Monitoring report form
(Version 03.2)

Monitoring report

Title of the project activity	Joburg Landfill Gas to Energy Project
Reference number of the project activity	6797
Version number of the monitoring report	V3
Completion date of the monitoring report	15/04/2014
Registration date of the project activity	12/11/2012
Monitoring period number and duration of this monitoring period	01 12/11/2012 to 30/04/2013 (Inclusive)
Project participant(s)	ENER-G Systems Joburg (PTY) Ltd Ecosecurities International Ltd
Host Party(ies)	Republic of South Africa
Sectoral scope(s) and applied methodology(ies)	Sectoral Scope 13 - Waste Handling and Disposal Methodology ACM0001 V11
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	60186 tCO2e From 12/11/2012 to 31/12/2012 159201 tCO2e From the 01/01/2013 to 30/04/2013
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	28306 tCO2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	From 12/11/2012 to 31/12/2012 25268 tCO2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	3038 tCO2e From the 01/01/2013 to 30/04/2013

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

The Joburg Landfill Gas to Energy Project developed by ENER-G Systems Joburg (Pty) Ltd is a landfill gas (LFG) collection and utilisation project located at the Johannesburg landfill sites in South Africa. The landfill site addresses and coordinates are detailed in section A 2 below.

The objective of the project is to collect and destruct/utilise the landfill gas (LFG) generated at five of the Johannesburg landfill sites. The project activity will consist of two distinct stages. In the first stage, LFG will be captured and destroyed by using a high temperature LFG flare, while in the second stage the captured LFG will be fed to the LFG flare and a modular electricity generation plant.

The technology installed at the two sites consists of a typical gas extraction and collection systems that is connected to a 2000m^3/h high temperature flare. The flare combusts the landfill gas in a high temperature stack and has a range of instrumentation and monitoring equipment for efficient operation.

The Robinson Deep was constructed between February 2011 and May 2011 and the site was commissioned on the 27 May 2011 and was in continuous operation from the 27 May 2011. The Marie Louise landfill site was constructed from February 2012 to May in 2012 and was commissioned on the 04 May 2012 and remained operational ever since. The other three landfill sites have not been constructed or commissioned to date.

The two sites that have been in operation since commissioning produced a combined total of 28306 GHG reductions under CDM for the entire monitoring period between the 12/11/2012 and the 30/04/2013.

Below is a table reflecting the anticipated implementation program for the balance of the landfill sites and for the power generation component of the projects. This is an estimated time frame for the installation at the balance of the sites based on the development program being implemented for the electricity generation component of the project. We are in the process of concluding a power sale agreement with the Department of Energy and this will be concluded in June 2014.

Landfill site	Start date for flaring	Start date for power generation
Robinson Deep		06/03/2015
Marie Louise		11/03/2015
Goudkoppies	23/03/2015	07/04/2015
Linbro Park	23/03/2015	07/04/2015
Ennerdale	21/04/2015	06/05/2015

A.2. Location of project activity

All the projects sites are located in The Republic of South Africa (Host Country) and reside in the greater Johannesburg Metropolitan City region which is located centrally in the Gauteng province. This is geographically located centrally in the north eastern region of South Africa as depicted in the map below (Figure 1).

Figure 1 Gauteng Province South Africa

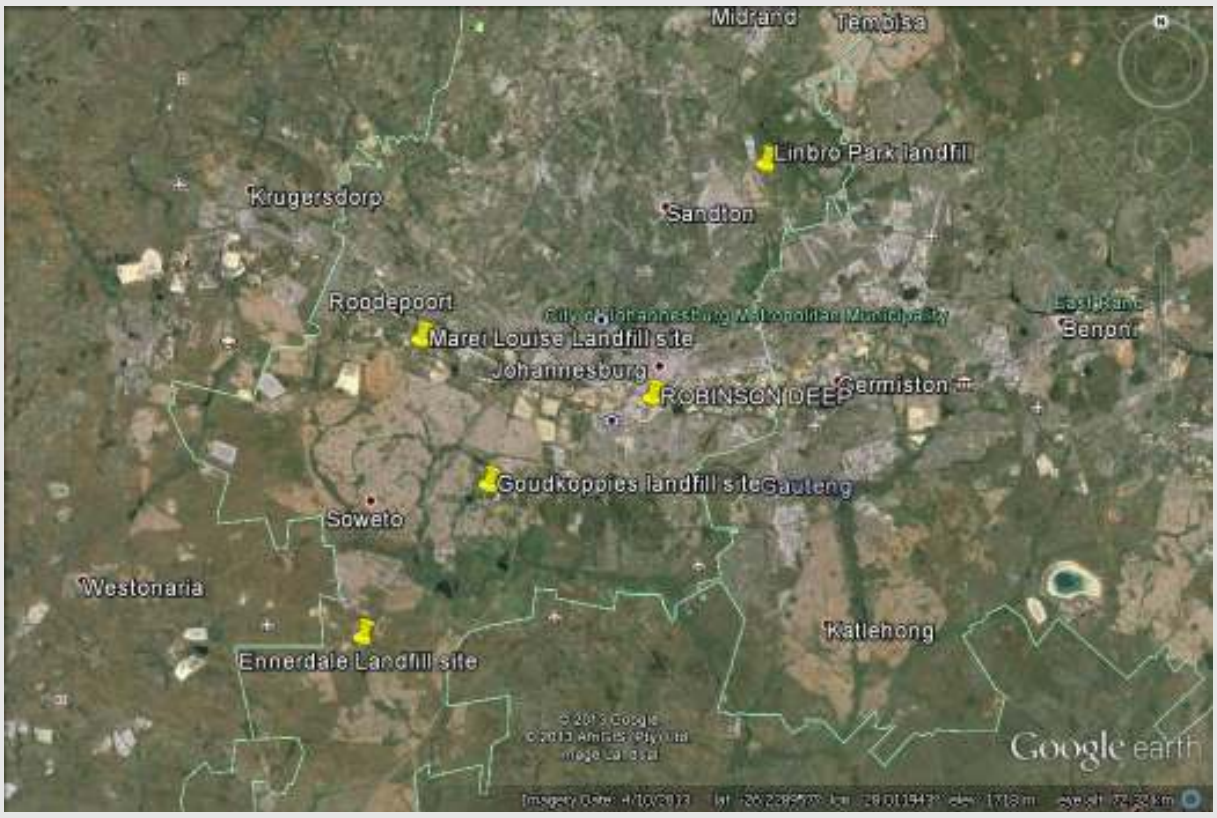


Figure 2 Map of Johannesburg with site markers.

Name of Site	Address	GPS Coordinates
Linbro Park	Marlboro Drive, Sandton, Johannesburg.	*26° 05' 41.85" S 28° 07' 13.43" E*
Marie Louise	Dobsonville Drive, Roodepoort, Johannesburg	*26° 11' 23.89" S 27° 53' 00.13" E*
Robinson Deep	Turffontein Road, Turffontein, Johannesburg.	*26° 13' 59.03" S 28° 02' 14.77" E*
Goudkoppies	Houthammer Road, Devland, Lenasia, Johannesburg	*26° 16' 52.31" S 27° 55' 24.93" E*
Ennerdale	Old Lawley Road, Lawley, Johannesburg	*26° 22' 07.78" S 27° 50' 02.80" E*

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party A (host) Republic of South Africa	ENER-G Systems Joburg PTY LTD (private entity)	No
Party B United Kingdom of Great Britain and Northern Ireland	Ecosecurities International Ltd (private entity)	No

A.4. Reference of applied methodology

The large scale methodology ACM0001 Version 11, adopted at EB47, "Consolidated baseline and monitoring methodology for landfill gas project activities" has been used in the project activity.

Furthermore, the project makes use of the following tools, which are referred to in ACM0001, ver. 11:

- "Tool for the demonstration and assessment of additionality"; Version 5.2, adopted at EB39 (hereafter also referred to as "Additionality tool")
- "Tool to determine project emissions from flaring gases containing methane"; Version 1, adopted at EB28.
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"; Version

01, adopted at EB 39.

- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"; Version 2, adopted at EB 41
- "Combined Tool to Identify Baseline Scenario and Demonstrate Additionality"; Version 2.2, adopted at EB 28
- "Tool to determine methane emissions avoided from disposing waste at a solid waste disposal site"; Version 04, adopted at EB 41.
- "Tool to calculate the emission factor for an electricity system"; Version 1.1, adopted at EB 35.

A.5. Crediting period of project activity

The project is registered for three renewable crediting periods of seven years each. The start date for the first crediting period is 12/11/2012.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

ENER-G Systems Joburg has secured the rights to develop landfill gas utilisation projects on five of the City of Joburg landfill sites. To date ENER-G Systems Joburg has installed and commission gas collection and flaring systems at two of the five sites. These initial flare projects have been constructed on the Robinson Deep landfill site and the Marie Louise landfill sites and were commissioned on 27 May 2011 and 04 May 2012 respectively. The sites consist of a gas extraction wells and a reticulation system that conveys the landfill gas to an equipment compound that houses the flaring equipment that combusts the landfill gas in an enclosed high temperature flare. To date no electricity generation has been installed as a buyer for the resultant power is in the process of being contracted. The balance of the sites will be constructed as indicated in the table reflected in section A1 above . Below is a diagram (diagram 1 Project Schematic) that shows the schematic of the project.

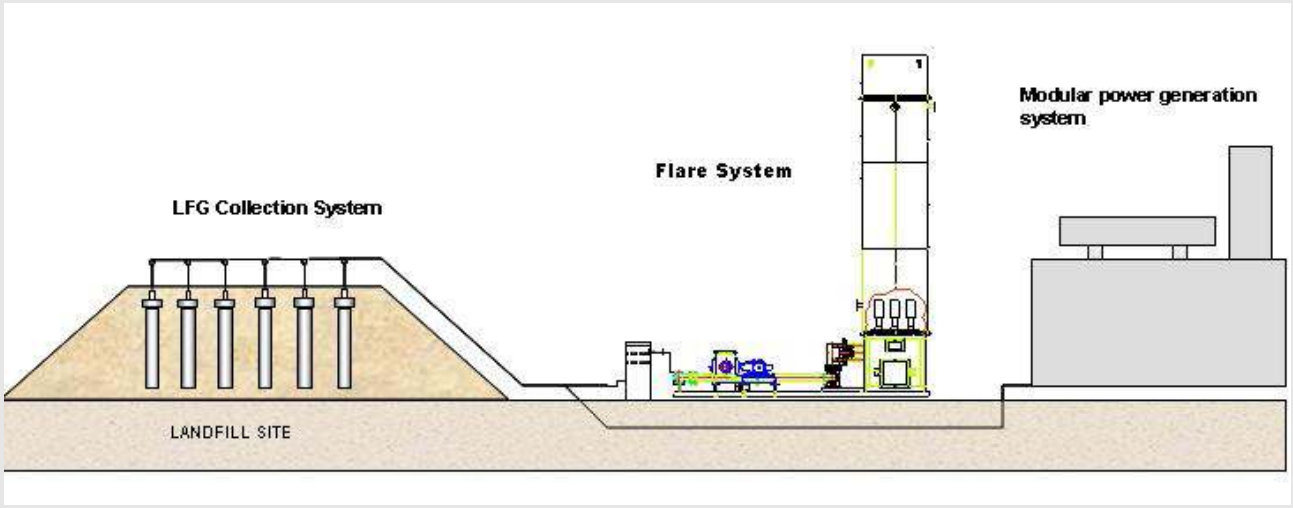


Diagram 1. Project Schematic.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

None for this monitoring period.

B.2.2. Corrections

No corrections required.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

None for this monitoring period.

B.2.4. Changes to project design of registered project activity

No notification or request of approval of changes from the project activity as described in the registered CDM-PDD has been made during this monitoring period.

B.2.5. Changes to start date of crediting period

No change.

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable.

SECTION C. Description of monitoring system

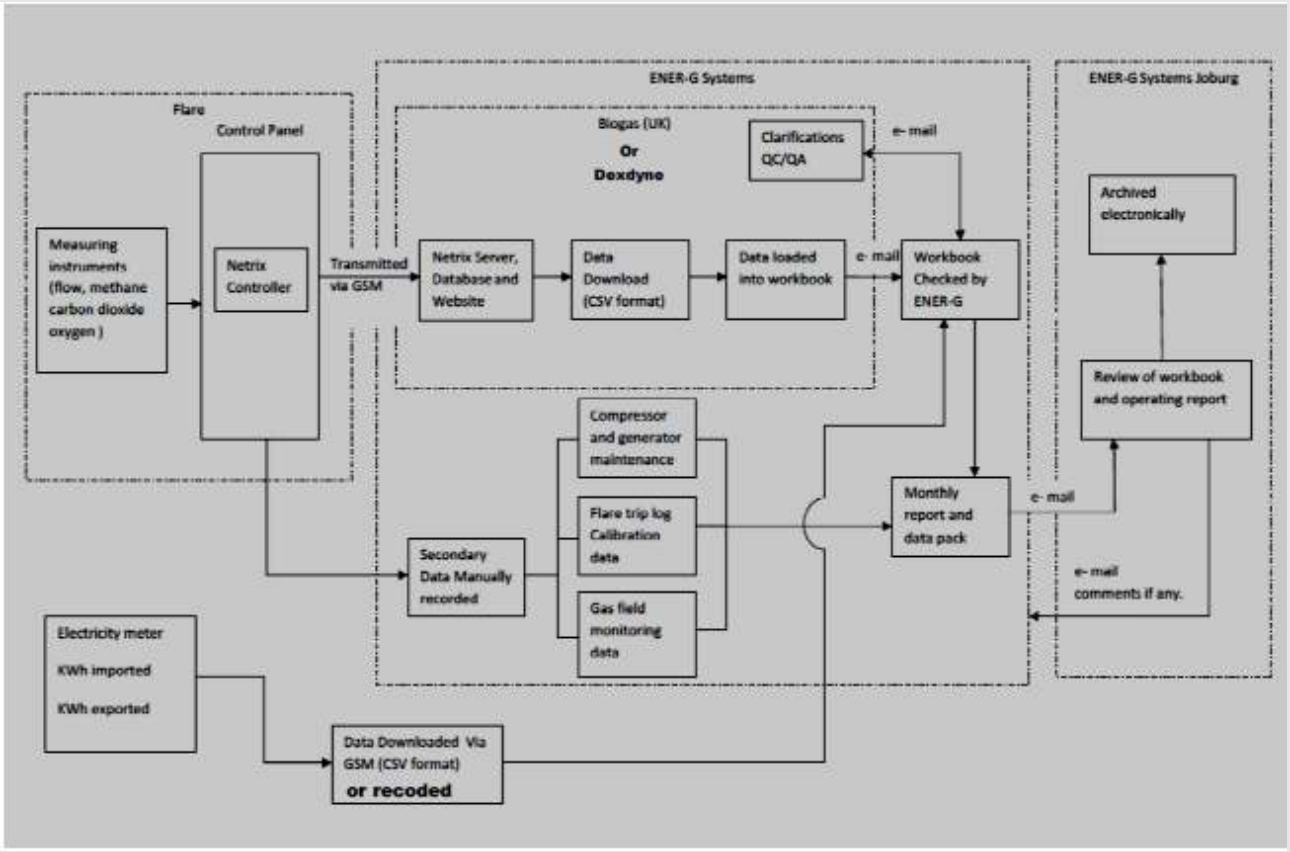
The monitoring system consists of total flow, flare flow and electricity flow meters that record the flow of landfill gas extracted from the site and conveyed to the flare and generators in Nm^3/h. The landfill gas is then analysed by a fixed gas analyser that measures the concentration of methane in the landfill gas. The gas is then combusted in a high temperature enclosed flare and the combustion temperature is monitored to ensure that the methane gas is combusted at a suitable temperature. All of the above measurements are recorded and transmitted via telemetry every 30 minutes to a central database where the raw data is stored in CSV (comma separated Values) format available for down load.

The data is downloaded monthly and compiled into a workbook were the raw data is used to calculate the number of emission reductions achieved by the flare by applying the approved calculations as detailed in the PDD.

The monthly reports are then reviewed and stored electronically by the operations manager and the general manager.

The workbooks only provide the electronic data for the methane destroyed by the projects activities. Other parameters are also recorded but are documented manually such as the projects emissions from fuel consumed or electricity consumed. This data is then included in the monitoring periods consolidated workbook that takes into account both emission reductions from the project activity and the project emissions and established the net reduction in tCO2e.

Below is a diagrammatic flow chart showing the flow of data from each site for the project.



Quality assurance

The data is compiled into a monthly workbook which collects the data and calculates the volume of CERs produced from the project activity. This data is reviewed for consistency and details of the plants' operations over the month. This data and the trip sheets are used to compile a brief monthly report that documents the sites performance and plant availability but also highlights any challenges being faced by the project. Internal auditing takes place every six months and an audit report is compiled and circulated for corrective action and filing.

Staff Training

ENER-G Systems embarks on continuous site based training that included induction training and CDM training when a new staff member joins the team and hands on technical training on a regular basis to enhance site based skills and knowledge. Training is very targeted and focussed on the individual areas of involvement and is recoded in a sheet titled on the Job Training and this signed off by the trainer and trainee.

Role and Responsibilities

Position and Respective Person	Responsibilities	Authorities
ENER-G Systems Joburg Process Operations Manager (Tony Cummings)	Overall responsibility for the landfill gas system. Overall responsibility for the Quality Management System for the landfill gas data collec-	Manages resources for operation of the landfill gas system

	tion system. Reviews performance data on landfill gas system Stores and archives data received for ENER-G Systems Joburg Robinson Deep and Marie Louise CDM projects.	
Ener-G Systems General Manager (David Cornish)	Overall responsibility for managing the projects and implementing the systems.	Manages resources for the system.
Ener-G Systems Site Technician Nhlahla Sepatake – RD Elleck Mkhari - RD Musa Mbombi - ML Tshimangadzo Manngo – ML	Day-to-day operation of the landfill gas system and flare maintenance and calibration of site instruments.	Controls the landfill gas system and flare
Data Controller- Tony Cummings	Reviews and compares primary data and secondary data from flare system. Prepares monthly workbook and submits to Ener-G Systems General Manager. Reviews comments.	Compile data into the monthly workbook.
Dexdyne is an automated data collection system	Responsible for data collection. Allows ENER-G Systems and Biogas access to down load the raw data collected from the sites.	Management and archiving of the raw data.

Emergency Procedures

A copy of our emergency procedures document for each of the sites has been provided which cover the procedure for shutting down the plant in the event of an emergency and reporting to an emergency evacuation point located on the site. The procedure further outlines the procedure for notifying the relevant line managers and site operators of the event and refers to the relevant incident report documents to be completed.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	Regulatory requirements relating to landfill gas projects
Unit:	-
Description:	Regulatory requirements relating to landfill gas projects
Source of data:	Draft 'Minimum Requirements for Waste Disposal by Landfill', Department of Water Affairs & Forestry, 2005, and Landfill Permits for all Landfill Sites.
Value(s) applied):	The National Environmental Management Act - Waste Act

Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**GWP_{CH4}**
unit:	tCO_2e/tCH_4
Description:	Global Warming Potential of methane
Source of data:	IPCC
Value (s) applied):	21
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	This parameter is also referred to in the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" Version 04, adopted at EB 41.

Data / Parameter:	**D_{CH4}**
unit:	tCH_4/m^3CH_4
Description:	Methane Density
Source of data:	ACM0001, Version 11
Value (s) applied):	0.0007168
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**$TDL_{j,y}$**
Unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*.
Source of data:	Eskom published annual report
Value(s) applied:	2012- 2013 year 9.1%
Purpose of data:	An input value used in the calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**$BE_{CH4,SWDS,y}$**
unit:	tCO_2e
Description:	Methane generation from the landfill in the absence of the project activity at year *y*
Source of data:	*Calculated as per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" Version 04, adopted at EB 41*
Value (s) applied):	*ex-ante* estimate: 479,133 tCO2e (annual average over 1st crediting period)
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	$CEF_{elec,BL,y}$
unit:	tCO_2/MWh
Description:	Carbon dioxide emission factor of grid electricity
Source of data:	*"Tool to calculate emission factor for an electricity system"; Version 1.1, adopted at EB 35.*
Value (s) applied):	0.977
Purpose of Data:	An input value used in the calculation of project emissions or actual net GHG removals by sinks
Additional comment:	Note that $CEF_{elec,BL,y}$ = $EF_{EL,i,y}$ from *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" and* $EF_{grid,CM,y}$ from *"Tool to calculate the emission factor for an electricity system";* Version 1.1, adopted at EB 35.

Data / Parameter:	$FC_{i,m,y}$
Data unit:	T
Description:	Amount of fossil fuel type *i* consumed by the group of power units *m* in year *y* (mass or volume unit)
Source of data used:	Eskom (South African electricity supply company) NERSA (National Electricity Regulator South Africa), Latest Electricity Supply Statistics
Value applied:	See Annex 3
Purpose of Data:	An input value used in the calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	See Annex 3
Purpose of Data:	An input value used in the calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	See Annex 3
Purpose of Data:	An input value used in the calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant / unit *m* in year *y*
Source of data used:	Eskom (South African electricity supply company) NERSA (National Electricity Regulator South Africa), Latest Electricity Supply Statistics
Value applied:	See Annex 3
Purpose of Data:	An input value used in the calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**Φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	Taken from the "*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"* Version 04, adopted at EB 41.
Value applied:	0.9
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	"*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"* Version 04, adopted at EB 41
Value applied:	0.1
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Purpose of Data:	An input value used in the calculation of project emissions or actual net GHG removals by sinks
Additional comment:	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.

Data / Parameter:	DOCf
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

Data / Parameter:	MCF
Data unit:	-
Description:	Methane Correction Factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	1.0
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter:	DOCj
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*.
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	The following values for the different waste types *j* are applied:
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	The values applied are for wet waste.

Waste type *j*	DOC_j (% wet waste)
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

Data / Parameter:	k_j
Data unit:	-

Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	

Waste type *j*		Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40

Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	The values applied are for Boreal & temperate (MAT< 20°C) and dry (MAP < 1000mm) conditions. Proof of the Climate data for Johannesburg from the South African Weather Service will be provided to the Validator upon request.

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	ACM0001
Value applied:	0
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

Data / Parameter:	**W_x**
Data unit:	Tons
Description:	Total amount of organic waste in year x (tons)
Source of data used:	Landfill Operator
Value applied:	3,720,393 tons[1]
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	This is determined once ex-ante for the purpose of estimating

[1] This value is only illustrative for the purposes of estimating ex- ante emission reductions.

	emission reductions.

Data / Parameter:	$\eta_{flare,h}$
Data unit:	-
Description:	Flare efficiency in the hour *h*
Source of data used:	*"Tool to determine project emissions from flaring gases containing methane" ; Version 1, adopted at EB28.*
Value applied:	90%
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment:	This is used for the purposes of estimating ex-ante emission reductions

Data / Parameter:	$COEF_{i,j}$
Data unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of fuel type *i* in year y
Source of data to be Used:	Calculated using Option B in the *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" ; Version 2, adopted at EB 41*
Value applied:	3.24
Purpose of Data:	Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comment:	This parameter will only be used if and when there is fossil fuel consumption. Fossil fuel consumption will be monitored as stated in section 7.1.

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ per mass or volume unit
Description:	Weighted average net calorific value of fuel type *i* in the year *y*
Source of data to be used:	IPCC default values as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value applied:	0.0433 TJ/t
Purpose of Data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	This parameter will only be used if and when there is fossil fuel consumption. Fossil fuel consumption will be monitored as stated in section 7.1.

Data / Parameter:	$EFCO_{2,i,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of fuel type *i* in the year *y*
Source of data to be used:	IPCC default values as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value applied:	74.8 tCO_2/TJ
Purpose of Data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	This parameter will only be used if and when there is fossil fuel consumption. Fossil fuel consumption will be monitored as stated in section 7.1.

D.2. Data and parameters monitored

Data / Parameter:	$\eta_{flare,h}$
Unit:	-
Description:	Flare efficiency in the hour *h*
Measured/ Calculated / Default	Operational parameters are monitored and measured continuously and recorded every 30 minutes. This data is then used to establish if the flares operations comply with the guidelines outlined in the tool and the OEM specifications.
Source of data:	Flare
Value(s) of monitored parameter:	The project has opted for the default value of 90% based on the plant compiling with the operational parameters and the tool.
Monitoring equipment:	Flare T_{flare} thermocouple mounted in the flare stack, $LFG_{flow,}$ W_{ch4} and operational time recorded in the workbook reflecting with the data collected.
Measuring/ Reading/ Recording frequency:	Monitored and measured continuously and recorded every thirty minutes.
Calculation method (if applicable):	ACM 0001, The flare continuously monitors the temperature, flow rate and methane concentrations to ensure that the flare operates within the manufacturers specifications and above the limits set in the tool. Should this not be achieved the flare will trip/shutdown. The measured data is recorded every 30 minutes and this data is used to check that the flare has indeed operated for a full hour above the limits established in the tool. If all these parameters are complied with, then workbook allocates a flare efficiency of 90%.
QA/QC procedures:	Calculation is checked at verification
Purpose of data:	Calculation of project emissions ;
Additional comment:	

Data / Parameter:	$LFG_{total,y}$

Unit:	Nm^3
Description:	Total amount of landfill gas captured at Normal Temperature and Pressure
Measured/ Calculated / Default:	Measured
Source of data:	Flow meters
Value(s) of monitored parameter:	For the period 3,750,839.6 Nm^3
Monitoring equipment:	For Robinson Deep Thermal Mass flow meters Type : E&H Proline T mass 65F Serial No: E2110C02000 Accuracy:<3% Calibration frequency: every three years as per manufacturer's specifications. 1st calibration date02/03/2011 Valid from 27/05/2011 to 26/05/2014 as per manufacturer's specifications. Please note that manufacturer stipulates that although the instrument was calibrated on a certain date the validity of the calibration remains valid for the first three years of operation from the date of use and not the date of calibration. For Marie Louise Thermal Mass flow meters Type : E&H Proline T mass 65F Serial No: E704AF02000 Accuracy:<3% Calibration frequency: every three years as per manufacturer's specifications. 1st calibration date 13/11/2011 Valid from 04/05/2012 to 03/05/2015 as per manufacturer's specifications. Please note that manufacturer stipulates that although the instrument was calibrated on a certain date the validity of the calibration remains valid for the first three years of operation from the date of use and not the date of calibration.
Measuring/ Reading/ Recording frequency:	The flow meter will express gas flow in normalized cubic meters, and is recorded every 30 minutes.
Calculation method (if applicable):	N/A
QA/QC procedures:	Meters are subject to routine maintenance and calibration as per the manufacturers specification and data is archived electronically
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks

Additional comment:	The flow meter will express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of LFG is necessary. $LFG_{electricity}$ =0, therefore LFG_{flare}=LFG_{total}

Data / Parameter:	**$LFG_{flare,y}$**
Unit:	Nm^3
Description:	Total amount of landfill gas captured at Normal Temperature and Pressure and flared
Measured/ Calculated / Default:	Measured
Source of data:	Flow meters
Value(s) of monitored parameter:	For the period 3,750,839.6 Nm^3

Monitoring equipment:	For Robinson Deep Thermal Mass flow meters Type : E&H Proline T mass 65F Serial No:E2110D02000 Accuracy:<3% Calibration frequency: every three years as per manufacturer's specifications. 1st calibration date 02/03/2011 Valid from 27/05/2011 to 26/05/2014 as per manufacturer's specifications. Please note that manufacturer stipulates that although the instrument was calibrated on a certain date the validity of the calibration remains valid for the first three years of operation from the date of use and not the date of calibration. For Marie Louise Thermal Mass flow meters Type : E&H Proline T mass 65F Serial No: E704B102000 Accuracy:<3% Calibration frequency: every three years as per manufacturer's specifications. 1st calibration date 13/11/2011 Valid from 04/05/2012 to 03/05/2015 as per manufacturer's specifications. Please note that manufacturer stipulates that although the instrument was calibrated on a certain date the validity of the calibration remains valid for the first three years of operation from the date of use and not the date of calibration.
Measuring/ Reading/ Recording frequency:	The flow meter will express gas flow in normalized cubic meters, and is recorded every 30 minutes.
Calculation method (if applicable):	N/A
QA/QC procedures:	Meters are subject to routine maintenance and calibration as per the manufacturers specification and data is archived electronically
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	The flow meter will express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of LFG is necessary.

Data / Parameter:	**$LFG_{Electricity,y}$**
Unit:	Nm^3

Description:	Amount of LFG combusted in power plant at Normal Temperature and Pressure	
Measured/ Calculated / Default:	Measured	
Source of data:	Flow meters	
Value(s) of monitored parameter:	0	
Monitoring equipment:	For Robinson Deep Thermal Mass flow meters Type : E&H Proline T mass 65F Serial No:E2110B02000 Accuracy:<3% Calibration frequency: every three years as per manufacturer's specifications. 1st calibration date 02/03/2011 Valid from 27/05/2011 to 26/05/2014 as per manufacturer's specifications. Please note that manufacturer stipulates that although the instrument was calibrated on a certain date the validity of the calibration remains valid for the first three years of operation from the date of use and not the date of calibration. For Marie Louise Thermal Mass flow meters Type : E&H Proline T mass 65F Serial No: E704B002000 Accuracy:<3% Calibration frequency: every three years as per manufacturer's specifications. 1st calibration date 12/11/2011 Valid from 04/05/2012 to 03/05/2015 as per manufacturer's specifications. Please note that manufacturer stipulates that although the instrument was calibrated on a certain date the validity of the calibration remains valid for the first three years of operation from the date of use and not the date of calibration.	
Measuring/ Reading/ Recording frequency:	The flow meter will express gas flow in normalized cubic meters, and is recorded every 30 minutes.	
Calculation method (if applicable):	N/A	
QA/QC procedures:	Meters are subject to routine maintenance and calibration as per the manufacturers specification and data is archived electronically	
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks	

Additional comment:	No power generation is installed at the sites at this stage and therefore a value of zero have been taken.

Data / Parameter:	**$PE_{flare,y}$**
Unit:	tCO_2e
Description:	Project emissions from flaring of the residual gas stream in year *y*
Measured/ Calculated / Default:	Measures and Calculated
Source of data:	Measured and Calculated
Value(s) of monitored parameter:	$PE_{flare\ total}$ = 295.23 $PE_{flare\ Robinson\ Deep}$ = *215.7* $PE_{flare\ Marie\ Louise}$ = *74.62*
Monitoring equipment:	Refer to Tflare and WCH4
Measuring/ Reading/ Recording frequency:	Monitored continuously and recorded every 30 minutes
Calculation method (if applicable):	Calculated as per the '*Tool to determine project emissions from flaring gases containing Methane*" ; Version 1, adopted at EB28.
QA/QC procedures:	Instruments and the flare are subject to routine maintenance and calibration as per the manufacturers specification and data is archived electronically
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	

Data / Parameter:	**w_{CH4}**
Unit:	Nm^3CH_4 / Nm^3LFG
Description:	Methane fraction in the landfill gas
Measured/ Calculated / Default:	Measured
Source of data:	Gas analyzer installed on each flare at each site.
Value(s) of monitored parameter:	Average for both sites 49.9% Average for Robinson Deep 50.7% Average for Marie Louise 49.4%

	Monitoring equipment:	Robinson Deep Trolex Serial No: BG 10931-inlet -GA Maximum Drift:+-0.05%/month Repeatability/Accuracy +-0.1% Calibration frequency: Monthly 1st calibration cert valid from 27 May 2011. The instrument is calibrated regularly utilizing a certified span gas on site until the unit is no longer able to be calibrated on site. Should the instrument not be able to be calibrated then the instrument is replaced. Hi Tech GIR 5000 gas analyzer Serial no: I - 05007 Stability:< 2% per month Resolution/Accuracy: +-0.5% Calibration frequency: Monthly 1st calibration on 25 January 2013 The instrument is calibrated regularly utilizing a certified span gas on site until the unit is no longer able to be calibrated on site. Should the instrument not be able to be calibrated then the instrument is replaced. Marie Louise Trolex Serial No: 017976 Maximum Drift:+-0.05%/month Repeatability/Accuracy +-0.1% Calibration frequency: Monthly 1st calibration Date 5 May 2012 Calibrated regularly utilizing a certified span gas on site until the unit is no longer able to be calibrated on site. Should the instrument not be able to be calibrated then the instrument is replaced.
	Measuring/ Reading/ Recording frequency:	Measured continuously and recorded every 30 minutes via telemetry.
	Calculation method (if applicable):	NA

QA/QC procedures:	Instruments are subject to routine maintenance and calibration as per the manufacturers' specification to ensure accuracy. The data and the maintenance and calibration records are archived and made available to the verifiers. Robinson Deep

Span gas composition in %:	**60%**	**40%**	**0**	**YEAR – 2013**					
Date	gas concentration read on span gas before calibration			gas concentration read on span gas after calibration					Calibrated by
Calibration needs to be done **weekly**	CH4	CO2	O2	CH4	CO2	O2	ERROR CH4 %	ERROR CO2 %	
04/01/13									
11/01/13									
17/01/13	New Instrument			60.0	40.0	0.9	0.0	0.0	E.M./T.C.
25/01/13	60.2	40.0	1.8	60.0	40.0	1.7	0.2	0.0	E.M./T.C.
01/02/13	59.6	40.5	1.9	60.0	40.0	1.8	0.4	0.5	E.M.
11/02/13	60.5	40.2	1.9	60.0	40.0	1.9	0.5	0.2	E.M.
14/02/13	60.0	40.1	2.0	60.0	40.0	1.9	0.0	0.1	E.M.
22/02/13	59.8	38.7	2.2	60.0	40.0	2.1	0.2	1.3	E.M.
04/03/13	60.3	39.8	0.8	60.0	40.0	0.8	0.3	0.2	E.M.
11/03/13	60.1	40.6	0.5	60.0	40.0	0.6	0.1	0.6	E.M./T.C.
15/03/13	60.0	40.3	0.5	60.0	40.0	0.5	0.0	0.3	E.M.
25/03/13	59.4	39.8	0.8	60.0	40.0	0.8	0.6	0.2	E.M.
04/04/13	60.5	40.1	0.9	60.0	40.0	0.8	0.5	0.1	E.M./T.C.
12/04/13	60.2	40.6	0.7	60.0	40.0	0.7	0.2	0.6	E.M.
18/04/13	60.6	39.8	0.9	60.0	40.0	0.9	0.6	0.2	E.M.
26/04/13	60.2	40.5	0.6	60.0	40.0	0.6	0.2	0.5	E.M.
03/05/13	60.8	39.7	0.7	60.0	40.0	0.7	0.8	0.3	E.M.
10/05/13	59.4	40.0	0.8	60.0	40.0	0.8	0.6	0.0	E.M.
17/05/13	60.3	40.7	0.7	60.0	40.0	0.7	0.3	0.7	E.M.
28/05/13	59.4	40.3	0.8	60.0	40.0	0.8	0.6	0.3	E.M.

Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

Data / Parameter:	**EL_{LFG}**

Unit:	MWh
Description:	Net amount of electricity generated using LFG
Measured/ Calculated / Default:	Project Developer
Source of data:	Site electricity meter
Value(s) of monitored parameter:	0
Monitoring equipment:	NA still to be installed
Measuring/ Reading/ Recording frequency:	Continuously and archived.
Calculation method (if applicable):	NA
QA/QC procedures:	Instruments are subject to routine maintenance and calibration as per the manufacturers' specification to ensure accuracy.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	There is no data for this parameter as the power generation component of this project is still to be installed.

Data / Parameter:	**Operation of the energy plant**
Unit:	Hours
Description:	Operation of the energy plant in a year *y*
Measured/ Calculated / Default:	Project Developer
Source of data:	Generator
Value(s) of monitored parameter:	0
Monitoring equipment:	NA still to be installed
Measuring/ Reading/ Recording frequency:	Continuously and archived.
Calculation method (if applicable):	NA
QA/QC procedures:	Instruments are subject to routine maintenance and calibration as per the manufacturers' specification to ensure accuracy.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	There is no data for this parameter as the power generation component of this project is still to be installed.

Data / Parameter:	**$PE_{EC,y}$**
Unit:	tCO_2
Description:	Project emissions from electricity consumption by the project activity during the year *y*
Measured/ Calculated / Default:	Calculated as per the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" ; Version 01, adopted at EB 39.*
Source of data:	Electricity supply meter and default values established at validation
Value(s) of monitored parameter:	Total PE_{ec}= 54 Robinson Deep PE_{ec}= 43 Marie Louise PE_{ec}= 11
Monitoring equipment:	Electricity meter: Type: Transformer Part No: CBI- EC330CM Accuracy: class 1 Calibration: Calibration not required Solid state instrument Robinson Deep Type: Transformer Part No: DEM024SJ Accuracy: class B Calibration: Calibration not required solid state instrument Marie Louise
Measuring/ Reading/ Recording frequency:	Continuously, recorded and archived.
Calculation method (if applicable):	NA
QA/QC procedures:	Instruments are subject to routine maintenance and calibration as per the manufacturers' specification to ensure accuracy.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	

Data / Parameter:	**$PE_{FC,j,y}$**
Unit:	tCO_{2e}
Description:	Project emissions from fossil fuel combustion in fossil fuel based generators during the year *y*
Measured/ Calculated / Default:	Calculated as per the "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" ; Version 2, adopted at EB 41*
Source of data:	NA
Value(s) of monitored parameter:	0

Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	As no standby generators are used at this stage there is no measurement of fuel as none is being used.

Data / Parameter:	**T_{flare}**
Unit:	˚C
Description:	Temperature in the exhaust gas of the flare
Measured/ Calculated / Default:	Measured
Source of data:	Type N Thermocouples installed in the flare stack to measure the combustion temperature.
Value(s) of monitored parameter	Average for Robinson Deep T_{flare}= 987.0 °C Average for Marie Louise T_{flare}= 849.1 °C
Monitoring equipment:	Robinson Deep Type N thermocouple Serial No: Part number T1TECNSX60 Accuracy:+-0.75% (333°C-1200°C) Calibration: Functionality test at least annually Marie Lousie Type N thermocouple Serial No: Part number T1TECNSX60 Accuracy:+-0.75% (333°C-1200°C) Calibration: Functionality test at least annually
Measuring/ Reading/ Recording frequency:	Measured continuously and recorded every 30 minutes via telemetry.
Calculation method (if applicable):	NA
QA/QC procedures:	The thermocouple will be subject to exchange or calibration at least on an annual basis to ensure accuracy.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

Data / Parameter:	Other Flare operational Parameters
Unit:	-
Description:	Temperature in the exhaust gas of the flare
Measured/ Calculated / Default:	Measured and calculated
Source of data:	Raw data from site
Value(s) of monitored parameter:	700°C< Tcomp<1200°C Tflare<*1200*°C *w*CH4 >25% v/v
Monitoring equipment:	Refer to Tflare and wCH4 above for monitoring equipment specification
Measuring/ Reading/ Recording frequency:	Measured continuously and recorded every 30 minutes via telemetry.
Calculation method (if applicable):	*"Tool to determine project emissions from flaring gases containing methane"; Version 1, adopted at EB28.*
QA/QC procedures:	The thermocouples are maintained according to the manufacturers specification and are subjected to routine functionality test. These are recorded and archived.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	

Data / Parameter:	$EC_{PJ,i.y}$
Unit:	MWh
Description:	Onsite consumption of electricity attributable to the project activity during the year *y*
Measured/ Calculated / Default:	Measured using electricity meters and data will aggregated annually.
Source of data:	Electricity supply meter installed at each site.
Value(s) of monitored parameter:	Robinson Deep = 40MWh Marie Louise = 10MWh

Monitoring equipment:	Electricity meter: Type: Transformer Part No: CBI- EC330CM Accuracy: class 1 Calibration: Calibration not required Solid state instrument Robinson Deep Type: Transformer Part No: DEM024SJ Accuracy: class B Calibration: Calibration not required solid state instrument Marie Louise
Measuring/ Reading/ Recording frequency:	Measured continuously, recorded monthly.
Calculation method (if applicable):	NA
QA/QC procedures:	Instruments are subject to regular maintenance and testing as per the manufacturers' specification to ensure accuracy.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	

Data / Parameter:	**$FC_{i,j,y}$**
Unit:	Tonns
Description:	Amount of diesel combusted to meet power requirements of project
Measured/ Calculated / Default:	Diesel will be supplied from tanks and ruler gauges will be used to determine volume of diesel consumed.
Source of data:	Project Developer
Value(s) of monitored parameter:	Robinson Deep = 0 Marie Louise = 0
Monitoring equipment:	None
Measuring/ Reading/ Recording frequency:	Measured.
Calculation method (if applicable):	NA
QA/QC procedures:	The ruler gauges will be part of the tank and calibrated at least once a year. The metered fuel consumption quantities may be cross-checked against purchase invoices (if available).
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks;
Additional comment:	No Diesel was used in this monitoring period.

D.3. Implementation of sampling plan

Not applicable – sampling approach is not used.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

BEy = (MDproject,y – MDBL,y) * GWPCH4 + (ELLFG,y . CEFelec,BL,y)

BEy Baseline emissions in year *y* [tCO2e];

Amount of methane that would have been destroyed/combusted during year *y*, in the project scenario [tCH4];

Amount of methane that would have been destroyed/combusted during year *y* in the absence of the project due to regulatory and/or contractual requirements [tCH4]; This is 0 as per approved PDD for the first commitment period.

GWPCH4 Global Warming Potential value for methane [tCO2e]

Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an on-site/off-site fossil fuel based captive power generation, during year *y* [MWh];

CEFelecy,BL,y CO2 emissions intensity of the baseline source of electricity displaced [tCO2e/MWh].

Therefore BEy = (MDproject,y - 0) * (21 + 0 * 0.977)

BEy = (MDproject,y)*(21)

MDproject,y = MDflared,y + MDelectricity, y

MDelectricty ,y = 0 as there was no electricity generation during this monitoring period.

Therefore

MDproject,y = MDflared,y

MDflared,y = (LFGflare,y * wCH4,y*DCH4) – (PEflare,y / GWPCH4)

All of the above calculations are contained in the monthly workbooks Refer to Workbooks (Robinson Deep -Flare Data and Marie Louise- Flare data). This data is then pulled through into a consolidated workbook titled “Consolidated Workbook 2013” were the accumulated number of CERs is reflected, refer to file Verification documents 2013.

BEy = 28360*

***As per calculation in the ER workbook**

E.2. Calculation of project emissions or actual net GHG removals by sinks

PE*y* = PEEC,*y* + PEFC*,,j,y*

Where

PE_y	tCO_2/yr	Project emissions in year *y*;
$PE_{EC,y}$	tCO_2/yr	Emissions from consumption of electricity in the project case. The project emissions from electricity consumption $PE_{EC,y}$ will be calculated following the latest version of *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" defined in section B.2*.
$PE_{FCj,y}$	tCO_2/yr	The CO_2 emissions from fossil fuel combustion in case of grid failure during the year *y*. The project emissions from fossil fuel consumption $PE_{FC,y}$ will be calculated following the latest version of *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"* defined in section B.2.

As there is no standby generator at either of the sites there was no fuel consumed to provide standby electricity therefore:

PEFC*,,j,y* = 0

Therefore

PE*y* = PEEC,*y*

And

PE_{EC},y = Σ EC_{PJ},j,y * EF_{EL},j,y * (1 + TDLj,y)

Where

Parameter	**Unit**	**Description**
$PE_{EC,y}$	tCO_2/yr	Project emissions from electricity consumption by the project activity in year *y*;
$EC_{PJ,j,y}$	MWh	Quantity of electricity consumed by the project electricity consumption source j in year y = 50MW;
$EF_{EL,j,y}$	tCO_2/MWh	Emission factor for electricity generation for source j in year y (0.977 as per PDD);
$TDL_{j,y}$	-	Average technical transmission and distribution losses for providing electricity to source j in year y. Refer to attached document titled Eskom 2012 annual report (T & G Loss = 9.1%).

ECPJ,j,y was recorded by a new electricity meter installed at each of the sites and the total reading was taken and recorded by the site technician on a monthly basis.

PE_{EC},y = 50 * 0.977 * (1 + 9.1%)

PE_{EC},y = 54

E.3. Calculation of leakage

>>

As stated in the PDD no Leakage effects need to be taken into account in this methodology.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

ERy = BEy – PEEC,y

Therefore

ERy = 28360-54

ERy = 28306

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	28360	54	0	28306

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	60186 tCO2e From 12/11/2012 to 31/12/2012 159201 tCO2e From the 01/01/2013 to 30/04/2013	12/11/2012 to 31/12/2012 – 3038 CERs 01/01/2013 to 30/04/2013 - 25268 CERs

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

As the project is still in the development phase and two of the five sites have completed the construction of phase one of their gas collection systems, the volume of emission reductions is lower than that expected when compared to when all the sites will be flaring landfill gas with full gas collections systems installed. We also constructed one of the sites in anticipate on the project being registered earlier and this has produced a significant volume of VERs prior to the actual registration date.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	3038	25268

- - - -

Annex 3

1. **Grid Emission Factor of the South African Electricity Grid** (Please see attached Grid Emission Factor Calculation)

Plant name and type	Fuel	OM plant?	2004 BM plant? (1=yes)	2005 BM plant?	Date of commission	Licensed capacity (MW)	Net energy sent out MWh 2002	2003	2004	2005	Fossil fuel consumption (various units - see separate column) 2002	2003	2004	2005	Unit
Grand Total						43 034	204,511,108	219,198,686	226,393,919	226,343,226	173,221	178,408	184,716	187,998	
Eskom generation						39 810	196,067,796	210,218,785	217,919,213	217,754,872	93,823	96,460	104,370	109,898	
Coal fired stations		1				35 607	181,749,299	194,046,490	203,564,592	206,605,894	93,823	96,460	104,370	109,898	
Arnot	Coal	1			1971/09/21	1 980	11,974,764	14,135,237	13,032,188	11,798,514	5,595	5,799	6,655	6,609	*kt*
Camden	Coal	1		1	2005-2006	1 520				768,108	-	-	-	390	*kt*
Duvha	Coal	1			1980/01/18	3 450	23,320,444	21,384,335	25,450,613	25,034,970	10,560	10,682	9,989	11,908	*kt*
Grootvlei	Coal	1			1969/06/30	1 130				-	-	-	-	-	*kt*
Hendrina	Coal	1			1970/05/12	1 895	12,752,987	12,329,325	12,037,179	12,513,689	6,475	6,551	6,432	6,644	*kt*
Kendal	Coal	1			1988/10/01	3 840	26,006,905	27,820,202	27,005,053	26,897,931	13,518	14,156	15,746	15,430	*kt*
Komati	Coal	1			1969/06/30	891	-	-	-	-	-	-	-	-	*kt*
Kriel	Coal	1			1976/05/06	2 850	19,165,265	18,347,304	19,866,814	20,120,150	10,033	10,020	9,307	9,297	*kt*
Lethabo	Coal	1	1	1	1985/12/22	3 558	22,019,627	23,505,543	22,807,524	24,041,645	15,309	15,368	16,410	17,042	*kt*
Majuba	Coal	1	1	1	1996/04/01	3 843	4,600,976	10,015,560	12,539,663	17,170,166	2,593	2,370	5,539	6,363	*kt*
Matimba	Coal	1	1	1	1987/12/04	3 690	25,145,393	26,510,802	26,894,454	28,401,085	12,362	12,960	13,803	13,786	*kt*
Matla	Coal	1			1979/09/29	3 450	25,577,292	25,802,219	25,673,648	23,938,437	12,884	12,924	13,169	13,445	*kt*
Tutuka	Coal	1	1		1985/06/01	3 510	11,185,646	14,195,963	18,257,456	15,921,199	4,493	5,629	7,320	8,984	*kt*
Gas turbine stations		1				342	-	341	350	77,942					
Acacia	Kerosene	1			1976/05/13	171	[redacted]	299	305	47,848	7	18	43	17,488	*kl = m3*
PortRex	Kerosene	1			1976/09/30	171		42	45	30,094	1	106	17	10,999	*kl = m3*
Hydro power stations		-				661	2,356,753	777,041	777,041	725,360					
Gariep	Hydro	-			1971/09/08	360	1,164,640	383,991	383,991	402,432	-	-	-	-	
Vanderkloof	Hydro	-			1977/01/01	240	1,192,113	393,050	393,050	322,928	-	-	-	-	
Colleywobbles(Mbashe)	Hydro	-				42	-	-	-	-	-	-	-	-	
First Falls	Hydro	-				6	-	-	-	-	-	-	-	-	
Second Falls	Hydro	-				11	-	-	-	-	-	-	-	-	
Ncora	Hydro	-				2	-	-	-	-	-	-	-	-	
Nuclear stations		-				1 800	11,961,744	12,662,591	13,365,123	11,292,654					
Koeberg	Nuclear	-			1984/07/21	1 800	11,961,744	12,662,591	13,365,123	11,292,654	-	-	-	-	
Pumped-storage stations		1				1 400	-	2,732,322	212,107	(946,978)					
Drakensberg	Hydro	1			1981/06/17	1 000	[redacted]	1,787,554	[redacted]	[redacted]	-	-	-	-	
Palmiet	Hydro	1	1	1	1988/04/18	400		944,768	212,107		-	-	-	-	
Municipal genera-						1 837	1,218,826	1,326,122	1,040,945	1,476,686	11,772	10,148	10,031	10,890	
Coal fired stations		1				1 323	1,201,006	1,038,433	1,027,337	1,110,036	11,685	10,104	9,996	10,800	
Athlone	Coal	1			n/a	180	76,596	76,596	10,230	(84)	745	745	100	(1)	*TJ*
Kroonstad	Coal	1				30					-	-	-	-	*TJ*
Swartkops	Coal	1				240					-	-	-	-	*TJ*
Bloemfontein	Coal	1			n/a	103	8,233	19,444	5,931	16,890	80	189	58	164	*TJ*
Orlando	Coal	1				300					-	-	-	-	*TJ*
Rooiwal	Coal	1			n/a	300	949,078	826,217	895,000	985,000	9,234	8,039	8,708	9,584	*TJ*
Pretoria West	Coal	1			n/a	170	167,099	116,176	116,176	108,230	1,626	1,130	1,130	1,053	*TJ*
Gas turbine stations		1				330	7,189	3,654	2,976	7,445	86	44	36	89	
Roggebaai	Kerosene	1			n/a	50	2,787	2,787	1,141	7,037	33	33	14	84	*TJ*
Athlone	Kerosene	1			n/a	40	867	867	1,827	229	10	10	22	3	*TJ*
Port Elizabeth	Kerosene	1			n/a	40		-	8	279	-	-	0	3	*TJ*
Johannesburg	Kerosene	1			n/a	176	3,535	-	-	(100)	42	-	-	(1)	*TJ*
Pretoria West	Kerosene	1				24					-	-	-	-	*TJ*
Hydro power stations		-				4	10,632	10,632	10,632	10,632	-	-	-	-	
Lydenburg	Hydro	-			n/a	2	6,000	6,000	6,000	6,000	-	-	-	-	
Ceres	Hydro	-			n/a	1	1,082	1,082	1,082	1,082	-	-	-	-	
Piet Retief	Hydro	-			n/a	1	3,550	3,550	3,550	3,550	-	-	-	-	
Pumped-storage stations		1				180	-	273,403	-	348,573	-	-	-	-	
Steenbras	Hydro	1			n/a	180	[redacted]	273,403	-	348,573	-	-	-	-	
Private generation						1 387	7,224,486	7,653,779	7,433,761	7,114,668	67,627	71,800	70,314	67,210	
Bagasse / coal fired stations		-				105	259,317	259,317	192,337	192,337	-	-	-	-	
Tongaat-Hulett Amatikulu	Bagasse-coal	-			n/a	12	26,781	26,781	26,781	26,781					
Tongaat Hulett - Darnall	Bagasse-coal	-			n/a	12	21,704	21,704	21,704	21,704					
Tongaat Hulett - Felixton	Bagasse-coal	-			n/a	32	66,510	66,510	66,510	66,510	(Assumed pure bagasse by conservativeness)				
Tongaat Hulett - Maidstone Mill	Bagasse-coal	-			n/a	29	67,397	67,397	67,397	67,397	=> Fossil fuel consumption = zero				
Transvaal Suiker Ltd	Bagasse-coal	-			n/a	20	76,925	76,925	9,945	9,945					
Coal fired stations		1				1 279	6,950,506	7,379,448	7,226,761	6,907,668	67,627	71,800	70,314	67,210	
Kelvin	Coal	1			n/a	540	1,721,353	1,721,353	1,568,666	1,568,666	16,748	16,748	15,263	15,263	*TJ*
Sasol Synth Fuels	Coal	1			n/a	600	4,421,074	4,738,677	4,738,677	4,606,484	43,016	46,106	46,106	44,820	*TJ*
Sasol Chem Ind	Coal	1			n/a	139	808,079	919,418	919,418	732,518	7,862	8,946	8,946	7,127	*TJ*
Hydro power stations		-				3	14,663	15,014	14,663	14,663	-	-	-	-	
Friedenheim	Hydro	-			n/a	3	14,663	15,014	14,663	14,663	-	-	-	-	

Calculation of fuel emission factors:				
	NCV GJ/t fuel	EF tCO2/TJ	Density t / m3	=> Emission factor
Coal	19.9	89.5		1.781 tCO2/t coal
Kerosene	42.4	70.8	0.804	2.414 tCO2/m3

Conversion factor:	277.78	MWh/TJ

Emission factors (tCO2/MWh)	**2004**	**2005**
OM	0.900	0.908
BM	0.950	0.951
CM	**0.925**	**0.930**

Sources and Assumptions made for the grid emission calculation

Sources:

1a/b/c/d. NERSA (2005/2006/2007/2008) Electricity supply statistics for South Africa 2002/2003/2004/2005 (brochures, with 2004 & 2005 electronic versions copied in tabs 1c, 1d)		
2. Eskom (2008) Website (http://www.eskom.co.za/live/content.php?Item_ID=4226)		
	%	i.e. MWhprod /TJcons
3a. Using CDM Tool default efficiency for old oil-fired gas turbines	30%	83.3
3b. Using CDM Tool default efficiency for old subcritical coal-fired plants	37%	102.8
4. IPCC (2006) Guidelines on National GHG Inventories, table 1.2 of Chapter 1 of Vol. 2 (Energy) Default values at the lower limit of the uncertainty at a 95% confidence interval		
5. Engineers Edge (2008) - See http://www.engineersedge.com/fluid_flow/fluid_data.htm		

Areas shaded: where net electricity sent out is negative, it is set to zero

Note: White and grey cells are for calculations

Document information

Version	*Date*	*Description*
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: issuance
Keywords: monitoring report, performance monitoring