Duerping Coal Mine Methane Utilization Project

Clean Development Mechanism (CDM)

CER Monitoring Report

Certified Emission Reductions

Monitoring Period: 27 June 2009– 26 October 2009

CDM Registration No: 1900

Date: 2 November 2009
Version 01

A project designed to meet the baseline and monitoring requirements of UN CDM Approved Consolidated Methodology

ACM0008 Version 3
"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"

Table of Contents

Table of Contents 2
1 General Project Activity Information 3
1.1 Title of Project Activity 3
1.2 CDM Registration date and crediting period 3
1.3 Contact Details 3
1.4 Short Description of the project activity 3
1.5 Monitoring Period Covered 5
1.6 Methodology applied to the Project Activity 5
1.7 Deviations or revisions to the registered PDD or Monitoring Plan 6
1.8 Special (accidental) events occurring during this reporting period 6
1.9 Changes since Last CER Verification 6
2 Monitoring Plan 6
2.1 Parameters Monitored 6
2.2 Quality Assurance /Quality Control 8
3 Formulae used to calculate Emission Reductions 11
3.1 Baseline Emissions 11
3.2 Project Emissions 14
3.3 Leakage 18
3.4 Emission Reductions 19
4 Calculation of Emission Reductions 20
4.1 Baseline Emissions 20
4.2 Project Emissions (PE) 21
4.3 Leakage 21
4.4 Emission Reductions ($tCO2_e$) 21
4.5 Comparison Actual Emission Reductions and PDD estimate ($tCO2_e$) 22

Annex 1. Monitoring and Calculation Details
Annex 2. Monitoring Equipment
Annex 3. CDM instruments removal and installation dates
Annex 4. Gas analysis results by TES Bretby
Annex 5. Operational events

1 General Project Activity Information

1.1 Title of Project Activity

Project 1900: Duerping Coal Mine Methane Utilization Project - China.

1.2 CDM Registration date and crediting period

Registration Date: 6 March 2009
Crediting Period: 10 years.

1.3 Contact Details

Mr. Gareth Phillips
Chief Climate Change Officer

Sindicatum Carbon Capital (SCC)
33 Duke Street, W1U 1JY
London, UK
Gareth.phillips@carbon-capital.com
Tel. +44(0) 20 7224 7555

Mr. Sven JP Starckx
Senior Climate Change Officer
Monitoring and Verification
sven.starckx@carbon-capital.com

1.4 Short Description of the project activity

The purpose of the project activity is the utilization and abatement of coal mine methane captured in underground coal mine workings to allow safe coal extraction at Duerping coal mine.

The project activity has installed the necessary power generation and abatement equipment; control, monitoring and safety systems; pipe-work and power connections to ensure that a high proportion of the coal mine methane that would normally be released to atmosphere is combusted. Investment in generation plant will be phased, totaling 5.1MW in year 1 and expanding progressively as gas supply is expanded up to an expected maximum of about 12.0MW. Currently the installed capacity is 5.1 MW while another 6.8MW will be operational in December 2009. Three 1.7MW gensets (combined capacity of 5.1 MW) were delivered to the site in November 2008 for installation and they started operation in May 2009. Another four 1.7MW gensets (combined capacity of 6.8MW) were delivered to the site in October 2009 for installation and it is expected that they will start operation in December 2009.

The total combined capacity of the plant is 11.9MW (5.1 MW Phase 1 plus 6.8MW Phase 2). This matches the final capacity of 12.0MW stated within the registered PDD v04.09. There will be no development of further phases.

During project development, about 15% of the gas emitted by the underground mining operations was being captured by methane drainage and 85% exhausted to the atmosphere as ventilation air methane (VAM). During the course of the project, the mine anticipates raising the capture efficiency substantially with a possible target of 40%.

The project will contribute to sustainable development by improving local air quality and reducing greenhouse gas emissions, and will not lead to the consumption of significant natural resources. There will not be any material increase in energy consumption because the pumping station has already been installed in order to comply with mine safety requirements, therefore any electricity used by the pumping station is included in the baseline. Generator noise is mitigated by sound-proof containment. Emissions from the generators will not exceed environmental standards.

The waste heat from the installed generators will remove the need to consume coal to heat the mine intake air during winter months [1], further saving natural resources and contributing to improved local air quality.

The project will provide social benefits through improved health and safety for workers and economic benefits by providing a new source of clean electricity displacing coal-fired power, and heat displacing coal burning in boilers.

Technology transfer benefits will arise from the installation of state-of-the-art power generation and heat recovery equipment and associated safety and monitoring equipment and control systems.

[1] During this monitoring period (warm season), no heating took place. Heat recovery system is expected to be operational from the end of November 2009 depending on the meteological conditions.

Location of the project activity

The coal mine is located 20 km west of Taiyuan, the capital of Shanxi Province.
The project site lies 8 km south west of the main mine buildings. The coal mine reserves are located within the area: Latitude: North 112° 14' 27"   Longitude: East 37° 46' 52"

Figure 1   Location of the project activity.

The project participants are:

Shanxi Coking Coal Group Company Ltd, a Chinese state-owned enterprise which was established under the laws of the People's Republic of China and having its registered office at Xin Jin Si Road, Taiyuan, Shanxi, PRC (hereinafter referred to as "Jiaomei").

Sindicatum Carbon Capital Ltd, a company incorporated under the laws of England and having its registered office at 33 Duke Street, London, W1U 1JY, United Kingdom (hereinafter referred to as "SCC").

1.5 Monitoring Period Covered

The monitoring period covered by this monitoring report: 27th June 2009 – 26th October 2009 (inclusive). The subsequent verification period will commence 27th October 2009 0:00h.

1.6 Methodology applied to the Project Activity

ACM0008 ver. 3 - "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".

A revised Monitoring Plan has been submitted for validation and further approval, which serves as the basis for this CDM Monitoring Report.

1.7 Deviations or revisions to the registered PDD or Monitoring Plan

Minor revisions to the initial monitoring plan included in the registered PDD v04.09 dd. 18 Feb. 2009 have been made. The revisions have been validated by TUV-Sued and their conclusions have been reported in validation report nr. 600500291. A request for revision of the monitoring plan has been submitted on July 07, 2009. A final approval of the revision to the monitoring plan by the UNFCCC is expected before finalizing the verification of this monitoring report.

1.8 Special (accidental) events occurring during this reporting period

During the monitoring period, no accidental events occurred.

Operational events including type, start and finsh dates are included in Annex 5 of this report.

1.9 Changes since Last CER Verification

The following changes have occurred at Duerping power plant since last verification due to enginnering requirements to improve the project operation and progress the Phase 2 installation. These modifications have a direct impact on CER generation and are set out in Annex 5.

Item	Start date	Finish date	Remark (detail process, trouble and approach)	Impact
Water tank	27 Aug 2009	28 Aug 2009	Water tank inlet and outlet connection with the power plant gas transport pipeline	Power plant stopped
Power plant phase 2 control system improvement	16 Sep 2009	19 Sep 2009	Gas pressure test: flare pre-treatment connection with flare chamber. Gas test branch gas pipe phase 2 engines to pre-treatment connection. Test vent system.	Power plant stopped
Flare system Phase 2 improvement	20 Sep 2009	22 Sep 2009	Signal wires for flare system and flare temperature signal relocated in new container.	Flare stopped
Flare system:	16:00 5 Oct 2009	19:00 5 Oct 2009	PLC programmed to increase maximum flare flow from 2,000m3/h to 3000m3/h.	Power plant stopped

2 Monitoring Plan

2.1 Parameters Monitored

The parameters monitored and the monitoring procedure applied for determination of the emission reductions is described in detail in the revision of the monitoring plan validated by TUV

Sued and submitted for approval to the UNFCCC dd. 21st August, 2009, the Duerping Project Design Document is available on the UNFCCC website.
http://cdm.unfccc.int/UserManagement/FileStorage/Q3PBR459OM8KI0Y6FATGX1SJW27HNC

An overview of the parameters monitored is provided in section 3 and details of the equipment used in the monitoring in Annex 2. The location of measurement devices installed is shown in Figure 2 below:

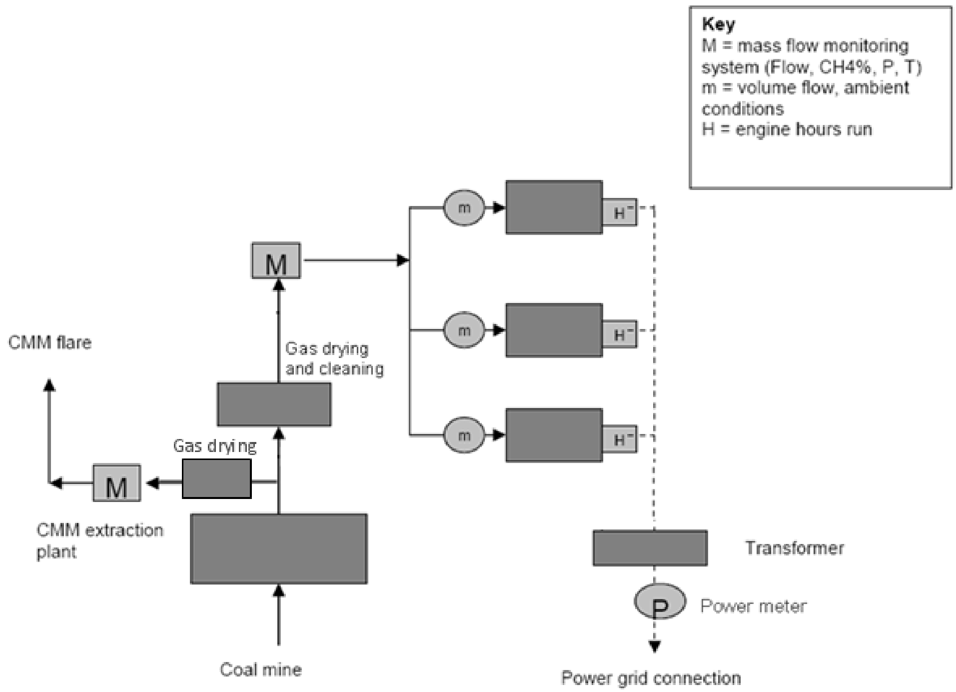

Figure 2 Location of the measurement devices

2.2 Quality Assurance /Quality Control

In order to guarantee the quality of the data and data collection system, a detailed monitoring manual has been developed and implemented. This detailed monitoring manual (available for verification by a designated operational entity (DOE)) is based upon the requirements set out in the PDD and revised monitoring plan and addresses as a minimum the items listed below.

- SCC CDM engineers record the value from each CDM monitoring instrument daily using a remote web page system to verify that the readings are within the range set by the manufacturer. Gross power values are recorded by Duerping mine operators and handed to SCC CDM engineers every week. The monitoring instrument data is log daily and it is available during verification. If the incorrect value persists for more than one hour SCC CDM engineers will ask the on-site operator to check the installation of the instrument and if the problem persists SCC will contact the installation company to replace the faulty instrument with an approved calibrated instrument in the shortest time possible.

- Monthly analysis of CH4 mass flow vs Gross power to confirm the parameters used for back-calculating null CH4 mass flow are consistent month to month.

An overview of the data collection process is provided in Table 1 and Annex 1. Detailed formulae for the calculation of emissions are presented in Section 3.

Table 1 Data collection process

Parameter	Reference	Procedure / Frequency	Registration	Check and correct primary measurements
Baseline Emissions	The baseline emissions are calculated using the formulae described in the PDD, section B6.1 - using the CDM spreadsheet	Primary data are electronically logged and stored together with keyboard entry data and processed electronically at the start of each month	CDM spreadsheet stored on SCC's Project File S-Server	The SCC project officer performs a consistency check based upon previous months. In case of irregularities data is double checked, corrected as necessary and the amendment logged
Leakage	In accordance with ACM0008 v3 no leakage is considered in the Project			

Project Emissions	The project emissions are calculated using the formulae described in the PDD, section B6.1 - using the CDM spreadsheet	Primary data are electronically logged and stored together with keyboard entry data and processed electronically at the start of each month	CDM spreadsheet stored on SCC's Project File S-Server	The SCC project officer performs a consistency check based upon previous months. In case of irregularities data is double checked, corrected as necessary and the amendment logged
Emissions Reductions	The emission reductions are calculated using the formulae described in the PDD, section B6.1 - using the CDM spreadsheet	Primary data are electronically logged and stored together with keyboard entry data and processed electronically at the start of each month	CDM spreadsheet stored on SCC's Project File S-Server	The SCC project officer performs a consistency check based upon previous months. In case of irregularities data is double checked, corrected as necessary and the amendment logged

Accuracy and calibration of instruments

All measurement devices are maintained to ensure a high level of accuracy. All meters are subject to a quality control regime that includes regular maintenance and are calibrated annually by Shanxi Province institute of Metrology Supervision and verification.

A record is available showing the location and unique identification number of each meter, the calibration status of that meter (last calibration, when next due for calibration). All CDM instruments (except the Flare Thermocouples) in the plant have integrated a Serial Number which is used to track the calibration records and installation certificates. In order to guarantee the appropriate installation of calibrated thermocouples SCC provides the installation certificates of these instruments with the installation dates matching the historical performance of the flare thermocouples.

All calibration records are retained for until two years after the end of the crediting period and are available for verification by the DOE.

Archiving of data

Data is archived periodically to a secure and retrievable storage format where it will be held for the crediting period plus 2 years.

Document Control

A document control system has been introduced ensuring that the current versions of necessary documents are available at the point of use. As a part of the document control system, an internal Technical Review Process has been established to ensure the quality of all relevant documents, including the CDM Monitoring Report.

Treatment of missing or corrupted data

Where data in the on-line system are corrupted or missing whilst the plant is operating, the corrupt or missing data can be corrected and justified using installed back-up metering devices, average previous hour readings and power – gas flow correlations.

In case errors are identified, both corrective and preventive actions are taken. During this monitoring period no missing or corrupted data has been identified. No malfunctions of monitoring equipment was observed during the monitoring period covered.

Internal Audit

An audit of the data collection and QC/QA system is performed periodically, at least once per year. An internal audit has been carried out dd. 30 June and 1,2 July 2009. A copy of the internal report is available for verification by the DOE.

Internal Training

Relevant process operators and CDM technical staff have received training to ensure compliance with the tasks and procedures set out in the monitoring plan. Training records are available for verification by the DOE.

3 Formulae used to calculate Emission Reductions

The formulae used for calculation are in accordance with the approved consolidated methodology CDM-EB 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”.

The above methodology draws on:

- ACM0002 Version 06 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”
- “Tool to determine project emissions from flaring gases containing methane”

3.1 Baseline Emissions

The formulae used for determination of the baseline emissions are described in section B.7.1 of the Project Design Document v4.09 dated 18 February 2009. Duerping Project Design Document is available on the UNFCCC website.
http://cdm.unfccc.int/UserManagement/FileStorage/Q3PBR459OM8KI0Y6FATGX1SJW27HNC

Baseline emissions are calculated as follows:

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} \tag{1}$$

Where

BE_y	Baseline emissions in year y (tCO_2e)
$BE_{MD,y}$	Baseline emissions from destruction of methane in the baseline scenario in year y (tCO_2e)
$BE_{MR,y}$	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e)
$BE_{Use,y}$	Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (tCO_2e)

$BE_{MD,y}$ (baseline emissions from the destruction of methane in the baseline scenario) are zero.

$$BE_{MRy} = GWP_{CH4} \times [\sum_i (CBMe_{i,y} - CBM_{BL\,i,y}) + \sum_i (CMM_{PJi,y} - CMM_{BL\,i,y}) + \sum_i (PMM_{PJi,y} - PMM_{BL\,i,y})] \tag{2}$$

Where,

$BE_{MR,y}$	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e)

I	Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
$CBMe_{i,.y}$	Eligible CBM captured, sent to and destroyed by use *i* in the project for year y (expressed in tCH_4) = 0
$CBM_{BLi,y}$	CBM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in the year y (expressed in tCH_4) = 0
$CMM_{PJ,i,y}$	Pre-mining CMM captured, sent to and destroyed by use *i* in the project activity in year y (expressed in tCH_4)
$CMM_{BL,i,y}$	Pre-mining CMM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in year y (expressed in tCH_4) = 0
$PMM_{PJ,i,y}$	post-mining CMM captured, sent to and destroyed by use *i* in the project activity in year y (tCH_4)
$PMM_{BLi,,y}$	post-mining CMM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in year y (tCH_4) = 0
GWP_{CH4}	Global warming potential of methane (21 tCO_2e/tCH_4)

In practice, the pre-mining and post-mining methane are indistinguishable, being extracted through the same pumping system in proportions that vary depending on mining activities, atmospheric pressure changes and day to day management of the ventilation systems.

The baseline emissions are determined ex post by measuring the methane emitted from the methane drainage system at the point where it enters the equipment.

Baseline emissions from grid power

The CEF_electricity is calculated as per ACM0002 v6, from the average of the operating margin and build margin in the North China Power Grid. The build margin is calculated from the newly installed capacity since 1999, which represents just over 20% of the total grid.

CEF_OM	1.1208	China Electric Power Yearbook 2006
CEF_BM	0.9397	China Electric Power Yearbook 2006

According ACM0002, the baseline emission factor is the simple average of BM and OM:

1.1208+0.9397/ 2 = 1.03025 tCO_2/MWh

Emission factor for heat generation

The baseline scenario includes existing heat generation that is replaced by the project activity. The Emissions Factor for displaced heat generation is calculated as follows:

$$EF_{heat,y} = \frac{EF_{CO2,i}}{Eff_{heat}} \times \frac{44}{12} \times \frac{1TJ}{1000GJ} \quad \textbf{(3)}$$

where:

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

Boiler efficiency is taken as 100% . During this monitoring period no heating occurred.

Total emissions displaced by use of coal mine methane

There are no pre-mining activities (including CBM) or post-mining activities.

There is no vehicle fuel used by this project, and therefore $VFUEL_y$ x EF_V is not considered. Also, heat provided by the boilers is waste heat, and therefore creates zero emissions so EF_{HEAT} is also not considered.

Therefore, $PBE_{Use,y}$ is defined for this project as:

$PBE_{Use,y} = GEN_y \times EF_{ELEC} + HEAT_y \times EF_{HEAT}$ **(4)**

Where,

$PBE_{Use,y}$	Potential total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO_2e)
GEN_y	Electricity generated by project activity in year y (MWh), including through the use of CBM
EF_{ELEC}	Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO_2/MWh) = 1.03025 (see above)
$HEAT_y$	Heat generation by project activity in year y (GJ), including through the use of CBM

3.2 Project Emissions

The formulae used for determination of the project emissions are described in section B.7.1 of the Project Design Document v4.09 dated 18 February 2009. Duerping Project Design Document is available on the UNFCCC website.
http://cdm.unfccc.int/UserManagement/FileStorage/Q3PBR459OM8KI0Y6FATGX1SJW27HNC

Project emissions are calculated as follows:

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad \textbf{(5)}$$

where:

PE_y	Project emissions in year y (tCO_2e)
PE_{ME}	Project emissions from energy use to capture and use methane (tCO_2e)
PE_{MD}	Project emissions from methane destroyed (tCO_2e)
PE_{UM}	Project emissions from un-combusted methane (tCO_2e)

$PE_{ME} = 0$ because the project activity simply takes the methane already captured and released in the baseline scenario. No additional energy is utilised.

$$PE_{MD} = (MD_{FL} + MD_{ELEC} + MD_{HEAT} + MD_{GAS}) \times ((1-r) \times CEF_{CH4} + r \times CEF_{NMHC}) \quad \textbf{(6)}$$[2]

with:

$$r = PC_{NMHC} / PC_{CH4} \quad \textbf{(7)}$$

where:[3]

PE_{MD}	Project emissions from CMM/CBM destroyed (tCO_2e)
MD_{FL}	Methane destroyed through flaring (tCH_4)
MD_{ELEC}	Methane destroyed through power generation (tCH_4)
MD_{HEAT}	Methane destroyed through heat generation (tCH_4) = 0
MD_{GAS}	Methane destroyed after being supplied to gas grid or for vehicle use (tCH_4) = 0
CEF_{CH4}	Carbon emission factor for combusted methane (2.75 tCO_2e/tCH_4)

[2] A factor of (1-r) is included to correctly weight the CEF by percentage of the respective gases
[3] Note that throughout this baseline methodology, it is assumed that measured quantities of coal mine gas are converted to tonnes of methane using the measured methane concentration of the coal mine gas and the density of methane.

CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) ($tCO_2eq/tNMHC$)
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 (%)

Not all of the methane sent to generate power, flare and heat will be combusted, so a small amount will escape to the atmosphere. These emissions are calculated using the following:

$$PE_{UM} = GWP_{CH4} \times \sum_i MM_i \times (1 - Eff_i) \qquad \textbf{(8)}$$

where:

PE_{UM}	Project emissions from un-combusted methane (tCO_2e)
GWP_{CH4}	Global warming potential of methane (21 tCO_2e/tCH_4)
I	Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
MM_i	Methane measured sent to use i (tCH_4)
Eff_i	Efficiency of methane destruction in use i (%)

Eff_{ELEC} (Efficiency of methane destruction/oxidation in power plant) will be taken as 99.5% from the 2006 Revised IPCC Guidelines for efficiency of methane oxidation/destruction in a power plant and as prescribed in ACM0008 version 03.

To determine project emissions from flaring gases containing methane

For the enclosed flares: Option (a) in the flaring tool of a 90% efficiency default value is used to determine the flare efficiency. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency is used for the calculations for the specific hour.

Applicable steps are:
STEP 1: Determination of the mass flow rate of the residual gas that is flared
STEP 5: Determination of methane mass flow rate of the residual gas on a dry basis
STEP 6: Determination of the hourly flare efficiency
STEP 7: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

Option (b) Continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).

The project activity follows the approach described as Option (a) using of 90% default flare efficiency. The manufacturer's specifications for the operation of the flare and the required data and procedures to monitor the flare operation are documented in the Project Design Document Monitoring Plan.

STEP 1. Determination of the mass flow rate of the residual gas that is flared
This step calculates the residual gas mass flow rate in each hour *h*, based on the volumetric flow rate and the density of the residual gas. The density of the residual gas is determined using the simplified approach as described in the methodology where only the volumetric fraction of methane is measured and the difference to 100% is considered as nitrogen.

$$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h} \quad (1)$$

Where:

Variable	SI Unit	Description
$FM_{RG,h}$	kg/h	Mass flow rate of the residual gas in hour *h*
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*

and:

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n} \quad (2)$$

Where:

Variable	SI Unit	Description
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour *h*
P_n	Pa	Atmospheric pressure at normal conditions (101 325)
R_u	$Pa.m^3/kmol.K$	Universal ideal gas constant (8 314)
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
T_n	K	Temperature at normal conditions (273.15)

and:

$$MM_{RG,h} = \sum_i (fv_{i,h} * MM_i) \quad (3)$$

Where:

Variable	SI Unit	Description
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
MM_i	kg/kmol	Molecular mass of residual gas component *i*
I		The components CH_4, CO, CO_2, O_2,H_2, N_2

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas (taken as only methane and nitrogen in accordance with the simplification in the methodology), as follows:

$$fm_{j,h} = \frac{\sum_{i} fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}} \quad (4)$$

Where:

Variable	SI Unit	Description
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
AM_j	kg/kmol	Atomic mass of element *j*
$NA_{j,i}$	-	Number of atoms of element *j* in component *i*
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
j		The elements carbon, hydrogen, oxygen and nitrogen
i		The components CH_4, CO, CO_2, O_2,H_2, N_2

STEP 5. Determination of methane mass flow rate in the residual gas

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas (*FVRG,h*), the volumetric fraction of methane in the residual gas (*fvCH4,RG,h*) and the density of methane (ρ*CH4,n,h*) in the same reference conditions (normal conditions and dry or wet basis). If the residual gas moisture is significant (temperature greater than 60ºC), the measured flow rate of the residual gas that is usually referred to wet basis should be corrected to dry basis due to the fact that the measurement of methane is usually undertaken on a dry basis (i.e. water is removed before sample analysis). In this case the gas temperature is less than 60oC and measurements are made as received, ie wet.

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n} \quad (13)$$

Where:

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*
$fv_{CH4,RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour *h* (NB: this corresponds to $fv_{i,RG,h}$ where *i* refers to methane).
$\rho_{CH4,n}$	kg/m^3	Density of methane at normal conditions (0.716)

STEP 6. Determination of the hourly flare efficiency

The project has an enclosed flare and the flare efficiency in the hour *h* (h*flare,h*) has been calculated after applying the following conditions:

- 0% if the temperature in the exhaust gas of the flare (Tflare) is below 500 °C for more than 20 minutes during the hour *h*.
- 50%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour *h,* but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*.
- 90%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturer's specifications on proper operation of the flare are met continuously during the hour *h*.

STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour *h*, based on the methane flow rate in the residual gas (*TMRG,h*) and the flare efficiency during each hour *h* (h*flare,h*), as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1-\eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000} \quad (15)$$

Where:

Variable	SI Unit	Description
$PE_{flare,y}$	tCO_2e	Project emissions from flaring of the residual gas stream in year *y*
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$\eta_{flare,h}$	-	Flare efficiency in hour *h*
GWP_{CH4}	tCO_2e/tCH_4	Global Warming Potential of methane valid for the commitment period

3.3 Leakage

There is no baseline thermal energy use and therefore no leakage to consider in this methodology (see section B.6.1 of the Project Design Document v4.09 dated 18 February 2009. Duerping Project Design Document is available on the UNFCCC website.
http://cdm.unfccc.int/UserManagement/FileStorage/Q3PBR459OM8KI0Y6FATGX1SJW27HNC

3.4 Emission Reductions

The formula used for determination of the emission reductions is described in section B.7.1 of the Project Design Document v4.09 dated 18 February 2009. Duerping Project Design Document is available on the UNFCCC website.
http://cdm.unfccc.int/UserManagement/FileStorage/Q3PBR459OM8KI0Y6FATGX1SJW27HNC

Emission reductions are calculated as the difference between baseline and project emissions for the same period y:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(9)}$$

where:

ER_y Emissions reductions of the project activity during the year *y* (tCO_2e)
$BE_{,y}$ Baseline emissions during the year *y* (tCO_2e)
PE_y Project emissions during the year *y* (tCO_2e)
LE_y Leakage emissions in year y (tCO_2e) = 0

4 Calculation of Emission Reductions

The data required to calculate baseline emissions, project emissions and leakage emissions is transferred to a protected spreadsheet on a secure, maintained server for electronic computation of the emission reductions using the formulae described in the previous section.

A hard copy sample of the CDM spreadsheet, check calculations and a temporary computer access code to facilitate inspection of the full data and algorithms will be provided to the DOE for verification purposes.

The results of the monitoring process for the monitoring period stated are summarized below – more details are provided in Annex 1.

Heat transfer to the mine shaft to warm the air intake into Duerping coalmine is a regular practice during winter months (November to February). However during warmer seasons this is not necessary as ambient temperature is appropriate to maintain suitable underground working conditions. Therefore during this monitoring period, which includes the summer months, no waste heat transfer from the generators to the mine ventilation occurred and as a consequence $Heat_y$, EFF_{heat} in not applicable.

4.1 Baseline Emissions

Baseline emissions are calculated as per formula 1 as indicated in section 3.1.

Period		**BE_MD**	**BE_MR**	**BE_USE**	**BEy**
From	**To**	**(tCO2e)**	**(tCO2e)**	**(tCO2e)**	**(tCO2e)**
		A	B	C	=A+B+C
27 Jun 09	26 Jul 09	0	13234	2281	15515
27 Jul 09	26 Aug 09	0	12750	2807	15557
27 Aug 09	26 Sep 09	0	11303	2480	13783
27 Sep 09	26 Oct 09	0	16095	2232	18327
TOTALS		0	53382	9800	63182

4.2 Project Emissions (PE)

Project emissions are calculated as per formula 5 as indicated in section 3.2.

Period		**PE_ME**	**PE_MD**	**PE_UM**	**PEy**
From	**To**	**(tCO2e)**	**(tCO2e)**	**(tCO2e)**	**(tCO2e)**
		A	B	C	=A+B+C
27 Jun 09	26 Jul 09	0	1660	560	2220
27 Jul 09	26 Aug 09	0	1624	350	1974
27 Aug 09	26 Sep 09	0	1434	346	1780
27 Sep 09	26 Oct 09	0	1961	1115	3076
TOTALS		0	6679	2371	9050

During the monitoring period no additional energy used.

The percentage of non-methane hydrocarbons in the coal mine gas PC_{NMHC} have been below 1% during the whole monitoring period and, in accordance with the methodology, can be ignored for the emission reduction calculations. See gas analysis laboratory results in Annex 4 (originals will be provided during verification).

4.3 Leakage

Not applicable (LE_y=0).

4.4 Emission Reductions ($tCO2_e$)

Emission reductions are calculated as per formula 9 as indicated in section 3.4.
The emission reductions during the specific periods are presented in the table below.

Period		**BEy**	**PEy**	**LEy**	**ERy**
From	**To**	**(tCO2e)**	**(tCO2e)**	**(tCO2e)**	**(tCO2e)**
		A	B	C	=A-B-C
27 Jun 09	26 Jul 09	15515	2220	0	13295
27 Jul 09	26 Aug 09	15557	1974	0	13583
27 Aug 09	26 Sep 09	13783	1780	0	12003
27 Sep 09	26 Oct 09	18327	3076	0	15251
TOTALS		63182	9050	0	54132

4.5 Comparison Actual Emission Reductions and PDD estimate ($tCO2_e$)

Estimate of emission reductions within the registered PDD (section A.4.4)		**Actual Emission reductions Claimed in tonnes of CO2 e**
Years	**Annual estimation of emission reductions in tonnes of CO2 e**	
Oct-Dec 08	41,325	None (registered march 6th, 2009)
2009	325,395	6 March – 26 June 09 50260 (First Verification period for which a monitoring report is currently available on the UNFCCC website and being verified by SGS Ltd[4]) 27 June 09 – 26 Oct 09 54123 (Current Verification period*)
2010 2011 2012 2013 2014 2015 2016 2017 Jan-Sep 2018	378,748 378,748 378,748 378,748 378,748 378,748 378,748 378,748 284,061	
Total estimated reductions	**3,680,764**	
Total number of crediting years	**10**	
Annual average over the crediting period of estimated reductions	**368,076**	

(*)During this monitoring period no heat utilisation occurred, due to no demand during the summer months.

[4] http://cdm.unfccc.int/Projects/DB/TUEV-SUED1214838535.8/iProcess/SGS-UKL1246615127.19/view

Annex 1 Monitoring / Calculation Details

GENERATOR

Period		Volumetric Flow Rate	PC CH4	Volumetric Flow Rate CH4	MM ELEC	MDelec	BE (MRy)	PE(MD)	PE(UM)	PEy	GENy	GENy x EFelec	HEAT y x Eff heat	BE (USE, y)	BE(y)	ER (period)
Unit		m3	%	m3	(tCH4)	(tCH4)	(tCO2e)	(tCO2e)	(tCO2e)	(tCO2e)	MWh			(tCO2e)	tCO2e	tCO2e
		A1	A2	A	B	C	D	E	F	G	H	I	J	K	L	M
from	to			A=A1 x A2	= A x ρ_{CH4}	= B x Effelec	= B x GWP_{CH4}	= B x CEF_{CH4} x EFF_{ELEC}	=B x GWP_{CH4} x (1 - EFF_{ELEC})	= E + F	(Power Meter)	= H x EFF_{ELEC}		= I+ J	=D+K	= L - G
27 Jun09	26 Jul 09	1511104	41.5	627790	421	419	8833	1151	44	1195	2214	2281	0	2281	11114	9919
27 Jul09	26 Aug 09	1580867	46.9	741271	497	494	10430	1359	52	1411	2725	2807	0	2807	13237	11826
27 Aug09	26 Sep 09	1569812	42.3	664074	445	443	9344	1217	47	1264	2408	2481	0	2481	11824	10560
27 Sep09	26 Oct 09	1520530	38.0	578193	387	385	8135	1060	41	1101	2167	2233	0	2233	10368	9267

Constants:

Density Methane at normal conditions ($\rho_{CH4)}$ = 0,67 kg/m3 (Revised 1996 IPCC Reference Manual p.1.24 and 1.16).
GWP_{CH4} is the Global Warming Potential (GWP) for methane = 21 tCO_2e/tCH_4
CEF_{CH4} is the carbon emission factor of coal mine methane = 2,75tCO_2e/tCH_4
EFF_{ELEC} is efficiency of the methane destruction in the power plant = 99,5% (IPCC)
Emissions factor of electricity (grid, captive or a combination) replaced by project = 1.03025 tCO_2/MWh
PC CH4 is the methane concentration of CMM gas delivered to the engines
The percentage of non-methane hydrocarbons in the coal mine gas PC_{NMHC} have been below 1% during the whole monitoring period and, in accordance with the methodology, can be ignored for the emission reduction calculations. See gas analysis laboratory results in Annex 4 (originals will be provided during verification).

Data Collection Process Gensets

The continuous CDM monitoring system at site records data every 30 seconds.

- V-cone differential pressure (DP) to engines (3 V-cones)
- Methane concentration (PC CH4) gas delivered to engines (one at the manifold pipe)
- Gauge pressure (P) gas to engines (one at the manifold)
- Barometric pressure
- Gas temperature (T) gas delivered to engines (one at the manifold pipe)

30seconds input data are used for calculation and outcome is aggregated into hourly, daily etc.

The only CDM parameter that is not recorded with the 30s frequency is the net power output which although is measured continuously it is manually recorded everyday by a site operator.

Back up data (generators running hours and generators gross power) is continuously recorded from the site PLCs in case CDM monitoring instruments fail to record the gas delivery to the power plant or flare.

Spreadsheets containing 30' readings and calculations are available for verification by the DOE.

FLARE

Period		Volumetric Flow Rate	fv CH4	Volumetric Flow Rate CH4	MM (Flare)	BE (MRy)	BE(y)	MD (FLARE)	PE(MD)	MM (Flare) x (1-Eff)	PE (UM)	PEy	ER
Unit		m3	%	m3	(tCH4)	(tCO2e)	(tCO2e)	(tCH4)	(tCO2e)	(tCH4)	(tCO2e)	(tCO2e)	(tCO2e)
				M	N	O	P	Q	R	S	T	U	V
from	to				= M x ρ CH4	= N x GWP_{CH4}	= O	= ∑ {N((hourly) x η flare,h)}	= Q x CEF_{CH4}	= ∑ {N((hourly) x (1-η flare,h)}	= S x GWP CH4	= R + T	= P - U
27 Jun09	26 Jul 09	800382	39.09	312832	210	4402	4402	185	509	25	516	1025	3376
27 Jul09	26 Aug 09	379698	43.45	164970	111	2321	2321	96	265	14	299	563	1757
27 Aug09	26 Sep 09	352841	39.48	139311	93	1960	1960	79	217	14	300	517	1443
27 Sep09	26 Oct 09	1540864	36.72	565778	379	7960	7960	328	902	51	1075	1976	5984

Constants:

Density Methane at normal conditions ($\rho_{CH4)}$ = 0,67 kg/m3 (Revised 1996 IPCC Reference Manual p.1.24 and 1.16).
fv CH4 volumetric fraction of methane in the residual gas delivered to the flare
GWP_{CH4} is the Global Warming Potential (GWP) for methane = 21 tCO2e/tCH4
CEFCH4 is the carbon emission factor of coal mine methane = 2,75tCO2e/tCH4

Data Collection Process Flare

The continuous CDM monitoring system at site records data every 30 seconds.

- V-cone differential pressure (DP) to flare (2 V-cones)
- Methane concentration (PC CH4) gas delivered to flare (one at the manifold pipe)
- Gauge pressure (P) gas to flare (one at the manifold)
- Barometric pressure
- Gas temperature (T) gas delivered to flare (one at the manifold pipe)

The methane destruction efficiency of the flare in the hour h is defined (Flaring Tool, Annex 13) as the ratio between the mass flow rate of methane delivered to the flare and the mass flow rate of methane in residual gas stream that is flared (both on dry basis and normal conditions).

In the case of enclosed flares there is a set of default values for the flare efficiency according to the performance of the flare. These sets values are:

Eff_{flare} = 0% if the temperature in the exhaust gas of the flare (Tflare) is below 500 °C for more than 20 minutes during the hour h.

Eff_{flare} = 50%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h.

Eff_{flare} = 90%, if the temperature in the exhaust gas of the flare (Tflare) is above 500 °C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h.

In order to calculate the flare efficiency the flame temperature is recorded every 30 seconds by at least 3 Type N Thermocouples. A fourth thermocouple was added to the flare stack on the 2nd April of 2009. Extra 3 thermocouples were used during the monitoring period to replace damaged ones on the following dates: 15th April 2009 and two more thermocouples were installed on the 18th June 2009 as described in the *Installation Certificate CDM instruments* document provided during Verification.

Spreadsheets containing 30' readings and calculations are available for verification by the DOE.

Annex 2 Monitoring Equipment I (valid until August 2009)

Item	Name	Instrument type	SN	scale	calibration certificate	Calibration date	Next date for calibration
1	T gas flare	Shanghai Hongda instruments and meters factory WZPK（Pt100）	070907966	0-100 ^{0}C	JZRX 20088112	2008-8-12	2009-8-11
2	T gas engine	Anhui Tiankang Group Inc WZP-240（Pt100）		-200-450 ^{0}C	JZRX 20088111	2008-8-12	2009-8-11
3	P gas flare	Rosemount 3051TG1A2B21AB4E5M5	4793856	0-207KPa	JZYL20087001	2008-8-12	2009-8-11
4	P gas engine	Hefei Keheng instruments CO.,LTD KH- AFY 801	72848	0-40KPa	JZYL20087002	2008-8-12	2009-8-11
5	flare CH%	Guardian plus, model:97460	26065	0-100%	JZYL20087004	2008-8-12	2009-8-11
6	engine CH4%	Guardian plus, model:97460	26060	0-100%	JZYL20087003	2008-8-12	2009-8-11
7	V-cone engine 1	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW08IIKC24FWN	7092005 /FE-105	0-1900m3/hr	TE08-JZ0003	2008-8-13	2010-8-12
8	DP engines 1	Rosemount 3051CD1A22A1AM5B4K5	4879836 /FE-105	0-6.22KPa	TE08-JZ0010	2008-8-13	2009-8-12
9	V-cone engine 2	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW08IIKC24FWN	7092003 /FE-103	0-1900m3/hr	TE08-JZ0005	2008-8-13	2010-8-12
10	DP engines 2	Rosemount 3051CD1A22A1AM5B4K5	4879835 /FE-103	0-6.22KPa	TE08-JZ0006	2008-8-13	2009-8-12

Item	Name	Instrument type	SN	scale	calibration certificate	Calibration date	Next date for calibration
11	V-cone engine 3	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW08IIKC24FWN	7092004 /FE-104	0-1900m3/hr	TE08-JZ0004	2008-8-13	2010-8-12
12	DP engines 3	Rosemount 3051CD1A22A1AM5B4K5	4870527 /FE-104	0-6.22KPa	TE08-JZ0008	2008-8-13	2009-8-12
13	V-cone 1# for flare	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW10IIAB24FWN	7102301 /FE-106	0-3000m3/hr	TE08-JZ0002	2008-8-13	2010-8-12
14	DP 1# for flare	Rosemount 3051CD1A22A1AM5B4K5	4870526 /FE-107	0-6.22KPa	TE08-JZ0007	2008-8-13	2009-8-12
15	V-cone 2# for flare	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW10IIAB24FWN	7102302 /FE-107	0-3000m3/hr	TE08-JZ0001	2008-8-13	2010-8-12
16	DP 2# for flare	Rosemount 3051CD1A22A1AM5B4K5	4870528 /FE-106	0-6.22KPa	TE08-JZ0009	2008-8-13	2009-8-12
17	Flare thermal couple	Nanjing Wanda Instruments factory WRMK-331 （N Type）		0-1300 ^{0}C	JZRX 20088115	2008-8-12	2009-8-11
					JZRX 20088116	2008-8-12	2009-8-11
					JZRX 20088117	2008-8-12	2009-8-11
					JZRX 20088129	2008-8-12	2009-8-11
					JZRX 20088130	2008-8-12	2009-8-11
					JZRX 20088131	2008-8-12	2009-8-11
					JZRX 20088132	2008-8-12	2009-8-11
					JZRX 20088133	2008-8-12	2009-8-11
18	Oil outlet T	Shanghai Hongda instruments and meters factory WZPK（Pt100）	070907985	0-300 ^{0}C	JZRX 20088114	2008-8-12	2009-8-11

Item	Name	Instrument type	SN	scale	calibration certificate	Calibration date	Next date for calibration
19	Oil return T	Shanghai Hongda instruments and meters factory WZPK（Pt100）	070907964	0-200 ^{0}C	JZRX 20088113	2008-8-12	2009-8-11
20	V-cone for oil pipe	KVW06IIAB24FWN	7092002 /FE-101	0-9000Kg/hr	TE08-JZ0013	2008-11-17	2010-11-16
21	DP for oil pipe	Rosemount CD1A22A1AM5B4K5	4870525 /FE-102	0-62.2KPa	JZYL20087008	2008-11-19	2009-11-18
22	Absolute pressure for barometric pressure	Rosemount TA1A2B21JE5Q4	4980063	0-141.33KPa	JZYL20087006	2008-10-10	2009-10-09
23	power meter	Jiangsu linyang Electronics Co., Ltd DSSD71	0040		JZDN20081018	2008-8-12	2009-8-11

Monitoring Equipment II (valid from August 2009)

Item	Name	Instrument type	SN	scale	calibration certificate	Calibration date	Next date for calibration
1	T gas flare	SBWZPK-241(PT100)	908174	0-100 ℃	JZRX 20093950	2009-8-10	2010-8-9
2	T gas engine	WZP-240(PT100)	908273	-200-450 ℃	JZRX 20093951	2009-8-10	2010-8-9
3	P gas flare	3051 TG1A2B21AB4E5M5	4793856	0-207Kpa	JZYL20090144	2009-8-11 (cal certificate issued on 2009-8-12)	2010-8-10
4	P gas engine	KH-AFY801	72848	0-40KPa	JZYL20090143	2009-8-11 (cal certificate issued on 2009-8-12)	2010-8-10
5	flare CH%	Guardian plus, model:97460	26065	0-100%	JZYL20090138	2009-8-5	2010-8-4
6	engine CH4%	Guardian plus, model:97460	26062	0-100%	JZYL20090147	2009-8-5	2010-8-4
7	V-cone engine 1	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW08IIKC24FWN	7092005	0-1900m3/hr	TE08-JZ0003	2008-8-13	2010-8-12
8	DP engines 1	Rosemount 3051 CD1A22A1AM5B4K5	4879836	0-6.22KPa	JZYL20090135	2009-8-4	2010-8-3
9	V-cone engine 2	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW08IIKC24FWN	7092003	0-1900m3/hr	TE08-JZ0005	2008-8-13	2010-8-12
10	DP engines 2	Rosemount 3051 CD1A22A1AM5B4K5	4879835	0-6.22KPa	JZYL20090136	2009-8-4	2010-8-3

Item	Name	Instrument type	SN	scale	calibration certificate	Calibration date	Next date for calibration
11	V-cone engine 3	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW08IIKC24FWN	7092004	0-1900m3/hr	TE08-JZ0004	2008-8-13	2010-8-12
12	DP engines 3	Rosemount 3051 CD1A22A1AM5B4K5	4870527	0-6.22KPa	JZYL20090137	2009-8-4	2010-8-3
13	V-cone 1# for flare	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW10IIAB24FWN	7102301	0-3000m3/hr	TE08-JZ0002	2008-8-13	2010-8-12
14	DP 1# for flare	Rosemount 3051 CD1A22A1AM5B4K5	4870526	0-6.22KPa	JZYL20090139	2009-8-4	2010-8-3
15	V-cone 2# for flare	MOORE-KINGWAYS (SHANGHAI)CONTROL SYSTEM CO.,LTD KVW10IIAB24FWN	7102302	0-3000m3/hr	TE08-JZ0001	2008-8-13	2010-8-12
16	DP 2# for flare	Rosemount 3051 CD1A22A1AM5B4K5	4870528	0-6.22KPa	JZYL20090134	2009-8-4	2010-8-3
17	Absolute pressure for barometric pressure	Rosemount TA1A2B21JE5Q4	4980061	0-141.33KPa	JZYL20090133	2009-8-4	2010-8-3
18	power meter	Jiangsu linyang Electronics Co., Ltd DSSD71	0040		JZDN20091031	2009-8-5	2010-8-4
19	Flare thermocouple	Honeywell STT830-173-TC.M3.W1.CD-WEEO-H10S-T7G6-A05T(Y)240-2D-000	070668960	0-1300 ℃	H2009-1264252	2009-9-20	2010-9-19
20			070668959	0-1300 ℃	H2009-1264251	2009-9-20	2010-9-19
21			080104620	0-1300 ℃	H2009-1264249	2009-9-20	2010-9-19
22			080104609	0-1300 ℃	H2009-1264250	2009-9-20	2010-9-19

Annex 3 CDM instruments removal and installation dates

No	location	Type	SN	Scale	Removal Date	Installation Date
1	DP engines 1	3051 CD1A22A1AM5B4K5	4879836	0-6.22KPa	8/3/2009	8/4/2009
2	DP engines 2	3051 CD1A22A1AM5B4K5	4879835	0-6.22KPa	8/3/2009	8/4/2009
3	DP engines 3	3051 CD1A22A1AM5B4K5	4870527	0-6.22KPa	8/3/2009	8/4/2009
4	DP 1# for flare	3051 CD1A22A1AM5B4K5	4870526	0-6.22KPa	8/3/2009	8/4/2009
5	DP for oil pipe	CD1A22A1AM5B4K5	4870525	0-62.2KPa	8/3/2009	-
6	Absolute pressure	TA1A2B21JE5Q4	4980061	0-141.33KPa	-	8/4/2009
7	DP 2# for flare	3051 CD1A22A1AM5B4K5	4870528	0-6.22KPa	8/4/2009	8/5/2009
8	power meter	DSSD71	0040	-	8/5/2009	8/5/2009
9	engine CH4%	Guardian plus, model:97460	26062	0-100%	8/5/2009	8/5/2009
10	flare CH%	Guardian plus, model:97460	26065	0-100%	8/5/2009	8/5/2009

11	P gas engine	KH-AFY801	72848	0-40KPa	8/11/2009	8/11/2009
12	P gas flare	3051 TG1A2B21AB4E5M5	4793856	0-207Kpa	8/11/2009	8/11/2009
13	T gas engine	WZP-240(PT100)	908273	-200-450 ℃	-	8/11/2009
14	T gas flare	SBWZPK-241(PT100)	908174	0-100 ℃	-	8/11/2009
15	Flare thermocouple	Honeywell	070668960	0-1300 ℃	-	9/23/2009
16	Flare thermocouple	Honeywell	80104609	0-1300 ℃	-	9/23/2009
17	Flare thermocouple	Honeywell	70668959	0-1300 ℃	-	9/23/2009
18	Flare thermocouple	Honeywell	80104609	0-1300 ℃	10/5/2009	-
19	Flare thermocouple	Honeywell	80104620	0-1300 ℃	-	10/5/2009

Annex 4 Gas analysis Duerping drainage station results by TES Bretby

Date Sampled: 15 & 20 January 2009
Date Analysed: 27 January 2009

Date Received: 27 January 2009
Site: **DUERPING**

Report No. 38607

TUBE NO.	**SAMPLE REF**	**Analysis % v/v**							
		CO_2	**CH_4**	**O_2**	**CO**	**C_2H_6**	**C_3H_8**	**n-C_4H_{10}**	**n-C_5H_{12}**
SCC2	Duerping Drainage Station	0.52	38.0	11.07	0.0010	0.03	<0.02	<0.02	<0.02
Accuracy of Analytical Method		±0.02	±1.0	±0.05	±0.0001	±0.02	±0.02	±0.02	±0.02
Method of Analysis		1	1	2	1	3	3	3	3

Method of Analysis:
1. Infra Red
2. Paramagnetic
3. G.C. – F.I.D
4. G.C. – T.C.D.

Analyst: I Thornewill

Customer Analytical Requirements CO_2, CH_4, O_2, CO, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}	By Letter	Authorised by: I Thornewill

Date Sampled: 26 February 2009/ 6 and 13 March
Date Analysed: 17 March 2009

Date Received: 17 March 2009
Site: **DUERPING**

Report No. 38879

TUBE NO.	**SAMPLE REF**	**Analysis % v/v**							
		CO_2	**CH_4**	**O_2**	**CO**	**C_2H_6**	**C_3H_8**	**n-C_4H_{10}**	**n-C_5H**
4	Drainage Station (Inlet) (26 Feb 09)	1.14	39.0(d)	9.62	0.0010	0.03	<0.02	<0.02	<0.02
1	Drainage Station (Outlet) (26 Feb 09)	1.08	37.0(d)	9.76	0.0010	0.04	<0.02	<0.02	<0.02
8	Pre Treatment Inlet (26 Feb 09)	1.12	37.0(d)	9.73	0.0010	0.04	<0.02	<0.02	<0.02
2	Pre treatment Inlet (26 Feb 09)	1.10	37.0(d)	9.68	0.0010	0.03	<0.02	<0.02	<0.02
7	Pre treatment Inlet (6 March 2009)	X	30.0(d)	X	X	0.03	<0.02	<0.02	<0.02
3	Middle Station (13 March2009)	0.16	0.50(a)	20.46	0.0002	<0.02	<0.02	<0.02	<0.02
Accuracy of Analytical Method		±0.02	a±0.2 d±1.0	±0.05	±0.0001	±0.02	±0.02	±0.02	±0.02
Method of Analysis		1	1	2	1	3	3	3	3

Method of Analysis: 1. Infra Red 3. G.C. – F.I.D
2. Paramagnetic 4. G.C. – T.C.D.

Analyst: I Thornewill

Customer Analytical Requirements CO_2, CH_4, O_2, CO, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}	By Letter	Authorised by: I Thornewill

Annex 5 Operational Events

Item	Start date	Finish date	Remark (detail process, trouble and approach)	Impact
Water tank	27 Aug 2009	28 Aug 2009	Water tank inlet and outlet connection with the power plant gas transport pipeline	Power plant stopped
Power plant phase 2 control system improvement	16 Sep 2009	19 Sep 2009	Gas pressure test: flare pre-treatment connection with flare chamber. Gas test branch gas pipe phase 2 engines to pre-treatment connection. Test vent system.	Power plant stopped
Flare system Phase 2 improvement	20 Sep 2009	22 Sep 2009	Signal wires for flare system and flare temperature signal relocated in new container.	Flare stopped
Flare system:	16:00 5 Oct 2009	19:00 5 Oct 2009	PLC programmed to increase maximum flare flow from 2,000m3/h to 3000m3/h.	Power plant stopped