MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 0, 23/02/2012

DURBAN LANDFILL-GAS-TO-ELECTRICITY PROJECT – MARIANNHILL AND LA MERCY LANDFILLS
Reference Number 0545
3rd Monitoring Period (01/03/2010 - 30/09/2011)

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

The Durban Landfill-Gas-to-Electricity Project is designed to provide active landfill gas extraction and treatment by combustion in engines to produce electricity for supply to the South African grid system, or alternatively by flaring. Capture and combustion of the landfill gas converts methane to carbon dioxide. Methane is a powerful greenhouse gas, some 21 times more damaging than carbon dioxide and therefore its capture and combustion reduces the release of greenhouse gases to atmosphere which would otherwise occur in the absence of the project.

The project is part of a 3-site program implemented by eThekwini Municipality. The third site is Bisasar Road, which has been registered as an entirely separate CDM project and is therefore not discussed within this report.

Mariannhill Landfill site is an active landfill, located in the western area of Durban, which is scheduled to remain operational until 2024. It extends over 49 hectares and receives up to 700 tonnes of waste per day. The site was officially designated a Nature Conservancy site in late 2002, the only landfill in South Africa granted such a status.

La Mercy Landfill site is an old, closed landfill located 35km to the north of Durban and remote from residential areas. The site received approximately 1 million tonnes of waste in total. The La Mercy site was decommissioned in June 2009 and is no longer contributing to the emission reductions of the project. Therefore this Monitoring Report only considers operations and emission reductions at the Mariannhill Landfill site.

Both sites incorporate typical landfill gas collection and treatment infrastructure including extraction wells, pipework, engines for generation of electricity, flares for combustion of surplus landfill gas and a range of monitoring equipment to record the necessary data. At Mariannhill, the gas extraction system will be progressively expanded as the site continues to receive waste and new landfill cells are developed.

The project was registered on December 15th 2006. The initial crediting period is 7 years, which is twice renewable for a total operating period of 21 years.

The total emission reductions achieved during the third Monitoring Period (01/03/2010 to 30/09/2011) is 56,399 tCO_2e.

A.2. Project Participants

The Project Participants as indicated by the project information on the UNFCCC website are:

- **Republic of South Africa:** Durban Solid Waste (DSW) as project developer and operator; eThekwini municipality as project sponsor;
- The International Bank for Reconstruction and Development as the Trustee of the Prototype Carbon Fund (PCF);
- **Netherlands:** Netherlands' Ministry of Infrastructure and the Environment (IenM); Electrabel S.A.; Netherlands' Ministry of Economic Affairs, Agriculture and Innovation (EL&I);
- **Canada:** Government of Canada – Ministry of Foreign Affairs & International Trade;
- **Finland:** Government of Finland - Ministry of Foreign Affairs of Finland; Fortum Corporation;
- **Japan**: Chubu Electric Power Co., Inc; The Chugoku Electric Power Co., Inc.; Kyushu Electric Power Co., Inc.; Mitsubishi Corporation; MIT Carbon Fund Co., Ltd.; Tohoku Electric Power Co., Inc.; The Tokyo Electric Power Co., Inc.; Shikoku Electric Power Co., Inc.; Japan International Cooperation Agency (JICA); Mitsui & Co. Ltd.;
- **Norway**: Government of Norway – Ministry of Foreign Affairs; Norsk Hydro ASA; Statoil ASA;
- **United Kingdom of Great Britain and Northern Ireland:** Deutsche Bank AG; BP Alternative Energy International Ltd;
- **Sweden**: Government of Sweden - Swedish Energy Agency;
- **Germany**: RWE Power AG;
- **France**: GDF SUEZ.

A.3. Location of the project activity:

The project is located within the KwaZulu Natal region of South Africa. The Mariannhill landfill site is located in the western area of the Durban unicity, around 20 km to the west of Durban in the Metro area, formerly called the Inner West City Council (IWCC).

Durban is geographically located in the southeast region of South Africa on the Indian Ocean coast.

The Mariannhill site is located at Latitude: -29.846389, Longitude: 30.837778

A.4. Technical description of the project

Durban Solid Waste (DSW) is the municipal agency responsible for management and operation of multiple landfills in the Durban metropolitan area. Under the project, DSW has commissioned the installation of landfill gas extraction wells, flare units and landfill gas generators for the Mariannhill landfill site. DSW functions as the technical advisor and operator of the project.

Specifically, the following technology has been installed:

- *Extraction wells*: Over time some 33 gas wells will be constructed during phased restoration of the site to extract the landfill gas as it is produced.
- *Gas collection pipework*: Pipes collect and transport the gas from the wells to the extraction plant from where the gas is used for electricity generation, with any surplus gas being flared.
- *Gas extraction plant (blower):* A centrifugal blower is required to extract landfill gas from the wells and supply this to either the generation engine or the flare unit. The blower creates lower pressure inside the wells than in the landfill, thereby sucking the gas from the landfill into the wells and from there to the extraction plant.
- *Flare unit:* A landfill gas flare with maximum capacity of 1,000Nm^3/hr has been installed at the site.
- *Landfill gas generator*: A single 1MW unit has been installed at Mariannhill, which can be turned down to as low as 50% capacity (Jenbacher type 320 engine); and
- *Switch gears, transformers and cabling:* have been installed as needed for interconnection with the eThekwini Electricity grid.

The system is also equipped with condensate knockout pots in order to keep pipework clear of liquids which form due to changes in temperature. All engine and flaring equipment is housed in a purpose built compound to ensure no unauthorised access and maintain high standards of health and safety. The engine is installed within acoustic housing to minimise noise nuisance. All equipment is manufactured to established European standards and instrument maintenance and calibration procedures are implemented in accordance with the recommendations of the respective manufacturer.

Switch gear, transformers and cabling have been supplied to provide interconnection to the electricity grid system. In addition, the site is equipped with the necessary monitoring and data capture instrumentation to ensure that the requirements of the PDD are addressed.

A regular program of operation and maintenance of gas extraction and combustion equipment has been implemented, based on suppliers recommendations. Specialist contractors are employed to carry out environmental monitoring, in addition to maintenance and servicing of the landfill gas flare and engine.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

The project was registered under approved baseline methodology AM0010: "Landfill gas capture and electricity generation projects where landfill gas capture is not mandated by law".

A.6. Registration date of the project activity:

15/12/2006

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

Start date on 15/12/2006 with 7-year crediting period, twice renewable to a total of 21 years.

A.8. Name of responsible person(s)/entity(ies):

This third Monitoring Report has been prepared by:

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SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

Status of Implementation

The project has involved the installation of a network of gas collection wells and pipework to which suction pressure is applied in order to draw landfill gas from the waste to undergo controlled combustion in order to generate electricity.

Construction of the landfill gas management system began on 1st February 2006. The gas combustion equipment was commissioned in November 2006 and the first monitoring period commenced on December 15th 2006.

The project implemented a substantial upgrade of a previously existing, small collection system at Mariannhill which comprised six gas collection wells installed as a pilot activity.

The gas utilisation system at Mariannhill currently comprises a single 1MW Jenbacher 320 engine and flare. The network of gas collection wells has been expanded on a phased basis as the site continues to develop, as summarised in the following table.

SCHEDULE OF GAS WELLS IN PLACE AS AT 30 MARCH 2011

NOTE:

FOR THE HORIZONTAL WELLS IN CELL 5 THE LAYOUT IS ESSENTIALLY SCHEMATIC,

WELL LENGTHS RANGE BETWEEN 70m AND 140m.

THERE IS A VERTICAL SEPARATION OF BETWEEN 3,5m AND 5m BETWEEN THE LAYERS OF HORIZONTAL WELLS **LA, LB** AND **LC.** HORIZONTAL WELLS ARE INSTALLED AS LANDFILLING TAKES PLACE AND WASTE THICKNESS INCREASES.

LA DENOTES LAYER A, THE DEEPEST LAYER OF WELLS WITH LAYER B (LB) SOME 3,5m TO 5m ABOVE THIS AND LAYER C (LC) ANOTHER 3,5m TO 5M ABOVE LAYER B.

THE RISERS ARE PERFORATED PIPES INSTALLED WITH THE CELL LINER AND BEDDED IN THE LEACHATE DRAINAGE LAYER ON THE SLOPES ONLY. THE RISERS THEREFORE EXTRACT GAS FROM THE BASE OF THE LANDFILL.

Base line wells - Cell 1	Vertical wells installed under Contract WS 5607 (1No. in Cell 1; 6No. In Cell 3	Gas Riser Pipe (GRP) wells connected under Contract WS 5607 (Cell 4)	Vertical wells installed by Envitech (Cell 4)	Horizontal wells & riser connections installed under Contract WS 5920 and O&M contract (Cell 5) Installed in 2009	Gas Riser Pipe (GRP) wells connected under Contract WS 5920 and O&M contract (Cell 4/5) Installed in late 2009
BASELINE GW 1	GW 1	GRP 1	GW 8	HW 1 - LA	3No. - Cell 5
BASELINE GW 2	GW 2	GRP 2	GW 9	HW 2 - LA	
BASELINE GW 3	GW 3	GRP 3	GW 10	HW 3 - LA	
BASELINE GW 4	GW 4	GRP 4	GW 11	HW 1 - LB	
BASELINE GW 5	GW 5	GRP 5		HW 2 - LB	
BASELINE GW 6	GW 6	GRP 6		HW 1 - LC	
	GW 7	GRP 7			
		GRP 8			
		GRP 9			

Further wells will be added at Mariannhill when new areas of landfilling are completed. For this monitored period, one new horizontal well (reference HW1 – LD was installed in May 2011.

Operation of the Activity

Events or situations that occurred during the monitoring period and how these have been addressed

Plant shutdowns due to ESKOM power supply interruptions were experienced throughout the verification period, these would typically last for a couple of hours up to a day, depending on the length of power interruption. Refer to individual monthly CDM 'Footnotes on presented Data' worksheets for dates and time periods, where applicable.

The baseline flow meter signalling barrier unit was damaged during an electrical storm, consequently it read incorrectly for the period 01/03/2010 to 16/04/2010, when it was replaced. During this period a conservative flow rate of $30m^3$/hr was used for CDM data processing. Manual baseline readings during this period ranged between 18 and $21m^3$/hr. Readings before barrier failure averaged at $21m^3$/hr and after replacement at $19m^3$/hr.

During January 2011 the UPS power supply to the site computer malfunctioned and power to the computer was lost. CDM data for 2 periods: 02/01/2011 to 05/01/2011 and 20/01/2011 to 25/01/2011 were not recorded. No CERs are claimed for these two periods, although electricity was exported, as data cannot be verified. The UPS unit was replaced.

Thermocouples are used on the flare stack to continuously measure the flare stack temperature. These are replaced on a continuous basis, when individual units fail. Towards the end of 2010, gas extraction quantities from the landfill increased due to additional gas wells becoming operational. The failure rate of individual thermocouples increased notably, an investigation attributed this to 'thermal shock' experienced during higher flow rate output. An Inconel Thermowell 'holster' was inserted in the thermocouple port on 04/07/2011, providing 'protection' to the thermocouple against thermal shock. No thermocouple failure was experienced for the rest of the verification period, or since.

All individual events that differ from normal practice are recorded by the monitoring contractor within the monthly SCADA workbooks.

B.2. Revision of the monitoring plan

A Request for Revision of the Monitoring Plan was submitted to the UNFCCC on July 1st 2011. The request included changes to the monitoring of the following parameters: $MV_{project,y}$, Methane content of the landfill gas, Amount of net electricity sold to the grid, Combustion Efficiency, LFG Temperature and Pressure, Flare working hours, Flare Temperature and Heat rate of the generator.

These changes bring the details of the Monitoring Plan into alignment with operational practice on site, while ensuring the level of accuracy and completeness in the monitoring and verification process is not reduced as a result of the revision.

The request was approved with corrections by the Meth Panel on its 53rd meeting, and also with corrections by the CDM EB on its 65th meeting on 25/11/2011.

B.3. Request for deviation applied to this monitoring period

There is no request for deviation for this third monitoring period.

B.4. Notification or request of approval of changes

A Notification of Changes to the PDD was submitted to the UNFCCC on July 1st to address the decommissioning of the La Mercy site which took place in June 2009.

The NoC was approved with corrections by the Meth Panel on its 53rd meeting, and by the CDM EB on its 65th meeting on 25/11/2011.

SECTION C. Description of the monitoring system

The monitoring system is based on the requirements specified by methodology AM0010. Gas flow rates are recorded, along with methane content and electricity generation as the principal parameters which are used in the calculation of emission reductions.

The instruments which are employed in the monitoring of the site are presented in the following table:

INSTRUMENTATION LIST: MARIANNHILL

	Instrument Name/Description	Manufacturer/Supplier	Model	Type / SN	Range	Accuracy	Used to measure:	Used in Calculation?	Calibration requirement	Factory/Field Calibrated	Factory/Field Calibrated	Factory/Field Calibrated	Factory/Field Calibrated	Due date
	Fixed Instrumentation used to measure Parameters													
1	Temperature Transmitter	WIKA	TR200	46002570	0 to 100 °C	0.7% of full scale	gas temperature	N	n/a					replace as req.
2	Pressure Transmitter	GE Sensing - Druck	PTX 510-1176	2343640	-250 to 0 mbar	+/- 0.15% full scale	Suction pressure	N	n/a					replace as req.
3	Pressure Transmitter	GE Sensing - Druck	PTX 7900-3399	2345399	0 to 250mb	+/- 0.25% full scale	Delivery Pressure	N	n/a					replace as req.
5	Pressure Gauge	Dresser Ashcroft	N5500	n/a	-250 to 0 mbar	1.6% of full scale	Suction Pressure	N	n/a					replace as req.
6	Pressure Gauge	Dresser Ashcroft	N5500	n/a	0 to 250mb	1.6% of full scale	Delivery Pressure	N	n/a					replace as req.
7	Thermal Mass Flow Meter	Kurz Instruments	Series 454FT	FD20272A	0-18000SFPM	+/- 0.75% of Rate	Flare Flow	Y	annual[1]	12/10/2006	13/04/2010	21/10/2010	28/11/2011	see footnote 1
8	Thermal Mass Flow Meter	Kurz Instruments	Series 454FT	FD20273A	0-18000SFPM	+/- 0.75% of Rate	Engine Flow	Y	annual[1]	12/10/2006	13/04/2010	21/10/2010	28/11/2011	see footnote 1
9	Thermal Mass Flow Meter	Kurz Instruments	Series 454FT	FD20271A	0-18000SFPM	+/- 0.75% of Rate	Baseline Flow	Y	annual[1]	22/06/2009	22/04/2010	21/10/2010	28/11/2011	see footnote 1
10	Stationary Gas Monitor - Methane	Edinburgh Instruments	Gascard II	25746	0 to 100%	+/- 2% of range	CH4	Y	annual[2]	17/09/2007				See footnote 2
11	Stationary Gas Monitor - CO2	Edinburgh Instruments	Gascard II	25696	0 to 50%	+/- 2%of range	CO2	N	annual[2]	02/10/2007				See footnote 2
12	Oxygen Analyzer	City Technology	T70X	12150830048	0 to 25%	+/- 0.5%	O2	N	n/a					replace as req.
13	Atmospheric Pressure Sensor	GE Sensing - Druck	PTX1400		800 to 1200mb	0.15%	Atmospheric Pressure	N	n/a					replace as req.
14	3 Phase 3 Wire Meter	Landis + Gyr	Dialog	95680700	0 to 5A	0.10%	11000V Meter Export check	Y	10 yrs[3]	12/11/2008				2018
15	3 Phase 4 Wire Meter	Landis + Gyr	Dialog	86342181	0 to 5A	0.10%	11000V Meter Export kW	Y	10 yrs[3]	22/03/2006				2016
16	3 Phase 4 Wire Meter	Landis + Gyr	Dialog	85066208	0 to 120A	0.10%	400V Meter Import kW	Y	10 yrs[3]	26/08/2005				2015
	Hand Held Instrumentation													
17	Hand Held Gas Analyzer	Geotechnical Instruments	GA2000	GA08915	0 to 60% CH4	3% CH4,CO2 and 1% O2	CH4, CO2, O2		annual[4]	04/06/2009		25/06/2010	23/08/2011	22/08/2012
18	Check Meter	Biogas		BM10509		3% CH4	CH4		annual				09/06/2001	08/06/2012

[1] Since April 2010, the Kurz flow meters are checked on at least an annual basis by a specialist contractor, in accordance with the recommendations of the manufacturer

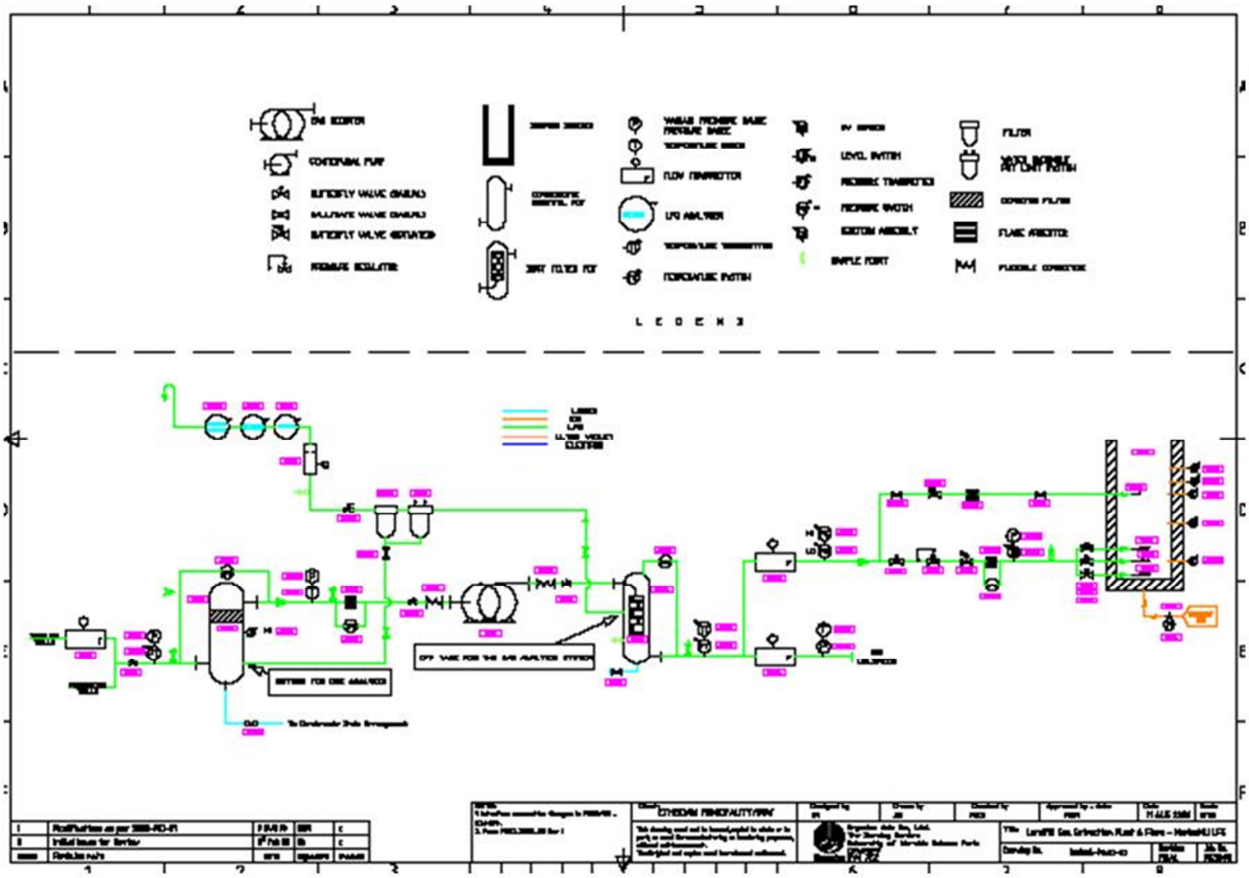
[2] The Gascard II analysers are regularly checked by the monitoring contractor using fully calibrated instruments and certified calibration gas in accordance with the recommendations of the manufacturer

[3] The performance of the electricity meters is monitored by the eThekwini Electricity company who are responsible for management of the local grid supply network.

[4] The GA2000 unit is calibrated by the manufacturer on an annual basis and is also checked at least monthly by the monitoring contractor against certified calibration gas.

It should be noted that the Mariannhill site includes six pre-existing gas collection wells which are considered to be baseline wells for the purposes of the calculation of emission reductions. Additional flow meters are provided as necessary in order to discount the gas collected from baseline wells.

The site is equipped with a Supervisory Control and Data Acquisition (SCADA) system to capture all relevant performance data and maintain a database from which monthly summary reports can be easily extracted. The system operates continuously and records data points at 15 minute intervals. A Process and Instrumentation Diagram for the site is presented below.



The SCADA facility provides the primary electronic record of the plant performance. The computerised system allows for automated recording and reporting of the data and ERs calculation. Access to the SCADA facility is restricted to authorised users and is password protected.

Raw data from the monitoring instrumentation are automatically logged at 15 minute intervals and stored on the computer system hard drive. The data are stored in CSV format with a file containing a month's data. On a monthly basis the data are exported from the CSV files to an Excel electronic workbook. The workbook includes capacity for the operator to record any occurrences which are relevant to the calculation of emission reductions and how such occurrences have been addressed. The calculation of emission reductions is checked by use of a bespoke manual *'Methodology for the Calculation of CERs for the Durban/World Bank CDM Landfill Gas to Electricity Project'*.

On a monthly basis the data are downloaded from each of the computerised SCADA systems. The download, in the form of a CD or memory stick, is reviewed by the CDM Manager and kept in the CDM Project Manager's office as a backup copy.

Quality Assurance

The project is operated in accordance with a bespoke manual *"Quality Assurance for the Operation of the Gas Extraction and Electricity Generation Systems"*.

This document describes in detail the arrangements and procedures which are followed concerning project personnel, equipment and data management.

Responsibilities

The organisational structure, along with detailed roles and responsibilities for the project are described within the CDM Management Manual for the project. The key participants are:

CDM Project Manager – Durban Solid Waste (DSW)
CDM Manager – Jon Pass (Wilson & Pass Engineers)
CDM Contractor - Monitoring – Envitech Solutions
CDM Contractor - Engine and Flare Maintenance – Agaricus Trading
Quality Assurance – SLR Consulting Limited

Staff Training

All required training was carried out prior to the implementation of the project, with new staff members being trained internally and externally as they have been appointed during the monitoring period. Subjects covered by the staff training have included:

- Reporting structures and lines of communication;
- Monitoring and balancing of the gas fields;
- Calibration of monitoring equipment;
- Data recording and analysis; and
- Impact of monitoring on the CDM activity.

Only authorized personnel that have received adequate training in the required fields are permitted to operate or perform any maintenance work on any of the equipment related to the project.

All monitoring data are to be retained for the duration of the crediting period and for at least two years thereafter.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	Methane Density
Data unit:	t CH_4/m^3CH_4
Description:	Density of methane at standard temperature and pressure (0 degrees Celsius and 1,013 bar)
Source of data used:	Mark's Standard Handbook for Mechanical Engineers Ninth Edition McGraw-Hill Book Company page 4-30, Table 4.1.7 The density of methane is given in the table as: 0.0416 pounds per cubic foot at 68 degrees F and 14.70 pounds per square inch. To convert that to kilograms per cubic meter at 1.013 bar and 0 degrees Centigrade: 293 degrees Kelvin/273 degrees Kelvin = 1.0732 which is

	the weight addition ratio at a constant volume, therefore 0.0416 x 1.0732 = 0.0446 pounds per cubic foot. 1 cubic meter = 35.31 cubic feet, therefore 0.446 x 35.31 = 1.5748 pounds per cubic meter / 2.2046 pounds per kilogram = 0.7143 kilograms per cubic meter.
Value(s) :	0.0007143
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Conversion of volume of gas collected to mass
Additional comment:	n/a

Data / Parameter:	GWP_{CH4}
Data unit:	tonnes CO_2e / tonnes CH_4
Description:	Global Warming Potential value for methane
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Conversion of emission reductions to carbon dioxide equivalent
Additional comment:	n/a

Data / Parameter:	Calorific Value of Methane
Data unit:	GJ/Nm^3
Description:	Energy content of the methane combusted
Source of data used:	PDD
Value(s) :	0.037
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Conversion of volume of gas collected to mass
Additional comment:	n/a

D.2. Data and parameters monitored

Data / Parameter:	Eskom Grid Emission Factor ($EI_{grid,y}$)
Data unit:	tCO_2/kWh
Description:	Emission factor of the South African grid system
Measured /Calculated /Default:	Default value published annually by Eskom
Source of data:	Published Eskom Annual reports, available on their website www.eskom.co.za
Value(s) of monitored parameter:	0.00103 from 01/03/2010 – 31/03/2010[1] 0.00099 from 01/04/2010 – 30/09/2011[2]
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reductions from displacement of power generated by the South African grid system (please refer to section E below). Eskom 2012 Annual Report not yet published so most recently available data have been used for the period 31/03/2011 – 30/09/2011.

[1] Eskom 2010 Annual Report, page 299; Calculated using data from 01/04/2009 to 31/03/ 2010; found online at http://financialresults.co.za/2010/eskom_ar2010/corp_tables_enviro.htm

[2] Eskom 2011 Annual Report, page 327; Calculated using data from 01/04/2010 to 31/03/ 2011; found online at http://financialresults.co.za/2011/eskom_ar2011/downloads/eskom-ar2011.pdf

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n/a
Measuring/ Reading/ Recording frequency:	Data are updated prior to submission to the DOE to ensure that the most appropriate factor is applied for each time period.
Calculation method (if applicable):	n/a
QA/QC procedures applied:	n/a

Data / Parameter:	Regulatory requirements relating to landfill gas projects
Data unit:	n/a
Description:	Applicable laws and regulation concerning the capture and combustion of landfill gas
Measured /Calculated /Default:	Measured
Source of data:	eThekwini Municipality legal advisors for the CDM project
Value(s) of monitored parameter:	No specific requirements have been put in place during the monitoring period
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions assessment
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n/a
Measuring/ Reading/ Recording frequency:	Annual check for updates
Calculation method (if applicable):	n/a
QA/QC procedures applied:	n/a

Data / Parameter:	$MV_{baseline,y}$
Data unit:	m^3
Description:	Gas collected from baseline wells
Measured /Calculated /Default:	Measured
Source of data:	Flow meter installed on site
Value(s) of monitored parameter:	Variable throughout the monitoring period – recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Serial Number: Kurz Instruments FD20271A Accuracy: +/-0.75% Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration within the monitored period: 22/06/2009, 22/04/2010 and 21/10/2010 Validity of Calibration Certificates for this monitored period: 22/06/2009 to 21/06/2010 22/04/2010 to 21/04/2011

	21/10/2010 to 20/10/2011
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	n/a
QA/QC procedures applied:	Meters subject to maintenance and in-situ calibration. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	$MV_{project,y}$
Data unit:	m^3
Description:	Gas collected from project wells
Measured /Calculated /Default:	Calculated.
Source of data:	3 flow meters installed
Value(s) of monitored parameter:	Variable throughout the monitoring period – recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1. Serial Number: Kurz Instruments FD20272A (flare flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 13/04/2010 and 21/10/2010 Validity of Calibration Certificate for this monitored period: 13/04/2010 to 12/04/2011 21/10/2010 to 20/10/2011 2. Serial Number: Kurz Instruments FD20273A (engine flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 13/04/2010 and 21/10/2010 Validity of Calibration Certificate for this monitored period: 13/04/2010 to 12/04/2011 21/10/2010 to 20/10/2011 3. Serial Number: Kurz Instruments FD20271A (baseline flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 22/06/2009, 22/04/2010 and 21/10/2010 Validity of Calibration Certificate for this monitored period: 22/06/2009 to 21/06/2010 22/04/2010 to 21/04/2011 21/10/2010 to 20/10/2011 (for further details see parameter $MV_{baseline,y}$ above)
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	The volume of gas collected from baseline wells (recorded by flow meter) is subtracted from the total gas extracted (recorded by engine and flare flow meters) to derive the volume collected from project wells.
QA/QC procedures applied:	Meters subject to maintenance and in-situ calibration. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Methane Content

Data unit:	%
Description:	Amount of the landfill gas collected which is methane
Measured /Calculated /Default:	Measured and calculated
Source of data:	Gas monitors installed on site
Value(s) of monitored parameter:	Variable throughout the monitoring period – recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Model: Edinburgh Instruments, Gascard II Serial Number:25746 Accuracy: +/- 2% of range Calibration frequency: calibration check at least annually Date of last calibrations during this monitored period: 15/04/2010 06/08/2010 23/11/2010 23/03/2011 12/08/2011 Validity of Calibration Certificate: valid throughout the current monitored period *The handheld GA2000 gas analyser is calibrated annually by the manufacturer and also checked and adjusted periodically by the monitoring contractor using certified calibration gas. The GA2000 is used in the event of failure of the stationary analysers and is also used to adjust and calibrate the stationary Gascard II gas analysers on site to maintain levels of accuracy. Calibration is carried out each time the GDU is serviced. Within the monitored period, calibrations of the stationary Gascard II gas analyzer using the GA2000 took place on 15/04/2010, 06/08/2010, 23/11/2010, 23/03/2011 and 12/08/2011.* *Whilst the GA2000 instrument is being calibrated, a handheld calibrated 'BioGas Check' meter (serial number BM10509) is used (June 24th 2011 – August 23rd 2011) to cross check and adjust the stationary analysers against the certified calibration gas.* Handheld Instrument (GA2000) Serial Number: GA08915 Accuracy: +/-3% of methane content Calibration frequency: annual Date of last calibrations: 04/06/2009, 25/06/2010 and 23/08/2011 Validity of Calibration Certificates during this monitored period: 04/06/2009 – 03/06/2010 25/06/2010 – 24/06/2011 23/08/2011 – 30/09/2011 Handheld Instrument (Biogas Check Meter) Serial Number: BM10509 Accuracy: +/-3% of methane content Calibration frequency: annual Date of last calibration: 09/06/2011 Validity of Calibration Certificate: 09/06/2011 – 08/06/2012

Measuring/ Reading/ Recording frequency:	Continuous and periodic. Periodic checks of the methane content from baseline wells are carried out at Mariannhill for crosschecking purposes.
Calculation method (if applicable):	n/a
QA/QC procedures applied:	Meters subject to maintenance and calibration. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Volume of Landfill Gas Consumed in Engines
Data unit:	m^3
Description:	Amount of collected landfill gas combusted by engines
Measured /Calculated /Default:	Measured
Source of data:	Flow meter installed on site
Value(s) of monitored parameter:	Variable throughout the monitoring period - recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1. Serial Number: Kurz Instruments FD20273A (engine flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 13/04/2010 and 21/10/2010 Validity of Calibration Certificates during this monitored period: 13/04/2010 to 12/04/2011 21/10/2010 to 20/10/2011
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	n/a
QA/QC procedures applied:	Meters subject to maintenance and in-situ calibration. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Volume of Landfill Gas Consumed in Flares
Data unit:	m^3
Description:	Amount of collected landfill gas combusted by flares
Measured /Calculated /Default:	Measured
Source of data:	Flow meter installed on site
Value(s) of monitored parameter:	Variable throughout the monitoring period - recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1. Serial Number: Kurz Instruments FD20272A (flare flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 13/04/2010 and 21/10/2010 Validity of Calibration Certificates during this monitored period: 13/04/2010 to 12/04/2011 21/10/2010 to 20/10/2011

Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	n/a
QA/QC procedures applied:	Meters subject to maintenance and in-situ calibration. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Electricity sold to the Grid (ES_y)
Data unit:	kWh
Description:	The net amount of electricity which is produced by the project for export to the grid, considering electricity usage on site.
Measured /Calculated /Default:	Measured and calculated
Source of data:	Electricity meters installed on site
Value(s) of monitored parameter:	Variable throughout the monitoring period - recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1. Serial Number: 86342181 (Export) Accuracy: 0.10% Calibration frequency: 10 years Date of last calibration: 2006 Validity of Calibration Certificate: valid throughout the current monitored period, up to 2016 2. Serial Number: 95680700 (Export backup meter) Accuracy: 0.10% Calibration frequency: 10 yrs Date of last calibration: 12/11/2008 Validity of Calibration Certificate: valid throughout the current monitored period, up to 2018 3. Serial Number: 85066208 (Import) Accuracy: 0.10% Calibration frequency: 10 years Date of last calibration: 2005 Validity of Calibration Certificate: valid throughout the current monitored period, up to 2015 Note: Backup export meters were not used during the monitoring period.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	Total amount of electricity imported (measured) is subtracted from the total amount of electricity exported (measured) to derive the net electricity produced by the project.
QA/QC procedures applied:	Meters subject to maintenance and performance monitoring by eThekwini Electricity. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	EG_y
Data unit:	kWh
Description:	Electricity produced by combustion of landfill gas
Measured /Calculated /Default:	Calculated
Source of data:	Electricity meters installed on site

Value(s) of monitored parameter:	Variable throughout the monitoring period – recorded in Summary CER calculation sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction crosscheck calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1. Serial Number: 86342181 (Export) Accuracy: 0.10% Calibration frequency: 10 years Date of last calibration: 2006 Validity of Calibration Certificate: valid throughout the current monitored period, up to 2016 2. Serial Number: 95680700 (Export backup meter) Accuracy: 0.10% Calibration frequency: 10 yrs Date of last calibration: 12/11/2008 Validity of Calibration Certificate: valid throughout the current monitored period, up to 2018 Note: Backup export meters were not used during the monitoring period.
Measuring/ Reading/ Recording frequency:	Recorded periodically for verification audit purposes
Calculation method (if applicable):	Value is calculated by adding 1.5% to the amount of electricity exported to account for transformer losses.
QA/QC procedures applied:	Meters subject to maintenance and performance monitoring by eThekwini Electricity. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Combustion Efficiency
Data unit:	%
Description:	Combustion efficiency of gas engines and flares
Measured /Calculated /Default:	Default values are used in the calculation of emission reductions. The combustion efficiency of engines is not actually used in the calculation of emission reductions, but is referenced in AM0010. Annual measurements of combustion efficiency are carried out as a quality assurance measure.
Source of data:	n/a for engines manufacturer statement for flares
Value(s) of monitored parameter:	100% for engines 97% for flares
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction crosscheck calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Field tests of combustion efficiency are carried out as a quality assurance measure.
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	n/a

QA/QC procedures applied:	Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	LFG Temperature and Pressure
Data unit:	ºC and Pa
Description:	Temperature and pressure of landfill gas
Measured /Calculated /Default:	The temperature and pressure are measured by thermal mass flow meters which automatically provide the normalised flow of the gas.
Source of data:	Thermal mass flow meters
Value(s) of monitored parameter:	n/a
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1. Serial Number: Kurz Instruments FD20272A (flare flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 13/04/2010 and 21/10/2010 Validity of Calibration Certificate: 13/04/2010 to 12/04/2011 21/10/2010 to 20/10/2011 2. Serial Number: Kurz Instruments FD20273A (engine flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 13/04/2010 and 21/10/2010 Validity of Calibration Certificate: 13/04/2010 to 12/04/2011 21/10/2010 to 20/10/2011 3. Serial Number: Kurz Instruments FD20271A (baseline flow) Accuracy: +/-0.75% of rate Calibration frequency: recommended annual re-certification and/or in-situ calibration Date of last calibration: 22/06/2009, 22/04/2010 and 21/10/2010 Validity of Calibration Certificate: 22/06/2009 to 21/06/2010 22/04/2010 to 21/04/2011 21/10/2010 to 20/10/2011 (for further details see parameter $MV_{baseline,y}$ above)
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	n/a
QA/QC procedures applied:	Meters subject to maintenance and in-situ calibration. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Flare Working Hours
Data unit:	-
Description:	Periods discounted, during which the temperature of the flare is below 500 ºC[3]
Measured /Calculated /Default:	Measured

[3] As per the revised version of the PDD, approved by the CDM EB on its 65th Meeting.

Source of data:	SCADA system
Value(s) of monitored parameter:	Variable throughout the monitoring period, as evidenced by flare temperature recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Thermocouples that monitor flare temperature, and SCADA system.
Measuring/ Reading/ Recording frequency:	Temperature data, as shown on the parameter below, is continuously monitored and recorded by the SCADA system; this is then checked monthly when finalising the emission reductions calculations for the preceding month.
Calculation method (if applicable):	Working hours are deemed to be those during which the flare temperature is greater than 500ºC. Periods during which the temperature is below this level are discounted from the emission reduction calculation.
QA/QC procedures applied:	Meters subject to maintenance and calibration. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Flare Temperature
Data unit:	ºC
Description:	Gas combustion temperature within the flare
Measured /Calculated /Default:	Measured
Source of data:	Thermocouples; used to confirm that the flare is operating at sufficient temperature to ensure methane combustion. Periods during which the temperature is below 500ºC are discounted from the emission reduction calculation.
Value(s) of monitored parameter:	Variable throughout the monitoring period – recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations in the QA Method (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1. Serial Number: WIKA TR200 46002570 Accuracy: 0.7% of full scale *Initial calibrations of the thermocouples are performed in the manufacturer's factory before being installed at the project site. Function is routinely checked by the monitoring contractor and items are replaced when malfunctions are noted, usually every few months, and should be replaced at least annually. The site record sheets show that replacements took place on the following dates at Mariannhill during the monitored period:* *25/08/10;* *13/01/11;* *03/02/11;* *12/02/11;* *30/03/11;* *13/04/11;*

	17/04/11; *21/04/11;* *29/04/11;* *03/05/11;* *14/05/11; and* *27/05/11.* *These frequent replacements demonstrate that the temperatures recorded are valid throughout the monitored period.*
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	Na
QA/QC procedures applied:	Thermocouples are subject to regular checks to ensure that they are operating as required or replaced if a failure is noted. Emission reductions calculations are manually adjusted during periods of thermocouple malfunction in accordance with the QA Manual of the monitoring contractor.

Data / Parameter:	Heat Rate (HR_y)
Data unit:	kJ/kWh
Description:	Heat rate of the engine
Measured /Calculated /Default:	Calculated every 15 minutes, aggregated to daily average and measured annually for QA purposes
Source of data:	SCADA system and manufacturer data
Value(s) of monitored parameter:	Variable throughout the period – recorded in SCADA sheets provided
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission reduction calculations (please refer to section E below)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Electricity export meter and engine manufacturer heat rate values for new engines.
Measuring/ Reading/ Recording frequency:	Every 15 minutes
Calculation method (if applicable):	Calculated from electricity export meter data and engine manufacturer heat rate values for new engines. The electricity output recorded is applied to an equation drawn from the engine manufacturer heat rate data for a new engine to derive a heat rate specific to the output level recorded. 15-minute values are averaged on a daily basis for use in the calculation of emission reductions.
QA/QC procedures applied:	Parameter is also measured annually by field testing as a QA check to ensure that the values used in the emission reduction calculations are conservative. Data will be kept electronically for the duration of the crediting period.

Data / Parameter:	Wx
Data unit:	Tons
Description:	Amount of waste deposited
Measured /Calculated /Default:	Measured by weighbridge when waste comes in and recorded electronically

Source of data:	Landfill site records
Value(s) of monitored parameter:	Please see FOD model spreadsheet for further details
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Weighbridge: Masskot 4321M Serial Number: 925374 Accuracy: +/-20kg Calibration frequency: every 24 months as per Trade Metrology Act Date of last calibration: 15/11/2010 Validity of Calibration Certificate 15/11/2010 to 15/11/2012
Measuring/ Reading/ Recording frequency:	As waste comes in
Calculation method (if applicable):	NA
QA/QC procedures applied:	Weighbridge is calibrated as per South African Trade Metrology Act, 1973

Data / Parameter:	Wj,x
Data unit:	Tons
Description:	Types of waste deposited
Measured /Calculated /Default:	Measured by weighbridge when waste comes in and recorded electronically
Source of data:	Landfill site records
Value(s) of monitored parameter:	Please see FOD model spreadsheet for further details
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Weighbridge: Masskot 4321M Serial Number: 925374 Accuracy: +/-20kg Calibration frequency: every 24 months as per Trade Metrology Act Date of last calibration: 15/11/2010 Validity of Calibration Certificate 15/11/2010 to 15/11/2012
Measuring/ Reading/ Recording frequency:	As waste comes in
Calculation method (if applicable):	NA
QA/QC procedures applied:	Weighbridge is calibrated as per South African Trade Metrology Act, 1973

Data / Parameter:	$p_{j,x}$
Data unit:	%
Description:	Waste composition in the year
Measured /Calculated /Default:	Calculated based on parameters Wx and Wj,x and used as input data to the FOD spreadsheet model.
Source of data:	Landfill site records
Value(s) of monitored parameter:	Based on the monitored data for 2010 and 2011

Waste Composition (%)	Average
Pulp, paper, Cardboard (other than Sludge)	0.0

	Textiles 0.00% Food and Food Waste, beverages and tobacco (other than sludge) 62.03% Garden,Yard and Park Waste 4.20% Wood & Wood Products 0.00% Other Innert Waste 33.77% Please see FOD model spreadsheet for further details
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Weighbridge: Masskot 4321M Serial Number: 925374 Accuracy: +/-20kg Calibration frequency: every 24 months as per Trade Metrology Act Date of last calibration: 15/11/2010 Validity of Calibration Certificate 15/11/2010 to 15/11/2012
Measuring/ Reading/ Recording frequency:	As waste comes in
Calculation method (if applicable):	NA
QA/QC procedures applied:	Weighbridge is calibrated as per South African Trade Metrology Act, 1973

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

As per methodology AM0010 and registered PDD, the baseline scenario in this case is defined as "the actions that need to be implemented to meet the regulation governing the allowed methane concentration, as well as good management practice to address safety and odour concerns."

At Mariannhill, baseline emissions ($MV_{baseline,y}$) are those attributable to the six pre-existing gas extraction wells. Flow meters are used to identify the contribution of these baseline wells to the overall volume of gas collected, to ensure that such contributions are deducted from the emission reductions claim. These values are presented in the summary data included as Annex 3.

E.2. Project emissions calculation

Project emissions comprise the consumption of electricity which powers the gas extraction and treatment infrastructure.

To ensure that this is accounted for within the calculation of emission reductions, separate meters are installed to record the amount of electricity imported and exported from the two sites. The difference between the amount imported and the amount exported (ES_y) is used in the calculation of emission reductions from displaced grid electricity. These values are presented in the summary data included as Annex 3.

E.3. Leakage calculation

As stated in the PDD, as there will be no increase in emissions outside of the project boundary, leakage is considered to be zero.

E.4. Emission reductions calculation / table

As per the methodology AM0010 and the PDD, the greenhouse gas emission reductions achieved by the project activity during a given year (ER_y) is the difference between the amount of methane actually destroyed/combusted during the year ($MD_{project,y}$) and the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{baseline,y}$), times the approved Global Warming Potential value for methane (GWP_CH_4) plus the quantity of electricity sold to the grid during the year (ES_y) multiplied by the CO_2 emissions intensity of the electricity displaced ($EI_{grid,y}$).

$$ER_y = (MD_{project,y} - MD_{baseline,y}) \times GWP\_CH_4 + ES_y \times EI_{grid,y}$$

ER_y is measured in tonnes of CO_2 equivalents (tCO_2e). $MD_{project,y}$ and $MD_{baseline,y}$ are measured in tonnes of methane (tCH_4). The approved Global Warming Potential value for methane (GWP_CH_4) for the first commitment period is $21tCO_2e/tCH_4$. ES_y is measured in megawatt hours (MWh). The CO_2 emissions intensity, $EI_{grid,y}$, is measured in tonnes of CO_2 equivalents per megawatt hour (tCO_2e/MWh).

The Monitoring Plan provides for the calculation of emission reductions from avoided methane emissions and from displaced grid electricity.

The project operator determines the applicable annual grid carbon emission factor based on the Eskom Annual Reports and multiplies this by the metered electricity delivered to the grid.

Using the formulae prescribed by AM0010, the total emission reductions have been calculated. The data required to complete the calculations are collected by either the Primary Method (PM) or the Quality Assurance Method (QA). The PM is based on downstream metering wherever possible, i.e. meters are placed as closely as possible to the location of combustion of methane gas or measure minor quantities thus avoiding sources of error. The QA method relies on up-stream metering and continuous analysis of the methane content in landfill gas. This method is used as a backup and for quality control purposes, in the event that engines are not operating.

The PM uses the monthly aggregates of the following four metered variables: Gross electricity production (kWh), volume of LFG sent to engines, volume of landfill gas flared, and volume of LFG extracted from baseline wells (all in m^3). The method first calculates the quantity of methane combusted in engines using engine kWh output and technical parameters (Steps 1 – 3 in Figure 2). Step 4 calculates the methane content in LFG using the quantity of LFG sent to engines, which is then used in Step 5 to derive methane combusted in flares from LFG quantity sent to flares. Step 6 calculates the proportion of LFG collected from project wells using the above information about LFG sent to engines and flares as well as LFG collected from baseline wells. This proportion is used in Step 7 to calculate the net amount of methane combusted by the project activity and for which credits can be claimed. Step 8 concludes the calculation by multiplying with the global warming potential of methane.

The QA method uses the monthly aggregates of the following three metered variables: Volume of landfill gas flared, volume of gas extracted from baseline wells, and volume of gas sent to the engines (all in m^3). The method also uses continuous analysis of the methane content in landfill gas. The method first calculates the proportion of LFG combusted using the above gas flow information together with the flare efficiency (Step 2). In Step 3, this proportion is used to derive the volume of combusted gas that is collected from project wells. Step 4 calculates the volume of methane combusted from the volume of combusted gas using continuous measurement of the methane content in LFG. Step 5 and 6 complete the calculation of emission reductions (CO_2equiv) by converting methane volume into tons of methane and multiplication with the global warming potential.

Each of the calculation methods is presented in graphical format below.

Key steps of the primary calculation method

Methane combusted in engines

Step 1

Take the metered gross annual electricity production (kWh) – (H)

Step 2

Obtain total energy input to engines (in GJ) – (I) by multiplying with generator heat rate. Use manufacturer information for heat rate – (h) (14,000 kJ/kWh as default).*

Step 3

Convert total energy input (in GJ) – (I) to tons of methane – (J), using calorific content of methane – (j) (37,000 kJ/m3) and weight of methane – (e) (0.000714 t CH4/m3)

Methane combusted in flares

Step 4

Calculate proportion of methane in LFG – (c), using volume of methane combusted in engines – (V) and LFG sent to engines (X)

Step 5

Calculate tons of methane combusted in flares – (K), using methane sent to flares – (C), flare efficiency – (a) (default 0.97), methane content in LFG – (c), and weight of methane – (e) (0.000714 t CH4/m3)

Step 6

Calculate proportion of project wells to total landfill gas collected – (k), using volumes of LFG sent to engines – (X), to flares – (C), and collected from baseline wells – (B)

Step 7

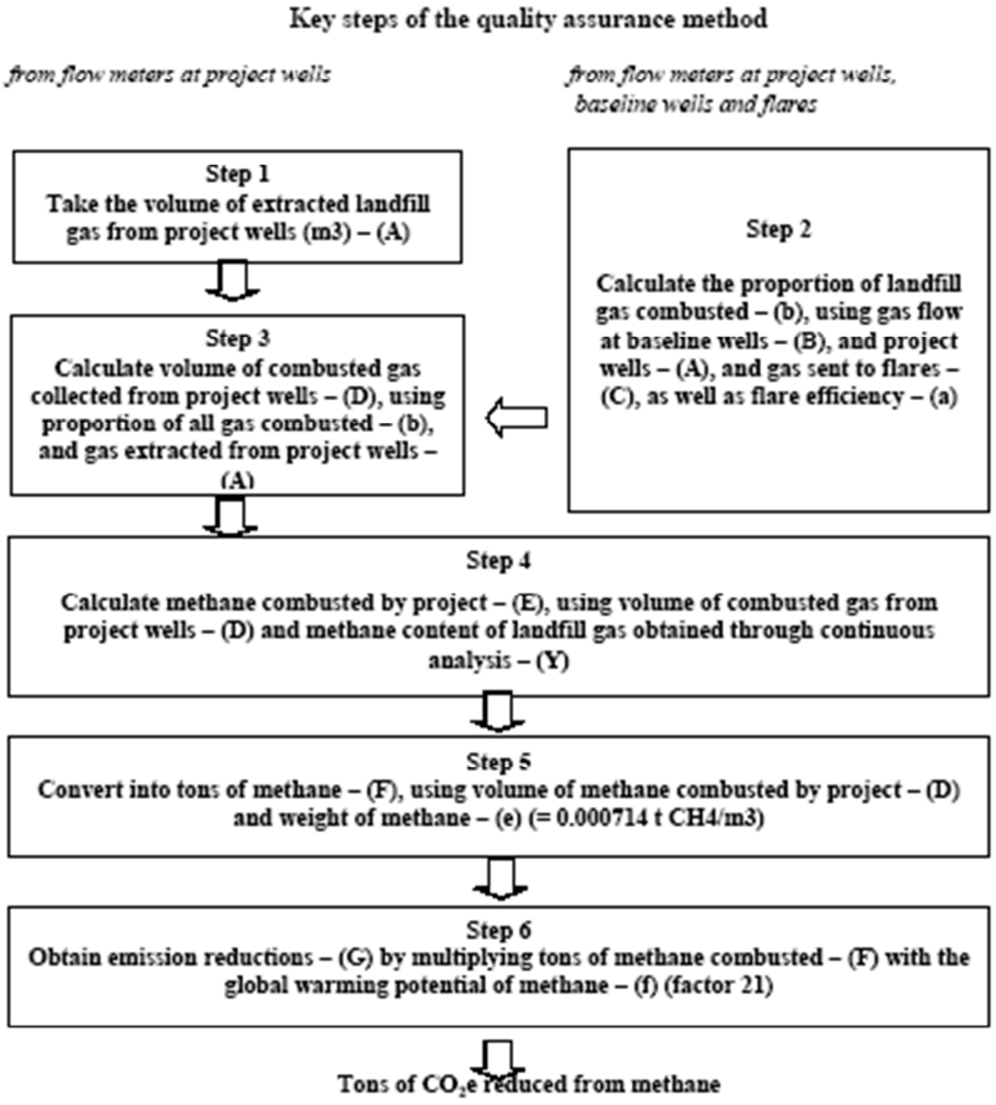
Calculate net amount of methane – (M), by adding methane combusted in engines – (J) and in flares – (K), and correcting for contribution of baseline wells to total landfill gas collected – (k)

Step 8

Obtain emission reductions – (N) by multiplying net amount of methane combusted – (M) with the global warming potential of methane – (f) (GWP factor: 21)

Tons of CO_2e reduced from methane

**Engine manufacturer to provide data on the heat rate figure for use in the calculation.*



A summary of the ERs calculated by the SCADA system for the period of 01/03/2010 to 30/09/2011 for Mariannhill is presented in the tables below. A more detailed summary of the data is provided in spreadsheet format in Annex 3. The full SCADA data files have been made available to the Verifier.

Mariannhill CERs

Month	Primary Method (PM)	QA Method (QA)	Power supplied	With power supply	Selected method	Applied Data
Mar-10	1,881	1,790	513	Applicable	PM	1,881
Apr-10	1,903	1,831	323	Applicable	PM	1,903
May-10	1,968	2,012	410	Applicable	PM	1,968
Jun-10	2,662	2,616	536	Applicable	PM	2,662
Jul-10	2,823	2,886	546	Applicable	PM	2,823
Aug-10	2,463	2,434	526	Applicable	PM	2,463
Sep-10	2,621	2,637	502	Applicable	PM	2,621

Month	Primary Method (PM)	QA Method (QA)	Power supplied	With power supply	Selected method	Applied Data
Oct-10	2,680	2,699	518	Applicable	PM	2,680
Nov-10	2,411	2,412	427	Applicable	PM	2,411
Dec-10	2,978	2,981	426	Applicable	PM	2,978
Jan-11	2,206	2,265	378	Applicable	PM	2,206
Feb-11	2,354	2,428	418	Applicable	PM	2,354
Mar-11	2,500	2,759	345	Applicable	PM	2,500
Apr-11	2,956	3,337	-1.25	N/A	PM	2,956
May-11	0	3,251	-13	N/A	QA	3,251
Jun-11	3,033	3,877	-5	N/A	PM	3,033
Jul-11	3,133	3,316	131	Applicable	PM	3,133
Aug-11	3,435	3,417	549	Applicable	PM	3,435
Sep-11	2,514	2,589	98	Applicable	PM	2,514
Total	46,521	51,537	**6,627**			**49,772**
Total CERs Calculated				**56,399**		

- **Total – 56,399 tCO_2e.**

In addition, in line with paragraph 35 (a) of the EB65 Meeting Report, the calculation of theoretical methane emissions using the first order decay model has been conducted to confirm the proposed approach for the parameter $MV_{project,y}$ "amount of landfill gas collected from the project wells". The results are the following:

Item	Theoretical CH_4 generated as per FOD model with monitored quantities and types of waste	Theoretical CH_4 collected as per FOD model with monitored quantities and types of waste	Monitored CH_4 from calculated $MV_{project,y}$ parameter, based on monitored data
Tons of CH_4	6,824 tCH_4 *	3,412 tCH_4 *	2,685 tCH_4

*The values have been calculated by prorating the FOD model yearly values by the number of days to match this monitored period (01/03/2010 to 30/09/2011).

Hence parameter $MV_{project,y}$ is deemed a conservative value as compared to the theoretical methane generation and collection estimate from the FOD model.

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

The following table shows a comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	73,856 tCO_2e *	56,399 tCO_2e

*The PDD value been calculated by prorating the PDD yearly values by the number of days to match this monitored period (01/03/2010 to 30/09/2011).

E.6. Remarks on difference from estimated value in the PDD

The actual emission reductions achieved during the monitoring period were significantly lower than predicted in the registered PDD.

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History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		