		SanPiN 2.1.8/2.2.4.1383-03; SanPiN 2.2.2/2.4.1340-03; SanPiN 2.2.4.1191-03
4	Illuminance	lx, %		Par. 6.9 of operation manual for the combined instrument – TKA-PLM (Set 8), Flicker meter+Luxmeter; GOST 24940-96

5.7.1 Ionizing Radiation Monitoring

In July 2017, ionizing radiation was measured in the waterproof pit for drilling waste and in drillwells.

Ionizing radiation measurement results are indicated in Table 5.8-2.

Table 5.8-2: Ionizing radiation measurement results

Place of measurement	Date of measurement	Measured value, µSv/h	MPL*
Waterproof pit for drilling waste	14.07.2017	0.83	**2.5**
9 drillwells		0.12	**2.5**

** - regulatory values are indicated in line with SanPiN 2.6.1.2523-09 Radiation Safety Standards NRB-99/2009*

5.7.2 Monitoring of Microclimate Parameters

Microclimate parameters were measured in July and December in Chayvo WS office and residential premises.

Microclimate parameter measurement results are indicated in Table 5.8-3.

Table 5.8-3: Microclimate parameter measurement results

Item	Measurement point location	Date of measurement	Air temperature*, C°	Relative air humidity*, %	Air velocity, m/s	Thermal radiation*, W/m^3	Surface temperature*, C°
Operator office premises							
1	Operator workplace	July 14, 2017	22,6-23,1	56	0,1	21,1-21,9	20
2	Operator workplace		22,5-23,0	56	0,1	21,1-21,9	20
3	Operator workplace		22,7-23,2	55	0,1	21,1-21,9	20
4	Operator workplace		22,8-23,6	58	0,1	21,8-22,5	20
Permissible conditions**			**20-28**	**15-75**	**≤0,1**	**≤24**	**19-29**
5	Operator workplace	December 23, 2017	22,1-22,3	16	0,1	0	20
6	Operator workplace		22,2-22,7	16	0,1	0	20
7	Operator workplace		22,2-22,6	16	0,1	0	21
8	Operator workplace		22,1-22,8	16	0,1	0	20
Permissible conditions**			**18-23**	**≤60**	**≤0,3**	**≤25**	**18-25**

** average values*

***SanPiN 2.2.4.548-96 (Table 2, Work category 1a, 2a) Hygienic Requirements to Microclimate in Production Facilities*

Microclimate parameter measurement results fully meet the hygienic requirements to microclimate in work spaces set by SanPiN 2.2.4.548-96 (Table 2, Work category 1a, 2a) *Hygienic Requirements to Microclimate in Production Facilities*.

5.7.3 Artificial and Natural Lighting Monitoring

In July 2017, illuminance was measured in Chayvo WS office premises.

Table 5.8-4: Artificial and natural lighting monitoring results

Office premises	Date	Artificial lighting, lx		Flicker index, %		Natural lighting, lx	
		Actual value	Regulatory value	Actual value	Regulatory value	Actual value	Regulatory value
Operator office space							
Operator workplace 1	July 14, 2017	308	**300***	1.2	**5**	540	**≥0.5***
Operator workplace 2	July 14, 2017	312	**300***	1.4	**5**	850	**≥0.5***
Operator workplace 3	July 14, 2017	305	**300***	1.3	**5**	650	**≥0.5***
Operator workplace 4	July 14, 2017	304	**300***	1.2	**5**	359	**≥0.5***

** SanPiN 2.2.4.3359-16 Sanitary-Epidemiological Requirements to Physical Impact Factors at Work Places*

Natural and artificial lighting measurement results (in Table 5.8-4) indicate that the limits set by Sanitary-Epidemiological Requirements to Physical Impact Factors at Work Places are not exceeded.

Artificial and natural lighting parameters at all measurement points met the regulatory values set by SP 52.13330.2011. *Regulations. Natural and Artificial Lighting*. Updated Version of SNiP 23-05-95 and SanPiN 2.2.2/2.4.1340-03 *Hygienic Requirements for Personal Computers and Work Process*.

5.7.4 Electromagnetic Field and Electrostatic Field Intensity Monitoring

Parameters of electric field intensity, magnetic field intensity and electrostatic field intensity were measured in 2017 at operator work places.

Electric and magnetic field intensity and electrostatic field intensity measurement results are indicated in Table 5.8-5.

Table 5.8-5: Electromagnetic field and electrostatic field intensity measurement results

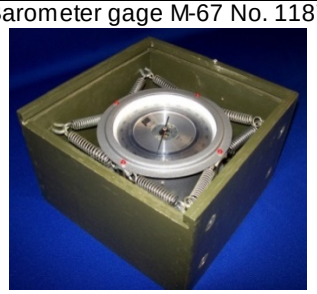
Location of measurement	Electric field intensity (E), kW/m			Magnetic field intensity (H), A/m			Electrostatic field intensity (E), kW/m
	5 Hz-2 kHz	2 kHz-400 kHz	50 Hz	5 Hz-2 kHz	2 kHz-400 kHz	50 Hz	
Operator office premises							
Operator work place 1	1;1;1	0.01;0.01;0.01	26;37;15	10;10;10	1;1;1	22;33;12	0.09;0.09;0.09
Operator work place 2	1;1;1	0.01;0.01;0.01	35;42;25	10;10;10	1;1;1	33;39;20	0.11;0.11;0.11
Operator work place 3	1;1;1	0.01;0.01;0.01	26;37;14	10;10;10	1;1;1	19;30;11	0.06;0.06;0.06
Operator work place 4	1;1;1	0.01;0.01;0.01	37;40;19	10;10;10	1;1;1	34;38;14	0.08;0.08;0.08
MPL	**25**	**2,5**	**-**	**250**	**25**	**-**	**15**

**SanPiN 2.2.2/2.4.1340-03 Hygienic Requirements for Personal Computers and Work Process and SanPiN 2.2.4.1191-03 Electromagnetic Fields in Production Conditions*

***Measurements were taken at elevations – 0.5 m; 1.0 m; 1.5 m*

Electric and magnetic field intensity and electrostatic field intensity measurement results (Table 5.8-5) indicate that sanitary-epidemiological requirements to work place arrangement are met.

Attachment A. List of devices used for industrial environmental control

DEVICE	CALIBRATION	SPECIFICATIONS
Air aspirator, single-channel AVA-1-120-02A 	No. 64-17, until April 9, 2018.	Volume of sample, dm^3/min – not limited. Sample volume measurement error - 5%
OP-824 TTs Aspirator 	No. 68-17, until April 9, 2018.	Gas rate settings in the range of 0.2-20.0 l/min Ranges of rate: channels 1,2 - 0.2-1.0 l/min channels 3,4 – 5.0-20.0 l/min Gas rate setting increment in the range: 0.2-1.0 l/min 0.2 l/min 5.0-20.0 l/min 5.0 l/min
Barometer gage M-67 No. 1187 	No. 649, until September 15, 2018.	Atmosphere pressure measurement range, kPa (mm Mercury) - 80 to 120 (610 to 790) Permissible error limits after corrections, mm Mercury ± 0.8
GANK-4 Gas analyzer 	No. 16001771321, until February 20, 2018.	Measurement range – 0.5 MPC daily avg. to 20 MPC w ork zone. Measurement error – not more than 20%
“Assistent” noise analyzer 	No. 16/11727, until July 10, 2017	Used for measurement and analysis of infrasound, sound, ultrasound, overall and local vibration. - Sound level measurement range 20 ÷ 140 dB; measurement frequency range: 2 ÷ 40000 Hz; - dynamic range of vibration acceleration level measurement 70 ÷ 170 dB; frequency range of vibration acceleration measurement 0.8 ÷ 1250 Hz.

Attachment A. List of devices used for industrial environmental control

DEVICE	CALIBRATION	SPECIFICATIONS
"Zaschita-K" acoustic calibration unit 	No. 3/340-2662-16, until December 13, 2017.	*Zaschita-K* device is used for the calibration and operability check of noise meters. - Nominal (setpoint) values of sound pressure levels, dB rel. 20 µPa 94, 114; - Nominal value of the primary SPL, dB rel. 20 µPa 114
PZ-50 Electromagnetic emission level measurement unit 	No. 2/204-14147-16, until December 7, 2017.	PZ-50 electromagnetic emission level measurement device is intended for: - electromagnetic field energy flux density measurement in the frequency range of 0.3 to 40 GHz; - electric field intensity measurement in the frequency range of 0.01-300 MHz; - magnetic field intensity measurement in the frequency range of 0.01-50 MHz;
PZ-41 Electomagnetic emission level measurement unit 	No. 2/204-14027-17, until March 28, 2018.	PZ-41 measurement device is designed for the detection and monitoring of biologically hazardous electromagnetic emission levels, energy flux density and exposure.
"Meteoskop" microclimate parameter measurement unit 	No. 207/17-02082p, until December 20, 2019.	Temperature measurement range: -40 to +85 ºC Relative humidity measurement range: 3 to 97% Air stream velocity measurement range: 0.1 to 20 m/s Air pressure measurement range: 80 to 110 kPa (600 to 825 mm Mercury)

Attachment A. List of devices used for industrial environmental control

DEVICE	CALIBRATION	SPECIFICATIONS
EU-100 level gage. Factory No. 506.13 	Not listed in the Register of Measuring Equipment as a piece of equipment subject to mandatory calibration	Maximum level of measurement for EU-100: 100 m Signals when water level is achieved: - light - sound
HI 98312 conductivity meter 	No. 17/00176 of January 26, 2018	Measurement range: EC 0.00 - 20.00 mS/cm (±0.01 mS/cm) TDS 0.00 - 10.00 ppt (±0.01 ppt) Temperature: 0.0 - 60.0°C (±0.1°C)
PE-1110 sampler 	Not subject to calibration	Volume of sample – 0.5-1.0 L Sampling depth – 0.3 – 2.0 m Sampling vessel type – polyethylene or glass bottle Material – fluoropolymer.