FOURTH PERIODIC MONITORING REPORT

SECOND PERIODIC JI MONITORING REPORT

Version 2.5

17 February 2009

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. JI registration number:

JI 0035

A.3. Short description of the project activity:

The purpose of this project is the avoidance of methane emissions into the atmosphere at Leasing Company "the Coal Mine named after A.F. Zasyadko", further referred to the Zasyadko mine or simply the mine. Coal Mine Methane, drained and recovered in the operating mine works and from mine ventilation works, as well as methane produced by surface goaf wells at Zasyadko Mine, are **used to (i) produce electricity**; **(ii) replaced heat** currently produced by coal- and gas-fired boiler, and **(iii) produced gas** for use as vehicle fuel.

The mine has four production sites, being Vostochnaya, Yakovlevskaya, Centralnaya and Gregoryevskaya. During this monitoring period one CHP-plant was in operation at the Vostochnaya production site. Electricity produced by this CHP-plant was delivered to the Mine's grid for local consumption by the mine. The generated heat of the Vostochnaya CHP-plant was delivered for heat consumption at the Vostochnaya production site. Automotive double-block gas filling stations at the Centralnaya site provided fuel to the Mine's truck fleet and other trucks in the neighbourhood.

In the future it is expected to commission the second CHP-plant at the Yakovlevskaya site plus a heat exchange grid. This will allow the mine to deliver surplus electricity to the grid, supply heat to the Vostochnaya, Yakovlevskaya, Centralnaya site and the municipal District Heating system. Furthermore gas filling stations will be built at the Yakovlevskaya site as well.

A.4. Monitoring period:

- Monitoring period starting date: 1/07/2008;
- Monitoring period closing date: 30/09/2008.[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 power (electrical or motive) and heat and/or destruction by flaring")* has been used to identify the baseline scenario of the proposed JI project. Furthermore version 02 of the "Tool for the demonstration and assessment of additionality" and the "Tool to determine project emissions from flaring gases containing Methane" (no version number available) has been applied[2].

A.5.2. Monitoring methodology: The approved consolidated methodology ACM0008/Version 03*"Consolidated monitoring methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring")* has been used to monitor the proposed JI project.

[1] Both days were included. Monitoring period includes time from 00:00 01/07/08 up to 24:00 30/09/08.

[2] For the document refer please http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

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

Activity	Date
Commissioning of blocks (#1,#2) at gas filling compressor stations at Vostochnaya site	March 2004
Commissioning of new block #3 at gas filling compressor station at Vostochnaya site	March 2005
Commissioning of the 1st CHP modules at Vostochnaya site	January 2006
Commissioning of the 12th CHP modules at Vostochnaya site	April 2006
Shut-down of boilers at Vostochnaya site	September 2006
Construction of vacuum pump station N 4 at Grigoryevskaya shaft with six vacuum pumps VVN-150 and build up 3 pipe lines	March 2007
Commissioning of the twelfth power unit on Yakovlevskaya industrial site	July- December 2009
Construction of heat supply unit on Central industrial site; Shut down of boiler houses on Centralnaya industrial site	May 2008
Construction and laying of heating main from Centralnaya site to municipal boiler houses	September 2008
Construction of heating main from Yakovlevskaya to Vostochnaya site. Construction of main Heat Substation. Shutdown boilers at Yakovlevskaya.	October 2009

Table 1: Status of implementation (according to PDD version 4.4)

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

There are no deviations from the PDD, made final at the JISC. A delay of the implementation schedule, compared to the implementation schedule in the PDD and listed above, was observed. As a result the following elements of the project were not operations during the monitoring period:

- Electricity: The Yakovlevskaya CHP-plant is not in operation yet. No electricity is being produced at this CHP-plant and as a result GEN_{CHP} only takes into account the net electricity produced at the Vostochnaya CHP-plant;
- Heat: No infrastructure was in place to supply heat to the four sites of the mine and the DH-system during this monitoring period, with the exception of direct delivery of heat from the Vostochnaya CHP-plant to the Vostochnaya production site. As a consequence the following variables have not been monitored in this monitoring period: $HEAT_{deliv,DH,y}$; $HEAT_{deliv,yak,y}$; $HEAT_{deliv,centr,y}$. The amount of total heat delivered equals the amount of heat delivered by the Vostochnaya power plant ($HEAT_{deliv,vost,y}$);
- CMM destroyed at CHP-plant: As the Yakovlevskaya CHP-plant was not in operation during this monitoring period, no CMM was destroyed at this CHP-plant. As a result $MM_{CHP,y}$ only takes into the account the CMM destroyed at Yakovlevskaya CHP-plant;
- CMM destroyed at AGFCP: Out of the five envisaged gas-filling stations (two at Vostochanya site, one at Centralnaya production site and two at Yakovslevskaya site), two blocks gas-filling stations at Vostochnaya production and one at the Centralnaya sitewere in operation during this monitoring report. As a result only gas delivery at these gas-filling stations were used for monitoring $MM_{GAS,y}$.

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

Compared to the monitoring plan, as described in the PDD version 4.4 which determination was made final on the 24th of August 2008, some meters were changed and added to improve the robustness of the monitored parameters. All these meters were calibrated (see below). The parameters were not changed nor where the formulae altered.

The following meters were added/changed effective 1 January 2008:
The primary and secondary meters were swapped as the metering at the CHP units was upgraded and improved. In addition new metering system blocks for methane of high concentration were installed:

- The Universal 1 meter for ignition methane at the CHP facility site instead of Gn6 with its sensors
- The Universal 2 meter for car fuel methane at AGFCS in addition to the equipment of gas filling blocks
- BKTM metering systems for fuel methane instead of Keuter, ADM Electronic

For detailed description of scheme and operation of equipment refer please to section B.

A.9. Changes since last verification:

There are no deviations since last verification which took place over the period 1/01/2008 – 30/06/2008.

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

Lease enterprise "Coal Mine named after A.F. Zasyadko"

- Boris Bokiy, Deputy General Director;
- Vyacheslav Kozirenko, Technical Director of the CHP facility;
- Yevgeniy Berezovskiy, CHP facility head;
- Maksim Myinka, Chief dispatch;
- Valeriy Cherednikov, Monitoring engineer.

Global Carbon B.V.

- Lennard de Klerk, Director;
- Valeriy Sade, Senior Consultant.

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 an electrical part, a heat part and a gas part[3].

Electrical measurements
There are no changes since last monitoring period.

Heat measurements
There are no changes since last monitoring period[4].

Measurement of CMM consumption
There are no changes since last monitoring period.

B.1. Monitoring equipment types

1. Electricity meters "Elster-Metronika"
2. Heat meter SA-94/2 M
3. Gas Analyzer ABB A02040 (for fuel and ignition methane)
4. DBT[5] equipment. (for fuel and ignition methane)
5. DRGM flow meters[6] (for fuel methane) as a part of BKTM metering systems.
6. Metering system "Universal"

[3] All calibration information for metering equipment will be submitted as separate documents.
[4] There were no changes in the heat distributing over the Mine sites since last monitoring and no heat was supplied to the DH network yet (planned later). Parameters B15, B17, B18, B21 and B23 are therefore not measured and monitored in this monitoring period. All changes will be after commissioning of Yakovlevskaya CHP facility and construction main heat distribution substation at Centralnaya site.
[5] Secondary meters.
[6] Primary meters.

B.1.2. Table providing information on the equipment used (incl. manufacturer, type, serial number, date of installation, date of last calibration, information to specific uncertainty, need for changes and replacements[7]

Electrical measurements

For the purpose of monitoring the emission reductions the following parameters are to be measured[8]:

- GEN_{CHP} Net electricity generated by the project activity of the CHP plants (MWh):
- El_{cons} Net electricity consumed by the mine (MWh)[9].

In accordance with the monitoring plan it has first been checked whether the net electricity generated at the CHP is larger or smaller than the net electricity consumption of the mine. The actual measured numbers are as follows:

- GEN_{CHP} = 31,864 MWh
- EL_{cons} = 48,635 MWh

As the net generated electricity of the CHP system is less than the electricity consumed at the mine, only the net electricity generation of the CHP is necessary for the purpose of monitoring the emission reductions (see also page 40 of the PDD).

The net electricity generated by the CHP plants is measured by two meters that feed the electricity into the Mine power grid:

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

For cross-checking purposes the net electricity generated by the CHP is monitoring by summing up the gross electricity generated of each individual CHP unit subtracting the auxiliary power consumption of the CHP plant. This is given in the following formula.

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

[7] For all technical data refer please to Monitoring Report for year 2004-2006.

[8] The relevant formulae of the Monitoring Plan of the PDD are given in section D.

[9] Net electricity consumption of the Mine is reflected in the statement given by Chief Energy Manager of the Mine according to the data of thirteen commercial meters located at the other substations 110kV

The relevant meters are listed in two tables below. As it is impossible to use meters data directly to check electricity generated at high voltage, currency and voltage transformers are used. In the first table the values of the meters are listed. In the second table the conversion values are given to calculate the actual values.

Electrical Meters

ID Number	Measuring instrument	Work parameter kWh, kVar	Manufacturer	Type	Serial Number	Uncertainty level of data and accuracy	Date of instal-lation	Data 1.07.2008	Data 30.09.2008	Difference	Date of last calibr.	Date of next calibr.	Remarks[10]
E1	Electricity meter at CHP system (6 kV) Wireway	Net electricity generated by CHP system. P,Q	"Elster-Metronika" Russia	Electronic	01116374	±0.2[11]%	N/A	4571.9506	4943.2106	371.2600	14.05.2005	14.05.2011	Double side. Cubicle #A21
E2	Electricity meter at CHP system (6 kV) Wireway	Net electricity generated by CHP system. P,Q	"Elster-Metronika" Russia	Electronic	01116376	±0.2%	N/A	4541.0153	5012.7242	471.7089	14.05.2005	14.05.2011	Double side. Cubicle #A22
E3	Electricity[12] meter at CHP system (6 kV) Auxiliary transformer	Auxiliary electricity generated by CHP system	"Elster-Metronika" Russia	Electronic	01103251	±0.2%	N/A	2320.4009	2611.6839	291.2830	03.09.2004	03.09.2010	Cubicle #1
E4	Electricity meter at CHP	Auxiliary electricity generated by	"Elster-Metronika"	Electronic	01103208	±0.2%	N/A	2545.6345	2781.0035	235.3690	03.09.2004	03.09.2010	Cubicle #2

[10] The Meters in cubicles from A2 to #16 are installed at CHP facility used as secondary meters for cross-checking at CHP facility.

[11] The measurement range (accuracy) is 80…120 V;0…5 (10-max) A.

[12] Auxiliary transformer meters are located at distribution board at CHP facility.

	system (6 kV) Auxiliary transformer	CHP system	Russia										
E5	Electricity meters at individual CHP modules (6 kV) #1	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117846	±0.2%	N/A	4305.7053	4868.7724	563.0671	16.06.2005	16.06.2011	Double side. Cubicle #5
E6	Electricity meters at individual CHP modules (6 kV) #3	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117849	±0.2%	N/A	5162.0924	5812.6942	650.6018	16.06.2005	16.06.2011	Double side. Cubicle #7
E7	Electricity meters at individual CHP modules (6 kV) #5	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117851	±0.2%	N/A	5733.1356	6347.7334	614.5978	16.06.2005	16.06.2011	Double side. Cubicle #9
E8	Electricity meters at individual CHP modules (6 kV) #7	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117852	±0.2%	N/A	6128.1049	6669.0870	540.9821	16.06.2005	16.06.2011	Double side. Cubicle#11
E9	Electricity meters at individual CHP modules (6 kV) #9	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117855	±0.2%	N/A	6255.3138	6874.1563	618.8425	16.06.2005	16.06.2011	Double side. Cubicle#13

E10	Electricity meters at individual CHP modules (6 kV) #11	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117856	±0.2%	N/A	5911.9374	6622.8262	710.8888	16.06.2005	16.06.2011	Double side. Cubicle #15
E11	Electricity meters at individual CHP modules (6 kV) #2	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117848	±0.2%	N/A	6089.8181	6788.1941	698.3760	16.06.2005	16.06.2011	Double side. Cubicle #6
E12	Electricity meters at individual CHP modules (6 kV) #4	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117645	±0.2%	N/A	4865.2849	4865.2849	0	10.08.2005	10.08.2011	Double side. Cubicle #8
E13	Electricity meters at individual CHP modules (6 kV) #6	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01122650	±0.2%	N/A	5224.3653	5794.0164	569.6511	10.08.2005	10.08.2011	Double side. Cubicle#10
E14	Electricity meters at individual CHP modules (6 kV) #8	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01117845	±0.2%	N/A	6564.5304	7479.1741	914.6437	16.06.2005	16.06.2011	Double side. Cubicle#12
E15	Electricity meters at individual CHP	Gross electricity generated by CHP system	"Elster-Metronika" Russia	Electronic	01132765	±0.2%	N/A	6091.6999	6823.3919	731.6920	09.02.2006	09.02.2012	Double side. Cubicle#14

	modules (6 kV) #10	P,Q											
E16	Electricity meters at individual CHP modules (6 kV) #12	Gross electricity generated by CHP system P,Q	"Elster-Metronika" Russia	Electronic	01132766	±0.2%	N/A	6101.1777	6101.1777	0	09.02.2006	09.02.2012	Double side. Cubicle #16
E17	Commercial electricity meter at 110 kV	Power consumption from or supply to the Ukrainian grid	"Elster-Metronika" Russia	Electronic	01116378	±0.2%	N/A	289.3706	296.6471	7.2765	N/A Belongs to supply company	N/A	Substation 110kV T1
E18	Commercial electricity meter at 110 kV	Power consumption from or supply to the Ukrainian grid	"Elster-Metronika" Russia	Electronic	01116380	±0.2%	N/A	303.9206	306.3680	2.4475	N/A Belongs to supply company	N/A	Substation 110kV T2

ID number	Measuring instrument	Work parameter kWh, kVar	Type	Serial Number	Data 1.07.2008	Data 30. 09.2008	Difference	Current transformer	Voltage transformer	Coefficient for calculations	Electricity Amount KWh
E1	Electricity meter at CHP system (6 kV) Wireway	Net electricity generated by CHP system. P,Q	Electronic	01116374	4571.9506	4943.2106	371.2600	3000/5	6300/100	37800	14,033.628[13]
E2	Electricity	Net electricity	Electronic	01116376	4541.0153	5012.7242	471.7089	3000/5	6300/100	37800	17,830.596

[13] Because of high voltage and currents it is impossible to get direct figures from electricity meters for electricity generation or consumption without current and voltage transformers for monitor equipment. The way of calculation used as following: F.e for meter # 01116374: Current is 3000/5= 600A; Voltage is 6300/100=63V (cumulative rate is 600x63=37800VA). Data of meter are 371 .260 Electricity power monitored with this meter will be: 371.2600 x 600x63=14,033,628 VA=14,033.628 kW.

	meter at CHP system (6 kV) Wireway	generated by CHP system. P,Q									
E3	Electricity meter at CHP system (6 kV) Auxiliary transformer	Auxiliary electricity generated by CHP system	Electronic	01103251	2320.4009	2611.6839	291.2830	200/5	6300/100	2520	734.033
E4	Electricity meter at CHP system (6 kV) Auxiliary transformer	Auxiliary electricity generated by CHP system	Electronic	01103208	2545.6345	2781.0035	235,3690	200/5	6300/100	2520	593.130
E5	Electricity meters at individual CHP modules (6 kV) #1	Gross electricity generated by CHP system P,Q	Electronic	01117846	4305.7053	4868.7724	563.0671	400/5	6300/100	5040	2,837.858
E6	Electricity meters at individual CHP modules (6 kV) #3	Gross electricity generated by CHP system P,Q	Electronic	01117849	5162.0924	5812.6942	650.6018	400/5	6300/100	5040	3,279.033
E7	Electricity meters at individual	Gross electricity generated by	Electronic	01117851	5733.1356	6347.7334	614.5978	400/5	6300/100	5040	3,097.573

	CHP modules (6 kV) #5	CHP system P,Q									
E8	Electricity meters at individual CHP modules (6 kV) #7	Gross electricity generated by CHP system P,Q	Electronic	01117852	6128.1049	6669.0870	540.9821	400/5	6300/100	5040	2,726.550
E9	Electricity meters at individual CHP modules (6 kV) #9	Gross electricity generated by CHP system P,Q	Electronic	01117855	6255.3138	6874.1563	618.8425	400/5	6300/100	5040	3,118.966
E10	Electricity meters at individual CHP modules (6 kV) #11	Gross electricity generated by CHP system P,Q	Electronic	01117856	5911.9374	6622.8262	710.8888	400/5	6300/100	5040	3,582.880
E11	Electricity meters at individual CHP modules (6 kV) #2	Gross electricity generated by CHP system P,Q	Electronic	1117848	6089.8181	6788.1941	698.3760	400/5	6300/100	5040	3,519.815
E12	Electricity meters at individual CHP modules (6 kV) #4	Gross electricity generated by CHP system P,Q	Electronic	01117645	4865.2849	4865.2849	0	400/5	6300/100	5040	0
E13	Electricity	Gross	Electronic	01122650	5224.3653	5794.0164	569.6511	400/5	6300/100	5040	2,871.042

	meters at individual CHP modules (6 kV) #6	electricity generated by CHP system P,Q									
E14	Electricity meters at individual CHP modules (6 kV) #8	Gross electricity generated by CHP system P,Q	Electronic	01117845	6564.5304	7479.1741	914.6437	400/5	6300/100	5040	4,609.804
E15	Electricity meters at individual CHP modules (6 kV) #10	Gross electricity generated by CHP system P,Q	Electronic	01132765	6091,6999	6823.3919	731.6920	400/5	6300/100	5040	3,687.728
E16	Electricity meters at individual CHP modules (6 kV) #12	Gross electricity generated by CHP system P,Q	Electronic	01132766	6101.1777	6101.1777	0	400/5	6300/100	5040	0
E17	Commercial electricity meter at 110 kV	Power consumption from or sup-ply to the Ukrainian grid	Electronic	01116378	289.3706	296.6471	7.2765	1000/5	110000/ 100	220000	16,008.30
E18	Commercial electricity meter at 110 kV	Power consumption from or sup-ply to the Ukrainian grid	Electronic	01116380	303.9206	306.3680	2.4475	1000/5	110000/ 100	220000	5,384.390

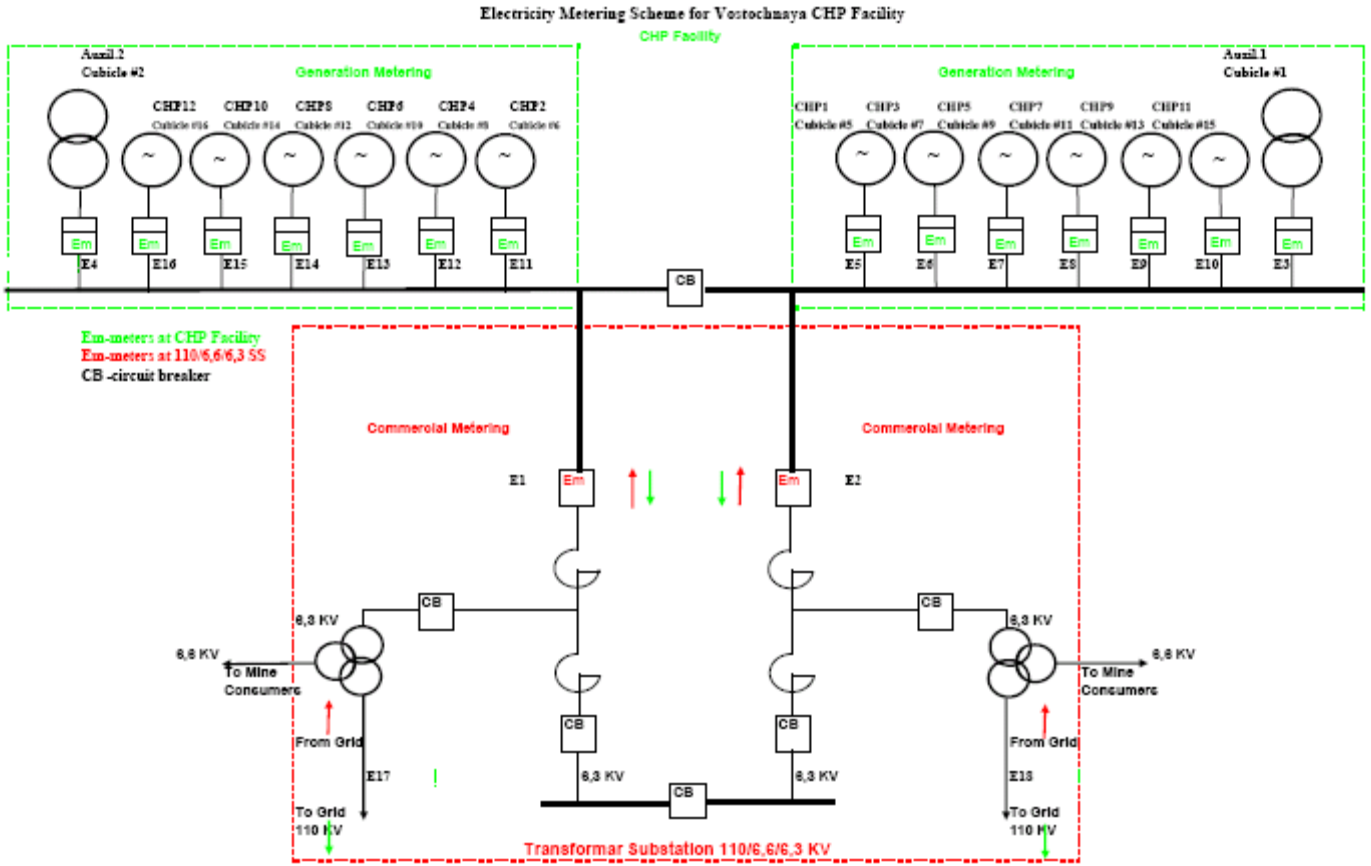

Figure 1: Electricity Metering Scheme for Vostochnaya CHP Facility

Heat measurements

For this monitoring period only heat was supplied directly by the CHP plant to the Vostochnaya site as described in section A.7. So for this monitoring period only one variable, being the amount of heat supplied by the CHP system to the heat transportation pipes is identical to the heat consumed by the Vostochnaya site, is being measured.

$HEAT_{deliv,vost}$ =Heat consumed at Vostochnaya site delivered by the project activity (GJ)

The amount of heat consumed by Vostochnaya site is reflected by data of heat meter in the table below.

$HEAT_{deliv,vost,y}$ = H1x4.1867 (3.)

Where:
4.1867 is coefficient from GCal to GJ

The meter H1 is given below.

ID number	Measuring instrument	Work parameter GCal	Manufacturer	Type	Serial number	Uncertainty level of data, accuracy	Date of installation	Data 1.07.2008 Gcal	Data 30.09.2008 Gcal	Diffe Rence Gcal	Date of last calibre.	Date of next calibre.	Remarks
H1	Heat meter SA 94/2M[14]	Amount of heat delivered to site system	ASWEGA	Mecha tronic	22903	±2%	N/A	57,659	61,609	3,950	04.06.07	04.06.09	T,V,Q (Total)

Calibration interval for heat meters is two years

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

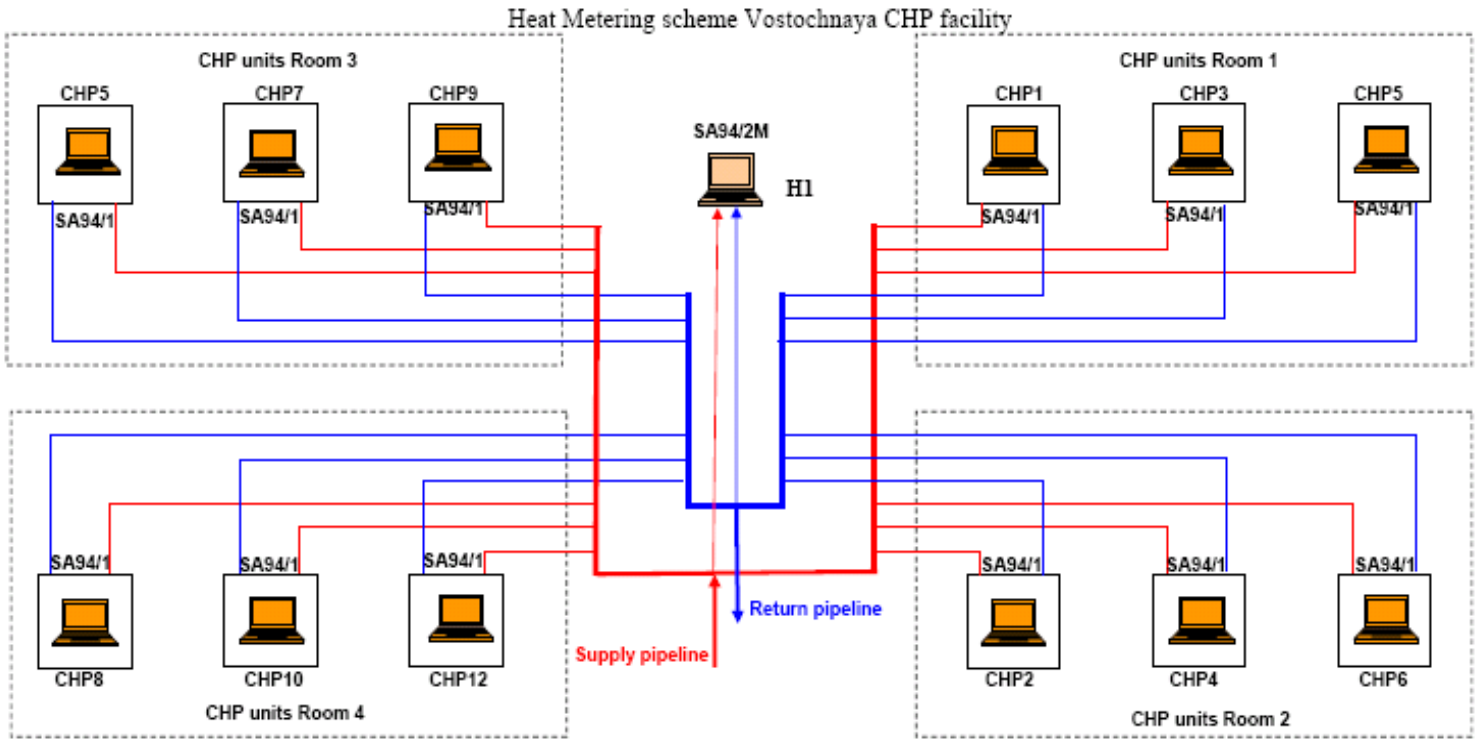

Figure 2: Heat Metering Scheme for Vostochnaya CHP Facility

CMM Metering

In accordance with the monitoring plant the following two variables have to be measured:

- MM_{CHP} Methane measured sent to the CHPs (tCH4)
- MM_{GAS} Methane measured supplied to vehicle by the new gas filling stations (tCH4)

The variable MM_{CHP} is built up of two components being the fuel gas consumption and the ignition gas consumption. To determine the amount of pure consumed CH_4 (in tonnes) the amount of pure CH_4 (in m^3) has to be measured under normal conditions[15]. 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 gas mixture
- Flow (m^3) of gas mixture
- Temperature (C) of gas mixture
- Pressure (bar) of gas mixture

In the scheme below the different meters and sensors are indicated that are installed at the Vostochnaya site.
We can classify the different meters/sensors:

- Primary meters/sensors that supply the data for determining the emission reductions as provided in section D of the Monitoring Report;
- Secondary meters/sensors used for cross-checking the data of the primary meters;
- Tertiary meters/sensors used to operated and control the installation only.

The tertiary meters/sensors are not of interest for monitoring purposes and are not mentioned further. In the table below the primary (yellow) and secondary meters/sensors (orange) are indicated with their number which listed in the scheme.

	Primary meters/sensors	Secondary meters/sensors used for determining CMM consumption for cross-checking purposes
Fuel gas		
Concentration (%)	K7	ABB AO 2040 (A1)
Flow (V)	G1-G12[16]	Gn5
Temperature (T)	T6-T17	Gn5 sensor
Pressure (P)	P11-P22	P6(Gn5's sensor)
Unit that converts data into pure methane (m3)	Automatic control system in dispatch	DBT equipment
Ignition gas		
Concentration (%)	ABB AO 2040 (A2)	ABB AO 2040 (A2)
Flow (V)	G13	Gn6
Temperature (T)	T5	Gn6 sensor
Pressure (P)	P10	P10(Gn6's sensor)
Unit that converts data into pure methane (m3)	'Universal-1 " metering system	DBT equipment
AGFCP gas		
Concentration (%)	ABB AO 2040 (A2)	ABB AO 2040 (A2)

[15] Normal conditions = 273K and 1 bar

[16] Meters G1-G12 are being used as primary meters.

Flow (V)	G14	Calculations according to pressure difference
Temperature (T)	T18	
Pressure (P)	P23	Manometers at AGFCS
Unit that converts data into pure methane (m3)	'Universal-2" metering system	Calculations

Table 2: Primary and secondary (cross-checking) metering of CMM

MM_{CHP} is the sum of each individual CHP unit consumption for fuel gas plus one meter for ignition gas as follows:

$$MM_{CHP} = (\sum_{1}^{12} M_i x C_1 + V_1 x C_2) x 0.7167 x 0.93 \quad (4.)$$

Where:

M_i is individual CHP unit consumption of fuel gas corrected for standard[17] conditions (m^3)
$C_{1,2}$ are CH_4 concentration meters (%)
V_1 is volume of methane supplied as ignition gas (m^3)
0.7167 density of methane under normal conditions (kg/m^3)
0.93 transfer coefficient from standard to normal conditions

The variable MM_{GAS} is measured as follows:

$$MM_{GAS} = V_{21} x C_2 x 0.7167 x 0.93 \quad (5.)$$

Where:

V_2 is volume of methane supplied as car fuel gas under standard condistions (m^3)
C_2 is CH_4 concentration meters (%)
0.7167 density of methane under normal conditions (kg/m^3)
0.93 transfer coefficient from standard to normal conditions

The meters are indicated in the tables that follow a more general description of methane flow.

Cross-check

The amount of methane, used as fuel gas for the CHP unites, is cross-checked. This is done by measuring the total amount of gas flow (m3) that is delivered by the gas treatment facility to the CHP units (fuel gas only). The relevant meter is indicated as meter Gn5 in Figure 3. The provided gas flow is corrected for normal conditions through the temperature and pressure sensors included in this meter. To calculate the actual pure amount of methane the gas flow is multiplied with the concentration provided by meter as indicated as A1 in Figure 3 or C1 in the Table below.

[17] Standard conditions: 293 K and 1 bar

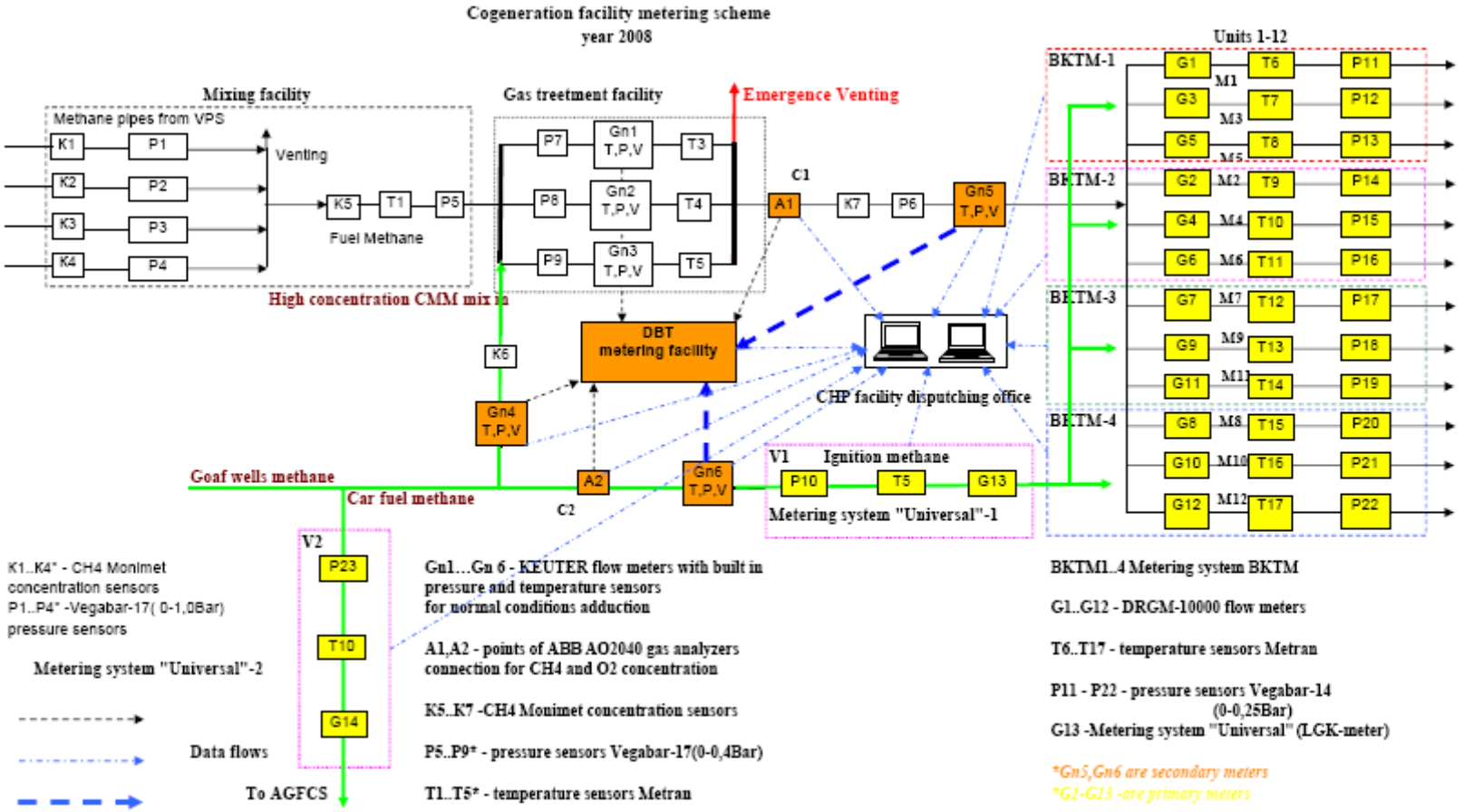

Figure 3: CMM metering scheme since year 2008

For a general understand of the full monitoring system, the general flow of CMM and the metering is described below.[18]

Coal mine gas of degassing and gas-suction activities is supplied through four lines from two Vacuum Pump Station (VPS) to the gas mixing section of the CHP gas treatment facility. The concentration and pressure of methane are different in each pipe-line. These parameters are measured by K1…K4 Monimet concentration sensors and P1…P4 Vegabar pressure sensors. *Measurements data of these sensors are not used in gas metering and are needed for operational purposes*; these data are channelled to an 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.

The methane concentration that is fed to the gas treatment facility is measured by the Monimet K5 sensor. Also in the flow the T1 temperature sensor and the P5 pressure sensor are installed. Methane from goag wells is mixed into fuel methane in case of necessity to increase the concentration. The flow of goaf wells methane is measured by Gn4 flow meter Keuter together with velocity pressure and temperature sensors. The concentration of mix in methane from goaf wells is measured by Monimet K6 sensor. Having all this data the automatic control system of the dispatch can calculate the amount of methane in the gas mixture.

At the gas treatment section of the facility methane is distributed between three lines where it is dried, cooled, cleaned and wormed. Flow measurements are provided by Gn1 - Gn3 Keuter flow meters together with velocity, pressure and temperature sensors. They transmit information to the calculation equipment developed by DBT which is installed in separate premise of the gas metering section. This block calculates the values of actual consumption for normal conditions and channel them to the automatic control system of the dispatch computer system for operation. For checking and reserve, pressure P7 – P109 and temperature T2 – T4 sensors have been installed in the pipelines.

At the outflow of gas treatment section the processing discharge valve is installed which smoothes the pressure swings at abrupt changes of the CHP operation regime. Pressure at the outflow of the section is controlled by processing sensor P6.

For the purpose of fuel gas concentration determination, gas testing is made at the outflow of the gas treatment section of facility at point A1 which is fed to the gas analyzer AO 2040 (ABB) mounted at gas metering unit. Metered concentration is checked for the compliance with sensor date Monimet K7. The flow meter Gn5 (Keuter) as a unit with speed, pressure and temperature sensors measures the gas amount used by CHP units. The methane amount is calculated based on the data of methane concentration *but is not used monitoring purposes.*

Then fuel gas is supplied to the units of CHPs engine rooms. The flow meters G1- G12, type DPG.M-10000, temperature sensors T6 - T17 and pressure sensors P11 - P22 are mounted on the line of each 12 units. Their data are transmitted to microprocessing control system BKT.M for calculation of 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. *Total amount in engine rooms gives the methane amount in fuel gas utilized by CHP and is recorded in the database.*

[18] From year 2008 DBT equipment is used as cross-checking equipment. Main meters installed at each CHP unite will be channel data to BKTM metering system. The BKTM meters will channel data to computer system. Besides all the data will be store at four BKTM. Every "BKTM unite" combines three CHP's. These systems operate with fuel methane. The ignition methane for all CHP is measured with a new metering system "Universal" which is includes LGK-Meter, temperature, pressure and flow sensors. All these data are stored at place and channel to CHP plant computer system.

Ignition gas is supplied to the CHP units from the gas pipes of surface degasification boreholes. Total current ignition gas consumption is metered by flow meter G13 (Universal). Gas concentration is metered by gas analyzer AO 2040 (ABB) with gas test at the point A2, pressure and temperature are measured by sensors P10 and T5. Based on it automatic control system of dispatch service determines the methane amount which is fed to the CHPs with *ignition gas which is recorded in database.*

Gas that is supplied for automobiles filling is metered by "Universal-2"metering system combining DRGM G14 flow meter, pressure and temperature sensors P23 and T10. Based on it the methane amount fed to AGFCS *for automobiles filling and recorded in database.*

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

Methane volume which is supplied with fuel gas and methane of ignition gas, methane for automobiles filling gives total amount of methane consumed by Zasyadko coal mine Vostochnaya site.

Figure 4: Sensors of flow, temperature and pressure at the CHP unit fuel methane pipeline
In the table below the description of the secondary meters (indicated brown in the schema) are given:

CMM measuring equipment

Gas analyzers

ID number	Measuring instrument Concentration	Work parameter, %	Manufacturer [19]	Type	Serial number	Uncertainty level of data, accuracy	Date of installation	Date of last calibr.	Date of next calibr.	Remarks
C1	Concentration of fuel gas	Concentration, %	ABB	AO2040 Electronic	3.244705.5	±1%	2005	13.07.07 10.07.08	13.07.08 10.07.09	A1 connection
C2	Concentration of car fuel and ignition gas	Concentration, %	ABB	AO2040 Electronic	3.244704.5	±1%	2005	11.07.07 11.07.08	13.07.08 11.07.09	A2 connection

Calibration interval for gas analyzers is two years

Flow meters for ignition gas and car fuel gas

ID	ID	Measuring instrument	Work parameter	Manufacturer	Type	Serial number	Uncertainty level of data, accuracy	Date of installation	Data 1.07.2008 m3	Data 30.09.2008 m3	Difference m3	Date of last calibr.	Date of next calibr.	Remarks
V1	G13	Volume of ignition gas	m3	NVP"GREMPIS" ltd	Universal-1	6023	±1%	4-th quarter 2007	1272092.1	1 670 318.9	398 226.8	27.08.07 23.07.08	23.07.10	Main meter
	T5	Temperature of ignition gas	K		PVT-01-1	6480		N/A				23.07.08	23.07.10	
	P10	Pressure of ignition gas	Bar		Vegabar-17	12307278		N/A				23.07.08	23.07.09	
V2	G14	Volume of car fuel gas	m3	NVP"GREMPIS" ltd	Universal-2	327	±1%	4-th quarter 2007	2477856	3 012 583	534 727	12.04.07 28.07.08	28.07.10	Main meter
	T18	Temperature of car fuel gas	K		TSNP-01-1	211						28.07.08	28.07.10	
	P23	Pressure of car fuel gas	Bar		SEN	45						28.07.08	28.07.09	

[19] One and a half year manufacturer warrantee obligations from commission date.

Calibration interval for flow meters is two years

Flow meters for fuel gas consumption

ID	ID	Measuring instrument	Work parameter	Manufacturer	Type	Serial number	Uncertainty level of data, accuracy	Date of installation	Data 1.07.2008 m3	Data 30.09.2008 m3	Difference	Date of last calibr.	Date of next calibr.	Remarks
M1	G1	Volume of fuel gas at CHP1	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	102	±1%	N/A	7832046	10854133	3022087	16.07.08	16.07.11	BKTM1 #094
	T6	Temperature of fuel gas at CHP1	K	Metran Industry Group, Russia	Metran-274-02	510745						22.07.08	22.07.10	
	P11	Pressure of fuel gas at CHP1	P	Vegabar	Vegabar 14	14536534						04.06.08	04.06.09	
M2	G2	Volume of fuel gas at CHP2	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	108	±1%	N/A	6473898	10118093	3644195	15.07.08	15.07.11	BKTM2 #100
	T9	Temperature of fuel gas at CHP2	K	Metran Industry Group, Russia	Metran-274-02	510735						21.07.08	21.07.10	
	P 14	Pressure of fuel gas at CHP2	P	Vegabar	Vegabar 14	14568471						02.06.08	02.06.09	
M3	G3	Volume of fuel gas at CHP3	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	109	±1%	N/A	6821492	10285075	3463583	18.07.08	18.07.11	BKTM1
	T7	Temperature of fuel gas at CHP3	K	Metran Industry Group, Russia	etran-274-02	510753						04.07.08	04.07.10	
	P12	Pressure of fuel	P	Vegabar	Vegabar	14536542						04.06.08	04.06.09	

		gas at CHP3			14									
M4	G4	Volume of fuel gas at CHP4	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	104	±1%	N/A	2923449	2923449	0	15.07.08	15.07.11	BKTM2
	T 10	Temperature of fuel gas at CHP4	K	Metran Industry Group, Russia	Metran-274-02	509670						21.07.08	21.07.10	
	P 15	Pressure of fuel gas at CHP4	P	Vegabar	Vegabar 14	14536186						02.06.08	02.06.09	
M5	G5	Volume of fuel gas at CHP5	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	103	±1%	N/A	6895780	10200714	3304934	17.07.08	17.07.11	BKTM1
	T8	Temperature of fuel gas at CHP5	K	Metran Industry Group, Russia	Metran-274-02	509669						22.07.08	22.07.10	
	P 13	Pressure of fuel gas at CHP 5	P	Vegabar	Vegabar 14	14447569						14.06.08	14.06.09	
M6	G6	Volume of fuel gas at CHP6	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	97	±1%	N/A	4976744	8022571	3045827	16.07.08	16.07.11	BKTM2
	T 11	Temperature of fuel gas at CHP6	K	Metran Industry Group, Russia	Metran-274-02	510733						21.07.08	21.07.10	
	P 16	Pressure of fuel gas at CHP6	P	Vegabar	Vegabar 14	14536368						02.06.08	02.06.09	

M7	G7	Volume of fuel gas at CHP7	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	98	±1 %	N/A	2472038	5403981	2931943	16.07.08	16.07.11	BKTM3 #099
	T 12	Temperature of fuel gas at CHP7	K	Metran Industry Group, Russia	Metran-274-02	510744						21.07.08	21.07.10	
	P 17	Pressure of fuel gas at CHP7	P	Vegabar	Vegabar 14	14568573						03.06.08	03.06.09	
M8	G8	Volume of fuel gas at CHP8	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	105	±1 %	N/A	9550037	14434110	4884073	17.07.08	17.07.11	BKTM4 #095
	T 15	Temperature of fuel gas at CHP8	K	Metran Industry Group, Russia	Metran-274-02	510754						24.07.08	24.07.10	
	P 20	Pressure of fuel gas at CHP8	P	Vegabar	Vegabar 14	14568589						05.06.08	05.06.09	
M9	G9	Volume of fuel gas at CHP9	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	99	±1 %	N/A	2590533	5867273	3276740	17.07.08	17.07.11	BKTM3
	T 13	Temperature of fuel gas at CHP7	K	Metran Industry Group, Russia	Metran-274-02	510742						21.07.08	21.07.10	
	P 18	Pressure of fuel gas at CHP7	P	Vegabar	Vegabar 14	14536304						03.06.08	03.06.09	

M10	G10	Volume of fuel gas at CHP10	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	96	±1 %	N/A	8496821	12445160	3948339	18.07.08	18.07.11	BKTM4
	T16	Temperature of fuel gas at CHP10	K	Metran Industry Group, Russia	Metran-274-02	510755						24.07.08	24.07.10	
	P21	Pressure of fuel gas at CHP10	P	Vegabar	Vegabar 14	14536306						05.06.08	05.06.09	
M11	G11	Volume of fuel gas at CHP11	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	101	±1 %	N/A	2676571	6446656	3770085	17.07.08	17.07.11	BKTM3
	T 14	Temperature of fuel gas at CHP11	K	Metran Industry Group, Russia	Metran-274-02	510738						21.07.08	21.07.10	
	P 19	Pressure of fuel gas at CHP11	P	Vegabar	Vegabar 14	14568610						03.06.08	03.06.09	
M12	G12	Volume of fuel gas at CHP12	m3	Sibnefteavtomatica, Russia	DRGM Elec-tronic	100	±1 %	N/A	7843509	7843509	0	15.07.08	15.07.11	BKTM4
	T17	Temperature of fuel gas at CHP12	K	Metran Industry Group, Russia	Metran-274-02	510747						24.07.08	24.07.10	
	P22	Pressure of fuel gas at CHP12	P	Vegabar	Vegabar 14	14568606						05.06.08	05.06.09	

Calibration interval DRGM flow meters is three years

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 power produced will be crosschecked to provide quality and reliability of monitored data. To ensure reliable and non-stop performance of cogeneration plant the inputs of natural gas from the natural gas pipeline are envisaged.

CMM consumption of gas filling stations

Each of two blocks of Vostochnaya gas filling station has records in the registers. Calculations of methane fueled are executed according to data pressure difference of manometers. Concentration of methane is measured monthly with ABB AO 2040 at Power Station and ground wells analysis. Besides, the concentration of methane is measured locally with an interferometer. Temperature and pressure meters are installed too. The volume of methane is measured by "Universal-2" metering system.

B.1.3. Calibration procedures

For Electricity Meters:

QA/QC 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. Manufacturer's warranty-36 months	Ukrainian Centre for Standardization and Metrology

For Heat Meters

QA/QC 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. Manufacturer's warranty-18 months	Ukrainian Centre for Standardization and Metrology

For CMM meters:

QA/QC procedures	Body responsible for calibration and certification
Keuter ADM1 Electronic. Calibration interval of such meters is 1 year[20].	Ukrainian Centre for Standardization and Metrology
Gas Analyzer ABB A02040. Calibration interval of such meters is 1 year.	Ukrainian Centre for Standardization and Metrology

B.1.4. Involvement of Third Parties:

Ukrainian Centre for Standardization and Metrology[21].

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

For the operational and management structure of the project see PDD, Figure 5 *: Monitoring and quality control system for Vostochnaya and Yakovlevskaya sites*

[20] 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.

[21] All measurement equipment should be calibrated according to terms and methodology defined by this centre requirements.

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	tCO2e/tCH4	Set at 2.75 tCO2e /tCH4 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	tCO2e/tCH4	Set at 21

Table 3: Project variables

ID number	Data variable	Source of data	Data unit	Comment
B13 $EF_{grid,produced,y}$	Emissions factor of electricity of replaced grid electricity production by the project activity in year	See annex 2	tCO_2/MWh	See annex 2 PDD See also table "Electrical Meters"
B14 $EF_{grid,reduced,y}$	Emissions factor of electricity of replaced on-site electricity consumption by the project activity	See annex 2	tCO_2/MWh	See annex 2 PDD See also table "Electrical Meters"
B20 $EF_{heat,vost}$	Emissions factor for heat at Vostochnaya site in the baseline scenario	Boiler efficiency	tCO_2/GJ	See annex 2 PDD See also table "Heat Meters"
B22 $EF_{heat,yak}$	Emissions factor for heat at Yakovlevskaya site in the baseline scenario	Boiler efficiency	tCO_2/GJ	See annex 2 PDD See also table "Heat Meters"
B24 $EF_{heat,centr}$	Emissions factor for heat at Centralnaya site in the baseline scenario	Boiler efficiency	tCO_2/GJ	See annex 2 PDD. See also table "Heat Meters"
B26 EF_v	Emissions factor for vehicle operation replaced by the project activity	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy	tCO_2/GJ	See annex 2 PDD

		Chapter 4: Fugitive Emissions		

Table 4: Baseline Variables

B.2.2. List of variables:

Project emissions variables to be measured:

MM_{CHP}	Methane measured sent to power plant (tCH4)
MM_{GAS}	Methane measured supplied to gas grid for vehicle use (tCH4)

Baseline emissions variables to be measured:

GEN_{CHP}	Net electricity generated by the project activity by the CHP plants (MWh)
El_{cons}	Net electricity consumed by the mine on-site (MWh)
$HEAT_{cons,vost}$	Heat consumed at Vostochnaya site delivered by the project (GJ)

B2.3. Data concerning GHG emissions by sources of the project activity (referring to paragraph 53(a)):

Year	MM_{GAS} *(tCH4)*
Total 2008 Q3	356

Table 5: Data to be collected in the project scenario

Year	MM_{CHP} *(tCH4)*
Total 2008 Q3	7,079

Table 6: 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 (referring to paragraph 53(b)):

Year	GEN_{CHP} *(MWh)*	El_{Cons}*(MWh)*	$HEAT_{cons\,,\,vost,\,y}$ *(GJ)*
2008 Q3	31 ,864	48,635	3,950

Table 7: Data collected in the baseline scenario

B.2.5. Data concerning leakage (referring to paragraph 53(c)):

Not Applicable.

B.2.6. Data concerning environmental impacts (referring to paragraph 53(d)):

Not Applicable.

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

All data will be archived electronic and paper.

B.4. Special event log:

No special events took place in this monitoring period.

SECTION C. Quality assurance and quality control measures

C.1. Documented procedures and management plan:

C.1.1. Roles and responsibilities:

The general project management is implemented by the Deputy General Director of the Zasyadko Coal Mine through supervising and coordinating activities of his subordinates, such as deputy director on surface degasification, chief power engineer, chief heating engineer, and heads 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, measuring 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. Three shifts by eight hours have been introduced.

At the main objects the responsibilities are as follows:

- VPS operator controls data before VPS and after VPS (at the gas treatment plant) including CMM and natural gas flow parameters;
- Two cogeneration plant operators control data at the inlets of cogeneration modules (at the gas treatment plant), work process parameters, and heat and power output;
- Substation operator controls data on electric power amounts dispatched to and supplied from the grid as well as in-house electricity consumption.

All the information will be channelled to the workstation of the Coal Mine central dispatching office and on-line monitored by the head of the shift that will be responsible for calculation of the CO_2 equivalent emission reductions. Such calculations are made on a monthly basis. The general supervision of the monitoring system is executed by Zasyadko Coal Mine administration under the existing control and reporting system.

C.1.2. Trainings:

The basic equipment for CHP plant, being the cogeneration units, was supplied by the GE Jenbacher Company (Austria). As stipulated in the delivery contract education of staff, that operates those units, were provided in Austria. Additional training was provided by GE Jenbacher technicians during installation and commissioning works. The employees responsible for the monitoring control also were dully trained during installation of such system.

Extra trainings are to be provided during operation of equipment. Training programs for CHP and VPS staff as well as Emergency training are submitted as separate document.

The regularly quarter monitoring training of staff took place at 6.06.2008. This training was aimed for six shift dispatchers. The responsible persons that provided this training were Head of CHP facility Evgeniy Berezovskiy and Chief Despatch Maksim Myinka.

C.2. Involvement of Third Parties:

The Ukrainian Centre for Standardization and Metrology is a Third Party involved.

C.3. Internal audits and control measures:

The responsible persons are :

- Head of CHP facility, Mr. Berezovskiy Evgeniy;
- Monitoring engineer, Mr. Cherednikov Valeriy;
- Chief Despatch, Mr Myinka Maksim

Introduction of a modern computerized control system allows for efficient on-line monitoring and reviewing work process performance at the Zasyadko Central Dispatching office every fifteen minutes. (Especially 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 efficiently coordinate adjustment actions of his shift subordinates including on-duty technical staff that will improve work process and eliminate such deviations.

C.4. Troubleshooting procedures[22]:

See C .1.2

In case of a break down 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 primary meters are *after* the venting stack, only combusted CMM will be accounted for.

[22] There is all necessary metering equipment of the same type at the CHP facility to replace main equipment for short period in case of break down or calibration – electrical and heat meters, CMM metering equipment, pressure , temperature sensors, e .t. c. Being connected or installed these devices are able to channel all data to computer system of monitoring and control. This equipment is also calibrated by the Ukrainian Centre for Standardization and Metrology in certain time.

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 tCO2e.

$$PE_y = PE_{MD} + PE_{UM} \quad (1)$$

Where:

PE_y	Project emission in year y (tCO2e)
PE_{MD}	Project emissions from methane destroyed (tCO2e)
PE_{UM}	Project emissions from un-combusted methane (tCO2e)

The project emissions from methane destroyed

The project emissions from methane destroyed are given by the equation below. Methane will be destroyed in CHPs (and in vehicles) and as the CHP produces both electricity and heat at one source, MD_{ELEC} and MD_{HEAT} are combined into MD_{CHP}. No flaring takes place so $MD_{FL} = 0$.

$$PE_{MD} = (MD_{CHP} + MD_{GAS}) x (CEF_{CH4} + r x CEF_{NMHC}) \quad (2)$$

With:

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

where:

PE_{MD}	Project emissions from CMM destroyed (tCO2e)
MD_{CHP}	Methane destroyed in the CHPs (tCH4)
MD_{GAS}	Methane destroyed by the vehicles supplied by the new gas filling stations (tCH4)
CEF_{CH4}	Carbon emission factor for combusted methane (2.75 tCO2e/tCH4)
[23]CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) ($tCO_e eq/tNMHC$)
R	Relative proportion of NMHC compared to methane
PC_{CH4}	Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC}	NMHC concentration (in mass) of extracted gas (%)

The relative proportion of NMHC was monitored and is less than 1%. Therefore NMHC has been excluded in the calculations. So:

$$PE_{MD} = (MD_{CHP} + MD_{GAS}) x CEF_{CH4} \quad (3)$$

Emissions of CHPs

The emissions of the CHPs are given by the following equation:

[23] 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.

$$MD_{CHP} = MM_{CHP} x Eff_{CHP} \quad (4)$$

where:

MD_{CHP} Methane destroyed in the CHPs (tCH4)
MM_{CHP} Methane measured sent to the CHPs (tCH4)
Eff_{CHP} Efficiency of methane destruction/oxidation in CHP (taken as 99.5% from IPCC)

D2. Emissions of gas utilization

Some methane will be supplied to the gas filling station that will supply the vehicles. The emissions as a result are given by the following equations.

$$MD_{GAS} = MM_{GAS} x Eff_{GAS} \quad (5)$$

where:

MD_{GAS} Methane destroyed by the vehicles supplied by the new gas filling stations (tCH4)
MM_{GAS} Methane measured supplied to vehicle by the new gas filling stations (tCH4)
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% from IPCC)

Emissions from un-combusted methane

$$PE_{UM} = GWP_{CH4} x(MM_{CHP} x(1 - Eff_{CHP}) + MM_{GAS} x(1 - Eff_{GAS})) \quad (6)$$

where:

PE_{UM} Project emissions from un-combusted methane (tCO2e)
GWP_{CH4} Global warming potential of methane (21 tCO2e/tCH4)
MM_{CHP} Methane measured sent to use at CHP (tCH4)
Eff_{CHP} Efficiency of methane destruction in CHP (taken as 99.5% from IPCC)
MM_{GAS} Methane measured sent to use for gas filling station (tCH4)
Eff_{GAS} Efficiency of methane destruction in vehicle usage (taken as 98.5% from IPCC)

D.3.1. Project emissions:

		2008 Q3
Project emissions	[tCO2e]	21 190
Total 2008 Q3	[tCO2e]	*21 190*

Table 8: Project emissions

D.3.2. Baseline emissions:

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

$$BE_y = BE_{MR,y} + BE_{Use,y} \quad (7)$$

Where:

BE_y Baseline emissions in year y (tCO2e)
$BE_{MR,y}$ Baseline emissions from release of methane into the atmosphere

	that is avoided by the project activity in year y (tCO2e)
$BE_{Use,y}$	Baseline emissions from the production of power, heat replaced by the project activity in year y (tCO2e)

Baseline emissions of methane avoided by project activity

As there is neither CBM nor CMM at the mine, the emissions equal the amount of post-mining CMM captured in the project activity that is sent to the CHP and the gas filling stations.

$$BE_{MR.y} = GWP_{CH4} x (CMM_{PJ,CHP,y} + CMM_{PJ,GAS,y}) \quad (8)$$

Where:

$CMM_{PJ,CHP,y}$	Pre-mining CMM captured, sent to and destroyed in the 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 of methane (=21 tCO_2e/tCH_4)

Baseline emissions of replacement of electricity, heat and vehicle fuel by the project activity

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

$$BE_{Use,y} = BE_{Use,el,y} + BE_{Use,heat,y} + BE_{Use,gas,y} \quad (9)$$

Where:

$BE_{Use,y}$	Potential total baseline emissions from the production of power, heat, and vehicle fuels replaced by the project activity in year y (tCO_2)
$BE_{Use,el,y}$	Total baseline emissions from the production of electricity replaced by the project activity in year y (tCO_2)
$BE_{Use,heat,y}$	Total baseline emissions from the production of heat replaced by the project activity in year y (tCO_2)
$BE_{Use,gas,y}$	Total baseline emissions of vehicle fuels replaced by the project activity in year y (tCO_2e)

Baseline emissions of replacement of electricity (power)

The baseline emissions of the replacement of electricity by the project activity are given by two equations. When the amount of electricity generated in a year by the project activity is less than the total amount of electricity consumed by the mine, the baseline emissions are as follows:

$$BE_{Use.el.y} = GEN_{CHP,y} x EF_{grid,reduced} \quad (10)$$

When the amount of electricity generated in a year by the project activity is more than the total amount of electricity consumed by the mine (i.e. electricity will be supplied to the grid), the baseline emissions are as follows:

$$BE_{Use,el,y} = (GEN_{CHP,y} - EL_{cons,y}) x EF_{grid,produced,y} + EL_{cons,y} x EF_{grid,reduced,y} \quad (11)$$

where:

$BE_{Use,el,y}$	Total baseline emissions from the production of electricity replaced by the project activity in year y (tCO2)
$GEN_{CHP,y}$	Net electricity generated by the project activity of the CHP plants in year y (MWh)
$EF_{grid,produced,y}$	Emissions factor of electricity of replaced grid electricity production by the project activity in year y (tCO_2/ MWh)
$EL_{cons,y}$	Net electricity consumed by the mine on-site in year y (MWh)[24]

[24] Net electricity consumed by the mine includes all electricity consumed by the Vostochnaya, Yakovlevskaya, Centralnaya, and Grigoryevskaya production sites but excluding electricity consumption of the project being the gas treatment facility

$EF_{grid,reduced,y}$ Emissions factor of electricity of replaced on-site electricity consumption by the project activity (tCO_2/ MWh)

Please note that for this monitoring period the net electricity generated is less than the net electricity consumed (see section B.1.2). As a consequence formula 10 was used and formula 11 was discarded.

Baseline emissions of replacement of heat

Heat is being replaced on site at three different sites[25], being at the on-site boilers at Vostochnaya, Yakovlevskaya, and Centralnaya[26]. Furthermore, heat is being replaced at the city district heating system. The baseline emissions are given in the following equation.

$$BE_{Use,Heat,y} = HEAT_{deliv,DH,y} xEF_{heat,DH,y} + HEAT_{deliv,vost,y} xEF_{heat,vost} + HEAT_{deliv,yak,y} xEF_{heat,yak} + HEAT_{deliv,centr,y} xEF_{heat,centr} \quad (12)$$

where:

$HEAT_{deliv,DH,y}$ Heat generation delivered to district heating by the project activity in the year y (GJ)
$EF_{heat,DH,y}$ Emissions factor for heat production at the District Heating system in the baseline scenario in the year y (tCO_2/GJ)
$HEAT_{deliv,vost,y}$ Heat delivered to Vostochnaya site delivered by the project activity in the year y (GJ)
$EF_{heat,vost}$ Emissions factor for heat at Vostochnaya site in the baseline scenario (tCO_2/GJ)
$HEAT_{deliv,yak,y}$ Heat delivered to Yakovlevskaya site delivered by the project activity in a year y (GJ)
$EF_{heat,yak}$ Emissions factor for heat at Yakovlevskaya site in the baseline scenario (tCO_2/GJ)
$HEAT_{deliv,centr,y}$ Heat delivered to Centralnaya site delivered by the project activity in a year y (GJ)
$EF_{heat,centr}$ Emissions factor for heat at Centralnaya site in the baseline scenario (tCO_2/GJ)

Please note that only Heat delivered to Vostochnaya site is monitored (see section A.7 and B.1.2).

Baseline emissions of replacement of vehicle fuels

The baseline emissions of the replacement of vehicle fuels by the project activity are given by the following equation.

$$BE_{Use.Gas} = VFUEL_y xEF_v \quad (13)$$

$VFUEL_y$ Vehicle fuel provided by the project activity (GJ)
EF_V Emissions factor for vehicle operation replaced by the project activity (tCO_2/GJ)

On-site heat generation emission factors

The three heat generation emission factors of Vostochnaya, Centralnaya, and Yakovlevskaya are fixed ex-ante by the following equation. As these boilers will be decommissioned no monitoring of emission factors will be possible. The specific value of each emission factor is given in Annex 2 of the PDD.

$$EF_{heat,i,y} = \frac{EF_{CO2,i}}{Eff_{heat,i}} x \frac{44}{12} x \frac{1TJ}{1000GJ} \quad (14)$$

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and the CHP system. Electricity consumed by the administrative building of the Zasyadko mine is also not included in the net electricity consumed in order to be conservative.

[25] Some heat will also be delivered to the Grigoryevskaya site replacing existing electricity heating. Due to the small heat consumption, the heat consumption will not be taken into account. As a result emission reductions will not be claimed, which is conservative.

[26] The boilers at the Centralnaya site include the boilers at the greenhouse and the garage.

where:

$EF_{heat,i,y}$	Emissions factor for heat generation (tCO_2/ GJ)
$EF_{CO2,i}$	CO_2 emission factor of fuel used in heat generation (tC/TJ)
$Eff_{heat,i}$	Boiler efficiency of the heat generation (%)
I	i stands for Vostochnaya, Centralnaya, or Yakovlevskaya
44/12	Carbon to Carbon Dioxide conversion factor
1/1000	TJ to GJ conversion factor

The fuel used at Vostochnaya and Yakovlevskaya site is natural gas. The emission factor of fuel used for natural gas is taken 15.3 tC/TJ (= IPCC default). The emission factor of the coal used at the Centralnaya boilers (grade G) is determined by the following equation.

$$EF_{CO2,centr} = \frac{C_r}{LHV_{coal}} x \frac{1000}{100} \qquad (15)$$

where:

$F_{CO2,centr}$	CO_2 emission factor of coal used in heat generation at Centralnaya site (tC/TJ)
C_r	Mass content of coal (%)
LHV_{coal}	Lower heating value of coal (GJ/ton coal)

Vehicle fuel emission factor

The emission factor as a result of vehicle fuel use is given by the following equation.

$$EF_V = \frac{EF_{CO2,i}}{Eff_V} x \frac{44}{12} x \frac{1TJ}{1000GJ} \qquad (16)$$

where:

EF_V	Emissions factor for vehicle operation replaced by the project activity (tCO_2/GJ)
EF_{CO2i}	CO_2 emission factor of fuel used for vehicle operation (tC/TJ)
Eff_V	Vehicle engine efficiency (%)
44/12	Carbon to Carbon Dioxide conversion factor
1/1000	TJ to GJ conversion factor

		2008 Q3
Baseline emissions	[tCO2e]	187 012
Total 2008 Q3	[tCO2e]	*187 012*

Table 9: Baseline emissions

D.3.3. Leakage:

Not Applicable

D.3.4. Summary of the emissions reductions during the monitoring period:

		2008 Q3
Emission reductions	[tCO2e]	165 822
Total 2008 Q3	[tCO2e]	*165 822*

Table 10: Emission Reductions