JI MONITORING REPORT

FOR REPORTING PERIOD 01.01.2011 – 31.05.2011

Version 2.0
25th of June 2011

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

A.3. Short description of the project activity:

According to data of the mine, during five months (01.01.2011— 31.05.2011) the following amount of methane has been utilized:

For electricity (and heat) m^3 (fuel gas)	20 233 243
For electricity (and heat) m^3 (ignition gas)	824 476
For AGFCP m^3	669 380
Total	21 727 099

Table 1: Amount of methane utilized during monitoring period.

The project is aimed to prevent methane emission into the atmosphere at Lease Enterprise Coal Mine named after A.F. Zasyadko, further referred to as Zasyadko Mine or simply Mine. CMM extracted and recovered during mine works and because of ventilation of Mine, obtained from surface wells drilled into the gob at Zasyadko Coal Mine, is utilized for:

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

Mine has four industrial sites: Vostochnaya, Yakovlevskaya, Centralnaya and Grigoryevskaya. During this monitoring period, Vostochnaya industrial site of Structural Unit Combined Heat and Electricity Plant (hereinafter referred to as SU CHP) was in operation. The electricity generated at SU CHP was supplied in Mine's main, for Mine's local consumption. Heat generated by SU CHP was fed for consumption at Vostochnaya site. Double-block automatic gas filling station (AGFCP) at Vostochnaya site supplies car fleet of Mine and other vehicles from neighbouring districts with fuel.

In the future, commissioning of the second SU CHP at Yakovlevskaya site is intended, and heat supply grid as well. This will make Mine able to feed excess electricity to general consumption grid, supply heat to Vostochnaya, Yakovlevskaya, and Centralnaya sites, and municipal heat supply grid. Besides, gas fuelling stations (AGFCP) will be installed at Yakovlevskaya site.

A.4. Monitoring period:

- Monitoring period starting date: 01/01/2011;
- Monitoring period closing date: 31/05/2011[1].

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 electricity (electrical or motive) and heat and/or destruction by flaring")* has been used to identify the baseline scenario of this JI project. This methodology also refers to the "Tool for calculation of 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".

[1] Both days were included. Monitoring period includes time from 00-00 01/01/11 up to 24-00 31/05/11.

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 electricity (electrical or motive) and heat and/or destruction by flaring")* was used to identify the baseline scenario of this JI project.

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

Activity	Planned installation date, as stated in the PDD	Implemetation 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 modules at Vostochnaya site	January 2006	January 2006
Commissioning of the 12th CHP modules at Vostochnaya site	April 2006	April 2006
Heat delivery from CHP modules to, and shut-down of boilers 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 delivery from CHP modules to, and shut-down of boilers Yakovlevskaya site	Jule 2008	Delayed due to accident 2007, planned for October 2012
Heat delivery from CHP modules to, and shut-down of boilers Centralnaya site	July 2009	Delayed due to accident 2007, planned for October 2012
Commissioning of the 1st CHP unit at Yakovlevskaya site	May 2008	Delayed due to accident 2007, planned for December 2011
Commissioning of 12th CHP unit at Yakovlevskaya site	December 2009	Delayed due to accident 2007, planned for March 2012
Supply of heat to DH - 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. A delay in the implementation schedule was noted as compared with implementation schedule from PDD as shown above. In view of this, within the monitoring period, following project parts have not been introduced:

- Electricity: Yakovlevskaya SU CHP is not in operation at this moment. At this site, electricity generation is not running; as a result, GEN_{CHP} includes only net electricity generated by Vostochnaya SU CHP;
- Heat: during this monitoring period, infrastructure for heat supply of four sites of Mine and municipal heat supply grid are absent, save heat supply from Vostochnaya SU CHP to Vostochnaya site. In view of this, at this monitoring period, monitoring of following variable data was not performed: $HEAT_{deliv,DH,y}$; $HEAT_{deliv,yak,y}$; $HEAT_{deliv,centr,y}$.

General amount of heat supplied is equal to amount of heat supplied from Vostochnaya SU CHP ($HEAT_{deliv,vost,y}$);

- Coal Mine Methane(CMM), utilized at SU CHP: As Yakovlevskaya SU CHP was not in operation during this monitoring period, CMM was not utilized at this SU CHP. Therefore, $MM_{CHP,y}$ included only CMM, utilized by Vostochnaya SU CHP;
- Coal Mine Methane(CMM) utilized at AGFCP. From four planned fuel stations (one- at Vostochnaya site, one- at Centralnaya site, and two-at Yakovlevskaya site), during this monitoring period, block gas filling station 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:

There are deviations in the monitoring plan compared to the final monitoring plan dd. 27 March 2008 as described in the PDD version 4.4. Subject to Order Approval of Specific Carbon Dioxide Emission Values in 2011 Nr. 75 dd. May 12, 2011 issued by State Environmental Investment Agency of Ukraine, following changes have been put:

- $EF_{grid, produced, y}$ — emission ratio for power related to substituted power generation of the grid by project activity in the year;
- $EF_{grid, reduced, y}$ — emission ratio for power related to substituted power consumption at the site by project activity in the year.

According to the diagram shown in figure 1, values of the specific carbon dioxide emissions by consumption of the power by the consumers which relate to the 1st category according to the Procedure of Definition of Consumer Category approved by National Regulatory Electricity Commission of Ukraine # 1052 dd. August 13, 1998. Calculation of baseline emissions by substitution of the power generation under project is performed under formula 14 Section D.3.2.

In case when net electricity to be fed under SU CHP project (GEN_{CHP}) exceeds net electricity consumed by the Mine $EL_{consumed}$, the calculation of baseline emissions by substitution of the power generation under project is performed under formula 15 Section D.3.2; at that, following items will apply:

- specific carbon dioxide emissions by electricity generation by heat and power plants which are connected to United Energy System of Ukraine;

- specific carbon dioxide emissions by electricity consumption by the consumers related to 1st category.

These figures for carbon dioxide specific emissions will be applied until new figures of carbon dioxide specific emissions will be approved by State Environmental Investment Agency of Ukraine. Other parameters have not been changed and formulae were not changed as well.
More detailed description of layout and work of metering equipment is shown in Section B.1.2.

A.9. Changes since last verification:

During 01/01/2011-31/05/2011, no changes occurred since last verification.

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

Structural Unit Combined Heat and Electricity Plant (SU CHP) at Lease Enterprise Coal Mine named after A.F. Zasyadko

- Borys Bokiy, Deputy General Director, Lease Enterprise Coal Mine named after A.F. Zasyadko
- Yevgen Berezovskiy, SU CHP Chief;
- Valeriy Cherednikov, Monitoring Engineer, SU CHP Gas Treatment Lead Engineer;

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.

Electricity measurements

There are no changes since last monitoring period.

Heat measurements

There are no changes since last monitoring period.

B.1. Monitoring equipment

There are no changes since last monitoring period.

1. Electricity meters "Elster-Metronika";
2. Heat meter 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 calibration, information to specific uncertainty, need for changes and replacements):

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

Electricity metering devices

Following parameters shall be measured for emission reduction monitoring[2]:

- GEN_{CHP} — net electricity generated by SU CHP under project(MWh);
- $El_{consumed}$ — net electricity consumed by Mine (MWh)[3].

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

- GEN_{CHP} = 69 692,321 MWh;
- $EL_{consumed}$ = 89 714,880 MWh.

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

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

Tables below show more detailed information about meters.

Amount of electricity which has been fed into energy system by Substation 110kV from SU CHP is summarized by way of addition of total electricity amount generated by each separate SU CHP unit excluding secondary electricity consumption by SU CHP itself.

This calculation is performed under 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 electricity fed to energy system of Substation -110 from SU CHP (kWh);

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

[3] Net electricity consumption of Mine El $_{consumed}$ is demonstrated in the report of Chief Energy Engineer of the Mine according to data of thirteen commercial meters located at other 110 kV substations at LE Mine named after A.F.Zasyadko. Meters E17, E18 are included in thirteen commercial meters and are located at Vostochnaya substation 110 kV.

- $\sum E_{mod}$ — gross electricity generated by each individual SU CHP unit (kWh);
- $\sum E_{aux}$ — own electricity consumption by SU CHP (kWh).

Respective description of meters see in the table 5 provided below. Because for check of electricity at high voltage, it is impossible to use data directly from meters, current and voltage transformers are used. In the first table, converted data for calculation of actual data are shown.

Cross-checking of EuroALPHA Electricity Meter Reading

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

Each genset cell is provided with universal microprocessor protection and control devices (REF), which allow, among other functions, performance of technical recording of electricity amount. Data from REF are hourly fixed in the database. Upon expiry of the day, hourly generation per each genset is fixed.

SU CHP Chief Dispatcher performs daily comparison of readings of AECRS and REF.

Summary crosschecking results from 01.01.2011until 31.05.2011 are shown in the table 3.

01.01.2011 – 31.05.2011			
Months	**Active electricity generation AECRS**	**Active electricity generation REF**	**Relative difference in AECRS-REF readings**
	kWh	**kWh**	**%**
January	**11 574 939**	**11 560 936**	**0,12**
February	**13 541 494**	**13 526 692**	**0,11**
March	**16 368 768**	**16 352 108**	**0,10**
April	**15 000 249**	**14 988 026**	**0,08**
May	**15 432 337**	**15 421 899**	**0,07**
Total	**71 917 786**	**71 849 662**	**0,09**

Table 3. AECRS – REF summary crosschecking results

Electricity Meters

Number	Metering instrument	Work parameter kWh, kVA	Manufacturer	Type	Serial Number	Accuracy[4]	Date of installation	Date 01.01.2011	Date 31.05.2011	Diffe-rence	Date of calibration	Date of next calibr.	Remarks
E1	Electricity meter at SU CHP system (6 kV) Wireway	Net electricity generated by SU CHP system. P,Q	"Elster-Metronika" Russia	Electronic	№ 01116374	0.2S[5]	N/A	9 100,0971	10 003,3812	903,2841	14.05.2005 13.05.2011	13.05.2017	Double side. Cubicle No.A21
E2	Electricity meter at SU CHP system (6 kV) Wireway	Net electricity generated by SU CHP system. P,Q	"Elster-Metronika" Russia	Electronic	№ 01116376	0.2S	N/A	9 531,4268	10 471,8549	940,4281	14.05.2005 13.05.2011	13.05.2017	Double side. Cubicle No.B22
E17	Commercial electricity meter 110 kV	Consumption of electricity from or supply Ukrainian grid with	"Elster-Metronika" Russia	Electronic	№ 01194835	0.2S	N/A	226,0750	230,6708	4,4558	N/A Belongs to supply company	N/A	Substation 110kV T1
E18	Commercial electricity meter 110 kV	Consumption of electricity from or supply Ukrainian grid with	"Elster-Metronika" Russia	Electronic	№ 01194834	0.2S	N/A	167,2187	192,2356	25,0169	N/A Belongs to supply company	N/A	Sub-station 110kV T2

Table 4. Electricity meters arranged at Substation 110kV site

[4] 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.

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

Number	Metering instrument	Work parameter kWh, kVA	Manufacturer	Type	Serial Number	Accuracy	Date of installation	Date 01.01.11	Date 31.05.11	Difference	Date of calibration	Date of next calibr.	Remarks
E3	Electricity meter at SU CHP system (6 kV) Auxiliary transformer	Electricity consumed by SU CHP system, P, Q	"Elster-Metronika" Russia	Electronic	№ 01103251	0.5S	N/A	4 781,4811	5 193,6832	412,2021	14.04.2010	14.04.2016	Cubicle No.1
E4	Electricity meter at SU CHP system (6 kV) Auxiliary transformer	Electricity consumed by SU CHP system, P, Q	"Elster-Metronika" Russia	Electronic	№ 01103208	0.5S	N/A	4 834,0080	5 180,3795	346,3715	14.04.2010	14.04.2016	Cubicle No.2
E5	Electricity meters at individual SU CHP modules (6 kV) No.1	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117846	0.2S	N/A	10 821,3317	12 015,7114	1 194,3797	14.04.2010	14.04.2016	Double side. Cubicle No.5
E6	Electricity meters at individual SU CHP modules (6 kV) No.3	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117849	0.2S	N/A	12 004,3140	13 257,1024	1 252,7884	12.04.2010	12.04.2016	Double side. Cubicle No.7
E7	Electricity meters at individual SU CHP modules (6 kV) No.5	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117851	0.2S	N/A	11 978,0501	13 233,1247	1 255,0746	07.04.2010	07.04.2016	Double side. Cubicle No.9
E8	Electricity meters at individual SU CHP modules (6 kV) No.7	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117852	0.2S	N/A	11 452,1590	12 667,4530	1 215,2940	13.04.2010	13.04.2016	Double side. Cubicle No.11
E9	Electricity meters at individual SU CHP modules (6 kV) No.9	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117855	0.2S	N/A	13 245,6354	14 563,6681	1 318,0327	13.04.2010	13.04.2016	Double side. Cubicle No.13
E10	Electricity meters at individual SU CHP modules (6 kV) No.11	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117856	0.2S	N/A	12 645,9226	13 835,1467	1 189,2241	07.04.2010	07.04.2016	Double side. Cubicle No.15

Number	Metering instrument	Work parameter kWh, kVA	Manufacturer	Type	Serial Number	Accuracy	Date of installation	Date 01.01.11	Date 31.05.11	Difference	Date of calibration	Date of next calibr.	Remarks
E11	Electricity meters at individual SU CHP modules (6 kV) No.2	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117848	0.2S	N/A	12 847,0514	13 021,0771	174,0257	12.04.2010	12.04.2016	Double side. Cubicle No.6
E12	Electricity meters at individual SU CHP modules (6 kV) No.4	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01122645	0.2S	N/A	8 299,7955	9 586,7755	1 286,9800	12.04.2010	12.04.2016	Double side. Cubicle No.8
E13	Electricity meters at individual SU CHP modules (6 kV) No.6	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01122650	0.2S	N/A	11 996,4435	13 456,0563	1 459,6128	14.04.2010	14.04.2016	Double side. Cubicle No.10
E14	Electricity meters at individual SU CHP modules (6 kV) No.8	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01117845	0.2S	N/A	14 211,0145	15 446,6688	1 235,6543	07.04.2010	07.04.2016	Double side. Cubicle No.12
E15	Electricity meters at individual SU CHP modules (6 kV) No.10	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01132765	0.2S	N/A	13 193,2966	14 594,1947	1 400,8981	13.04.2010	13.04.2016	Double side. Cubicle No.14
E16	Electricity meters at individual SU CHP modules (6 kV) No.12	Electricity generated by SU CHP system P,Q	"Elster-Metronika" Russia	Electronic	№ 01132766	0.2S	N/A	9 821,6752	11 109,1123	1 287,4371	14.04.2010	14.04.2016	Double side. Cubicle No.16

Table 5. Electricity meters arranged at individual SU CHP unit

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

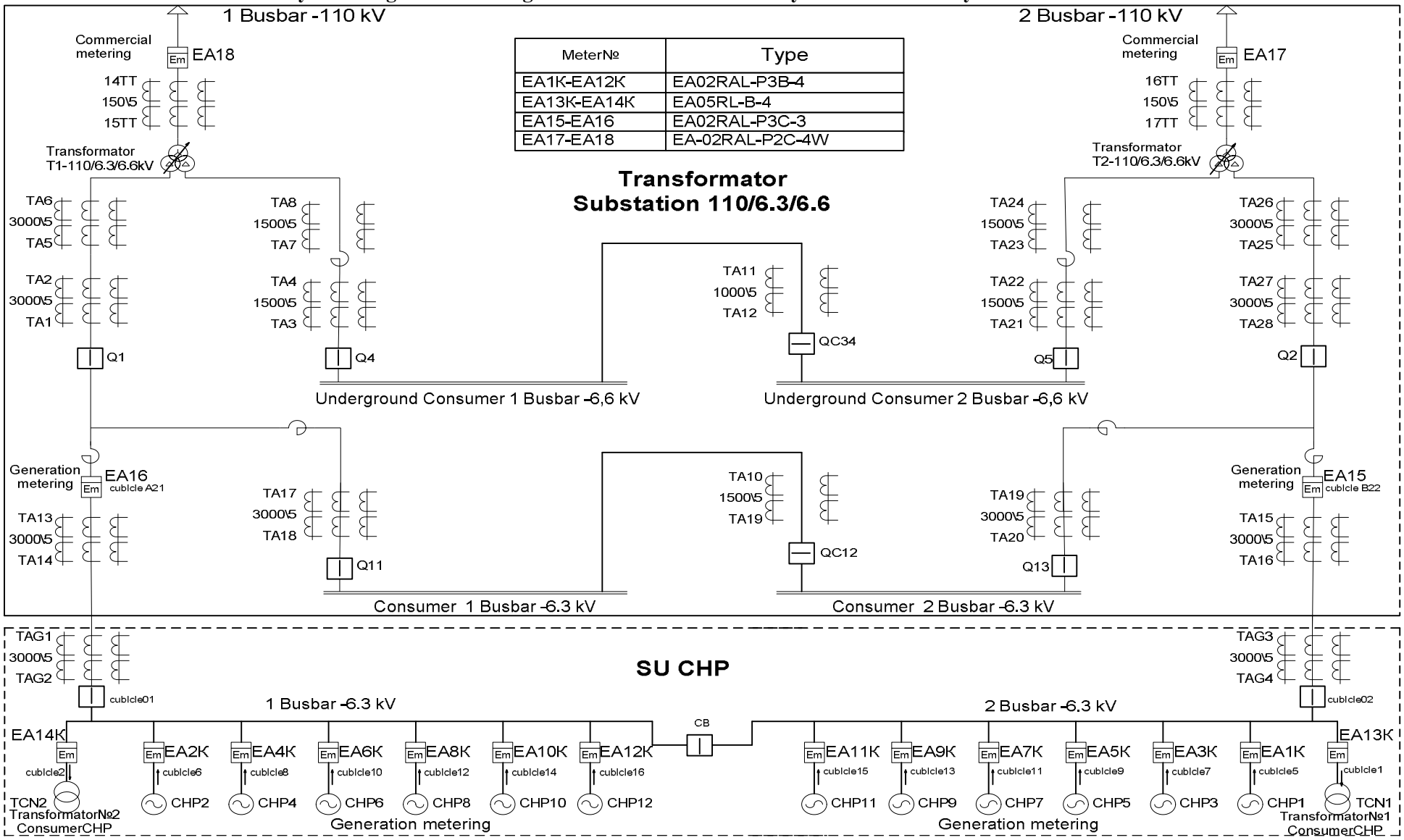
In view of high voltage and currents, it is impossible to obtain direct data from electricity meters on generation and consumption of electricity without current and voltage transformers, for accounting of equipment operation. The calculation method is following example for meter No. 01116374: Current -3000/5= 600 A; voltage-6300/100=63 V (gross factor -600 x 63 =37800 VA). ***Date on meter -903,2841. Electricity to be accounted with this meter makes up: 903,2841x 600 x 63=34 144 138,98 VA = 34 144 138,98 kW***

Number	Metering instrument	Work parameter kWh, kVA	Type	Serial Number	Current transformer	Voltage transformer	Coefficient for calculations	Electricity Amount
E1	Electricity meter at SU CHP system (6 kV) Wireway	Net electricity generated by SU CHP system, P,Q	Electronic	№ 01116374	3000/5	6300/100	37800	34 144 138,98
E2	Electricity meter at SU CHP system (6 kV) Wireway	Net electricity generated by SU CHP system, P,Q	Electronic	№ 01116376	3000/5	6300/100	37800	35 548 182,18
E3	Electricity meter at SU CHP system (6 kV) Auxiliary transformer	Electricity consumed by SU CHP system, P, Q	Electronic	№ 01103251	200/5	6300/100	2520	1 038 749,29
E4	Electricity meter at SU CHP system (6 kV) Auxiliary transformer	Electricity consumed by SU CHP system, P, Q	Electronic	№ 01103208	200/5	6300/100	2520	872 856,18
E5	Electricity meters at individual SU CHP modules (6 kV) No.1	Electricity generated by SU CHP system, P,Q	Electronic	№ 01117846	400/5	6300/100	5040	6 019 673,69
E6	Electricity meters at individual SU CHP modules (6 kV) No.3	Electricity generated by SU CHP system P,Q	Electronic	№ 01117849	400/5	6300/100	5040	6 314 053,54
E7	Electricity meters at individual SU CHP modules (6 kV) No.5	Electricity generated by SU CHP system P,Q	Electronic	№ 01117851	400/5	6300/100	5040	6 325 575,98
E8	Electricity meters at individual SU CHP modules (6 kV) No.7	Electricity generated by SU CHP system P,Q	Electronic	№ 01117852	400/5	6300/100	5040	6 125 081,76
E9	Electricity meters at individual SU CHP modules (6 kV) No.9	Electricity generated by SU CHP system P,Q	Electronic	№ 01117855	400/5	6300/100	5040	6 642 884,81
E10	Electricity meters at individual SU CHP modules (6 kV) No.11	Electricity generated by SU CHP system P,Q	Electronic	№ 01117856	400/5	6300/100	5040	5 993689,46
E11	Electricity meters at individual SU CHP modules (6 kV) No.2	Electricity generated by SU CHP system P,Q	Electronic	№ 1117848	400/5	6300/100	5040	877 089,53
E12	Electricity meters at individual SU CHP modules (6 kV) No.4	Electricity generated by SU CHP system P,Q	Electronic	№ 01122645	400/5	6300/100	5040	6 486 379,20
E13	Electricity meters at individual SU CHP modules (6 kV) No.6	Net electricity generated by SU CHP system, P,Q	Electronic	№ 01122650	400/5	6300/100	5040	7 356 448,51
E14	Electricity meters at individual SU CHP modules (6 kV) No.8	Net electricity generated by SU CHP system, P,Q	Electronic	№ 01117845	400/5	6300/100	5040	6 227 697,67

Number	Metering instrument	Work parameter kWh, kVA	Type	Serial Number	Current transformer	Voltage trans-former	Coefficient for calculations	Electricity Amount
E15	Electricity meters at individual SU CHP modules (6 kV) No.10	Net electricity generated by SU CHP system, P,Q	Electronic	№ 01132765	400/5	6300/100	5040	7 060 526,42
E16	Electricity meters at individual SU CHP modules (6 kV) No.12	Net electricity generated by SU CHP system, P,Q	Electronic	№ 01132766	400/5	6300/100	5040	6 488 682,98
E17	Commercial electricity meter 110 kV	Consumption of electricity from or supply Ukrainian grid with	Electronic	№ 01194835	150/5	110000/100	33000	151 661,40
E18	Commercial electricity meter 110 kV	Consumption of electricity from or supply Ukrainian grid with	Electronic	№ 01194834	150/5	110000/100	33000	825 557,70

Table 6. Electricity calculation

Electricity Metering Device Arrangement Scheme for Vostochnaya SU 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: Electricity Metering Device Arrangement Scheme for Vostochnaya SU CHP and 110 kV Substation

Heat Meter

Heat measurements

For this monitoring period, only heat is considered that was directly fed by Vostochnaya SU CHP, as described in paragraph A.7. Therefore, for this monitoring period, only one variable is measured that expresses heat amount fed by SU CHP system to heat supply pipelines, and is equal to heat amount consumed by Vostochnaya site.

Metering instrument	Work parameter Gcal	Manufacturer	Type	Serial number	accuracy	Date of installation	Date 01.01.2011 Gcal	Date 31.05.2011 Gcal	Difference	Date of calibration	Date of next calibr.	Remarks
Heat meter SA 94/2M[6]	Amount of heat delivered to site system	ASWEGA	Mechatronic	22903	Heat- 4 Flow-2	N/A	149 138,73	165 149,89	16 011,16	04.06.09 05.05.11	05.05.13	Principal Metering System

Table 7. Heat meters arranged at SU CHP site.

[6] For meter SA 94/2M DN=300mm; Q=1000m^3/h

Heat Metering Scheme for Vostochnaya SU CHP Facility

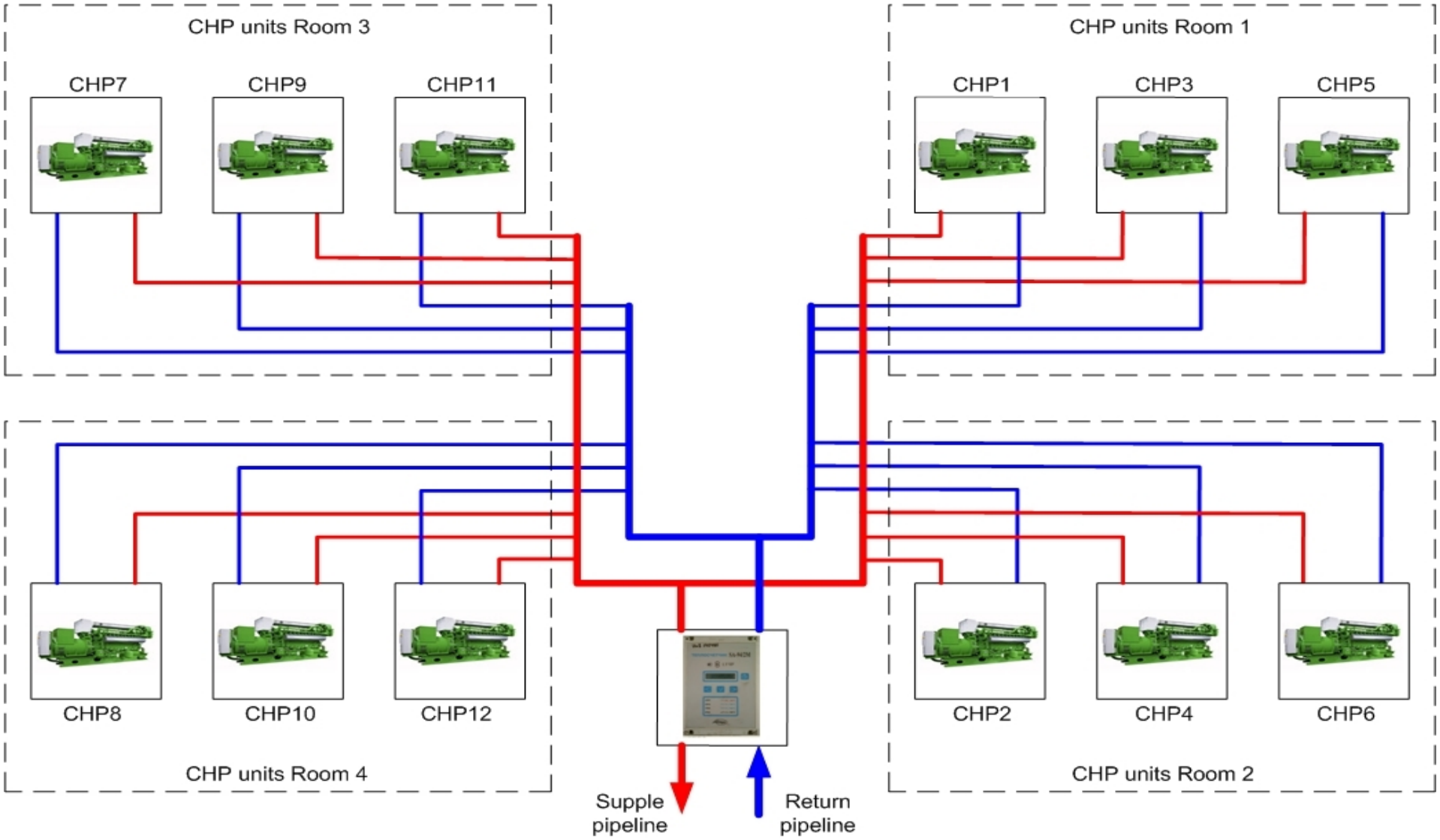


Figure 2: Heat Metering Scheme for Vostochnaya SU CHP Facility

CMM Meters

Measurement of CMM consumption

According to monitoring plan, two variables are measured:

- MM_{CHP} - measured amount of methane consumed by SU CHP units (tCH_4);
- MM_{GAS} - measured amount of methane fuelled in 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 pure consumed CH_4 consumed by SU CHP (in tonnes) the amount of pure CH4 (in m^3) has to be measured under normal conditions[7]. 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)* the different meters and sensors are indicated that are installed at the Vostochnaya site. We can classify the different meters/sensors:

- Scheme of location of main primary 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 location of meters/sensors (with addition of secondary meters/ sensors) (*Figure 4)* used for cross-checking 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 the table 8 the primary and secondary meters/sensors are indicated with their numbers which 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[8] 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" [9] 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" [9] metering system	Calculations

Table 8: Primary and secondary coal mine methane metering devices

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

[8] 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 meter.

[9] 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 an amount of fuel gas consumption at each SU CHP unit, including one ignition gas metering device, represented as following:

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

where:

VM_n — fuel gas consumption by separated SU CHP unit, brought to standard[10]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 following:

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

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 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 SU CHP units 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 about flow meter are shown in table 10. This device has structure as block of velocity, pressure and temperature sensors that measure volumetric flow of gas consumed by SU CHP units and data on methane concentration in point A1 with gas analyzer AO 2040 (ABB). Amount of methane to be calculated on the base of these data, but it is not used for database formation; it is used only together with technological purposes and for crosschecking and control of SU CHP operation systems. This procedure is carried out on regular basis -daily. Summary results of the internal cross checkings from 01.01.2011 until 31.05.2011 are presented in the table 9

01.01.2011 - 31.05.2011				
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 ∑ ВКТ.М1- ВКТ.М4, %**
	Gn5	***Gn5 * CH4/100***	***∑ BKT.M1-BKT.M4***	
January	11 163 734,84	3 189 181,49	3 189 151,88	0,00
February	13 220 657,02	3 859 439,42	3 862 113,94	-0,07
March	15 882 921,41	4 685 344,75	4 686 886,19	-0,03
April	14 355 882,00	4 210 081,22	4 210 634,89	-0,01
May	14 296 991,77	4 285 881,00	4 284 455,76	0,03
Total	**68 920 187,04**	**20 229 927,88**	**20 233 242,66**	**- 0,02**

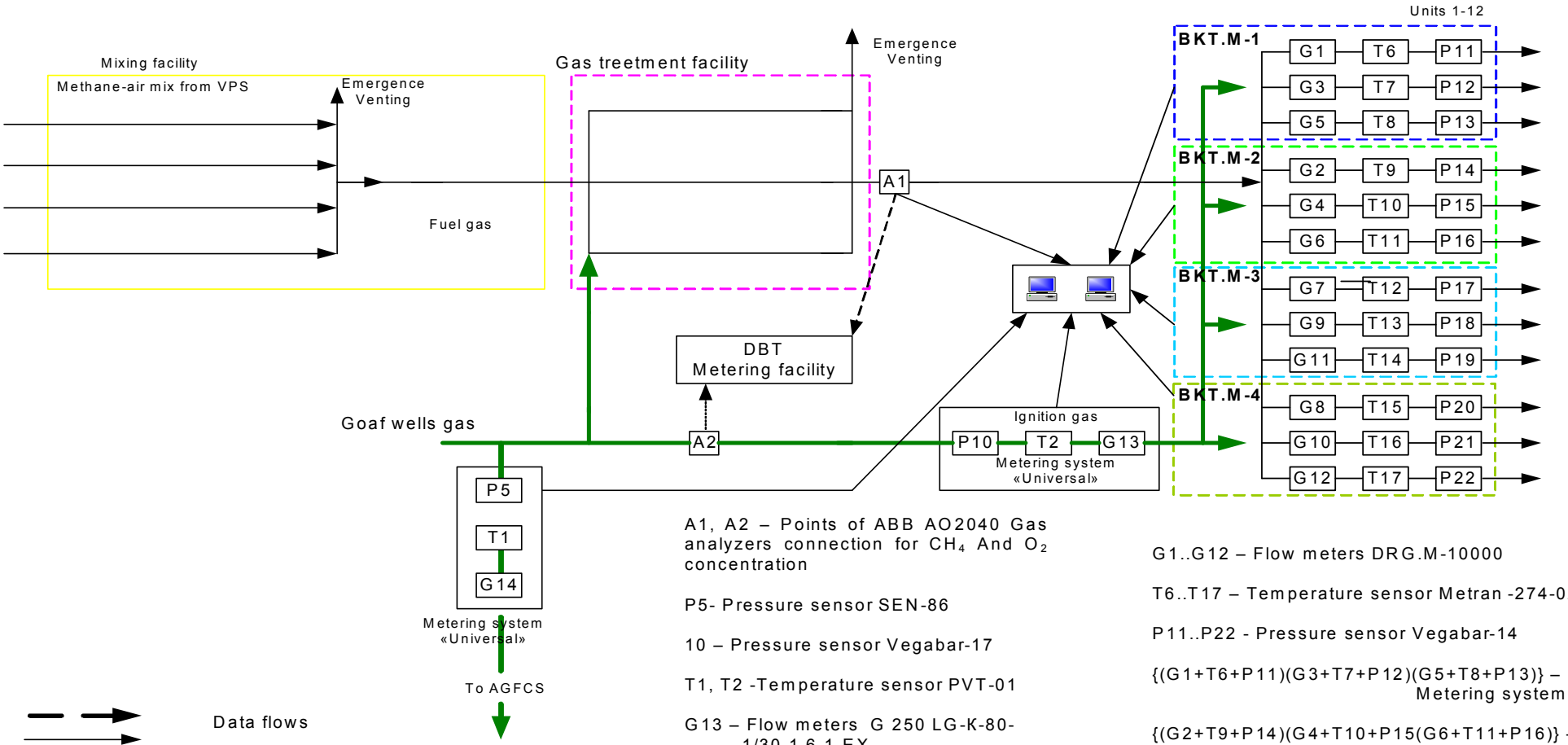
Table 9. Summary results of cross checking

Measurement System	Manufacturer	Type	Serial Number	Allowable uncertainty	Calibration Date	Next Calibration Date
ADM	Keuter	Electronic	167	heat – 0,25% pressure – 0,5%	02.07.10	02.07.11

Table 10. Metering Device Gn5

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

Scheme of location of main meters /sensors at Vostochnaya SU CHP in 2011



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

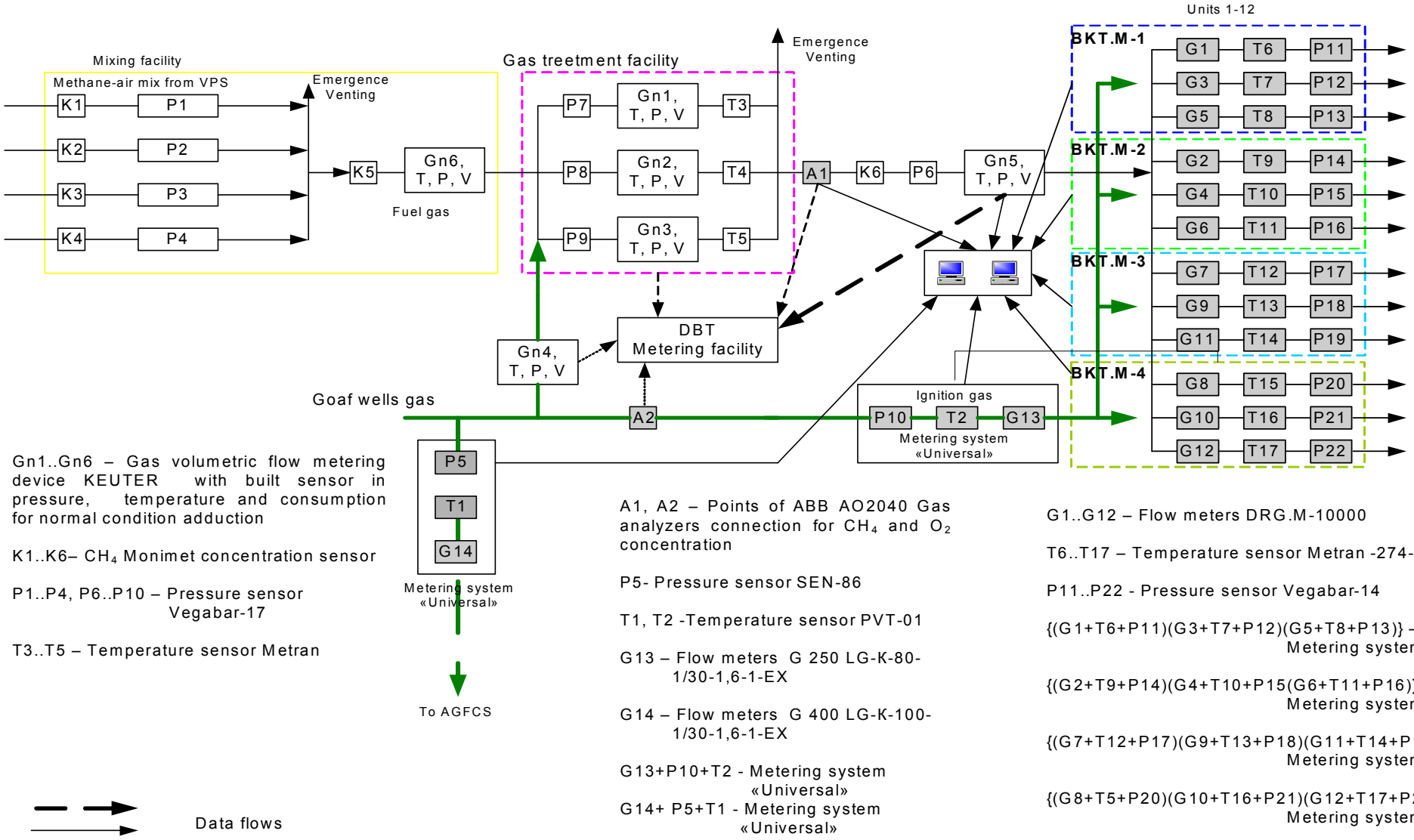
{(G2+T9+P14)(G4+T10+P15(G6+T11+P16)} – Metering system BKT.M-2

{(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 location of primary meters/ sensors

General scheme of location of meters /sensors at Vostochnaya SU CHP in 2011



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 location of meters/ sensors including secondary meters/sensors

The general flow of CMM and the metering can be described as follows.[11]

Coal mine gas of degassing and gas-suction is supplied through four lines from two Vacuum Pump Station (VPS) to gas mixing section of the SU CHP gas treatment facility. 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 in coal mine gas metering and have technological meaning; these data are channelled to automatic control system of the dispatch 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 unit 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 by flow meter Gn4 (Keuter, ADM metering system). The concentration of methane is measured by gas analyser AO 2040 (ABB) in 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 this 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. Acting flow measurements is provided by Gn1 - Gn3 (Keuter) flow meters together with velocity, pressure and temperature sensors. They transmit information to calculation equipment developed by DBT which is installed in separate premise. This unit calculates the values of actual consumption for normal conditions and channelled them to automatic control system of the dispatch computer system for operation 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 e pressure swings at abrupt changes of SU CHP operation regime. Pressure at the outflow of the section is controlled by processing sensor P6 (Vegabar-17).

With the purpose of fuel gas concentration definition, gas testing is made at the outflow of gas treatment section of facility in point A1 which is fed to gas analyzer AO 2040 (ABB) mounted at gas metering unit. Concentration measured is checked for the compliance with sensor K6 (Monimet). Flow meter Gn5 (Keuter) as a unit with velocity, pressure and temperature sensors, measures the gas amount used by SU CHP units. The methane amount is calculated based on the data of methane concentration but is not used for database establishment and metering, it is used only for technological purposes and establishment of crosscheckings.

Further, fuel gas is supplied to the units of SU 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 12 units. Their data are transmitted to micro- processing control system BKT.M designed for transformation of input information about gas parameters and for calculation of the base thereof of amount and volumetric amount of gas flow brought to standard conditions to calculate fuel gas amount which is used by each unit, and total amount in each engine room. Fuel gas amount is calculated based on the data of methane concentration in it. Fuel gas amount calculation is performed on the base of data received from control units for gas record BKT.M1-BKT.M4, and concentration of methane therein as received from gas analyzer AO 2040 (ABB) in 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 CHP gas methane utilized. This information is entered into database and logs.

[11] From 2008, DBT equipment is used as equipment for operation and control of stations, as well as for crosschecking. Main meters and sensors which are installed at each SU CHP unit, 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. These systems are run with fuel gas. Ignition gas for all SU CHP units is measured with a new metering system Universal. All this data are stored and are transmitted to SU CHP computer system.

Ignition gas is supplied to SU CHP units from gas pipes of surface degasification wells 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 of the base thereof of amount and volumetric amount of gas flow brought to standard conditions, which included 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 in the point A2. Based on data received from metering system Universal, ignition gas automatic control system is kept, which gas is supplied to SU CHP units and recorded in database and log.

Gas for vehicle fuelling is also supplied to SU CHP units from gas pipes of surface degasification wells 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 of the base thereof of amount and volumetric amount of gas flow brought to standard conditions, which included gas metering device G14 (G 400 LG-K-100-1/30-1,6-1-Ex), temperature sensor T1 (PVT-01-1), and pressure sensor P5 (SEN-8601). Because the gas being fed for vehicle fuelling and ignition gas to feed to SU CHP units is a gas of uniform system of surface degasification wells, control of the gas concentration is performed by gas analyzer AO 2040 (ABB) with gas test in the point A2. Based on these data, amount of methane consumed at AGFCP as vehicle fuel is fixed in database and log.

Methane volume which is supplied with fuel gas and ignition gas gives total amount of methane supplied to SU CHP Units.

Methane volume which is supplied with fuel gas and ignition gas, and methane for vehicle filling give total amount of methane consumed by Vostochnaya site of Zasyad'ko Coal Mine.

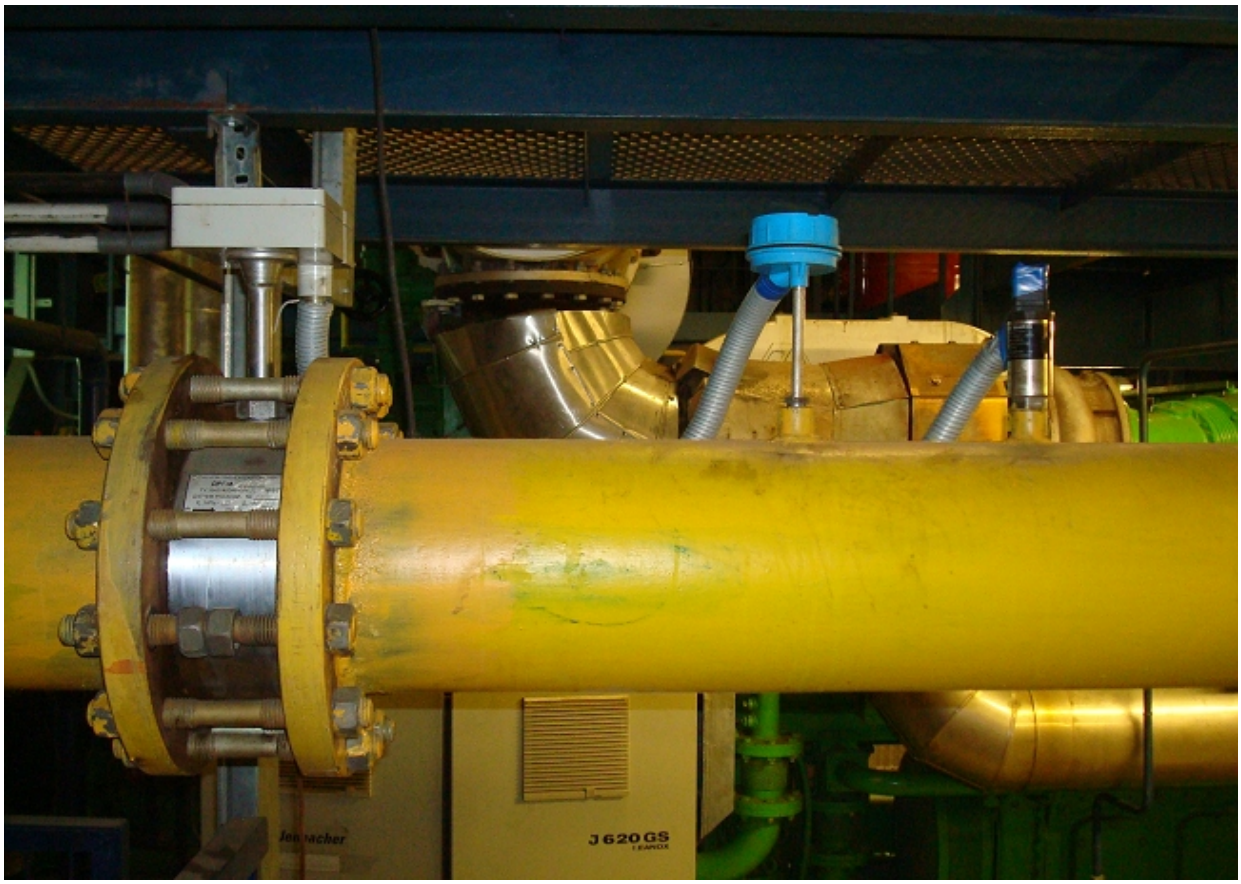


Figure 5: Gas flow meter DRG.M-10000[12] temperature sensor Metran 274-02 and pressure sensor Vegabar-14 of metering system for gas record BKT.M at fuel gas pipeline of SU CHP unit.

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

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

CHP gas metering equipment

Item No.	Metering instrument design	Work parameter	Manufacturer	Type	Serial number	Uncertainty level of data	Date of installation	Date of calibration	Date of next calibr.	Remarks
C1	Concentration of fuel gas	%	ABB	AO 2040 Electronic	3.244705.5	± 1%	2005	09.07.10	09.07.11	Connection A1
C2	Concentration of ignition gas	%	ABB	AO 2040 Electronic	3.244704.5	± 1%	2005	09.07.10	09.07.11	Connection A2

Table 11. Gas analyzers.

Item No.	Gas to be measured	Metering instrument design	Work parameter	Manufacturer	Type	Serial number	Uncertainty level of data	Date of installation	Date of calibration	Date of next calibr.	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	10.03.09 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	10.03.09 10.03.11	10.03.13	Connection T2
		Ignition gas pressure measurement	bar	"VEGA" Germany	Vegabar-17	12307278	± 0.5%	4 quarter 2007	09.03.10 09.03.11	09.03.12	Connection P10

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

Item No.	Gas to be measured	Metering instrument design	Work parameter	Manufacturer	Type	Serial number	Uncertainty level of data	Date of installation	Date of calibration	Date of next calibr.	Remarks
V2	Gas for motor vehicle filling	Gas for motor vehicle filling 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	15.07.09	15.07.11	Connection G14
		Gas for motor vehicle filling temperature measurement	^oC	NVP"GREMPIS" ltd	PVT-01-1	211	± 0.5%	4 quarter 2007	28.07.10	28.07.12	Connection T1
		Gas for motor vehicle filling pressure measurement	bar	"COBOLD" Germany	SEN-8601	45	± 0.5%	4 quarter 2007	28.07.10	28.07.11	Connection P5

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

Item No.	Metering system	Work parameter: m^3 /h	manufacturer	Type	Serial number	Uncertainty level of data and accuracy	Date of installation	Data as of 01.01.2011 m^3	Data as of 31.05.2011 m^3	Difference	Date of calibration	Date of next calibration	Remarks
V_1	Universal	Ignition gas amount	NVP"GREMPIS" ltd	Universal -2	6023	± 0.2 %	4 quarter 2007	5 866 986,6	6 753 520,5	886 533,9	10.03.09 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	7 457 355	8 177 118	719 763	28.07.10	28.07.12	Main metering block

Table 14. Gas amount and volumetric flow computing block

Item No.	Metering system	Work parameter: m^3	Manufacturer	Serial number	Uncertainty level of data and accuracy	Date of installation	Unit No.	Data as of 01.01.2011 m^3	Data as of 31.05.2011 m^3	Difference	Date of calibration	Date of 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 defintion status brought to standard conditions, not exceeding ±0.35 %; • Change of running time, not exceeding ±0.1 %.	N/A	**M1**	4 473 476	10 630 702	6 157 226	05.05.09	05.05.12	Main metering block
							M3	5 395 689	11 831 409	6 435 720			
							M5	4 673 455	11 208 443	6 534 988			
V_4	BKT.M - 2	Fuel gas amount	Sibnefteavtomatika, Russia	**095**		N/A	**M2**	22 198 704	23 074 776	876 072	20.01.09	20.01.12	Main metering block
							M4	17 171 774	23 852 614	6 680 840			
							M6	24 370 534	31 962 758	7 592 224			
V_5	BKT.M - 3	Fuel gas amount	Sibnefteavtomatika, Russia	**Before 01.03.11 100**		N/A	**M7**	Data on the testimony BKT.M see below			18.03.08	18.03.11	Main metering block
				After 01.03.11 5668			**M9** **M11**				17.03.09	17.03.12	
V_6	BKT.M - 4	Fuel gas amount	Sibnefteavtomatika, Russia	**099**		N/A	**M8**	31 045 742	37 452 000	6 406 258	05.08.08	05.08.11	Main metering block
							M10	29 260 138	36 585 252	7 325 114			
							M12	18 583 728	25 149 112	6 565 384			

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 01.01.2011 m^3	Data as of 01.03.2011 m^3	Difference	Serial number	Data as of 01.03.2011 m^3	Data as of 31.05.2011 m^3	Difference	∑ fuel gas
V_5	**ВКТ.М-3**	**100**	**M7**	29 684 186	31 545 786	1 861 600	**5668**	0	4 402 882	4 402 882	6 264 482
			M9	38 669 428	41 251 468	2 582 040		0	4 249 490	4 249 490	6 831 530
			M11	36 909 120	39 030 120	2 121 000		0	4 000 159	4 000 159	6 121 159

Table 16. Records of BKT.M-3 (before and after substitution)

Item No.	Gas to be metered	Symbol on scheme	Metering device designation	Work parameter	Manufacturer	Type	Serial number	Allowed uncertainty	Date of installation	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	19.08.09	19.08.11	Fuel gas metering system BKT.M- 1
		T6	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	510745	± 0,5%	N/A	22.07.10	22.07.11	
		P11	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536534	± 0,5%	N/A	04.06.10	04.06.11	
M3	Fuel	G3	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	109	± 1.0%	N/A	19.08.09	19.08.11	
		T7	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	510753	± 0,5%	N/A	02.07.10	02.07.11	
		P12	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536342	± 0,5%	N/A	04.06.10	04.06.11	
M5	Fuel	G5	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	103	± 1.0%	N/A	19.08.09	19.08.11	
		T8	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	509669	± 0,5%	N/A	22.07.10	22.07.11	
		P13	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14447569	± 0,5%	N/A	04.06.10	04.06.11	

Table 17. Meters/sensors of fuel gas metering system BKT.M-1

Item No.	Gas to be metered	Symbol on scheme	Metering device designation	Work parameter	Manufacturer	Type	Serial number	Allowed uncertainty	Date of installation	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	15.06.09 28.04.11	28.04.14	Fuel gas metering system BKT.M - 2
		T9	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	510735	± 0.5%	N/A	21.07.10	21.07.11	
		P14	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568471	± 0.5%	N/A	02.06.10	02.06.11	
M4	Fuel	G4	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	104	± 1.0%	N/A	15.06.09 28.04.11	28.04.14	
		T10	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	509670	± 0.5%	N/A	21.07.10	21.07.11	
		P15	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536186	± 0.5%	N/A	02.06.10	02.06.11	
M6	Fuel	G6	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	097	± 1.0%	N/A	15.06.09 28.04.11	28.04.14	
		T11	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	510733	± 0.5%	N/A	21.07.10	21.07.11	
		P16	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536368	± 0.5%	N/A	02.06.10	02.06.11	

Table 18. Meters/ sensors of fuel gas metering system BKT.M – 2

Item No.	Gas to be metered	Symbol on scheme	Metering device designation	Work parameter	Manufacturer	Type	Serial number	Allowed uncertainty	Date of installation	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	17.07.09	17.07.11	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	21.07.10	21.07.11	
		P17	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568573	± 0.5%	N/A	03.06.10	03.06.11	
M9	Fuel	G9	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	099	± 1.0%	N/A	17.07.09	17.07.11	
		T13	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran -274-02	510742	± 0.5%	N/A	21.07.10	21.07.11	
		P18	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536304	± 0.5%	N/A	03.06.10	03.06.11	
M11	Fuel	G11	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	101	± 1.0%	N/A	17.07.09	17.07.11	
		T14	Fuel gas temperature measurement	^oC	Metran Industrial Group, Russia	Metran -274-02	510738	± 0.5%	N/A	21.07.10	21.07.11	
		P19	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568610	± 0.5%	N/A	03.06.10	03.06.11	

Table 19. Meters/ sensors of fuel gas metering system BKT.M – 3

Item No.	Gas to be metered	Symbol on scheme	Metering device designation	Work parameter	Manufacturer	Type	Serial number	Allowed uncertainty	Date of installation	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	01.07.09	01.07.11	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	23.07.10	23.07.11	
		P20	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568589	± 0.5%	N/A	04.06.10	04.06.11	
M10	Fuel	G10	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	096	± 1.0%	N/A	01.07.09	01.07.11	
		T16	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	510755	± 0.5%	N/A	23.07.10	23.07.11	
		P21	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14536306	± 0.5%	N/A	04.06.10	04.06.11	
M12	Fuel	G12	Fuel gas consumption measurement	m^3	Sibnefteavtomatika, Russia	DRG.M-10000 Electronic	100	± 1.0%	N/A	01.07.09	01.07.11	
		T17	Fuel gas temperature measurement	°C	Metran Industrial Group, Russia	Metran -274-02	510747	± 0.5%	N/A	23.07.10	23.07.11	
		P22	Fuel gas pressure measurement	bar	"VEGA" Germany	Vegabar 14	14568606	± 0.5%	N/A	04.06.10	04.06.11	

Table 20. Meters/ sensors of fuel gas metering system BKT.M – 4

The monitoring system for the emission reductions achieved in the course of the project implementation has been integrated in the Zasyadko Coal Mine existing controlling and reporting system. That allows for 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 and electricity generated were crosschecked to provide quality and reliability of monitored data. To ensure reliable and non-stop performance of SU 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 pressure difference of manometers. Concentration of methane is measured monthly with ABB AO 2040 at SU CHP and surface well gas analysis. Besides, the concentration of methane is measured locally with an interferometer. Temperature and pressure meters are installed too. 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 of such meters is six years. Calibration procedures for meters are implemented in compliance with calibration methodology developed for "Elster-Metronika" meters, Russia. Calibration interval – once per 72 months.	Donetsk Centre for Standardization, Metrology and Certification

Table 21. For Electricity Meters

QA/QC (Quality Assurance/ Quality Control) procedures	Body responsible for calibration and certification
Calibration interval of such meters is two years. Calibration procedures for meters are implemented in compliance with calibration methodology developed for ASWEGA meters, Russia. Calibration interval – once per 24 months.	Donetsk Centre for Standardization, Metrology and Certification

Table 22. For Heat Meters

QA/QC (Quality Assurance/ Quality Control) procedures	Body responsible for calibration and certification
Keuter ADM1 Electronic. Calibration interval of such meters is 12 months[13]	Donetsk Centre for Standardization, Metrology and Certification
Gas Analyzer A0 2040 (ABB). Calibration interval of such meters is 12 months [14].	Donetsk Centre for Standardization, Metrology and Certification
Gas Record Unit BKT.M for amount and volumetric flow of gas record. Calibration interval for such meters is once per 36 months.	Tyumen Centre for Standardization, Metrology and Certification
«Universal» Metering System for amount and volumetric flow of gas record. Calibration interval for such meters is once per 24 months.	Donetsk Centre for Standardization, Metrology and Certification

Table 23. For CMM meters

[13] As there is no state regulation for such kind of equipment there was a decision of Ukrainian Centre for Standardization and Metrology for one year calibration period.

[14] 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 Centre for Standardization, Metrology and Certification;
- Ivano-Frankovsk Scientific and Generation Centre Standardization, Metrology and Certification;
- Tyumen Centre for Standardization, Metrology and Certification;
- Respirator Mining Scientific and Research Institute.

B.2. Date 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	Date variable	Source of data	Date 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 in 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 at the 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 24: Project Variable Values

ID number	Date variable	Source of data	Date unit	Comment
B13 $EF_{grid, produced, y}$	Emissions factor of electricity of replaced grid electricity generation by the project activity in year	Order Nr. 75 dd. May 12, 2011 issued by State Environmental Investment Agency of Ukraine	tCO_2/MWh	Set at 1,063
B14 $EF_{grid,reduced,y}$	Emissions factor of electricity of replaced on-site electricity consumption by the project activity	Order Nr. 75 dd. May 12, 2011 issued by State Environmental Investment Agency of Ukraine	tCO_2/MWh	Set at 1,090
B20 $EF_{heat,vost}$	Emissions factor for heat 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 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 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	Emissions factor for vehicle operation replaced by the project activity	2006 IPCC	tCO_2/GJ	See annex 2 PDD. Set at 0,072

Table 25: Baseline Default Values

B.2.2. List of variables:

Project emissions variables to be measured:

- MM_{CHP} — Methane measured consumed by SU CHP units (tCH_4);
- MM_{GAS} — Methane measured consumed as a fuel at new AGFCPs (tCH_4).

Baseline emissions variables to be measured:

- GEN_{CHP} — Net electricity generated by the project activity by the SU CHP (MW*h);
- $El_{Cconsumed}$ — Net electricity consumed by the mine;
- $HEAT_{consumed, vost, y}$ — Heat consumed at Vostochnaya site delivered by the project

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

Year	MM_{GAS} (tCH_4)
01.01.2011– 31.05.2011	*480*

Table 26: Data to be collected in the project scenario

Year	MM_{CHP} (tCH_4)
01.01.2011– 31.05.2011	*15 092*

Table 27: Data to be collected in the project scenario

For Methane analysis data refer please to Annex 1 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)
01.01.2011– 31.05.2011	*69 692,321*	*89 714,880*	*67 035*

Table 28: 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. At construction of SU CHP and AGFCP, Environmental Impact Assessment has been performed. Pursuant to Atmospheric Air Protection Law of Ukraine, as approved by Decree of Ukrainian Cabinet of Ministers on 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 conducted with the assistance of third-party certified company that provides screening and analysis of samples contaminants pollutant substance with own standard equipment.

Reporting an 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 to the condition of waters is insignificant due tot use of water for domestic needs only. At SU CHP, Grid Water Consumption Metering Device Reading Log is kept; data therefrom are used for preparation of statistical reports. Environmental Impact monitoring for 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 relate to domestic activity only (service and repair of equipment), and household activity. 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. Date processing and archiving (incl. software used):

All dispatchers are responsible for data management. Besides, dispatchers prepare standard daily, weekly, monthly, and annual repots. All appropriate data are collected daily, and archived both in electronic and paper form (see calculation CO_2) All data will be saved in 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 who has access thereto.

Commissioning of modern computer control system will provide efficient online monitoring and performance 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 AGFCP gas record -keeping;
2. Alfa- Center measuring and computing complex integrated into ASKUE (common mine automatic system of electricity commercial record -keeping) - electricity record -keeping;
3. DIA.NE.XT (software delivered with CHP units)– control, regulation, indication, setting, and saving of data for CHP unit.

For calculation of Greenhouse Gas (GHG) Emission Reductions, the SU CHP TP ACS Service has developed own Data Gathering and Processing Automated System (ASZPD) which maintains calculation of fuel gas and heat. 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 01.03.2011, the BKT.M # 100 has been substituted by BKT.M # 5668 because of sending thereof to state calibration at Tyumen Centre for Standardization, Metrology and Certification.

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 Lease Enterprise Zasyadko Coal Mine through supervising and coordinating activities of his subordinates, such as deputy director on surface degasification, chief electricity engineer, chief heating engineer, and chief of safety engineering departments.

On-site day-to-day management is implemented by the manager of cogeneration station who directs two shift operators responsible for cogeneration modules and gas treatment plant performance. An on-duty electrician works at the plant. During the daytime a group of mechanics who are responsible for preventive measures and maintenance of all technological equipment, metering instruments as well as of automation tools and telemechanics are present on-site. On-line information transmitted directly to the head of the shift into the Coal Mine Central Dispatching Office. The cogeneration plant is in 24 hours operation.

At the main objects, the responsibilities are as follows:

- AGFCP operator controls and prepares data and transmits them to SU CHP dispatching office, and performs day-to-day gas record keeping log;
- Two CHP dispatchers control data on CHP unit inputs (gas treatment plant), operational process parameters, and heat and electricity output; they perform daily keeping of logs for consumption of fuel, ignition, and surface degasification well gas consumed by AGFCP.
- 110/6.3/6.6 kV operator controls data about amount of electricity fed into main and received from main and also auxiliary electricity consumption by the mine.

All information is transferred to SU CHP dispatching office, and is controlled in online mode by shift foreman. Based on information provided by dispatching office, monitoring engineer prepares monthly and annual reports about monitoring of electricity, gas, heat and emissions, and provides them to SU CHP Director and Lease Enterprise Mine named after A.F. Zasyadko General Director Deputy. General supervision over monitoring system is carried out by management of Zasyadko Coal Mine according to control and reporting system in place.

Monitoring Dataflow Chart is shown below.

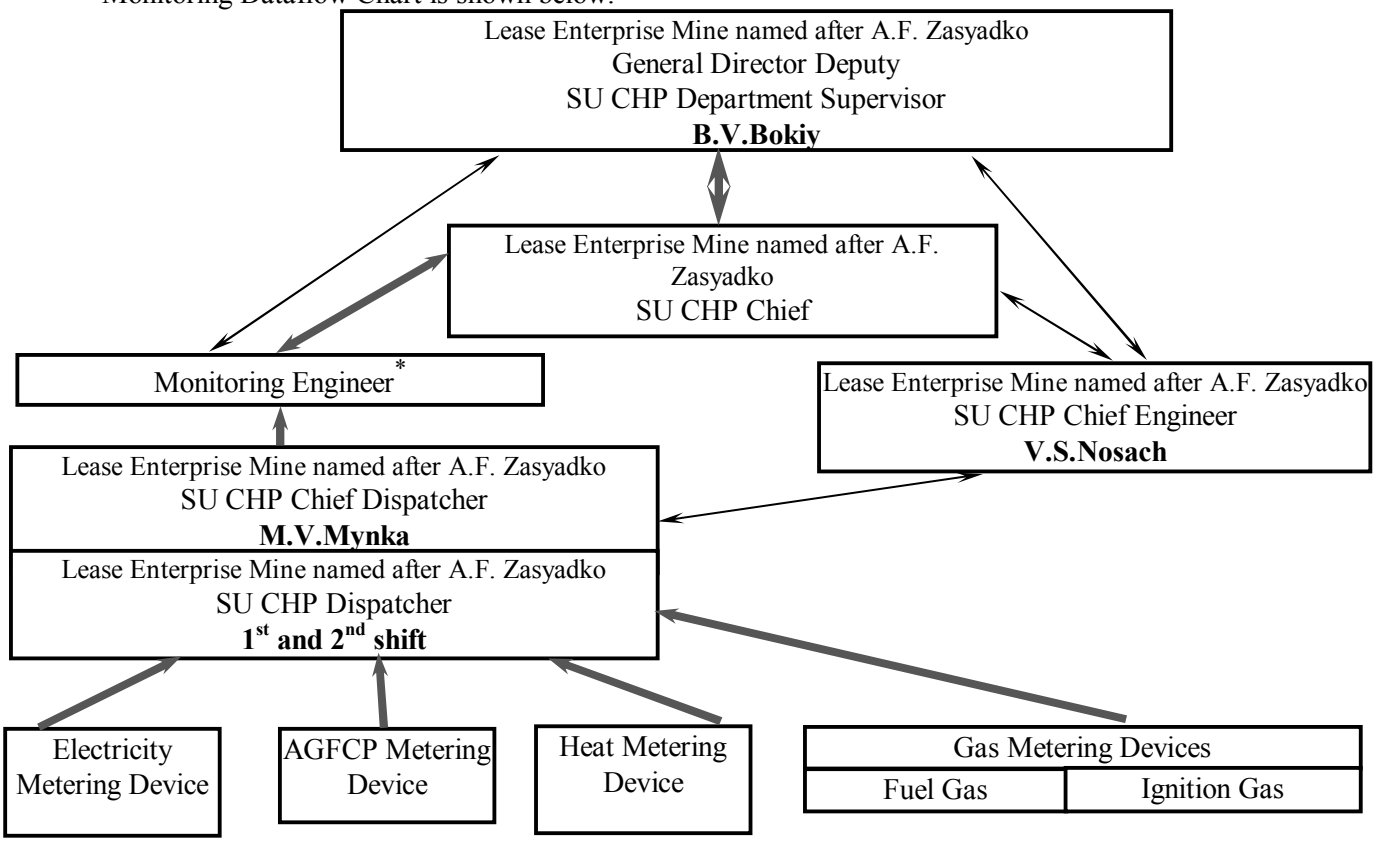


Figure 6: Monitoring Dataflow Chart

*For 2011, this duty is performed by **V.V. Cherednikov**, Gas Treatment Lead Engineer**.**

C.1.2. Trainings:

GE Jenbacher (Austria) has delivered SU CHP main equipment being CHP units. As specified in the contract, training of staff that operates these units was performed in Austria. GE Jenbacher technicians have performed extra training during installation and commissioning works. Employees in charge for monitoring control have also passed training during installation of the said system.

Extra training is performed during equipment operation. SU CHP and VPS staff training program, as well as emergency training, are submitted as separate document represented as EMISSION MONITORING MANUAL FOR SU CHP Lease Enterprise Mine named after A.F.Zasyadko (Manual 3), which also includes structural diagram of technical maintenance provision and state calibration of meters of automated metering system. SU CHP Chief Dispatcher is responsible for training program development. Training programs required approval of SU CHP Director.

Safety measure training is performed once every three months, all employees pass an exam in safety measures once a year. Staff and visitors are provided with individual protection devices for protection from harmful factors of activity.

C.2. Involvement of Third Parties:

The Donetsk Centre for Standardization, Metrology and Certification, Ivano-Frankovsk Centre for Standardization, Metrology and Certification, and Tyumen Centre for Centre for Standardization, Metrology and Certification are Third Parties involved.

C.3. Internal audits and control measures:

Introduction of a modern computerized control system allows for efficient on-line monitoring and reviewing work process performance at the Lease Enterprise Mine named after A.F. Zasyadko Central Dispatching office every fifteen minutes. (in particular, for fuel and ignition gas consumption, their parameters and electricity and heat 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 the head of shift to coordinate efficiently the adjustment actions of his shift subordinates including on-duty technical staff that eliminates such deviations and repairs equipment. This system improved operational process and eliminated lacks in control of SU CHP gas consumption.

C.4. Troubleshooting procedures

See C .1.2

In case of a breakdown of CMM supply system (either of 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 after the venting stack, only combusted CMM will be accounted for.

SECTION D. Calculation of GHG emission reductions

D.1. Project emissions

The project emissions of the project are given by the following equation. The emissions for the use to capture and use methane PE_{ME} have not been taken as the energy use for the vacuum pumps are outside the project boundary (see section B.3 of PDD) and the annual electricity 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 in 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 SU 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 SU CHP units by generation of heat and electricity (tCH_4);
- MD_{GAS} — methane destroyed by the vehicles supplied by the 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)[15];
- 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 SU CHP units

The emissions of SU CHP units are given by following equations:

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

where :

- MD_{CHP} — methane destroyed at heat and electricity generation (tCH_4);
- MM_{CHP} — measured methane consumed by SU CHP units (tCH_4);
- Eff_{CHP} — efficiency of methane destruction/ oxidation at CHP (taken as 99.5% of IPCC).

D.2. Emissions of gas utilization

Some methane will be supplied to the gas filling stations that will supply the vehicles. 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 by the vehicles supplied by the new AGFCPs (tCH_4);

[15] 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.

- MM_{GAS} — methane measured supplied to vehicles supplied by new AGFCPs (тCH4);
- 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 SU CHP units (tCH_4);
- Eff_{CHP} — efficiency of methane destruction in SU CHP (taken as 99.5% of IPCC);
- MM_{GAS} — methane measured consumed as a fuel for vehicle fuelling at new AGFCPs (tCH_4);
- Eff_{GAS} — efficiency of methane destruction in vehicle usage (taken as 98.5% of IPCC).

D.3.1. Project emissions:

Year	[тCO2e/year]	
Total: 01.01.2011– 31.05.2011	[тCO2e]	*44 331*

Table 29: Project emissions

D.3.2. Baseline emissions:

The baseline emissions are given by 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 in year y (tCO_2e);
- $BE_{MR,y}$ — baseline emissions from release of methane into the atmosphere that are avoided by the project activity in year y (tCO_2e);
- $BE_{Use,y}$ — baseline emissions from the generation of electricity, heat replaced by the project activity in 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 the amount of post-mining CMM captured in the project activity that is sent to SU CHP and AGFCPs.

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

where :

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

Baseline emissions as result of electricity and heat generation, and vehicle fuel by the project activity

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

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

where:

- $BE_{Use,y}$ — potential total baseline emissions from the generation of electricity, heat, and vehicle fuels replaced by the project activity in year y (tCO_2);
- $BE_{Use,el,y}$ — total baseline emissions from the generation of electricity, replaced by the project activity in year y (tCO_2);

- $BE_{Use,heat,y}$ — total baseline emissions from the generation of heat, replaced by the project activity in year y (tCO_2);
- $BE_{Use,gas}$ — total baseline emissions of vehicle fuels, replaced by the project activity in year y(tCO_2e).

Baseline emissions of replacement of electricity generation

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

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

If net electricity amount supplied under project by SU CHP is greater than total amount of electricity consumed by the mine for the year (i.e. the electricity will be fed into grid), the baseline emissions will be 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 electricity, replaced by the project activity in year y (tCO_2);
- $GEN_{CHP,y}$ — net electricity supplied by the project activity of the SU CHP units (MWh);
- $EF_{grid,produced,y}$ — emission factor of electricity of replaced grid electricity generation by the project activity in year y (tCO_2/ MWh);
- $EL_{Consumed,y}$ — net electricity consumed by mine on-site in year y (MWh);
- $EF_{grid,reduced,y}$ — emissions factor for electricity of replaced on-site electricity consumption by the project activity (tCO_2/MWh)

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

Baseline emission of replacement of heat

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

Baseline emissions of replacement of vehicle fuels

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

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

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:

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

where:

- EF_v — emission factor for vehicle fuel replaced by the project activity (tCO2/GJ);

- $EF_{cos\lambda}$ — emission factors for CO_2 four fuels used for vehicle operation replaced by the project activity (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	[тCO2e/year]	
Total: 01.01.2011– 31.05.2011	[тCO2e]	*408 922*

Table 30: Baseline emissions

D.3.3. Leakages:

Not Applicable

D.3.4. Emission reductions summary in monitoring period:

Year	[тCO2e/year]	
Total: 01.01.2011– 31.05.2011	[тCO2e]	*364 591*

Table 31: Emission reductions

ANNEX 1

Gas sample analysis – 1st quarter 2011[16]

APPROVED

P.S.Pashkovskiy
First Director Deputy
Science Activity
Dr. Sc.
Respirator Mining Scientific and Research Institute
< signature>
Seal
March 03, 2011

Percentage of matters in samples of gas taken on 02.03.11 at Lease Enterprise Mine named after A.F. Zasyadko

Main Components	Sampling Point			
	Vacuum Pump Station-1		Vacuum Pump Station -2	
	First group	Second group	First group	Second group
	Concentration, %		Concentration, %	
Methane CH_4	15,3	15,7	29,3	15,3
Ethan C_2H_6	0,08	0,04	0,7	0,08
Propane C_3H_8	0,04	0,06	0,06	0,04
Butane C_4H_{10}	0,008	0,005	0,005	0,008
Pentane C_5H_{12}	0,006	n/a	0,004	0,006
Hexane C_6H_{14}	n/a	n/a	n/a	n/a
Carbon Oxide CO	n/a	n/a	n/a	n/a
Hydrogen H_2	n/a	n/a	n/a	n/a
Carbon Dioxide CO_2	0,06	0,05	0,06	0,06
Nitrogen N_2	66,8	67,1	55,3	66,8
Oxygen O_2	16,9	16,1	13,1	16,9
Argon Ar	0,07	0,08	0,42	0,07
Micro-Components	**mg/Nm^3**			
Ammonia NH_3	0,004	0,005	n/a	0,004
Chlorine Cl_2	n/a	n/a	n/a	n/a
Fluorine F_2	n/a	n/a	n/a	n/a
hydrogen sulfide H_2S	0,006	0,007	n/a	0,006
Sulfide dioxide SO_2	n/a	n/a	n/a	n/a
Dust, mg/m^3	<1	<1	<1	<1
Moisture, %	100	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 person in charge signed V.K. Sokolov

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

APPROVED

P.S.Pashkovskiy
First Director Deputy
Science Activity
Dr. Sc.
Respirator Respirator Mining Scientific and Research Institute
< signature>
Seal
March 03, 2011

Percentage of matters in fuel gas and ignition gas samples taken on 02.03.11 at Lease Enterprise Mine named after A.F. Zasyadko

Main components	Fuel Gas, Concentration, %	Ignition Gas, Concentration, %
Methane CH_4	31,5	96,8
Ethan C_2H_6	0,25	0,53
Propane C_3H_8	0,07	0,08
Butane C_4H_{10}	0,04	0,006
Pentane C_5H_{12}	0,006	0,004
Hexane C_6H_{14}	0,0008	0,0008
Carbon Oxide CO	0,0005	0,006
Hydrogen H_2	0,06	0,05
Carbon Dioxide CO_2	0,05	n/a
Nitrogen N_2	53,5	1,6
Oxygen O_2	14,1	0,8
Argon Ar	0,28	0,11
Micro-Components	**mg/Nm^3**	
Ammonia NH_3	0,006	n/a
Chlorine Cl_2	n/a	n/a
Fluorine F_2	n/a	n/a
Hydrogen sulfide H_2S	0,004	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 person in charge signed V.K. Sokolov

Gas sample analysis –2nd quarter 2011

APPROVED

P.S.Pashkovskiy
First Director Deputy
Science Activity
Dr. Sc.
Respirator Mining Scientific and Research Institute
< signature>
Seal
May 16, 2011

Percentage of matters in samples of gas taken on 10.05.11 at Lease Enterprise Mine named after A.F.Zasyadko

Main Components	Sampling Point			
	Vacuum Pump Station-1		Vacuum Pump Station -2	
	First group	Second group	First group	Second group
	Concentration, %		Concentration, %	
Methane CH_4	14,7	19,3	40,3	14,7
Ethan C_2H_6	0,07	0,05	0,6	0,07
Propane C_3H_8	0,06	0,04	0,05	0,06
Butane C_4H_{10}	0,007	0,006	0,006	0,007
Pentane C_5H_{12}	0,005	n/a	0,005	0,005
Hexane C_6H_{14}	n/a	n/a	n/a	n/a
Carbon Oxide CO	n/a	n/a	n/a	n/a
Hydrogen H_2	n/a	n/a	n/a	n/a
Carbon Dioxide CO_2	0,07	0,06	0,05	0,07
Nitrogen N_2	67,8	64,8	46,6	67,8
Oxygen O_2	17,3	13,8	11,2	17,3
Argon Ar	0,08	0,07	0,32	0,08
Micro-Components	mg/Nm^3			
Ammonia NH_3	0,005	0,004	n/a	0,005
Chlorine Cl_2	n/a	n/a	n/a	n/a
Fluorine F_2	n/a	n/a	n/a	n/a
hydrogen sulfide H_2S	0,007	0,006	n/a	0,007
Sulfide dioxide SO_2	n/a	n/a	n/a	n/a
Dust, mg/m^3	<1	<1	<1	<1
Moisture, %	100	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 person in charge signed V.K. Sokolov

APPROVED

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First Director Deputy
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Respirator Mining Scientific and Research Institute
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Seal
May 16, 2011

Percentage of matters in samples of gas taken on 10.05.11 at Lease Enterprise Mine named after A.F.Zasyadko

Main components	Fuel Gas, Concentration, %	Ignition Gas, Concentration, %
Methane CH_4	32,6	97,2
Ethan C_2H_6	0,22	0,49
Propane C_3H_8	0,06	0,07
Butane C_4H_{10}	0,04	0,005
Pentane C_5H_{12}	0,005	0,005
Hexane C_6H_{14}	0,0007	0,0007
Carbon Oxide CO	0,0005	0,007
Hydrogen H_2	0,08	0,06
Carbon Dioxide CO_2	0,08	n/a
Nitrogen N_2	52,2	1,3
Oxygen O_2	12,6	0,3
Argon Ar	0,24	0,7
Micro-Components	**mg/Nm^3**	
Ammonia NH_3	0,007	n/a
Chlorine Cl_2	n/a	n/a
Fluorine F_2	n/a	n/a
Hydrogen sulfide H_2S	0,006	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 person in charge signed V.K. Sokolov