CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Title: Beatrix Vlakpan Borehole Methane Capture Project
Version: 01
Date: 2 July 2010

A.2. Description of the small-scale project activity:

The Beatrix Gold Mine (referred to as Beatrix from here on) is a gold mine that is owned by GFI Mining South Africa; of which Gold Fields is the holding company. Gold Fields is a publicly listed company with its primary listing on the JSE (Johannesburg Stock Exchange) and a secondary listing on the NYSE. The listing requirements of these exchanges stipulate that the company must perform its reserve estimation according to certain prescribed procedures.

Beatrix' mine plan requires that reserves in a new area called Vlakpan be opened up for mining development from 2012 onwards. The project to open up this area will require a large capital investment and take months to implement. In order to justify this investment the ore reserves must be estimated at a certain level of accuracy. The current level of accuracy of the ore reserve estimation is inadequate. The only way to increase the accuracy of the ore reserve estimation is by increasing the sampling information in the area.

The Vlakpan geology consists of a thin Beatrix reef with variable grade (878 cmg/t Zone 29, 100% extraction) and complex regional structure. It is clear that an information gap exists in the project area, despite existing five surface boreholes. Drilling five additional surface boreholes would increase coverage of drilling to a 600 m grid. The current plan is to mine the Vlakpan area from 4 levels developed from Beatrix 3 Shaft. This is also illustrated in Figure 1. The area to be mined is approximately 1,275,026 m_2 accessed through developing 18,732 m of Drive and RAW meters. Given that the development has to proceed through a number of down throw faults that have a combined down throw of 150 m and then continue on strike 60 m below the reef, optimal placement of the drives is critical in reducing safety and financial risks.

Vlakpan is a marginal, though financially, highly geared project that can potentially add significant value to Beatrix. Increased detail in geological structure, facies distribution and anticipated values will contribute to reduce the technical and financial risk with this project.

There are five existing surface boreholes in the area. This project involves the drilling of five additional surface boreholes to increase the geological confidence and reduce the overall risk. Each borehole will be approximately 1313 metres deep and it is anticipated that these boreholes will be drilled using a single rig over a 24 month period commencing in June 2009.

The proposed project activity involves the destruction and utilisation of methane from the additional surface boreholes. Some existing boreholes in the region have intersected methane-carrying geological structures.

Scenario existing prior to implementation of the project activity (baseline):
Beatrix publicly declares its Mineral Resource and Reserve. This is estimated geostatistically using, amongst others, surface borehole data. In order to improve the estimate of its Mineral Resource and Reserve, Beatrix plans to drill an additional set of five surface boreholes in the Vlakpan region. Vlakpan is situated in Beatrix's mineral rights area. There are five existing surface boreholes in the Vlakpan region.

The Vlakpan region covers a vast area, but has a relatively small amount of sampling information. The proposed surface boreholes will provide additional geological and evaluation information, helping not only with grade and geological structure estimation, but also improving the overall Resource and Reserve confidences as defined by the SAMREC Code[1].

It is possible that some or all of the surface boreholes may intersect methane-carrying geological structures resulting in methane venting to the atmosphere.

Purpose of project activity:
Once the boreholes are drilled, the project proponent will identify which of the boreholes emit methane. The purpose of the project activity is:

1. To capture and destroy any methane emitted in an enclosed flare;
2. If a borehole emits methane in sufficient quantities, the methane will be captured and compressed. The methane will then be transported by virtual pipeline (road transport system) to various end users. The methane is compressed to 250bar, stored it in specialised modules and transported to end users. It is de-compressed and regulated into the end user network. The end users for this project activity are microbus taxi fleets.

Greenhouse gas reduction:
The methane which would be vented to atmosphere will be captured and destroyed in an enclosed flare.

In the case where the methane flow rate is economically viable for capture and transport by the virtual pipeline. The methane which is captured will be used to replace petrol in mini-bus taxis. The combustion of the methane in the taxi engines will result in reduced greenhouse gas emissions.

Since methane has 21 times the global warming potential of carbon dioxide, the project will result in a reduction of GHG emissions.

Contribution to Sustainable Development:
The project will make positive contributions to sustainable development.

Social:
The project will assist in the social development of the region as a portion of the revenue earned from the CERs generated will be earmarked for the Gold Fields Foundation. Work done by this Foundation forms the basis the social responsibility investment of Gold Fields in the region. The foundation is involved in a number of projects aimed at the social uplifting of local communities.

[1] THE SOUTH AFRICAN CODE FOR THE REPORTING OF EXPLORATION RESULTS , MINERAL RESOURCES AND MINERAL RESERVES (THE SAMREC CODE) 2007 EDITION; as amended July 2009; Prepared by: The South African Mineral Resource Committee (SAMREC) Working Group; www.samcode.co.za

Environmental:
Global Impact: The project will result in a reduction of greenhouse gas emissions by eliminating the release of methane, which has a global warming potential 21 times that of carbon dioxide.

Regional impact: The methane from the project will be used to replace liquid fossil fuels in the transport sector. 36% of South Africa's liquid fuels is manufactured by synthetic fuel processes (Coal to Liquid (CTL) or Gas to Liquid). The displacement of fuel leads to positive environmental impacts through the reduction of coal mining activities as well as the environmental footprint of the CTL process. In addition, the use of methane instead of other liquid fossil fuels results in lower nitrogen oxide (NOx) emissions.

Economic:
The project will contribute to foreign reserve earnings for South Africa via the carbon credit sales revenue. In addition, the contribution of the CERs towards the mine's income profile will be to enhance the mine's income and to reduce the volatility of the mine's income.

Switching from liquid fossil fuels to methane will result in lower maintenance costs for vehicles, a reduction in fuel costs, a drop in theft and decreased breakdown costs.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (host)	Gold Fields Ltd Promethium Carbon (Pty) Ltd	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: *When the PDD is filled in support of a proposed new methodology (forms CDM-NBM and CDM-NMM)*, at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

The host party is the Republic of South Africa.

A.4.1.2. Region/State/Province etc.:

The project is located in the Free State Province.

A.4.1.3. City/Town/Community etc:

The project is located in the area know as the “Welkom Gold Fields”, close to the town of Virginia.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

Beatrix is located on the farm Leeubult 52 in the district of Theunisen.

The location is indicated below:

Figure 1: Map of southern Africa[2]

Project Location

2 This map was extracted from www.nationsonline.org website.

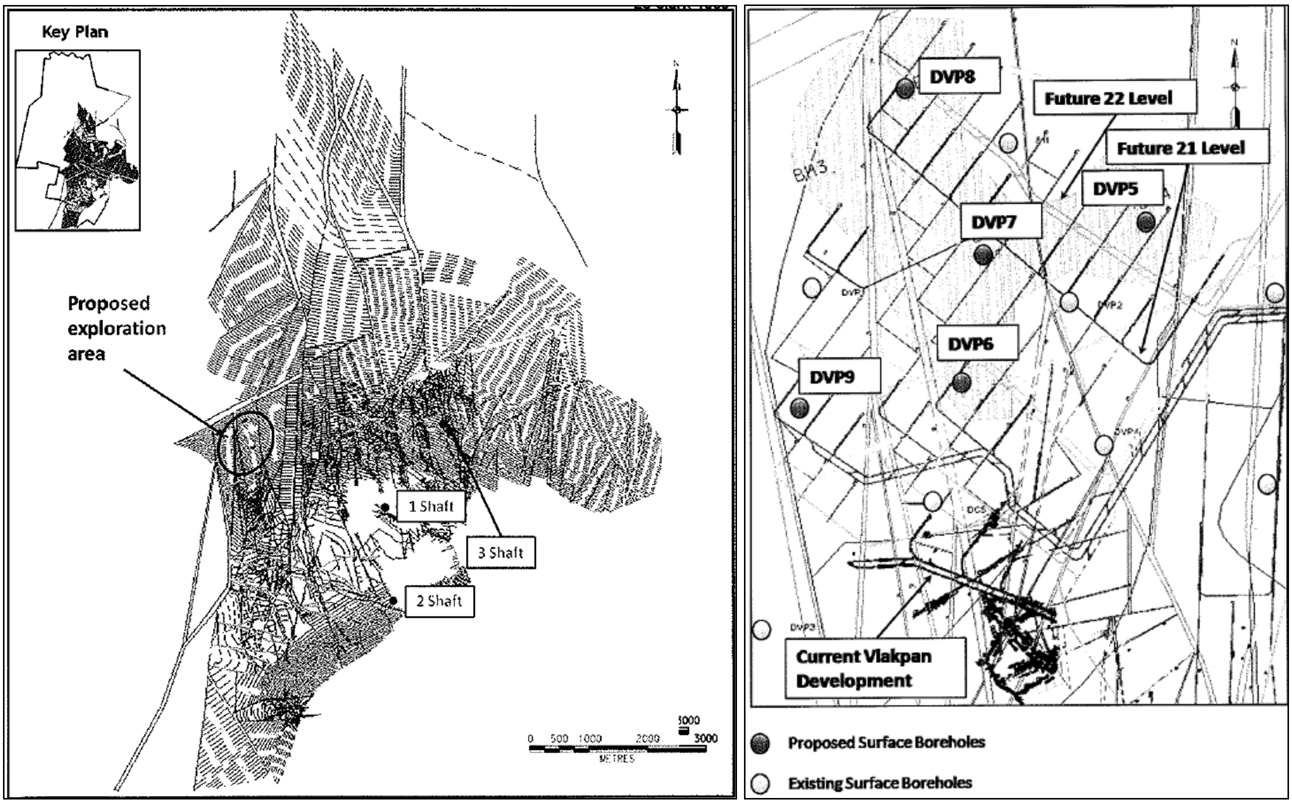

Figure 2: Existing and proposed Vlakpan boreholes at Beatrix

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

The project is of type III W: Methane capture and destruction in non-hydrocarbon mining activities, Version 01, Scope 10.

The five proposed exploration boreholes are geographically far apart from each other.

In the case where methane is vented from a borehole, the methane will be destroyed through flaring at that borehole. Installed flares will have the monitoring equipment required to claim the default flare efficiency of 90% in accordance with the "Tool to determine project emissions from flaring gases containing methane."

Should the methane flowrate exceed a certain economic quantity, the methane will be captured and compressed. It will then be transported by virtual pipeline (road transport system) to dedicated end users. The methane is compressed to 250bar, stored it in specialised modules and transported to end users. It is de-compressed and regulated at the end user. The end users for this project activity are microbus taxi fleets.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

The estimated amount of emission reduction over the chosen crediting period is:

Years	**Annual estimation of emission reduction in tonnes of CO2e**
2011	50,320
2012	50,320
2013	50,320
2014	50,320
2015	50,320
2016	50,320
2017	50,320
Total estimated reductions (tonnes of CO2e)	**352,240**
Total number of crediting years	**7 (renewable twice)**
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	50,320

A.4.4. Public funding of the small-scale project activity:

No public funding will be used.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

This project is not a debundled large scale project since it does not meet the criteria for a debundled component of a large project activity. This is illustrated in the table below. The text in italics is from the Guidelines on assessment of de-bundling for SSC project activities (EB 54, Annex 13).

A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:	**Project activity**	**Were the applicability criteria for a debundled large scale project met?**
(a) With the same project participants	There is no registered small-scale CDM project activity with the same project participants. The project participant has not submitted an application to register another small scale project.	No
(b) In the same project category and technology/measure; and	There is no registered small-scale CDM project activity in the same project category and technology/measure.	No
(c) Registered within the previous	There is no registered small-scale CDM	No

2 years, and	project activity that was registered within the previous two years.	
(d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.	There is no registered small-scale CDM project activity whose project boundary is within 1km of the Vlakpan area.	No

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

AMS III W: Energy efficiency and fuel switching measures for industrial facilities
Version 01, Sectoral Scope: 10, EB 41

Methodological Tool: Tool to determine project emissions from flaring gases containing methane.
Version 01, EB 28 (Section A.4.2 and B.6.1)

Methodological Tool: Combined tool to identify the baseline scenario and demonstrate additionality.
Version 02.2, EB 28 (Section B.4 and B.5)

Methodological Tool: Tool to calculate baseline, project and/or leakage emissions from electricity consumption.
Version 01, EB 39 (Section B.6.1)

Methodological Tool: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion.
Version 02, EB 41 (Section B.6.1)

Methodological Tool: Tool to calculate the emission factor for an electricity system.
Version 02, EB 50 (Section B.6.1)

B.2 Justification of the choice of the project category:

Criteria as described in AMS III W

	Technology/measure	*In the project activity*
1.	*This methodology comprises activities that capture and utilise, to produce electricity, motive power and/or thermal energy, and/or destroy through flaring methane released directly from holes bored to geological formations specifically for mineral exploration and prospecting.*	The project activity will 1. Capture and utilise and the methane from proposed exploration boreholes, if the flowrates are viable. The methane will be utilised to fuel taxi vehicles.

		2. If the methane flowrates are not viable or if the flowrate is too variable, the methane will be captured and destroyed in enclosed flares. The proposed boreholes will be drilled to geological formations specifically for mineral exploration.
2.(a)	*Abandoned or decommissioned mines, as well as open cast mines are excluded. Coal extraction mines or oil shale, as well as boreholes or wells opened for gas/oil exploration or extraction do not qualify under this methodology.*	Beatrix is not an abandoned, decommissioned or open cast mine. It is a gold mine, not a coal extraction or oil shale mine. The boreholes are not being drilled for gas/oil exploration or extraction.
2.(b)	*Project participants are able to demonstrate that the methane captured would have been emitted to the atmosphere in the absence of the project activity using historic mine records and safety procedures. The exploration plans shall be available as required evidence.*	For safety reasons no boreholes may be blocked and any methane venting from the boreholes will be emitted to the atmosphere.
2.(c)	*Only methane emitted from structures (adits, boreholes, etc.) designed and installed solely for prospecting of mineral qualify; pre mining drainage related to minerals for which the mine was developed and is being operated does not qualify. Dedicated methane or natural gas extraction is excluded.*	The boreholes will be drilled solely for the prospecting of gold and not as pre mining drainage. The boreholes will be drilled to improve the overall Resource and Reserve confidences as defined by the SAMREC Code.
2.(d)	*This methodology is applicable to the following cases:* *(i) Structures installed, or boreholes drilled before end of 2001; or* *(ii) Structures installed, or boreholes drilled after 2001, where it can be demonstrated that the structures or the boreholes were part of an exploration plan. The assessment of the reserve mapping programme must be conducted by independent competent external reserve mapping experts.*	The proposed Vlakpan boreholes are drilled as part of a reserve mapping programme within 5 years prior to the submission of this project activity for validation. It can be demonstrated that the boreholes are part of an exploration plan. The assessment of the reserve mapping programme was conducted by independent competent external reserve mapping experts.
2.(e)	*This methodology is applicable if baseline scenario is a total atmospheric release of methane. That is, the methodology is not applicable to project activities where part of the methane released is already combusted or*	Any methane resulting from the proposed boreholes will be totally released to the atmosphere.

	used for an application before the implementation of the project activity.	
2.(f)	*The methodology requires that baseline scenario is compliant with national or local safety requirement or local regulations.*	The baseline scenario is compliant with national and local safety requirements and regulations. The drilling programme is executed in accordance with an approved Environmental Management Programme Report (EMPR).
3.	*This methodology excludes measures that would increase the amount of methane emissions from the boreholes beyond the natural release as would occur in the baseline. This means forced extraction by pumping; the use of CO_2 or any other fluid/gas to enhance methane drainage is excluded. If a fan or compressor for a flare or methane utilisation equipment is used, the lowest possible fan/compressor capacity should be established under which flare / compressor can properly operate.*	The project will not force methane extraction by pumping, the use of CO_2 or any other fluid/gas to enhance methane drainage. The lowest possible fan capacity will be used for the flares. Methane will only be compressed after extraction from the boreholes. No additional pumping is envisaged to remove methane from the boreholes in excess of natural releases.
4.	*Measures are limited to those that result in emission reductions of less than or equal to 60kt CO_2 equivalent annually.*	The emission reductions are less than 60kt CO_2 equivalent annually.

The project meets the applicability criteria

B.3. Description of the project boundary:

In accordance with the methodology the spatial extent of the project boundary comprises of:

- All equipment installed and used as part of the project activity for the extraction, compression, and storage of methane at the project site, and its transportation to off-site users;
- Flaring, captive power and heat generation facilities installed and used as part of the project activity;
- Power plants connected to the electricity grid, where the project activity exports or imports power from the grid, as per the definition of an electricity system in the latest approved version of the “Tool to calculate the emission factor for an electricity system”.

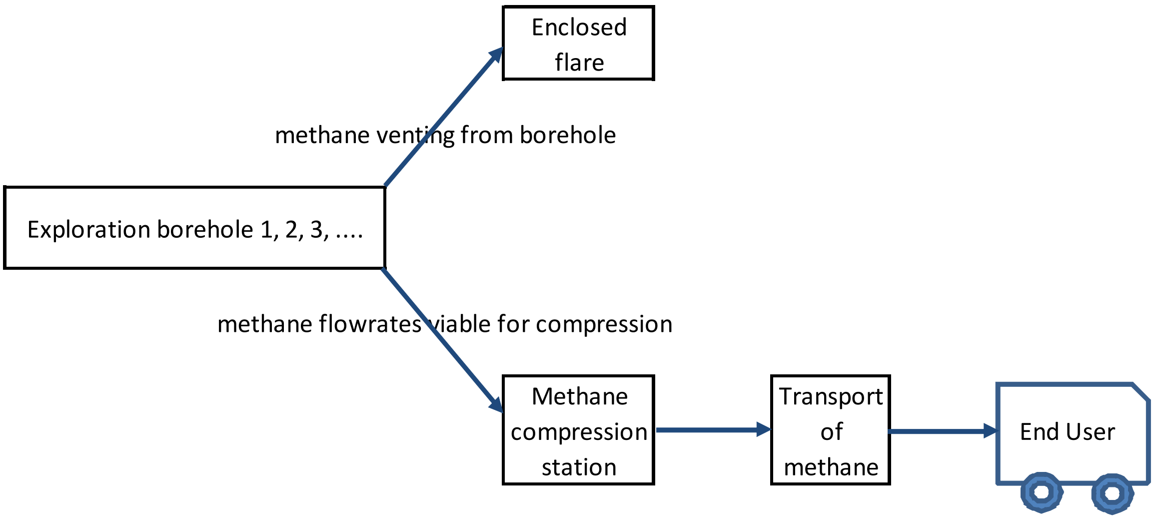

Figure 3: Utilisation and destruction of borehole methane

B.4. Description of baseline and its development:

The "Combined tool to identify the baseline scenario and demonstration of additionality" (Version 02.2) was used to identify the baseline scenario.

Step 1: Identification of alternative scenarios

Sub-Step 1a: Define alternative scenarios to the proposed CDM project activity

The baseline scenario alternatives include all possible options that are technically feasible which comply with safety regulations. These options are:

Technically feasible options for the handling of the methane from the proposed boreholes:

i. Vented to atmosphere;
ii. Used, for example to generate power or thermal heat;
iii. Flared;
iv. Fed into gas pipeline (to be used as fuel for vehicles or heat/power generation);
v. Fed into a virtual gas pipeline (to be used as fuel for vehicles or heat/power generation);
vi. Flaring without being registered as a CDM project activity.

Sub-Step 1b: Consistency with mandatory applicable laws and regulations:

All options comply with the mandatory applicable laws and regulations.

STEP 2: Barrier analysis

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios:

A list of the alternative scenarios and the investment, technological barriers and barriers due to prevailing practice that they face is presented below:

Scenario i: The borehole methane can be vented to atmosphere
This is the current practice. Any methane is released from the boreholes into the atmosphere. This scenario has no barriers and can be considered a plausible baseline scenario.

Scenario ii: The borehole methane can be used, for example to generate power or thermal heat
The boreholes are geographically far apart from each other and from the main shaft. If electricity and/or heat were generated from the methane then it would need to be transported to the mine. The distance between the closest planned borehole and the main shaft is more than 1 km. This distance makes is difficult to transport the energy produced from the borehole methane to the main shaft.

In addition, based on existing boreholes in the Vlakpan area, the methane flow rate is low or varies and this makes the generation of electricity and/or heat from the methane unfeasible. The generation of electricity from borehole methane is not the core business of the mine. Hence, training and the sourcing of personnel with expertise in this area would be essential. The safety risk associated with transporting and using this methane is a considerable barrier to this alternative scenario. Hence, this can be eliminated as a plausible baseline scenario.

Scenario iii: The borehole methane can be flared
This is not current practice at the mine. Existing boreholes have been venting methane for a number of years without this methane being destroyed by the mine. The methane released from the boreholes is not a risk to the mine and its operations as a result of the distance of the boreholes from the main shaft. Hence, the mine has had no reason to flare this methane. Hence, this option can be eliminated as a possible baseline scenario.

Scenario vi: The borehole methane can be fed into a gas pipeline
The closest natural gas pipeline is 178 km in a straight line away from the site (Sasolburg)[3]. This option is prohibited by the distance over which the methane would need to be transported and the cost of such a pipeline. It is not feasible to construct such a pipeline for boreholes which may not even vent methane.

Scenario vii: The borehole methane can be fed into a virtual gas pipeline
This option would involve the installation of a costly infrastructure and a distribution network and can be eliminated as a potential baseline option.

Scenario viii: The borehole methane can be flared without being registered as a CDM project activity.
Flaring of borehole methane is not current practice at the mine. Existing boreholes have been venting methane for a number of years without this methane being destroyed by the mine. The methane released from the boreholes is not a risk to the mine and its operations as a result of the distance of the boreholes from the main shaft. Hence, the mine has had no reason to flare the non-mine methane. Hence, this option can be eliminated as a possible baseline scenario.

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers:

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[3] This distance was calculated online using http://distancecalculator.globefeed.com/South_Africa_Distance_Result.asp?fromplace=Sasolburg%20(Free%20State)&toplace=Virginia%20(Free%20State)&fromlat=-26.8135767809105&tolat=-28.1166667&fromlng=27.8169536590576&tolng=26.9.

This has been done in the analysis of the scenarios above. The only scenarios that are not eliminated as a result of the barriers are:

i. The borehole methane is vented to atmosphere.

The alternative scenario that does not face any barriers is the baseline scenario. Hence, the baseline scenario for Beatrix is the continuation of the current practice, which is to vent any borehole methane into the atmosphere.

The baseline scenario is the situation where, in the absence of the project activity, methane is emitted to atmosphere. There is no flaring in the baseline.

It has happened in the past that some of the methane emitting surface boreholes caught fire and remained burning. In such cases the fires are always extinguished immediately by the farmers as these burning holes could, in strong windy conditions, cause veld fires again that lead to the destruction of grazing land and crop. As veld fires are typically started by lightning, negligent smokers or cooking fires and not the boreholes itself, no emissions from the burning of grassland is taken into account.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

The "Combined tool to identify the baseline scenario and demonstration of additionality" (Version 02.2) was used to demonstrate additionality.

Section B.4. lists the alternatives scenarios in Step 1 and the barriers that these scenarios face in Step 2. Apart from the identified baseline, the alternatives scenarios, including the proposed project activity, face barriers. Therefore, all the other alternative scenarios, including the proposed project activity, are additional.

Step 3: Investment Analysis

The capital cost of the borehole flares will be available at validation. The only revenue from the borehole methane is the CERs. Hence, the carbon credits are needed to make this project financially viable. This makes the project additional.

Step 4: Common practice analysis

There is currently no virtual pipeline to compress and distribute methane to end users in South Africa. In addition Gold Fields does not flare methane from boreholes. The project activity is not common practice at gold miners in South Africa.

In addition, there are no registered CDM projects using AMS III W. There are also no projects under validation using AMS III W.

As a result of the above analysis it can be concluded that the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The emission reductions (ER), baseline emissions (BE), project emissions (PE) and leakage emissions (LE) are calculated as set out below:

Baseline emissions:

$$BE_y = BE_{MR,y} + BE_{Use,y} \quad \textbf{(1)}$$

Where:

BE_y	Baseline emissions in year y (tCO_2e/yr)
$BE_{MR,y}$	Baseline emissions from the release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e/yr)
$BE_{Use,y}$	Baseline emissions from the production of power or heat or vehicle fuel displaced by the project activity in year y (tCO_2e/yr)

Baseline emissions from methane emitted to atmosphere

Historically, all methane from exploration boreholes was emitted to atmosphere and this will be the case with the proposed boreholes.

$$BE_{MR,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \frac{GWP_{CH4}}{1000} \quad \textbf{(2)}$$

$BE_{MR,y}$	Baseline emissions from the release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e/yr)
GWP_{CH4}	Global warming potential for methane (value of 21)
$TM_{RG,h}$	Mass flow rate of methane in the residual gas (in the "*Tool to determine project emissions from flaring gases containing methane*" it is defined as the gas stream flowing to the flare) in the hour h (kg/h)
1/1000	Factor to convert kg/year to ton/year

The "*Tool to determine project emissions from flaring gases containing methane*" was used to calculate the mass flow rate of methane in the residual gas.

Baseline emissions from power/heat generation and vehicle fuel replaced by project activity

$$BE_{Use,y} = GEN_y * EF_{ELEC,y} + HEAT_y * EF_{HEAT,y} + VFUEL_y * EF_{V,y} + ABS_y * \frac{COP_{ABS}}{COP_{ELEC}} * EF_{ELEC,y} \quad \textbf{(3)}$$

Where:

$BE_{Use,y}$	= Baseline emissions from the production of power or heat or vehicle fuel use replaced by the project activity in year *y* (tCO_2e/yr)
GEN_y	= Electricity generated by the project activity in year *y* (MWh)

$EF_{ELEC,y}$	=	Emission factor for electricity generation (grid, captive or a combination) replaced by project activity (tCO_2/MWh)
$HEAT_y$	=	Heat generation by project activity in year *y* (GJ)
$EF_{HEAT,y}$	=	Emission factor for heat generation replaced by the project activity (tCO_2/GJ)
$VFUEL_y$	=	Vehicle fuel provided by the project activity in year *y* (GJ),
$EF_{V,y}$	=	Emission factor for vehicle operation replaced by project activity (tCO_2/GJ)
ABS_y	=	Chilling produced in project activity by absorption chillers in year *y* (MWh)
COP_{ABS}	=	Coefficient of performance of the absorption chillers (MW thermal input/MW thermal output)
COP_{ELEC}	=	Coefficient of performance of the electrical chillers used in the baseline Chillers (MW electrical input/MW thermal output)

As the methane will only be used to replace vehicle fuel and not for power or heat generation, this equation can be simplified to:

$$BE_{Use,y} = VFUEL_y * EF_{V,y} \tag{3a}$$

Where:

$BE_{Use,y}$	=	Baseline emissions from the vehicle fuel use replaced by the project activity in year *y* (tCO_2e/yr)
$VFUEL_y$	=	Vehicle fuel provided by the project activity in year *y* (GJ),
$EF_{V,y}$	=	Emission factor for vehicle operation replaced by project activity (tCO_2/GJ)

Vehicle fuel use emissions factor

If the project activity includes supply of methane for the use as vehicle fuel, the emissions factor for displaced vehicle fuel use in the baseline is calculated as follows:

$$EF_{V,y} = \frac{EF_{CO2,i,y}}{Eff_V} \times \frac{44}{12} \times \frac{1}{1000} \tag{7}$$

Where:

$EF_{V,y}$	=	Emissions factor for vehicle operation replaced by project activity (tCO2/GJ)
$EF_{CO2,i,y}$	=	CO_2 emissions factor of fuel used for vehicle operation during year *y* (tC/TJ)
Eff_V	=	Vehicle engine efficiency (%)
44/12	=	Carbon to Carbon Dioxide conversion factor
1/1000	=	TJ to GJ conversion factor

To estimate vehicle engine efficiency, project participants should select the highest value among the following three values as a conservative approach:

- Measured fuel efficiency prior to the start of the project activity;
- Measured fuel efficiency during monitoring;
- Manufacturer's specifications for efficiency of vehicle.

Project emissions:

Project emissions are defined by the following equation:

$$PE_y = PE_{ME,y} + PE_{MD,y} + PE_{UM,y} \quad \textbf{(8)}$$

Where:

PE_y Project emissions in year y (tCO_2e/yr)

$PE_{ME,y}$ Project emissions from energy use to capture and use methane in year y(tCO_2e/yr)

$PE_{MD,y}$ Project emissions from methane destroyed in year y (tCO_2e/yr)

$PE_{UM,y}$ Project emissions from un-combusted methane in year y (tCO_2e/yr)

$$PE_{ME,y} = PE_{ELEC,y} + PE_{FF,y} \quad \textbf{(9)}$$

Where:

$PE_{ELEC,y}$ Project emissions from the use of electricity for the capture, transportation, compression and utilisation or destruction of borehole methane in the project activity in year *y* calculated in accordance with the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (tCO_2e)

$PE_{FF,y}$ Project emissions from the combustion of fossil fuels for the capture, transportation, compression and utilisation or destruction of borehole methane in the project activity in year y calculated in accordance with the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (tCO_2e)

(a) Project emissions from methane combustion in year *y* ($PE_{MD,y}$) shall be determined as follows:

$$PE_{MD,y} = (MD_{FL,y} + MD_{ELEC,y} + MD_{HEAT,y} + MD_{GAS,y}) * (CEF_{CH4} + r * CEF_{NMHC}) \quad \textbf{(10)}$$

Where:

$PE_{MD,y}$ = Project emissions from methane destroyed in year *y* (tCO_2e/yr)

$MD_{FL,y}$ = Amount of methane destroyed through flaring in year *y* (tCH_4)

$MD_{ELEC,y}$ = Amount of methane destroyed through power generation in year *y* (tCH_4)

$MD_{HEAT,y}$ = Amount of methane destroyed through heat generation in year *y* (tCH_4)

$MD_{GAS,y}$ = Amount of methane destroyed after being supplied to gas grid or for vehicle use in year *y* (tCH_4)

CEF_{CH4} = Carbon emission factor for combusted methane (2.75 tCO_2/tCH_4)

CEF_{NMHC} = Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) ($tCO_2/tNMHC$)

r = Relative proportion of NMHC compared to methane, $r = PC_{NMHC} / PC_{CH4}$

PC_{CH4} = Concentration (in mass) of methane in extracted gas (%), measured on wet basis

PC_{NMHC} = NMHC concentration (in mass) in extracted gas (%)

As the methane will either be used to replace vehicle fuel and not for power or heat generation, or flared, this equation can be simplified to:

$$PE_{MD,y} = (MD_{FL,y} + MD_{GAS,y}) * (CEF_{CH4} + r * CEF_{NMHC}) \quad \textbf{(10a)}$$

Where:

$PE_{MD,y}$	=	Project emissions from methane destroyed in year *y* (tCO_2e/yr)
$MD_{FL,y}$	=	Amount of methane destroyed through flaring in year *y* (tCH_4)
$MD_{GAS,y}$	=	Amount of methane destroyed after being supplied to gas grid or for vehicle use in year *y* (tCH_4)
CEF_{CH4}	=	Carbon emission factor for combusted methane (2.75 tCO_2/tCH_4)
CEF_{NMHC}	=	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) ($tCO_2/tNMHC$)
r	=	Relative proportion of NMHC compared to methane, $r = PC_{NMHC} / PC_{CH4}$
PC_{CH4}	=	Concentration (in mass) of methane in extracted gas (%), measured on wet basis
PC_{NMHC}	=	NMHC concentration (in mass) in extracted gas (%)

In each end-use, the amount of gas destroyed depends on the efficiency of combustion:

$$MD_{FL,y} = MMES_{FL,y} - (PE_{flare,y} / GWP_{CH4}) \quad \textbf{(11)}$$

Where:

$MD_{FL,y}$	=	Amount of methane destroyed through flaring in year *y* (tCH_4)
$MMES_{FL,y}$	=	Amount of methane sent to flare in year *y* (tCH_4)
$PE_{flare,y}$	=	Project emissions of non-combusted CH_4, expressed in terms of tCO_2e, from flaring of the residual gas stream in year *y* (tCO_2e)
GWP_{CH4}	=	Global warming potential of methane (21 tCO_2e/tCH_4)

The project emissions of non-combusted CH_4 expressed in terms of CO_2e from flaring of the residual gas stream ($PE_{flare,y}$) shall be calculated following the procedures described in the “Tool to determine project emissions from flaring gases containing methane”.

$$MD_{GAS,y} = MMES_{GAS,y} * Eff_{GAS} \quad \textbf{(14)}$$

Where:

$MMES_{GAS,y}$	=	Amount of methane supplied to gas grid for vehicle use or heat/power generation off-site (tCH_4)
Eff_{GAS}	=	Overall efficiency of methane destruction/oxidation through gas grid to various combustion end uses, combining fugitive emissions from the gas grid and combustion efficiency at end user (taken as 98.5% from IPCC)

Project emissions from un-combusted methane

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

$$PE_{UM,y} = [GWP_{CH4} \times \sum_{i} MMES_{i,y} \times (1 - Eff_i)] + PE_{flare,y} \quad \textbf{(15)}$$

Where:

$PE_{UM,y}$ = Project emissions from un-combusted methane in year *y* (tCO_2e)

GWP_{CH4} = Global warming potential of methane (21 tCO_2e/tCH_4)

i = Use of methane (power generation, heat generation, supply to gas grid to various combustion end uses)

$MMES_{i,y}$ = Methane sent to use *i* in year *y* (tCH_4)

Eff_i = Efficiency of methane destruction in use *i* (%)

$PE_{flare,y}$ = Project emissions of non-combusted CH_4 expressed in terms of CO_2e from flaring of the residual gas stream (tCO_2e)

As the methane will either be used to replace vehicle fuel and not for power or heat generation, this equation can be simplified to:

$$PE_{UM,y} = [GWP_{CH4} \times MMES_{gas,y} \times (1 - Eff_{gas,y})] + PE_{flare,y} \quad \textbf{(15a)}$$

Where:

$PE_{UM,y}$ = Project emissions from un-combusted methane in year *y* (tCO_2e)

GWP_{CH4} = Global warming potential of methane (21 tCO_2e/tCH_4)

$MMES_{gas,y}$ = Methane sent to use *i* in year *y* (tCH_4)

Eff_{gas} = Efficiency of methane destruction in use *i* (%)

$PE_{flare,y}$ = Project emissions of non-combusted CH_4 expressed in terms of CO_2e from flaring of the residual gas stream (tCO_2e)

The project emissions from flaring of the residual gas stream ($PE_{flare,y}$) shall be calculated following the procedures described in the "Tool to determine project emissions from flaring gases containing methane". $PE_{flare,y}$ can be calculated on an annual basis or for the required period of time using this tool.

Leakage due to project activity:

No leakage is considered in accordance with AMS III W, as no methane recovery and combustion technology equipment is transferred from another activity and no existing equipment is transferred to another activity.

Emission reductions

The emission reduction ER_y by the project activity during a given year y is the difference between the baseline emissions (BE_y) and project emissions (PE_y). The leakage emissions (LE_y) in this project activity are zero as no activity which uses methane occurred in the baseline. No baseline methane application was thus displaced. The emission reduction is calculated as below:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(16)}$$

Where:

ER_y	Emission reductions in year y (tCO_2e/yr)
BE_y	Baseline emissions in year y (tCO_2e/yr)
PE_y	Project emissions in year y (tCO_2e/yr)
LE_y	Leakage emissions in year y (tCO_2e/yr)

B.6.2. Data and parameters that are available at validation:

The following table with values is reproduced from the flaring tool:

Parameter	SI Unit	Description	Value
MM_{CH4}	kg/kmol	Molecular mass of methane	16.04
MM_{CO}	kg/kmol	Molecular mass of carbon monoxide	28.01
MM_{CO2}	kg/kmol	Molecular mass of carbon dioxide	44.01
MM_{O2}	kg/kmol	Molecular mass of oxygen	32
MM_{H2}	kg/kmol	Molecular mass of hydrogen	2.02
MM_{N2}	kg/kmol	Molecular mass of nitrogen	28.02
AM_c	kg/kmol (g/mol)	Atomic mass of carbon	12
AM_h	kg/kmol (g/mol)	Atomic mass of hydrogen	1.01
AM_o	kg/kmol (g/mol)	Atomic mass of oxygen	16
AM_n	kg/kmol (g/mol)	Atomic mass of nitrogen	14.01
P_n	Pa	Atmospheric pressure at normal conditions	101 325
R_u	$Pa.m^3/kmol.K$	Universal ideal gas constant	8 314.472
T_n	K	Temperature at normal conditions	273.15
MF_{O2}	Dimensionless	O2 volumetric fraction of air	0.21
GWP_{CH4}	t_{CO2}/t_{CH4}	Global warming potential of methane	21
MV_n	$m^3/Kmol$	Volume of one mole of any ideal gas at normal	22.414

Data / Parameter:	$Eff_{CO2, i,y}$
Data unit:	tC/TJ
Description:	CO_2 emissions factor of fuel used for vehicle operation during year y
Source of data used:	IPCC default value (IPCC V2.3 Chapter 3 Mobile Combustion, pg 16)
Value applied:	74.1
Justification of the choice of data or description of measurement methods	IPCC default value

and procedures actually applied :	
Any comment:	

Data / Parameter:	CEF_{CH4}
Data unit:	tCO_2/tCH_4
Description:	Carbon emission factor for combusted methane
Source of data used:	As stated in AMS III W
Value applied:	2.75
Justification of the choice of data or description of measurement methods and procedures actually applied :	Ex ante value stated in AMS III W
Any comment:	44/16 = 2.75 tCO_2e/tCH_4

Data / Parameter:	Eff_{GAS}
Data unit:	Percentage
Description:	Efficiency of methane destruction/oxidation in power plant
Source of data used:	IPCC default value as stated in AMS III W
Value applied:	99.5%
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value as stated in AMS III W
Any comment:	

Data / Parameter:	$EF_{grid,y}$
Data unit:	tCO_2/MWh
Description:	The emission factor for the electricity grid in year y
Source of data used:	The combined margin emission factor, determined according to the latest approved version of the “Tool to calculate emission factor for an electricity system”.
Value applied:	1.02
Justification of the choice of data or description of measurement methods and procedures actually applied :	This figure is calculated using the “Tool to calculate emission factor for an electricity system” at the beginning of the project and kept constant for the life of the project.
Any comment:	

Data / Parameter:	$NCV_{d,y}$
Data unit:	MJ/kg

Description:	The weighted average net calorific value of the diesel in year y
Source of data used:	IPCC default value for diesel (IPCC V2.1 Chapter 1 Introduction, pg 18)
Value applied:	43.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value for diesel (IPCC V2.1 Chapter 1 Introduction, pg 18)
Any comment:	

Data / Parameter:	$NCV_{p,y}$
Data unit:	MJ/kg
Description:	The weighted average net calorific value of the petrol (motor gasoline) in year y
Source of data used:	IPCC default value for motor gasoline (IPCC V2.1 Chapter 1 Introduction, pg 18)
Value applied:	44.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value for motor gasoline (IPCC V2.1 Chapter 1 Introduction, pg 18)
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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Equation 1:

$$BE_y = BE_{MR,y} + BE_{Use,y}$$

Year	BE_y	$BE_{MR,y}$	$BE_{Use,y}$
2011	58,322	51,830	6,492
2012	58,322	51,830	6,492
2013	58,322	51,830	6,492
2014	58,322	51,830	6,492
2015	58,322	51,830	6,492
2016	58,322	51,830	6,492
2017	58,322	51,830	6,492

Equation 2:

$$BE_{MR,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \frac{GWP_{CH4}}{1000}$$

Year	$BE_{MR,y}$	GWP_{CH4}	$TM_{RG,h}$
2011	51,830	21	2,468,073
2012	51,830	21	2,468,073
2013	51,830	21	2,468,073
2014	51,830	21	2,468,073
2015	51,830	21	2,468,073
2016	51,830	21	2,468,073
2017	51,830	21	2,468,073

Equation 3a:

$$BE_{Use,y} = VFUEL_y * EF_{V,y}$$

Year	$BE_{use,y}$	$VFUEL_y$	$EF_{V,y}$
2011	6,492	84318	0.08
2012	6,492	84318	0.08
2013	6,492	84318	0.08
2014	6,492	84318	0.08
2015	6,492	84318	0.08
2016	6,492	84318	0.08
2017	6,492	84318	0.08

Equation 7:

$$EF_{V,y} = \frac{EF_{CO2,i,y}}{Eff_V} \times \frac{44}{12} \times \frac{1}{1000}$$

	$EF_{V,y}$	$EF_{CO2,i,y}$ *44/12	Eff_V
2011	0.08	69	0.90
2012	0.08	69	0.90
2013	0.08	69	0.90
2014	0.08	69	0.90
2015	0.08	69	0.90
2016	0.08	69	0.90
2017	0.08	69	0.90

Equation 8:

$$PE_y = PE_{ME,y} + PE_{MD,y} + PE_{UM,y}$$

Year	PE_y	$PE_{ME,y}$	$PE_{MD,y}$	$PE_{UM,y}$
2011	8,002	264	6,071	1,667
2012	8,002	264	6,071	1,667
2013	8,002	264	6,071	1,667
2014	8,002	264	6,071	1,667
2015	8,002	264	6,071	1,667
2016	8,002	264	6,071	1,667
2017	8,002	264	6,071	1,667

Equation 9:

$$PE_{ME,y} = PE_{ELEC,y} + PE_{FF,y}$$

Year	$PE_{ME,y}$	$PE_{ELEC,y}$	$PE_{FF,y}$
2011	264	105	159
2012	264	105	159
2013	264	105	159
2014	264	105	159
2015	264	105	159
2016	264	105	159
2017	264	105	159

Equation 10a:

$$PE_{MD,y} = (MD_{FL,y} + MD_{GAS,y}) * (CEF_{CH4} + r * CEF_{NMHC})$$

Year	$PE_{MD,y}$	$MD_{FL,y}$	$MD_{GAS,y}$	CEF_{CH4}	r
2011	6,071	477	1,730	2.75	0
2012	6,071	477	1,730	2.75	0
2013	6,071	477	1,730	2.75	0
2014	6,071	477	1,730	2.75	0
2015	6,071	477	1,730	2.75	0
2016	6,071	477	1,730	2.75	0
2017	6,071	477	1,730	2.75	0

Equation 11:

$$MD_{FL,y} = MMES_{FL,y} - (PE_{flare,y} / GWP_{CH4})$$

Year	$MD_{FL,y}$	$MMES_{FL,y}$	$PE_{flare,y}$	GWP_{CH4}
2011	477	530	1,114	21

2012	477	530	1,114	21
2013	477	530	1,114	21
2014	477	530	1,114	21
2015	477	530	1,114	21
2016	477	530	1,114	21
2017	477	530	1,114	21

Equation 14:

$$MD_{GAS,y} = MMES_{GAS,y} * Eff_{GAS}$$

Year	$MD_{FL,y}$	$MMES_{GAS,y}$	Eff_{GAS}
2011	1,730	1,757	0.99
2012	1,730	1,757	0.99
2013	1,730	1,757	0.99
2014	1,730	1,757	0.99
2015	1,730	1,757	0.99
2016	1,730	1,757	0.99
2017	1,730	1,757	0.99

Equation 15a:

$$PE_{UM,y} = [GWP_{CH4} \times \sum_{i} MMES_{i,y} \times (1 - Eff_i)] + PE_{flare,y}$$

Year	$PE_{UM,y}$	GWP_{CH4}	$MMES_{GAS,y}$	Eff_{GAS}	$PE_{flare,y}$
2011	1,667	21	1,757	98.5%	1,114
2012	1,667	21	1,757	98.5%	1,114
2013	1,667	21	1,757	98.5%	1,114
2014	1,667	21	1,757	98.5%	1,114
2015	1,667	21	1,757	98.5%	1,114
2016	1,667	21	1,757	98.5%	1,114
2017	1,667	21	1,757	98.5%	1,114

Equation 16:

$$ER_y = BE_y - PE_y - LE_y$$

Year	ER_y	BE_y	PE_y	L_y
2011	50,320	58,322	8,002	0
2012	50,320	58,322	8,002	0
2013	50,320	58,322	8,002	0

2014	50,320	58,322	8,002	0
2015	50,320	58,322	8,002	0
2016	50,320	58,322	8,002	0
2017	50,320	58,322	8,002	0

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Year	**Estimation of project activity emissions (tonnes of CO_2 e)**	**Estimation of baseline emissions (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of overall emission reductions (tonnes of CO_2 e)**
2011	50,320	58,322	8,002	0
2012	50,320	58,322	8,002	0
2013	50,320	58,322	8,002	0
2014	50,320	58,322	8,002	0
2015	50,320	58,322	8,002	0
2016	50,320	58,322	8,002	0
2017	50,320	58,322	8,002	0
Total (tonnes of CO_2 e)	**352,240**	**408,254**	**56,014**	**0**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	$FV_{RG,h}$
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
Source of data to be used:	Measurements will be taken using a flow meter at each borehole
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1 = 126.22 2 = 175.13 3 = 20.65 4 = 23.69 5 = 46.27
Description of measurement methods and procedures to be applied:	A flowmeter will be installed to measure the flowrate of gas sent to the flare at each borehole. The flowmeter will have temperature and pressure compensation and reports the flowrate in Nm^3/hr. The analysis will be done on a dry basis ensuring that the moisture is extracted before the measurement is taken.
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to manufacturer's specifications.

Any comment:	

Data / Parameter:	$fv_{i,h}$
Data unit:	-
Description:	Volumetric fraction of component i in the residual gas in the hour *h* Where i is CH_4,CO,CO_2,O_2,H_2,N_2
Source of data to be used:	The methane concentration of the residual gas will be measured and the remainder will be considered as N_2
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**1** $fv_{CH4,h}$ = 1.00 $fv_{N2,h}$ = 0 **2** $fv_{CH4,h}$ = 0.99 $fv_{N2,h}$ = 0.01 **3** $fv_{CH4,h}$ = 1.00 $fv_{N2,h}$ = 0 **4** $fv_{CH4,h}$ = 0.99 $fv_{N2,h}$ = 0.01 **5** $fv_{CH4,h}$ = 1.00 $fv_{N2,h}$ = 0
Description of measurement methods and procedures to be applied:	The methane concentration of the gas will be monitored continuously, integrated daily and logged electronically. The remainder will be considered as N_2.
QA/QC procedures to be applied:	The instrument measuring the concentration of methane will be calibrated according to manufacturer's specifications.
Any comment:	

Data / Parameter:	Tflare
Data unit:	°C
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	600 °C
Description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. The temperature should be measured continuously.
QA/QC procedures to	Thermocouples should be replaced or calibrated every year.

be applied:	
Any comment:	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter:	$VFUEL_y$
Data unit:	GJ/yr
Description:	Vehicle fuel provided by the project activity in year y
Source of data to be used:	Measurements by project participants.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	84,318 GJ/year
Description of measurement methods and procedures to be applied:	The mass of methane provided as vehicle fuel will be monitored on a daily basis. The energy content of the methane is determined using the IPCC calorific value for methane of 48MJ/kg.
QA/QC procedures to be applied:	The flowmeter and concentration meter will be calibrated according to manufacturer's specifications.
Any comment:	

Data / Parameter:	Eff_y
Data unit:	percentage
Description:	Vehicle engine efficiency
Source of data to be used:	Manufacturer's specification
Value of data applied for the purpose of calculating expected emission reductions in section B.5	45%
Description of measurement methods and procedures to be applied:	A statistical sample will be taken of the engines of the fleet supplied during year y. The manufacturer's specification will be used for the engines identified.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$MMES_{FL,y}$
Data unit:	tCH_4/yr
Description:	Amount of methane sent to flare in year y
Source of data to be used:	A flow meter and concentration meter will be installed to measure the flowrate of methane sent to the flare.
Value of data applied for the purpose of	530tCH_4/year

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The flow meter will measure the flowrate of gas. The flow meter has temperature and pressure compensation. The methane value of that gas will be monitored and used to calculate the flowrate of methane.
QA/QC procedures to be applied:	The flowmeter and methane concentration meter will be calibrated in accordance with manufacturer's specifications.
Any comment:	

Data / Parameter:	$MMES_{GAS,y}$
Data unit:	tCH_4/yr
Description:	Amount of methane supplied for vehicle use in year y
Source of data to be used:	A flow meter and concentration meter will be installed to measure the flowrate of methane supplied for vehicle use.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,757tCH_4/year
Description of measurement methods and procedures to be applied:	The flow meter will measure the flowrate of gas. The flow meter has temperature and pressure compensation. The methane value of that gas will be monitored and used to calculate the flowrate of methane.
QA/QC procedures to be applied:	The flowmeter and methane concentration meter will be calibrated in accordance with manufacturer's specifications.
Any comment:	

Data / Parameter:	PC_{CH4}
Data unit:	%
Description:	Concentration (in mass) of methane in extracted gas (%), measured on wet basis
Source of data to be used:	The methane concentration of the gas is monitored at the flare.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100%
Description of measurement methods and procedures to be applied:	The concentration will be monitored continuously, integrated hourly and logged electronically. The methane concentration will be measured in volume percent. Using the flowrate of the gas, the volumetric concentrations of the components in the gas and molar masses; the volume percent will be converted into a mass percent.

	The concentration will be monitored on a wet basis and this value will be reported on a wet basis. The concentration is metered by a gas analysis device. This device will first, cool the gas to a temperature of 5 degree (condensate will be evacuated), logically the gas is now 100% wet since it is very close to the dew point. Afterwards, the gas will move to the measuring cells in this status. So the gas is wet.
QA/QC procedures to be applied:	Maintenance of concentration meters will be done according to manufacturer's specification; which comply with manufacturer's specifications.
Any comment:	

Data / Parameter:	PC_{NMHC}
Data unit:	%
Description:	NMHC concentration (in mass) in extracted gas
Source of data to be used:	The gas will be sampled every 3 months initially and tested for the NMHC concentration. The frequency of this will be reduced to twice a year after the first year of operation of the plant. The methane concentration will be monitored continuously. If the methane concentration falls below the 75% indicated by the analysis taken prior to the project activity or the average concentration in that year then the gas will be sampled again and the new NMHC concentration will be used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0%
Description of measurement methods and procedures to be applied:	The gas is sampled and the samples are sent to a laboratory for testing.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$EC_{PJ,,y}$
Data unit:	MWh/y
Description:	Quantity of electricity consumed by the project activity in year *y*
Source of data to be used:	The electricity consumed by the plant will be measured.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100MWh/year
Description of measurement methods and procedures to be applied:	The electricity consumption of the methane capture and compression equipment and auxiliaries will be measured. The continuous monitored data will be logged electronically.
QA/QC procedures to	The measuring equipment will be calibrated according to manufacturer's

be applied:	specifications.
Any comment:	

Data / Parameter:	TDL_y
Data unit:	percentage
Description:	Average technical transmission and distribution losses for providing electricity to source in year y
Source of data to be used:	A default value of 3% was used because the scenario presented below was found to be applicable to the project (verbatim text in italics): *(b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies.*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Default 3% as stated in "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*"
Description of measurement methods and procedures to be applied:	The tool will be checked annually for updates and new default values.
QA/QC procedures to be applied:	Default values, as stated in the tool, will be used.
Any comment:	

Data / Parameter:	$\mathbf{FC_{i,j,y}}$
Data unit:	t/year
Description:	is the quantity of fuel type i combusted in process j during the year y
Source of data to be used:	Diesel used in the project to deliver methane to customers will be measured.
Value of data	50
Description of measurement methods and procedures to be applied:	The flow meter will measure the flowrate of diesel.
Monitoring frequency	The flowmeter will be calibrated in accordance with manufacturer's specifications.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**i**
Data unit:	t/year
Description:	are the fuel types combusted in process j during year y
Source of data to be used:	It is anticipated that only diesel will be used to transport the compressed methane.
Value of data	Diesel
Description of measurement methods and procedures to be applied:	A survey will be done to determine which fossil fuels are being used in the project activity.
Monitoring frequency	Any fossil fuel used will be checked annually and should another fuel be used, eg petrol, this will be included as per the *"Tool to calculate the project or leakage CO2 emissions from fossil fuel combustion"*.
QA/QC procedures to be applied:	
Any comment:	

B.7.2 Description of the monitoring plan:

1. <u>Data to be monitored.</u>

The monitoring equipment and the placing of the equipment in the project are shown in the diagrams below. For boreholes 1 and 2, which will supply methane for vehicle fuel replacement, the following parameters will be monitored as per the applied monitoring methodology:

- The flowrate of the gas compressed for vehicle fuel
- The methane concentration in the extracted gas
- The NMHC concentration in the extracted gas
- The fossil fuel consumption for the transport of the compressed methane
- The electricity consumption of the project activity.

The monitoring equipment is depicted in the diagram below:

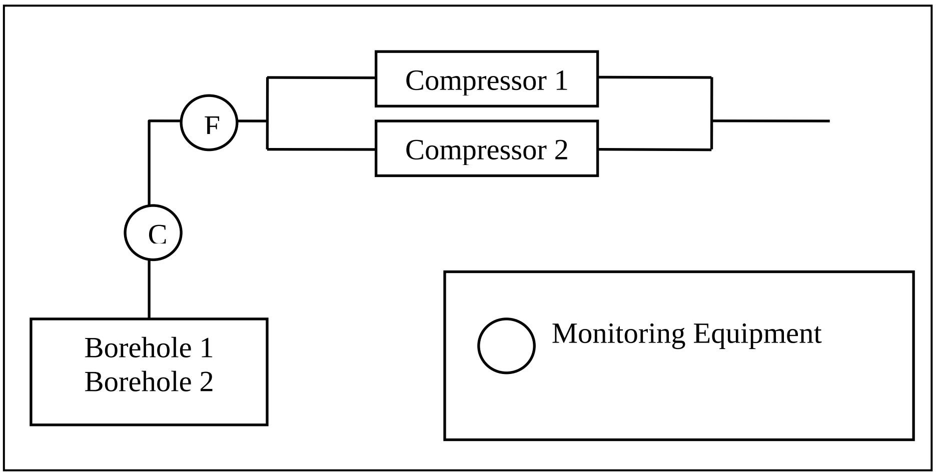

Figure 4: Methane compression monitoring system

In addition, the electricity consumption of the compression stations will be monitored continuously and the fossil fuel consumption for the transportation of the compressed methane will be monitored.

A description of the symbols appears below:

Symbol	Description	Function
F	Gas Flow Meter	Measure gas flowrate sent to compressors
C	Gas composition	Measuring the composition of the gas (CH_4, NMHC). The gas will be sampled every 3 months and tested for the NMHC concentration.

Enclosed flares will be installed at the borehole 3, 4 and 5. The enclosed flares will have temperature sensors to monitor that the combustion temperature remains above 500ºC. The flares will come equipped with inlet flowrate and composition meters. A default combustion efficiency of 90% will be used in accordance with the tool. This is reflected in the diagram below:

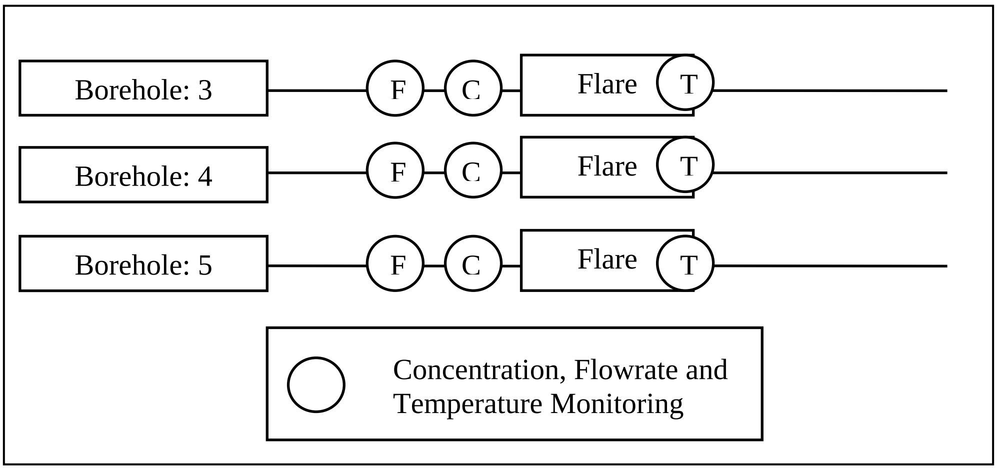

Figure 5: Mine flaring monitoring systems

Symbol	Description	Function
C	Concentration Meter	Measure CH_4 concentration of the gas
F	Gas Flow Meter	Measure methane sent to flare
T	Thermocouple	Measures the temperature of the flare to ensure correct operation

2. <u>Responsibility for data monitoring, recording and management.</u>

The operations manager will be responsible for ensuring that the data is monitored and recorded and that the instruments are all in working order.

3. Calibration of meters and metering

The following procedures will be implemented by the project to ensure accurate measurement and therefore accurate knowledge of GHG emission reductions.

- The metering equipment will be calibrated in accordance with manufacturer's specifications.
- The metering equipment will be calibrated and checked for accuracy in accordance with manufacturer's specifications.
- The instrumentation has not been finally selected yet. However, the instrumentation must have an accuracy of at least 95%. This can be checked at the first verification.

4. Verification Procedure

Verification will be done annually.

- The project participants will provide the data and calculated emission reductions to the DOE during verification.
- The operations personnel and the project participants will cooperate with the DOE during the verification process. The personnel working on this project will be available for consultation during the entire verification and will provide correct data to substantiate all queries.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date: 23/08/2010
Entity: Promethium Carbon (Pty) Ltd

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

18/08/2010 (the date when the flares are expected to be ordered)

C.1.2. Expected operational lifetime of the project activity:

Duration of the equipment, if maintained in accordance with manufacturers instructions is beyond 21 years.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

01/12/2010 or the date of registration, whichever occurs later.

C.2.1.2. Length of the first crediting period:

Seven years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

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D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The project does not involve any activity that is listed in terms of the National Environmental Management Act and, as such, does not require an environmental impact assessment or a basic assessment.

Following meetings with the regional director of The Department of Minerals and Energy (DME) for Welkom, the project will need to be included as an addendum to the Environmental Monitoring Programme Report (EMPR). DEAT expects this process to take four months.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The environmental impacts are positive as the methane is destroyed. The project will have to be included as an addendum to the EMPR of the mine.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

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An advertisement will be placed in a local newspaper in both English and Afrikaans. Afrikaans is the language of the area. The advertisement will be placed in the Vista newspaper Comments will be invited on the project with a reasonable closing date for comments.

There will also be a stakeholder meeting as required by the process for the Addendum to the Environmental Management Programme (EMP).

E.2. Summary of the comments received:

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Will be completed once comments are received.

E.3. Report on how due account was taken of any comments received:

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Will be completed once comments are received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	GFI Mining South Africa (Pty) Ltd.
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Building:	
City:	Welkom
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Postfix/ZIP:	
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Represented by:	
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Salutation:	
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Middle Name:	
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Department:	
Mobile:	
Direct FAX:	
Direct tel:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding has been used in the development of this project.

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

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