



**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**

<b>Title of the project activity</b>	Macaúbas Landfill Gas Project	
<b>UNFCCC reference number of the project activity</b>	9063	
<b>Version number of the PDD applicable to this monitoring report</b>	11	
<b>Version number of this monitoring report</b>	1	
<b>Completion date of this monitoring report</b>	16/02/2021	
<b>Monitoring period number</b>	3 <sup>rd</sup> monitoring period	
<b>Duration of this monitoring period</b>	From 31/07/2020 to 31/12/2020	
<b>Monitoring report number for this monitoring period</b>	Not applicable	
<b>Project participants</b>	Vital Engenharia Ambiental S.A.	
<b>Host Party</b>	Brazil	
<b>Applied methodologies and standardized baselines</b>	ACM0001: Flaring or use of landfill gas, version 19.0;	
<b>Sectoral scopes</b>	Sectoral Scope: 1 (Energy industries) Sectoral Scope: 13 (waste handling and disposal)	
<b>Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period</b>	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	-	122,065
<b>Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD</b>	170,116 <sup>1</sup>	

<sup>1</sup>Calculated using the PDD estimation for 2020 (170,116).

## SECTION A. Description of project activity

### A.1. General description of project activity

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Macaúbas Landfill Gas Project is a landfill gas collection, use and flare project in Brazil. The project's core idea is to avoid emissions of methane gas to the atmosphere from the landfill called "*Central de Tratamento de Resíduos Macaúbas*" (hereinafter referred to as *CTR Macaúbas*) located in the municipality of Sabará in the state of Minas Gerais, Brazil. The project activity comprises the installation of a new active LFG extraction, flaring and electricity generation systems. The main equipment currently installed in this project activity are:

- 2 blowers;
- 1 flare;
- 5 Electricity Group Generators
- Several collection wells, manifolds and transmission pipelines;

See section B.1. for further details on the technology employed.

Vital Engenharia Ambiental S.A. is the company responsible for the implementation and operation of the landfill (disposing around 4,000 tons of solid waste per day) and Asja Sabará Serviços para o Meio Ambiente S/A. is responsible for electricity generation and commercialization. The project consists on:

- LFG capture and flaring, reducing uncontrolled release to atmosphere;
- Generation of electricity from LFG. Part of the electricity will be used for self-consumption and the other part will be exported to the grid.

The commissioning date considering Group generators are below:

- Group generator 1: 03/07/2017
- Group generator 2: 03/07/2017
- Group generator 3: 06/07/2017
- Group generator 4: 06/07/2017
- Group generator 5: 16/07/2018

The commercial operation start-up date considering Group generators are below:

- Group Generators 1 and 2: 30/06/2017
- Group Generators 3 and 4: 12/07/2017
- Group Generator 5: 27/07/2018

The landfill gas was collected only through a passive system, with no systematic and monitored flare. Therefore, an extra-incentive was needed to make additional investments and enhance its landfill gas collection rate and install appropriate facilities to properly flare the methane produced at the site and generate electricity.

The total emission reductions achieved in this period is **122,065 tCO<sub>2</sub>e**.

### A.2. Location of project activity

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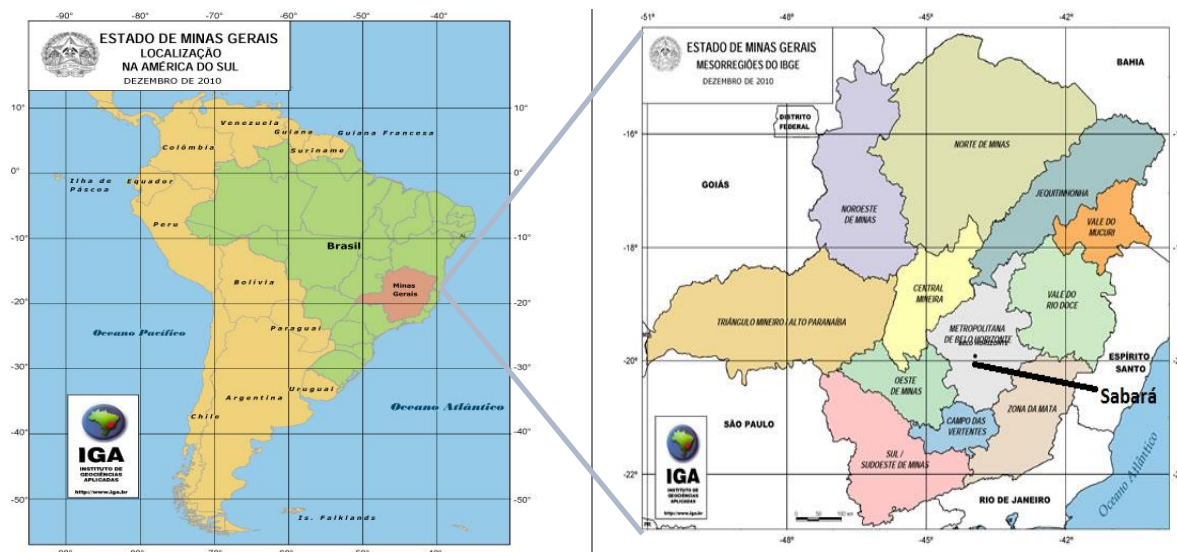
Macaúbas Landfill is located in the city of Sabará at MG-05, Km 8, 1-Parte, Sabará (city), Minas Gerais (State), Brazil.

Landfill is located at the following Geographic coordinates

Geo-coordinates: Latitude: 19° 51' 23" S and Longitude: 43° 50' 40" W

Decimal coordinates: Latitude: -19.856389° Longitude: -43.844444°

The picture below presents the detailed location of the landfill



**Figure 1 - Geographical position of Sabará city, inside of Minas Gerais State in Brazil**

(Source: Minas Gerais State website)

### A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Vital Engenharia Ambiental S.A. (private entity)	No

This monitoring report was developed and reviewed by:

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### A.4. References to applied methodologies and standardized baselines

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The applied methodology is ACM0001 - Flaring or use of landfill gas, version 19.0.

Tools to which the methodology refers are the following:

- Large-scale Consolidated Methodology ACM0001: “Flaring or use of landfill gas” (Version 19.0)<sup>2</sup>;
- TOOL02 Methodological tool: “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 07.0)<sup>3</sup>;
- TOOL03 Methodological tool: “Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion” (Version 03.0)<sup>4</sup>.
- TOOL04 Methodological tool: “Emissions from solid waste disposal sites” (Version 08.0)<sup>5</sup>;
- TOOL05 Methodological tool: “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 03.0)<sup>6</sup>;
- TOOL06 Methodological tool: “Project emissions from flaring” (Version 03.0)<sup>7</sup>;
- TOOL07 Methodological tool: “Tool to calculate the emission factor for an electricity system” (Version 07.0)<sup>8</sup>;
- TOOL08 Methodological tool: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0)<sup>9</sup>;
- TOOL09 Methodological tool: “Determining the baseline efficiency of thermal or electric energy generation systems” (Version 02.0)<sup>10</sup>;
- TOOL10 Methodological Tool: “Tool to determine the remaining lifetime of equipment” (Version 01)<sup>11</sup>;
- TOOL12 Methodological tool: “Project and leakage emissions from transportation of freight” (Version 01.1.0)<sup>12</sup>;
- TOOL32 Methodological tool: “Positive lists of technologies” (Version 02.0)<sup>13</sup>.

#### A.5. Crediting period type and duration

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The renewable crediting period is from 31/07/2020 to 30/07/2027 (2<sup>nd</sup> Crediting Period).

### SECTION B. Implementation of project activity

#### B.1. Description of implemented project activity

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Macaúbas Landfill Gas Project started its operations on 03/07/2017, as per commissioning date of first group generator.

During this monitoring period, the project has operated with one flare, two blowers and five group generators destroying the LFG collected in only one landfill site.

<sup>2</sup> <https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M>

<sup>3</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf>

<sup>4</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf>

<sup>5</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf>

<sup>6</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf>

<sup>7</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf>

<sup>8</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf>

<sup>9</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf>

<sup>10</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v2.0.pdf>

<sup>11</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf>

<sup>12</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf>

<sup>13</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v2.0.pdf>

Flare	Manufacturer	Biotechnogas (BTG)
	Type	Enclosed
	Commissioning date	08/09/2017
	Model	2500 HT
	Serial number	BTG2500HT – 143/08-b
	Year of manufacturing	2009
	Nominal gas flow	2,500 Nm <sup>3</sup> /h
	Minimum retention time	0.7 seconds
	Minimum methane content	30%
	Minimum efficiency	98%
	Lowest operation temperature	850°C
Blower 1	Year	2018
	Manufacturer	Continental Industries
	Model	151A.04
	Serial number	181510018
	Maximum capacity	3700 RPM
Blower 2	Year	2016
	Manufacturer	Continental Industries
	Model	151A.03
	Serial number	101510069
	Maximum capacity	3760 RPM

**Table 1 –Technical details of equipment installed at Project Activity**

The system has installed group generators, to supply electricity for the project internal consumption and electricity export to the grid. The specification of these equipment is presented in the table below:

Group Generator 1 Manufacturer: GE Jenbacher
Group Generator 2 Manufacturer: GE Jenbacher
Group Generator 3 Manufacturer: GE Jenbacher
Group Generator 4 Manufacturer: GE Jenbacher
Group Generator 5 Manufacturer: GE Jenbacher
Group Generator 1 Model: JGC 420 GS-L.L.
Group Generator 2 Model: JGC 420 GS-L.L.
Group Generator 3 Model: JGC 420 GS-L.L.
Group Generator 4 Model: JGC 420 GS-L.L.
Group Generator 5 Model: JGS 420 GS-L.L.
Serial Number Group Generator 1: 1146782
Serial Number Group Generator 2: 1146787
Serial Number Group Generator 3: 6642811
Serial Number Group Generator 4: 6642911
Serial Number Group Generator 5: 1358539
Group Generator 1 installed capacity: 1.426 kW
Group Generator 2 installed capacity: 1.426 kW
Group Generator 3 installed capacity: 1.426 kW
Group Generator 4 installed capacity: 1.426 kW
Group Generator 5 installed capacity: 1.426 kW
Year GG1: 2016
Year GG2: 2016
Year GG3: 2010
Year GG4: 2010
Year GG5: 2018

**Table 2 – Group Generators specifications**

Most of this monitoring period the system has been in normal operation. There were a few days with significant down period and those were listed in a separate spreadsheet and have no impact on the methodology applicability.

## **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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Not applicable

### **B.2.2. Corrections**

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Not applicable

### **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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The revised PDD includes permanent changes from registered monitoring plan prior approved by the Board on 02/04/2020 (PRC-9063-001).

- 1) Permanent changes to the registered monitoring plan description due to consequential changes to the methodology version;

#### **B.2.6. Changes to project design**

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Changes to Project Design, PDD version 5, that have been approved on 02/04/2020, post-registration changes reference number PRC-9063-001.

- 1) Permanent changes to project design by voluntary update of the applied methodology version, ACM0001 v19.0;
- 2) Permanent changes to project design by emission reduction calculation changes due to consequential changes to the methodology version;
- 3) Permanent changes to the project design, not affecting the additionality, since the LFG power plant will be expected to install approximately 9.982 MW upon project completion which is below 10 MW defined in TOOL32 Methodological tool: "Positive lists of technologies.
- 4) Permanent changes in the Demonstration of additionality considering the simplified procedure to identify the baseline scenario and demonstrate additionality of Methodological tool: Positive lists of technologies Version 01.0 due to the changes of project design and methodology version update;
- 5) Permanent changes in the annual estimation of emission reductions in tonnes of CO<sub>2</sub>e due to the changes of project design and methodology version update;
- 6) Permanent change in the project design regarding the electricity generation plant installed capacity due to LFG availability and waste disposal increase;
- 7) Permanent change in the project design regarding Appendix 4 - Further background information on ex ante calculation of emission reductions, including baseline Information, key parameters and waste disposal due to changes in project design;
  - a) GWP for methane: from 21 to 25
  - b) Installed capacity of Power Plant (MW): from 12.8 to 9.982 MW
- 8) Permanent changes in determination of flare efficiency option (Option A: Default value of the flare efficiency) according to "Project emissions from flaring" due to changes in project design.

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

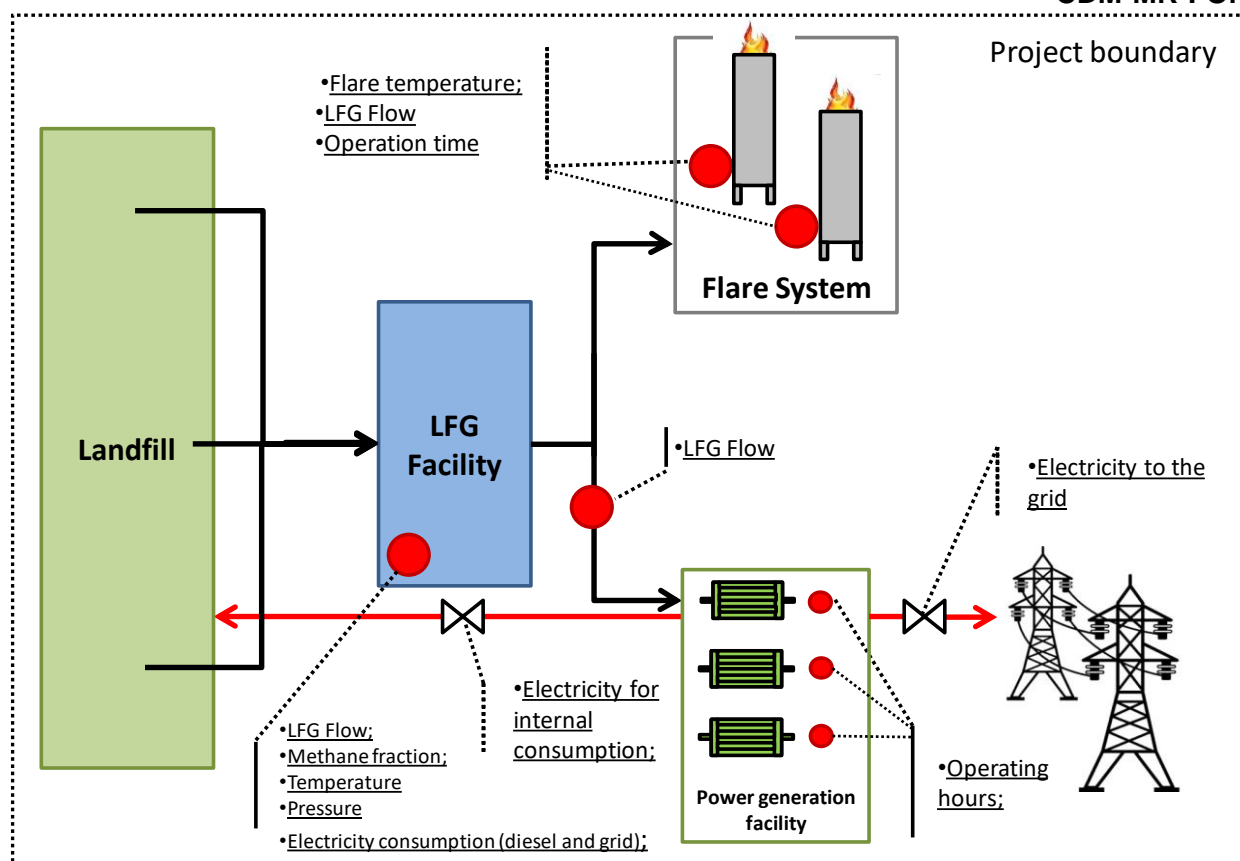
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Not applicable.

### **SECTION C. Description of monitoring system**

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The monitoring equipment and their location are presented in below.



Considering the monitoring parameters presented in the registered PDD, it is important to highlight the current monitoring system situation for the present monitoring period:

- (1) Since the flow meters already measures the volumetric flow rate of the residual gas at normal conditions, the parameters Temperature of the landfill gas (T) and Pressure of the landfill gas (P) have not been measured for normalizing purposes.

All monitoring instruments were running properly and calibrated (some period were identified with delayed calibration and the procedures defined paragraph 369 of the CDM validation and verification standard for project activities have been adopted) during this monitoring period.

Type	Manufacturer	Model	Location	Range
Flow Meter Flare <sup>14</sup>	FCI	ST51	Flare pipeline	0.3 to 400 sfps
Flow Meter Group Generators line <sup>15</sup>	FCI	ST51	GGs pipeline	0.3 to 400 sfps
Temperature meter Flare (Thermocouple)	ECIL	Type K	Flare	0 to 1260 °C
Methane content analyzer in the residual gas	Siemens	ULTRAMAT 23	Main pipeline	0 to 100% CH <sub>4</sub>
LFG temperature meter	Ecil	PT 100	Main pipeline	-200 to 850°C
LFG Pressure meter	ABB	266HSHHSTA1	Main pipeline	0.07 to 160 kPa

**Table 3 – Monitoring instruments**

<sup>14</sup> Flow meter automatically converts the flow to Nm<sup>3</sup>.

<sup>15</sup> Flow meter automatically converts the flow to Nm<sup>3</sup>.



All data are electronically collected and continually stored in a server.

The errors and uncertainties applied in the relevant monitoring period are presented below:

Instrument	TAG	Manufacturer	Model	Serial number	Accuracy Class	Starting period	Finishing period	Calibration frequency	Date of Calibration	Validity	Error used in data discount (%)
Gas Analyser	VAN-02	Siemens	Ultramat 23	N1J6603	2.00%	31/07/2020	31/12/2020	Yearly	12/05/2020	11/05/2021	-
LFG Pressure	PT-05	ABB	266HSHHSTA1	3k646617022100	from 0.06 % of calibrated span (optional 0.04 %)	31/07/2020	23/11/2020	Yearly	03/12/2019	02/12/2020	-
						24/11/2020	31/12/2020			24/11/2020	23/11/2021
LFG Temperature	TT-05	ECIL	PT 100	PI 117146	0.1 °C + 0.05%	31/07/2020	23/11/2020	Yearly	03/12/2019	02/12/2020	-
						24/11/2020	31/12/2020			24/11/2020	23/11/2021
Temperature (flare)	TT-09	ECIL	Tipo K	6232	0.40%	31/07/2020	28/12/2020	Yearly	01/06/2020	31/05/2021	-
				7438		29/12/2020	31/12/2020			03/10/2020	02/10/2021
Flow meter flare	FT-03	FCI	ST51	671426	2.00%	31/07/2020	25/11/2020	18 months	13/06/2019	12/12/2020	-
				662114		26/11/2020	31/12/2020			21/09/2020	20/03/2022
Flow meter main pipe GE TOTAL	N/A	FCI	ST51	683687	2.00%	31/07/2020	31/12/2020	18 months	08/04/2020	07/10/2021	-
Electricity meter	N/A	Schneider	ION 8650	MW-1701A841-02	0.20%	31/07/2020	31/12/2020	5 years	Meter calibration and maintenance continuously carried out by the energy distribution company		-
		Schneider	ION 8650	MW-1701A941-02		31/07/2020	31/12/2020	5 years			-

## SECTION D. Data and parameters

### D.1. Data and parameters fixed ex ante

The following ex ante parameters, listed in the registered PDD, will not be used in this monitoring period and thus not presented in the tables below since have been not used in the calculation of emission reductions:

- Waste composition
- Efficiency of the LFG capture system that will be installed in the project activity ( $\eta_{PJ}$ )
- Default value for model correction factor to account for model uncertainties ( $\phi_{\text{default}}$ )
- Oxidation factor (reflecting the amount of methane from the considered SWDS that is oxidized in the soil (or other material covering the waste)) (OX)
- Fraction of methane in the SWDS gas (volume fraction) (F)
- Default value for the fraction of degradable organic carbon in MSW that decomposes in the SWDS ( $\text{DOC}_{f,\text{default}}$ )
- Methane correction factor ( $\text{MCF}_{\text{default}}$ )
- Fraction of degradable organic carbon in the waste type j (weight fraction) ( $\text{DOC}_j$ )
- Decay rate for the waste type j ( $k_j$ )
- Universal ideal gas constant ( $R_u$ )
- Atmospheric pressure at reference conditions ( $P_{\text{ref}}$ )
- Temperature at reference conditions ( $T_{\text{ref}}$ )
- Molecular mass of greenhouse gas i ( $\text{MM}_i$ )
- Molecular mass of gas k ( $\text{MM}_k$ )
- Molecular mass of water ( $\text{MM}_{\text{H}_2\text{O}}$ )

Data/Parameter	$\text{EF}_{\text{grid,BM},y}$
Data unit	tCO <sub>2</sub> /MWh
Description	Build margin emission factor of the Brazilian grid
Source of data	Brazilian DNA
Value(s) applied	0.1370 (Data from 2018 according to STEP 5, option 2 of Tool to calculate the emission factor for an electricity system)
Choice of data or measurement methods and procedures	Value applicable is calculated by considering the applicable guidance of the “Tool to calculate the emission factor for an electricity system”.
Purpose of data	Calculation of baseline and project emission
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, were included in the monitoring plan.

Data/Parameter	$OX_{top\_layer}$
Data unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites"
Value(s) applied	0.1
Choice of data or measurement methods and procedures	Default value used, according to ACM0001
Purpose of data	Calculation of baseline emission
Additional comment	Applicable to Step A

Data/Parameter	$GWP_{CH_4}$
Data unit	t CO <sub>2</sub> e/t CH <sub>4</sub>
Description	Global warming potential of CH <sub>4</sub>
Source of data	IPCC
Value(s) applied	25 Updated for the 2 <sup>nd</sup> commitment period according to COP/MOP decisions <sup>16</sup>
Choice of data or measurement methods and procedures	Default value used, according to IPCC Fourth Assessment Report: Climate Change 2007, item 2.10.2: Direct Global Warming Potentials, Table 2.14
Purpose of data	Calculation of baseline emission
Additional comment	In opposite of the PDD registered on 31/07/2013 using GWP of 21, it has been updated to 25.

Data / Parameter	$SPEC_{flare}$		
Unit	Temperature - °C Flow rate - Nm <sup>3</sup> /h Maintenance schedule - number of days		
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule		
Source of data	Flare Manufacturer		
Value(s) applied			
Choice of data or Measurement methods and procedures	<p><b>Enclosed flares</b></p> <p>There is no control of minimum and maximum temperatures, only the detection of the flame. The methods and procedures will be manufacturer manual/recommendation.</p> <p>According to manufacturer manual/recommendation.</p> <table border="1" data-bbox="670 1818 1248 1863"> <tr> <td>Flare model</td><td>2500 HT</td></tr> </table>	Flare model	2500 HT
Flare model	2500 HT		

<sup>16</sup>IPCC Fourth Assessment Report: Climate Change 2007, item 2.10.2: Direct Global Warming Potentials, Table 2.14, available at: [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/ch2s2-10-2.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html), accessed on 11/01/2018 and in accordance with EB69, Annex 3 and decision 4/CMP.7, available at: [http://cdm.unfccc.int/Reference/Standards/meth/reg\\_stan02.pdf](http://cdm.unfccc.int/Reference/Standards/meth/reg_stan02.pdf), accessed on 11/01/2018.

	Minimum flare temperature	850 °C
	Maximum flare temperature	1200 °C
	Minimum and maximum inlet flow rate	Minimum flow: 500 Nm³/h * --- Maximum flow: 2,500 Nm³/h
	Maximum duration in days between maintenance events	7 days <sup>17</sup>
Purpose of data	Calculation of project emissions	
Additional comment		

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<sup>17</sup> The maximum duration in days between maintenance events has been chosen considering preventive maintenance program which defines the frequency for checking flare equipment situation every week.

Data / Parameter	$f_y$
Unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
Source of data	Select the maximum value from the following: (a) contract or regulation requirements specifying the amount of methane that must be destroyed/used (if available) and (b) historic data on the amount captured
Value(s) applied	0
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emission
Additional comment	According to ACM0001 methodology, the parameter $f_y$ in the methodological tool "Emissions from solid waste disposal sites" shall be assigned a value of 0 (zero) because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology. Also, according to ACM0001 methodology, the parameter X begins with the year that the SWDS started receiving wastes (2010). For this reason, the parameter $f_y$ and X will not be monitored.

## D.2. Data and parameters monitored

The following monitored parameters, listed in the registered PDD, will not be used in this monitoring period and thus not presented in the tables below since have been not used in the calculation of emission reductions:

- $P_{H_2O,t,Sat}$ : Saturation pressure of  $H_2O$  at temperature  $T_t$  in time interval  $t$
- $F_{CH_4,EG,t}$ : Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period  $t$
- $EC_{PJ2,y} = EG_{EC2,y}$ : Quantity of electricity consumed from diesel generator by the project activity during the year  $y$
- $V_{t,w,b}$  = Volumetric flow of the gaseous stream in time interval  $t$  on a wet basis
- $V_{i,t,wb}$  = Volumetric fraction of greenhouse gas  $i$  in a time interval  $t$  on a wet basis

### **Baseline, project and/or leakage emission from electricity consumption and monitoring of electricity generation**

Data/parameter:	$EF_{grid,CM,y}$
Unit	tCO <sub>2</sub> /MWh
Description	CO <sub>2</sub> emission factor of the Brazilian grid electricity during the year y
Measured/calculated/default	Calculated as the weighted average of the dispatch data analysis OM (Operating Margin) and the BM (Build margin).
Source of data	Brazilian DNA
Value(s) of monitored parameter	0.2162 (2020)

Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Value applicable is calculated by considering the applicable guidance of the “Tool to calculate the emission factor for an electricity system”.
QA/QC procedures	Apply procedures in the “Tool to calculate the emission factor for an electricity system”
Purpose of data/parameter	Calculation of baseline/project emissions or actual net GHG removals by sinks;
Additional comments	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, were included in the monitoring plan.

<b>Data/parameter:</b>	$EF_{grid,OM,y}$
Unit	tCO <sub>2</sub> /MWh
Description	Operating margin emission factor of the Brazilian grid
Measured/calculated/default	Calculated (based on official monthly values as calculated and published by the DNA of Brazil).
Source of data	Brazilian DNA
Value(s) of monitored parameter	0.4536 (2020)
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Value applicable is calculated by considering the applicable guidance of the “Tool to calculate the emission factor for an electricity system”.
QA/QC procedures	Apply procedures in the “Tool to calculate the emission factor for an electricity system”
Purpose of data/parameter	Calculation of baseline/project emissions or actual net GHG removals by sinks;
Additional comments	All data and parameters to determine the grid electricity emission factor, as required by the “Tool to calculate the emission factor for an electricity system”, were included in the monitoring plan.

<b>Data/parameter:</b>	TDL <sub>y</sub>
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 value
Source of data	Default value as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Value(s) of monitored parameter	26.3% (2020)
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years

Calculation method (if applicable):	Not applicable
QA/QC procedures	-
Purpose of data/parameter	Calculation of baseline/project emissions or actual net GHG removals by sinks;
Additional comments	National Electricity Energy Balances 2017, 2018 and 2019

<b>Data/parameter:</b>	$EC_{PJ1,y} = EG_{EC1,y}$																																			
Unit	MWh/y																																			
Description	Quantity of electricity consumed from the grid by the project activity during the year y;																																			
Measured/calculated/default	Continuously measured by electricity meter.																																			
Source of data	Measurement from Project participants.																																			
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.																																			
Monitoring equipment	<table border="1"> <tr> <td>Instrument</td><td colspan="2">Electricity meter</td></tr> <tr> <td>TAG</td><td colspan="2">N/A</td></tr> <tr> <td>Manufacturer</td><td>Schneider</td><td>Schneider</td></tr> <tr> <td>Model</td><td>ION 8650</td><td>ION 8650</td></tr> <tr> <td>Serial number</td><td>MW-1701A841-02</td><td>MW-1701A941-02</td></tr> <tr> <td>Accuracy Class</td><td colspan="2">0.20%</td></tr> <tr> <td>Starting period</td><td>31/07/2020</td><td>31/07/2020</td></tr> <tr> <td>Finishing period</td><td>31/12/2020</td><td>31/12/2020</td></tr> <tr> <td>Calibration frequency</td><td>5 years</td><td>5 years</td></tr> <tr> <td>Date of Calibration</td><td colspan="2" rowspan="2">Meter calibration and maintenance continuously carried out by the energy distribution company</td></tr> <tr> <td>Validity</td></tr> <tr> <td>Error used in data discount (%)</td><td>-</td><td>-</td></tr> </table>		Instrument	Electricity meter		TAG	N/A		Manufacturer	Schneider	Schneider	Model	ION 8650	ION 8650	Serial number	MW-1701A841-02	MW-1701A941-02	Accuracy Class	0.20%		Starting period	31/07/2020	31/07/2020	Finishing period	31/12/2020	31/12/2020	Calibration frequency	5 years	5 years	Date of Calibration	Meter calibration and maintenance continuously carried out by the energy distribution company		Validity	Error used in data discount (%)	-	-
Instrument	Electricity meter																																			
TAG	N/A																																			
Manufacturer	Schneider	Schneider																																		
Model	ION 8650	ION 8650																																		
Serial number	MW-1701A841-02	MW-1701A941-02																																		
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Starting period	31/07/2020	31/07/2020																																		
Finishing period	31/12/2020	31/12/2020																																		
Calibration frequency	5 years	5 years																																		
Date of Calibration	Meter calibration and maintenance continuously carried out by the energy distribution company																																			
Validity																																				
Error used in data discount (%)	-	-																																		
Measuring/reading/recording frequency:	Continuously																																			
Calculation method (if applicable):	Not applicable																																			
QA/QC procedures	As per the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" According to electricity reports provided by the Electricity Chamber Company (main data) and local Electricity Trader Company (cross check data).																																			
Purpose of data/parameter	(b) Calculation of project emissions or actual net GHG removals by sinks;																																			
Additional comments	The data will be archived throughout the crediting period and two years thereafter.																																			

**ACM0001: Flaring or use of landfill gas**

<b>Data/parameter:</b>	Management of SWDS
Unit	-
Description	Management of SWDS

Measured/calculated/default	As per the adopted monitoring procedure for the project activity, the management of the landfill is yearly compared against the previously conceived original construction and operational design of the landfill in order to confirm that the overall management and operation of the landfill (including relevant aspects related to landfilling practice) were not modified with the unique aim to increase generation of methane on site. By performing the checking annually, it is monitored whether any practice aiming to increase methane generation in the landfill has occurred. As required by ACM0001, any change in the management of the landfill after the implementation of the project activity should be justified by referring to applicable technical or regulatory specifications.
Source of data	<p>Project Participant</p> <p>The current configuration and operational conditions of the landfill were compared against the previously conceived design and operational conditions of the landfill prior to the implementation of the project activity.</p> <p>According to the declaration issued by the Project Participant on May 2020:</p> <ul style="list-style-type: none"> <li>• Inside landfill does not exist organic waste recycling;</li> </ul>
Value(s) of monitored parameter	Not applicable
Monitoring equipment	-
Measuring/reading/recording frequency:	Annually
Calculation method (if applicable):	Not applicable
QA/QC procedures	-
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	-

<b>Data/parameter:</b>	$EG_{PJ,y} = EC_{BL,k,y}$
Unit	MWh
Description	Amount of electricity generated using LFG by the project activity in year y
Measured/calculated/default	Measured by Project Participant
Source of data	Electricity meter
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.



Monitoring equipment	Instrument	Electricity meter	
	TAG	N/A	
	Manufacturer	Schneider	Schneider
	Model	ION 8650	ION 8650
	Serial number	MW-1701A841-02	MW-1701A941-02
	Accuracy Class	0.20%	
	Starting period	31/07/2020	31/07/2020
	Finishing period	31/12/2020	31/12/2020
	Calibration frequency	5 years	5 years
	Date of Calibration	Meter calibration and maintenance continuously carried out by the energy distribution company	
	Validity		
	Error used in data discount (%)	-	-
Measuring/reading/recording frequency:	Continuous		
Calculation method (if applicable):	Not applicable		
QA/QC procedures	<p>This parameter is required for calculating baseline emissions associated with electricity generation (<math>BE_{EC,y}</math>) using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"</p> <p>According to electricity reports provided by the Electricity Chamber Company (main data) and local Electricity Trader Company (cross check data).</p>		
Purpose of data/parameter	(b) Calculation of project emissions or actual net GHG removals by sinks;		
Additional comments	The data will be archived throughout the crediting period and two years thereafter.		

<b>Data/parameter:</b>	$O_{pj,h}$
Unit	-
Description	Operation of the equipment that consumes the LFG

Measured/calculated/default	<p>For each equipment unit <math>j</math> using the LFG monitor that the plant is operating in hour <math>h</math> by the monitoring any one or more of the following three parameters:</p> <p>(a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD;</p> <p>(b) Flame. Flame detection system is used to ensure that the equipment is in operation;</p> <p>(c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns.</p> <p><math>O_{pj,h}=0</math> when:</p> <p>(a) One of more temperature measurements are missing or below the minimum threshold in hour <math>h</math> (instantaneous measurements are made at least every minute);</p> <p>(b) Flame is not detected continuously in hour <math>h</math> (instantaneous measurements are made at least every minute);</p> <p>(c) No products are generated in the hour <math>h</math>.</p> <p>Otherwise, <math>O_{pj,h}=1</math></p>
Source of data	Measurements by Project participant using a device integrated with the operational software at the landfill gas plant.
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.
Monitoring equipment	Flame detection system / Flares temperature meters
Measuring/reading/recording frequency:	Once per minute
Calculation method (if applicable):	Not applicable
QA/QC procedures	The calibration of this equipment is not applicable since it is a device integrated with the operational software at the landfill gas plant.
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	-

***Tool to determine the mass flow of a greenhouse gas in a gaseous stream***

Data/parameter:	$V_{t,db}$
Unit	$m^3/h$
Description	Volumetric flow of the gaseous stream in time interval $t$ on a dry basis
Measured/calculated/default	Measured
Source of data	Measurements by Project participants using a flow meter
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.

Monitoring equipment	Instrument	Flow meter flare		Flow meter main pipe GE TOTAL
	TAG	FT-03		N/A
	Manufacturer	FCI		FCI
	Model	ST51		ST51
	Serial number	671426	662114	683687
	Accuracy Class	2.00%		2.00%
	Starting period	31/07/2020	26/11/2020	31/07/2020
	Finishing period	25/11/2020	31/12/2020	31/12/2020
	Calibration frequency	18 months		18 months
	Date of Calibration	13/06/2019	21/09/2020	08/04/2020
	Validity	12/12/2020	20/03/2022	07/10/2021
	Error used in data discount (%)	-		-
Measuring/reading/recording frequency:	Continuous recorded and hourly aggregated			
Calculation method (if applicable):	Not applicable			
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be in accordance with manufacturer's specifications.			
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;			
Additional comments	The design of the installed LFG flow meter for measuring the LFG flow to the flare ensures that measurement data is automatically converted and recorded in normal cubic meters per hour (Nm <sup>3</sup> /h). Due to that, as further explained in Section D.1, measurements of LFG pressure and LFG temperature are not required for determining $V_{t,db}$ Monitored in case of Option A from tool			

<b>Data/parameter:</b>	$V_{i,t,db}$
Unit	m <sup>3</sup> gas i/m <sup>3</sup> dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Measured/calculated/default	Continuously measured by continuous CH <sub>4</sub> content gas analyzer.
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (CH <sub>4</sub> content gas analyzer)
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.

Monitoring equipment	Instrument	Gas Analyser
	TAG	VAN-02
	Manufacturer	Siemens
	Model	Ultramat 23
	Serial number	N1J6603
	Accuracy Class	2.00%
	Starting period	31/07/2020
	Finishing period	31/12/2020
	Calibration frequency	Yearly
	Date of Calibration	12/05/2020
	Validity	11/05/2021
	Error used in data discount (%)	-
Measuring/reading/recording frequency:	Continuous recorded and hourly aggregated	
Calculation method (if applicable):	Not applicable	
QA/QC procedures	Calibration should include zero verification with an inert gas (e.g. N <sub>2</sub> ) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.	
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;	
Additional comments	-	

<b>Data/parameter:</b>	T <sub>t</sub>		
Unit	K		
Description	Temperature of the gaseous stream in time interval t		
Measured/calculated/default	Measured by Project Participant using temperature sensor		
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (temperature sensor)		
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.		
Monitoring equipment	Instrument	LFG Temperature	
	TAG	TT-05	
	Manufacturer	ECIL	
	Model	PT 100	
	Serial number	PI 117146	
	Accuracy Class	0.1 °C + 0.05%	
	Starting period	31/07/2020	24/11/2020
	Finishing period	23/11/2020	31/12/2020
	Calibration frequency	Yearly	
	Date of Calibration	03/12/2019	24/11/2020
	Validity	02/12/2020	23/11/2021
	Error used in data discount (%)	-	-
Measuring/reading/recording frequency:	Continuous		
Calculation method (if applicable):	Not applicable		

QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. The calibration frequency of this monitoring equipment should be according to the manufacturer's specifications
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60°C is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data/parameter:	P <sub>t</sub>																																						
Unit	Pa																																						
Description	Pressure of the gaseous stream in time interval t																																						
Measured/calculated/default	Measurements by Project participant using a pressure meter																																						
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (pressure meter)																																						
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.																																						
Monitoring equipment	<table><tr><td>Instrument</td><td colspan="2">LFG Pressure</td></tr><tr><td>TAG</td><td colspan="2">PT-05</td></tr><tr><td>Manufacturer</td><td colspan="2">ABB</td></tr><tr><td>Model</td><td colspan="2">266HSHHSTA1</td></tr><tr><td>Serial number</td><td colspan="2">3k646617022100</td></tr><tr><td>Accuracy Class</td><td colspan="2">from 0.06 % of calibrated span (optional 0.04 %)</td></tr><tr><td>Starting period</td><td>31/07/2020</td><td>24/11/2020</td></tr><tr><td>Finishing period</td><td>23/11/2020</td><td>31/12/2020</td></tr><tr><td>Calibration frequency</td><td colspan="2">Yearly</td></tr><tr><td>Date of Calibration</td><td>03/12/2019</td><td>24/11/2020</td></tr><tr><td>Validity</td><td>02/12/2020</td><td>23/11/2021</td></tr><tr><td>Error used in data discount (%)</td><td>-</td><td>-</td></tr></table>			Instrument	LFG Pressure		TAG	PT-05		Manufacturer	ABB		Model	266HSHHSTA1		Serial number	3k646617022100		Accuracy Class	from 0.06 % of calibrated span (optional 0.04 %)		Starting period	31/07/2020	24/11/2020	Finishing period	23/11/2020	31/12/2020	Calibration frequency	Yearly		Date of Calibration	03/12/2019	24/11/2020	Validity	02/12/2020	23/11/2021	Error used in data discount (%)	-	-
Instrument	LFG Pressure																																						
TAG	PT-05																																						
Manufacturer	ABB																																						
Model	266HSHHSTA1																																						
Serial number	3k646617022100																																						
Accuracy Class	from 0.06 % of calibrated span (optional 0.04 %)																																						
Starting period	31/07/2020	24/11/2020																																					
Finishing period	23/11/2020	31/12/2020																																					
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Date of Calibration	03/12/2019	24/11/2020																																					
Validity	02/12/2020	23/11/2021																																					
Error used in data discount (%)	-	-																																					
Measuring/reading/recording frequency:	Continuous																																						
Calculation method (if applicable):	Not applicable																																						
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly. In case the pressure meter is not a capacitive or resistive pressure transducer, the calibration frequency of this monitoring equipment should be according to the manufacturer's specifications.																																						
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;																																						

Additional comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency)
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<b>Data/parameter:</b>	Status of biogas destruction device
Unit	-
Description	Operational status of biogas destruction devices
Measured/calculated/default	Measured by Project Participant
Source of data	Flame detector
Value(s) of monitored parameter	-
Monitoring equipment	UV flame detector
Measuring/reading/recording frequency:	Continuous
Calculation method (if applicable):	Not applicable
QA/QC procedures	-
Purpose of data/parameter	(a) Calculation of baseline emissions or baseline net GHG removals by sinks;
Additional comments	For Flame detector devices refer to the methodological tool "Project emissions from flaring"

### **Methodological tool "Project emissions from flaring"**

<b>Data/parameter:</b>	Flame <sub>m</sub>
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Measured/calculated/default	Measurements by project participants using a continuous Ultra Violet flame detector
Source of data	Whenever flame is detected in the flare, flame status "on" or "1" value is attributed. Whenever no flame is detected in the flare, flame status "off" or "0" is attributed.
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.
Monitoring equipment	UV flame detectors in each flare
Measuring/reading/recording frequency:	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
Calculation method (if applicable):	Not applicable
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data/parameter	Calculation of baseline and project emissions when the flame is on <sup>18</sup> .
Additional comments	-

<sup>18</sup> When the flame is off, neither baseline nor project emissions occurs since the LFG is not combusted and instead released to the atmosphere.

<b>Data/parameter:</b>	Maintenance <sub>y</sub>
Unit	Calendar dates
Description	Maintenance events completed in year y
Measured/calculated/default	-
Source of data	Project participants maintenance logs
Value(s) of monitored parameter	<p>As per the applied maintenance practice for the project activity, general inspection services on the flares are performed daily.</p> <p>Performed maintenance and overhauling services in the flare are performed under by specialized technical service team under conformance with maintenance requirements for the flares (as established by equipment manufacturer) and as required by the ex-ante determined parameter SPEC<sub>flare</sub>. Further details about the parameter SPEC<sub>flare</sub> are included in Section D.1.</p>
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Daily
Calculation method (if applicable):	Not applicable
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data/parameter	Calculation of baseline and project emissions when the flame is on <sup>19</sup> .
Additional comments	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer (SPEC <sub>flare</sub> ).

<b>Data/parameter:</b>	T <sub>EG,m</sub>
Unit	° C
Description	Temperature in the exhaust gas of the enclosed flare in minute m
Measured/calculated/default	Measurements by project participants with thermocouples installed in each enclosed flares
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (thermocouples)
Value(s) of monitored parameter	The CERs calculation spreadsheet includes all records of measurement data of this parameter during the considered monitoring period.

<sup>19</sup> When the maintenance is being carried out, neither baseline nor project emissions occurs since the LFG is not combusted and released to the atmosphere.

Monitoring equipment	Instrument	Temperature (flare)	
	TAG	TT-09	
	Manufacturer	ECIL	
	Model	Tipo K	
	Serial number	6232	7438
	Accuracy Class	0.40%	
	Starting period	31/07/2020	29/12/2020
	Finishing period	28/12/2020	31/12/2020
	Calibration frequency	Yearly	
	Date of Calibration	01/06/2020	03/10/2020
	Validity	31/05/2021	02/10/2021
	Error used in data discount (%)	-	
	Measuring/reading/recording frequency:	Once per minute	
Calculation method (if applicable):	Not applicable		
QA/QC procedures	Thermocouples will be replaced or calibrated every year		
Purpose of data/parameter	(b) Calculation of project emissions or actual net GHG removals by sinks;		
Additional comments	-		

### D.3. Implementation of sampling plan

&gt;&gt;

Not applicable

## SECTION E. Calculation of emission reductions or net anthropogenic removals

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

&gt;&gt;

#### Baseline emission calculation

The table below shows the consolidated collected and calculated data for the current monitoring period.

	DEVIATION applied	BE <sub>y</sub>	BEEC <sub>y</sub>	BECH <sub>4,y</sub>	FCH <sub>4PJ,y</sub>	FCH <sub>4BL,y</sub>	FCH <sub>4flared,y</sub>	FCH <sub>4EL,y</sub>	% CH <sub>4</sub>	FCH <sub>4 sent flare,y</sub>	ECBL	Total methane for Group generators	Total methane to Flare	FCH <sub>4RG,t</sub>	PE <sub>flare,y</sub>
	(yes/no)	tCO <sub>2</sub>	tCO <sub>2</sub>	tCO <sub>2</sub>	tCH <sub>4</sub>	tCH <sub>4</sub>	tCH <sub>4</sub>	tCH <sub>4</sub>	%	tCH <sub>4</sub>	MWh	Nm <sup>3</sup> CH <sub>4</sub>	Nm <sup>3</sup> CH <sub>4</sub>	kg	tCO <sub>2</sub>
From 31/07/2020	No	761	37	725	41	8	12.1	29	53.9%	16.6	134	40,816	23,103	16,560	110
08/2020	No	23,845	1,180	22,665	1,295	259	347.9	947	52.6%	505.0	4,323	1,321,461	704,483	504,974	3,926
09/2020	No	23,870	1,172	22,698	1,297	259	331.7	965	53.9%	466.5	4,294	1,346,709	650,832	466,516	3,371
10/2020	No	23,914	1,236	22,678	1,296	259	312.3	984	54.9%	448.5	4,527	1,372,223	625,745	448,534	3,407
11/2020	No	24,182	1,162	23,020	1,315	263	345.6	970	54.8%	456.8	4,256	1,352,997	637,221	456,760	2,780
12/2020	No	25,493	1,223	24,270	1,387	277	328.1	1,059	55.6%	411.6	4,480	1,477,032	574,201	411,587	2,086

The baseline emission was calculated according to the following formula:

$$BE_y = BE_{CH_4,y} + BE_{EC,y}$$

Where:

- $BE_y$  = Baseline emissions in year  $y$  (t CO<sub>2</sub>e/yr)  
 $BE_{CH_4,y}$  = Baseline emissions of methane from the SWDS in year  $y$  (t CO<sub>2</sub>e/yr)  
 $BE_{EC,y}$  = Baseline emissions associated with electricity generation in year  $y$  (t CO<sub>2</sub>/yr)

Therefore,  $BE_y = BE_{CH_4,y} + BE_{EC,y}$

#### Step (A): Baseline emissions of methane from the SWDS ( $BE_{CH_4,y}$ )



$$BE_{CH_4} = \left( (1 - OX_{top\_layer}) \times F_{CH_4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH_4}$$

Where:

- $BE_{CH_4,y}$  = Baseline emissions of LFG from the SWDS in year  $y$  (t CO<sub>2</sub>e/yr)  
 $OX_{top\_layer}$  = Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)  
 $F_{CH_4,PJ,y}$  = Amount of methane in the LFG which is flared and/or used in the project activity in year  $y$  (t CH<sub>4</sub>/yr)  
 $F_{CH_4,BL,y}$  = Amount of methane in the LFG that would be flared in the baseline in year  $y$  (t CH<sub>4</sub>/yr)  
 $GWP_{CH_4}$  = Global warming potential of CH<sub>4</sub> (t CO<sub>2</sub>e/t CH<sub>4</sub>)

#### Step A.1: *Ex-post* determination of $F_{CH_4,PJ,y}$

During the crediting period, the  $F_{CH_4,PJ,y}$  will be determined as follows:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y}$$

The following requirements apply:

- CH<sub>4</sub> is the greenhouse gas for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool);
- The mass flow should be calculated on an hourly basis for each hour  $h$  in year  $y$ ;
- The mass flow calculated for hour  $h$  is 0 if the equipment is not working in hour  $h$  ( $Op_{j,h}$ =not working), the hourly values are then summed to a yearly unit basis.

The amount of methane destroyed by flaring ( $F_{CH_4,flared,y}$ ) will be determined as follows:

$$F_{CH_4,flared,y} = F_{CH_4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH_4}}$$

Where:

- $F_{CH_4,flared,y}$  = Amount of methane in the LFG which is destroyed by flaring in year  $y$  (t CH<sub>4</sub>/yr)  
 $F_{CH_4,sent\_flare,y}$  = Amount of methane in the LFG which is sent to the flare in year  $y$  (t CH<sub>4</sub>/yr)  
 $PE_{flare,y}$  = Project emissions from flaring of the residual gas stream in year  $y$  (t CO<sub>2</sub>e/yr)  
 $GWP_{CH_4}$  = Global warming potential of CH<sub>4</sub> (t CO<sub>2</sub>e/t CH<sub>4</sub>)

$F_{CH_4,sent\_flare,y}$  will be determined directly using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, applying the requirements described below. The tool shall be applied to the gaseous stream flowing in the LFG delivery pipeline to each flare.

According to “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” the following option will be considered for the present project activity:

- Option A (Volume flow in dry basis and volumetric fraction in dry basis) when the temperature of the gaseous stream is less than 60°C (333.15 K) at the flow measurement point

## Option A

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. The demonstration will be made as following:

- Demonstrate that the temperature of the gaseous stream ( $T_t$ ) is less than 60°C (333.15 K) at the flow measurement point.

The mass flow of greenhouse gas  $i$  ( $F_{i,t}$ ) is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

Where:

- $F_{i,t}$  = Mass flow of greenhouse gas  $i$  in the gaseous stream in time interval  $t$  (kg gas/h)
- $V_{t,db}$  = Volumetric flow of the gaseous stream in time interval  $t$  on a dry basis (m<sup>3</sup> dry gas/h)
- $v_{i,t,db}$  = Volumetric fraction of greenhouse gas  $i$  in the gaseous stream in a time interval  $t$  on a dry basis (m<sup>3</sup> gas  $i$ /m<sup>3</sup> dry gas)
- $\rho_{i,t}$  = Density of greenhouse gas  $i$  in the gaseous stream in time interval  $t$  (kg gas /m<sup>3</sup> gas  $i$ )
- $P_t$  = Absolute pressure of the gaseous stream in time interval  $t$  (Pa)
- $MM_i$  = Molecular mass of greenhouse gas  $i$  (kg/kmol)
- $R_u$  = Universal ideal gases constant (8,314 Pa.m<sup>3</sup>/kmol.K )
- $T_t$  = Temperature of the gaseous stream in time interval  $t$  (K)

$PE_{flare,y}$  shall be determined using the methodological tool “Project emissions from flaring”. If LFG is flared through more than one flare, then  $PE_{flare,y}$  is the sum of the emissions for each flare determined separately.

Enclosed flare(s) have been installed in the project activity to increase the destruction efficiency. Those flares reach 99% (minimum)<sup>20</sup> of methane destruction efficiency.

To determine the project emissions from flaring gases was used the tool “Project emissions from flaring”. The project emissions calculation procedure is given in the following steps:

- STEP 1: Determination of the methane mass flow of the residual gas;
- STEP 2: Determination of the flare efficiency;
- STEP 3: Calculation of project emissions from flaring.

### **Step 1: Determination of the methane mass flow in the residual gas**

The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” shall be used to determine the following parameter:

Parameter	SI Unit	Description
$F_{CH4,m}$	kg	Mass flow of methane in the residual gaseous stream in the minute m

<sup>20</sup> The document about the specification of the flare efficiencies has been provided to DOE.

The following requirements apply:

- The gaseous stream tool shall be applied to the residual gas;
- The flow of the gaseous stream shall be measured continuously;
- CH<sub>4</sub> is the greenhouse gas *i* for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval *t* for which mass flow should be calculated is every minute *m*

$F_{CH_4,m}$ , which is measured as the mass flow during minute *m*, shall then be used to determine the mass of methane in kilograms fed to the flare in minute *m* ( $F_{CH_4,RG,m}$ ).  $F_{CH_4,m}$  shall be determined on a dry basis.

The option chosen for the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” by the project participant is option A.

## Step 2: Determination of flare efficiency

### Enclosed flare

In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute *m* ( $\eta_{flare,m}$ ).

Option A: Apply a default value for flare efficiency

Option B: Measure the flare efficiency.

The project participant has chosen Option A.

For enclosed flares that are defined as low height flares, which is the case of the project activity, the flare efficiency in the minute *m* ( $\eta_{flare,m}$ ) shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency as determined in Option A. For example, the default value applied should be 80%, rather than 90%, and if for example the measured value was 99%, then the value to be used shall correspond to 89%.

### Option A: Default value

The flare efficiency for the minute *m* ( $\eta_{flare,m}$ ) is 90% when the following two conditions are met to demonstrate that the flare is operating:

- (1) The temperature of the flare ( $T_{EG,m}$ ) and the flow rate of the residual gas to the flare ( $F_{RG,m}$ ) is within the manufacturer’s specification for the flare ( $SPEC_{flare}$ ) in minute *m*; and
- (2) The flame is detected in minute *m* ( $Flame_m$ ).

Otherwise  $\eta_{flare,m}$  is 0%.

Flare efficiency results have been presented in a separate spreadsheet related to this monitoring period.

## Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based on the methane mass flow in the residual gas ( $F_{CH_4,RG,m}$ ) and the flare efficiency ( $\eta_{flare,m}$ ), as follows:

$$PE_{\text{flare},y} = GWP_{\text{CH}_4} \times \sum_{m=1}^{525600} F_{\text{CH}_4,\text{RG},m} \times (1 - \eta_{\text{flare},m}) \times 10^{-3}$$

Where:

- $PE_{\text{flare},y}$  = Project emissions from flaring of the residual gas in year  $y$  (tCO<sub>2</sub>e)  
 $GWP_{\text{CH}_4}$  = Global warming potential of methane valid for the commitment period (tCO<sub>2</sub>e/tCH<sub>4</sub>)  
 $F_{\text{CH}_4,\text{RG},m}$  = Mass flow of methane in the residual gas in the minute  $m$  (kg)  
 $\eta_{\text{flare},m}$  = Flare efficiency in minute  $m$

**Table 4 – Parameters<sup>21</sup> used in the Tool “Project emissions from flaring”**

Parameter	Description	Value	Unit
$P_{\text{ref}}$	Atmospheric pressure at reference conditions	101,325	Pa
$R_u$	Universal ideal gas constant	0.008314472	Pa.m <sup>3</sup> /kmol.K
$T_{\text{ref}}$	Temperature at reference conditions	273.15	K
$GWP_{\text{CH}_4}$	Global warming potential of methane valid for the commitment period	25 <sup>22</sup>	tCO <sub>2</sub> /tCH <sub>4</sub>
$\rho_{\text{CH}_4,n}$	Density of methane at reference conditions	0.716	kg/m <sup>3</sup>

#### Step A.2: Determination of $F_{\text{CH}_4,\text{BL},y}$

In the baseline there are no regulatory or contractual requirements, or to address safety and odour concerns to capture and destroy LFG. Thus, the case of the project activity for determining methane captured and destroyed in the baseline is **Case 3** because there is existing LFG capture system (passive system), however there is no requirement to destroy methane. In this case:

$$F_{\text{CH}_4,\text{BL},y} = F_{\text{CH}_4,\text{BL},\text{sys},y} = F_{\text{CH}_4,\text{sent\_flare},y}$$

Where:

- $F_{\text{CH}_4,\text{BL},\text{sys},y}$  = Amount of methane in the LFG that would be flared in the baseline in year  $y$  for the case of an existing LFG capture system (t CH<sub>4</sub>/yr)  
 $F_{\text{CH}_4,\text{sent\_flare},y}$  = Amount of methane in the LFG which is sent to the flare in year  $y$  (t CH<sub>4</sub>/yr)

The amount of methane captured with the existing system will be monitored along with the amount captured under the project activity and there is no historic data on the amount of methane that was captured in the year prior to the implementation of the project activity. Thus, the situation to determine  $F_{\text{CH}_4,\text{BL},y}$  is:

If there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, then:

$$F_{\text{CH}_4,\text{BL},\text{sys},y} = 20\% \times F_{\text{CH}_4,\text{PJ},y}; \text{ or}$$

$$F_{\text{CH}_4,\text{BL},y} = 20\% \times F_{\text{CH}_4,\text{PJ},y}$$

#### Baseline emissions associated with electricity generation ( $BE_{\text{EC},y}$ )

<sup>21</sup> As the Option B.1 of the tool “Project emissions from flaring” has been adopted to calculate the flare efficiency, the molecular mass parameters are not mentioned.

<sup>22</sup> Value for the 2nd commitment period updated according to COP/MOP decisions

$$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y})$$

Where:

- $BE_{EC,y}$  = Baseline emissions from electricity generation in year  $y$  (tCO<sub>2</sub>/yr)  
 $EC_{BL,k,y} = EG_{PJ,y}$  = Net amount of electricity generated using LFG in year  $y$  (MWh/yr)  
 $EF_{EL,k,y}$ <sup>23</sup> = Emission factor for electricity generation for source  $k$  in year  $y$  (tCO<sub>2</sub>/MWh)  
 $TDL_{k,y}$  = Average technical transmission and distribution losses for providing electricity to source  $k$  in year  $y$ .

The baseline emissions associated with electricity generation in year  $y$  ( $BE_{EC,y}$ ) shall be calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

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

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The table below shows the consolidated collected and calculated data for the current monitoring period.

	DEVIATION applied	PE <sub>y</sub>	PEEC1	PEEC2	ECPJ1	ECPJ2
	(yes/no)	tCO <sub>2</sub>	tCO <sub>2</sub>	tCO <sub>2</sub>	MWh	MWh
From 31/07/2020	No	0.00	0.00	0.00	0.00	0.00
08/2020	No	0.09	0.09	0.00	0.35	0.00
09/2020	No	0.03	0.03	0.00	0.11	0.00
10/2020	No	0.06	0.06	0.00	0.22	0.00
11/2020	No	0.08	0.08	0.00	0.28	0.00
12/2020	No	0.09	0.09	0.00	0.32	0.00

### Project emissions:

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

Where:

- $PE_y$  = Project emissions in year  $y$  (t CO<sub>2</sub>/yr)  
 $PE_{EC,y}$  = Emissions from consumption of electricity due to the project activity in year  $y$  (t CO<sub>2</sub>/yr)  
 $PE_{FC,y}$  = Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year  $y$  (t CO<sub>2</sub>/yr)

There is no consumption of fossil fuels due to the project activity for purpose other than electricity generation, in year  $y$  (tCO<sub>2</sub>/yr), therefore  $PE_{FC,y} = 0$

### Calculation of $PE_{EC,y}$ – project emission from consumption of electricity

According to "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", the project emission from consumption of electricity will be from two sources:

<sup>23</sup> According to the "Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion",  $EF_{EL,k,y} = EF_{grid,CM,y}$

- $PE_{EC1,y}$  - Grid (Brazilian interconnected electric system);
- $PE_{EC2,y}$  - Diesel generator(s) (off-grid captive power plant)

Thus,

$$PE_{EC,y} = PE_{EC1,y} + PE_{EC2,y}$$

#### $PE_{EC1,y}$ - Project emission from electricity consumption from the grid

As electricity will be consumed from the grid, the option A1 of the scenario A was chosen, as follows:

*Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the “Tool to calculate the emission factor for an electricity system” ( $EF_{EL,j/k/l,y} = EF_{grid,CM,y}$ ).*

Thus, the project emission is calculated as following:

$$PE_{EC1,y} = EC_{PJ1,y} \times EF_{grid,CM,y} \times (1 + TDL_y)$$

Where:

$EC_{PJ1,y}$	= quantity of electricity consumed from the grid by the project activity during the year y (MWh);
$EF_{grid,CM,y}$	= the emission factor for the grid in year y (tCO <sub>2</sub> /MWh);
$TDL_y$	= 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.

#### $PE_{EC2,y}$ - Project emission from electricity consumption from an off-grid captive power plant (diesel generator(s))

As electricity will be consumed from diesel generators (off-grid captive power plant), a conservative approach was adopted and the option B2 of the scenario B was chosen because: “The electricity consumption source is a project or leakage electricity consumption source”. Therefore, the value used will be 1.3 tCO<sub>2</sub>/MWh for project emission from diesel generator(s).

$$PE_{EC2,y} = EC_{PJ2,y} \times EF_{diesel\_generator,y} \times (1 + TDL_y)$$

Where:

$EC_{PJ2,y}$	= quantity of electricity consumed from diesel generator by the project activity during the year y (MWh);
$EF_{diesel\_generator,y}$	= the emission factor for the diesel generator in year y (tCO <sub>2</sub> /MWh);
$TDL_y$	= 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.

### **E.3. Calculation of leakage emissions**

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Not applicable

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

	Baseline GHG emissions or baseline net GHG removals (t CO <sub>2</sub> e)	Project GHG emissions or actual net GHG removals (t CO <sub>2</sub> e)	Leakage GHG emissions (t CO <sub>2</sub> e)	GHG emission reductions or net anthropogenic GHG removals (t CO <sub>2</sub> e)		
				Before 01/01/2013	From 01/01/2013	Total amount
<b>Total</b>	122,065	0	-	-	122,065	122,065

**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 <sub>2</sub> e)	Amount estimated ex ante for this monitoring period in the PDD (t CO <sub>2</sub> e)
122,065	170,116 <sup>24</sup>

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

&gt;&gt;

Calculated using the PDD estimation for 2020 (170,116).

**E.6. Remarks on increase in achieved emission reductions**

&gt;&gt;

The difference between the CERs calculated value for this monitoring period and estimated value in registered PDD is -28%.

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

&gt;&gt;

Not applicable.

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<sup>24</sup>Calculated using the PDD estimation for 2020 (170,116).

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**Document information**

<i>Version</i>	<i>Date</i>	<i>Description</i>
07.0	31 May 2019	Revision to: <ul style="list-style-type: none"> <li>• Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);</li> <li>• Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period;</li> <li>• Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes;</li> <li>• Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods;</li> <li>• Make editorial improvements.</li> </ul>
06.0	7 June 2017	Revision to: <ul style="list-style-type: none"> <li>• Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);</li> <li>• Make editorial improvements.</li> </ul>
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> <li>• Include provisions related to delayed submission of a monitoring plan;</li> <li>• Provisions related to the Host Party;</li> <li>• Remove reference to programme of activities;</li> <li>• Overall editorial improvement.</li> </ul>
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> <li>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));</li> <li>• Include provisions related to standardized baselines;</li> <li>• Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;</li> <li>• Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>;</li> <li>• Editorial improvement.</li> </ul>
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).



<i>Version</i>	<i>Date</i>	<i>Description</i>
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.
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