JI0077 - CMM utilisation on the coal mine Shcheglovskaya-Glubokaya of the State Holding Joint-Stock Company „GOAO Shakhtoupravlenye Donbass“

Revised Monitoring Plan

Version 5
19 May 2011

CONTENTS

Annexes

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

A monitoring plan based on the “Approved consolidated baseline methodology ACM0008”, Version 03, Sectoral Scope: 8 and 10, EB28 is applied to the project [ACM0008]. The differences to the ACM0008 are listed below.

The calculation of the emission reductions is not calculated on a yearly basis, but for an individual period. Flow data and flare efficiency as well as the methane amount destroyed by flaring MD_{FL} are calculated in 15 min. intervals in Excel sheets. The heat amount produced by the ventilation air heater and the power amount produced by the emergency power generation are not measured but calculated using the utilised methane amount. The main emissions variables for project emissions, baseline emissions and emissions reductions are calculated on a monthly basis. Yearly sums and a total sum for the monitoring are calculated.

The formula for the calculation of project emissions from uncombusted methane has been updated. Formulae from the methodological “Tool to determine project emissions from flaring gases containing methane”, EB 28 Meeting report, Annex 13, [AM_Tool_07] has been adopted for the determination of the project emissions from flaring. The calculation of project emissions from uncombusted methane from flaring is now more accurate.

In difference to the flaring tool a combustion efficiency of 99.5%, according to the IPCC guidelines [IPCC] (see also ACM0008 Version 1 and Version 2), has been taken into account for combustion temperatures above 850°C; see justification in Annex 2. The default value of 90% is used in the range from 500°C to 850°C and the default value of 0% below 500°C.

Applicability requirements for the monitoring plan of the ACM0008 methodology are identical to respective requirements of the baseline setting. For a detailed overview of the ACM0008 applicability please refer to section B.I of the PDD.

General remarks to the Revised Monitoring Plan:

- This document is the first updated Monitoring Plan, made during the second verification under JI Track 2
- Generally all project variables determined on a yearly basis in the original version of the monitoring plan have been transferred to individual periods

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

The ID Numbers used in the tables below refer to the ID numbers as used in ACM0008; missing ID numbers refer to parameters, which are listed in the monitoring plan of the ACM0008, and which are not applicable to the project.

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P1 PE	Project emissions	monitored data	tCO_{2eq}	c	monthly	100%	electronic	calculated using formula (1) in Section D.1.1.2, see below
P2 PE_{ME}	Project emissions from energy use to capture and use methane	monitored data	tCO_{2eq}	c	monthly	100%	electronic	calculated using formula (2) in Section D.1.1.2, see below
P3 PE_{MD}	Project emissions from methane destroyed	monitored data	tCO_{2eq}	c	monthly	100%	electronic	calculated using formula (3) in Section D.1.1.2, see below
P4 PE_{UM}	Project emissions from uncombusted methane	monitored data	tCO_{2eq}	c	monthly	100%	electronic	calculated using formula (9) in Section D.1.1.2, see below
P5 $CONS_{ELEC,PJ}$	Additional electricity consumption by project	monitored data	MWh	c	monthly	100%	electronic	calculated using formula (31) in Section D.1.1.2, see below

P8 $CEF_{ELEC,PJ}$	Carbon emission factor of $CONS_{ELEC,PJ}$	data published by National Environmental Investment Agency of Ukraine, NEIA [NEIA]	$t\,CO_{2eq}/MWh$	e, c	ex ante, annually	main power generation plants	paper	Official Ukrainian data have been published at 28/03/2011 and 12/05/2011 at the NEIA website. According to the information given in the PDD these data are taken into account. Set to: 1.067 $t\ CO_2$ / MWh for 2010 and 1.063 for 2011 Value for thermal power plants which are connected to the Ukrainian Power grid. [NEIA]
P9 PE_{Flare}	Project emissions from flaring	monitored data	$t\,CO_{2eq}$	c	15 min. cycle	100%	electronic	calculated using formula (9a) in Section D.1.1.2, see below

P11 MD_{FL}	Methane destroyed by flare	monitored data	t CH_4	c	monthly	100%	electronic	calculated using formula (5) in Section D.1.1.2, see below
P12 MM_{FL}	Methane sent to flare	flow meter	t CH_4	m	15 min. cycle	100%	electronic	A flow meter is recording gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.717 kg/m³ [DIN EN ISO 6976 (1995)] (1013 mbar, 273.15°K)

P13 Eff_{FL} or η_{Flare}	Flare/combus-tion efficiency, determined by the flame temperature of the flare T_{Flame}	monitored data	% / ℃	m	15 min. cycle	100%	electronic	The efficiency is set to 99.5% for a flame temperature above 850°C, 90% in the range from 500°C to 850°C and 0% below 500°C See Annex 2 of the MR for justification. The flame temperature of the flare is monitored continuously.
T_{Flame}	Flame temperature of the flare	thermo couple	℃	m	15 min. cycle	100%	electronic	
P14 MD_{ELEC}	Methane destroyed by power generation	monitored data	tCH_4	c	monthly	100%	electronic	calculated using formula (6) in Section D.1.1.2, see below
P15 MM_{ELEC}	Methane sent to power generation	monitored data	tCH_4	c	monthly	100%	electronic	calculated using formula (6a) in Section D.1.1.2, see below

MM_{CHP}	Methane sent to cogeneration unit	flow meter	tCH_4	m	15 min. cycle	100%	electronic	A flow meter is recording gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.717 kg/m³ DIN EN ISO 6976 (1995) (1013 mbar, 273.15°K)
MM_{EPG}	Methane sent to emergency power generator	flow meter	tCH_4	m	15 min. cycle	100%	electronic	A flow meter is recording gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.717 kg/m³ DIN EN ISO 6976 (1995) (1013 mbar, 273.15°K)
P16 Eff_{ELEC}	Efficiency of methane destruction / oxidation in power plant	ACM0008/ IPCC	%	e	ex ante	100%	paper	set at 99.5% (ACM0008/ IPCC)

P17 MD_{HEAT}	Methane destroyed by heat generation	monitored data	t CH_4	c	monthly	100%	electronic	calculated using formula (7) in Section D.1.1.2, see below
P18 MM_{HEAT}	Methane sent to heat generation	flow meters	t CH_4	m	15 min. cycle	100%	electronic	calculated using formula (7a) in Section D.1.1.2, see below
MM_{WBoil}	Methane sent to winter boilers	flow meter	t CH_4	m	15 min. cycle	100%	electronic	A flow meter is recording gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.717 kg/m³ DIN EN ISO 6976 (1995) (1013 mbar, 273.15°K)

MM_{SBoil}	Methane sent to summer boilers	flow meter	$t CH_4$	m	15 min. cycle	100%	electronic	A flow meter is recording gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.717 kg/m³ DIN EN ISO 6976 (1995) (1013 mbar, 273.15°K)
MM_{VAH}	Methane sent to ventilation air heater	flow meter	$t CH_4$	m	15 min. cycle	100%	electronic	A flow meter is recording gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.717 kg/m³ DIN EN ISO 6976 (1995) (1013 mbar, 273.15°K)
P19 Eff_{HEAT}	Efficiency of methane destruction / oxidation in heat plant	ACM0008/ IPCC	%	e	ex ante	100%	paper	set at 99.5% (ACM0008/ IPCC)

P23 CEF_{CH4}	Carbon emission factor for combusted methane	ACM0008/ IPCC	$t\ CO_{2eq}/t\ CH_4$	e	ex ante	100%	paper	set at 2.75 $t\ CO_{2eq}/t\ CH_4$ (ACM0008/ IPCC)
P24 CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (various)	lab analysis	$t\ CO_{2eq}$ / t NMHC	c	annually	main components	paper	Calculated if applicable, based on the lab analysis. (See P26)
P25 PC_{CH4}	Concentration of methane in extracted gas	IR measurement	%	m	15 min. cycle	100%	electronic	measurement
P26 PC_{NMHC}	NMHC concentration in coal mine gas	lab analysis	%	m	annually	main components	paper	Used to check if more than 1% of emissions and to calculate r
P27 r	Relative proportion of NMHC compared to methane	lab analysis	%	c	annually	100%	paper	Calculated if applicable, based on the lab analysis.
P28 GWP_{CH4}	Global warming potential of methane	ACM0008/ IPCC	$t\ CO_{2eq}/t\ CH_4$	e	ex ante	100%	paper	set at 21 (ACM0008/ IPCC)

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Project emissions are defined by the following equation

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

Project emissions from energy use to capture and use methane (PE_{ME}), is obtained by the equation:

$$PE_{ME} = CONS_{ELEC,PJ} \times CEF_{ELEC,PJ} \quad (2)$$

Where:

PE_{ME}	Project emissions from energy use to capture and use methane (tCO_2e)
$CONS_{ELEC,PJ}$	Additional electricity consumption for capture and use of methane, if any (MWh)
CEF_{ELEC}	Carbon emissions factor of electricity used by coal mine (tCO_2e/MWh)

All utilisation units are supplied with CMM from the CMM suction system of the coal mine. The CMM pressure provided by the suction system is sufficient for the operation of all utilisation units and no further compression is needed. The CMM suction system is always in operation for safety reasons in the underground of the coal mine. The CMM suction system would be also in operation in the absence of the project; in this case the methane would be simply blown into the atmosphere. Thus the energy use for capture of the methane is outside the project boundaries and only the part for use methane is regarded.

The flares need only very few additional electric power for operation – only for the measurement and control devices. This power consumption is negligible and is not taken into account. The flares, which will be placed on degassing wells are equipped with own gas pumps. This combined flares / gas pumps replace old gas pumps, which are currently in operation and which would remain in operation in absence of the project. The power consumption of the new gas pumps is lower than that of the old ones. In case of the project less power will be consumed. To keep conservative $CONS_{ELEC,PJ}$ is set to zero.

The upgraded CMM fired boilers needs less electric power than the old coal fired boilers. In absence of the project the heat generation would furthermore remain in operation using the coal fired boilers. In case of the project less power will be consumed. To keep conservative $CONS_{ELEC,PJ}$ is set to zero.

The cogeneration unit need additional power especially for the cooling fans. The power amount consumed by the power generation units is taken into account as $CONS_{ELEC,PJ}$. The additional energy is not measured with power meters, but calculated using a fixed percentage of the produced power. The percentage has been fixed to 3.5% based on experience made with more than 120 cogeneration units in Germany.

$$CONS_{ELEC} = GEN_{CHP} * 0.035 \quad (31)$$

where

$CONS_{ELEC}$	Additional power consumption by project activity (MWh)
GEN_{CHP}	Electricity generated by the cogeneration unit (MWh)

Project emissions from methane destroyed (PE_{MD}) can be obtained by the equation:

$$PE_{MD} = (MD_{FL} + MD_{ELEC} + MD_{HEAT}) \text{ x } (CEF_{CH4} + r \text{ x } CEF_{NMHC}) \quad (3)$$

with:

$$r = PC_{NMHC} / PC_{CH4} \quad (4)$$

where:

PE_{MD}	Project emissions from CMM destroyed (t CO_2eq)
MD_{FL}	Methane destroyed through flaring (t CH_4)
MD_{ELEC}	Methane destroyed through power generation
MD_{HEAT}	Methane destroyed through heat generation
CEF_{CH4}	Carbon emission factor for combusted methane (2.75 t CO_2eq/t CH_4)
CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (various) (t CO_2eq/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) in extracted gas (%)

The formula for the methane destroyed through flaring has been adopted from the «Methodological "Tool to determine project emissions from flaring gases containing methane"» [AM_Tool_07]):

$$MD_{FL} = \sum_{i=1}^{n} MM_{FL,i} x \eta_{flare,i} \quad (5)$$

where:

MD_{FL}	Methane destroyed through flaring (t CH_4)
$MM_{FL,i}$	Methane sent to flaring in the interval i (t CH_4)
$\eta_{flare,i}$	Efficiency of methane destruction/oxidation in flare in the interval i, see below
n	number of samples (intervals) in the regarded period

The interval is set to 15 min during the monitoring period, which is more accurate than the 1 h intervals from the «Methodological "Tool to determine project emissions from flaring gases containing methane"» [AM_Tool_07]).

For $\eta_{flare,i}$ three different values are taken, depending on the current combustion temperature $T_{Flame,i}$ of the flare in the interval i:

$T_{Flame,i}$	$\eta_{flare,i}$
> 850°C	99.5%
500-850°C	90.0%
< 500°C	0.0%

where:
$T_{Flame,i}$ Flame temperature of the flare in the regarded interval i (°C)
$\eta_{flare,i}$ flare efficiency in the interval i, see Annex 3.1 of this document for justification

$$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC} \quad (6)$$

where:
MD_{ELEC} methane destroyed through power generation (t CH_4)
MM_{ELEC} methane measured sent to power plant (t CH_4)
Eff_{ELEC} efficiency of methane destruction/oxidation in power plant (take as 99.5% from (ACM0008/IPCC)

$$MM_{ELEC} = MM_{CHP} + MM_{EPG} \quad (6a)$$

where:
MM_{ELEC} Methane sent to power generation (t CH_4)
MM_{CHP} methane sent to cogeneration unit, measured by flow meter (t CH_4)
MM_{EPG} methane sent to emergency power generator, measured by flow meter (t CH_4)

During the first month of the monitoring period (April 2010), the data acquisition system of the cogeneration unit was disturbed, so that no reasonable electronically data for power production (KMU) and methane amount consumed by the unit are available. For this period manually recorded data from the NZR journal have been taken for the power production.

The methane amount utilised in April 2010 has been recalculated using the produced power amount (NZR) and the average power generation efficiency determined from the later steady operation period.

$$MM_{CHP} = \frac{GEN_{CHP}}{Eff_{ELEC} \times HV_{CH4}} \quad (29)$$

with

MM_{CHP} methane amount sent to cogeneration unit [t CH_4]
GEN_{CHP} electricity produced by the cogeneration unit [MWh]
Eff_{CHP} efficiency of power generation in cogeneration unit [%] recalculated from later steady operation period
HV_{CH4} heating value of methane [9.965 kWh/m³, equal to 13.899 MWh/t, DIN EN ISO 6976]

The efficiency of power generation is recalculated from later steady operation period:

$$Eff_{CHP} = \frac{GEN_{CHP}}{MM_{CHP} \times HV_{CH4}} \tag{30}$$

with

Eff_{CHP} efficiency of power generation in cogeneration unit
GEN_{CHP} Electricity produced by the cogeneration unit [MWh]
MM_{CHP} Methane amount sent to the cogeneration unit, measured by flow meter [t CH_4]
HV_{CH4} heating value of methane [9.965 kWh/m³, equal to 13.899 MWh/t, DIN EN ISO 6976]

$$MD_{HEAT} = MM_{HEAT} \text{ x } Eff_{HEAT} \tag{7}$$

where:

MD_{HEAT} Methane destroyed through heat generation (t CH_4)
MM_{HEAT} Methane measured sent to heat plant (t CH_4)
Eff_{HEAT} Efficiency of methane destruction/oxidation in heat plant (take as 99.5% from ACM0008/IPCC)

$$MM_{HEAT} = MM_{WBOIL} + MM_{SBOIL} + MM_{VAH} \tag{7a}$$

where:

MM_{HEAT} methane sent to heat generation (t CH_4)
MM_{WBoil} methane sent to winter boilers, measured by flow meter (t CH_4)
MM_{SBoil} methane sent to summer boilers, measured by flow meter (t CH_4)
MM_{VAH} methane sent to ventilation air heater, measured by flow meter (t CH_4)

Uncombusted methane from flaring and end uses (PE_{UM}) can be obtained through the equation:

$$PE_{UM} = GWP_{CH4} \times [MM_{ELEC} \times (1 - Eff_{ELEC}) + MM_{HEAT} \times (1 - Eff_{HEAT})] + PE_{Flare} \quad (9)$$

where

PE_{UM}	Project emissions from un-combusted methane (tCO_2e)
GWP_{CH4}	Global warming potential of methane (21 tCO_2e/tCH_4)
MM_{ELEC}	Methane measured sent to power generation (tCH_4)
MM_{HEAT}	Methane measured sent to heat generation (tCH_4)
Eff_{ELEC}	Efficiency of methane destruction in power plant (%)
Eff_{HEAT}	Efficiency of methane destruction in heat plant (%)
PE_{Flare}	Project emissions from flaring (tCO_2e)

The project emissions from flaring are calculated using the equation:

$$PE_{Flare} = (MM_{Fl} - MD_{FL}) * GWP_{CH4} \quad (9a)$$

where:

PE_{Flare}	Project emissions from flaring in the regarded period (t CO_2eq)
MD_{FL}	Methane destroyed through flaring (t CH_4)
MM_{FL}	Methane measured sent to flaring (t CH_4)
GWP_{CH4}	Global warming potential of methane (21 tCO_2eq/tCH_4)

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B1 BE	Baseline emissions	monitored data	t CO_{2eq}	c	monthly	100%	electronic	calculated using formula (10) in Section D.1.1.4, see below
B3 BE_{MR}	Baseline emissions from release of methane into the atmosphere that is avoided by the project activity	monitored data	t CO_{2eq}	c	monthly	100%	electronic	calculated using formula (14) in Section D.1.1.4, see below
B4 BE_{Use}	Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity	monitored data	t CO_{2eq}	c	monthly	100%	electronic	calculated using formula (24) in Section D.1.1.4, see below
B14 CMM_{PJ}	CMM captured in the project activity	flow meters	t CH_4	m	monthly	100%	electronic	calculated using formula (14a) in Section D.1.1.4, see below
B18 GWP_{CH4}	Global warming potential of methane	ACM0008/ IPCC	t CO_{2eq} / t CH_4	e	ex ante	100%	paper	21 t CO_{2eq} / t CH_4

B19 CEF_{CH4}	Carbon emission factor for combusted methane	ACM0008/ IPCC	t CO_{2eq} / t CH_4	e	ex ante	100%	paper	44/16 = 2.75 tCO_2e/tCH_4
B46 GEN	Electricity generation by project	monitored data	MWh	m	monthly	100%	electronic and paper	calculated using formula (27) in Section D.1.1.4, see below
GEN_{CHP}	Electricity generated by the cogenera-tion unit	power meter	MWh	m	15 min. cycle	100%	electronic	
GEN_{EPG}	Electricity generated by the emergency power generator	monitored data	MWh	c	monthly	100%	electronic	calculated using monitored data
Eff_{CHP}	efficiency of power genera-tion in the cogeneration unit	monitored data	%	c	ex-ante	100%	electronic	calculated using formula (30) in Section D.1.1.4, see below
Eff_{EPG}	Efficiency of the power generation by emergency power generator	PDD	%	e	ex-ante	100%	electronic	Set to 36% [PDD]
B47 HEAT	Heat generation by project	heat meter	MWh	m	monthly	100%	electronic	calculated using formula (25) in Section D.1.1.4, see below

$HEAT_{WBoil}$	Heat generation by winter boilers	heat meter	MWh	m	15 min. cycle	100%	electronic	
$HEAT_{SBoil}$	Heat generation by summer boilers	heat meter	MWh	m	15 min. cycle	100%	electronic	
$HEAT_{VAH}$	Heat generation by ventilation air heater	monitored data	MWh	c	monthly	100%	electronic	calculated using formula (26) in Section D.1.1.4, see below
Eff_{VAH}	Efficiency of the heat generation by ventilation air heater	VAH technical report	%	e	ex-ante	100%	electronic	Set to 97.25 % [VAH technical report]

B49 EF_{ELEC}	CO_2 emission factor of the grid	data published by National Environmental Investment Agency of Ukraine, NEIA [NEIA]	t CO_2eq/MWh	e, c	ex ante, annually	main power generation plants	paper	Official Ukrainian data have been published at 28/03/2011 and 12/05/2011 at the NEIA website. According to the information given in the PDD these data are taken into account. Set to: 1.067 t CO_2 / MWh for 2010 and 1.063 for 2011 Value for thermal power plants which are connected to the Ukrainian Power grid. [NEIA]
B55 EF_{HEAT}	CO_2 emission factor of fuel used for captive power or heat	IPCC	t CO_2 / MWh	e	ex ante	100%	paper	Set to 0.3406 t CO_2/MWh Using the value for “Other Bituminous Coal” of 94,600 kg CO_2 /TJ [IPCC-2].

B57 Eff_{COAL}	Energy efficiency of previously coal fired heat plant	manufacturer data	%	e	ex ante	100%	paper	90.0 % for upgraded winter boiler (measured value) 89.0 % for summer boilers
HV_{CH4}	Heating value of methane	DIN EN ISO 6976	kWh/m³ MWh/t	m	ex-ante	100%	electronic	set to 9.965 kWh/m³, equal to 13.899 MWh/t

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Baseline emissions are given by the following equation:

$$BE = BE_{MR} + BE_{Use} \tag{10}$$

where

BE Baseline emissions of the project (tCO_2e)
BE_{MR} Baseline emissions from the release of methane into the atmosphere (tCO_2e)
BE_{Use} Baseline emissions from the production of power or heat replaced by the project activity (tCO_2e)

The baseline emissions from release of methane into the atmosphere (BE_{MR}) are obtained by the following equation:

$$BE_{MR} = CMM_{PJ} \times GWP_{CH4} \tag{14}$$

where

BE_{MR} Baseline emissions from the release of methane into the atmosphere (tCO_2e)
CMM_{PJ} CMM captured in the project activity (t CH_4)
GWP_{CH4} Global warming potential of methane (21 tCO_2e/tCH_4)

$$CMM_{PJ} = MM_{FL} + MM_{ELEC} + MM_{HEAT} \tag{14a}$$

where:

CMM_{PJ} CMM captured in the project activity (tCH_4)
MM_{FL} Methane amount sent to flare (tCH_4)
MM_{ELEC} Methane amount sent to power generation (tCH_4)
MM_{HEAT} Methane amount sent to heat generation (tCH_4)

The total emissions reductions from displacement of power/heat generation are given by the following equation:

$$BE_{Use} = GEN * EF_{ELEC} + (HEAT / Eff_{COAL}) * EF_{HEAT} \quad (24)$$

where
BE_{Use} Total baseline emissions from the production of power or heat replaced by the project activity (tCO_{2e})
GEN Electricity generated by project activity (MWh)
EF_{ELEC} Emissions factor of electricity (grid, captive or a combination) replaced by the project activity (tCO_2/MWh)
HEAT Heat generation by project activity (MWh)
EF_{HEAT} Emissions factor for heat production replaced by project activity (tCO_2/MWh)
Eff_{COAL} Efficiency of the former coal fired heat generation unit, which is displaced by project activity (%)

The heat generation by project activity HEAT (MWh) is calculated as sum of the heat generation by summer boilers, winter boilers and ventilation air heater.

$$HEAT = HEAT_{WBoil} + HEAT_{SBoil} + HEAT_{VAH} \quad (25)$$

where
HEAT Heat generation by project activity (MWh)
$HEAT_{WBoil}$ Heat generation by winter boilers (MWh)
$HEAT_{SBoil}$ Heat generation by summer boilers (MWh)
$HEAT_{VAH}$ Heat generation by ventilation air heater (MWh)

As the heat amount produced by the ventilation air heater can not be measured, it has to be calculated using the methane amount utilised by the unit and the VAH heat generation efficiency.

$$HEAT_{VAH} = MM_{VAH} \times Eff_{HEAT} \times Eff_{,VAH} \times HV_{CH4} \quad (26)$$

with

$HEAT_{VAH}$	heat generated by the ventilation air heater [MWh]
MM_{VAH}	methane amount sent to ventilation air heater [t CH_4]
Eff_{HEAT}	Efficiency of methane destruction/oxidation in heat plant (take as 99.5% from ACM0008/IPCC)
Eff_{VAH}	efficiency of heat production in ventilation air heater; set to 97.25%
HV_{CH4}	heating value of methane [9.965 kWh/m³, equal to 13.899 MWh/t, DIN EN ISO 6976]

The power generation by project activity GEN (MWh) is calculated as sum of the power generation by cogeneration unit and emergency power generator.

$$GEN = GEN_{CHP} + GEN_{EPG} \qquad (27)$$

where

GEN	Electricity generated by project activity (MWh)
GEN_{CHP}	Electricity generated by the cogeneration unit (MWh)
GEN_{EPG}	Electricity generated by the emergency power generation unit (MWh)

The power amount of the emergency power generator has not been counted. The electricity production has been recalculated using the methane amount consummated by the unit and the power efficiency as given in the PDD.

$$GEN_{EPG} = MM_{EPG} \times Eff_{ELEC} \times Eff_{EPG} \times HV_{CH_4} \qquad (28)$$

with

GEN_{EPG}	electricity produced by the emergency power generation [MWh]
MM_{EPG}	methane amount sent to emergency power generation, measured with flow meter [t CH_4]
Eff_{ELEC}	efficiency of methane destruction/oxidisation in power plant, set to 99.5% (ACM0008/IPCC)
Eff_{EPG}	efficiency of emergency power generation; set to 36% as given in the PDD
HV_{CH4}	heating value of methane [9.965 kWh/m³, equal to 13.899 MWh/t, DIN EN ISO 6976]

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

not applicable

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

not applicable

D.1.3. Treatment of leakage in the monitoring plan:

In accordance with ACM0008 the following leakages should be considered:

1. Displacement of baseline thermal energy uses
2. CBM drainage from outside the de-stressed zone
3. Impact of the JI project on coal production
4. Impact of the JI project on coal prices

There is no leakage in the project as:

1. There is no CMM being used for thermal demand under the baseline scenario. Hence there is no leakage for displacement of baseline thermal energy uses;
2. There is no CBM involved hence no leakage occurs from CDM drainage from outside the de-stressed zone
3. There is no impact of the JI project on coal production as degasification activities are independent from the JI project
4. The impact of the JI project on coal prices is difficult to assess. The JI project as such does not influence coal production so it is unlikely that the JI project will impact coal prices

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable. There are no leakages and no indirect emissions

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

Not applicable. There are no leakages and no indirect emissions.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

The greenhouse gas emission reduction gained by the project over a period is the difference between the total baseline emissions over the period and the total project emissions over the period. This is given by the equation:

$$ER = BE - PE \qquad (18)$$

where:
ER Emissions reductions of the project activity (t CO_{2eq})
BE Baseline emissions (t CO_{2eq})
PE Project emissions (t CO_{2eq})

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

To maintain a consistent and reliable performance of the automatic controlling and monitoring system an adequate quality control and assurance procedures have been implemented that is regulated by the calibration standards and quality norms of the national legislation. Under these requirements of quality control system, regular maintenance and testing regime to ensure accuracy of flow meters, gas-analysers, electricity and heat measuring instruments is provided. All measuring instruments are calibrated periodically. The calibration protocols are archived and proved by an independent entity on an annual basis. A consistency check for all measurement data and the calculation of the emission reductions is carried out and reported monthly.

Furthermore emissions measurement for dust, CO, NOx etc. for all combustion units will be carried out and archived as required by the legal requirements of the Ukrainian Authorities

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P5 *Power consumption*	low	The calibration interval is 1 year. Calibration procedures for power meters are implemented in compliance with the calibration methodology developed by the Ukrainian Centre for Standardisation and Metrology.
P12 P15 P18 B14 *Methane amount*	medium	The flow meters consist of an orifice and a pressure difference meter. The measured volumetric flow rates are designed for a standardised gas composition and have to be corrected by the actual gas condition. The measured flow rates is continuously converted from operation condition to standard state condition by use of the ideal gas law and the actually gas temperature and pressure. The meters have been initially controlled during the final inspection by the manufacturer and are checked regularly according to the manufacturer's instructions. The indications of the measurement instruments are controlled during the regular inspections while the operation time, and a gauge which is obviously out of order should be substituted. The calibration interval is 1 year. Calibration procedures for all meters are implemented in compliance with the calibration methodology developed by the Ukrainian Centre for Standardization and Metrology.
P13 *Combustion efficiency off the flare*	low	The chosen flares are designed to fulfil the German regulations for flaring of landfill gas. In these regulations a minimum efficiency of 99.9 % is required. This efficiency is proved by a continuous measurement of the combustion temperature, which has to be above 850°C. Additionally the emissions of the flare have to be verified every three years by a measurement. According to the German Regulations a measurement of the emissions, especially the total C amount in the flue gas, which indicates the combustion efficiency of the flare, should be carried out every three years by an approved expert, laboratory, institute etc. The temperature meter has been initially controlled during the final inspection by the manufacturer and is checked regularly according to the manufacturer's instructions. The gauge has usually hardly any fluctuations and no recalibration is needed. The gauge should be controlled during the regular inspections while the operation time and a gauge which is obviously out of order should be substituted. The temperature meter has to be changed yearly according to the methodological "Tool to determine project emissions from flaring gases containing methane"
P25 *Methane concentration*	medium	The indication of the CH_4 gas analyser is drifting and has to be recalibrated periodically. The recalibration is carried out regularly according to the manufacturer's instructions.

P26 *NMHC Concentration*	low	The determination is provided by an accredited laboratory.
B46 *Power production*	low	The calibration interval of the power meters is 1 year. Calibration procedures for power meters are implemented in compliance with the calibration methodology developed by the Ukrainian Centre for Standardization and Metrology.
B47 *Heat production*	low	The indication of the measurement instrument should be initially controlled during the final inspection by the manufacturer and will be checked regularly according to the manufacturer's instructions. The gauge will be recalibrated by the manufacturer according to his own recalibration intervals. The indication of the measurement instrument should be controlled during the regular inspections while the operation time and a gauge which is obviously out of order should be substituted.

Irrespective the monitoring plan all installed aggregates and gauges are controlled during the regular inspections, at least weakly, to assure a proper operation of the facility. Beside the monitored values any other values which are needed for the supervision of the plant should be logged.

Any gauge or apparatus which is detected as obviously out of order is immediately substituted.

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

The plants installed in the project are designed to run fully automatic, so that the operating personnel have only to supervise the correct operation of the plant and the plausibility of the collected and monitored data. In case of disturbances and emergency the plant is shut down automatically and no unintended emissions are caused. The CMM supply is locked by quick acting valves. Fire arresters prevent from backfiring into the CMM pipe for safety of the personnel and equipment. During the downtime of the plant the unused CMM is vented by the coal mine as it would be without the project activity.

In case of emergency an alarm message is sent to a permanently manned place in the control room. The operating personnel, who are on duty, check the plant status and decide on further procedures as clearing the fault, eliminating danger and restarting the plant, sending a service team, informing the project manager, a fire brigade, etc.
Every emergency case is journalised.

The collected data are stored electronically by a data logger and on paper in journals by the coal mine personnel. The data are read out hourly from the data logger and stored and archived in an internet-based data base. The data base is provided with an internet front end, by which all stored data can be visualised, controlled and analysed. Eco-Alliance, the administrator of the data base is responsible for the proper work of the data base, routine backups and save storage.

Eco-Alliance is responsible for correctness of the logged data and the administration of the data base. Eco-Alliance regularly verifies the electronically recorded data with the handwritten data and checks the stored data for plausibility, errors, deviations and non-conformity. All inconsistencies are discussed with the service and the operation teams, at which the operational and monitoring experience is gained, the plant operation is optimised, and a more accurate monitoring results.

All stored data are kept during the whole operation period of the plant and furthermore for at least 5 years.

The plant manager is responsible for the preparation of the standardised weekly report. He is also in charge for the preparation of the summarised monthly and yearly reports, which are revised by the project manager.

The plant manager is keeping an operational journal which includes the following information:

- compilation and description of all data recorded, required for the calculation of the emission reductions
- description of all records to be kept during the regular inspections, including all corrective action undertaken
- manually logged data collected during the regular inspections
- particular events
- all calibrations carried out, incl. all calibration protocols

The visualisation of the data via internet provides a prompt control of the project operation by the project manager. All data are continuously checked for consistency, completeness and integrity by Eco-Alliance. A detailed plausibility check should be carried out at least monthly.

Based on the procedure described above a detailed annual report should be prepared by Eco-Alliance and confirmed by the verifier.

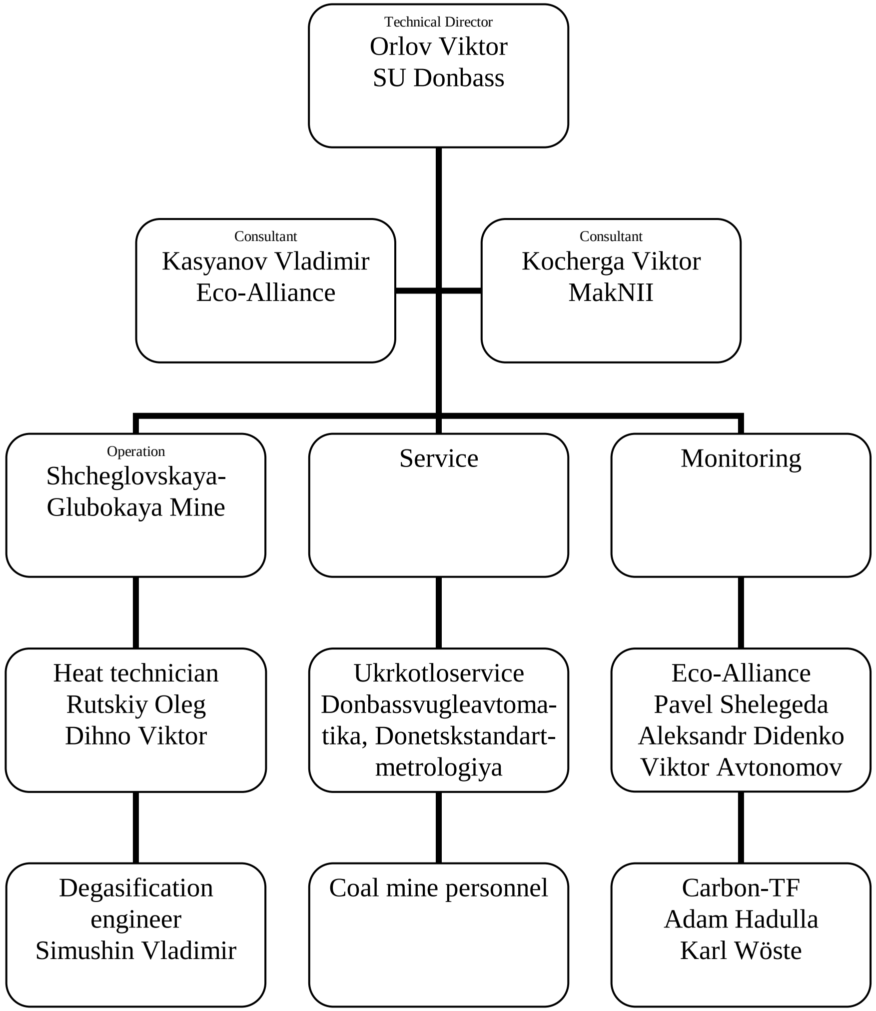

Figure D-1 - Project management structure

The responsible personnel of Eco-Alliance has been trained on the handling with CMM-utilisation units and the applied monitoring systems, during an eight week long practical course in Germany in the autumn of 2005. In this course which has been carried out by A-TEC Anlagentechnik GmbH, a Joint-Venture participant of Eco-Alliance, also the basic principles of emissions trading and the background of the monitoring has been explained. A-TEC Anlagentechnik GmbH is already running several CMM utilisation plants and monitoring systems in Germany.

These trained personnel is the basis of a team of engineers, which should establish a specialised service team in the Ukraine and instruct further operating and monitoring personnel, as well for this project. At the time there is no final training procedure established. The project management is carried out by «SU Donbass». The operation of the plants is done by Eco-Alliance together with the operational personnel of the coal mine. The service and maintenance of the boilers, the ventilation air heater and the emergency power generator is done by the third parties commissioned by the coal mine. The service and maintenance of the cogeneration unit and the flare should be done by Eco-Alliance. The monitoring is carried out by the project manager of «SU Donbass» together with Eco-Alliance and Carbon-TF B.V.

The experience of the Ukrainian personnel is gained by training on the job. Detailed work instruction should be worked out and wrote down.

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

Date of completion of the monitoring plan: 2011-05-19

Name of person / entity setting the monitoring plan: Adam Hadulla, Carbon-TF B.V.

Annex 1

Data Sources

[PDD] Project Design Document; Version 07, dated 2009-08-06

[IPCC] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual (Volume 3),Chapter Energy, 1.4.1 Unoxidized Carbon, Adjustments For Carbon Unoxidised, Page 1.32, and Table 1-6, pg. 1.29 http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm

[IPCC-2] IPCC - Terms of Reference, Chapter1, Introduction, Source of Categories, Table 1.2

[IPCC-2006] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (Energy) Chapter 1.4 Data collection issues, 1.4.2 Emission factors, Table 1-4, pg. 1.24

[NEIA] Baseline carbon emission factor approved in Ukraine: http://www.neia.gov.ua/nature/doccatalog/document?id=126006

[TA-Luft] TA-Luft 2002, Technical Instructions on Air Quality Control Act, Pages 170/172

[AM_Tool_7] Methodological "Tool to determine project emissions from flaring gases containing methane", EB 28, Meeting report, Annex 13

Annex 2

MONITORING PLAN

A2.1 Justification of the combustion efficiency of the chosen flare

The chosen flare is designed to fulfill the German regulations for flaring of landfill gas or other gases (CMM). In these regulations a minimum efficiency of 99.9 % is required [TA-Luft]. This efficiency is proved by a continuous measurement of the combustion temperature, which has to be above 1,000°C for landfill gas or above 850°C for other gases (CMM), whereas a minimum retention time of at least 0.3 s is required [TA-Luft]. The 2006 IPCC guidelines [IPCC-2006] specify a combustion efficiency of 100% for gas, while the 1996 IPCC guidelines [IPCC] specify a value of 99.5%. The conservative value of 99.5% from the 1996 IPCC guidelines has been taken into account as flaring efficiency above 850°C.

According to ACM0008 the methodological "Tool to determine project emissions from flaring gases containing methane", EB 28 Meeting report, Annex 13, has been taken for the determination of the project emissions from flaring. In difference to the flaring tool a combustion efficiency of 99.5%, according to the 1996 IPCC guidelines [IPCC], has been taken into account for combustion temperatures above 850°C. The default value of 90% is used in the range from 500°C to 850°C and the default value of 0% below 500°C.

T_{Flame}	η_{flare}	Source
> 850°C	99.5%	[IPCC]
500-850°C	90.0%	[AM_Tool_07]
< 500°C	0.0%	[AM_Tool_07]

where:

T_{Flame} Flame temperature of the flare (°C)

η_{flare} flare efficiency

A2.1.1 German regulations

The chosen flare is designed to fulfill the German regulations for flaring of landfill gas or other gases (CMM). In these regulations a minimum efficiency of 99.9 % is required [TA-Luft]. This efficiency is proved by a continuous measurement of the combustion temperature, which has to be above 1,000°C for landfill gas or above 850°C for other gases (CMM), whereas a minimum retention time of at least 0.3 s is required [TA-Luft]. Additionally the emissions of the flare have to be verified every three years by a measurement.

In case of flaring of landfill gas the German Authorities started with a required combustion temperature of 1,200°C. The temperature has been dropped to 1,000°C after first good experience in flaring of landfill gas has been made. This minimum temperature of 1,000°C is claimed for landfill gas or gas from waste utilisation plants only; in case of other gases e.g. CMM a temperature of 850°C is sufficient (there are no polycyclic aromatic hydrocarbons contained in CMM).

A combustion temperature of more than 850°C assures the complete conversion of hydro carbons contained in the fuel gas into carbon dioxide with minimum proportion of carbon monoxide and marginal, negligible fraction of other components containing carbon, so that an efficiency of minimum

99.9 % is reached. This is state of the art and has been proven in numerous combustion plants in Germany and throughout the world.

There are no legal obligatory regulations about the monitoring of flares in Germany. According to the German [TA-Luft], these regulations have to be examined in every individual case by the Authorising Authority. Normally a periodical emissions measurement of the main components CO, NO_x and total carbon, which indicates the combustion efficiency of the flare, has to be carried out every three years by an approved expert laboratory, institute etc. At this the value of 20 mg/m³ total carbon in flue gas [TA-Luft] is taken.

A2.1.2 Description of the flare equipment

The flare, which is supposed to be used in this project, is an enclosed flare with a controlled combustion process. The flare is designed for a combustion temperature of more than 850°C and a retention time of about 0.3 sec. The flare is a further development of flares for landfill gas, which has been installed on numerous landfill sites in Germany, France, Belgium, Spain, Portugal, Hungary and Croatia.

Characteristic for landfill gas flares is the continuous operation of the flaring process and the controlled combustion process. The German Regulations require a minimum temperature of 1000°C for landfill gas flares and 850°C for CMM flares. To fulfil this legal requirement a special design of the burning system and an adequate controlling system is applied. The main difference to other flaring systems is the controlled combustion process – the combustion temperature and combustion output are controlled and regulated.

The fuel gas is fed in via a distribution system into the combustion chamber. The main pipe is split up in several distribution pipes fitted with nozzles, which are evenly distributed over the whole cross section of the combustion chamber. The uniform distribution of the fuel gas provides a smooth combustion over the whole cross section of the combustion chamber; generation of possible schlieren of uncombusted gas is minimised in that way.

The combustion air is sucked in into the combustion chamber by the natural drought of the chimney effect of the combustion pipe. The amount of the combustion air is regulated by lamellar lids in the supply air inlet, whereas the lid position is controlled by the temperature in the combustion chamber. In that way the desired value for the combustion temperature in the flare is kept constant.

The retention time of 0.3 s is achieved by the height of the flare pipe. The amount of the fuel gas is regulated by a throttle in the main fuel gas conduit. Hereby the combustion output of the flare is controlled.

The given combustion output is automatically controlled by the control system. The flare has a minimum combustion output, at which the minimum combustion temperature of 850°C can be reached and a maximum combustion output, at which the minimum retention time can be reached. Both limiting values are monitored by the control system. If the combustion temperature falls under the minimal value or the combustion output exceeds the maximal value, the system is automatically shut down.

The flare is provided with an automatic firing device and a flame detector. Both devices are standards from heating boilers section.

All process and operation data, especially the combustion temperature and the CMM amount is monitored, stored and archived.

Annex3

Differences between the determined PDD and implemented monitoring plan

The differences between the determined PDD and implemented monitoring plan are listed in the table below.
The conditions defined by paragraph 33 of the JI guidelines are still met for the project.

- The physical location of the project has not changed.
- The emission sources have not changed.
- The baseline scenario has not changed.
- The changes are consistent with the JI specific approach and/or the clean development mechanism (CDM) methodology upon which the determination was prepared for the project.

ID Number	difference	justification
P1, PE, B1, BE, B3, BE_{MR}, B4, BE_{Use}, B14, CMM_{PJ}, B46, GEN, B47, HEAT	Index y deleted	The calculation of the emission reductions is not calculated on a yearly basis, but for an individual period.
P5, $CONS_{ELEC}$, Formula (31)	Calculation instead of measurement	$CONS_{ELEC}$ is not measured with a power meter but calculated using a fixed factor of 3.5% of the produced power amount.. The value is set in a conservative manner.
P9, PE_{Flare}, T_{Flame}, η_{flare}, Formulae 5, 9, 9a	modified / added	Flow data and flare efficiency as well as the methane amount destroyed by flaring MD_{Fl} are calculated in 15 min. intervals in Excel sheets. The main emissions variables for project emissions, baseline emissions and emissions reductions are calculated on a monthly basis. Yearly sums and a total sum for the monitoring are calculated. The formula for the calculation of project emissions from uncombusted methane has been updated. Formulae from the «Methodological “Tool to determine project emissions from flaring gases containing methane”» [AM_Tool_07]) have been applied, see Annex 4. The calculation of project emissions from uncombusted methane from flaring is now more accurate.
P15, MM_{ELEC}, MM_{CHP}, MM_{EPG}, Formula (6a)	modified / added	MM_{ELEC} represents the calculated sum of two separate measurements.
P18, MM_{HEAT}, MM_{WBoil}, MM_{SBoil}, MM_{VAH}, Formula (7a)	modified / added	MM_{HEAT} represents the calculated sum of three separate measurements.
B46, GEN, GEN_{CHP}, GEN_{EPG}, Formula (27)	modified / added	GEN represents the calculated sum of two separate measurements.
GEN_{EPG}, Formula (28)	Calculation instead of measurement	GEN_{EPG} is not measured with a power meter but calculated using a fixed power generation efficiency of 36% as stated in the PDD. The value is set in a conservative manner.
HEAT $HEAT_{WBoil}$, $HEAT_{SBoil}$, $HEAT_{VAH}$, Formula (25)	modified / added	HEAT represents the calculated sum of two separate measurements.

$HEAT_{VAH}$, Formula (26)	Calculation instead of measurement	$HEAT_{VAH}$ is not measured with a heat meter but calculated using the heat generation efficiency specified by the manufacturer. The heat can not be measured.
B55 EF_{HEAT}	modified	Symbol name changed (now congruent to ACM0008), justification of the chosen value added to ‘comment’.
B57 Eff_{COAL}	modified	Symbol name changed (previously multiple), justification of the chosen value added to ‘comment’.
B14, CMM_{PJ}, Formula 14a	added	This formula was missing.
MM_{CHP}, Formula (24) Eff_{CHP}, Formula (30)	added	These formulae have been used temporarily for the calculation of MM_{CHP} due to missing data for April 2010, due to malfunctioning data acquisition.
D.3. responsibilities	modified	The responsibilities have been adapted to the current situation.

The flare stopped operation in the end of October 2010 and has been moved to the Coal Mine Nr.22 Kommunarskaya – another JI-project of the same project owner.

Annex 4

History of the Document

Version	Date	Nature of Revision
1	10 March 2011	Initial adoption. sent to BV
2	08 April 2011	Second version, for internal use only
3	26 April 2011	Revised version
4		For internal use only
5	19 May 2011	Revised version