SNAS
Reg. No. 226/S-188

QAL2 Report for dust and AST Report for CO, NO_x, SO_2 and O_2.

FROM THE VERIFICATION OF CONTINUOUS EMISSION MONITORING SYSTEM

Installed in

CHP-2 H150

AB "Vilniaus Šilumos tinklai"

Report No. **523/2019**

In Slovakia, Košice, December 17, 2019

Approved by

Ignác Kožej	**Miloš Varga**
managing director	manager of the measurements
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signature	signature
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stamp	

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SYMBOLS AND ABBREVIATIONS

Symbols

a	intercept of the calibration function
b	slope of the calibration function
D_i	difference between measured SRM value y_i and calibrated CEMS values $\hat{y}$
D_{avg}	average of D_i
EL	emission limit
i	index
k_v	test value for variability test based on a χ^2-test, with a β-value of 50 %, for n number of paired measurements
max	maximal value (as index)
n	number of paired samples in parallel measurements
p	pressure
S_c	standard deviation of the SRM
S_A	standard deviation (CEMS), CEMS integral performance
S_D	standard deviation of the differences D_i in parallel measurements
$t_{0,95}$	students t-factor for a confidence level of 95 %
x	CEMS measured signal
y	SRM measured value
$\hat{y}$	best estimate for the "true value"; calculated from CEMS signal x by means of calibration function
z_i	difference (according to meaning)
σ_0	uncertainty derived from requirements of legislation

Abbreviations

AMS	Automated Measuring System, also CEMS
AST	Annual Surveillance Test
CEMS	Continuous Emission Monitoring System, also AMS
CEN	Comité Européen de Normalisation
(C)RM	(Certified) Reference Material
ELV	Emission Limit Value
QAL	Quality Assurance Level
ISO	International Organization for Standardization
SRM	Standard Reference Method

Annexes

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1 PARTICIPANTS OF TEST

1.1 OPERATOR

Name:	AB “Vilniaus Šilumos tinklai”
Address:	Elektrinės g. 2, LT-03150, Vilnius, Lithuania
Address of the plant:	Elektrinės g. 2, LT-03150, Vilnius, Lithuania
Contact:	Miroslavas Mečkovskis
ID:	124135580

1.2 THE OBJECTIVE OF THE QAL2 AND AST TESTS

The purpose of the QAL2 and AST tests was to verify the compliance of the continuous emission monitoring system with the requirements of EN 141 81. The following components of CEMS have been verified within the frame of the tests: concentration of CO, NO_X (as NO_2), SO_2, dust and O_2.

Records of preparation measurement is in Annex No. 1.

1.3 EMISSION SOURCE

Heating and power plant, CHP-2 H150, Chimney No. 4.

1.4 REPRESENTATIVES OF THE OPERATOR

Name	Position
Rimvydas Kvedaravičius	E2 head manager

2 TESTING LABORATORY

2.1 NAME OF TESTING LABORATORY

Name:	EKO-TERM SERVIS s.r.o.
Address:	Napájadlá 11, 040 12 Košice, Slovakia
Contact:	Ing. Ignác Kožej
ID:	316 95 671

2.2 ACCREDITATION OF TESTING LABORATORY

Testing laboratory EKO-TERM SERVIS s.r.o. is accredited by Slovak National Accreditation Service.

The testing laboratory is qualified to carry out measurement of selected components of waste gases emitted into the atmosphere from stationary air emission sources, take samples of exhaust gases and to express opinions and interpretations by the scope of the accreditation according to the certificate No. S-188.

The inspection body is qualified to carry out inspection of Continuous Emission Monitoring Systems (complete functional test, periodic functional test and functional test according to the customer's requirements) in the scope of the accreditation according to the certificate No. I-029.

Calibration laboratory which is competent to carry out of calibration of automated measuring systems of stack emissions within the accreditation scope according to the certificate No. K-071.

2.3 PERSONEL OF TESTING LABORATORY

Name	Position
Ignác Kožej	managing director
Miloš Varga	manager of the measurements
Juraj Bél	manager of the testing a calibration laboratory
František Eperješi	technician
Martin Kuba	
Jaroslav Šuster	

3 OBJECT OF THE TEST

3.1 DESCRIPTION OF THE EQUIPMENT

Combustion equipment: continuous burning process. Installed combustion installation: hot water and steam boilers.

The equipment produces steam and hot water in Hot water boiler room and Steam boiler room. The hot water is connected to the central heating of buildings in the city of Vilnius. The steam boilers produce steam which is used in steam turbines for producing of electricity.

Characteristic operating parameters of boilers: fuel consumption, quantity of steam and hot water, temperature and pressure of steam, temperature of hot water.

Tables of operating parameters and conditions during measurement are listed in Annex No. 2 to this protocol.

3.1.1 OPERATIONAL CONDITIONS

The basic operating modes of the boilers are start-up, steady state and shutdown.

3.1.2 FUELS

The natural gas and HFO was fired during QAL2 and AST test. This fuel is used during normal operation.

3.1.3 BOILERS

Hot water boilers – total number: 3

Designation:	**5**	**6**	**7**
Type:	VK KVGM-100	VK KVGM-100	VK KVGM-100
Fuel	natural gas, HFO	natural gas, HFO	natural gas, HFO
Rated thermal input in MW:	100	100	100

Steam boilers – total number: 3

Designation:	**3**	**5**	**6**
Type:	BKZ-75-39FB	BKZ-75-39FB	BKZ-75-39FB
Fuel	natural gas, HFO	natural gas, HFO	natural gas, HFO
Rated thermal input in MW:	60	60	60

3.1.4 PURIFICATION SYSTEMS

No purification systems are installed on the boilers firing natural gas and heavy fuel oil.

3.2 MEASURING SITE AND PLACE OF INSTALLATION OF CEMS

3.2.1 CHIMNEY AND MEASURING SITE

- Chimney: self-standing, brick, common to all boilers.
- The cross section of the chimney is circular, measuring site is located at height of 85 m, distance from the top of the chimney is 65 m.
- The diameter of the chimney at the measuring site: internal – 7,82 m.
- Number of sampling points and straight lines (axes): points (on one line) - 8; lines – 2.
- Number of sampling holes: 4.

3.2.2 WORKING PLATFORM AND SECURITY OF THE MEASURING SITE

- Location of working platform - see Art. 3.2.1.
- Width of the working platform: about 0,8 m.
- Access to the working platform: ladder.
- Stabile electric power supply is installed.

3.2.3 SAMPLING

- The sample of the waste gas is extracted from the sampling point. The sampling line consists of a heated stainless probe with dust filter, a heated. Teflon hose and of a gas conditioning system located in the CEMS cabinet.

3.3 DESCRIPTION OF THE CEMS

3.3.1 CEMS FOR MONITORING OF GASEOUS POLLUTANTS (SO_2)

- Manufacturer: SICK MAIHAK GmbH, Hamburg, Germany
- Model: SIDOR
- Type of monitoring technique: dry basis extractive
- Serial No.: 763 768
- Measuring principle: SO_2 – NDIR
- Measuring range: SO_2 – (0 to 2000) mg/m^3
- Analogue output signals (from 4 mA to 20 mA) for all components; offset: 4 mA.

3.3.2 CEMS FOR MONITORING OF GASEOUS POLLUTANTS (CO, NO) AND OXYGEN

- Manufacturer: SICK MAIHAK GmbH, Hamburg, Germany
- Model: SIDOR
- Type of monitoring technique: dry basis extractive
- Serial No.: 761 286
- Measuring principle: CO, NO – NDIR; O_2 – paramagnetic
- Measuring range: CO – (0 to 3000) mg/m^3; NO – (0 to 2000) mg/m^3; O_2 – (0 to 25) % vol.
- Analogue output signals (from 4 mA to 20 mA) for all components; offset: 4 mA.

3.3.3 CEMS FOR MONITORING OF PARTICULATE MATTER

- Manufacturer: SICK MAIHAK GmbH, Hamburg, Germany
- Model: Dusthunter R02/T10
- Type of monitoring technique: in situ
- Serial No.: 14508401 / 14508405
- Measuring principle: PM – opacity (change in brightness of the light beam)
- Measuring range: PM – (0 to 1000) mg/m^3
- Analogue output signals (from 4 mA to 20 mA) for all components; offset: 4 mA.

3.3.4 CEMS FOR MONITORING OF STATE VALUES (TEMPERATURE, PRESSURE)

- Measurement of temperature: Pt100 platinum resistance sensor
- Serial No.: 9061713
- Measurement of pressure: Absolute pressure gauge PM50
- Serial No.: C6000201FD

3.3.5 CEMS FOR MESURING OF THE VOLUME FLOW (VELOCITY)

- Measuring devices of volume flow or velocity are not installed.

3.3.6 ON DATA ACQUISITION SYSTEM

- The system of evaluation of emission parameters MEAC2000 consists of:
  - data processing unit (data logger),
  - emission PC,
  - emission software.
- Manufacturer of software: Maihak AG, Hamburg, Germany.
- Software model: MEAC2000, version 1.28 EU.

3.3.7 ACTUAL CALCULATION CONSTANTS

Table No. 1: Summary of the actual conversion factors

Conversion factors	value
Consumption of natural gas kg/h, to flue gas flow Nm^3/h dry @ 3 %vol. O_2	12,14694
Density of natural gas @ 20 °C (kg/Nm^3)	0,68227
NO_2 correction in the exhaust gases	2,3 %
Recalculation of NO mg/m^3 to NO_2 mg/m^3	1,533

4 MEASUREMENT RESULTS

4.1 TESTS OF PERFORMANCE CHARACTERISTICS

Table No. 2: Summary of the results of the performance characteristics of CEMS (monitoring of CO)

Performance characteristics	Measured component: "CO"				
	Standard / Requirement of the Standard		Results	Assessment	Note
Detection limit	ISO 12039	≤ 2 %R	0,07 %R	Compliance	1)
Lack of fit		≤ 2 %R	0,33 %R	Compliance	1)
Interferences		≤ 4 %R	0,00 %R	Compliance	1), 5)
Zero drift		≤ 2 %R	-	-	1), 6)
Span drift		≤ 4 %RM	-	-	2), 6)
Response time		≤ 200 s	69 s	Compliance	-
Lag time		≤ 180 s	49 s	Compliance	-
Rise time		≤ 20 s	20 s	Compliance	-
Fall time		≤ 20 s	20 s	Compliance	-
Standard deviation		≤ ± 5 %R	0,01 %R	Compliance	1)
Systematic error		≤ ± 2 %R	0,32 %R	Compliance	1)
Variability test	EN 14181	≤ 16,546	1.06	Compliance	3), 4)
Calibration test		≤ 11,927	10.358	Compliance	3)
Correlation coefficient		≥ 0,90	1	Compliance	3)

Table No. 3: Summary of the results of the performance characteristics of CEMS (monitoring of NO)

Performance characteristics	Measured component: "NO"				
	Standard / Requirement of the Standard		Results	Assessment	Note
Detection limit	ISO 10849	≤ 2 %R	0,10 %R	Compliance	1)
Lack of fit		≤ ± 2 %R	0,35 %R	Compliance	1)
Interferences		≤ ± 4 %R	0,31 %R	Compliance	1), 5)
Zero drift		≤ 2 %R	-	-	1), 6)
Span drift		≤ ± 4 %RM	-	-	2), 6)
Response time		≤ 200 s	73 s	Compliance	-
Standard deviation		≤ ± 5 %R	0,05 %R	Compliance	1)
Systematic error		≤ ± 2 %R	0,22 %R	Compliance	1)
Variability test	EN 14181	≤ 56,485	3,626	Compliance	3), 4)
Calibration test		≤ 39,596	12,4	Compliance	3)
Correlation coefficient		≥ 0,90	0,99	Compliance	3)

Table No. 4: Summary of the results of the performance characteristics of CEMS (monitoring of Dust).

Performance characteristics	Measured component: "Dust"				
	Standard / Requirement of the Standard		Results	Assessment	Note
Linearity	ISO 10155	≤ 3 %R	0,01 %R	Compliance	-
Standard deviation		-	- %R	-	1)
Systematic error		-	- %R	-	1)
Confidence coefficient		± 10 %ELV	± 0,05 %ELV	Compliance	-
Tolerance coefficient		± 25 %ELV	± 0,28 %ELV	Compliance	-
Variability test	EN 14181	≤ 4,115	2,139	Compliance	3), 4)
Calibration test		-	-	-	3)
Correlation coefficient		≥ 0,95	1	Compliance	3), 7)

Table No. 5: Summary of the results of the performance characteristics of CEMS (monitoring of O_2)

Performance characteristics	Measured component: "O_2"				
	Standard / Requirement of the Standard		Results	Assessment	Note
Detection limit	ISO 12039	≤ 2 %R	0,16 %R	Compliance	1)
Lack of fit		≤ 2 %R	0,40 %R	Compliance	1)
Interferences		≤ 4 %R	0,08 %R	Compliance	-
Zero drift		≤ 2 %R	-	-	1), 6)
Span drift		≤ 4 %RM	-	-	2), 6)
Response time		≤ 200 s	69 s	Compliance	-
Lag time		≤ 180 s	49 s	Compliance	-
Rise time		≤ 20 s	20 s	Compliance	-
Fall time		≤ 20 s	20 s	Compliance	-
Standard deviation		≤ ± 5 %R	0,03 %R	Compliance	1)
Systematic error		≤ ± 2 %R	0,38 %R	Compliance	1)
Variability test	EN 14181	≤ 1,128	0,028	Compliance	3), 4)
Calibration test		≤ 0,776	0,089	Compliance	3)
Correlation coefficient		≥ 0,90	1	Compliance	3)

Table No. 6: Summary of the results of the performance characteristics of CEMS (monitoring of SO_2)

Performance characteristics	Measured component: "SO_2"				
	Standard / Requirement of the Standard		Results	Assessment	Note
Detection limit	ISO 7935	≤ 2 %R	0,5 %R	Compliance	1)
Lack of fit		≤ ± 2 %R	1,65 %R	Compliance	1)
Interferences		≤ ± 2 %R	0,00 %R	Compliance	1), 5)
Zero drift		≤ 2 %R	-	-	1), 6)
Span drift		≤ ± 4 %RM	-	-	2), 6)
Response time		≤ 200 s	170 s	Compliance	-
Standard deviation		≤ ± 2,5 %R	-	Compliance	1), 7)
Systematic error		≤ ± 2 %R	1,17 %R	Compliance	1), 7)
Variability test	EN 14181	≤ 63,786	5,829	Compliance	3),4),7)
Calibration test		≤ 45,54	39,476	Compliance	3), 7)
Correlation coefficient		≥ 0,90	1	Compliance	3)

Comments – Notes

1) related to the entire measuring range
2) related to the measured value
3) related to each verified value
4) calculated according article 8.5 of EN 14181
5) related to the entire measuring range in case of gas mixture
6) audited control drifts, according Annex A.10 of EN 14181
7) see Article 6.3
8) not given emission limit and confidence interval

The measured and calculated values of CEMS and SRM, *x-y* diagrams of calibrated CEMS against SRM and performance characteristics are listed in Annex No. 3 to this report.

4.2 TESTING OF THE SAMPLING SYSTEM

Table No. 7: Testing of the sampling system

Functional parameter	Sampling system CEMS			
	Regulation	Requirement	Reality	Evaluation
Change of the concentration of O_2 during leak test	–	–	2,2 %vol.	–
Tightness of the sampling system	EN 13284-1	≤ 2 % of the flow	11,14 %	Non-Compliance
Testing under pressure	–	–	-	–
Dew point of gases	–	–	37,6 °C	Compliance
Temperature of the sampling system	ISO 10396	15 ° C above the dew point	108 °C	
Materials used in AMS		Chemical resistance	teflon, stain. steel	Compliance

4.3 FUNCTIONAL TESTS

Requirement - parameter	*Reference*	*Controlled*	*Notes*
Alignment and cleanliness			
Visual inspection:			
• Internal control of analyzers	**1**	**yes**	**O.K.**
• Cleanliness of the optical components	**1**	**yes**	**O.K.**
Documentation and records			
• Plan of the CEMS	**1**	**yes**	**O.K.** (stored in special folder for CEMS)
• All manuals (maintenance, users, etc.)	**1**	**yes**	**O.K.** (stored in special folder for CEMS)
• Log books (records of maintenance and operation of CEMS)	**1**	**yes**	**O.K.** (Log book is kept in CEMS cabinet.)
• Management system procedures for maintenance, calibration and training	**1**	**yes**	**O.K.** (in manuals)
• Training records	**1**	**yes**	**O.K.** (stored in special folder for CEMS)
• Maintenance schedule	**1**	**yes**	**O.K.** (stored in special folder in CEMS housing)
Sampling system			
Visual inspection of the sampling system:			
• Sampling probe	**1**	**yes**	**O.K.**
• Gas conditioning system	**1**	**yes**	**O.K.**
• Pumps	**1**	**yes**	**O.K.**
• All connections	**1**	**yes**	**O.K.**
• Sample line	**1**	**yes**	**O.K.**
• Power supplies	**1**	**yes**	**O.K.**
• Filters	**1**	**yes**	**O.K.**
• The sampling system shall be in good condition and free of any visible faults	**1**	**yes**	**O.K.**
Leak test			
• Leak test	**1**	**yes**	**N.O.K.**
Performance characteristics of CEMS			
• Lack of fit	**1**	**yes**	**O.K.** See Article 4.1
• Zero and span drift	**1**	**yes**	**O.K.** See Article 4.1
• Interference	**1**	**yes**	**O.K.** See Article 4.1
Emission data acquisition system			
• Intervals of data storage	**-**	**yes**	**O.K.**
• Data collection and recording	**-**	**yes**	**O.K.** (The raw data are collected in a data logger, the recalculated data in a PC.)
• On line control	**-**	**yes**	**O.K.**
• Data evaluation (calculation formulas, constants)	**-**	**yes**	**O.K.** (The volumetric flow rate is calculated from the consumption of natural gas and from the oxygen content of the

Requirement - parameter	*Reference*	*Controlled*	*Notes*
			exhaust gas. The calculation procedure is correct.)
• Excess of ELV	**-**	**yes**	**O.K.** (indication on the monitor of emission PC, record in the emission protocol)
• Data storage (electronic, CD, paper version)	**-**	**yes**	**O.K.** (in electronic version)
• Privacy (access, delete)	**-**	**yes**	**O.K.** (data are protected against erasure)
• Update of software	**-**	**yes**	**O.K.** (Significant changes are carried out by the manufacturer of CEMS. Modifications and changes (constants, formulas) perform the supply organization (Axis Industries). Changes in the configuration and settings are protected against unauthorized modification by password. All changes of setting are electronically recorded.)
Emission protocols			
• Emission protocols	**1**	**yes**	**O.K.** (The system generates daily, monthly and annual emission protocols)
• Units	**1**	**yes**	**O.K.** (mg/m^3 for PM, %vol. for O_2; °C for temperature, hPa for pressure, kg/h for mass flow, Nm^3/h for volume flow)
Serviceability			
• Safe and clean working environment with sufficient space and weather protections	**1**	**yes**	**O.K.** (CEMS is installed in a separate building beside the chimney in the air-conditioned housing.)
• Easy and safe access to the CEMS itself	**1**	**yes**	**O.K.**
• Adequate supplies of calibration materials, tools and spare parts	**1**	**yes**	**O.K.** (For CO, NO, SO_2 analyzers are available suitable calibration gases. Test gases meet the requirements for stability, uncertainty and the concentration values. Oxygen analyzer is verified by the ambient air.)
Measuring site			
• Location of the measuring site	**2**	**yes**	**O.K.** (The measuring site is located on the chimney at height of 65 m. Access to the measuring site can be limited in case of bad weather conditions.)
• Measuring holes	**2**	**yes**	**O.K.** (On the chimney are installed 4 circular measuring holes for 2 measuring axes.)
• Working platform	**2**	**yes**	**O.K.** (The working platform has a satisfactory parameters under Art. 6.2.3.2 of EN 15259.)
• Protection from weather conditions	**2**	**yes**	**O.K.** (The installed sampling probes are suitable for location in the external environment.)
Documentation and certificates			
• Project documentation of CEMS	**1**	**yes**	**O.K.**
• Certificates	**1**	**yes**	**O.K.**
QAL3			
• QAL 3 documentation (actions taken as a result of out of control situations)	**1**	**yes**	**O.K.** (QAL3 procedures are established.)
• Evaluation of the drift and precision	**1**	**yes**	**O.K.**

Requirement - parameter	*Reference*	*Controlled*	*Notes*
• Recording of any faults	**1**	**yes**	**O.K.**

References: 1 – EN 14181:2016
2 – EN 15259:2007
Rated by Annex No. 4 of this report

4.4 CALIBRATION FUNCTIONS AND VALID CALIBRATION RANGES

Table No. 8: Summary of the calibration functions

Component	Unit of raw values	Conversion of function	$\hat{y} = c\,x^2 + b\,x + a$			Calibrated range $1{,}1 * \hat{y}_{s,max}$
			c	b	a	
CO	mg/m^3	mA to mg/m^3	0	187,5	-750,00	1001 [1)]
NO	mg/m^3	mA to mg/m^3	0	125,0	-500,00	294 [1)]
SO_2	mg/m^3	mA to mg/m^3	0	62,5	-250,00	601 [1)]
PM	mg/m^3	mA to mg/m^3	0	62,447 [3)]	-249,189 [3)]	4.8 [1)]
O_2	vol.%	mA to %vol.	0	1,5625	-6,25	9,5 [2)]

[1)] Values are given under standard conditions in dry gas recalculated to the ref. oxygen content.
[2)] Values are given under standard conditions in dry gas
[3)] Comment in chapter 6.3

x [mA]; $\hat{y}$ [mg/m^3; vol.%]

The results of the validation of the calibration ranges recalculation to the reference oxygen content (3 % vol.) are listed in Annex No. 3.

The calibration functions are valid for the ranges of working conditions of technologies that were adjusted during QAL2 tests.

4.5 CORRECTIVE AND PREVENTIVE ACTIONS

Proposal for corrective and preventive action:

- To ensure the consistent maintenance of the relevant parts of CEMS (to prevent malfunctions or incorrect operations of CEMS).
- To establish a control of the excess of valid calibration ranges of the analysers according to the applicable requirements of Article 6.5 of EN 14181.

5 METHODS AND APPARATUS

5.1 METHODS USED

Parameter	Methods	Name
sampling	ISO 10396	Stationary source emissions - Sampling for the automated determination of gas emission concentrations for permanently-installed monitoring systems.
measuring site	EN 15259	Air quality - Measurement of stationary source emissions - Requirements for measurement sections and sites and for the measurement objective, plan and report
CO, CO_2, O_2	ISO 12039	Stationary source emissions - Determination of carbon monoxide, carbon dioxide and oxygen - Performance characteristics and calibration of automated measuring systems.
O_2	EN 14789	Stationary source emissions - Determination of volume concentration of oxygen (O_2) - Reference method - Paramagnetism.
CO	EN 15058	Stationary source emissions - Determination of the mass concentration of carbon monoxide (CO) - Reference method: Non-dispersive infrared spectrometry.
SO_2	EN 14791	Stationary source emissions - Determination of mass concentration of sulphur dioxide - Reference method
	ISO 7935	Stationary source emissions. Determination of SO_2. Performance characteristics and calibration of automated measuring systems.
NO and NO_2	EN 14792	Stationary source emissions. Determination of NO_X. Reference method – CL.
	ISO 10849	Stationary source emissions - Determination of the mass concentration of nitrogen oxides - Performance characteristics of automated measuring systems
Certification	EN 15267-3	Stationary source emissions - Certification of automatic monitoring systems. Performance characteristics and calibration of automated measuring systems.
dust	ISO 10155	Stationary source emissions - Sampling for the automated determination of gas emission concentrations for permanently-installed monitoring systems.
	EN 13284-1	Stationary source emissions - Determination of low range mass concentration of PM - Part 1: Manual gravimetric method.
	EN 13284-2	Stationary source emissions - Determination of low range mass concentration of PM - Part 2: Automated measuring systems
velocity and volume flow rate of gas streams	ISO 14164	Stationary source emissions - Determination of the volume flow rate of gas streams in ducts - Automated method.
	EN ISO 16911-1	Stationary source emissions - Measurement of velocity and volume flow rate of gas streams in ducts. - Part 1: Manual reference method.
	EN ISO 16911-2	Stationary source emissions - Measurement of velocity and volume flow rate of gas streams in ducts. - Part 2: Automatic monitoring system.
water vapour	EN 14790	Stationary Source Emissions - Determination of The Water Vapour in Ducts.
verification test, data evaluation	EN 14181	Stationary source emissions. Quality assurance of automated measuring systems

5.1.1 SAMPLING AND DEVIATIONS FROM THE METHODS USED

The sampling of exhaust gas for parallel measurements was performed from the sampling line of CEMS.

5.1.2 UNCERTAINTY AND THE ORIGINAL MEASUREMENT DATA

Uncertainty of results comparative measurements of SRM are listed in Annex of accreditation certificate S-188. The methods used were no deviations. Source measurement data are archived in electronic and written form in the archives of the company EKO-TERM SERVIS s.r.o. for at least six years, and for verification purposes may be granted only to authorized organizations.

5.2 DESCRIPTION OF THE SRM

The measurements of the concentration of gases pollutants were performed using an external sampling (extractive) emission measurement system according to internal methodologies and internal working procedures in accordance with ISO 10396. The measuring system has a valid certification under QAL1.

For the comparative (parallel) measurements were used as the reference methods for the individual components the following external measuring equipment's.

The determination of the concentrations of dust, status variables (gas temperature, static pressure, water vapour) and flow rate was carried out by means of apparatus DadoLab ST5 - isokinetic gravimetric with filtration in the pipeline – method according to in chapter 5.1.

Concentration of CO, O_2, NO_X as NO_2, SO_2, PG 350 E with the physical principle of measurement according to in chapter 5.1.

The summary tables of used equipment, accessories, and reference materials are listed in Annex 4 of this report. We used for measure of SRM methods filtration system with porosity 0,1 microns (solid particles of these dimensions behave like gas).

6 CONFIDENCE TO MEASUREMENTS AND DISCUSSION OF RESULTS

6.1 TIMETABLE OF MEASUREMENTS AND TESTS

Measurements of gaseous pollutants and oxygen were performed continuously for one day.

Table No. 9: Timing of measurements

Date of measurement	Parallel measurements	Date of tests	Functional tests
20.11.2019	start: 13:20	20.11.2019	normative characteristics, response time, leak test,
21.11.2019	0:00 – 23:59		
22.11.2019	end: 14:40	-	-

6.2 DATA EVALUATION

From the measured data were selected count half-hourly averages to calculate the variability and the total deviation.

Table No. 10: Summary of the number of measurements.

Component	Number of measurements	Integration time [minute]
SO_2	20	30
NO	22	30
CO	12	30
O_2	20	30
Dust	16	48

The performance characteristics were calculated according to the relationships from the standards given in point 5.1 for each pollutant.

The calibration function variability and validity tests were performed according to the procedures described in EN 14181. The emission and uncertainty limits for dust, CO, SO_2, O_2 and NO_X as NO_2 are given in Table No 11.

Table No. 11: ELV and uncertainties of measured components

Component	Fuel	ELV [mg/m^3]	Requirement for uncertainty [%]	Actual uncertainty of measurement [%]
CO	natural gas and HFO	100	10	1
NO_X as NO_2		375	20	2
O_2		-	6	0,2
SO_2		424,2	20	3
Dust		27,5	30	16

6.3 OPINIONS AND INTERPRETATIONS

The findings correspond to the actual state at the time of the measuring and test.

The exit port of the ladder to the measuring platform is too tight and does not allow safe and convenient climb on the measuring platform. Its size must be increased.

System of sampling is leaking. Criterium of standard is 2% of volume of sample. During AST test was found 11,14% leak. System of sampling must by tight.

During paired measurements, of the current in mA for dust changed minimally. The reason was measured low concentration of dust and high range of analyser. For the next QAL 2 test, we recommend reduce range of analyser to 1,5 times of the ELV. ELV assigned for both fuels - natural gas and heavy fuel oil.

The measured values of concentration of dust by the standard method were nearly the same. Based on the above, the auto-calibration value of the automated measuring system was used to determine the calibration function.

We recommend keep calibration function set by producer of analyser of dust.

7 STATEMENT OF COMPLIANCE

7.1 EVALUATION OF COMPLIANCE WITH THE SPECIFICATIONS

Testing and calibration laboratory EKO-TERM SERVIS s.r.o. performed the QAL2 and AST verification of continuous emission monitoring system installed at the air pollution source CHP-2, H150 Hot Water Boiler House No. 2 and Steam Boiler House in Vilnius, Lithuania. The verification was performed from November 20, 2019 to November 22, 2019.

Based on the results of parallel measurements and functional tests EKO-TERM SERVIS s.r.o. confirms the following statement:

SUMMARY STATEMENT OF CONFORMITY

THE CONTINUOUS EMISSION MONITORING SYSTEM

“SICK MAIHAK SIDOR”, Serial number 763 768,
“SICK MAIHAK SIDOR”, Serial number 761 286,

INSTALLED IN CHP-2,

HAS FULFILLED THE REQUIREMENTS OF AST ACCORDING TO EN 14181

THE CONTINUOUS EMISSION MONITORING SYSTEM

“SICK MAIHAK Dusthunter R02/T10 ”, Serial number 14508401 / 14508405

INSTALLED IN CHP-2,

HAS FULFILLED THE REQUIREMENTS OF QAL2 ACCORDING TO EN 14181

Under the European directive 2010/75/EC the AST procedure shall be performed at least every year.

Under the European directive 2010/75/EC a QAL2 procedure shall be performed for all parameters at least every 5 years and more frequently: