JI MONITORING REPORT

FOR REPORTING PERIOD 01.06.2011 – 30.04.2012

Version 4.0
May 31, 2012

CONTENTS

SECTION A. General Project activity information

A.1 Title of the project activity:

"Utilization of Coal Mine Methane at the Coal Mine named after A.F. Zasyadko".

A.2. Registration number at JISC:

UA2000004 / JI0035.
The project is approved as JI-project.[1]

A.3. Short description of the project activity:

According to data of the mine, during eleven months (01.06.2011 — 30.04.2012) the following amount of methane was utilized:

For electrical power and heat power. m^3 (fuel gas)	22 411 173
For electrical power and heat power, m^3 (ignition gas)	849 376
For AGFCS m^3	1 226 783
Total	24 487 332

Table 1: Amount of methane utilized during monitoring period.

The project is aimed to prevent methane emission into the atmosphere at Public Joint-Stock Company "Shakhta imeni O.F. Zasyadka", further referred to as PJSC "Shakhta im. O.F. Zasyadka"[2]. CMM extracted and recovered during mine works and and because of ventilation of mine, including CMM obtained from surface wells drilled into the gob at PJSC "Shakhta im. O.F. Zasyadka", is utilized for:

- Electrical power generation;
- Replacement of heat power that is now generated by coal and gas boilers;
- Production of gas and its use as motor vehicle fuel.

PJSC "Shakhta im. O.F. Zasyadka" has four industrial sites: Vostochnaya, Yakovlevskaya, Centralnaya and Grigoryevskaya. During this monitoring period, there operated Vostochnaya industrial site of Separate Subdivision Combined Heat and Power Plant of Public Joint-Stock Company "Shakhta imeni O.F. Zasyadka" (hereinafter referred to as SS CHP of Public Joint-Stock Company "Shakhta im.O.F. Zasyadka"or SS CHP)[3]. The electrical power generated at SS CHP was fed to Mine's main, for PJSC "Shakhta im. O.F. Zasyadka" local consumption. Heat Power generated by SS CHP was fed for consumption at Vostochnaya site. Double-block automatic gas filling station (hereinafter AGFCS) at Vostochnaya site supplies fuel for car fleet of PJSC "Shakhta im. O.F. Zasyadka" and other vehicles of neighbouring districts.

In future, commissioning of the second SS CHP at Yakovlevskaya site is planned, as well as of heat power supply grid. This will allow the Mine to feed excess electrical power to the general consumption grid, supply heat power to Vostochnaya, Yakovlevskaya, and Centralnaya sites, as well as municipal heating network. Besides, car gas fuelling stations (AGFCS) are to be installed at Yakovlevskaya site.

A.4. Monitoring period:

- Monitoring period starting date: 01/06/2011;
- Monitoring period closing date: 30/04/2012[4].

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[1] Project was approved by Ukraine with letter # 2568/01-10 from March 17th 2006. Approval was re-confirmed with letter #8169/10/10-07 from July 24th 2007. Project was approved by Japan with letter from January 30th 2007. Project was approved by Switzerland with letter #G185-0703 from May 4th 2007. Project was approved by The Netherlands with letter from May 16th 2007.

[2] Form of ownership of the Mine was changed. On July 22nd 2011 modifications were incorporated into constitutive documents, as a consequence company name Lease Enterprise "Coal Mine named after A.F. Zasyadko" was changed to Public Joint Stock Company "Shakhta imeni O.F. Zasyadka"

[3] In view of alterations in statutory documents dated July 22nd 2011, the name Structural Unit "Combined Heat and Power Plant" of Lease Enterprise "Coal Mine named after A.F. Zasyadko" has been changed into Separate Subdivision "Combined Heat and Power Plant" of Public Joint Stock Company "Shakhta imeni O.F. Zasyadka"

[4] Both days were included. Monitoring period includes time from 00-00 01/01/11 up to 24-00 30/04/12.

A.5. Methodology applied to the project activity (incl. version number):

A.5.1. Baseline methodology:

The approved consolidated methodology ACM0008/Version 03 *"Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction through flaring"* was used to identify the baseline scenario of this JI project. This methodology also refers to the "Tool to calculate emission factor for *electricity* systems", the latest version of the "Tool for the demonstration and assessment of additionality" and the latest version of the "Tool to determine project emissions from flaring gases containing methane".

A.5.2. Monitoring methodology:

The approved consolidated methodology ACM0008/Version 03 *"Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction through flaring"* was used for monitoring of this JI project.

A.6. Status of implementation including timetable for major project parts:

Activity	Planned installation date, as stated in the PDD	Implementation status
Commissioning of two gas filling compressor stations	March 2004	March 2004
Commissioning of one new gas filling compressor station	March 2005	March 2005
Commissioning of the 1st CHP module at Vostochnaya site	January 2006	January 2006
Commissioning of the 12 CHP modules at Vostochnaya site	April 2006	April 2006
Heat power delivery from CHP modules , and shut-down of boilers at Vostochnaya site	September 2006	September 2006
Commissioning of one new gas filling compressor station	November 2007	March 2005
Commissioning of one new gas filling compressor station	January 2008	Delayed due to accident 2007, planned for September 2012
Heat Power delivery from CHP modules , and shut-down of boilers at Yakovlevskaya site	July 2008	Delayed due to accident 2007, planned for October 2012
Heat Power delivery from CHP modules , and shut-down of boilers at Centralnaya site	May 2008	Delayed due to accident 2007, planned for October 2012
Commissioning of the 1st CHP module at Yakovlevskaya site	July 2009	Delayed due to reduction of scopes of mining works after accident of 2007; planned for December 2012
Commissioning of 12 CHP modules at Yakovlevskaya site	December 2009	Delayed due to reduction of scopes of mining works after accident of 2007; planned for December 2012
Heat power delivery to district heat supply system	September 2009	Delayed due to accident 2007, planned for December 2012

Table 2: Status of implementation (according to PDD version 4.4)

A.7. Intended deviations or revisions to the registered PDD:

There are no deviations from final version of PDD approved by JISC. There was a delay in the implementation schedule if compared with implementation schedule defined in PDD version 4.4 (vide ante). Specifically, within the monitoring period, following project parts have not been introduced:

- Electrical power: Yakovlevskaya SS CHP is not in operation at this moment. At this site, electrical power is not being generated; as a result, GEN_{CHP} includes only net electrical power generated by Vostochnaya SS CHP;
- Heat Power: during this monitoring period, there is no infrastructure that allows heat delivery to four sites of the Mine and municipal heating network, except for heat power supply system from Vostochnaya SS CHP to Vostochnaya site. In view of this, within this monitoring period, monitoring of the following variable data was not performed: $HEAT_{deliv,DH,y}$; $HEAT_{deliv,yak,y}$; $HEAT_{deliv,centr,y}$.
  Total amount of heat power supplied equals to the amount of heat power supplied from Vostochnaya SS CHP ($HEAT_{deliv,vost,y}$);
- Coal Mine Methane (CMM), utilized at SS CHP: As Yakovlevskaya SS CHP was not operating within this monitoring period; CMM was not utilized at this SS CHP. Therefore, $MM_{CHP,y}$ includes only CMM, utilized by Vostochnaya SS CHP;
- Coal Mine Methane (CMM) utilized at AGFCS. Out of four scheduled fuel stations (one - at Vostochnaya site, one - at Centralnaya site, and two - at Yakovlevskaya site), within this monitoring period, only AGFCS at Vostochnaya site has been operating. Therefore, for $MM_{GAS,y}$ monitoring, only measured amount of gas supplied to this gas fueling station was used.

A.8. Intended deviations or revisions to the registered monitoring plan:

During 01/06/2011-30/04/2012, no changes occurred since last verification.

A.9. Changes since last verification:

During 01/06/2011-30/04/2012, no changes occurred since last verification.

A.10. Person(s) responsible for the preparation and submission of the monitoring report:

Separate Subdivision Combined Heat and Power Plant (SS CHP) of PJSC «Shakhta im. O.F.Zasyadka»

- Borys Bokiy, Deputy General Director, PJSC «Shakhta im. O.F.Zasyadka»
- Yevgen Berezovskiy, Director; SS CHP of PJSC «Shakhta im. O.F.Zasyadka»;
- Valeriy Cherednikov, Lead Engineer, Gas Treatment and Monitoring, SS CHP of Public Joint-Stock Company «Shakhta im. O.F.Zasyadka»;

LLC "Carbon Emissions Partnership Technic".

- Svitlana Lyubarets, Director.

SECTION B. Key monitoring activities according to the monitoring plan for the monitoring period stated in A.4.

The control and monitoring system can be divided into electrical part, heat part, and gas part.

Electrical power measurements

There are no changes since last monitoring period.

Heat Power measurements

There are no changes since last monitoring period.

Coal Mine Methane consumption measurements

There are no changes since last monitoring period.

B.1. Monitoring equipment

1. Electrical power meters "Elster-Metronika";
2. Heat Power metering systems SA-94/2 M;
3. Gas Analyzer ABB A02040 (for fuel and ignition gas);
4. DBT equipment. (for fuel and ignition gas);
5. DRG.M -10000 flow meters (for fuel GAS) as a part of BKT.M metering systems;
6. Metering system "Universal".

B.1.2. Table providing information on metering equipment used (incl. manufacturer, type, serial number, date of installation, date of the latest calibration, information to specific uncertainty, need for changes and replacements):

The control and monitoring system can be divided into electrical part, heat power part, and gas part.

Electrical power metering devices

Following parameters shall be measured for emission reduction monitoring[5]:

- GEN_{CHP} — net electrical power generated by SS CHP under the project (MWh);
- $El_{consumed}$ — net electrical power consumed by Mine (MWh)[6].

According to the monitoring plan, initially excess or lack of net electrical power amount GEN_{CHP} generated by SS CHP was checked as in comparison to net electrical power consumed by Mine $El_{consumed}$. Actual parameters measured are:

- GEN_{CHP} = 76 927,819 MWh;
- $EL_{consumed}$ = 189 329,138 MWh.

As net electrical power amount generated by SS CHP GEN_{CHP} under the project is less than net electrical power consumed by Mine $El_{consumed}$., for emission reduction monitoring (see also page 40 of PDD), only amount of net electrical power generated by SS CHP under the project is required. This electrical power is measured with two meters (see Table 4) arranged at Substation -110kV site is calculated under the formula:

$$GEN_{CHP} = (E1 + E2), \qquad (1.)$$

See tables below for more detailed information on meters.

Amount of electrical power fed into energy system by Substation 110kV from SS CHP is calculated by way of adding total electrical power amount generated by each separate SS CHP module excluding electrical power consumption by SS CHP itself.

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[5] Section D contains respective formulae from Monitoring Plan of PDD.

[6] Net electrical power consumption of Mine $El_{consumed}$ is demonstrated in the report of Chief Energy Engineer of the Mine based on data of thirteen commercial meters located at other 110 kV substations of PJSC "Shakhta im. O.F. Zasyadka". Meters E17, E18 are included in thirteen commercial meters and are arranged at Vostochnaya substation 110 kV.

This calculation is performed from the following formula.

$$TM_{CHP} = \left(\sum_{5}^{16} E_{mod} - \sum_{3}^{4} E_{aux} \right) = (E5 + E6 + E7 + E8 + E9 + E10 + E11 + E12 + E13 + E14 + E15 + E16) - (E3 + E4), \quad (2.)$$

where:

- TM_{CHP} — net electrical power fed to energy system of Substation -110 from SS CHP (kWh);
- $\sum E_{mod}$ — gross electrical power generated by each individual SS CHP module (kWh);
- $\sum E_{aux}$ — SS CHP own electrical power consumption (kWh).

Respective description of meters see in table 5 provided below. For in order to check electrical energy generation at high voltage, it is impossible to use data directly from meters, current and voltage transformers are used. Readings of meters are shown in table 4 and table 5. Calculation readings for electrical power are shown in table 6.

Cross-checking of EuroALPHA Electrical power Meter Reading

Accounting of electrical power generated by SS CHP is fixed by automated electrical power commercial recording system (AECRS) which includes twelve EuroALPHA non -commercial E-meters (E5 — E16), to record generation of each genset, as well as two EuroALPHA non-commercial E-meters (E3 — E4), to record SS CHP electrical power consumption.

Each genset cell is provided with universal microprocessor protection and control devices (REF) that allow, among other functions, to perform technical record keeping of electrical power amount. Data from REF are hourly registered in the database. In the end of each day, hourly generation per each genset is summarized.

SS CHP Chief Dispatcher compares readings of AECRS and REF daily.

Summary crosschecking results from 01.06.2011 until 30.04.2012 are shown in the table 3.

01.06.2011 – 30.04.2012			
Month	**Active electrical power generation AECRS**	**Active electrical power generation REF**	**Relative difference in AECRS-REF readings**
	kWh	**kWh**	**%**
June 2011	**14 041 884**	**14 036 639**	**0,04**
July 2011	**9 105 239**	**9 096 804**	**0,09**
August 2011	**6 817 563**	**6 810 667**	**0,10**
September 2011	**5 092 989**	**5 082 700**	**0,20**
October 2011	**5 410 837**	**5 401 090**	**0,18**
November 2011	**3 376 516**	**3 372 716**	**0,11**
December 2011	**6 283 449**	**6 276 707**	**0,11**
January 2012	**7 835 715**	**7 828 686**	**0,09**
February 2012	**7 475 599**	**7 466 826**	**0,12**
March 2012	**7 277 876**	**7 269 977**	**0,11**
April 2012	**7 596 213**	**7 591 766**	**0,06**
Total	**80 313 879**	**80 234 579**	**0,10**

Table 3. AECRS – REF summary crosschecking results

Electrical power Meters

Number	Metering instrument	Work parameter kWh, kVA	Manufacturer	Type	Serial Number	Accuracy[7]	Installation Date	Data as of 01.06.2011	Data as of 30.04.2012	Difference	Calibration Date	Date of the next calibration	Remarks
E1	Electrical power meter of SS CHP system (6 kV) Wireway	Net electrical power generated by SS CHP system. P,Q	"Elster-Metronika" Russia	Electronic	№ 01116374	0.2S[8]	N/A	10 003,3812	11 026,3366	1 022,9554	13.05.2011	13.05.2017	Double side. Cubicle No.A21
E2	Electrical power meter of SS CHP system (6 kV) Wireway	Net electrical power generated by SS CHP system. P,Q	"Elster-Metronika" Russia	Electronic	№ 01116376	0.2S	N/A	10 471,8549	11 484,0280	1 021,1731	13.05.2011	13.05.2017	Double side. Cubicle No.B22
E17	Commercial electrical power meter 110 kV	Consumption of electrical power from or supply to Ukrainian grid	"Elster-Metronika" Russia	Electronic	№ 01194835	0.2S	N/A	230,6708	760,1514	529,5006	N/A Competence of supplying company	N/A	Substation 110kV T1
E18	Commercial electrical power meter 110 kV	Consumption of electrical power from or supply to Ukrainian grid	"Elster-Metronika" Russia	Electronic	№ 01194834	0.2S	N/A	192,2356	781,9862	589,7506	N/A Competence of supplying company	N/A	Sub-station 110kV T2

Table 4. Electrical power meters arranged at Substation 110kV site

[7] Accuracy level is a generalized parameter of measurement devices that is defined with limits of allowable main and extra uncertainties, as well as with range of other properties that influence accuracy of measurements performed with them. Accuracy levels are regulated by norms for certain types of measurement devices with use of metrological parameters and methods of their normalization.

[8] Accuracy levels 0.2S and 0.5S; letter S means that meter accuracy is normalized commencing from lower limit not in 5% of I_{nom} (nominal limit) (as the case is for meters with no letter, e.g. levels 0,2 and 0,5) but from 1% of I_{nom}, according to GOST 30206-94.

Number	Metering instrument	Work parameter kWh, kVA	Manufacturer	Type	Serial Number	Accuracy	Installation Date	Data as of 01.06.2011	Data as of 30.04.2012	Difference	Calibration Date	Date of the next calibration	Remarks
E3	Electrical power meter of SS CHP system (6 kV) Auxiliary transformer	Electrical power consumed by SS CHP system, P, Q	"Elster-Metronika" Russia	Electronic	№ 01103251	0.5S	N/A	5 193,6832	5 793,8235	600,1403	14.04.2010	14.04.2016	Cubicle No.1
E4	Electrical power meter of SS CHP system (6 kV) Auxiliary transformer	Electrical power consumed by SS CHP system, P, Q	"Elster-Metronika" Russia	Electronic	№ 01103208	0.5S	N/A	5 180,3795	5 788,5187	608,1392	14.04.2010	14.04.2016	Cubicle No.2
E5	Electrical power meters at a single SS CHP module (6 kV) No.1	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117846	0.2S	N/A	12 015,7114	13 291,8884	1 276,1770	14.04.2010	14.04.2016	Double side. Cubicle No.5
E6	Electrical power meters at a single SS CHP module (6 kV) No.3	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117849	0.2S	N/A	13 257,1024	14 538,7929	1 281,6905	12.04.2010	12.04.2016	Double side. Cubicle No.7
E7	Electrical power meters at a single SS CHP module (6 kV) No.5	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117851	0.2S	N/A	13 233,1247	14 740,0544	1 506,9297	07.04.2010	07.04.2016	Double side. Cubicle No.9
E8	Electrical power meters at a single SS CHP module (6 kV) No.7	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117852	0.2S	N/A	12 667,4530	14 048,7973	1 381,3443	13.04.2010	13.04.2016	Double side. Cubicle No.11
E9	Electrical power meters at a single SS CHP module (6 kV) No.9	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117855	0.2S	N/A	14 563,6681	15 757,4098	1 193,7417	13.04.2010	13.04.2016	Double side. Cubicle No.13
E10	Electrical power meters at a single SS CHP module (6 kV) No.11	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117856	0.2S	N/A	13 835,1467	15 116,6903	1 281,5436	07.04.2010	07.04.2016	Double side. Cubicle No.15

Number	Metering instrument	Work parameter kWh, kVA	Manufacturer	Type	Serial Number	Accuracy	Installation Date	Data as of 01.06.2011	Data as of 30.04.2012	Difference	Calibration Date	Date of the next calibration	Remarks
E11	Electrical power meters at a single SS CHP module (6 kV) No.2	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117848	0.2S	N/A	13 021,0771	14 923,1989	1 902,1218	12.04.2010	12.04.2016	Double side. Cubicle No.6
E12	Electrical power meters at a single SS CHP module (6 kV) No.4	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01122645	0.2S	N/A	9 586,7755	9 897,5097	310,7342	12.04.2010	12.04.2016	Double side. Cubicle No.8
E13	Electrical power meters at a single SS CHP module (6 kV) No.6	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01122650	0.2S	N/A	13 456,0563	15 216,2645	1 760,2082	14.04.2010	14.04.2016	Double side. Cubicle No.10
E14	Electrical power meters at a single SS CHP module (6 kV) No.8	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117845	0.2S	N/A	15 446,6688	16 088,5724	641,9036	07.04.2010	07.04.2016	Double side. Cubicle No.12
E15	Electrical power meters at a single SS CHP module (6 kV) No.10	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01132765	0.2S	N/A	14 594,1947	16 693,5044	2 099,3097	13.04.2010	13.04.2016	Double side. Cubicle No.14
E16	Electrical power meters at a single SS CHP module (6 kV) No.12	Electrical power generated by SS CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01132766	0.2S	N/A	11 109,1123	12 408,7016	1 299,5893	14.04.2010	14.04.2016	Double side. Cubicle No.16

Table 5. Electrical power meters arranged at individual SS CHP module

As it is impossible to use meters data directly to check electrical power generated we have to take into account special coefficients that appear from multiplying of transformation coefficients for current and voltage transformers for each meter. Their data is presented in table below.

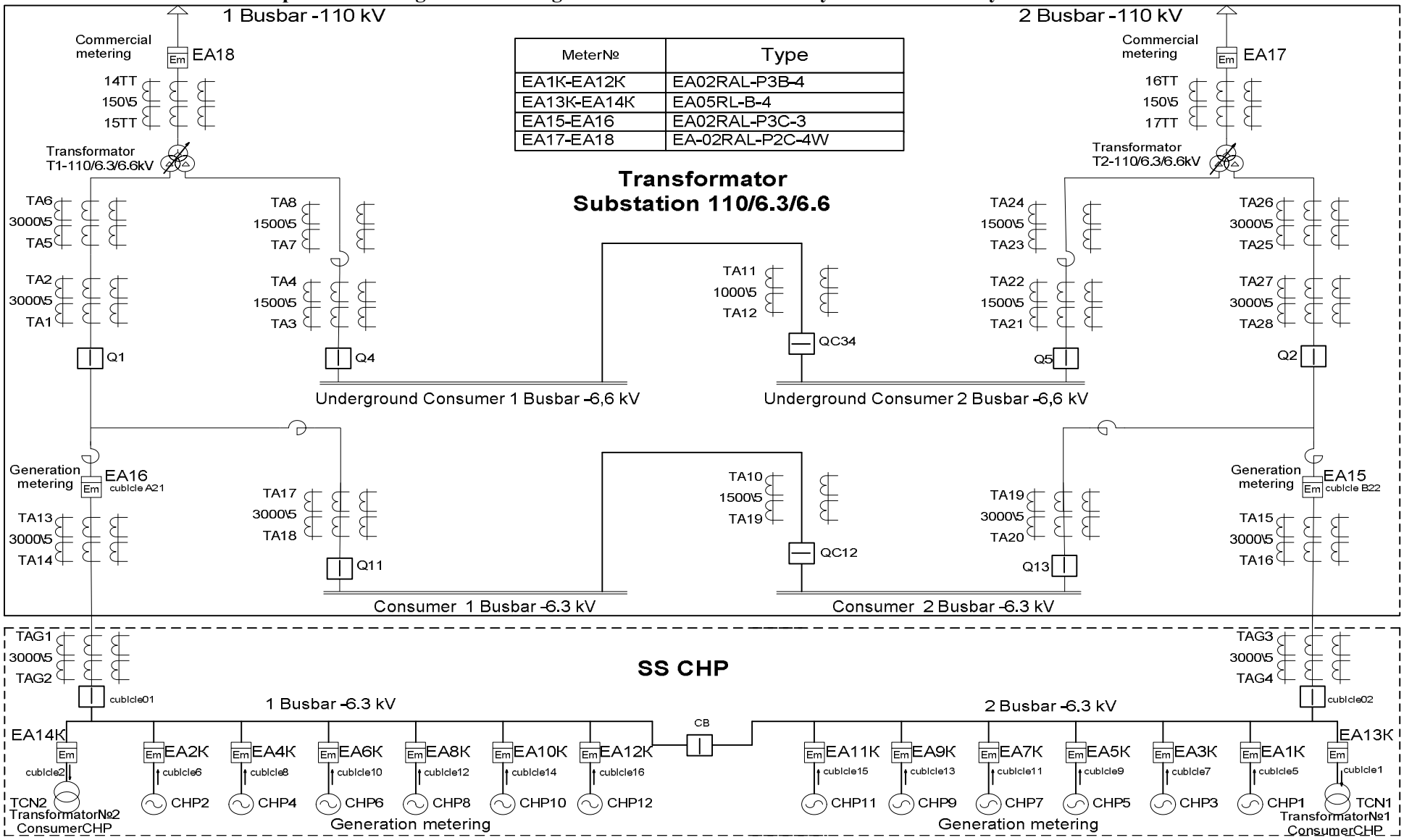
In view of high voltage and currents, it is impossible to obtain direct data from electrical power meters on generated and consumed electrical power without current and voltage transformers, for record keeping of equipment operation. The calculation method is following example for meter No. 01116374: Current -3000/5= 600 A; voltage-6300/100=63 V (gross factor -600 x 63 =37800 VA). ***Data on meter -1 022,9554. Electrical power to be accounted based on meter readings is equal to: 1 022,9554x 600 x 63=38 667 714,12 VA = 38 667 714,12 kW***

Number	Metering instrument	Work parameter kWh, kVA	Type	Serial Number	Current transformer	Voltage transformer	Coefficient for calculations	Electrical power amount
E1	Electrical power meter of SS CHP system (6 kV) Wireway	Net electrical power generated by SS CHP system, P,Q	Electronic	№ 01116374	3000/5	6300/100	37800	38 667 714,12
E2	Electrical power meter of SS CHP system (6 kV) Wireway	Net electrical power generated by SS CHP system, P,Q	Electronic	№ 01116376	3000/5	6300/100	37800	38 260 143,18
E3	Electrical power meter of SS CHP system (6 kV) Auxiliary transformer	Electrical power consumed by SS CHP system, P, Q	Electronic	№ 01103251	200/5	6300/100	2520	1 512 353,56
E4	Electrical power meter of SS CHP system (6 kV) Auxiliary transformer	Electrical power consumed by SS CHP system, P, Q	Electronic	№ 01103208	200/5	6300/100	2520	1 532 510,78
E5	Electrical power meters at a single SS CHP module (6 kV) No.1	Electrical power generated by SS CHP system, P,Q	Electronic	№ 01117846	400/5	6300/100	5040	6 431 932,08
E6	Electrical power meters at a single SS CHP module (6 kV) No.3	Electrical power generated by SS CHP system P,Q	Electronic	№ 01117849	400/5	6300/100	5040	6 459 720,12
E7	Electrical power meters at a single SS CHP module (6 kV) No.5	Electrical power generated by SS CHP system P,Q	Electronic	№ 01117851	400/5	6300/100	5040	7 594 925,69
E8	Electrical power meters at a single SS CHP module (6 kV) No.7	Electrical power generated by SS CHP system P,Q	Electronic	№ 01117852	400/5	6300/100	5040	6 961 975,27
E9	Electrical power meters at a single SS CHP module (6 kV) No.9	Electrical power generated by SS CHP system P,Q	Electronic	№ 01117855	400/5	6300/100	5040	6 016 458,17
E10	Electrical power meters at a single SS CHP module (6 kV) No.11	Electrical power generated by SS CHP system P,Q	Electronic	№ 01117856	400/5	6300/100	5040	6 458 979,74
E11	Electrical power meters at a single SS CHP module (6 kV) No.2	Electrical power generated by SS CHP system P,Q	Electronic	№ 1117848	400/5	6300/100	5040	9 586 693,87
E12	Electrical power meters at a single SS CHP module (6 kV) No.4	Electrical power generated by SS CHP system P,Q	Electronic	№ 01122645	400/5	6300/100	5040	1 566 100,37
E13	Electrical power meters at a single SS CHP module (6 kV) No.6	Net electrical power generated by SS CHP system, P,Q	Electronic	№ 01122650	400/5	6300/100	5040	8 871 449,33
E14	Electrical power meters at a single SS CHP module (6 kV) No.8	Net electrical power generated by SS CHP system, P,Q	Electronic	№ 01117845	400/5	6300/100	5040	3 235 194,14

Number	Metering instrument	Work parameter kWh, kVA	Type	Serial Number	Current transformer	Voltage trans-former	Coefficient for calculations	Electrical power amount
E15	Electrical power meters at a single SS CHP module (6 kV) No.10	Net electrical power generated by SS CHP system, P,Q	Electronic	№ 01132765	400/5	6300/100	5040	10 580 520,89
E16	Electrical power meters at individual SS CHP modules (6 kV) No.12	Net electrical power generated by SS CHP system, P,Q	Electronic	№ 01132766	400/5	6300/100	5040	6 549 930,07
E17	Commercial electrical power meter 110 kV	Consumption of electrical power from or supply to Ukrainian grid	Electronic	№ 01194835	150/5	110000/100	33000	17 473 518,20
E18	Commercial electrical power meter 110 kV	Consumption of electrical power from or supply to Ukrainian grid	Electronic	№ 01194834	150/5	110000/100	33000	19 461 768,20

Table 6. Electrical power calculation

Electrical power Metering Device Arrangement Scheme for Vostochnaya SS CHP Facility and 110 kV Substation



MeterNo	Type
EA1K-EA12K	EA02RAL-P3B-4
EA13K-EA14K	EA05RL-B-4
EA15-EA16	EA02RAL-P3C-3
EA17-EA18	EA-02RAL-P2C-4W

Figure 1: Electrical power Metering Device Arrangement Scheme for Vostochnaya SS CHP and 110 kV Substation

Heat Power Metering Systems

Heat Power measurements

For this monitoring period, only heat power directly fed by Vostochnaya SS CHP is considered, as described in paragraph A.7. Therefore, for this monitoring period, only one variable is measured that reflects the amount of heat power fed by SS CHP system to heating line, and is equal to the amount of heat power consumed by Vostochnaya site.

Metering instrument	Work parameter Gcal	Manufacturer	Type	Serial number	Accuracy	Installation Date	Data as of 01.06.2011 Gcal	Data as of 30.04.2012 Gcal	Difference	Calibration Date	Date of the next calibration	Remarks
Heat Power meter SA 94/2M[9]	Amount of heat power delivered to site system	ASWEGA	Mechatronic	22903	Heat power– 4 Flow - 2	N/A	165 149,89	186 875,55	21 725,66	05.05.11	05.05.13	Principal Metering System

Table 7. Heat Power meters arranged at SS CHP site.

[9] For heat power metering system SA 94/2M DN=300mm; Q=1000m^3/h

Heat Power Metering Systems Layout Chart at Vostochnaya SS CHP Facility

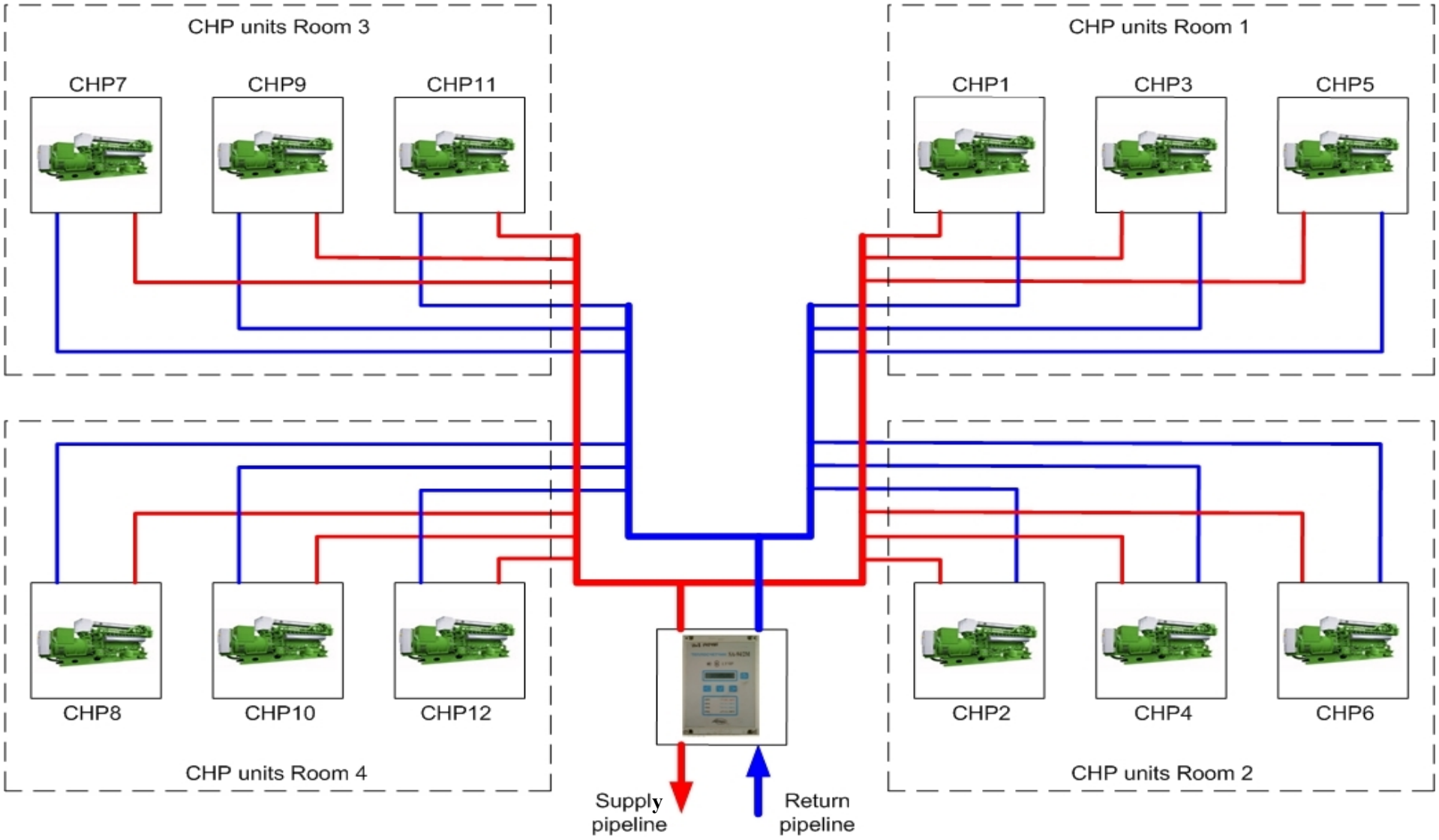


Figure 2: Heat Power Metering Systems Layout Chart at Vostochnaya SS CHP Facility

CMM Metering Systems

Measurement of CMM consumption

According to monitoring plan, two variables are measured:

- MM_{CHP} - measured amount of methane consumed by SS CHP modules (tCH_4);
- MM_{GAS} - measured amount of methane used as fuel for vehicles at new automotive gas filling stations (tCH_4).

Variable MM_{CHP} has two components: fuel gas consumption and ignition gas consumption. To determine the amount of net volume of CH_4 consumed by SS CHP (in tones) the amount of pure CH_4 (in m^3) has to be measured under normal conditions[10]. The amount of pure CH_4 (in m^3) can be measured (or more correctly - calculated) based on four parameters:

- Concentration (%) of CH_4 in the air and gas mixture;
- Flow (m^3) of air and gas mixture;
- Temperature (°C) of air and gas mixture;
- Pressure (bar) of air and gas mixture.

In the schemes below *(Figure 3 and Figure 4)* different meters and sensors installed at Vostochnaya site are indicated. We define the following different meters/sensors:

- Scheme of arrangement of main meters/sensors *(Figure 3)* that supply the data for determining the emission reductions as provided in section D of the Monitoring Report;
- General scheme of arrangement of meters/sensors (with addition of secondary meters/ sensors) (*Figure 4)* used for crosschecking the data of the primary meters, as well as meters/sensors used to operate and control the installation.

The secondary meters/sensors are not of interest for monitoring purposes and are not mentioned further. In table 8 the primary and secondary meters/sensors are indicated with their numbers that are listed in the scheme.

	Primary meters/sensors	Secondary meters/sensors
Fuel gas		
Concentration (%)	ABB AO 2040 (A1)	K1-K6
Flow (V)	G1-G12	Gn1-Gn6
Temperature (T)	T6-T17	Gn5 sensor
Pressure (P)	P11-P22	P6(Gn5's sensor)
Amount and volumetric gas flow (m^3)	BKT.M[11] metering system	DBT equipment
Ignition gas		
Concentration (%)	ABB AO 2040 (A2)	ABB AO 2040 (A2)
Flow (V)	G13	
Temperature (T)	T2	
Pressure (P)	P10	
Amount and volumetric gas flow (m^3)	"Universal" [12] metering system	Pressure sensors on pipeline
AGFCP gas		
Concentration (%)	ABB AO 2040 (A2)	ABB AO 2040 (A2)
Flow (V)	G14	Calculations according to pressure difference
Temperature (T)	T1	
Pressure (P)	P5	Manometers at AGFCS
Amount and volumetric gas flow (m^3)	"Universal" [12] metering system	Calculations

Table 8: Primary and secondary coal mine methane metering devices

[10] Normal conditions=273K and 760 mm Hg.

[11] BKT.M is designed for conversion of input data of gas parameters and calculation on the base thereof of amount and volumetric gas flow brought to standard conditions, in the composition of DRG.M 10000 consumption metering device.

[12] Universal is designed for conversion of input data of gas parameters and calculation on the base thereof of amount and volumetric gas flow brought to standard conditions.

MM_{CHP} – is a total amount of fuel and ignition gas consumption, represented as follows:

$$MM_{CHP} = (\sum_{1}^{12} VM_n \times C_1 + V_1 \times C_2) \times 0,7167 \times 0,93, \quad (3.)$$

where:

VM_n — fuel gas consumption by separated SS CHP unit, brought to standard[13] conditions (m^3);
$C_{1,2}$ — CH_4 concentration sensors (%);
V_1 — amount of methane consumed as ignition gas (m^3);
0,7167 — methane density in normal conditions subject to the standard DIN ISO 6976 (1995) (кg/m^3);
0,93 — standard conditions to normal conditions conversion ratio.

Variable MM_{GAS} to be calculated as follows:

$$MM_{GAS} = V_2 \times C_2 \times 0,7167 \times 0,93, \quad (4.)$$

where:

V_2 — amount of methane fed as fuel for vehicles, in standard conditions (m^3);
C_2 — CH_4 concentration sensor (%);
0,7167 — methane density in normal conditions subject to the standard DIN ISO 6976 (1995) (кg/m^3);
0,93 — standard conditions to normal conditions conversion ratio.

Sensors and devices are represented in tables, shown after general description of methane flow process description and measurement of parameters thereof.

Crosschecking

Amount of methane used as fuel gas for SS CHP modules undergoes crosschecking. This operation is performed by way of measurement of total amount of gas consumption (m^3) that is defined by flow meter Gn5 (Keuter, ADM Metering system). Data on flow meter are shown in table 10. This device is a block of velocity, pressure and temperature sensors that measures volumetric flow of gas consumed by SS CHP modules.Data on methane concentration is defined with gas analyzer AO 2040 (ABB) at point A1. Amount of methane is calculated on the base of these data, but it is not used for database formation; it is only used with technological purposes and for crosschecking and control of SS CHP systems operation. Such procedure is exercised on regular basis -daily. Summary results of the internal crosschecks from 01.06.2011 to 30.04.2012 are presented in table 9

01.06.2011 - 30.04.2012				
Month	**Q Fuel Gas Consumption, m^3/month**	**F Fuel Gas, Net Consumption, m^3/month**	**Q Fuel Gas, Net Consumption, m^3/month**	**Relative Difference in Readings Gn5*CH4/100 and ∑ BKT.M1- BKT.M4, %**
	Gn5	***Gn5 * CH4/100***	***∑ BKT.M1-BKT.M4***	
June 2011	**12 854 486,60**	**3 946 294,25**	**3 946 647,20**	**-0,01**
July 2011	**8 323 806,24**	**2 532 418,62**	**2 532 957,12**	**-0,02**
August 2011	**6 397 775,56**	**1 909 074,17**	**1 908 285,17**	**0,04**
September 2011	**4 933 854,11**	**1 419 147,38**	**1 418 946,32**	**0,01**
October 2011	**5 135 326,05**	**1 499 252,26**	**1 499 246,28**	**0,00**
November 2011	**3 256 187,24**	**940 544,87**	**940 027,71**	**0,06**
December 2011	**5 709 941,99**	**1 717 180,84**	**1 717 982,27**	**-0,05**
January 2012	**6 976 023,40**	**2 121 377,89**	**2 122 092,93**	**-0,03**
February 2012	**6 948 964,28**	**2 094 627,77**	**2 094 235,02**	**0,02**
March 2012	**6 860 464,61**	**2 059 409,63**	**2 059 637,87**	**-0,01**
April 2012	**7 060 541,83**	**2 171 304,63**	**2 171 115,16**	**0,01**
Total	**74 457 371,91**	**22 410 632,31**	**22 411 173,05**	**0,00**

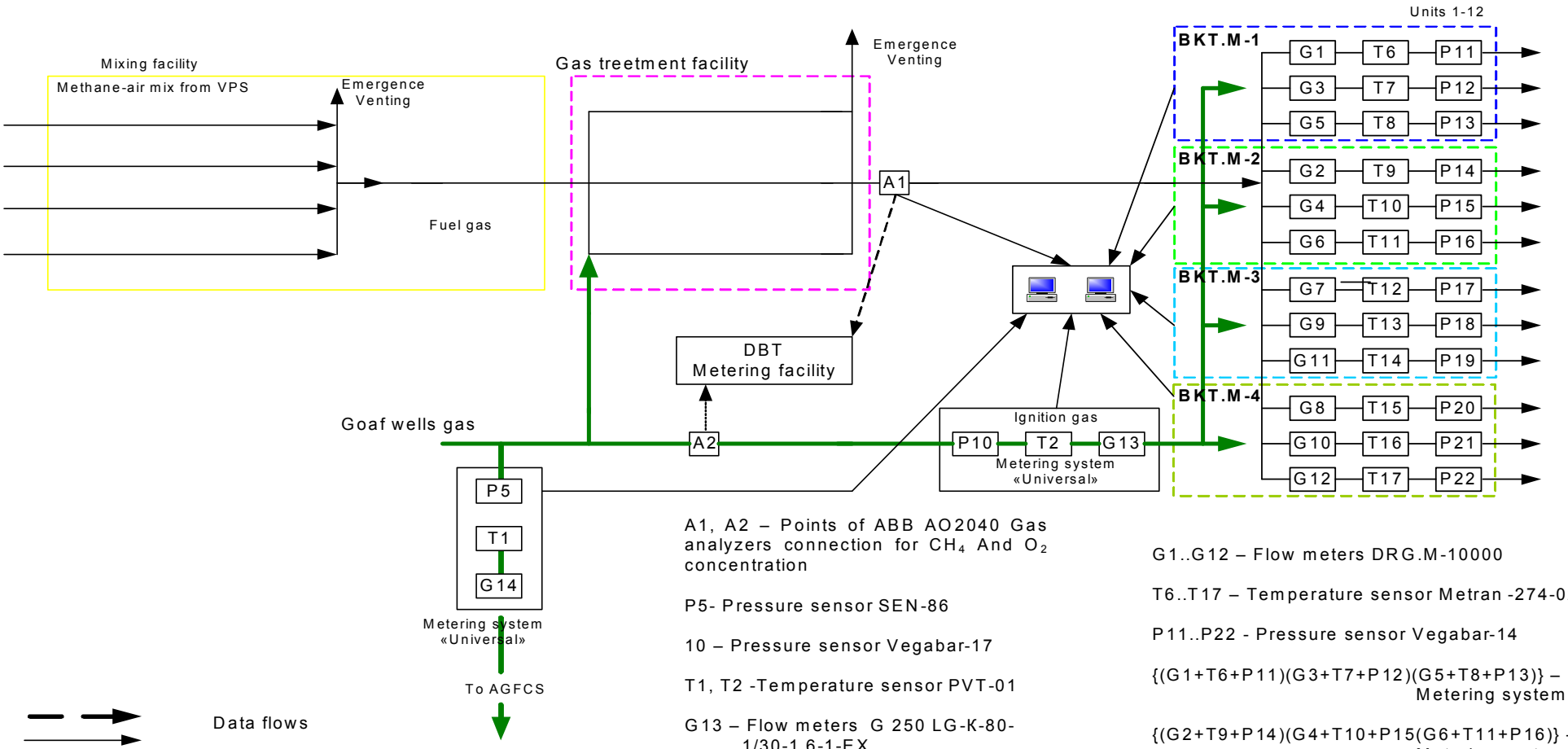
Table 9. Crosschecking Summary Results

[13] Standard conditions=293K and 760 mm Hg.

Measurement System	Manufacturer	Type	Serial Number	Allowable error	Calibration Date	Date of the next calibration
ADM	Keuter	Electronic	167	heat– 0,25% pressure – 0,5%	08.06.11	08.06.12

Table 10. Metering Device Gn5

Scheme of arrangement of main meters /sensors at Vostochnaya SS CHP in 2011 - 2012



A1, A2 – Points of ABB AO2040 Gas analyzers connection for CH_4 And O_2 concentration

P5- Pressure sensor SEN-86

10 – Pressure sensor Vegabar-17

T1, T2 -Temperature sensor PVT-01

G13 – Flow meters G 250 LG-K-80-1/30-1,6-1-EX

G14 – Flow meters G 400 LG-K-100-1/30-1,6-1-EX

G13+P10+T2- Metering system «Universal»

G14+ P5+T1 - Metering system «Universal»

G1..G12 – Flow meters DRG.M-10000

T6..T17 – Temperature sensor Metran -274-02

P11..P22 - Pressure sensor Vegabar-14

{(G1+T6+P11)(G3+T7+P12)(G5+T8+P13)} – Metering system BKT.M-1

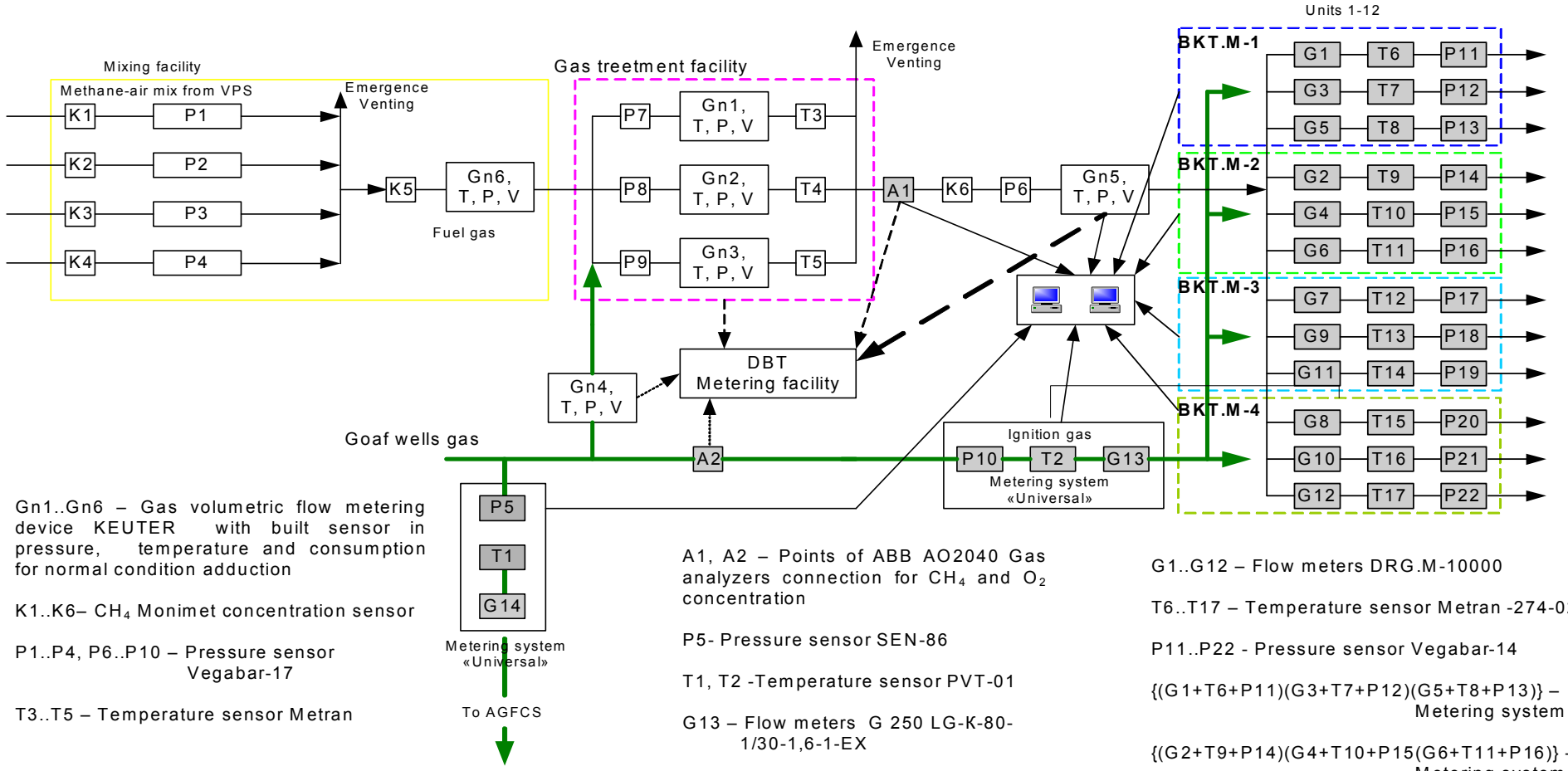
{(G2+T9+P14)(G4+T10+P15(G6+T11+P16)} – Metering system BKT.M-2

{(G7+T12+P17)(G9+T13+P18)(G11+T14+P19)} – Metering system BKT.M-3

{(G8+T5+P20)(G10+T16+P21)(G12+T17+P22)} – Metering system BKT.M-4

Figure 3: Scheme of arrangement of primary meters/ sensors

General scheme of arrangement of meters /sensors at Vostochnaya SS CHP in 2011 - 2012



Gn1..Gn6 – Gas volumetric flow metering device KEUTER with built sensor in pressure, temperature and consumption for normal condition adduction

K1..K6– CH_4 Monimet concentration sensor

P1..P4, P6..P10 – Pressure sensor Vegabar-17

T3..T5 – Temperature sensor Metran

A1, A2 – Points of ABB AO2040 Gas analyzers connection for CH_4 and O_2 concentration

P5- Pressure sensor SEN-86

T1, T2 -Temperature sensor PVT-01

G13 – Flow meters G 250 LG-K-80-1/30-1,6-1-EX

G14 – Flow meters G 400 LG-K-100-1/30-1,6-1-EX

G13+P10+T2 - Metering system «Universal»

G14+ P5+T1 - Metering system «Universal»

G1..G12 – Flow meters DRG.M-10000

T6..T17 – Temperature sensor Metran -274-02

P11..P22 - Pressure sensor Vegabar-14

{(G1+T6+P11)(G3+T7+P12)(G5+T8+P13)} – Metering system BKT.M-1

{(G2+T9+P14)(G4+T10+P15(G6+T11+P16)} – Metering system BKT.M-2

{(G7+T12+P17)(G9+T13+P18)(G11+T14+P19)} – Metering system BKT.M-3

{(G8+T5+P20)(G10+T16+P21)(G12+T17+P22)} – Metering system BKT.M-4

Figure 4: General scheme of arrangement of meters/ sensors including secondary meters/sensors

The general flow of CMM and the metering can be described as follows.[14]

Coal mine gas from degassing and gas-suction is supplied through four lines to gas mixing section of the SS CHP using two vacuum-pump stations. The concentration of methane in coal mine gas and pressure are different in each pipeline. These parameters are measured by K1…K4 (Monimet) concentration sensors and P1…P4 (Vegabar-17) pressure sensors. Measurements data of these sensors are not used to measure coal mine gas but have technological meaning; these data are transmitted to the dispatching automatic control system and used only for controlling purposes in order to obtain at the output homogeneous fuel methane with necessary concentration.

Concentration of methane that is fed to the gas treatment facility is measured by the sensor K5 (Monimet); temperature, pressure and flow are measured by flow meters Gn6 (Keuter, ADM metering system), a block of velocity, pressure, and temperature sensors. Surface well methane is mixed with fuel gas, if increase of its concentration is required. Gas methane parameters (flow, temperature, and pressure) to be fed to admix section are measured by flow meter Gn4 (Keuter, ADM metering system). The concentration of methane is measured by gas analyzer AO 2040 (ABB) at A2 point (concentrations of methane in admix and ignition gas are equal as these are included in common system of surface degasification- surface well gas methane). Having all these data, the automatic control system of the dispatch can calculate "net" amount of methane in the coal mine gas (or air and mixture as referred hereafter).

At the gas treatment section of facility, methane is distributed between three lines where it is dried, cooled, cleaned and warmed. Flow measurements are provided by Gn1 - Gn3 (Keuter) flow meters together with velocity, pressure and temperature sensors. They transmit information to calculation equipment developed by DBT that is installed in separate premise. This system calculates the values of actual consumption for normal conditions and transmits them to automatic control system of the dispatch computer system for processing and saving in database. For checking and reserve, pressure sensors P7 – P9 (Vegabar-17) and temperature sensors T3 – T5 (Metran) have been installed in pipelines.

At the outflow of gas treatment section the processing discharge valve is installed which levels out pressure swings at abrupt changes of SS CHP operation regime. Pressure at the outflow of the section is controlled by processing sensor P6 (Vegabar-17).

To define fuel gas concentration gas is tested at the outflow of gas treatment section in point A1 with the results being transmitted to gas analyzer AO 2040 (ABB). Concentration measured is checked for the compliance with sensor K6 (Monimet). Flow meter Gn5 (Keuter) measures the gas amount used by SS CHP modules. The methane amount is calculated based on the data of methane concentration but is not used for database establishment and metering, it is only used with technological purposes and crosschecking.

Further, fuel gas is supplied to SS CHP engine rooms. The flow meters G1- G12, type (DRG.M-10000), temperature sensors T6 - T17 (Metran 274-02), and pressure sensors P11 - P22 (Vegabar -14) are mounted on the line of each of 12 modules. Their data are transmitted to micro- processing control system BKT.M designed for transformation of input information on gas parameters and for calculation on the base thereof of amount and volumetric amount of gas flow brought to standard conditions to calculate fuel gas amount used by each unit, and total amount for each engine room. Fuel gas amount is calculated based on data received from control systems BKT.M1-BKT.M4 and concentration of methane therein as received from gas analyzer AO 2040 (ABB) at point A1. Total amount of fuel gas is calculated by way of addition of figures of all gas record units BKT.M, and serves as a figure of gas methane utilized by SS CHP. This information is entered into database and logs.

Ignition gas is supplied to SS CHP modules from surface degasification gas pipes where surface degasification wells are combined. Total ignition gas consumption is metered by system Universal designed for transformation of input information about gas parameters and for calculation on the base thereof of amount and volumetric amount of gas flow brought to standard conditions, which includes gas metering device G13 (G 250 LG-K-80-1/30-1,6-1-Ex), temperature sensor T2 (PVT-01-1), and pressure sensor P10 (Vegabar-17). Gas concentration is metered by gas analyzer AO 2040 (ABB) with gas test at the point A2. Based on data received from metering system Universal, ignition gas volume supplied to SS CHP modules is automatically controlled what is recorded in database and log.

[14] Starting 2008, DBT equipment is used as equipment for operation and control of stations, as well as for crosschecking. Main meters and sensors installed at each SS CHP module, transmit data to metering systems of the gas record units BKT.M (amount and volumetric flow of gas measurement). This gas record system transmits data to computer. Each BKT.M system unites three SS CHP modules. These systems are run with fuel gas. Ignition gas for all SS CHP modules is measured with a new metering system Universal. All these data are stored and are transmitted to SS CHP computer system.

Gas for vehicle fuelling is also supplied to SS CHP modules via surface degassing gas pipelines where surface degasification wells are combined. Total vehicle fuelling gas consumption is metered by system Universal designed for transformation of input information about gas parameters and for calculation on the base thereof of amount and volumetric amount of gas flow brought to standard conditions, which includes gas metering device G14 (type G 400 LG-K-100-1/30-1,6-1-Ex), temperature sensor T1 (PVT-01-1), and pressure sensor P5 (SEN-8601). Whereas the gas being fed for vehicle fuelling and ignition gas supplied to SS CHP modules make up an integrated system of surface degassing, gas concentration is checked with gas analyzer AO 2040 (ABB) at the point A2. Based on these data, amount of methane consumed at AGFCS as vehicle fuel is recorded in database and log.

Methane volume supplied with fuel gas and ignition gas gives a total amount of methane supplied to SS CHP Modules.

Methane volume supplied with fuel gas and ignition gas, and methane for vehicle fueling give total amount of methane consumed by Vostochnaya site of Zasyadka Coal Mine.

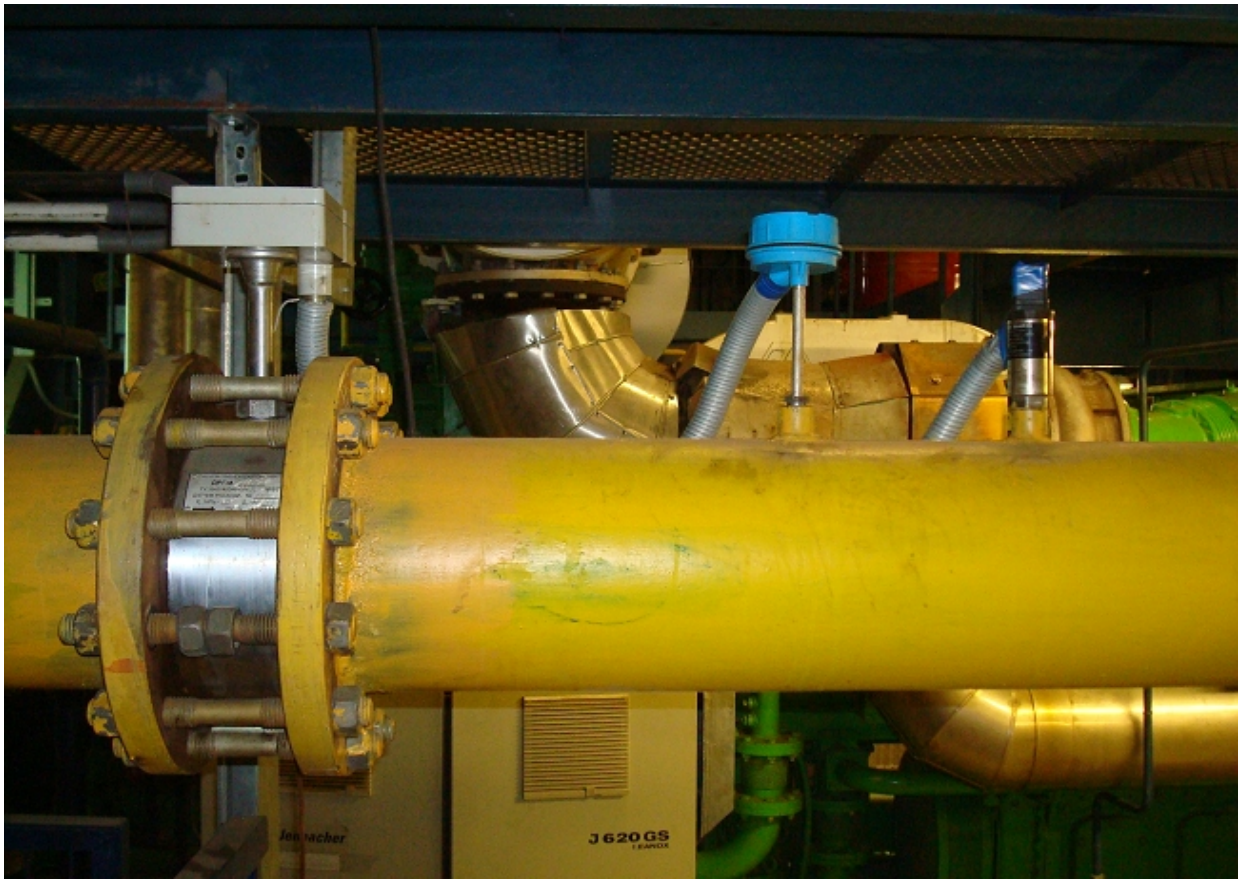


Figure 5: Gas flow meter DRG.M-10000[15] temperature sensor Metran 274-02 and pressure sensor Vegabar-14 of metering system for gas record BKT.M at fuel gas pipeline of SS CHP module.

[15] DRG.M – 10000 — gas flow meter designed for transformation of volumetric flow of gas (at working pressure) into numeric and impulsive signal.

In the tables 11-20 please find description of meters/sensors and metering systems for gas record that are part of monitoring report drawing:

CHP gas metering equipment

Item No.	Metering device application	Operating capabilities	Manufacturer	Type	Serial number	Data Uncertainty level	Installation Date	Calibration Date	Date of the next calibration	Remarks
C1	Fuel Gas Concentration	%	ABB	AO 2040 Electronic	3.244705.5	± 1%	2005	14.06.11	14.06.12	Connection A1
C2	Ignition Gas Concentration	%	ABB	AO 2040 Electronic	3.244704.5	± 1%	2005	14.06.11	14.06.12	Connection A2

Table 11. Gas analyzers.

Item No.	Gas to be measured	Metering device application	Operating capabilities	Manufacturer	Type	Serial number	Data Uncertainty level	Installation Date	Calibration Date	Date of the next calibration	Remarks
V1	Ignition	Ignition gas amount measurement	m^3	NVP "GREMPIS" ltd	G 250 LGK-80-1/30-1,6-1-Ex	9771	± 1% 60 to 400 m^3/h	4 quarter 2007	10.03.11	10.03.13	Connection G13
		Ignition gas temperature measurement	^oC	NVP "GREMPIS" ltd	PVT-01-1	6480	± 0.5%	4 quarter 2007	10.03.11	10.03.13	Connection T2
		Ignition gas pressure measurement	bar	"VEGA" Germany	Vegabar-17	12307278	± 0.5%	4 quarter 2007	09.03.12	09.03.13	Connection P10

Table 12. Ignition gas record system Universal meters/sensors.

Item No.	Gas to be measured	Metering device application	Operating capabilities	Manufacturer	Type	Serial number	Data Uncertainty level	Installation Date	Calibration Date	Date of the next calibration	Remarks
V2	Gas for motor vehicle filling	Gas for motor vehicle fueling amount measurement	m^3	NVP "GREMPIS" ltd	G 400 LGK-100-1/30-1,6-1-Ex	9786	± 1% 97,5 to 650 m^3/h	4 quarter 2007	10.06.11	10.06.13	Connection G14
		Gas for motor vehicle fueling temperature measurement	^oC	NVP"GREMPIS" ltd	PVT-01-1	211	± 0.5%	4 quarter 2007	10.06.11	10.06.12	Connection T1
		Gas for motor vehicle fueling pressure measurement	bar	"COBOLD" Germany	SEN-8601	45	± 0.5%	4 quarter 2007	10.06.11	10.06.12	Connection P5

Table 13. Motor vehicle fueling gas metering system Universal meters/ sensors for recording of amount and volumetric flow of gas consumed as AGFCS fuel

Item No.	Metering system	Operating capabilities: m^3 /h	Manufacturer	Type	Serial number	Data uncertainty level and its accuracy	Date of installation	Data as of 01.06.2011 m^3	Data as of 30.04.2012 m^3	Difference	Date of calibration	Date of the next calibration	Remarks
V_1	Universal	Ignition gas amount	NVP"GREMPIS" ltd	Universal - 2	6023	± 0.2 %	4 quarter 2007	6 753 520,5	7 666 827,5	913 307,0	10.03.11	10.03.13	Main metering block
V_2	Universal	Motor vehicle fuelling gas amount	NVP"GREMPIS" ltd	Universal - 2	327	± 0.2 %	4 quarter 2007	8 177 118	9 496 234	1 319 116	09.06.11	09.06.13	Main metering block

Table 14. Gas amount and volumetric flow computing block

Item No.	Metering system	Operating capabilities: m^3	Manufacturer	Serial number	Data uncertainty level and its accuracy	Date of installation	Unit No.	Data as of 01.06.2011 m^3	Data as of 31.12.2011 m^3	Difference	Date of calibration	Date of the next calibration	Remarks
V_3	BKT.M - 1	Fuel gas amount	Sibnefteavtomatika, Russia	**094**	• Pressure channels, not exceeding ±0.3 %; • Temperature channels, not exceeding ±0.5 %; • Consumption channels, not exceeding ±0.1 %; • Gas consumption definition status brought to standard conditions, not exceeding ±0.35 %; • Gas amount definition status brought to standard conditions, not exceeding ±0.35 %; • Change of running time, not exceeding ±0.1 %.	**N/A**	**M1** **M3** **M5**	See data below			05.05.09	05.05.12	Main metering block
V_4	BKT.M - 2	Fuel gas amount	Sibnefteavtomatika, Russia	**095** **099**		**N/A**	**M1** **M3** **M1**	See data below			20.01.09 27.10.11	20.01.12 27.10.14	Main metering block
V_5	BKT.M - 3	Fuel gas amount	Sibnefteavtomatika, Russia	**5668** **095**		**N/A**	**M7** **M9** **M11**	See data below			17.03.09 01.03.12	17.03.12 01.03.15	Main metering block
V_6	BKT.M - 4	Fuel gas amount	Sibnefteavtomatika, Russia	**099** **100**		**N/A**	**M8** **M10** **M12**	See data below			05.08.08 19.04.11	05.08.11 19.04.14	Main metering block

Table 15. Gas amount and volumetric flow computing blocks BKT.M -1 — BKT.M - 4

Item No	Metering system	Serial number	Unit No.	Data as of 01.06.2011 m^3	Data as of 01.08.2011 m^3	Difference	Serial number	Data as of 01.08.2011 m^3	Data as of 30.04.2012 m^3	Difference	**∑ fuel gas**
V_6	**ВКТ.М-4**	**099**	**М8**	37 452 000	39 557 104	2 105 104	**100**	0	1 091 139	1 091 139	3 196 243
			М10	36 585 252	38 485 824	1 900 572		0	8 676 080	8 676 080	10 576 652
			М12	25 149 112	27 430 544	2 281 432		0	4 099 539	4 099 539	6 380 971

Table 16. Records of BKT.M-4 (before and after substitution)

Item No	Metering system	Serial number	Unit No.	Data as of 01.06.2011 m^3	Data as of 03.01.2012 m^3	Difference	Serial number	Data as of 03.01.2012 m^3	Data as of 30.04.2012 m^3	Difference	**∑ fuel gas**
V_4	**ВКТ.М-2**	**095**	**М2**	23 074 776	29 139 744	6 064 968	**099**	0	3 562 989	3 562 989	9 627 957
			М4	23 852 614	25 401 938	1 549 324		0	0	0	1 549 324
			М6	31 962 758	37 444 664	5 481 906		0	3 381 390	3 381 390	8 863 296

Table 17. Records of BKT.M-2 (before and after substitution)

Item No	Metering system	Serial number	Unit No.	Data as of 01.06.2011 m^3	Data as of 17.03.2012 m^3	Difference	Serial number	Data as of 17.03.2012 m^3	Data as of 30.04.2012 m^3	Difference	**∑ fuel gas**
V_5	**ВКТ.М-3**	**5668**	**М7**	4 402 882	10 502 612	6 099 730	**095**	0	736 003,3	736 003,3	6 835 733,3
			М9	4 249 490	9 545 961	5 296 471		0	847 509,6	847 509,6	6 143 980,6
			М11	4 000 159	9 124 484	5 124 325		0	1 277 736	1 277 736	6 402 061

Table 18. Records of BKT.M-3 (before and after substitution)

Item No	Metering system	Serial number	Unit No.	Data as of 01.06.2011 m^3	Data as of 29.03.2012 m^3	Difference	Serial number	Data as of 29.03.2012 m^3	Data as of 30.04.2012 m^3	Difference	**∑ fuel gas**
V_3	**ВКТ.М-1**	**094**	**M1**	10 630 702	17 030 176	6 399 474	**094**	0	18 171 1	18 171,1	6 417 645,1
			M3	11 831 409	17 040 544	5 209 135		0	1 208 092	1 208 092	6 417 227
			M5	11 208 443	17 756 216	6 547 773		0	1 176 910	1 176 910	7 724 683

Table 19. Records of BKT.M-1 (before and after nulling)

Item No.	Gas to be metered	Symbol on scheme	Metering device application	Operating capabilities	Manufacturer	Type	Serial number	Acceptable deviation	Installation Date	Date of calibration	Date of next calibration	Remarks
M1	Fuel	G1	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	102	± 1.0%	N/A	26.07.11	26.07.14	Fuel gas metering system BKT.M- 1
		T6	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	510745	± 0,5%	N/A	04.06.11	04.06.12	
		P11	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536534	± 0,5%	N/A	04.06.11	04.06.12	
M3	Fuel	G3	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	109	± 1.0%	N/A	26.07.11	26.07.14	
		T7	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	510753	± 0,5%	N/A	04.06.11	04.06.11	
		P12	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536342	± 0,5%	N/A	04.06.11	04.06.12	
M5	Fuel	G5	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	103	± 1.0%	N/A	26.07.11	26.07.14	
		T8	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	509669	± 0,5%	N/A	04.06.11	04.06.11	
		P13	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14447569	± 0,5%	N/A	04.06.11	04.06.12	

Table 20. Meters/sensors of fuel gas metering system BKT.M-1

Item No.	Gas to be metered	Symbol on scheme	Metering device application	Operating capabilities	Manufacturer	Type	Serial number	Acceptable deviation	Installation Date	Date of calibration	Date of next calibration	Remarks
M2	Fuel	G2	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	108	± 1.0%	N/A	28.04.11	28.04.14	Fuel gas metering system BKT.M - 2
		T9	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	510735	± 0.5%	N/A	02.06.11	02.06.12	
		P14	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568471	± 0.5%	N/A	02.06.11	02.06.12	
M4	Fuel	G4	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	104	± 1.0%	N/A	28.04.11	28.04.14	
		T10	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	509670	± 0.5%	N/A	02.06.11	02.06.12	
		P15	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536186	± 0.5%	N/A	02.06.11	02.06.12	
M6	Fuel	G6	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	097	± 1.0%	N/A	28.04.11	28.04.14	
		T11	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	510733	± 0.5%	N/A	02.06.11	02.06.12	
		P16	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536368	± 0.5%	N/A	02.06.11	02.06.12	

Table 21. Meters/ sensors of fuel gas metering system BKT.M – 2

Item No.	Gas to be metered	Symbol on scheme	Metering device application	Operating capabilities	Manufacturer	Type	Serial number	Acceptable deviation	Installation Date	Date of calibration	Date of next calibration	Remarks
M7	Fuel	G7	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	098	± 1.0%	N/A	14.07.11	14.07.14	Fuel gas metering system BKT.M - 3
		T12	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	510744	± 0.5%	N/A	03.06.11	03.06.12	
		P17	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568573	± 0.5%	N/A	03.06.11	03.06.12	
M9	Fuel	G9	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	099	± 1.0%	N/A	14.07.11	14.07.14	
		T13	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	510742	± 0.5%	N/A	03.06.11	03.06.12	
		P18	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536304	± 0.5%	N/A	03.06.11	03.06.12	
M11	Fuel	G11	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	101	± 1.0%	N/A	14.07.11	14.07.14	
		T14	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran - 274-02	510738	± 0.5%	N/A	03.06.11	03.06.12	
		P19	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568610	± 0.5%	N/A	03.06.11	03.06.12	

Table 22. Meters/ sensors of fuel gas metering system BKT.M – 3

Item No.	Gas to be metered	Symbol on scheme	Metering device application	Operating capabilitie	Manufacturer	Type	Serial number	Acceptable deviation	Installation Date	Date of calibration	Date of next calibration	Remarks
M8	Fuel	G8	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	105	± 1.0%	N/A	27.06.11	27.06.14	Fuel gas metering system BKT.M - 4
		T15	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran - 274-02	510754	± 0.5%	N/A	04.06.11	04.06.12	
		P20	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568589	± 0.5%	N/A	04.06.11	04.06.12	
M10	Fuel	G10	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	096	± 1.0%	N/A	27.06.11	27.06.14	
		T16	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran - 274-02	510755	± 0.5%	N/A	04.06.11	04.06.12	
		P21	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536306	± 0.5%	N/A	04.06.11	04.06.12	
M12	Fuel	G12	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	100	± 1.0%	N/A	27.06.11	27.06.14	
		T17	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran - 274-02	510747	± 0.5%	N/A	04.06.11	04.06.12	
		P22	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568606	± 0.5%	N/A	04.06.11	04.06.12	

Table 23. Meters/ sensors of fuel gas metering system BKT.M – 4

The monitoring system for the emission reductions developed in the course of the project implementation has been integrated with the existing controlling and reporting system at Zasyadko Coal Mine. That allows obtaining reliable and easy verifiable data related to the project performance, ensuring thus the quality and efficiency of the monitoring system.

All source information on performance parameters and calculations have been obtained directly on site and after that reported to the Coal Mine dispatching office. The work parameters of CMM flows as well as heat power and electrical power generated were crosschecked to provide quality and reliability of monitored data. To ensure reliable and non-stop performance of SS CHP the inputs of natural gas from the natural gas pipeline are envisaged.

CMM gas flow filling stations

Each gas filling station keeps records in the register. Calculations of methane fuelled are executed according to data on pressure difference of manometers. Concentration of methane is measured monthly with ABB AO 2040 at SS CHP and by way of surface well gas analysis. Besides, the concentration of methane is measured locally with an interferometer. There are also temperature and pressure meters. The amount and volumetric consumption of methane is measured by "Universal" metering system.

B.1.3. Calibration procedures

QA/QC (Quality Assurance/ Quality Control) procedures	Body responsible for calibration and certification
Calibration interval for such meters is six years. Calibration procedures for meters are performed in compliance with calibration methodology developed for "Elster-Metronika" meters, Ukraine.	Donetsk Standardization, Metrology and Certification Centre

Table 24. For Electrical power meters

QA/QC (Quality Assurance/ Quality Control) procedures	Body responsible for calibration and certification
Calibration interval for such meters is two years. Calibration procedures for meters are performed in compliance with calibration methodology developed for ASWEGA meters, Ukraine.	Donetsk Standardization, Metrology and Certification Centre

Table 25. For Heat Power meters

QA/QC (Quality Assurance/ Quality Control) procedures	Body responsible for calibration and certification
Keuter ADM1 Electronic. Calibration interval for such meters is 12 months[16]	Donetsk Standardization, Metrology and Certification Centre
Gas Analyzer A0 2040 (ABB). Calibration interval for such meters is 12 months [17].	Donetsk Standardization, Metrology and Certification Centre
Gas Record Unit BKT.M for gas amount and volumetric flow record. Calibration interval is once in 36 months.	Tyumen Standardization, Metrology and Certification Centre
«Universal» Metering System for gas amount and volumetric flow record. Calibration interval is once in 24 months.	Donetsk Standardization, Metrology and Certification Centre

Table 26. For CMM meters

[16] As there is no state regulation for such kind of equipment, it was decide by Ukrainian Centre for Standardization and Metrology for one -year calibration period.

[17] All metering equipment shall be calibrated subject to provisions and methods as defined by regulations of this centre.

B.1.4. Involvement of Third Parties:

- Donetsk Standardization, Metrology and Certification Centre;
- Tyumen Standardization, Metrology and Certification Centre;
- Mitallservice" LLC - Central Geological and Chemical Laboratory;
- CJSC "Ukrtechprylad TD";
- STCH "Hydrocentre" LLC;
- Respirator Mining Scientific and Research Institute.

B.2. Data on collection (accumulated data for the whole monitoring period):

For the operational and management structure of the project, see PDD Version 4.4, Figure 9: *Monitoring and quality control system for Vostochnaya and Yakovlevskaya sites*

B.2.1. List of fixed default values:

ID number	Data variable	Source of data	Data unit	Comment
P6 CEF_{CH4}	Carbon emission factor for combusted methane	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy Chapter 4: Fugitive Emissions	tCO_2e/tCH_4	Set at 2.75 tCO_2e /tCH_4 See also table CMM meters
P12 Eff_{CHP}	Efficiency of methane destruction/oxidation at SS CHP	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy Chapter 4: Fugitive Emissions	%	Set at 99.5%
P14 Eff_{GAS}	Overall efficiency of methane destruction/oxidation used as fuel for vehicles	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy Chapter 4: Fugitive Emissions	%	Set at 98.5%
P15 GWP_{CH4}	Global warming potential of methane	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy Chapter 4: Fugitive Emissions	tCO_2e/tCH_4	Set at 21

Table 27. Project Variable Values

ID number	Data variable	Source of data	Data unit	Comment
B13 $EF_{grid, produced, y}$	Emission factor for electrical power relating to replaced grid electrical power generation under the project activity per year	Order Nr. 75 dd. 12.05.2011 issued by State Environmental Investment Agency of Ukraine	tCO_2/MWh	Set at 1,063
B14 $EF_{grid,reduced,y}$	Emissions factor for electrical power relating to replaced on-site electrical power consumption under the project activity per year	Order Nr. 75 dd. 12.05.2011 issued by State Environmental Investment Agency of Ukraine	tCO_2/MWh	Set at 1,090
B20 $EF_{heat,vost}$	Emissions factor for heat power at Vostochnaya site in the baseline scenario	See Annex 2 PDD	tCO_2/GJ	Boiler efficiency 90% Set at 0,063
B22 $EF_{heat,yak}$	Emissions factor for heat power at Yakovlevskaya site in the baseline scenario	See Annex 2 PDD	tCO_2/GJ	Boiler efficiency 90% Set at 0,063
B24 $EF_{heat,centr}$	Emissions factor for heat power at Centralnaya site in the baseline scenario	See Annex 2 PDD	tCO_2/GJ	Boiler efficiency 90% Set at 0,143
B25 $VFUEL_y$	Vehicle fuel provided by the project activity	Fuel Meters	GJ	This value will be calculated based MM_{GAS} of the project scenario multiplied with LHV of methane
B26 EF_v	Emission factor for vehicle operation replaced by the project activity	IPCC Default Value	tCO_2/GJ	See annex 2 PDD. Set at 0,072

Table 28. Baseline Default Values

B.2.2. List of variables:

Project emissions variables to be measured:

- MM_{CHP} — Measured methane amount consumed by SS CHP modules (tCH_4);
- MM_{GAS} — Measured methane amount consumed as fuel at new AGFCSs (tCH_4).

Baseline emissions variables to be measured:

- GEN_{CHP} — Net electrical power generated under the project by SS CHP (MW*h);
- $El_{Cconsumed}$ — Net electrical power consumed by the mine;
- $HEAT_{consumed, vost, y}$ — Heat Power consumed at Vostochnaya site delivered under the project

B.2.3. Data concerning GHG emissions by sources of the project activity:

Year	MM_{GAS} (tCH_4)
01.06.2011 – 31.12.2011	*550,6*
01.01.2012 – 30.04.2012	*328,7*
Total: 01.06.2011 – 30.04.2012	**879,3**

Table 29. Data to be collected in the project scenario

Year	MM_{CHP} (tCH_4)
01.06.2011 – 31.12.2011	*10 392,5*
01.01.2012 – 30.04.2012	*6 278,4*
Total: 01.06.2011 – 30.04.2012	**16 670,9**

Table 30. Data to be collected in the project scenario

For Methane analysis data refer please to Annex 1 of the Document.

B.2.4. Data concerning GHG emissions by sources of the baseline:

Year	GEN_{CHP} (MWh)	El_{Cons} (MWh)	$HEAT_{cons, vost, y}$ (GJ)
01.06.2011 – 31.12.2011	*47 821,420*	*120 300,092*	*51 184*
01.01.2012 – 30.04.2012	*29 106,399*	*69 029,046*	*39 777*
Total: 01.06.2011 – 30.04.2012	**76 927,819**	**189 329,138**	**90 961**

Table 31. Data collected in the baseline scenario

B.2.5. Data concerning leakage:

Not Applicable.

B.2.6. Data concerning environmental impacts:

Activity under the project is performed subject to Ukrainian current environmental law. In the process of construction of SS CHP and AGFCS, Environmental Impact Assessment has been performed. Pursuant to Atmospheric Air Protection Law of Ukraine, as approved by Decree of Ukrainian Cabinet of Ministers dated March 13, 2002 # 302 and Order of Ukrainian Ministry of Environmental Protection dd. 09.03.2006 # 108. Mine obtains permits for emission of contaminating substances. Pollutant emissions inventory is carried out with the assistance of third-party certified company that provides screening and analysis of samples of contaminants using its own standard equipment.

Accounting and monitoring of emissions is performed constantly; all statistical reports are prepared and submitted pursuant to Guide to Filling In the State Statistical Control Statements for Atmospheric Air # 2 - TP (air) (annual) and # 2- TP (air) (quarterly) Atmospheric Air Protection Report issued by Derzhkomstat (State Committee of Statistics) # 674 dd. 30.12.2004.

The impact of the project on the condition of water bodies is insignificant due to water being used for domestic needs only. At SS CHP, Meter Reading Log on Grid Water Consumption is kept; data wherefrom are

used for statistical reports. Monitoring of Environmental Impact on water condition is performed and all statistic report statements are submitted pursuant to the current law of Ukraine.

During project implementation, waste is established that deals with domestic (service and repair of equipment), and household activities only. Monitoring of waste is performed, and statistical report statements are submitted: # 1-VT "Waste and Package and Tare Accounting pursuant to the current law of Ukraine.

B.3. Data processing and archiving (incl. software used):

All dispatchers are responsible for data management. Besides, dispatchers prepare daily, weekly, monthly, and annual standardized repots. All appropriate data are collected daily, and archived both in electronic and paper form (see calculation CO_2). All data will be saved on electronic data carriers and in paper form at least two years after completion of final transaction of emission reduction units. Passwords on servers are subject to monthly change, and each server has its own person in charge with an access thereto.

Commissioning of modern computer control system will provide efficient online monitoring and work efficiency analysis. Data from all controlling equipment are automatically transferred to database with the aid of appropriate software:

1. Checker 8 (integrated software developed and written by the manufacturer; to be supplied with the Universal control unit) – ignition gas and AGFCS gas record -keeping;
2. Alfa- Center measuring and computing complex integrated into ASKUE (common mine automatic system of electrical power commercial record -keeping) - electrical power record -keeping;
3. DIA.NE.XT (software delivered with CHP modules) – control, regulation, indication, setting, and saving of data for CHP module.

For calculation of Greenhouse Gas (GHG) Emission Reductions, the SS CHP CAM Service has developed its own Data Gathering and Processing Automated System (ASZPD) that maintains calculation of fuel gas and heat power. This system is based on the database being created with licensed software that is included into measuring system kit.

B.4. Special event log:

On 01.08.2011, the BKT.M # 099 has been substituted by BKT.M # 100 because of sending thereof for state calibration to Tyumen Standardization, Metrology and Certification Centre.

On 03.01.2012, the BKT.M # 095 has been substituted by BKT.M # 099 because of sending thereof for state calibration to Tyumen Standardization, Metrology and Certification Centre.

On 17.03.2012, the BKT.M # 5668 has been substituted by BKT.M # 095 because of sending thereof for state calibration to Tyumen Standardization, Metrology and Certification Centre.

On 29.03.2012 BKT.M # 094 unit was nulled. Based on the results of examination electro-static discharges caused failure in operation. BKT.M # 094 unit is functionally operative, its further operation in a regular mode is allowed.

SECTION C. Quality assurance and quality control measures:

C.1. Documented procedures and management plan:

C.1.1. Roles and responsibilities:

General project management is implemented by the Deputy General Director of the PJSC «Shakhta im. O.F.Zasyadka» through supervising and coordinating activities of his subordinates, such as deputy director on surface degassing, chief electricity engineer, chief heating engineer, and deputy director on safety engineering.

On-site day-to-day management is implemented by the Director of SS CHP of PJSC «Shakhta im. O.F.Zasyadka» and two shift dispatchers responsible for cogeneration modules and gas treatment plant operation. During the daytime, workers of mechanical, electrical, heating and SS CHP CAM services perform preventive measures and maintenance of all technological equipment, metering instruments as well as of automation tools and telemechanics. On-line information is transmitted directly to the shift dispatcher. The combined heat and power plant operates the clock round.

At the main facilities, the responsibilities are shared as follows:

- AGFCS operator controls and prepares data and transmits them to SS CHP dispatching office, and keeps day-to-day log for gas;
- Two SS CHP dispatchers control data on CHP module inputs (gas treatment plant), operational process parameters, and heat power and electrical power output; they keep daily logs on consumption of fuel, ignition, and surface degasification well gas consumed by AGFCS.
- 110/6.3/6.6 kV operator controls data on amount of electrical power fed into main and received from main and internal electrical power consumption by the mine.

All information is transferred to SS CHP dispatching office, and is controlled in online mode by shift supervisor. Based on information provided by dispatching office, monitoring engineer prepares monthly and annual reports on monitoring of electrical power, gas, heat power and emissions, and provides them to SS CHP Director and General Director Deputy of PJSC «Shakhta im. O.F.Zasyadka». General supervision over monitoring system is carried out by management of PJSC «Shakhta im. O.F.Zasyadka» in accordance with control and reporting system in place.

Monitoring Dataflow Chart is shown below.

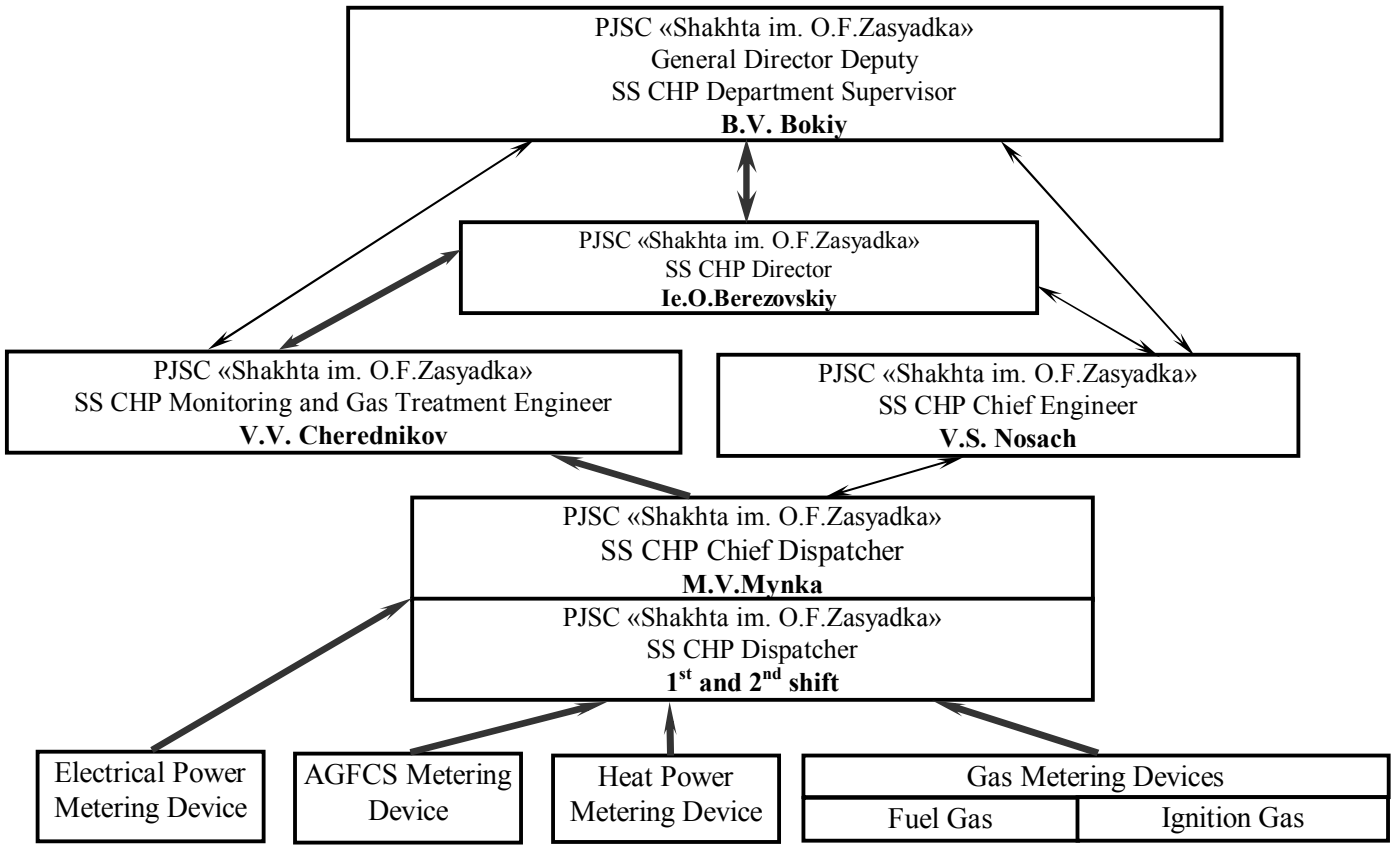


Figure 6. Monitoring Dataflow Chart

C.1.2. Trainings:

GE Jenbacher (Austria) has delivered SS CHP main equipment that is CHP modules. As specified in the contract, personnel's training in operating these modules was held in Austria. GE Jenbacher technicians have performed extra training during installation and commissioning works. Employees in charge for monitoring control have also completed training during installation of the said system.

Extra training is performed during equipment operation. SS CHP and VPS staff training program, as well as emergency training, are submitted in form of a separate document represented as EMISSION MONITORING MANUAL for SS CHP of PJSC «Shakhta im. O.F.Zasyadka» (Manual 4), which also includes structural diagram of technical maintenance provision and state calibration of meters of automated metering system. SS CHP Chief Dispatcher is responsible for the development of the training program. SS CHP Director shall approve training programs.

Safety training is performed once every three months, all employees take an exam in safety measures once a year. Staff and visitors are provided with individual protection means for protection from harmful production factors.

C.2. Involvement of Third Parties:

Donetsk Standardization, Metrology and Certification Centre, Tyumen Standardization, Metrology and Certification Centre, "Mitallservice" LLC - Central Geological and Chemical Laboratory, CJSC "Ukrtechpryld TD", STCH "Hydrocentre" LLC, Respirator Mining Scientific and Research Institute are the Third Parties involved.

C.3. Internal audits and control measures:

Introduction of modern computerized control system allows for efficient on-line monitoring and reviewing of work process performance at Central Dispatching office of Public Joint-Stock Company «Shakhta im. O.F.Zasyadka» (in particular, for fuel and ignition gas consumption, their parameters, electrical power and heat power generated; data can be obtained every 10 seconds if requested). Any considerable deviation of monitored data from given work parameters will be promptly noticed and source of such deviation will be easily identified. In turn, this enables shift leader to coordinate efficiently actions of his shift subordinates including on-duty technical staff responsible for eliminating defects and equipment repairs. Such system improved operational process and eliminated lacks in control of SS CHP gas consumption.

C.4. Troubleshooting procedures

See C .1.2

In case of breakdown of CMM supply system (either whole system or separate feeding pipe) methane-air mixture will be urgently released into the atmosphere through the emergency gas vent stack. The shut-off valves will automatically close CMM supply pipes, natural gas will be fed into gas treatment plant and consequently into the inlets of engines and into pre-chambers. As the main gas record blocks (Figure 3) are situated next to the venting stack, only combusted CMM will be accounted for.

SECTION D. Calculation of GHG emission reductions

D.1. Project emissions

The project emissions are measured by the following equation. The emissions at capturing and utilization of methane PE_{ME} have not been taken into account as use of electrical power for vacuum pumps is outside the project boundary (see section B.3 of PDD) and the annual electrical power consumption of the gas filling station results in emission below 2,000 tCO_2e.

$$PE_y = PE_{MD} + PE_{UM}, \quad (5.)$$

where:

- PE_y — project emission per year y (tCO_2e)
- PE_{MD} — project emissions from methane destroyed (tCO_2e);
- PE_{UM} — project emissions from un-combusted methane (tCO_2e)

The project emissions from methane destroyed

The project emissions from methane destroyed are given by the equation below. Methane will be destroyed at SS CHP; thus, MD_{ELEC} and MD_{HEAT} are combined into MD_{CHP}. No flaring takes place so $MD_{FL} = 0$.

$$PE_{MD} = (MD_{CHP} + MD_{GAS}) \times (CEF_{CH4} + r \times CEF_{NMHC}), \quad (6.)$$

At $r=PC_{NMHC} / PC_{CH4}$

where:

- PE_{MD} — project emissions from CMM destroyed (tCO_2e);
- MD_{CHP} — methane destroyed in the SS CHP modules generating heat power and electrical power (tCH_4);
- MD_{GAS} — methane destroyed as fuel for vehicles filled at new gas filling stations (tCH_4);
- CEF_{CH4} — carbon emission factor for combusted methane (2.75 tCO2e/tCH_4).
- CEF_{NMHC} — carbon emission factor for combusted non-methane hydrocarbons (the concentration varies, and, therefore, to be obtained through periodical analysis of captured methane) (tCO_2eq/tNMHC)[18];
- r — relative proportion of NMHC compared with methane;
- PC_{CH4} — concentration (in mass) of methane in extracted gas (%);
- PC_{NMHC} — concentration (in mass) of NMHC in extracted gas (%).

The relative proportion of NMHC was monitored, and their concentration is less than 1%. Therefore, NMHC were excluded from calculation. So:

$$PE_{MD} = (MD_{CHP} + MD_{GAS}) \times CEF_{CH4}, \quad (7.)$$

Emissions of SS CHP modules

The emissions of SS CHP modules are given by the following equations:

$$MD_{CHP} = MM_{CHP} \times Eff_{CHP}, \quad (8.)$$

where :

- MD_{CHP} — methane destroyed at SS CHP as a result of heat power and electrical power generation (tCH_4);
- MM_{CHP} — measured methane amount consumed by SS CHP modules (tCH_4);
- Eff_{CHP} — efficiency of methane destruction/ oxidation at CHP (taken as 99.5% of IPCC).

[18] At the moment, non-methane hydrocarbons are not included in calculation because of concentration less than 1%. Their concentration is checked quarterly with laboratory analyses. In case of concentration more than 1%, it will be considered in calculations.

D.2. Emissions of gas utilization

Some methane is supplied to the gas filling stations where vehicles are fueled. The emissions as a result are given by the following equations.

$$MD_{GAS} = MM_{GAS} \times Eff_{GAS}, \quad (9.)$$

where:

- MD_{GAS} — methane destroyed as fuel for vehicles fueling at new AGFCSs (tCH_4);
- MM_{GAS} — measured methane amount consumed as fuel for vehicles fueling at new AGFCSs ($тCH_4$);
- Eff_{GAS} — overall efficiency of methane destruction/ oxidation through gas grid to various combustion end uses, combining fugitive emissions from the gas grid and combustion efficiency at end user (taken as 98.5% of IPCC).

Emissions from un-combusted methane.

$$PE_{UM} = GWP_{CH4} \times (MM_{CHP} \times (1 - Eff_{CHP}) + MM_{GAS} \times (1 - Eff_{GAS})), \quad (10.)$$

where:

- PE_{UM} — project emissions from un-combusted methane (tCO_2e);
- GWP_{CH4} — global warming potential of methane (21 tCO_2e/tCH_4);
- MM_{CHP} — methane consumed by SS CHP modules (tCH_4);
- Eff_{CHP} — efficiency of methane destruction at SS CHP (taken as 99.5% of IPCC);
- MM_{GAS} — measured methane amount consumed as fuel for vehicle fuelling at new AGFCSs (tCH_4);
- Eff_{GAS} — efficiency of methane destruction when being used as fuel for vehicles (taken as 98.5% of IPCC).

D.3.1. Project emissions:

Year	[$тCO_2e$/year]	
01.06.2011 – 31.12.2011	[$тCO_2e$]	*31 192*
01.01.2012 – 30.04.2012	[$тCO_2e$]	*18 832*
Total: 01.06.2011 – 30.04.2012	**[$тCO_2e$]**	**50 024**

Table 33 Project emissions

D.3.2. Baseline emissions:

The baseline emissions are given by the following equation. There is no destruction of methane in baseline scenario at the mine, $BE_{MD,y} = 0$

$$BE_y = BE_{MR,y} + BE_{Use,y}, \quad (11.)$$

where:

- BE_y — baseline emissions per year y (tCO_2e);
- $BE_{MR,y}$ — baseline emissions from release of methane into the atmosphere that are avoided by the project activity per year y (tCO_2e);
- $BE_{Use,y}$ — baseline emissions from generation of electrical power, heat power replaced by the project activity per year y (tCO_2e).

Baseline emissions of methane avoided by the project activity.

As there is neither CBM (coal bed methane) nor CMM (coal mine methane) at the mine, the emissions equal to the amount of post-mining CMM captured in the project activity and sent to SS CHP and AGFCSs.

$$BE_{MR,y} = GWP_{CH4} \times (CMM_{PJ,CHP,y} + CMM_{PJ,GAS,y}), \quad (12.)$$

where :

- $CMM_{PJ,CHP,y}$ — post-mining CMM captured, sent to and destroyed in the SS CHP in the project activity per year y (tCH_4);

- $CMM_{PJ,GAS,y}$ — pre-mining CMM captured, supplied to the net gas filling stations and destroyed when being used as fuel for vehicles in the project activity per year y (tCH_4);
- GWP_{CH4} — global warming potential for methane (= 21 tCO_2e/tCH_4).

Baseline emissions as result of electrical power and heat power generation and vehicle fuel by the project activity

As there is only post-mining CMM involved the baseline emissions are given by the following equation:

$$\boldsymbol{B_{Use,y} = BE_{Use,el,y} + BE_{Use,heat,y} + BE_{Use,gas}}, \qquad (13.)$$

where:

- $BE_{Use,y}$ — potential total baseline emissions from the generation of electrical power , heat power, and vehicle fuels replaced by the project activity per year y (tCO_2);
- $BE_{Use,el,y}$ — total baseline emissions from the generation of electrical power , replaced by the project activity per year y (tCO_2);
- $BE_{Use,heat\ power,y}$ — total baseline emissions from the generation of heat power, replaced by the project activity per year y (tCO_2);
- $BE_{Use,gas}$ — total baseline emissions of vehicle fuels, replaced by the project activity per year y (tCO_2e).

Baseline emissions upon replacement of electrical power generation

Baseline emissions upon replacement of electrical power generation by the project activity are given by two equations. If net electrical power amount supplied under project by SS CHP is less than total amount of electrical power consumed by the mine for the year, the baseline emissions will be the following:

$$\boldsymbol{BE_{Use.el.y} = GEN_{CHP,y} \times EF_{grid,reduced}}, \qquad (14.)$$

If net electrical power amount supplied under the project by SS CHP is greater than total amount of electrical power consumed by the mine for the year (i.e. the electrical power will be fed into grid), the baseline emissions will be the following:

$$\boldsymbol{BE_{Use,el,y} = (GEN_{CHP,y} - EL_{Consumed,y}) \times EF_{grid,produced,y} + EL_{Consumed,y} \times EF_{grid,reduced,y}}, \qquad (15.)$$

where:

- $BE_{Use,el,y}$ — total baseline emissions from the generation of electrical power , replaced by the project activity per year y (tCO_2);
- $GEN_{CHP,y}$ — net electrical power supplied by the project activity of the SS CHP modules (MWh);
- $EF_{grid,produced,y}$ — emission factor for electrical power relating to replaced grid electrical power generation under the project activity per year y (tCO_2/ MWh);
- $EL_{Consumed,y}$ — net electrical power consumed by mine on-site per year y (MWh);
- $EF_{grid,reduced,y}$ — emissions factor for electrical power relating to replaced on-site electrical power consumption by the project activity (tCO_2/MWh)

For this monitoring period, the net electrical power supplied under project by SS CHP is less than net electrical power consumed (see section B.1.2). Therefore, formula 14 was used.

Baseline emission upon replacement of heat power

Heat Power produced by CHP supplies Vostochnaya site. Baseline emissions are given by following equation:

$$\boldsymbol{BE_{Use,\ Heat,\ y} = HEAT_{cons,\ vost,\ y} \times EF_{Heat,\ vost}}, \qquad (16.)$$

where:

- $HEAT_{cons,vost,y}$ — heat power consumed at Vostochnaya site, supplied by the project activity per year y (GJ);
- $EF_{Heat,vost}$ — emission factor for heat power at Vostochnaya site in the baseline scenario (tCO_2/GJ).

Baseline emissions upon replacement of vehicle fuels

The baseline emissions upon replacement of vehicle fuel by the project activity are given by the following equation:

$$BE_{Use.Gas} = VFUEL_y \times EF_v \qquad (17.)$$

where:

- $VFUEL_y$ — vehicle fuel provided by the project activity (GJ);
- EF_v — emission factor for vehicle operation replaced by the project activity (tCO_2/GJ).

Emission factor for vehicle fuels

Emission factor for vehicle fuel is given by following equation:

$$EF_V = \frac{EF_{cos\lambda}}{Eff_V} \times \frac{44}{12} \times \frac{1TJ}{1000GJ} \qquad (18.)$$

where:

- EF_v — emission factor for vehicle fuel replaced by the project activity (tCO2/GJ);
- $EF_{cos\lambda}$ — emission factors for CO_2 for fuels used for vehicle operation (tCO_2/GJ);
- Eff_v — efficiency of vehicle motors (%);
- *44/12* — carbon to Carbon Dioxide conversion factor;
- *1/1000* — TJ to GJ conversion factor.

Year	[тCO_2e/year]	
01.06.2011 – 31.12.2011	[тCO2e]	*287 135*
01.01.2012 – 30.04.2012	[тCO2e]	*174 162*
Total: 01.06.2011 – 30.04.2012	**[тCO2e]**	**461 297**

Table 33. Baseline emissions

D.3.3. Leakages:

Not Applicable

D.3.4. Emission reductions summary in monitoring period:

Year	[тCO_2e/year]	
01.06.2011 – 31.12.2011	[тCO2e]	*255 943*
01.01.2012 – 30.04.2012	[тCO2e]	*155 330*
Total: 01.06.2011 – 30.04.2012	**[тCO2e]**	**411 273**

Table 34. Emission reductions

Gas sample analysis – 3d quarter 2011[19]

APPROVED

P.S.Pashkovskiy
First Director Deputy
Science Activity
Dr. Sc.
Respirator MSRI
<signature>
Seal
October 10, 2011

Percentage of matters in samples of gas taken on 19.09.11
at Public Joint-Stock Company «Shakhta im. O.F.Zasyadka»

Main Components	Sampling Point		
	Vacuum Pump Station-1	Vacuum Pump Station -2	
	Second group Longwall 18^{w} seam m_3	First group Longwall 18^{w} seam m_3	Second group Longwall 18^{w} seam m_3
	concentration, %	concentration, %	
Methane CH_4	15,3	15,3	35,8
Ethan C_2H_6	0,05	0,05	0,5
Propane C_3H_8	0,04	0,04	0,04
Butane C_4H_{10}	0,003	0,003	0,004
Pentane C_5H_{12}	0,005	0,005	0,0007
Hexane C_6H_{14}	n/a	n/a	n/a
Carbon Oxide CO	n/a	n/a	n/a
Hydrogen H_2	n/a	n/a	n/a
Carbon Dioxide CO_2	0,07	0,07	0,07
Nitrogen N_2	66,2	66,2	49,2
Oxygen O_2	17,5	17,5	13,8
Argon Ar	0,07	0,07	0,28
Micro-Components*	**mg/m^3**		
Ammonia NH_3	4,7	4,8	4,7
Chlorine Cl_2	n/a	n/a	n/a
Fluorine F_2	n/a	n/a	n/a
hydrogen sulfide H_2S	4,0	5,0	4,0
Sulfide dioxide SO_2	n/a	n/a	n/a
Dust, mg/m^3	<1	<1	<1
Moisture, %	100	100	100

VPS 1 (first group) includes first and VPS 2(second group) set combined in common degasification line.
* re-calculated per dry gas

Analysis results person in charge _____ B.I. Koshovskiy
(signature)

[19] Gas sampling analysis is performed by RESPIRATOR Mining Scientific and Research Institute

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First Director Deputy
Science Activity
Dr. Sc.
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October 10, 2011

Percentage of matters in samples of gas taken on 19.09.11
at Public Joint-Stock Company «Shakhta im. O.F.Zasyadka»

Main components	Fuel Gas, concentration, %	Ignition Gas, concentration, %
Methane CH_4	29,4	97,4
Ethan C_2H_6	0,25	0,62
Propane C_3H_8	0,08	0,08
Butane C_4H_{10}	0,04	0,004
Pentane C_5H_{12}	0,007	0,008
Hexane C_6H_{14}	0,0005	0,0006
Carbon Oxide CO	0,0005	0,008
Hydrogen H_2	0,07	0,06
Carbon Dioxide CO_2	0,03	n/a
Nitrogen N_2	52,2	1,3
Oxygen O_2	16,3	0,9
Argon Ar	0,46	0,32
Micro-Components*	**mg/m^3**	
Ammonia NH_3	3,2	n/a
Chlorine Cl_2	n/a	n/a
Fluorine F_2	n/a	n/a
Hydrogen sulfide H_2S	6,0	n/a
Sulfide dioxide SO_2	n/a	n/a
Dust, mg/m^3	<1	<1
Moisture, %	100	100

* re-calculated per dry gas

Analysis results person in charge _____ B.I. Koshovskiy
(signature)

Gas sample analysis –4th quarter 2011

APPROVED

A.S. Chumak,
Cand. Sc.
Director Deputy, Science,
Respirator MSRI
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Seal
December 22, 2011

Percentage of matters in samples of gas taken on 14.12.11
at Public Joint-Stock Company «Shakhta im. O.F.Zasyadka»

Main Components	Sampling Point		
	Vacuum Pump Station-4		Vacuum Pump Station-2
	First Group 19^0 Longwall seam m_3	Second Group 19^0 Longwall seam m_3	Second Group 18^w Longwall seam m_3
	concentration, %		concentration, %
Methane CH_4	23,8	8,9	20,7
Ethan C_2H_6	0,4	0,29	0,07
Propane C_3H_8	0,07	0,022	0,06
Butane C_4H_{10}	0,006	0,0015	0,007
Pentane C_5H_{12}	0,006	0,008	0,005
Hexane C_6H_{14}	0,0006	0,0007	n/a
Carbon Oxide CO	n/a	n/a	n/a
Hydrogen H_2	n/a	n/a	n/a
Carbon Dioxide CO_2	0,09	0,06	0,07
Nitrogen N_2	61,2	70,8	63,8
Oxygen O_2	13,7	19,1	15,3
Argon Ar	0,05	0,73	0,08
Micro-Components*	mg/m^3		
Ammonia NH_3	n/a	5,0	6,0
Chlorine Cl_2	n/a	n/a	n/a
Fluorine F_2	n/a	n/a	n/a
hydrogen sulfide H_2S	n/a	6,0	8,0
Sulfide dioxide SO_2	n/a	n/a	n/a
Dust, mg/m^3	<1	<1	<1
Moisture, %	100	100	100

VPS-4 — (First Group) combined in common line: degasification + gas suction
VPS-2 — (Second Group) combined in common line: degasification + gas suction
* re-calculated per dry gas

Test conducted by
Engineer, VBEP SHPV[20] _____ O.M. Luganskiy
(signature)

Analysis results person in charge
Lead Scientist, VBEP SHPV, Cand.of.Chem.Sc. _____ B.I. Koshovskiy
(signature)

[20] Department of Breeding Fire Fighting in Mines and Waste Rock Dumps

APPROVED

A.S. Chumak,
Cand. Sc.
Director Deputy, Science,
Respirator MSRI
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Seal
December 22, 2011

Percentage of matters in samples of gas taken on 14.12.11
at Public Joint-Stock Company «Shakhta im. O.F.Zasyadka»

Main components	Fuel Gas, concentration, %	Ignition Gas, concentration, %
Methane CH_4	29,4	97,4
Ethan C_2H_6	0,25	0,62
Propane C_3H_8	0,08	0,08
Butane C_4H_{10}	0,04	0,004
Pentane C_5H_{12}	0,007	0,008
Hexane C_6H_{14}	0,0005	0,0006
Carbon Oxide CO	0,0005	0,008
Hydrogen H_2	0,07	0,06
Carbon Dioxide CO_2	0,03	n/a
Nitrogen N_2	52,2	1,3
Oxygen O_2	16,3	0,9
Argon Ar	0,46	0,32
Micro-Components*	**mg/m^3**	
Ammonia NH_3	8,0	n/a
Chlorine Cl_2	n/a	n/a
Fluorine F_2	n/a	n/a
Hydrogen sulfide H_2S	7,0	n/a
Sulfide dioxide SO_2	n/a	n/a
Dust, mg/m^3	<1	<1
Moisture, %	100	100

* re-calculated per dry gas

Test conducted by
Engineer, VBEP SHPV _____ O.M. Luganskiy
(signature)

Analysis results person in charge
Lead Scientist, VBEP SHPV, Cand.of.Chem.Sc. _____ B.I. Koshovskiy
(signature)

Gas sample analysis– 1st quarter 2012[21]

Customer: **PJSC«Shakhta im.O.F.Zasyadka»**
Sampling Point: **VPS-4. First Group, 19⁰ Longwall, seam m_3, dd. 14.03.2012**

Results of Laboratory Analysis of Gas Components

Item	Description of Parameters		Content, % vol.
	Component	Sign	
1	2	3	4
1	Helium	He	0,03
2	Hydrogen	H_2	n/a
3	Oxygen	O_2	10,30
4	Nitrogen	N_2	54,3
5	Carbon Dioxide	CO_2	0,09
6	Carbon Monoxide	CO	n/a
7	Methane	CH_4	33,5
8	Ethane	C_2H_6	0,5
9	Propane	C_3H_8	0,07
10	Iso- Butane	i-C_4H_{10}	0,002
11	N- Butane	n-C_4H_{10}	0,004
12	Iso- Pentane	i-C_5H_{12}	0,003
13	N- Pentane	n-C_5H_{12}	0,003
14	Iso- Hexane	i-C_6H_{14}	n/a
15	N- Hexane	n-C_6H_{14}	n/a
16	Heptane	C_7H_{16}	n/a

VPS – 4 (First Group) — combined pipeline: degasification + gas suction

Date of performance: 19.03.2012

Lead Engineer _____ O.O. Kozlitin
(signature)

Head of Central
Geological and Chemical Laboratory _____ T.M. Makeieva
(signature)

[21] Analysis of gas samples performed by CENTRAL GEOLOGICAL AND CHEMICAL LABORATORY (Certificate No. BL-276/2011 dd. 14.11.2011.)

Customer: **PJSC«Shakhta im.O.F.Zasyadka»**
Sampling Point: **VPS-2. First Group, 18^{w} Longwall, seam m_3, dd. 14.03.2012**

Results of Laboratory Analysis of Gas Components

Item	Description of Parameters		Content, %vol.
	Component	Sign	
1	2	3	4
1	Helium	He	traces
2	Hydrogen	H_2	n/a
3	Oxygen	O_2	16,20
4	Nitrogen	N_2	65,50
5	Carbon Dioxide	CO_2	0,09
6	Carbon Monoxide	CO	n/a
7	Methane	CH_4	17,10
8	Ethane	C_2H_6	0,70
9	Propane	C_3H_8	0,08
10	Iso-Butane	i-C_4H_{10}	0,002
11	N-Butane	n-C_4H_{10}	0,003
12	Iso-Pentane	i-C_5H_{12}	0,002
13	N-Pentane	n-C_5H_{12}	0,005
14	Iso-Hexane	i-C_6H_{14}	n/a
15	N-Hexane	n-C_6H_{14}	n/a
16	Heptane	C_7H_{16}	n/a

Date of performance: 19.03.2012

Lead Engineer _____ O.O. Kozlitin
(signature)

Head of Central
Geological and Chemical Laboratory _____ T.M. Makeieva
(signature)

Customer: **PJSC«Shakhta im.O.F.Zasyadka»**
Sampling Point: **SS CHP, Fuel Gas, dd. 14.03.2012**

Results of Laboratory Analysis of Gas Components

Item	Description of Parameters		Content, %vol.
	Component	Sign	
1	2	3	4
1	Helium	He	0,023
2	Hydrogen	H_2	0,06
3	Oxygen	O_2	14,10
4	Nitrogen	N_2	53,50
5	Carbon Dioxide	CO_2	0,05
6	Carbon Monoxide	CO	0,0005
7	Methane	CH_4	31,50
8	Ethane	C_2H_6	0,18
9	Propane	C_3H_8	0,07
10	Iso-Butane	i-C_4H_{10}	0,01
11	N-Butane	n-C_4H_{10}	0,03
12	Iso- Pentane	i-C_5H_{12}	0,002
13	N-Pentane	n-C_5H_{12}	0,004
14	Iso-Hexane	i-C_6H_{14}	0,0003
15	N-Hexane	n-C_6H_{14}	0,0005
16	Heptane	C_7H_{16}	n/a

Date of performance: 19.03.2012

Lead Engineer _____ O.O. Kozlitin
(signature)

Head of Central
Geological and Chemical Laboratory _____ T.M. Makeieva
(signature)

Customer: **PJSC«Shakhta im.O.F.Zasyadka»**
Sampling Point: **SS CHP, Ignition Gas, dd. 14.03.2012**

Results of Laboratory Analysis of Gas Components

Item	Description of Parameters		Content, %vol.
	Component	Sign	
1	2	3	4
1	Helium	He	n/a
2	Hydrogen	H_2	0,06
3	Oxygen	O_2	1,30
4	Nitrogen	N_2	1,90
5	Carbon Dioxide	CO_2	n/a
6	Carbon Monoxide	CO	0,004
7	Methane	CH_4	96,80
8	Ethane	C_2H_6	0,43
9	Propane	C_3H_8	0,05
10	Iso-Butane	i-C_4H_{10}	0,003
11	N-Butane	n-C_4H_{10}	0,005
12	Iso-Pentane	i-C_5H_{12}	0,003
13	N-Pentane	n-C_5H_{12}	0,004
14	Iso-Hexane	i-C_6H_{14}	0,00025
15	N-Hexane	n-C_6H_{14}	0,00030
16	Heptane	C_7H_{16}	n/a

Date of performance: 19.03.2012

Lead Engineer _____ O.O. Kozlitin
(signature)

Head of Central
Geological and Chemical Laboratory _____ T.M. Makeieva
(signature)