Monitoring report form for CDM project activity
(Version 07.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Mare Chicose Landfill Gas Project	
UNFCCC reference number of the project activity	4359	
Version number of the PDD applicable to this monitoring report	Version 07.1 dated 02/10/2012	
Version number of this monitoring report	1.0	
Completion date of this monitoring report	14/09/2020	
Monitoring period number	Seventh Monitoring Period	
Duration of this monitoring period	01/01/2018 to 31/03/2019, both days inclusive	
Monitoring report number for this monitoring period	1	
Project participants	Sotravic Limited (Republic of Mauritius) Rhizome Limited (Republic of Mauritius)	
Host Party	Republic of Mauritius	
Applied methodologies and standardized baselines	Approved Methodology: ACM0001, version 11, "Consolidated baseline and monitoring methodology for landfill gas project activities" Standardized Baseline: N/A	
Sectoral scopes	Sectoral Scope 13: Waste Handling and Disposal	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	110,658 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	36,328 tCO_2e	

SECTION A. Description of project activity

A.1. General description of project activity

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(a) Purpose of the project activity and the measures taken for GHG emission reductions or net anthropogenic GHG removals by sinks;

The purpose of the proposed project is to utilize landfill gas to generate electricity, while excess landfill gas is flared. The Project generates certified emission reductions (CERs) by displacing electricity generation from grid connected fossil fuel-fired power plants that would otherwise be generating equivalent electricity and; destroying methane within the landfill gas that would otherwise have been vented directly into the atmosphere.

The project activity reduces Greenhouse Gas (GHG) emissions by setting up a more efficient gas collection system and destruction system (e.g. construction of additional wells, piping and installation of intermediary gas collection stations) than that required by the contractual obligations under landfill management agreement. A higher efficiency gas collection system enables emission reduction by combustion of higher volume of gas through flaring / generating electricity and displacement of equivalent fossil fuel-based electricity from the Mauritius grid.

The Mare Chicose landfill is a fully managed landfill site in Mauritius with leachate collection system and a leachate basin. The Mare Chicose landfill was operational as an active landfill since 1997.

In the baseline scenario, the landfill gas would have been collected and flared using the basic gas collection systems. The basic system would have been set up to flare the minimum amount of landfill gas as stated by Ministry of Local Government (MoLG) in its tender document, and no electricity would be generated.

(b) Brief description of the installed technology and equipment;

The project activity involves the installation of state-of-the-art Landfill Gas (LFG) collection technology:

- The project uses vertical wells drilled into the waste to extract the LFG. Horizontal wells have also been drilled to extract the maximum amount of gas from open cells.
- End-of-line collection system with pipes that connect groups of gas wells to manifolds. The manifolds are connected to a main pipe and then into the main header pipe which delivers the gas to the extraction plant and the flare. They allow the optimization of the extraction of gas from each well.
- The project activity involves two stationary enclosed gas flares provided by Hofstetter, consisting of pipe work, valves, blower, stack with burners, instrumentation and control panel. The combined maximum designed capacity for the flares is 3000 Nm^3/h (1500Nm^3/h X 2). The combustion temperature in the flare stack is specified to be between 1000° – 1200° C. Besides, the installed capacity of LFG engine generator set is 3 X 1.1 MW which uses captured LFG to generate electricity.

(c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.);

- The first flare was commissioned on 28 May 2008
- The second flare was commissioned on 18 September 2009.
- Commissioning of electricity generation system (2 X 1.1 MW) was on 31 October 2011
- Commissioning of the electricity generation system (1 X 1.1 MW) was on 22 January 2013

The systems have been under continued operation since their commissioning. In the current monitoring period, flare 2 has not been used as the gas available was sufficient to be consumed in the electricity generation system and flare 1 combined.

(d) Total GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period.

Total GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period: 110,658 tCO_2e.

A.2. Location of project activity

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Cluny Road, Mare Chicose, Grand Port District, South Eastern Region of Mauritius, Republic of Mauritius (the "Host Country").

The geographic coordinates of the site are: 57^0 37' 54.2" E and 20^0 23' 11.8" S

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Mauritius (host)	Sotravic Limited	No
Republic of Mauritius (host)	Rhizome Limited	No

A.4. References to applied methodologies and standardized baselines

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ACM0001, version 11, "Consolidated baseline and monitoring methodology for landfill gas project activities"

The following tools have been used as required by ACM0001, version 11:

"Tool to determine project emission from flaring gases containing methane", version 01 adopted at EB28;

"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", version 05, adopted at EB 55;

"Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 01, adopted at EB 39; and

"Tool to calculate the emission factor for an electricity system", version 02, adopted at EB 50

All version numbers stated in this paragraph apply for the whole document. The above referred documents are available at http://cdm.unfccc.int/methodologies/PAmethodologies/approved

A.5. Crediting period type and duration

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Renewable, duration: 01/04/2012 to 31/03/2019.

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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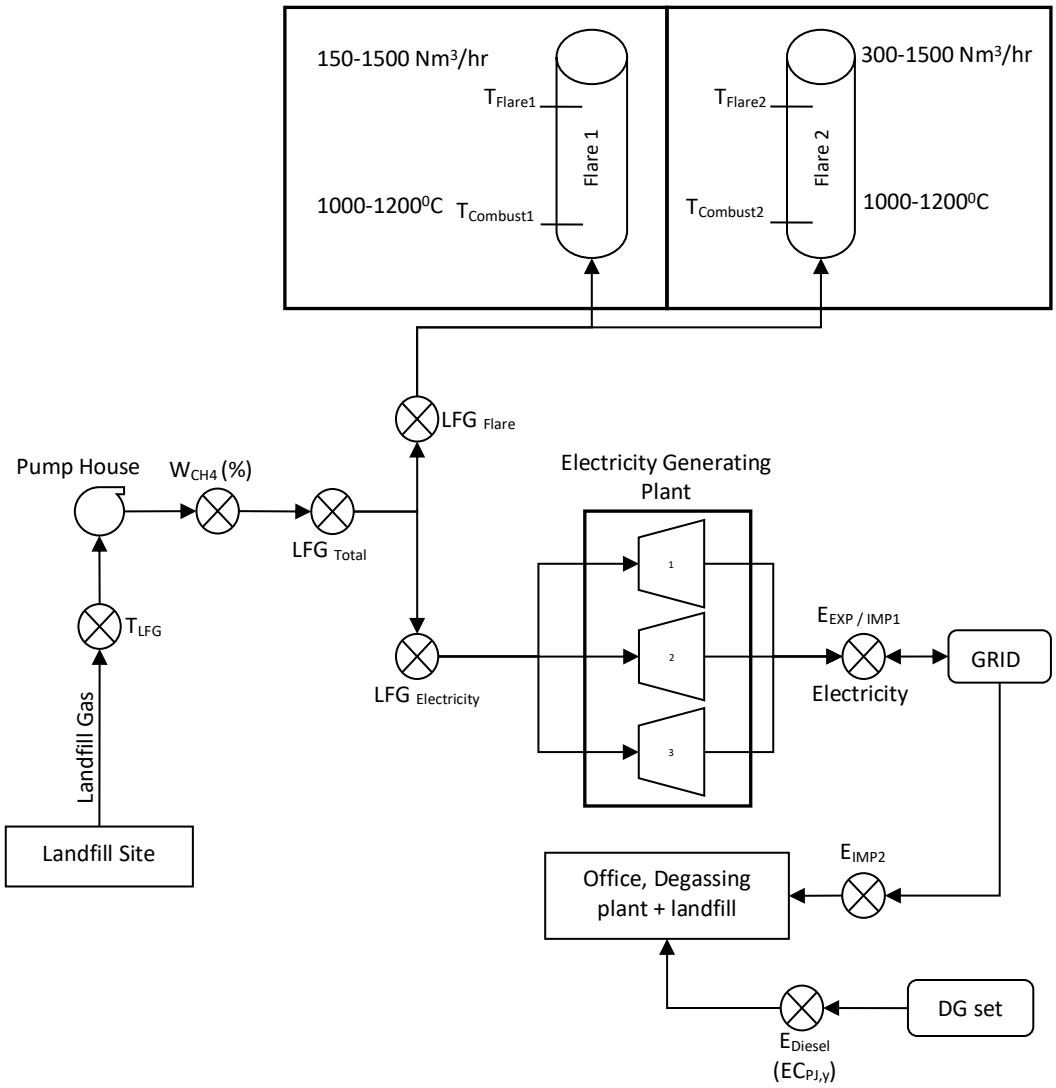
The project activity is demonstrated in the line diagram below:



Landfill Gas Collection System

The project activity involves the installation of LFG collection technology. This includes:

• Gas Collection Wells used to extract gas;

• Blowers to draw the LFG into the flare and/or the energy generator;

• Landfill capped by soil to provide cover for the site;

Flare technology:

The project activity involves the installation of two stationary enclosed gas flares consisting of pipe work, valves, blower, stack with burners, instrumentation and control panel. The details of the installed flares are as follows:

Description	Make	Flow capacity range (Nm^3/h)	Combustion temperature range (^0C)	Commissioning date
Flare 1	Hofstetter LPM	150 – 1500	1000 - 1200	28 May 2008
Flare 2	Hofstetter LPM	300 – 1500	1000 - 1200	18 September 2009

Energy generation technology:

The project has an installed electricity generation capacity of 3.3 MW using captured landfill gas as follows:

Description	Make	Gas Engine capacity (kW)	Generator capacity (kW)	Commissioning date

Generator 1	Caterpillar G3516	1136	1100	31 October 2011
Generator 2	Caterpillar G3516	1136	1100	31 October 2011
Generator 3	Caterpillar G3516	1136	1100	22 January 2013

Besides, the project also has a backup diesel generator to meet the auxiliary electricity demand during power outage / shutdown as detailed below:

Description	Make	Capacity (kW)	Generator capacity (kW)
DG	Scomat 3306	221	180

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

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For the period 04 October 2018 – 31 March 2019, the thermocouples for measurement T_{flare} and $T_{combust}$ are deemed out of calibration. Thus, for this period, the temperatures measured by the thermocouples have been considered as 0 as a conservative measure.

The energy meters are deemed out of calibration for the period 16 Aug 2018 - 20 Aug 2018. For this period, the measured values have been adjusted by the permissible error of the meters.

B.2.2. Corrections

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No corrections from the approved post registration changes revised registered PDD version 7.1, 02/10/2012 available at: https://cdm.unfccc.int/PRCContainer/DB/prcp399589485/view

B.2.3. Changes to the start date of the crediting period

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Not applicable

B.2.4. Inclusion of monitoring plan

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Not applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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No permanent changes from the approved post registration changes revised registered PDD version 7.1, 02/10/2012 available at: https://cdm.unfccc.int/PRCContainer/DB/prcp399589485/view

B.2.6. Changes to project design

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No project design changes from the approved post registration changes revised registered PDD version 7.1, 02/10/2012 available at: https://cdm.unfccc.int/PRCContainer/DB/prcp399589485/view

B.2.7. Changes specific to afforestation or reforestation project activity

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Not applicable

SECTION C. Description of monitoring system

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Data generation: Total LFG captured, and LFG sent to generators and/or the flares are continuously measured by the flow meters as mentioned in section D.2. Methane fraction in LFG is measured by a continuous gas analyzer and electricity exported and imported are measured continuously by electricity meter(s) (please see section D.2 for details).

Data recording: Measurements of the quantity of total LFG captured, and LFG sent to generators and/or the flares are recorded electronically on a continuous basis at every 10 minutes. Methane fraction readings are recorded continuously at every 10-minute interval. Electricity meter readings are recorded manually every month. All manual recordings are subsequently entered in an excel sheet.

Data aggregation: The monitored landfill gas data and electricity supplied to the grid are respectively summed over the monitoring period.

Calculation: see section D.2 and section E.

Reporting: The calculated values are included in an Excel sheet and reported in the CDM-MR.

Clear roles and responsibilities have been assigned to all staff involved in the CDM project, as described in the monitoring manual.

All staff involved in the collection of data and records are coordinated by the designated 'CDM Monitoring Manager'. The CDM monitoring manager sends the data to Climate-Secure India Pvt. Ltd. (CSIPL) periodically for checking. CSIPL checks the data and calculates the achieved emission reductions. At the end of each monitoring period, CSIPL prepares the monitoring report.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data/Parameter	**MD_{BL}**
Unit	tCH_4/yr
Description	Regulatory requirements relating to landfill gas projects
Source of data	Regulatory requirements as specified in the Tender document and follow-up documents,
Value(s) applied	1709
Choice of data or measurement methods and procedures	As mentioned in registered PDD, Table 6 (2009-2030)
Purpose of data/parameter	Baseline emission calculation
Additional comments	-

Data/Parameter	**GWP_{CH4}**
Unit	tCO_2e/tCH_4
Description	Global Warming Potential of methane (CH_4)
Source of data	IPCC
Value(s) applied	25
Choice of data or measurement methods and procedures	"Standard for Application of the Global Warming Potentials to Clean Development Mechanism Project Activities and Programmes of Activities for the Second Commitment Period of the Kyoto Protocol" released in EB69, Annex 3. http://cdm.unfccc.int/faq/Reference/Standards/meth/reg_stan02.pdf. The adoption of GWP of CH4 as 25 (100 year) is in line with the requirements specified by paragraphs 2,3 and 4 of the aforesaid standard and Fourth Assessment Report of IPCC, page 212 as available below: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter2.pdf
Purpose of data/parameter	Baseline emission calculation
Additional comments	As applicable for the second commitment period

Data/Parameter	D_{CH4}
Unit	tCH_4/m^3CH_4
Description	Methane Density
Source of data	Chemical constant
Value(s) applied	0.0007168
Choice of data or measurement methods and procedures	At standard temperature and pressure (0° C and 1,013 bar) the density of methane is 0.0007168 tCH_4/m^3CH_4.
Purpose of data/parameter	Baseline emission calculation
Additional comments	-

Data/Parameter	$CEF_{elec,BL,y}$
Unit	tCO_2/MWh
Description	Emission factor for the grid in year y
Source of data	Calculated in the PDD as per the "Tool to calculate the emission factor of an electricity system"
Value(s) applied	0.967
Choice of data or measurement methods and procedures	As mentioned in registered PDD
Purpose of data/parameter	Baseline emission calculation
Additional comments	-

Data/Parameter	$PP_{CP,Gen}$
Unit	MW
Description	Rated capacity of the captive power plant that provides the project consumption sources with electricity
Source of data	Diesel Generator nameplate
Value(s) applied	180kW
Choice of data or measurement methods and procedures	Not applicable
Purpose of data/parameter	Project emission calculation
Additional comments	-

Data/Parameter	$EF_{EL,j,y}$
Unit	tCO_2/MWh
Description	Emission factor for electricity consumed
Source of data	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Value(s) applied	1.3
Choice of data or measurement methods and procedures	Default value as per the tool
Purpose of data/parameter	Project emission calculation
Additional comments	-

D.2. Data and parameters monitored

(Copy this table for each data or parameter.)

Data/Parameter	$LFG_{total,y}$
Unit	Nm^3

Description	Total amount of landfill gas captured at Normal Temperature and Pressure
Measured/calculated/ default	Measured using normalised flow meter.
Source of data	On-site records
Value(s) of monitored parameter	14,327,464 (for 10 minutes interval values refer the ER Calculation spreadsheet)
Monitoring equipment	Normalised Gas Flow meter

Period	01 Jan 18 – 29 June 18	30 June 18 – 31 Mar 19
Type	Emerson Rosemount Mass Probar	
Serial Number	8669403 02/09	8669402 02/09
Previous Calibration date	29 June 2017	28 June 2018
Calibration Frequency	Annual	Annual
Calibration status	Ok	ok
Accuracy	1% of flow rate	1% of flow rate
Permissible Error	±1%	±1%

Measuring/reading/recording frequency	Flow rate measured continuously, recorded electronically at 10 minutes' interval. Aggregated monthly.
Calculation method (if applicable)	The measured flow rate at every 10-minute interval, is time aggregated to give LFG_{total}
QA/QC procedures	Flow meter is subject to a regular maintenance regime to ensure accuracy.
Purpose of data/parameter	Baseline emission calculation
Additional comments	-

Data/Parameter	**$LFG_{flare,y}$**
Unit	Nm^3
Description	Amount of LFG flared at Normal Temperature and Pressure
Measured/calculated/ default	Measured using normalised flow meter
Source of data	On-site records
Value(s) of monitored parameter	110,711 (for 10 minutes interval values refer the ER Calculation spreadsheet)

<table>
<tr><td>Monitoring equipment</td><td>Normalised Gas Flow meter
<table>
<tr><td>Period</td><td>01 Jan 18 – 27 Apr 18</td><td>28 April 18 – 31 Mar 19</td></tr>
<tr><td>Type</td><td colspan="2">Emerson Rosemount Mass Probar</td></tr>
<tr><td>Serial Number</td><td>8669402 02/09</td><td>8669404 02/09</td></tr>
<tr><td>Previous Calibration date</td><td>23 Mar 2017</td><td>08 April 2018</td></tr>
<tr><td>Calibration Frequency</td><td>Annual</td><td>Annual</td></tr>
<tr><td>Calibration status</td><td>Ok</td><td>Ok</td></tr>
<tr><td>Accuracy</td><td>1% of flow rate</td><td>1% of flow rate</td></tr>
<tr><td>Permissible Error</td><td>±1%</td><td>+1%</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Flow rate measured continuously, recorded electronically at 10 minutes' interval. Aggregated monthly.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>The measured flow rate at every 10-minute interval, is time aggregated to give LFG_{flared}</td></tr>
<tr><td>QA/QC procedures</td><td>Flow meter is subject to a regular maintenance regime to ensure accuracy.</td></tr>
<tr><td>Purpose of data/parameter</td><td>Baseline emission calculation</td></tr>
<tr><td>Additional comments</td><td>* The flowmeter 8669402 02/09 was calibrated on 23 Mar 2017 and was put to first use, post calibration, on 27 April 2017 for measuring $LFG_{flare,y}$. Thus, the validity of calibration for this meter is deemed till 27 April 2018.</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>$LFG_{electricity,y}$</td></tr>
<tr><td>Unit</td><td>Nm^3</td></tr>
<tr><td>Description</td><td>Amount of LFG combusted in power plant at Normal Temperature and Pressure</td></tr>
<tr><td>Measured/calculated/ default</td><td>Measured using normalised flow meter</td></tr>
<tr><td>Source of data</td><td>On-site records</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>13,897,596
(for 10 minutes interval values refer the ER Calculation spreadsheet)</td></tr>
<tr><td>Monitoring equipment</td><td>Normalised Gas Flow meter
<table>
<tr><td>Period</td><td>01 Jan 18 – 26 Sep 18</td><td>27 Sep 18 – 31 Mar 19</td></tr>
<tr><td>Type</td><td colspan="2">Emerson Rosemount Mass Probar</td></tr>
<tr><td>Serial Number</td><td>8669401 02/09</td><td>8669403 02/09</td></tr>
<tr><td>Previous Calibration date</td><td>27 Sep 2017</td><td>11 Sept 2018</td></tr>
<tr><td>Calibration Frequency</td><td>Annual</td><td>Annual</td></tr>
<tr><td>Calibration status</td><td>Ok</td><td>Ok</td></tr>
<tr><td>Accuracy</td><td>1% of flow rate</td><td>1% of flow rate</td></tr>
<tr><td>Permissible Error</td><td>±1%</td><td>±1%</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Flow rate measured continuously, recorded electronically at 10 minutes' interval. Aggregated monthly.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>The measured flow rate at every 10-minute interval, is time aggregated to give $LFG_{electricity}$</td></tr>
<tr><td>QA/QC procedures</td><td>Flow meter is subject to a regular maintenance regime to ensure accuracy</td></tr>
</table>

Purpose of data/parameter	Baseline emission calculation
Additional comments	-

Data/Parameter	**$PE_{flare,y}$**
Unit	tCO_2e
Description	Project emissions from flaring of the residual gas stream in year y
Measured/calculated/ default	Calculated
Source of data	On-site records
Value(s) of monitored parameter	474 (for 10 minutes interval values refer the ER Calculation spreadsheet)
Monitoring equipment	NA. Calculated value.
Measuring/reading/recording frequency	Calculated for every 10-minute interval. Aggregated monthly.
Calculation method (if applicable)	Calculated as per the "Tool to determine project emissions from flaring gases containing Methane".
QA/QC procedures	All equipment's are subject to a regular maintenance regime to ensure accuracy.
Purpose of data/parameter	Project emission calculations
Additional comments	-

Data/Parameter	**w_{CH4}**
Unit	Nm_3CH_4 / Nm^3 LFG
Description	Methane fraction in the landfill gas
Measured/calculated/ default	Measured using continuous methane gas analyser.
Source of data	On-site records.
Value(s) of monitored parameter	53.62 (average over the monitoring period, for 10-minute interval values refer the ER Calculation spreadsheet)
Monitoring equipment	Online continuous methane fraction analyser

Period	01 Jan 18 – 29 May 18	30 May 18 – 31 Mar 19
Type	NUK	
Serial Number	A1257	A1702
Previous Calibration date	30 May 2017	24 May 2018
Calibration Frequency	Annual	Annual
Calibration Status	ok	ok
Accuracy	2%	2%
Permissible Error	±2%	±2%

Measuring/reading/recording frequency	Measured and recorded electronically at 10-minute interval. Aggregated monthly.
Calculation method (if applicable)	The measured methane fraction at every 10-minute interval is averaged to give w_{CH4}
QA/QC procedures	The gas analyser is subject to a regular maintenance regime to ensure accuracy according to manufacturer's recommendation.
Purpose of data/parameter	Baseline emission calculation
Additional comments	-

<table>
<tr><td>Data/Parameter</td><td>EL_{LFG}</td></tr>
<tr><td>Unit</td><td>MWh</td></tr>
<tr><td>Description</td><td>Net amount of electricity generated using LFG.</td></tr>
<tr><td>Measured/calculated/ default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>On-site records</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>26,607
for monthly values refer ER Spreadsheet</td></tr>
<tr><td>Monitoring equipment</td><td>Energy meters
<table>
<tr><td>Description</td><td>CEB Main meter (Bidirectional)</td><td>Import Meter 2</td></tr>
<tr><td>Period</td><td>01 Jan 18– 31 Mar 2019</td><td>01 Jan 18 – 31 Mar 2019</td></tr>
<tr><td>Type</td><td>Elster A1500</td><td>EDMI MK10E</td></tr>
<tr><td>CEB Serial number</td><td>10529112</td><td>14550052</td></tr>
<tr><td>Previous Calibration date</td><td>16 Aug 2017</td><td>16 Aug 2017</td></tr>
<tr><td>Subsequent Calibration</td><td>20 Aug 2018</td><td>20 Aug 2018</td></tr>
<tr><td>Calibration Frequency</td><td>Annual</td><td>Annual</td></tr>
<tr><td>Calibration status</td><td>ok</td><td>ok</td></tr>
<tr><td>Accuracy</td><td>0.2S</td><td>0.5%</td></tr>
<tr><td>Permissible Error</td><td>+/- 0.2 %</td><td>+/- 0.5 %</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Measured continuously using energy meters. Recorded monthly.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Electricity export – Electricity import</td></tr>
<tr><td>QA/QC procedures</td><td>The electricity meter is subject to regular maintenance in accordance with stipulation of the meter supplier to ensure accuracy.</td></tr>
<tr><td>Purpose of data/parameter</td><td>Baseline emission calculations</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

Data/Parameter	**Operation of the energy plant**
Unit	Hours
Description	Operation of the energy plant in a year y
Measured/calculated/ default	Measured
Source of data	On-site records
Value(s) of monitored parameter	10,858.3 hrs
Monitoring equipment	Scada time meter
Measuring/reading/recording frequency	Monitored Continuously.
Calculation method (if applicable)	NA
QA/QC procedures	-
Purpose of data/parameter	Data is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational

Additional comments	-

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
Source of data	On-site records
Value(s) of monitored parameter	6 for monthly values refer Annex I below
Monitoring equipment	NA
Measuring/reading/recording frequency	Calculated monthly
Calculation method (if applicable)	Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
QA/QC procedures	All related equipment is maintained in accordance with stipulation of the supplier to ensure accuracy.
Purpose of data/parameter	Project emissions calculation
Additional comments	The electricity consumption from grid has already been accounted under EL_{LFG}. This parameter provides project emissions from the standby diesel generator at the project site.

Data/Parameter	**$EC_{PJ,y}$**
Unit	MWh
Description	Onsite consumption of electricity provided by the grid and/or the captive power plant, attributable to the project activity during the year y
Measured/calculated/ default	Calculated
Source of data	On-site records
Value(s) of monitored parameter	0.378 for monthly values refer Annex I below
Monitoring equipment	Calculated and recorded monthly
Measuring/reading/recording frequency	Metered electricity consumption from the diesel genset

Description	**Diesel Genset Meter**
Type	Elster A1350
Manufacturer Serial Number	01306516
CEB Serial Number	09519555
Previous Calibration date	16 Aug 2017
Subsequent Calibration	20 Aug 2018
Calibration Frequency	Annual
Calibration Status	Ok
Accuracy	1%
Permissible Error	+/- 1%

Calculation method (if applicable)	The meter(s) are maintained in accordance with stipulation of the supplier to ensure accuracy.
QA/QC procedures	Project emission calculation
Purpose of data/parameter	The project emissions from electricity imported from Grid are already account in the calculation of EL_{LFG} (as net of export and import from grid)
Additional comments	-

Data/Parameter	TDL_y
Unit	%
Description	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.
Measured/calculated/ default	Default
Source of data	Mauritius Central Electricity Board, annual report 2017-18
Value(s) of monitored parameter	5.82
Monitoring equipment	NA
Measuring/reading/recording frequency	NA
Calculation method (if applicable)	NA
QA/QC procedures	NA
Purpose of data/parameter	Project emissions
Additional comments	-

Data/Parameter	T_{flare}	
Unit	˚C	
Description	Temperature in the exhaust gas of the flare[1]	
Measured/calculated/ default	Measured	
Source of data	On-site records	
Value(s) of monitored parameter	Refer "T_{flare}" in the ER Calculation spreadsheet	
Monitoring equipment	Period	01 Jan 18 – 31 Mar 2019
	Type	JUMO type S
	Installation date	04 Oct 2017
	Replacement due date (annual replacement)	04 Oct 2018
	Replaced on	--
	Calibration status	Not Ok (for the period 04 Oct 2018 – 31 Mar 2019)
	Accuracy	$\pm 1.0^0$C
	Correction factor to be applied	Not applicable
Measuring/reading/recording frequency	Measured and recorded electronically every 10 minutes.	
Calculation method (if applicable)	NA	
QA/QC procedures	The thermocouple is replaced every year.	
Purpose of data/parameter	Project and Baseline emission calculation	
Additional comments	For the period 04 Oct 2018 – 31 Mar 2019, the value of T_{flare} has been considered as 0 as a conservative measure, given the thermocouples are deemed out of calibration.	

[1] Flare 2 has not operated during the entire monitoring period hence the conditions for flare 2 have not been mentioned for simplification.

Data/Parameter	**Other flare[2] operation parameters**
Unit	Various
Description	Operational parameters for optimal operation of flare: a) Minimum flare 1 flow (Nm^3/h) - 150 Nm^3/h b) Maximum flare 1 flow (Nm^3/h) - 1500 Nm^3/h c) Minimum CH_4 concentration to flare (%) – 30% d) Minimum Temperature of Combustion (ºC) – 1000^0C e) Maximum Temperature of Combustion (ºC) – 1200^0C f) Minimum Temperature of Flare (ºC) (Tool condition) – 500^0C
Measured/calculated/ default	Measured
Source of data	On-site records
Value(s) of monitored parameter	a) Minimum flare 1 flow (Nm^3/h) – refer "$\mathbf{LFG_{flare,y}}$" above and in ER Calculation spreadsheet. b) Maximum flare 1 flow (Nm^3/h) – refer "$\mathbf{LFG_{flare,y}}$" above and in ER Calculation spreadsheet. c) Minimum CH_4 concentration to flare 1 (%) – refer $\mathbf{w}_{CH4}$ above and in ER Calculation spreadsheet. d) Minimum Temperature of Combustion (ºC) – refer $T_{combust1}$ in ER Calculation spreadsheet. e) Maximum Temperature of Combustion (ºC) - refer $T_{combust1}$ in ER Calculation spreadsheet. f) Minimum Temperature of Flare (ºC) (Tool condition) – refer T_{flare1} in the ER Calculation spreadsheet.
Monitoring equipment	a) Minimum flare 1 flow (Nm^3/h) – See parameter "$\mathbf{LFG_{flare,y}}$" b) Maximum flare 1 flow (Nm^3/h) – See parameter "$\mathbf{LFG_{flare,y}}$" c) Minimum CH_4 concentration to flare (%) – See parameter $\mathbf{w}_{CH4}$ d) Minimum Temperature of Flare (ºC) (Tool condition) – refer T_{flare1} e) Minimum / Maximum Temperature of Combustion (ºC) - $T_{combust1}$
Measuring/reading/recording frequency	Recorded at 10 minutes interval
Calculation method (if applicable)	NA
QA/QC procedures	All relevant equipment is maintained in accordance with stipulation of the supplier to ensure accuracy.
Purpose of data/parameter	Project and Baseline emission calculation
Additional comments	For the period 04 Oct 2018 – 31 Mar 2019, the value of $T_{combust}$ has been considered as 0 as a conservative measure, given the thermocouples are deemed out of calibration.

Period	01 Jan 18 – 31 Mar 2019
Type	JUMO Type S
Installation date	04 Oct 2017
Replacement due date (annual replacement)	04 Oct 2018
Replaced on	--
Calibration Status	Not Ok (for the period 04 Oct 2018 – 31 Mar 2019)
Accuracy	$\pm 1.0^0C$
Correction factor to be applied	Not applicable

Data/Parameter	$\eta_{flare,h}$
Unit	%

[2] Flare 2 has not operated during the entire monitoring period hence the conditions for flare 2 have not been mentioned for simplification.

Description	Flare efficiency in hour h
Measured/calculated/ default	Default value as per the monitored flare parameters
Source of data	"Tool to determine project emissions from flaring gases containing methane"
Value(s) of monitored parameter	Refer ER Calculation spreadsheet for calculation of flare efficiency at 10-minute intervals
Monitoring equipment	NA
Measuring/reading/recording frequency	Recorded at 10-minute interval
Calculation method (if applicable)	NA
QA/QC procedures	All related equipment are maintained in accordance with stipulation of the supplier to ensure accuracy.
Purpose of data/parameter	Baseline emission calculation
Additional comments	-

D.3. Implementation of sampling plan

>>

Not applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

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$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH4} + (EL_{LFG,,y} * CEF_{elec,BL,y})$$

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y}$$

$$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$$

$$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$$

$$PE_{flare,y} = \Sigma\, TM_{RG,h} * (1-\eta_{flare,h}) * GWP_{CH4} / 1000$$

$$TM_{RG,h} = FV_{RG,h} * fv_{CH4,RG,h} * \rho_{CH4,n}$$

Where:

BE_y	Baseline emissions in year y [tCO_2e];
$MD_{project,y}$	Methane destroyed/combusted by the project activity during a year y [tCH_4];
$MD_{BL,y}$	The amount of methane that would have been destroyed/combusted the year in the absence of the project due to regulatory and/or contractual requirement [tCH_4];
GWP_{CH4}	Global Warming Potential value for methane [tCO_2e/tCH_4][3];
$EL_{LFG,y}$	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 onsite/off-site fossil fuel based captive power generation, during year y [MWh];
$CEF_{elecy,BL,y}$	CO2 emissions intensity of the baseline source of electricity displaced [tCO_2e/MWh].
$MD_{flared,y}$	Quantity of methane destroyed by flaring during year y [tCH_4];
$LFG_{flare,y}$	Quantity of landfill gas fed to the flare(s) during the year y [Nm^3LFG];
$w_{CH4,y}$	Average methane fraction of the landfill gas as measured[4] during a year y [Nm^3CH_4/Nm^3LFG];

[3] This is 25 for the second commitment period.

[4] Methane fraction of the landfill gas to be measured on wet basis.

D_{CH4}	Methane density [tCH4/Nm^{3}CH4][5];
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y determined following the procedure described in the "Tool to determine project emissions from flaring gases containing methane" [tCO_2e];
$MD_{electricity,y}$	Quantity of methane destroyed by generation of electricity during year y [tCH_4];
$LFG_{electricity,y}$	Quantity of landfill gas fed into the electricity generator during year y [Nm^{3}LFG];
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h [kg/h
$\eta_{flare,\ h}$	Flare efficiency in hour h; 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500° C for more than 20 minutes during the hour h. 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500° C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h. 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500° C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h.
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h [kg/h]
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h [Nm^3/h]
$fv_{CH4,RG,h}$	Volumetric fraction of methane in the residual gas on dry basis in hour h
$\rho_{CH4,n}$	Density of methane at normal conditions (0.7168 kg/Nm^3)

For monthly values refer Annex 1. For detailed calculations refer "ER calculator"

E.2. Calculation of project emissions or actual net removals

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$$PE_y = PE_{EC,y}$$

$$PE_{EC,y} = \sum EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y})$$

Where:

$PE_{EC,y}$	Project emissions from electricity consumption by the project activity during the year *y* [tCO_2/yr];
$EC_{PJ,y}$	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* [MWh/yr];
$EF_{EL,j,y}$	Emission factor for electricity generation for source j in year *y* [tCO_2/MWh];
$TDL_{j,y}$	Average technical transmission and distribution losses in the grid in year *y* for the voltage level at which electricity is obtained from the grid at the project site;
J	Sources of electricity consumption in project

For monthly values refer Annex 1. For detailed calculations refer "ER calculator"

E.3. Calculation of leakage emissions

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$$LE_y = 0$$

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or	Project GHG emissions or actual net	Leakage GHG emissions	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)

[5] At standard temperature and pressure (0º C and 1,013 bar) the density of methane is 0.0007168 tCH_4 / m^3CH_4.

				Before 01/01/2013	From 01/01/2013	Total amount
Total	110,664	6	0	0	110,658	110,658

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante for this monitoring period in the PDD (t CO_2e)
110,658	36,328

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

>>
As per Section B.5 of the registered PDD

E.6. Remarks on increase in achieved emission reductions

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The ex-post monitored emission reductions are higher than the ex-ante estimate because of the following:

1. Use of updated GWP of methane as 25 instead of 21. At a GWP of 21 the ex-post ERs would be 97,073 which is 167.21% higher than the PDD ex-ante estimate. For detailed calculations refer "ER calculator"
2. The reason for actual ERs higher than the ex-ante estimate in the PDD is because of practical variations between theoretical IPCC Tier II based calculation values in the PDD Vs. actual ex-post monitored values. A comparison of various parameters is illustrated below.

Parameter	Value in PDD	Value in MR	Comment
$LFG_{total,y}$	9,480,351	14,327,464	LFG generated by the landfill site is higher than that estimated in the registered PDD and is based on actual measurement records.
$LFG_{flare,y}$	0	110,711	Actual LFG sent to flares during the monitoring period is non-zero considering the scenario when electricity generators were not available, and gas had to be flared. The PDD assumed no flaring as ideal scenario.
$LFG_{electricity,y}$	9,480,351	13,897,596	LFG sent to gas engines is higher than that in the registered PDD due to relatively more landfill gas available from landfill as compared to that envisaged ex-ante in the PDD.
w_{CH4}	50	53.62	Methane fraction is similar to that in the registered PDD. It is based on the actual measurement records.
EL_{LFG}	6,570	26,607	Actual electricity generation is higher than that in the registered PDD due to the need for combusting relatively a higher volume of landfill gas available and reduced downtime of the energy plant. In the registered PDD (ex-ante cashflow, table 26) for year 2017, electricity generation was considered as 0 and a salvation revenue from sales of engine was instead considered. This approach was attributed to the fact that

			Sotravic, then, had a contract to operate the landfill till 2017. This contract, however, has been extended by the Ministry of Local Government. If revenue from electricity generation of 21,681 MWh is considered in 2018 as well (without removal of sales revenue from engines and without adding O&M and other variable costs from electricity generation as a conservative measure) in the ex-ante cashflow, the revised IRR still remains below the benchmark (19.3%).
Operation of plant energy	6570	10858	Based on actual operation log. This is higher due to the need for combusting relatively a higher volume of landfill gas available and reduced downtime of the energy plant.
$EC_{PJ,y}$	900	0.378	Electricity consumption based on actual values. This parameter only includes electricity imported from the diesel generator set. Electricity consumption from the grid is already accounted in the parameter $EL_{LFG,y}$.
TDL_y	9.70	5.82	Transmission loss value sourced from the latest Annual Report (2018) published by Mauritius Central Electricity Board

Moreover, the following comparison illustrates that over a long term, the emission reductions achieved by the project activity are not exceeding the PDD estimates. A long-term comparison is deemed more suitable in case of landfill gas to energy projects, because of dynamic nature of the project performance (variable landfill gas quantity and quality utilized) compared to the theoretically modelled values in the PDD.

Sl. No.	MP#	PDD value (at GWP of 21)	PDD value (at GWP of 25)	Monitored ERs
1.	MP # 1	87,223	87,223[6]	30,054
2.	MP # 2	105,164	121,447	77,143
3.	MP # 3	84,045	96,810	86,228
4.	MP # 4	66,454	76,420	83,352
5.	MP # 5	52,754	60,553	62,961
6.	MP # 6	37,207	43,329	52,614
7.	MP # 7 (Jan 2018 – Mar 2019)	36,328	42,040	110,658
Total (tCO_2e)		**469,174**	**527,822**	**503,010**
Average ERs (tCO_2e per annum)		**67,025**	**75,403**	**71,859**

E.7. Remarks on scale of small-scale project activity

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Not Applicable, the project is a large-scale project.

[6] MP#1 was in 2012 for which GWP of 25 is not applicable

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Document information

Version	*Date*	*Description*
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
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 GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, 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).

Version	Date	Description
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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